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| Technical Specification | |
| 3rd Generation Partnership Project;  Technical Specification Group Core Network and Terminals;  Proximity-services (ProSe) in 5G System (5GS) protocol aspects;  Stage 3  (Release 17) | |
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Contents

Foreword 11

1 Scope 13

2 References 13

3 Definitions of terms, symbols and abbreviations 14

3.1 Terms 14

3.2 Abbreviations 14

4 General 14

4.1 Overview 14

5 Provisioning of configuration information for 5G ProSe 15

5.1 Overview 15

5.2 Configuration and precedence of 5G ProSe configuration information 15

5.2.1 General 15

5.2.2 Precedence of 5G ProSe configuration information 15

5.2.3 Configuration parameters for 5G ProSe direct discovery 16

5.2.4 Configuration parameters for 5G ProSe direct communication over PC5 interface 17

5.2.5 Configuration parameters for 5G ProSe UE-to-network Relay 18

5.3 Procedures 19

5.3.1 General 19

5.3.2 UE-requested ProseP provisioning procedure 20

5.3.2.1 General 20

5.3.2.2 UE-requested ProseP policy provisioning procedure initiation 20

5.3.2.3 UE-requested ProseP policy provisioning procedure accepted by the network 20

5.3.2.4 UE-requested ProseP policy provisioning procedure not accepted by the network 21

5.3.2.5 Abnormal cases on the network side 21

5.3.2.6 Abnormal cases on the UE 21

6 5G ProSe direct discovery 21

6.1 Overview 21

6.1.1 Transport protocol for PC3a Control Protocol messages for 5G ProSe direct discovery 21

6.1.2 Handling of UE-initiated procedures 21

6.1.2.1 General 21

6.1.2.2 5G DDNMF discovery 22

6.1.3 Handling of 5G DDNMF-initiated procedures 22

6.1.3.1 General 22

6.1.3.2 HTTP long polling 22

6.1.3.3 OMA Push 23

6.2 Procedures 23

6.2.1 Types of 5G ProSe direct discovery procedures 23

6.2.2 Announce request procedure for open ProSe direct discovery 23

6.2.2.1 General 23

6.2.2.2 Announce request procedure initiation 24

6.2.2.3 Announce request procedure accepted by the 5G DDNMF 25

6.2.2.4 Announce request procedure completion by the UE 28

6.2.2.5 Announce request procedure not accepted by the 5G DDNMF 28

6.2.2.6 Abnormal cases 29

6.2.2.6.1 Abnormal cases in the UE 29

6.2.2.6.2 Abnormal cases in the 5G DDNMF 30

6.2.3 Announce request procedure for restricted ProSe direct discovery model A 30

6.2.3.1 General 30

6.2.3.2 Announce request procedure initiation 30

6.2.3.3 Announce request procedure accepted by the 5G DDNMF 32

6.2.3.4 Announce request procedure completion by the UE 34

6.2.3.5 Announce request procedure not accepted by the 5G DDNMF 35

6.2.3.6 Abnormal cases 36

6.2.3.6.1 Abnormal cases in the UE 36

6.2.3.6.2 Abnormal cases in the 5G DDNMF 36

6.2.4 Monitor request procedure for open ProSe direct discovery 36

6.2.4.1 General 36

6.2.4.2 Monitor request procedure Initiation 37

6.2.4.3 Monitor request procedure accepted by the 5G DDNMF 38

6.2.4.4 Monitor request procedure completion by the UE 40

6.2.4.5 Monitor request procedure not accepted by the 5G DDNMF 40

6.2.4.6 Abnormal cases 41

6.2.4.6.1 Abnormal cases in the UE 41

6.2.4.6.2 Abnormal cases in the 5G DDNMF 41

6.2.5 Monitor request procedure for restricted ProSe direct discovery model A 41

6.2.5.1 General 41

6.2.5.2 Monitor request procedure Initiation 42

6.2.5.3 Monitor request procedure accepted by the 5G DDNMF 43

6.2.5.4 Monitor request procedure completion by the UE 45

6.2.5.5 Monitor request procedure not accepted by the 5G DDNMF 46

6.2.5.6 Abnormal cases 46

6.2.5.6.1 Abnormal cases in the UE 46

6.2.5.6.2 Abnormal cases in the 5G DDNMF 47

6.2.6 Discoveree request procedure for restricted ProSe direct discovery model B 47

6.2.6.1 General 47

6.2.6.2 Discoveree request procedure initiation 47

6.2.6.3 Discoveree request procedure accepted by the 5G DDNMF 49

6.2.6.4 Discoveree request procedure completion by the UE 50

6.2.6.5 Discoveree request procedure not accepted by the 5G DDNMF 51

6.2.6.6 Abnormal cases 51

6.2.6.6.1 Abnormal cases in the UE 51

6.2.6.6.2 Abnormal cases in the 5G DDNMF 51

6.2.7 Discoverer request procedure for restricted ProSe direct discovery model B 52

6.2.7.1 General 52

6.2.7.2 Discoverer request procedure initiation 52

6.2.7.3 Discoverer request procedure accepted by the 5G DDNMF 54

6.2.7.4 Discoverer request procedure completion by the UE 55

6.2.7.5 Discoverer request procedure not accepted by the 5G DDNMF 56

6.2.7.6 Abnormal cases 56

6.2.7.6.1 Abnormal cases in the UE 56

6.2.7.6.2 Abnormal cases in the 5G DDNMF 57

6.2.8 Match report procedure for open ProSe direct discovery 57

6.2.8.1 General 57

6.2.8.2 Match report procedure initiation 57

6.2.8.3 Match report procedure accepted by the 5G DDNMF 59

6.2.8.4 Match report procedure completion by the UE 60

6.2.8.5 Match report procedure not accepted by the 5G DDNMF 60

6.2.8.6 Abnormal cases 61

6.2.8.6.1 Abnormal cases in the UE 61

6.2.9 Match report procedure for restricted ProSe direct discovery model A 61

6.2.9.1 General 61

6.2.9.2 Match report procedure initiation 61

6.2.9.3 Match report procedure accepted by the 5G DDNMF 63

6.2.9.4 Match report procedure completion by the UE 64

6.2.9.5 Match report procedure not accepted by the 5G DDNMF 64

6.2.9.6 Abnormal cases 65

6.2.9.6.1 Abnormal cases in the UE 65

6.2.10 Match report procedure for restricted ProSe direct discovery model B 65

6.2.10.1 General 65

6.2.10.2 Match report procedure initiation 65

6.2.10.3 Match report procedure accepted by the 5G DDNMF 67

6.2.10.4 Match report procedure completion by the UE 68

6.2.10.5 Match report procedure not accepted by the 5G DDNMF 68

6.2.10.6 Abnormal cases 69

6.2.10.6.1 Abnormal cases in the UE 69

6.2.11 Direct discovery update procedure for open discovery 69

6.2.11.1 General 69

6.2.11.2 Direct discovery update procedure initiation 69

6.2.11.3 Direct discovery update procedure accepted by the UE 71

6.2.11.4 Direct discovery update procedure completed by the 5G DDNMF 71

6.2.11.5 Direct discovery update procedure not accepted by the UE 71

6.2.11.6 Abnormal cases 72

6.2.11.6.1 Abnormal cases in the 5G DDNMF 72

6.2.11.6.2 Abnormal cases in the UE 72

6.2.12 Direct discovery update procedure for restricted discovery 72

6.2.12.1 General 72

6.2.12.2 Revocation of restricted discovery filters 72

6.2.12.2.1 Restricted discovery filters revocation procedure initiation 72

6.2.12.2.2 Restricted discovery filters revocation procedure accepted by the UE 73

6.2.12.2.3 Restricted discovery filters revocation procedure completion by the 5G DDNMF 73

6.2.12.2.4 Restricted discovery filters revocation procedure not accepted by the UE 73

6.2.12.2.5 Abnormal cases 73

6.2.12.2.5.1 Abnormal cases in the 5G DDNMF 73

6.2.12.2.5.2 Abnormal cases in the UE 74

6.2.12.3 Allocation of new ProSe restricted code 74

6.2.12.3.1 New ProSe restricted code allocation procedure initiation 74

6.2.12.3.2 ProSe restricted code allocation procedure accepted by the UE 75

6.2.12.3.3 ProSe restricted code allocation procedure completion by the 5G DDNMF 75

6.2.12.3.4 ProSe restricted code allocation procedure not accepted by the UE 75

6.2.12.3.5 Abnormal cases 75

6.2.12.3.5.1 Abnormal cases in the 5G DDNMF 75

6.2.12.3.5.2 Abnormal cases in the UE 76

6.2.13 Announcing alert procedure 76

6.2.13.1 General 76

6.2.13.2 Announcing alert procedure initiation 76

6.2.13.3 Announcing alert procedure accepted by the UE 77

6.2.13.4 Announcing alert procedure completion by the 5G DDNMF 78

6.2.13.5 Announcing alert procedure not accepted by the UE 78

6.2.13.6 Abnormal cases 78

6.2.13.6.1 Abnormal cases in the 5G DDNMF 78

6.2.13.6.2 Abnormal cases in the UE 78

6.2.14 5G ProSe direct discovery procedure over PC5 interface 78

6.2.14.1 General 78

6.2.14.2 Procedures 79

6.2.14.2.1 5G ProSe direct discovery procedure over PC5 interface with model A 79

6.2.14.2.1.1 General 79

6.2.14.2.1.2 Announcing UE procedure for 5G ProSe direct discovery initiation 79

6.2.14.2.1.3 Announcing UE procedure for 5G ProSe direct discovery completion 81

6.2.14.2.1.4 Monitoring UE procedure for 5G ProSe direct discovery initiation 81

6.2.14.2.1.5 Monitoring UE procedure for 5G ProSe direct discovery completion 83

6.2.14.2.2 5G ProSe direct discovery procedure over PC5 interface with Model B 83

6.2.14.2.2.1 General 83

6.2.14.2.2.2 Discoverer UE procedure for 5G ProSe direct discovery initiation 83

6.2.14.2.2.3 Discoverer UE procedure for 5G ProSe direct discovery completion 85

6.2.14.2.2.4 Discoveree UE procedure for 5G ProSe direct discovery initiation 85

6.2.14.2.2.5 Discoveree UE procedure for 5G ProSe direct discovery completion 87

6.2.15 Group member discovery over PC5 interface 88

6.2.15.1 General 88

6.2.15.2 Procedures 88

6.2.15.2.1 Group member discovery over PC5 interface with Model A 88

6.2.15.2.1.1 General 88

6.2.15.2.1.2 Announcing UE procedure for group member discovery initiation 88

6.2.15.2.1.3 Announcing UE procedure for group member discovery completion 90

6.2.15.2.1.4 Monitoring UE procedure for group member discovery initiation 90

6.2.15.2.1.5 Monitoring UE procedure for group member discovery completion 91

6.2.15.2.2 Group member discovery over PC5 interface with Model B 91

6.2.15.2.2.1 General 91

6.2.15.2.2.2 Discoverer UE procedure for group member discovery initiation 91

6.2.15.2.2.3 Discoverer UE procedure for group member discovery completion 93

6.2.15.2.2.4 Discoveree UE procedure for group member discovery initiation 93

6.2.15.2.2.5 Discoveree UE procedure for group member discovery completion 95

7 5G ProSe direct communications 96

7.1 Overview 96

7.2 Unicast mode 5G ProSe direct communication over PC5 96

7.2.1 Overview 96

7.2.2 5G ProSe direct link establishment procedure 96

7.2.2.1 General 96

7.2.2.2 5G ProSe direct link establishment procedure initiation by initiating UE 97

7.2.2.3 5G ProSe direct link establishment procedure accepted by the target UE 99

7.2.2.4 5G ProSe direct direct link establishment procedure completion by the initiating UE 101

7.2.2.5 5G ProSe direct direct link establishment procedure not accepted by the target UE 102

7.2.2.6 Abnormal cases 103

7.2.2.6.1 Abnormal cases at the initiating UE 103

7.2.2.6.2 Abnormal cases at the target UE 103

7.2.3 5G ProSe direct link modification procedure 104

7.2.3.1 General 104

7.2.3.2 5G ProSe direct link modification procedure initiated by initiating UE 104

7.2.3.3 5G ProSe direct link modification procedure accepted by the target UE 105

7.2.3.4 5G ProSe direct link modification procedure completion by the initiating UE 106

7.2.3.5 5G ProSe direct link modification procedure not accepted by the target UE 106

7.2.3.6 Abnormal cases at the initiating UE 107

7.2.4 5G ProSe direct link identifier update procedure 107

7.2.4.1 General 107

7.2.4.2 5G ProSe direct link identifier update procedure initiation by initiating UE 108

7.2.4.3 5G ProSe direct link identifier update procedure accepted by the target UE 109

7.2.4.4 5G ProSe direct link identifier update procedure acknowledged by the initiating UE 110

7.2.4.5 5G ProSe direct link identifier update procedure completion by the target UE 110

7.2.4.6 5G ProSe direct link identifier update procedure not accepted by the target UE 111

7.2.4.7 Abnormal cases 111

7.2.4.7.1 Abnormal cases at the initiating UE 111

7.2.4.7.2 Abnormal cases at the target UE 112

7.2.5 5G ProSe direct link keep-alive procedure 112

7.2.5.1 General 112

7.2.5.2 5G ProSe direct link keep-alive procedure initiation by the initiating UE 112

7.2.5.3 5G ProSe direct link keep-alive procedure accepted by the target UE 113

7.2.5.4 5G ProSe direct link keep-alive procedure completion by the initiating UE 114

7.2.5.5 Abnormal cases 114

7.2.5.5.1 Abnormal cases at the initiating UE 114

7.2.5.5.2 Abnormal cases at the target UE 114

7.2.6 5G ProSe direct link release procedure 115

7.2.6.1 General 115

7.2.6.2 5G ProSe direct direct link release procedure initiation by initiating UE 115

7.2.6.3 5G ProSe direct direct link release procedure accepted by the target UE 116

7.2.6.4 5G ProSe direct direct link release procedure completion by the initiating UE 116

7.2.6.5 Abnormal cases 116

7.2.6.5.1 Abnormal cases at the initiating UE 116

7.2.7 PC5 QoS flow establishment over 5G ProSe direct link 117

7.2.8 PC5 QoS flow match over 5G ProSe direct link 118

7.2.9 Data transmission over 5G ProSe direct link 118

7.2.9.1 Transmission 118

7.2.9.2 Procedure for UE to use provisioned radio resources for ProSe communication over PC5 118

7.3 Broadcast mode 5G ProSe direct communication over PC5 118

7.3.1 Overview 118

7.3.2 Transmission of broadcast mode 5G ProSe communication over PC5 119

7.3.2.1 Initiation 119

7.3.2.1.1 Broadcast mode 5G ProSe communication over PC5 triggered by upper layers 119

7.3.2.1.2 PC5 QoS flow match and establishment 120

7.3.2.2 Transmission 121

7.3.2.3 Procedure for UE to use provisioned radio resources for 5G ProSe communication over PC5 122

7.3.2.4 Privacy of 5G ProSe transmission over PC5 123

7.3.3 Reception of broadcast mode 5G ProSe communication over PC5 123

8 5G ProSe UE-to-network relay 124

8.1 Overview 124

8.2 Procedures 124

8.2.1 UE-to-Network relay discovery over PC5 interface 124

8.2.1.1 General 124

8.2.1.2 UE-to-Network relay discovery over PC5 interface with Model A 124

8.2.1.2.1 Announcing UE relay discovery for UE-to-Network relay discovery 124

8.2.1.2.1.1 General 124

8.2.1.2.1.2 Announcing UE procedure for UE-to-Network relay discovery initiation 125

8.2.1.2.1.3 Announcing UE procedure for UE-to-Network relay discovery completion 126

8.2.1.2.2 Monitoring UE relay discovery for UE-to-Network relay discovery 126

8.2.1.2.2.1 General 126

8.2.1.2.2.2 Monitoring UE procedure for UE-to-Network relay discovery initiation 126

8.2.1.2.2.3 Monitoring UE procedure for UE-to-Network relay discovery completion 128

8.2.1.2.3 Announcing UE procedure for Relay Discovery Additional Information 128

8.2.1.2.3.1 General 128

8.2.1.2.3.2 Announcing procedure for Relay Discovery Additional Information 128

8.2.1.2.4 Monitoring UE procedure for Relay Discovery Additional Information 129

8.2.1.2.4.1 General 129

8.2.1.2.4.2 Monitoring procedure for Relay Discovery Additional Information 129

8.2.1.3 UE-to-Network relay discovery over PC5 interface with Model B 131

8.2.1.3.1 Discoverer UE procedure for UE-to-Network Relay discovery 131

8.2.1.3.1.1 General 131

8.2.1.3.1.2 Discoverer UE procedure for UE-to-Network Relay discovery initiation 131

8.2.1.3.1.3 Discoverer UE procedure for UE-to-Network Relay discovery completion 133

8.2.1.3.2 Discoveree UE procedure for UE-to-Network Relay discovery 134

8.2.1.3.2.1 General 134

8.2.1.3.2.2 Discoveree UE procedure for UE-to-Network Relay discovery initiation 134

8.2.1.3.2.3 Discoveree UE procedure for UE-to-Network Relay discovery completion 135

8.2.2 UE-to-network relay selection procedure 136

8.2.2.1 General 136

8.2.2.2 UE-to-network relay selection procedure initiation 136

8.2.2.3 UE-to-network relay selection procedure completion 136

8.2.3 UE-to-network relay reselection procedure 136

8.2.3.1 General 136

8.2.3.2 UE-to-network relay reselection procedure initiation 136

9 Handling of unknown, unforeseen, and erroneous protocol data 137

9.1 General 137

9.2 Handling of unknown, unforeseen, and erroneous protocol data in messages sent over the PC3a interface 137

9.2.1 Unforeseen message type 137

9.3 Handling of unknown, unforeseen, and erroneous protocol data in messages sent over the PC5 interface 138

9.3.1 Message too short or too long 138

9.3.1.1 Message too short 138

9.3.1.2 Message too long 138

9.3.2 Unknown or unforeseen message type 138

9.3.3 Non-semantical mandatory information element errors 138

9.3.4 Unknown and unforeseen IEs in the non-imperative message part 138

9.3.4.1 IEIs unknown in the message 138

9.3.4.2 Out of sequence IEs 138

9.3.4.3 Repeated IEs 138

9.3.5 Non-imperative message part errors 139

9.3.5.1 General 139

9.3.5.2 Syntactically incorrect optional IEs 139

9.3.5.3 Conditional IE errors 139

9.3.6 Messages with semantically incorrect contents 139

10 Message functional definitions and contents 139

10.1 Overview 139

10.2 5G ProSe direct discovery messages 139

10.2.1 Message definition 139

10.3 PC5 signalling messages 142

10.3.1 ProSe direct link establishment request 142

10.3.1.1 Message definition 142

10.3.1.2 Target user info 143

10.3.1.3 Key establishment information container 143

10.3.1.4 Nonce\_1 143

10.3.1.5 MSB of KNRP-sess ID 143

10.3.1.6 KNRP ID 143

10.3.2 ProSe direct link establishment accept 143

10.3.2.1 Message definition 143

10.3.2.2 IP address configuration 143

10.3.2.3 Link local IPv6 address 144

10.3.3 ProSe direct link establishment reject 144

10.3.3.1 Message definition 144

10.3.4 ProSe direct link release request 144

10.3.4.1 Message definition 144

10.3.5 ProSe direct link release accept 144

10.3.5.1 Message definition 144

10.3.6 ProSe direct link modification request 145

10.3.6.1 Message definition 145

10.3.7 ProSe direct link modification accept 145

10.3.7.1 Message definition 145

10.3.7.2 QoS flow descriptions 146

10.3.8 ProSe direct link keepalive request 146

10.3.8.1 Message definition 146

10.3.8.2 Maximum inactivity period 146

10.3.9 ProSe direct link keepalive response 146

10.3.9.1 Message definition 146

10.3.10 ProSe direct link authentication request 147

10.3.10.1 Message definition 147

10.3.11 ProSe direct link authentication response 147

10.3.11.1 Message definition 147

10.3.12 ProSe direct link authentication reject 148

10.3.12.1 Message definition 148

10.3.13 ProSe direct link security mode command 148

10.3.13.1 Message definition 148

10.3.13.2 Nonce\_2 149

10.3.13.3 LSB of KNRP-sess ID 149

10.3.13.4 Key establishment information container 149

10.3.13.5 MSBs of KNRP ID 149

10.3.13.6 UE PC5 unicast signalling security policy 149

10.3.14 ProSe direct link security mode complete 149

10.3.14.1 Message definition 149

10.3.14.2 IP address configuration 150

10.3.14.3 Link local IPv6 address 150

10.3.14.4 LSBs of KNRP ID 150

10.3.15 ProSe direct link security mode reject 150

10.3.15.1 Message definition 150

10.3.16 ProSe direct link rekeying request 151

10.3.16.1 Message definition 151

10.3.16.2 Key establishment information container 151

10.3.16.3 Nonce\_1 151

10.3.16.4 MSB of KNRP-sess ID 151

10.3.16.5 Re-authentication indication 151

10.3.17 ProSe direct link rekeying response 152

10.3.17.1 Message definition 152

10.3.18 ProSe direct link identifier update request 152

10.3.18.1 Message definition 152

10.3.18.2 Source user info 152

10.3.18.3 Source link local IPv6 address 152

10.3.19 ProSe direct link identifier update accept 153

10.3.19.1 Message definition 153

10.3.19.2 Target user info 153

10.3.19.3 Target link local IPv6 address 153

10.3.19.4 Source user info 153

10.3.19.5 Source link local IPv6 address 153

10.3.20 ProSe direct link identifier update ack 154

10.3.20.1 Message definition 154

10.3.20.2 Target user info 154

10.3.20.3 Target link local IPv6 address 154

10.3.21 ProSe direct link identifier update reject 154

10.3.21.1 Message definition 154

10.3.22 ProSe direct link modification reject 155

10.3.22.1 Message definition 155

10.3.23 ProSe direct link authentication failure 155

10.3.23.1 Message definition 155

10.3.23.2 Key establishment information container 156

10.4 Provisioning of 5G ProSe configuration information signalling messages 156

10.4.1 UE policy provisioning request 156

10.4.2 UE policy provisioning reject 156

11 Information elements coding 156

11.1 Overview 156

11.2 5G ProSe direct discovery message formats 156

11.2.1 Message Type 156

11.2.2 ProSe Application Code 157

11.2.3 ProSe Restricted Code 157

11.2.4 MIC 158

11.2.5 UTC-based counter 158

11.2.6 Discovery Group ID 158

11.2.7 User Info ID 158

11.2.8 GMDS Composition 158

11.2.9 Target User Info 159

11.2.10 Target Group Info 159

11.3 PC5 signalling message formats 159

11.3.1 ProSe PC5 signalling message type 159

11.3.2 Sequence number 160

11.3.3 ProSe application identifier 160

11.3.4 Application layer ID 161

11.3.5 PC5 QoS flow descriptions 161

11.3.6 IP address configuration 168

11.3.7 Link local IPv6 address 169

11.3.8 PC5 signalling protocol cause 169

11.3.9 Key establishment information container 170

11.3.10 Nonce 170

11.3.11 UE security capabilities 171

11.3.12 UE PC5 unicast signalling security policy 174

11.3.13 MSB of KNRP-sess ID 174

11.3.14 KNRP ID 175

11.3.15 LSB of KNRP-sess ID 175

11.3.16 MSBs of KNRP ID 175

11.3.17 LSBs of KNRP ID 176

11.3.18 Configuration of UE PC5 unicast user plane security protection 176

11.3.19 Link modification operation code 177

11.3.20 Keep-alive counter 178

11.3.21 Maximum inactivity period 178

11.3.22 Selected security algorithms 178

11.3.23 UE PC5 unicast user plane security policy 179

11.3.24 Re-authentication indication 180

11.3.25 Layer-2 ID 180

12 List of system parameters 181

12.1 Overview 181

12.2 Timers of provisioning of parameters for 5G ProSe configuration procedures 181

12.3 Timers of 5G ProSe direct link management procedures 182

12.4 Timers of 5G ProSe direct discovery procedures over PC3a 184

12.5 Timers of broadcast mode 5G ProSe communication over PC5 interface 193

Annex A (informative): Change history 194

# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

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**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document specifies the protocols for Proximity-based Services (ProSe) in 5G system as specified in 3GPP TS 23.304 [2] for:

a) 5G ProSe direct discovery;

b) 5G ProSe communication over the PC5 interface; and

c) 5G ProSe-enabled UE-to-network relay.

The present document defines the associated procedures for 5G ProSe service authorisation, 5G ProSe direct discovery (e.g. the procedures between 5G ProSe-enabled UE and 5G Direct Discovery Name Management Function (DDNMF) over the PC3a interface, the procedures over the PC5 interface), 5G ProSe UE-to-network relay discovery, and 5G ProSe direct communication.

The present document also defines the message format, message contents, error handling and system parameters applied by the protocols for ProSe in 5GS.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.304: "Proximity based Services (ProSe) in the 5G System (5GS); Stage 2".

[3] IETF RFC 7230: "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing".

[4] IETF RFC 7231: "Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content".

[5] 3GPP TS 24.526: "UE policies for 5G System (5GS); Stage 3".

[6] OMA-WAP-TS-PushOTA-V2\_1-20110405-A: "Push Over the Air".

[7] OMA-AD-Push-V2\_2-20110809-A: "Push Architecture".

[8] WAP-168-ServiceLoad-20010731-a: "Service Loading".

[9] 3GPP TS 29.555: "Inter-5G Direct Discovery Name Management Function (DDNMF) signalling aspects; Stage 3".

[10] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[11] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[12] 3GPP TS 23.003: "Numbering, addressing and identification".

[13] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol Specification".

[14] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

[15] 3GPP TS 38.304: "User Equipment (UE) procedures in Idle mode and RRC Inactive state".

[16] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".

[17] 3GPP TS 24.555: "Proximity-services (ProSe) in 5G System (5GS); User Equipment (UE) policies; Stage 3".

[18] 3GPP TS 24.587: "Vehicle-to-Everything (V2X) services in 5G System (5GS); Protocol aspects; Stage 3".

[19] 3GPP TS 29.343: "Proximity-services (ProSe) function to ProSe application server aspects (PC2); Stage 3".

[20] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".

[21] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description; Stage 2".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

5G ProSe 5G Proximity-based Services

LSB Least Significant 8 Bits

MSB Most Significant 8 Bits

NCGI NG-RAN Cell Global ID

ProseP 5G ProSe Policy

# 4 General

## 4.1 Overview

Proximity-based Services (ProSe) are services that can be provided by the 3GPP system based on UEs being in proximity to each other. In this release of the document, the 3GPP system enablers for ProSe include the following functions:

a) 5G ProSe direct discovery;

b) 5G ProSe direct communication; and

c) UE-to-Network relay.

The above functions are applicable for both Public Safety UE and commercial UEs.

# 5 Provisioning of configuration information for 5G ProSe

## 5.1 Overview

5G ProSe configuration parameters are configured by the related procedures which allow configuration of necessary 5G ProSe configuration parameters to UE.

## 5.2 Configuration and precedence of 5G ProSe configuration information

### 5.2.1 General

UE’s usage of 5G ProSe service is controlled by 5G ProSe configration information.

The 5G ProSe configuration information consist of the configuration parameters for ProSe direct discovery, ProSe direct communication, ProSe UE-to-network relay and ProSe usage reporting configuration and rules.

Editor’s note: It is FFS and subject to SA2 to decide that which 5G ProSe configuration parmaters/rules can be configured in UICC or provided by a ProSe application server via PC1 reference point.

### 5.2.2 Precedence of 5G ProSe configuration information

The 5G ProSe configuration information for ProSe direct discovery, ProSe direct communication, ProSe UE-to-network relay and ProSe usage reporting configuration and rules can be:

a) pre-configured in the ME;

b) configured in the UICC;

c) provided as a ProSeP using the UE policy delivery service as specified in 3GPP TS 24.501 [11] annex D;

d) provided by a ProSe application server via PC1 reference point except:

1) authorization policy for ProSe direct discovery and restricted ProSe discovery UE ID for restricted direct discovery in parameters for ProSe direct discovery;

2) authorization policy in parameters for ProSe direct communication; and

3) the following parameters for UE-to-network relay:

i) authorization policy for acting as a ProSe UE-to-network relay

ii) QoS mapping rules for Layer-3 ProSe UE-to-network relay;

iii) authorization policy for using a ProSe UE-to-network relay;

iv) radio parameters for ProSe relay discovery when the UE is not "served by NG-RAN "; and

v) radio parameters for ProSe relay communication when the UE is not "served by NG-RAN"; or

e) a combination of case a), b), c) or d) above.

The UE should not request or accept any 5G ProSe configuration information from PCF when the UE is working as a Remote UE using a Layer-3 ProSe UE-to-Network Relay without involving N3IWF.

For ProSe group member discovery and ProSe groupcast mode direct communication, the 5G ProSe configuration information provided/updated by ProSe application server shall take a higher precedence than the same configuration information that are provided/updated by the PCF, provisioned in the ME or configured in the UICC.

Apart from that, the UE shall use the 5G ProSe configuration parameters in the following order of decreasing precedence:

a) the 5G ProSe configuration information provided as a ProseP using the UE policy delivery service as specified in annex D of 3GPP TS 24.501 [11];

b) the 5G ProSe configuration information provided by a ProSe application server via PC1 reference point;

c) the 5G ProSe configuration information configured in the UICC; and

d) the 5G ProSe configuration information pre-configured in the ME.

### 5.2.3 Configuration parameters for 5G ProSe direct discovery

The configuration parameters for ProSe Direct Discovery over PC5 reference point consist of:

a) a validity timer for the validity of the configuration Parameter for ProSe Direct Discovery over PC5 interface;

b) a list of PLMNs in which the UE is authorised to perform open ProSe Direct Discovery Model A monitoring when the UE is served by NG-RAN;

c) a list of PLMNs in which the UE is authorized to perform open ProSe Direct Discovery Model A announcing when the UE is served by NG-RAN and an Authorised discovery range for announcing per PLMN;

d) a list of PLMNs in which the UE is authorised to perform restricted ProSe Direct Discovery Model A monitoring when the UE is served by NG-RAN;

e) a list of PLMNs in which the UE is authorized to perform restricted ProSe Direct Discovery Model A announcing when the UE is served by NG-RAN and an Authorised discovery range for announcing per PLMN;

f) a list of PLMNs in which the UE is authorized to perform restricted Model B Discoverer operation when the UE is served by NG-RAN and an Authorised discovery range for announcing per PLMN;

g) a list of PLMNs in which the UE is authorized to perform restricted Model B Discoveree operation when the UE is served by NG-RAN and an Authorised discovery range for announcing per PLMN;

h) an indication of whether the UE is authorized to perform ProSe Direct Discovery for Model A or Model B when "not served by NG-RAN";

i) radio parameters for ProSe direct discover per NR PC5 applicable per geographical area(s) with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when "not served by NG-RAN";

NOTE 1: Whether a frequency band is "operator managed" or "non-operator managed" in a given Geographical Area is defined by local regulations.

j) a ProSe Direct Discovery UE ID for Restricted Direct Discovery;

k) a list of Group Member Discovery parameters that enable the Group Member Discovery. For each group the list consists of, one Application Layer Group ID, Layer-2 Group ID, User Info ID and Discovery Group ID;

NOTE 2: User Info ID is expected to be assigned uniquely to a user within the discovery group.

l) a list of ProSe Application identifiers to be used for direct discovery over PC5 interface;

m) a list of Security parameters used for direct discovery over PC5; and

n) a list of ProSe Application identifiers to default destination Layer-2 ID for initial discovery signalling mapping rule. Each mapping rule contains one or more ProSe Application identifiers and the default destination Layer-2 ID for the initial signalling of direct discovery.

Editor's note: Whether the security parameters can be provided by the PCF and details of security parameters will be determined by SA3 WG.

### 5.2.4 Configuration parameters for 5G ProSe direct communication over PC5 interface

The configuration parameters for 5G ProSe direct communication over PC5 interface consist of:

a) a validity timer for the validity of the configuration parameters for 5G ProSe direct communication over PC5 interface;

b) a list of PLMNs in which the UE is authorized to use 5G ProSe direct communication over PC5 interface when the UE is served by NG-RAN. Each entry of the list contains a PLMN ID in which the UE is authorized to use 5G ProSe direct communication over PC5 interface;

c) an indication of whether the UE is authorized to use 5G ProSe direct communication over PC5 interface when the UE is not served by NG-RAN;

d) the radio parameters of the 5G ProSe direct communication over PC5 interface applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN;

e) configuration parameters for groupcast mode 5G ProSe direct communication for each application layer group, consisting of:

1) Application layer group ID;

2) ProSe Layer-2 Group identifier;

3) ProSe group IP multicast address;

4) an indication of whether the UE is authorized to use IPv4 or IPv6;

5) optionally, an IPv4 address to be used by the UE as a source address for a specific Group if the UE is authorized to use IPv4; and

6) group security related content;

Editor’s note: Details of group security related content are FFS and will be determinated by SA3 WG.

f) configuration parameters for privacy support, consisting of:

1) a list of ProSe Applications requiring privacy. Each entry of the list contains one or more ProSe Application identifiers and one or more geographical areas where the privacy is required; and

2) a privacy timer value as specified in 3GPP TS 24.555 [17];

g) optionally, a list of ProSe Application identifier to ProSe NR frequency mapping rules. Each mapping rule contains one or more ProSe Application identifiers and the ProSe NR frequencies with associated geographical areas;

h) a list of ProSe Application identifier to destination Layer-2 ID for broadcast mapping rules. Each mapping rule contains one or more ProSe Application identifiers and the destination Layer-2 ID for broadcast;

i) optionally, a default destination Layer-2 ID for broadcast;

j) a list of ProSe Application identifier to default destination Layer-2 ID for unicast initial signaling mapping rules. Each mapping rule contains one or more ProSe Application identifiers and the default destination Layer-2 ID for initial signalling to establish unicast connection;

k) a list of ProSe Application identifier to PC5 QoS parameters mapping rules. The PC5 QoS parameters are specified in clause 5.7 of 3GPP TS 23.304 [2];

l) an AS configuration, including a list of SLRB mapping rules applicable when the UE is not served by NG-RAN. Each SLRB mapping rule contains a PC5 QoS profile and an SLRB. The PC5 QoS profile contains the following parameters:

1) the PC5 QoS profile containing a PQI;

2) if the PQI of the PC5 QoS profile identifies a GBR QoS, the PC5 QoS profile containing a PC5 flow bit rates consisting of a guaranteed flow bit rate (GFBR) and a maximum flow bit rate (MFBR);

3) if the PQI of the PC5 QoS profile identifies a non-GBR QoS, the PC5 QoS profile containing the PC5 link aggregated bit rate consisting of a per link aggregate maximum bit rate (PC5 LINK-AMBR);

NOTE: PC5 link aggregated bit rate is only used for unicast mode communications over PC5 interface.

4) the PC5 QoS profile containing a range, which is only used for groupcast mode communications over PC5 interface; and

5) the PC5 QoS profile optionally containing the priority level, the averaging window, and the maximum data burst volume. If one or more of the priority level, the averaging window or the maximum data burst volume are not contained in the PC5 QoS profile, their default values apply;

m) a list of 5G ProSe direct security policies. Each entry in the list contains an 5G ProSe direct security policy composed of:

1) one or more ProSe Application identifiers;

2) the signalling integrity protection policy for the ProSe Application identifier(s);

3) the signalling ciphering policy for the ProSe Application identifier(s);

4) the user plane integrity protection policy for the ProSe Application identifier(s);

5) the user plane ciphering policy for the ProSe Application identifier(s);

6) one or more geographical areas where the 5G ProSe direct security policy applies;

Editor’s note: Details of 5G ProSe direct security policies related content are FFS and will be determinated by SA3 WG.

n) a list of ProSe Application identifiers to default mode of communication mapping rules. Each mapping rule contains one or more ProSe Application identifiers and the default mode of communication (one of unicast, groupcast or broadcast); and

o) a list of ProSe Application to path preference mapping rules (i.e. PC5 preferred, Uu preferred, or no preference) as defined in clause x.x.

Editor's note: It is FFS on how to identify ProSe Applications for path selection.

### 5.2.5 Configuration parameters for 5G ProSe UE-to-network Relay

The configuration parameters for the role of a ProSe UE-to-network relay over PC5 reference point consist of:

a) a validity timer for the validity of the configuration parameter for 5G ProSe UE-to-network Relay over PC5 interface;

b) a list of PLMNs in which the UE is authorised to relay traffic for Remote UEs when the UE is served by NG-RAN, and in each PLMN;

1) an indication of whether the UE is authorized to be a 5G ProSe UE-to-Network Relay;

Editor's note: It is FFS whether the indication distinguishes L2 or L3 for U2N Relay, i.e., a separate indication for L2 or L3 U2N Relay.

c) a User Info ID for the UE-to-Network Relay discovery;

d) one or more Relay Service Code(s) for the UE-to-Network Relay discovery, and for each Relay Service Code:

1) security related content for ProSe Relay Discovery; and

2) for Layer 3 ProSe UE-to-Network Relay, a set of PDU session parameters:

i) PDU Session type;

ii) DNN;

iii) SSC Mode;

iv) S-NSSAI; or

v) Access Type Preference.

Editor's note: Details of security related content are FFS and will be determinated by SA WG3.

e) For Layer 3 ProSe UE-to-Network Relay, mapping rules between a 5QI value and a 5G ProSe PQI value over PC5 for traffic relayed over the PC5 interface.

f) the radio parameters of the 5G ProSe Relay Discovery applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN; and

g) the radio parameters of the 5G ProSe direct communication applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN.

The configuration parameters for the role of a 5G ProSe Remote UE consist of:

a) a validity timer for the validity of the configuration parameters for 5G ProSe Remote UE;

b) a list of PLMNs in which the UE is authorized to use a ProSe UE-to-Network Relay:

1) an indication of whether the UE is authorized to be a 5G ProSe Remote UE;

Editor's note: It is FFS whether the indication distinguishes L2 or L3 for U2N Relay, i.e., a separate indication for L2 or L3 Remote UE.

c) a User Info ID for the UE-to-Network Relay discovery;

d) one or more Relay Service Code(s) for the UE-to-Network Relay discovery, and for each Relay Service Code:

1) security related content for ProSe Relay Discovery; and

2) for Layer 3 ProSe UE-to-Network Relay, a set of PDU session parameters:

i) PDU Session type;

ii) DNN;

iii) SSC Mode;

iv) S-NSSAI; or

v) Access Type Preference.

Editor's note: Details of security related content are FFS and will be determinated by SA WG3.

e) the radio parameters of the 5G ProSe Relay Discovery applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN; and

f) the radio parameters of the 5G ProSe direct communication applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN.

NOTE: Whether a frequency band is "operator managed" or "non-operator managed" in a given Geographical Area is defined by local regulations.

## 5.3 Procedures

### 5.3.1 General

The procedure for provisioning of parameters for 5G ProSe allows the UE to obtain 5G ProSe policy (ProseP).

### 5.3.2 UE-requested ProseP provisioning procedure

#### 5.3.2.1 General

The UE-requested ProseP policy provisioning procedure enables the UE to request ProseP from the PCF in the following cases:

a) if the T5051 for a UE policies for 5G ProSe direct discovery expires;

b) if the T5052 for a UE policies for 5G ProSe direct communications expires;

c) if the T5053 for a UE policies for 5G ProSe UE-to-network relay expires;

d) if the T5054 for UE policies for 5G ProSe Remote UE expires; and

e) if there are no valid configuration parameters, e.g., for the current area, or due to abnormal situation.

The UE shall follow the principles of PTI handling for UE policy delivery service procedures defined in 3GPP TS 24.501 [11] clause D.1.2.

#### 5.3.2.2 UE-requested ProseP policy provisioning procedure initiation

In order to initiate the UE-requested ProseP policy provisioning procedure, the UE shall create a UE POLICY PROVISIONING REQUEST message (see example in figure 5.3.2.2.1). The UE:

a) shall allocate a PTI value currently not used and set the PTI IE to the allocated PTI value;

b) shall include the Requested UE policies IE indicating whether the UE policies for 5G ProSe direct discovery, the UE policies for 5G ProSe direct communications, the UE policies for 5G ProSe UE-to-network relay or any combination of them are requested;

c) shall transport the UE POLICY PROVISIONING REQUEST message using the NAS transport procedure as specified in 3GPP TS 24.501 [11] clause 5.4.5; and

d) shall start timer T5040.



Figure 5.3.2.2.1: UE-requested ProseP policy provisioning procedure

#### 5.3.2.3 UE-requested ProseP policy provisioning procedure accepted by the network

Handling in 3GPP TS 24.587 [18] clause 5.3.2.3 shall apply.

If new UE policies for 5G ProSe direct discovery are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5051 if it is running and start timer T5051 with the value included in the UE policies for 5G ProSe direct discovery, and start using the new UE policies for 5G ProSe direct discovery included in the MANAGE UE POLICY COMMAND message.

If new UE policies for 5G ProSe direct communications are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5052 if it is running and start timer T5052 with the value included in the UE policies for 5G ProSe direct communications, and start using the new UE policies for 5G ProSe direct communications included in the MANAGE UE POLICY COMMAND message.

If new UE policies for 5G ProSe UE-to-network relay are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5053 if it is running and start timer T5053 with the value included in the UE policies for 5G ProSe UE-to-network relay, and start using the new UE policies for 5G ProSe UE-to-network relay included in the MANAGE UE POLICY COMMAND message.

If new UE policies for 5G ProSe Remote UE are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5054 if it is running and start timer T5054 with the value included in the UE policies for 5G ProSe Remote UE, and start using the new UE policies for 5G ProSe Remote UE included in the MANAGE UE POLICY COMMAND message.

#### 5.3.2.4 UE-requested ProseP policy provisioning procedure not accepted by the network

Handling in 3GPP TS 24.587 [18] clause 5.3.2.4 shall apply.

#### 5.3.2.5 Abnormal cases on the network side

Handling in 3GPP TS 24.587 [18] clause 5.3.2.5 shall apply.

#### 5.3.2.6 Abnormal cases on the UE

Handling in 3GPP TS 24.587 [18] clause 5.3.2.6 shall apply.

# 6 5G ProSe direct discovery

## 6.1 Overview

### 6.1.1 Transport protocol for PC3a Control Protocol messages for 5G ProSe direct discovery

The UE and 5G DDNMF shall use HTTP 1.1 as specified in IETF RFC 7230 [3] and IETF RFC 7231 [4] as the transport protocol for 5G ProSe messages over the PC3a interface. The 5G ProSe messages described here shall be included in the body of either an HTTP request message or an HTTP response message.

### 6.1.2 Handling of UE-initiated procedures

#### 6.1.2.1 General

The following rules apply for UE-initiated procedures:

a) the UE initiates 5G ProSe transactions with an HTTP request message containing the PC3a request(s);

b) the 5G DDNMF responds to the requests with an HTTP response message containing the PC3a response(s) for the PC3a request(s); and

c) HTTP POST methods are used for PC3a direct discovery procedures.

The UE may use UE local configuration or URSP, as defined in 3GPP TS 24.526 [5], to establish a PDU session for reaching the HPLMN 5G DDNMF:

a) if a PDU session for reaching the HPLMN 5G DDNMF is not established yet, the UE shall establish the PDU session for reaching the HPLMN 5G DDNMF and shall send the HTTP request message via the PDU session for reaching the HPLMN 5G DDNMF; and

b) if a PDU session for reaching the HPLMN 5G DDNMF is already established (e.g. either due to other 5G ProSe feature or due to other application), the UE shall send the HTTP request message via the PDU session for reaching the HPLMN 5G DDNMF.

#### 6.1.2.2 5G DDNMF discovery

The IP address of the 5G DDNMF in the HPLMN may be pre-configured in the UE. The UE may use the pre-configured IP address or the FQDN of the 5G DDNMF in the HPLMN to discover the 5G DDNMF.

### 6.1.3 Handling of 5G DDNMF-initiated procedures

#### 6.1.3.1 General

The 5G DDNMF-initiated messages for 5G ProSe direct discovery over the PC3a interface shall be contained in an HTTP response message. Either HTTP long polling, or OMA Push, can be used to trigger the HTTP request corresponding to this HTTP response message. The UE and the 5G DDNMF shall support OMA Push for network initiated procedures. The UE and 5G DDNMF should support long polling as well for network initiated procedures.

If the UE supports the HTTP long polling, the UE shall include a Network-Initiated Transaction Method set to "HTTP long polling" in the DISCOVERY\_REQUEST message to the 5G DDNMF.

Upon receiving a DISCOVERY\_REQUEST message containing a Network-Initiated Transaction Method set to "HTTP long polling", if the 5G DDNMF supports the HTTP long polling, the 5G DDNMF shall include a Network-Initiated Transaction Method set to "HTTP long polling" in the DISCOVERY\_RESPONSE message.

If the UE receives a DISCOVERY\_RESPONSE message including a Network-Initiated Transaction Method set to "HTTP long polling", the UE shall use the HTTP long polling for network initiated procedures. Otherwise, the UE shall assume that the 5G DDNMF uses OMA Push for network initiated procedures.

#### 6.1.3.2 HTTP long polling

The HTTP long polling method is described by the following steps:

a) the UE sends an empty HTTP request message as a polling request when it expects network initiated message(s) over the PC3a interface;

b) the 5G DDNMF defers its response to the UE's request until;

1) one or more network-initiated PC3a message(s) for the UE are available. The 5G DDNMF encloses the message(s) in an HTTP response message and send it to the UE; or

2) a particular timeout for HTTP polling has occurred. The 5G DDNMF then sends an empty HTTP response message as the polling response to the UE; and

c) after receiving the response from the 5G DDNMF, the UE may keep polling after some waiting period if:

1) the UE receives an empty polling response; or

2) the UE receives 5G DDNMF-initiated message(s) from the 5G DDNMF but still expects additional network-initiated message(s).

NOTE: The implementation of the HTTP polling process can be coordinated with the SUPL (Secure User Plane Location) procedures to synchronize the SUPL location report procedures and the HTTP polling procedure so as to reduce unnecessary wait time of polling.

If the UE is trigged to send a PC3a message to the 5G DDNMF while it has a pending HTTP polling request, the UE shall open another HTTP connection to the 5G DDNMF to send this new request. Alternately the UE may always use a separate dedicated HTTP connection for polling.

#### 6.1.3.3 OMA Push

The OMA Push method is described by the following steps:

a) if one or more network-initiated PC3a message(s) for the UE are available, the 5G DDNMF sends a push message containing a particular URL to the UE via the OMA-Push Architecture as defined in OMA-AD-Push-V2\_2-20110809-A [6]. The URL is linked to the PC3a message(s) to be sent to the UE. The 5G DDNMF (performing OMA Push Proxy Gateway functionality) generates a Push Message as specified in OMA-WAP-TS-PushOTA-V2\_1-20110405-A [7] with the PDU set according to WAP-168-ServiceLoad-20010731-a [8]. The URL information shall be included in the PDU payload;

b) after receiving the push message, the UE retrieves the URL from the payload of the message and sends an HTTP GET request to the 5G DDNMF with this URL; and

c) the 5G DDNMF sends an HTTP response message containing the PC3a message(s) to the UE.

## 6.2 Procedures

### 6.2.1 Types of 5G ProSe direct discovery procedures

The following PC3a Control Protocol procedures are defined:

a) announce request;

b) monitor request;

c) discoveree request;

d) discoverer request;

e) match report;

f) network initiated direct discovery update; and

g) announcing alert request.

In the following descriptions of PC3a Control Protocol procedures, the terms "request" and "response" refer to the corresponding PC3a Control Protocol messages, not to the HTTP request or response. The following procedure descriptions use a single PC3a Control Protocol message for illustration purposes.

NOTE: A single HTTP request message can contain multiple PC3a Control Protocol requests and a single HTTP response message can contain multiple PC3a Control Protocol responses.

### 6.2.2 Announce request procedure for open ProSe direct discovery

#### 6.2.2.1 General

The purpose of the announce request procedure for open ProSe direct discovery is for the UE:

a) to obtain one or more ProSe Application Code(s) to be announced over the PC5 interface, upon a request for announcing from upper layers as defined in 3GPP TS 23.304 [2];

b) to inform the 5G DDNMF that the UE wants to stop announcing a ProSe Application Code as defined in 3GPP TS 23.304 [2]; or

c) to upload metadata associated with a ProSe Application ID to the 5G DDNMF as defined in 3GPP TS 23.304 [2].

The UE shall be authorized for open ProSe direct discovery announcing in the registered PLMN or the local PLMN based on the service authorization procedure as specified in clause 5, before initiating the announce request procedure.

The UE includes one of the ProSe Application Code(s) obtained as a result of a successful announce request procedure per PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY messages to the lower layers for transmission over the PC5 interface.

#### 6.2.2.2 Announce request procedure initiation

Before initiating the announce request procedure for open ProSe direct discovery, the UE is configured with the data structure of the ProSe Application IDs appropriate for its HPLMN. This step is performed using mechanisms out of scope of 3GPP.

If the UE is authorized to perform open ProSe direct discovery announcing in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate an announce request procedure:

a) when the UE is triggered by an upper layer application to announce a ProSe Application ID and the UE has no valid corresponding ProSe Application Code for that upper layer application;

b) when the validity timer T5060 assigned by the 5G DDNMF to a ProSe Application Code has expired and the request from upper layers to announce the ProSe Application ID corresponding to that ProSe Application Code is still in place;

c) when the UE selects a new PLMN while announcing a ProSe Application Code and intends to announce in the new PLMN, and the UE is authorized for open ProSe direct discovery announcing in the new PLMN;

d) when, while announcing a ProSe Application ID, the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe Application Code for this new PLMN yet;

e) when the UE needs to inform the 5G DDNMF that the UE wants to stop announcing a ProSe Application Code; or

f) when the UE needs to update metadata associated with a ProSe Application ID to the 5G DDNMF.

When the UE selects a new PLMN while announcing a ProSe Application Code and the UE is not yet authorized for open ProSe direct discovery announcing in the new PLMN, the UE shall initiate an announce request procedure only after the UE is authorized for open ProSe direct discovery announcing in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing a ProSe Application Code corresponding to the same ProSe Application ID, the UE can initiate the announce request procedure before the TTL timer T5060 assigned by the 5G DDNMF for a Prose Application Code expires.

The UE shall initiate the announce request procedure for open ProSe direct discovery by sending a DISCOVERY\_REQUEST message with:

a) a new transaction ID;

b) the ProSe Application ID set to the ProSe Application ID received from upper layers;

c) the command set to "metadata\_update" if the UE has a valid ProSe Application Code corresponding to the ProSe Application ID and intends to update metadata associated with the ProSe Application ID to the 5G DDNMF, otherwise set to "announce";

d) the UE identity set to the UE's SUPI;

e) the Application Identity set to the Application Identity of the upper layer application that requested the announcing;

f) the Discovery Entry ID set to 0 when this is a new request or set to the Discovery Entry ID received from the 5G DDNMF if the announce request is to update a previously sent announce request;

g) the ACE Enabled Indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers or "normal" if application-controlled extension is not used;

h) optionally the Requested Timer set to the length of validity timer associated with the ProSe Application Code that the UE expects to receive from the 5G DDNMF;

i) optionally the Metadata set to the metadata received from upper layers associated with the ProSe Application ID; and

j) optionally the Announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for announcing this ProSe Application ID.

If open ProSe direct discovery with application-controlled extension is requested by upper layers, the DISCOVERY\_REQUEST message shall also include the Application Level Container, which contains application-level data transparent to the 3GPP network, to be used by the ProSe Application Server e.g. to assign ProSe Application Code Suffix(es).

When the UE initiates the announce request procedure to inform the 5G DDNMF that the UE wants to stop announcing a ProSe Application Code before the associated valid timer expires, the UE shall set the Requested Timer to 0.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY\_REQUEST message for different ProSe Application IDs, and receive corresponding <response-announce> element or <response-reject> element in a DISCOVERY\_RESPONSE message for each respective transaction. In the following description of the announce request procedure, only one transaction is included.

Figure 6.2.2.2.1 illustrates the interaction of the UE and the 5G DDNMF in the announce request procedure.



Figure 6.2.2.2.1: Announce request procedure

#### 6.2.2.3 Announce request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY\_REQUEST message with the command set to "announce", if the Requested Timer is included in the DISCOVERY\_REQUEST message and the Requested Timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the Discovery Entry ID included in the DISCOVERY\_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall inform the 5G DDNMF in the announcing PLMN to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9] when the announcing PLMN is not the same as that of the PLMN to which the 5G DDNMF belongs and remove the discovery entry identified by the Discovery Entry ID from the UE's context. Then the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-announce> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message; and

b) the Discovery Entry ID set to the identifier associated with the corresponding discovery entry.

Upon receiving a DISCOVERY\_REQUEST message with the command set to "announce", if the Requested Timer is not included in the DISCOVERY\_REQUEST message or the Requested Timer included in the DISCOVERY\_REQUEST message is not set to 0, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is authorized for open ProSe direct discovery announcing. If the application is authorized for open ProSe direct discovery announcing, the 5G DDNMF may also check whether the ProSe Application ID contained in the DISCOVERY\_REQUEST message is known. If the ProSe Application ID is known or the 5G DDNMF skips the check of the ProSe Application ID, the 5G DDNMF shall check whether there is an existing context for the UE associated with the requested ProSe Application ID.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for open ProSe direct discovery announcing as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorized then:

a) the 5G DDNMF shall check whether the UE is authorized to announce the ProSe Application ID contained in the DISCOVERY\_REQUEST message;

b) if the UE is authorized to announce the ProSe Application ID, the ACE Enabled Indicator is included and set to "application-controlled extension enabled", the Application Level Container is included in the DISCOVERY\_REQUEST message and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall invoke the procedure described in 3GPP TS 29.343 [19] to check whether the UE is authorized to announce the requested ProSe Application ID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The 5G DDNMF shall then allocate one ProSe Application Code Prefix and a value for validity timer T5060 to be used with the ProSe Application Code Suffix(es) obtained from the ProSe Application Server for the given ProSe Application ID as specified in 3GPP TS 29.343 [19]. The 5G DDNMF may take into account the Requested Timer if contained in the DISCOVERY\_REQUEST message;

c) if the UE is authorized to announce the ProSe Application ID, the ACE Enabled Indicator is included and set to "normal" in the DISCOVERY\_REQUEST message and the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe Application Code(s) and a value for validity timer T5060. The 5G DDNMF may take into account the Requested Timer if contained in the DISCOVERY\_REQUEST message;

d) if the UE is authorized to announce the ProSe Application ID, the ACE Enabled Indicator is set included and to "normal" in the DISCOVERY\_REQUEST message, the Application Level Container is included in the DISCOVERY\_REQUEST and the requested application only uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, 5G DDNMF shall invoke the procedure described in 3GPP TS 29.343 [19] to check whether the UE is authorized to announce the requested ProSe Application ID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The 5G DDNMF shall then allocate one ProSe Application Code Prefix and a value for validity timer T5060 to be used with the ProSe Application Code Suffix(es) obtained from the ProSe Application Server for the given ProSe Application ID as specified in 3GPP TS 29.343 [19]. The 5G DDNMF may take into account the Requested Timer if contained in the DISCOVERY\_REQUEST message;

e) if the UE is authorized to announce the ProSe Application ID, the ACE Enabled Indicator is included and set to "application-controlled-extension enabled" and the Application Level Container is included in the DISCOVERY\_REQUEST message but the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe Application Code(s) and a value for validity timer T5060. The 5G DDNMF may consider the Requested Timer if contained in the DISCOVERY\_REQUEST message; and

f) if the UE is authorized to announce the ProSe Application ID and the ACE Enabled Indicator is not included in the DISCOVERY\_REQUEST message, the 5G DDNMF shall allocate the corresponding ProSe Application Code(s) and a value for validity timer T5060. The 5G DDNMF may consider the Requested Timer if contained in the DISCOVERY\_REQUEST message.

Editor's Note: The referenced specification for interaction between 5G DDNMF and ProSe Application Sever (TS 29.343, PC2 interface) can be updated if CT3 decides to create new TS for PC2a interface.

NOTE: The 5G DDNMF can allocate multiple ProSe Application Codes for a given ProSe Application ID for instance in the case when one or more labels in the ProSe Application ID Name are wild carded as described in clause 24.2.2 of 3GPP TS 23.003 [12].

If the requested ProSe Application ID is country-specific or global as described in clause 24.2 of 3GPP TS 23.003 [12], the 5G DDNMF shall allocate the corresponding ProSe Application Code(s) or ProSe Application Code Prefix according to clause 24.3 of 3GPP TS 23.003 [12]. The temporary identity part of each ProSe Application Code or ProSe Application Code Prefix is taken from the data structure corresponding to the country-specific or global ProSe Application ID namespace according to clause 24.3 of 3GPP TS 23.003 [12]. The 5G DDNMF shall use the MCC and MNC of the PLMN ID of this 5G DDNMF for the PLMN ID part of the ProSe Application Code or ProSe Application Code Prefix.

After the ProSe Application Code(s) or ProSe Application Code Prefix allocation, the 5G DDNMF then associates the ProSe Application Code(s) or ProSe Application Code Prefix with a new discovery entry identified by a non-zero value Discovery Entry ID in the new context for the UE that contains the UE's subscription parameters obtained from the UDM, and starts timer T5061. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. For a given set of ProSe Application Codes or the allocated ProSe Application Code Prefix, timer T5061 shall be longer than timer T5060. By default, the value of timer T5061 is 4 minutes greater than the value of timer T5060.

If there is an existing context for the UE that contains the UE's subscription parameters obtained from the UDM, but no discovery entry identified by the Discovery Entry ID contained in the DISCOVERY\_REQUEST message, the 5G DDNMF shall behave as if the Discovery Entry ID included in the DISCOVERY\_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero Discovery Entry ID for this entry.

If the Metadata is included in the DISCOVERY\_REQUEST message, the 5G DDNMF shall allocate the ProSe Application Code or ProSe Application Code Prefix including a Metadata Index to indicate the current version of the Metadata, and store the received metadata in the UE context.

Moreover, if the command is set to "metadata\_update" in the DISCOVERY\_REQUEST message and there is an existing UE context stored in the 5G DDNMF, the 5G DDNMF shall update the metadata in the UE context by using the received Medadata in the DISCOVERY\_REQUEST message, and update the ProSe Application Code or ProSe Application Code Prefix in the UE context by changing the Metadata Index portion and keeping the rest unchanged.

After the ProSe Application Code(s) allocation, the 5G DDNMF then associates the ProSe Application Code(s) with a new discovery entry identified by a non-zero value Discovery Entry ID in the UE context, and starts timer T5061.

If there is an existing context for the UE and a discovery entry identified by the Discovery Entry ID contained in the DISCOVERY\_REQUEST message associated with the requested ProSe Application ID, the 5G DDNMF shall either update the discovery entry with a new validity timer T5060, or allocate new ProSe Application Code(s) or ProSe Application Code Prefix for the requested ProSe Application ID with a new validity timer T5060, and restart timer T5061. The 5G DDNMF may consider the Requested Timer if contained in the DISCOVERY\_REQUEST message.

If a new discovery entry was created or an existing discovery entry was updated and the UE is currently roaming or the Announcing PLMN ID is included in the DISCOVERY\_REQUEST message, the 5G DDNMF checks with the 5G DDNMF of the VPLMN or in case of open ProSe direct discovery the local PLMN identified by the Announcing PLMN ID whether the UE is authorized for open ProSe direct discovery announcing as described in 3GPP TS 29.555 [9].

If the check indicates that the UE is authorized, then the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-announce> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message from the UE;

b) either the ProSe Application Code(s) set to the ProSe Application Code(s) allocated by the 5G DDNMF, or the ProSe Application Code ACE parameter set to include the ProSe-Application Code- Prefix allocated by the 5G DDNMF, and one or more ProSe Application Code Suffix Ranges which contain the suffix(es) for the ProSe Application ID received in the DISCOVERY\_REQUEST message from the UE;

c) Validity Timer T5060 set to the T5060 timer value assigned by the 5G DDNMF to the ProSe Application Code(s):

d) if the ACE Enabled Indicator was included by the UE in the DISCOVERY\_REQUEST message, the ACE Enabled Indicator set to:

1) "application-controlled extension enabled" if application-controlled extension is used; or

2) "normal" if application-controlled extension is not used;

e) the Discovery Entry ID set to the identifier associated with the corresponding discovery entry; and

f) the Discovery Key set to a value provided by the 5G DDNMF.

If timer T5061 expires, the 5G DDNMF shall remove the discovery entry identified by the Discovery Entry ID from the UE's context.

#### 6.2.2.4 Announce request procedure completion by the UE

Upon receipt of the DISCOVERY\_RESPONSE message, if only the transaction ID and the Discovery Entry ID are contained in the <response-announce> element and the transaction ID and the Discovery Entry ID match the corresponding values sent by the UE in a DISCOVERY\_REQUEST message, the UE shall:

a) stop the validity timer T5060 corresponding to the ProSe Application Code(s) or ProSe Application Code Prefix in the discovery entry identified by the Discovery Entry ID;

b) remove the discovery entry identified by the Discovery Entry ID included; and

c) instruct the lower layers to stop announcing.

Upon receipt of the DISCOVERY\_RESPONSE message, if the transaction ID contained in the <response-announce> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "announce", the UE shall create a new discovery entry or update an existing discovery entry with the received ProSe Application Code(s) and the PLMN ID of the intended announcing PLMN. For this discovery entry, the UE shall stop the validity timer T5060 if running and start the validity timer T5060 with the received value. Otherwise the UE shall discard the DISCOVERY\_RESPONSE message and shall not perform the procedures below.

For any one of the received ProSe Application Codes or ProSe Application Code Prefix in this discovery entry, the UE may perform open ProSe direct discovery announcing as described in clause 6.2.14.2.1.1.

#### 6.2.2.5 Announce request procedure not accepted by the 5G DDNMF

If the DISCOVERY\_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY\_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is not authorized for open ProSe direct discovery announcing, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #1 "Invalid application".

If the ProSe Application ID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #2 "Unknown ProSe Application ID".

If the UE is not authorized for open ProSe direct discovery announcing, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

If the UE is not authorized to use the ProSe Application ID contained in the DISCOVERY\_REQUEST message, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

If the UE requests a country-specific ProSe Application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has not authorized the UE to announce in that country, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #8 "Scope Violation in Prose Application ID".

If the UE requests a country-specific ProSe Application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has no agreement to access the country-wide ProSe Application ID database of that country, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #8 "Scope Violation in Prose Application ID".

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF and the Requested Timer is set to zero, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value # 10 "Unknown or invalid Discovery Entry ID".

If the UE is not authorized to use ACE, but the DISCOVERY\_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #12 "UE unauthorized for discovery with Application-Controlled Extension".

If the DISCOVERY\_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", but does not contain the Application Level Container parameter, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #14 "Missing Application Level Container".

If the ProSe Application Server indicates to the 5G DDNMF that the Application Level Container in the DISCOVERY REQUEST message contains invalid information, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #15 "Invalid Data in Application Level Container".

If the DISCOVERY\_REQUEST message does not contain the ACE Enabled Indicator and the requested application only uses application-controlled extension, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #1 "Invalid Application".

#### 6.2.2.6 Abnormal cases

##### 6.2.2.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_REQUEST message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the announce request procedure.

b) No response from the 5G DDNMF after the DISCOVERY\_REQUEST message has been successfully delivered (e.g. TCP ACK has been received for the DISCOVERY\_REQUEST message)

The UE shall retransmit the DISCOVERY\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to announce the ProSe Application ID is no longer in place after sending the DISCOVERY\_REQUEST message, but before the announce request procedure is completed

The UE shall acknowledge the DISCOVERY\_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the announce request procedure is completed, the procedure shall be aborted. If the UE is authorized to announce in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

e) Absence of Discovery Entry ID parameter in a DISCOVERY\_RESPONSE message received in response to a DISCOVERY\_REQUEST message which contained a Discovery Entry ID parameter

If the DISCOVERY\_REQUEST message:

1) included a Requested Timer which is set to 0; or

2) included an Announcing PLMN ID;

the UE shall acknowledge the DISCOVERY\_RESPONSE message received from the 5G DDNMF but discard its content and then abort the procedure.

##### 6.2.2.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5061, if running.

### 6.2.3 Announce request procedure for restricted ProSe direct discovery model A

#### 6.2.3.1 General

The purpose of the announce request procedure for restricted ProSe direct discovery model A is for the UE:

a) to obtain a ProSe Restricted Code corresponding to the Restricted ProSe Application User ID (RPAUID) to be announced over the PC5 interface, upon a request for announcing from upper layers (e.g., application client) as defined in 3GPP TS 23.304 [2]; or

b) to inform the 5G DDNMF that the UE wants to stop announcing a ProSe Restricted Code as defined in 3GPP TS 23.304 [2].

Before initiating the announce request procedure, the UE shall be authorized for restricted ProSe direct discovery model A announcing in the registered PLMN or local PLMN based on the service authorization procedure as specified in clause 5.

The UE includes the ProSe Restricted Code obtained from a successful announce request procedure in a PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY message to the lower layers for transmission over the PC5 interface.

#### 6.2.3.2 Announce request procedure initiation

Before initiating the announce request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorization procedure as specified in clause 5 and obtains an RPAUID associated with the UE's PDUID from the ProSe Application Server. The UE may provide metadata to be associated with the RPAUID, and the ProSe Application Server stores the metadata. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorized to perform restricted ProSe direct discovery model A announcing in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate an announce request procedure:

a) when the UE is triggered by an upper layer application to announce an RPAUID and the UE has no valid corresponding ProSe Restricted Code for that RPAUID of the upper layer application;

b) when the validity timer T5062 assigned by the 5G DDNMF to a ProSe Restricted Code has expired and the request from upper layers to announce the RPAUID corresponding to that ProSe Restricted Code is still in place;

c) when the UE selects a new PLMN while announcing a ProSe Restricted Code and intends to announce in the new PLMN, and the UE is authorized for restricted ProSe direct discovery model A announcing in the new PLMN;

d) when, while announcing a RPAUID, the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe Restricted Code for this new PLMN yet; or

e) when the UE needs to update a previously sent restricted ProSe direct discovery model A announcing request.

When the UE selects a new PLMN while announcing a ProSe Restricted Code and the UE is not yet authorized for restricted ProSe direct discovery model A announcing in the new PLMN, the UE shall initiate an announce request procedure only after the UE is authorized for restricted ProSe direct discovery model A announcing in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing a ProSe Restricted Code corresponding to the same RPAUID, the UE can initiate the announce request procedure before the validity timer T5062 assigned by the 5G DDNMF for a ProSe Restricted Code expires.

The UE shall initiate the announce request procedure by sending a DISCOVERY\_REQUEST message with:

a) a new transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the RPAUID set to the RPAUID received from upper layers;

c) the command set to "announce";

d) the UE identity set to the UE's SUPI;

e) the Application Identity set to the Application Identity of the upper layer application that requested the announcing;

f) the Discovery Type set to "Restricted discovery";

g) the ACE Enabled Indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers or "normal" if application-controlled extension is not used;

h) the announcing type set to "on demand" if on demand announcing is requested by upper layers and "normal" if on demand announcing is not requested by upper layers;

i) optionally the Requested Timer set to the length of validity timer associated with the ProSe Restricted Code that the UE expects to receive from the 5G DDNMF;

j) the Discovery Entry ID set to a 0 if the announcing request is a new request, and set to the Discovery Entry ID received from the 5G DDNMF if the announcing request is to update a previously sent announcing request; and

k) optionally the Announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for announcing the RPAUID.

If restricted ProSe direct discovery model A with application-controlled extension is requested by upper layers, the DISCOVERY\_REQUEST message shall also include the Application Level Container, which contains application-level data transparent to the 3GPP network, to be used by the ProSe Application Server e.g. to assign ProSe Restricted Code Suffix(es).

When the UE initiates the announce request procedure to inform the 5G DDNMF that the UE wants to stop announcing a ProSe Restricted Code before the associated valid timer expires, the UE shall set the Requested Timer to 0.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY\_REQUEST message for different RPAUIDs, and receive corresponding <restricted-announce-response> element or <response-reject> element in a DISCOVERY\_RESPONSE message for each respective transaction. In the following description of the announce request procedure, only one transaction is included.

Figure 6.2.3.2.1 illustrates the interaction of the UE and the 5G DDNMF in the announce request procedure.



Figure 6.2.3.2.1: Announce request procedure for restricted ProSe direct discovery model A

#### 6.2.3.3 Announce request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY\_REQUEST message with the command set to "announce" and the Discovery Type set to "Restricted discovery", if the Requested Timer is included in the DISCOVERY\_REQUEST message and the Requested Timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the Discovery Entry ID included in the DISCOVERY\_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall inform the 5G DDNMF in the announcing PLMN to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9] when the announcing PLMN is not the same as that of the PLMN to which the 5G DDNMF belongs and remove the discovery entry identified by the Discovery Entry ID from the UE's context. Then the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <restricted-announce-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message; and

b) the Discovery Entry ID set to the identifier associated with the corresponding discovery entry.

Upon receiving a DISCOVERY\_REQUEST message with the command set to "announce" and the Discovery Type set to "Restricted discovery", if the Requested Timer is not included in the DISCOVERY\_REQUEST message or the Requested Timer included in the DISCOVERY\_REQUEST message is not set to 0, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is authorized for restricted ProSe direct discovery model A announcing. If the application is authorized for restricted ProSe direct discovery model A announcing, the 5G DDNMF shall check whether there is an existing context for the UE.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for restricted ProSe direct discovery model A announcing as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorized, the 5G DDNMF creates a UE context that contains the UE's subscription parameters obtained from the UDM. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. If the UE context exists, the 5G DDNMF shall then check whether the UE is authorized for restricted ProSe direct discovery model A announcing in the currently registered PLMN or in the local PLMN identified by the Announcing PLMN ID included in the DISCOVERY\_REQUEST message.

If the UE is authorized and the Discovery Entry ID included in the DISCOVERY\_REQUEST message is set to 0 then:

a) the 5G DDNMF shall check whether the UE is authorized to announce the RPAUID contained in the DISCOVERY\_REQUEST message. Optionally this can include checking with the ProSe Application Server as described in 3GPP TS 29.343 [19] to obtain the binding between the RPAUID and PDUID, and then verifying that the PDUID belongs to the requesting UE;

b) if the UE is authorized to announce the RPAUID, the ACE Enabled Indicator is set to "application-controlled extension enabled", the Application Level Container is included in the DISCOVERY\_REQUEST message and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall invoke the procedure described in 3GPP TS 29.343 [19] to check whether the UE is authorized to announce the requested RPAUID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The 5G DDNMF shall then allocate a ProSe Restricted Code Prefix and a value for validity timer T5062 to be used with the ProSe Restricted Code Suffix(es) obtained from the ProSe Application Server for the given RPAUID as specified in 3GPP TS 29.343 [19]. The 5G DDNMF may take into account the Requested Timer if contained in the DISCOVERY\_REQUEST message when allocating validity timer T5062;

c) if the UE is authorized to announce the RPAUID, the ACE Enabled Indicator is set to "normal" in the DISCOVERY\_REQUEST message and the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe Restricted Code and a value for validity timer T5062. The 5G DDNMF may take into account the Requested Timer if contained in the DISCOVERY\_REQUEST message when allocating validity timer T5062;

d) if the UE is authorized to announce the RPAUID, the ACE Enabled Indicator is set to "normal" in the DISCOVERY\_REQUEST message, the Application Level Container is included in the DISCOVERY\_REQUEST and the requested application only uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall invoke the procedure described in 3GPP TS 29.343 [19] to check whether the UE is authorized to announce the requested RPAUID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The 5G DDNMF shall then allocate a ProSe Restricted Code Prefix and a value for validity timer T5062 to be used with the ProSe Restricted Code Suffix(es) obtained from the ProSe Application Server for the given RPAUID as specified in 3GPP TS 29.343 [19] The 5G DDNMF may consider the Requested Timer if contained in the DISCOVERY\_REQUEST message when allocating validity timer T5062;

e) if the UE is authorized to announce the RPAUID, the ACE Enabled Indicator is set to "application-controlled-extension enabled" and the Application Level Container is included in the DISCOVERY\_REQUEST message but the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe Restricted Code and a value for validity timer T5062. The 5G DDNMF may consider the Requested Timer if contained in the DISCOVERY\_REQUEST message when allocating validity timer T5062; and

f) the 5G DDNMF associates the allocated ProSe Restricted Code or ProSe Restricted Code Prefix with a new discovery entry in the UE's context, and starts timer T5063. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. For a given ProSe Restricted Code, timer T5063 shall be longer than timer T5062. By default, the value of timer T5063 is 4 minutes greater than the value of timer T5062.

Editor's Note: The referenced specification for interaction between 5G DDNMF and ProSe Application Sever (TS 29.343, PC2 interface) can be updated if CT3 decides to create new TS for PC2a interface.

If the Discovery Entry ID included in the DISCOVERY\_REQUEST message is not set to 0 and if there is an existing discovery entry for this Discovery Entry ID value in the UE's context, the 5G DDNMF shall either update the discovery entry with a new validity timer T5062, or allocate a new ProSe Restricted Code or ProSe Restricted Code Prefix for the requested RPAUID with a new validity timer T5062, restart timer T5063, and clear any existing on demand announcing enabled indicator. The 5G DDNMF may consider the Requested Timer if contained in the DISCOVERY\_REQUEST message when allocating validity timer T5062.

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the Discovery Entry ID included in the DISCOVERY\_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero Discovery Entry ID for this entry.

If the announcing type is set to "on demand" in the DISCOVERY\_REQUEST message, the 5G DDNMF shall check if "on demand" announcing is authorized and enabled based on the Application Identity and the operator's policy. If "on demand" announcing is authorized and enabled, and there is no ongoing monitoring request for this RPAUID, then the 5G DDNMF shall set the on demand announcing enabled indicator to 1 for the corresponding discovery entry in the UE's context.

If a new UE context was created or an existing UE context was updated, and the UE is currently roaming or the Announcing PLMN ID is included in the DISCOVERY\_REQUEST message, and the on demand announcing enabled indicator is not set to 1 for this discovery entry in the UE's context, the 5G DDNMF checks with the 5G DDNMF of the VPLMN or the local PLMN represented by the Announcing PLMN ID whether the UE is authorized for restricted ProSe direct discovery model A announcing as described in 3GPP TS 29.555 [9].

The 5G DDNMF shall then send a DISCOVERY\_RESPONSE message containing a <restricted-announce-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message from the UE;

b) if the on demand announcing enabled indicator is not set to 1 in the UE's context for this discovery entry, either the ProSe Restricted Code set to the ProSe Restricted Code or the ProSe Restricted Code Prefix allocated by the 5G DDNMF, and optionally one or more ProSe Restricted Code Suffix Ranges which contain the suffix(es) for the RPAUID received in the DISCOVERY\_REQUEST message;

c) a Validity Timer T5062 set to the T5062 timer value assigned by the 5G DDNMF to the ProSe Restricted Code;

d) the ACE Enabled Indicator set to "application-controlled extension enabled" if application-controlled extension is used, or "normal" if application-controlled extension is not used;

e) the Restricted Security set to a value containing the security-related information for restricted discovery provided by the 5G DDNMF;

f) the On Demand Announcing Enabled Indicator indicating whether the on demand announcing is enabled or not for this discovery entry if the Announcing Type is set to "on demand" in the DISCOVERY\_REQUEST message; and

g) the Discovery Entry ID set to the ID of the discovery entry associated with this announce request in the UE's context.

If timer T5063 expires, the 5G DDNMF shall remove the discovery entry associated with the corresponding RPAUID from the UE's context.

#### 6.2.3.4 Announce request procedure completion by the UE

Upon receipt of the DISCOVERY\_RESPONSE message, if only the transaction ID and the Discovery Entry ID are contained in the <restricted-announce-response> element and the transaction ID and the Discovery Entry ID match the corresponding values sent by the UE in a DISCOVERY\_REQUEST message, the UE shall:

a) stop the validity timer T5062 for the discovery entry corresponding to the Discovery Entry ID received in the DISCOVERY\_RESPONSE message;

b) remove the discovery entry identified by the Discovery Entry ID included; and

c) instruct the lower layers to stop announcing.

Upon receipt of the DISCOVERY\_RESPONSE message, if the transaction ID contained in the <restricted-announce-response> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "announce", the UE shall create a new discovery entry or update an existing discovery entry with the received ProSe Restricted Code or ProSe Restricted Code Prefix and the PLMN ID of the intended announcing PLMN. For this discovery entry, the UE shall stop the validity timer T5062, if running, for the discovery entry corresponding to the Discovery Entry ID received in the DISCOVERY\_RESPONSE message, and start the validity timer T5062 for this discovery entry with the received value in the DISCOVERY\_RESPONSE message. Otherwise the UE shall discard the DISCOVERY\_RESPONSE message and shall not perform the procedures below.

If the DISCOVERY\_RESPONSE message includes new ProSe Restricted Code or ProSe Restricted Code Prefix to replace the existing ProSe Restricted Code being announced, the UE shall notify lower layer to stop announcing the old ProSe Restricted Code in PC5 interface.

If the DISCOVERY RESPONSE message contains an On Demand Announcing Enabled Indicator set to 1, the UE shall wait for an Announcing Alert Request message from the 5G DDNMF of the HPLMN before starting to perform restricted ProSe direct discovery model A announcing. Otherwise, the UE may perform restricted ProSe direct discovery model A announcing as described in clause 6.2.14.2.1.

#### 6.2.3.5 Announce request procedure not accepted by the 5G DDNMF

If the DISCOVERY\_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY\_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is not authorized for ProSe direct discovery announcing, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF or ProSe Application Server, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #9 "Unknown RPAUID".

If the RPAUID contained in the DISCOVERY\_REQUEST message does not match the stored RPAUID for the requested Discovery Entry ID, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorized for restricted ProSe direct discovery model A announcing, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

If the UE is not authorized for restricted "on demand" restricted ProSe direct discovery model A announcing, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #13 "UE unauthorized for on-demand announcing".

If the RPAUID contained in the DISCOVERY\_REQUEST message is not associated with the PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorization Failure".

If the UE is not authorized to use ACE, but the DISCOVERY\_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #12 "UE unauthorized for discovery with Application-Controlled Extension".

If the DISCOVERY\_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", but does not contain the Application Level Container parameter, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #14 "Missing Application Level Container".

If the ProSe Application Server indicates to the 5G DDNMF that the Application Level Container in the DISCOVERY REQUEST message contains invalid information, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #15 "Invalid Data in Application Level Container".

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF and the Requested Timer is set to zero, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value # 10 "Unknown or invalid Discovery Entry ID".

#### 6.2.3.6 Abnormal cases

##### 6.2.3.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_REQUEST message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the announce request procedure.

b) No response from the 5G DDNMF after the DISCOVERY\_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY\_REQUEST message)

The UE shall retransmit the DISCOVERY\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to announce the RPAUID is no longer in place after sending the DISCOVERY\_REQUEST message, but before the announce request procedure is completed

The UE shall acknowledge the DISCOVERY\_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the announce request procedure is completed, the procedure shall be aborted. If the UE is authorized to announce in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

##### 6.2.3.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5063, if running.

### 6.2.4 Monitor request procedure for open ProSe direct discovery

#### 6.2.4.1 General

The purpose of the monitor request procedure for open ProSe direct discovery is to allow a UE:

a) to receive and process PROSE PC5 DISCOVERY messages upon a request for monitoring from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to inform the 5G DDNMF that the UE wants to stop using Discovery Filters for direct discovery monitoring as defined in 3GPP TS 23.304 [2].

The UE shall only initiate the monitor request procedure if it has been authorized for open ProSe direct discovery monitoring at least in one PLMN based on the service authorization procedure.

As a result of the monitor request procedure completing successfully, the UE obtains one or more Discovery Filters, along with a TTL (Time-To-Live) timer T5064 for each Discovery Filter indicating the time during which the filter is valid.

#### 6.2.4.2 Monitor request procedure Initiation

Before initiating the monitor request procedure, the UE is configured with the data structure of the ProSe Application IDs it wants to monitor. This step is performed using mechanisms that are out of scope of 3GPP.

If the UE is authorized to perform open ProSe direct discovery monitoring in at least one PLMN, it shall initiate a monitor request procedure:

a) when the UE is triggered by an upper layer application to perform open ProSe direct discovery monitoring corresponding to a ProSe Application ID and the UE has no valid Discovery Filters corresponding to the requested ProSe Application ID for that upper layer application;

b) when the TTL timer T5064 assigned by the 5G DDNMF to a Discovery Filter has expired and the request from upper layers to monitor that ProSe Application ID is still in place; or

c) when the UE needs to inform the 5G DDNMF that the UE wants to stop using Discovery Filters for direct discovery monitoring.

NOTE 1: To ensure service continuity if the UE needs to keep monitoring the same Discovery Filter, the UE can initiate the monitor request procedure before the TTL timer T5064 assigned by the 5G DDNMF for a Discovery Filter expires.

The UE shall initiate the monitor request procedure for open ProSe direct discovery by sending a DISCOVERY\_REQUEST message with:

a) a new transaction ID;

the ProSe Application ID set to the ProSe Application ID received from upper layers;

b) the command set to "monitor"

c) the UE identity set to the UE's SUPI;

d) the Application Identity set to the Application Identity of the upper layer application that requested the monitoring;

e) the ACE Enabled Indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers, or "normal" if application-controlled extension is not used;

f) the Discovery Entry ID set to 0 if this is a new request or set to the Discovery Entry ID received from the 5G DDNMF if the monitor request is to update a previously sent monitor request; and

g) optionally, the Requested Timer set to 0 only when the UE wants to stop using Discovery Filters for direct discovery monitoring.

If open ProSe direct discovery with application-controlled extension is requested by upper layers, the DISCOVERY\_REQUEST message shall also include the Application Level Container, which contains information corresponding to the ProSe Application Code Suffix, e.g. group or user-specific information.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY\_REQUEST message for one or more ProSe Application IDs, and receive corresponding <response-monitor> element or <response-reject> element in the DISCOVERY\_RESPONSE message for each respective transaction. In the following description of the monitor request procedure, only one transaction is included.

Figure 6.2.4.2.1 illustrates the interaction between the UE and the 5G DDNMF in the monitor request procedure.



Figure 6.2.4.2.1: Monitor request procedure

#### 6.2.4.3 Monitor request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY\_REQUEST message with the command set to "monitor", if the Requested Timer is included in the DISCOVERY\_REQUEST message and the Requested Timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the Discovery Entry ID included in the DISCOVERY\_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall remove the discovery entry identified by the Discovery Entry ID from the UE's context. When the associated ProSe Application ID is PLMN-specific and that PLMN ID indicated by the ProSe Application ID is not the same as that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF shall inform the 5G DDNMF in the PLMN indicated by the ProSe Application ID to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9]. Then the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-monitor> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message; and

b) the Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY\_REQUEST message.

Upon receiving a DISCOVERY\_REQUEST message with the command set to "monitor", if the Requested Timer is not included in the DISCOVERY\_REQUEST message, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is authorized for open ProSe direct discovery monitoring. If the application is authorized for open ProSe direct discovery monitoring, the 5G DDNMF checks whether there is an existing context for the UE associated with the requested ProSe Application ID.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for open ProSe direct discovery monitoring as described in 3GPP TS 29.503 [10]. The UDM provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. If the subscription check indicates that the UE is authorized, the 5G DDNMF creates a new context for the UE and a new discovery entry identified by a non-zero value Discovery Entry ID which is associated with the requested ProSe Application ID.

If the ACE Enabled Indicator in the DISCOVERY\_REQUEST message is included and set to "application-controlled extension enabled" and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall also use the procedure described in 3GPP TS 29.343 [19] to obtain the mask(s) for monitoring the ProSe Application Code Suffix (es) corresponding to the requested ProSe Application ID.

Editor's Note: The referenced specification for interaction between 5G DDNMF and ProSe Application Sever (TS 29.343, PC2 interface) can be updated if CT3 decides to create new TS for PC2a interface.

If the PLMN ID indicated in the ProSe Application ID is PLMN-Specific and that PLMN ID is not the same as that of the PLMN to which the 5G DDNMF belongs, then the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to obtain the Discovery Filter(s) for the ProSe Application ID. Otherwise, the 5G DDNMF shall allocate one or more Discovery Filters for the requested ProSe Application ID if it is known to the 5G DDNMF, and at least one corresponding valid ProSe Application Code or ProSe Application Code Prefix is available in the 5G DDNMF. Each Discovery Filter consists of a ProSe Application Code, one or more ProSe Application Masks, and a TTL timer T5064. If application-controlled extension is used, the allocated Discovey Filter shall be applicable to match both prefix and suffix portions of the ProSe Application Code.

If the requested ProSe Application ID is country-specific or global or PLMN-specific as defined respectively in clause 24.2 of 3GPP TS 23.003 [12], the 5G DDNMF shall allocate the Discovery Filter which contains ProSe Application Code and ProSe Application Mask(s) in the corresponding scope. If the ProSe Application ID is country-specific or global, the ProSe Application Mask(s) enclosed in the Discovery Filter hides the PLMN ID part correspondingly and the temporary identity part is taken from the data structure corresponding to the global or country-wide ProSe Application ID namespace, as specified in clause 24.3 of 3GPP TS 23.003 [12]. If the requested ProSe Application ID is PLMN-specific, the 5G DDNMF shall allocate one or more PLMN-specific Discovery Filters. Each of these Discovery Filters shall contain a PLMN-specific Prose Application Code and the ProSe Application Mask(s) whose PLMN ID portion shall be set such that when the mask is applied to the ProSe Application Code, the outcome matches the full PLMN ID of that specific PLMN.

After the Discovery Filter(s) are allocated, the 5G DDNMF then associates the Discovery Filters with the new discovery entry in the UE context and starts timer T5065 assigned for each Discovery Filter. For a given Discovery Filter timer T5065 shall be longer than timer T5064. By default, the value of timer T5065 is 4 minutes greater than the value of timer T5064.

If there is an existing context for the UE that contains the UE's subscription parameters obtained from the UDM, but no discovery entry identified by the Discovery Entry ID contained in the DISCOVERY\_REQUEST message, the 5G DDNMF shall check whether the UE is authorized for ProSe direct discovery monitoring. If the UE is authorized, the 5G DDNMF shall allocate the Discovery Filter as specified above.

After the Discovery Filter is allocated, the 5G DDNMF then associates the Discovery Filter with a new discovery entry identified by a non-zero value Discovery Entry ID in the UE context, and starts timer T5065 assigned for each Discovery Filter.

Similarly, if there is an existing context and a discovery entry identified by the Discovery Entry ID contained in the DISCOVERY\_REQUEST message for the UE associated with the requested ProSe Application ID, the 5G DDNMF updates the content of Discovery Filter(s), associate the discovery entry with the updated Discovery Filter(s) and restart timer T5065 for each filter. The update of a Discovery Filter content includes setting new TTL timer(s) and if necessary, assigning new ProSe Application Code or ProSe Application Code Prefix and ProSe Application Mask(s).

Then the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-monitor> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message from the UE;

b) the Discovery Entry ID set to the identifier associated with the discovery entry; and

c) if the ACE Enabled Indicator was included by the UE in the DISCOVERY\_REQUEST message, the ACE Enabled Indicator set to:

1) "application-controlled extension enabled" if application-controlled extension is used; or

2) "normal" if application-controlled extension is not used; and

d) one or more Discovery Filters allocated by the 5G DDNMF(s) for the ProSe Application ID received in the DISCOVERY\_REQUEST message from the UE.

If timer T5065 expires, the 5G DDNMF shall remove the UE's association with the corresponding Discovery Filter. Furthermore, the 5G DDNMF shall remove the discovery entry from the UE's context if there is no Discovery Filter corresponding to the ProSe Application ID.

#### 6.2.4.4 Monitor request procedure completion by the UE

Upon receipt of the DISCOVERY\_RESPONSE message, if only the transaction ID and the Discovery Entry ID are contained in the <response-monitor> element and the transaction ID and the Discovery Entry ID match the corresponding values sent by the UE in a DISCOVERY\_REQUEST message, the UE shall:

a) stop TTL timer T5064 for each Discovery Filter in the discovery entry identified by the Discovery Entry ID;

b) remove the discovery entry identified by the Discovery Entry ID; and

c) instruct the lower layers to stop monitoring.

Upon receipt of the DISCOVERY\_RESPONSE message, if the transaction ID contained in the <response-monitor> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "monitor", the UE shall, for each Discovery Filter assigned by the 5G DDNMF, stop TTL timer T5064 if running and start TTL timer T5064 with the received value. Otherwise the UE shall discard the DISCOVERY\_RESPONSE message and shall not perform the procedures below.

The UE may perform open ProSe direct discovery monitoring for discovery messages received over the PC5 interface as described in clause 6.2.14.2.1.3.

#### 6.2.4.5 Monitor request procedure not accepted by the 5G DDNMF

If the DISCOVERY\_REQUEST message is not accepted by the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is not authorized for open ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #1 "Invalid application".

If the ProSe Application ID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #2 "Unknown ProSe Application ID".

If the UE is not authorized for open ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

If the UE requests a country-specific ProSe Application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has not authorized the UE to monitor in that country, it shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #8 "Scope Violation in Prose Application ID".

If the UE requests a country-specific ProSe Application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has no agreement to access the country-specific ProSe Application ID database of that country, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #8 "Scope Violation in Prose Application ID".

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF and the Requested Timer is set to 0, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #10 "Unknown or invalid Discovery Entry ID ".

If the 5G DDNMF cannot retrieve a valid ProSe Application Code corresponding to the ProSe Application ID contained in the DISCOVERY\_REQUEST message, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #17 "No Valid ProSe Application Code".

If the UE is not authorized to use ACE, but the DISCOVERY\_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #12 "UE unauthorized for discovery with Application-Controlled Extension".

If the DISCOVERY\_REQUEST message does not contain the ACE Enabled Indicator and the requested application only uses application-controlled extension, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #1 "Invalid Application".

#### 6.2.4.6 Abnormal cases

##### 6.2.4.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_REQUEST message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the monitor request procedure.

b) No response from the 5G DDNMF after the DISCOVERY\_REQUEST message has been successfully delivered (e.g. TCP ACK has been received for the DISCOVERY\_REQUEST message)

The UE shall retransmit the DISCOVERY\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to monitor the ProSe Application ID is no longer in place after sending the DISCOVERY\_REQUEST message, but before the monitor request procedure is completed

The UE shall acknowledge the DISCOVERY\_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the monitor request procedure is completed, the procedure shall be aborted. If the UE is authorized to monitor in the new PLMN, the procedures shall be restarted once the UE is registered on the new PLMN.

##### 6.2.4.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_RESPONSE message

After receiving an indication from lower layer that the DISCOVEY\_RESPONSE message has not been successfully acknowledged, the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5065, if running.

### 6.2.5 Monitor request procedure for restricted ProSe direct discovery model A

#### 6.2.5.1 General

The purpose of the monitor request procedure for restricted ProSe direct discovery model A is:

a) to allow a UE participating in restricted ProSe direct discovery model A to receive and process PROSE PC5 DISCOVERY messages upon a request for monitoring from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to inform the 5G DDNMF that the UE wants to stop using Restricted Discovery Filter(s) for direct discovery monitoring as defined in 3GPP TS 23.304 [2].

The UE shall only initiate the restricted ProSe direct discovery model A monitor request procedure if it has been authorized for restricted ProSe direct discovery model A monitoring in at least in one PLMN based on the service authorization procedure.

As a result of the monitor request procedure completing successfully, the UE obtains one or more Restricted Discovery Filters, along with a TTL (Time-To-Live) timer T5066 for each Restricted Discovery Filter indicating the time during which the filter is valid.

#### 6.2.5.2 Monitor request procedure Initiation

Before initiating the monitor request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorization procedure as specified in clause 5, and obtains an RPAUID associated with the UE's PDUID and the target RPAUID(s) to be monitored from the ProSe Application Server. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorized to perform ProSe direct discovery model A monitoring in at least one PLMN, it shall initiate a monitor request procedure:

a) when the UE is triggered by an upper layer application to perform restricted ProSe direct discovery model A monitoring corresponding to at least one RPAUID, and the UE has no valid Restricted Discovery Filters corresponding to the requested RPAUID for that upper layer application; or

b) when the TTL timer T5066 assigned by the 5G DDNMF to a Restricted Discovery Filter has expired and the request from upper layers to monitor that RPAUID is still in place; or

NOTE 1: To ensure service continuity if the UE needs to keep monitoring the same Restricted Discovery Filter, the UE can initiate the monitor request procedure before the TTL timer T5066 assigned by the 5G DDNMF for a Restricted Discovery Filter expires.

c) when the UE needs to update a previously sent restricted ProSe direct discovery model A monitoring request.

The UE shall initiate the monitor request procedure by sending a DISCOVERY\_REQUEST message with:

a) a new transaction ID;

b) the RPAUID set to the RPAUID received from upper layers;

c) the command set to "monitor";

d) the Discovery Type set to "Restricted discovery"

e) the UE identity set to the UE's SUPI;

f) the Application Identity set to the Application Identity of the upper layer application that requested the monitoring;

g) the ACE Enabled Indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers, or "normal" if application-controlled extension is not used;

h) the Application Level Container set to the target RPAUIDs to monitor;

i) the Discovery Entry ID set to 0 if the monitoring request is a new request, and set to the Discovery Entry ID received from the 5G DDNMF if the monitoring request is to update a previously sent monitoring request; and

j) optionally, the Requested Timer set to 0 only when the UE wants to stop using Restricted Discovery Filter(s) for direct discovery monitoring.

If restricted direct discovery model A with application-controlled extension is requested by upper layers, the Application Level Container included in the DISCOVERY\_ REQUEST also contains information corresponding to the ProSe Restricted Code Suffix, e.g. group or user-specific information.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY\_REQUEST message for one or more different monitoring targets, and receive corresponding <response-monitor> element or <response-reject> element in the DISCOVERY\_RESPONSE message for each respective transaction. In the following description of the monitor request procedure, only one transaction is included.

Figure 6.2.5.2.1 illustrates the interaction between the UE and the 5G DDNMF in the monitor request procedure.



Figure 6.2.5.2.1: Monitor request procedure for restricted ProSe direct discovery model A

#### 6.2.5.3 Monitor request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY\_REQUEST message with the command set to "monitor" and the Discovery Type set to "Restricted discovery", if the Requested Timer is included in the DISCOVERY\_REQUEST message and the Requested Timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the Discovery Entry ID included in the DISCOVERY\_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall remove the discovery entry identified by the Discovery Entry ID from the UE's context. For each of the PDUIDs corresponding to the target RPAUIDs contained the Restricted Discovery Filters in the discovery entry, if the PDUID is PLMN-specific and that PLMN ID indicated by the PDUID is not the same as that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF shall inform the 5G DDNMF in the PLMN indicated by the PDUID to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9]. Then the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <restricted-monitor-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message; and

b) the Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY\_REQUEST message.

Upon receiving a DISCOVERY\_REQUEST message with the command set to "monitor" and the Discovery Type set to "Restricted discovery", if the Requested Timer is not included in the DISCOVERY\_REQUEST message, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is authorized for ProSe direct discovery model A monitoring. If the application is authorized for restricted ProSe direct discovery model A monitoring, the 5G DDNMF shall check whether there is an existing UE context.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for restricted ProSe direct discovery model A monitoring as described in 3GPP TS 29.503 [10]. The UDM provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. If the subscription check indicates that the UE is authorized, the 5G DDNMF creates a new UE context containing the UE's subscription parameters obtained from the UDM.

If the Discovery Entry ID included in the DISCOVERY\_REQUEST is set to 0 then:

a) the 5G DDNMF shall use the procedure described in 3GPP TS 29.343 [19] to pass the Application Level Container included in the DISCOVERY\_REQUEST message to the ProSe Application Server and obtain a list of PDUID(s) , an Application Level Container and optionally Metadata Indicator(s) corresponding to the authorized target RPAUID(s) from the ProSe Application Server;

b) if the ACE Enabled Indicator in the DISCOVERY\_REQUEST message is set to "application-controlled extension enabled" and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall also use the procedure described in 3GPP TS 29.343 [19] to obtain the mask(s) for monitoring a ProSe Restricted Suffix Pool corresponding to each of the Target RPAUIDs.

Editor's Note: The referenced specification for interaction between 5G DDNMF and ProSe Application Sever (TS 29.343, PC2 interface) can be updated if CT3 decides to create new TS for PC2a interface.

NOTE 1: The ProSe Application Server can reject the request for some of the target RPAUIDs included in the Application Level Container in the DISCOVERY\_REQUEST message because they are ineligible to be monitored by the requesting UE. Depending on the operator policy and application layer permissions, it is possible that only a subset of valid RPAUIDs are authorized by the ProSe Application Server.

c) for each of the PDUIDs corresponding to an authorized target RPAUID, if the PLMN ID of the PDUID is not the same as that of the PLMN to which the 5G DDNMF belongs, then the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to obtain the ProSe Restricted Code or ProSe Restricted Code Prefix for the target RPAUID and creates Restricted Discovery Filter(s). Otherwise, for each target RPAUID, the 5G DDNMF shall allocate one or more Restricted Discovery Filter(s). If the ACE Enabled Indicator in the DISCOVERY\_REQUEST message does not match the ACE configuration in the 5G DDNMF or ProSe Application Server for this application, the ACE configuration in the 5G DDNMF or ProSe Application Server shall be used to create Restricted Discovery Filter(s). Each Restricted Discovery Filter consists of a ProSe Restricted Code, one or more masks, a TTL timer T5066, optionally the target RPAUID, optionally a metadata indicator and optionally metadata associated with this RPAUID;

d) the 5G DDNMF associates the Restricted Discovery Filters with a new discovery entry in the UE's context; and

e) the 5G DDNMF starts timer T5067 assigned for each Restricted Discovery Filter. For a given Restricted Discovery Filter, timer T5067 shall be longer than timer T5066. By default, the value of timer T5067 is 4 minutes greater than the value of timer T5066.

NOTE 2: For each target RPAUID, the 5G DDNMF either allocates one Restricted Discovery Filter for full-matching the ProSe Restricted Code assigned to this RPAUID, or allocates one or more Restricted Discovery Filter(s) for matching the ProSe Restricted Code Prefix and Suffix Pool assigned to this RPAUID.

If the Discovery Entry ID included in the DISCOVERY\_REQUEST message is not set to 0 and if there is an existing discovery entry for this Discovery Entry ID in the UE's context, the 5G DDNMF shall check whether the UE is authorized for restricted ProSe direct discovery model A monitoring. If the UE is authorized, the 5G DDNMF shall process the request as above-mentioned and update this discovery entry with the contents of the Restricted Discovery Filter(s) associated with this discovery entry and restart timer T5067(s) for each filter. The update of a Restricted Discovery Filter content includes setting new TTL timer(s) and if necessary, obtaining new ProSe Restricted Code and ProSe Restricted Mask(s) via the procedure defined in 3GPP TS 29.555 [9].

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the Discovery Entry ID included in the DISCOVERY\_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero Discovery Entry ID for this entry.

Then the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <restricted-monitor-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message from the UE;

b) one or more Restricted Discovery Filter(s) allocated by the 5G DDNMF(s) for the authorized target RPAUID(s);

c) the ACE Enabled Indicator set to "application-controlled extension enabled" if application-controlled extension is used, or "normal" if application-controlled extension is not used;

d) the Discovery Entry ID set to the ID of the discovery entry associated with this monitor request; and

e) the Application Level Container set to the application-level data received from the ProSe Application Server.

If T5067 expires, the 5G DDNMF shall remove the corresponding Restricted Discovery Filter from the discovery entry in the UE's context. Furthermore, if there are no valid Restricted Discovery Filters associated with the discovery entry (e.g, all Restricted Discovery Filters have expired), the 5G DDNMF shall delete the discovery entry from the UE's context.

#### 6.2.5.4 Monitor request procedure completion by the UE

Upon receipt of the DISCOVERY\_RESPONSE message, if only the transaction ID and the Discovery Entry ID are contained in <restricted-monitor-response> element and the transaction ID and the Discovery Entry ID match the corresponding values sent by the UE in a DISCOVERY\_REQUEST message with the command set to "monitor", the UE shall:

a) stop TTL timer T5066 for each Restricted Discovery Filter in the discovery entry identified by the Discovery Entry ID;

b) remove the discovery entry identified by the Discovery Entry ID; and

c) instruct the lower layers to stop monitoring.

Upon receipt of the DISCOVERY\_RESPONSE message, if the transaction ID contained in the <restricted-monitor-response> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "monitor" and, the UE shall process as follow:

a) If the DISCOVERY\_RESPONSE creates a new discovery entry, start the TTL timer T5066 with the received value for each Restricted Discovery Filter information element received in the DISCOVERY\_RESPONSE message.

b) If the DISCOVERY\_RESPONSE updates an existing discovery entry, the UE shall

1) stop the T5066 timer(s) of any Restricted Discovery Filter in this discovery entry which are no longer authorized by the 5G DDNMF, ask lower layers to stop using those filters in monitoring operation, and remove the corresponding Restricted Discovery Filter from the discovery entry;

2) restart the T5066 timer(s) for those remain eligible; and

3) start the T5066 timer(s) for any new Restricted Discovery Filter(s) included in the DISCOVERY\_RESPONSE message.

Otherwise the UE shall discard the DISCOVERY\_RESPONSE message and shall not perform the procedures below.

The UE may perform monitoring for discovery messages received over the PC5 interface as described in clause 6.2.14.2.1.3.

#### 6.2.5.5 Monitor request procedure not accepted by the 5G DDNMF

If the DISCOVERY\_REQUEST message is not accepted by the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is not authorized for ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY\_REQUEST message is unknown to the ProSe Application Server, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #9 "Unknown RPAUID".

If none of the RPAUID(s) contained in the Application Level Container in the DISCOVERY\_REQUEST message is eligible to be discovered by the requesting RPAUID, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #11 "Invalid Discovery Target".

If the RPAUID contained in the DISCOVERY\_REQUEST message does not match the stored RPAUID for the requested Discovery Entry ID, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorized for restricted ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

If the RPAUID contained in the DISCOVERY\_REQUEST message is not associated with a PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorization Failure".

If the UE is not authorized to use ACE, but the DISCOVERY\_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #12 "UE unauthorized for discovery with Application-Controlled Extension".

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF and the Requested Timer is set to 0, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #10 "Unknown or invalid Discovery Entry ID".

#### 6.2.5.6 Abnormal cases

##### 6.2.5.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_REQUEST message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the monitor request procedure.

b) No response from the 5G DDNMF after the DISCOVERY\_REQUEST message has been successfully delivered (e.g. TCP ACK has been received for the DISCOVERY\_REQUEST message)

The UE shall retransmit the DISCOVERY\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to monitor the targets contained in Application Level Container is no longer in place after sending the DISCOVERY\_REQUEST message, but before the monitor request procedure is completed

The UE shall acknowledge the DISCOVERY\_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the monitor request procedure is completed, the procedure shall be aborted. If the UE is authorized to monitor in the new PLMN, the procedures shall be restarted once the UE is registered on the new PLMN.

##### 6.2.5.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY\_RESPONSE message has not been successfully acknowledged, the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5067, if running.

### 6.2.6 Discoveree request procedure for restricted ProSe direct discovery model B

#### 6.2.6.1 General

The purpose of the discoveree request procedure for restricted ProSe direct discovery model B is for the UE to obtain Discovery Query Filter(s) to be used for monitoring a model B query for a Restricted ProSe Application User ID (RPAUID) over the PC5 interface, and a ProSe Response Code to be announced over the PC5 interface as a response to a model B query, as defined in 3GPP TS 23.304 [2].

Before initiating the discoveree request procedure, the UE shall be authorised for restricted ProSe direct discovery model B discoveree operation in the registered PLMN or the local PLMN based on the service authorisation procedure as specified in clause 5.

As the result of successful completion of this procedure, the UE obtains one or more Discovery Query Filters and applies them to the monitoring operation in PC5 interface. The UE shall also include the ProSe Response Code in a PROSE PC5 DISCOVERY message and passes the message to the lower layers for transmission over the PC5 interface when there is a match of the Discovery Query Filter(s).

#### 6.2.6.2 Discoveree request procedure initiation

Before initiating the discoveree request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorisation procedure as specified in clause 5 and obtains an RPAUID associated with the UE's PDUID from the ProSe Application Server. The UE can provide metadata to be associated with the RPAUID, and the ProSe Application Server stores the metadata. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorised to perform restricted ProSe direct discovery model B discoveree operation in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate a discoveree request procedure:

a) when the UE is triggered by an upper layer application to announce an RPAUID in Model B and the UE has no valid corresponding ProSe Response Code and Discovery Query Filter(s) for that RPAUID of the upper layer application;

b) when the validity timer T5068 assigned by the 5G DDNMF to a ProSe Response Code and the corresponding Discovery Query Filter(s) has expired and the request from upper layers to announce the RPAUID corresponding to that ProSe Response Code is still in place;

c) when the UE selects a new PLMN while announcing or waiting for announcing a ProSe Response Code and intends to announce in the new PLMN, and the UE is authorised for restricted ProSe direct discovery model B discoveree operation in the new PLMN;

d) when, while announcing or waiting for announcing a ProSe Response Code, the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe Response Code for this new PLMN yet; or

e) when the UE needs to update a previously sent restricted ProSe direct discovery model B discoveree request.

When the UE selects a new PLMN while announcing or waiting for announcing a ProSe Response Code and the UE is not yet authorised for restricted ProSe direct discovery model B discoveree operation in the new PLMN, the UE shall initiate a discoveree request procedure only after the UE is authorised for restricted ProSe direct discovery model B discoveree operation in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing in Model B a ProSe Response Code corresponding to the same RPAUID, the UE can initiate the discoveree request procedure before the validity timer T5068 assigned by the 5G DDNMF for a ProSe Response Code expires.

The UE shal initiate the discoveree request procedure by sending a DISCOVERY\_REQUEST message with:

a) a new transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the RPAUID set to the RPAUID received from upper layers;

c) the command set to "response";

d) the UE identity set to the UE's SUPI;

e) the Application Identity set to the Application Identity of the upper layer application that requested the announcing;

f) the Discovery Type set to "Restricted discovery";

g) the Discovery Model set to "Model B";

h) the Discovery Entry ID set to a 0 if the discoveree request is a new request, and set to the Discovery Entry ID received from the 5G DDNMF if the discoveree request is to update a previously sent discoveree request; and

i) optionally the Announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for announcing the RPAUID.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY\_REQUEST message for different RPAUIDs (e.g., for different applications), and receive corresponding <restricted-discoveree-response> element or <response-reject> element in a DISCOVERY\_RESPONSE message for each respective transaction. In the following description of the discoveree request procedure, only one transaction is included.

Figure 6.2.6.2.1 illustrates the interaction of the UE and the 5G DDNMF in the discoveree request procedure.



Figure 6.2.6.2.1: Discoveree request procedure for restricted ProSe direct discovery model B

#### 6.2.6.3 Discoveree request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY\_REQUEST message, the 5G DDNMF shall check that the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is authorised for restricted ProSe direct discovery model B discoveree operation. If the application is authorised for restricted ProSe direct discovery model B discoveree operation, the 5G DDNMF shall check whether there is an existing context for the UE.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorised for restricted ProSe direct discovery model B discoveree operation as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorised, the 5G DDNMF creates a UE context that contains the UE's subscription parameters obtained from the UDM. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered.

If the UE context exists, the 5G DDNMF shall check whether the UE is authorized for restricted ProSe direct discovery model B discoveree operation in the currently registered PLMN or the local PLMN identified by the Announcing PLMN ID included in the DISCOVERY\_REQUEST message.

If the UE is authorized and the Discovery Entry ID included in the DISCOVERY\_REQUEST message is set to 0 then:

a) the 5G DDNMF shall check whether the UE is authorised to announce the RPAUID contained in the DISCOVERY\_REQUEST message. Optionally this can include checking with the ProSe Application Server as described in 3GPP TS 29.343 [19] to obtain the binding between the RPAUID and PDUID, and then verifying that the PDUID belongs to the requesting UE;

Editor's Note: The referenced specification for interaction between 5G DDNMF and ProSe Application Sever (TS 29.343, PC2 interface) can be updated if CT3 decides to create new TS for PC2a interface.

b) if the UE is authorised to announce the RPAUID, the 5G DDNMF shall allocate the corresponding ProSe Response Code and ProSe Query Code for the RPAUID. It shall also allocate Discovery Query Filter(s) based on the allocated ProSe Query Code. Then it shall assign a value for validity timer T5068, which is associated with the ProSe Response Code, PorSe Query Code and Discovery Query Filter(s); and

c) the 5G DDNMF associates the allocated ProSe Response Code, ProSe Query Code, and Discovery Query Filter with a new discovery entry ID in the UE context, and starts timer T5069. For a given ProSe Response Code, timer T5069 shall be longer than timer T5068. By default, the value of timer T5069 is 4 minutes greater than the value of timer T5068.

If the Discovery Entry ID included in the DISCOVERY\_REQUEST message is not set to 0 and if there is an existing discovery entry for this Discovery Entry ID value in the UE context, the 5G DDNMF shall either update the discovery entry with a new validity timer T5068, or allocate a new ProSe Response Code, ProSe Query Code and the Discovery Query Filter(s) for the requested RPAUID with a new validity timer T5068, restart timer T5069.

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the Discovery Entry ID included in the DISCOVERY\_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero Discovery Entry ID for this entry.

If a new UE context was created or an existing UE context was updated, and the UE is currently roaming or the Announcing PLMN ID is included in the DISCOVERY\_REQUEST message, the 5G DDNMF checks with the 5G DDNMF of the VPLMN or the local PLMN identified by the Announcing PLMN ID whether the UE is authorised for restricted ProSe direct discovery model B discoveree operation as described in 3GPP TS 29.555 [9].

The 5G DDNMF shall then send a DISCOVERY\_RESPONSE message containing a <restricted-discoveree-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message from the UE;

b) the ProSe Response Code set to the ProSe Response Code allocated for the RPAUID received in the DISCOVERY\_REQUEST message;

c) one or more ProSe Query Filters set to the ProSe Query Filter(s) used to match a query for the RPAUID received in the DISCOVERY\_REQUEST message;

d) a Validity Timer T5068 set to the T5068 timer value assigned by the 5G DDNMF to the ProSe Response Code and the Discovery Query Filter(s);

e) the Restricted Security set to a value containing the security-related information for restricted discovery provided by the 5G DDNMF; and

f) the Discovery Entry ID set to the ID of the discovery entry associated with this discoveree request in the UE context.

If timer T5069 expires, the 5G DDNMF shall remove the discovery entry associated with the corresponding RPAUID from the UE's context.

#### 6.2.6.4 Discoveree request procedure completion by the UE

Upon receipt of the DISCOVERY\_RESPONSE message, if the transaction ID contained in the <restricted-discoveree-response> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "response", the UE shall create a new discovery entry or update an existing discovery entry with the ProSe Response Code and Discovery Query Filter(s) received in the DISCOVERY\_RESPONSE message and the PLMN ID of the intended announcing PLMN. For this discovery entry, the UE shall stop the validity timer T5068 if running and start the validity timer T5068 with the received value. The UE shall also use the received ProSe Response Code and Discovery Query Filter(s) to replace the old counterparts if they are currently used. This may involve notifying the lower layers to stop announcing the old ProSe Response Code or to stop monitoring with the old Discovery Query Filter(s). Otherwise the UE shall discard the DISCOVERY\_RESPONSE message and shall not perform the procedures described in clause 6.2.14.2.2.3.

#### 6.2.6.5 Discoveree request procedure not accepted by the 5G DDNMF

If the DISCOVERY\_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY\_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is not authorised for ProSe direct discovery Model B discoveree operation, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF or ProSe Application Server, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #9 "Unknown RPAUID".

If the RPAUID contained in the DISCOVERY\_REQUEST message does not match the stored RPAUID for the requested Discovery Entry ID, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorised for restricted ProSe direct discovery model B discoveree operation, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation failure".

If the RPAUID contained in the DISCOVERY\_REQUEST message is not associated with a PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation Failure".

#### 6.2.6.6 Abnormal cases

##### 6.2.6.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_REQUEST message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the discoveree request procedure.

b) No response from the 5G DDNMF after the DISCOVERY\_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY\_REQUEST message)

The UE shall retransmit the DISCOVERY\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to announce the RPAUID in model B is no longer in place after sending the DISCOVERY\_REQUEST message, but before the discoveree request procedure is completed

The UE shall acknowledge the DISCOVERY\_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the discoveree request procedure is completed, the procedure shall be aborted. If the UE is authorized to perform restricted ProSe direct discovery model B discoveree operation in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

##### 6.2.6.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5069, if running.

### 6.2.7 Discoverer request procedure for restricted ProSe direct discovery model B

#### 6.2.7.1 General

The purpose of the discoverer request procedure for restricted ProSe direct discovery model B is for the UE to obtain ProSe Query Code(s) and Discovery Response Filter(s) to be used for sending query and monitoring responses over the PC5 interface based on the information provided by the upper layer application, as defined in 3GPP TS 23.304 [2].

Before initiating the discoverer request procedure, the UE shall be authorised for restricted ProSe direct discovery model B discoverer operation in the registered PLMN or the local PLMN based on the service authorisation procedure as specified in clause 5.

As the result of successful completion of this procedure, the UE obtains one or more ProSe Query Code(s) which can be included in a PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY message to the lower layers for transmission over the PC5 interface. The UE also obtains Discovery Response Filter(s) and apply it to the monitoring operation in PC5 interface to match potential responses for the sent query request for the target RPAUID.

#### 6.2.7.2 Discoverer request procedure initiation

Before initiating the discoverer request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorisation procedure as specified in clause 5 and obtains an RPAUID associated with the UE's PDUID from the ProSe Application Server. The UE can also obtain the target RPAUID(s) from the ProSe Application Server. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorised to perform restricted ProSe direct discovery model B discoverer operation in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate a discoverer request procedure:

a) when the UE is triggered by an upper layer application to perform the query for one or more target RPAUIDs in Model B and the UE has no valid corresponding ProSe Query Code and Discovery Response Filter for those target RPAUIDs of the upper layer application;

b) when the validity timer T5070 assigned by the 5G DDNMF to a ProSe Query Codes and the corresponding Discovery Response Filter has expired and the request from upper layers to announce the RPAUID corresponding to that ProSe Response Code is still in place;

c) when the UE selects a new PLMN while announcing a ProSe Query Code or waiting for a ProSe Response Code and intends to announce the ProSe Query Code in the new PLMN, and the UE is authorised for restricted ProSe direct discovery model B discoverer operation in the new PLMN;

d) when, while querying for target RPAUID(s), the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe Query Code for this new PLMN yet; or

e) when the UE needs to update a previously sent restricted ProSe direct discovery model B discoverer request.

When the UE selects a new PLMN while announcing a ProSe Query Code or waiting for a ProSe Response Code and the UE is not yet authorised for restricted ProSe direct discovery model B discoverer operation in the new PLMN, the UE shall initiate a discoverer request procedure only after the UE is authorised for restricted ProSe direct discovery model B discoverer operation in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing in Model B a ProSe Query Code corresponding to the same RPAUID, the UE can initiate the discoverer request procedure before the validity timer T5070 assigned by the 5G DDNMF for a ProSe Query Code expires.

The UE shall initiate the discoverer request procedure by sending a DISCOVERY\_REQUEST message with:

a) a new transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the RPAUID set to the RPAUID received from upper layers;

c) the Application Level Container set to contain the application-layer information, e.g., target RPAUID(s) to discover;

d) the command set to "query";

e) the UE identity set to the UE's SUPI;

f) the Application Identity set to the Application Identity of the upper layer application that requested the announcing;

g) the Discovery Type set to "Restricted discovery";

h) the Discovery Model set to "Model B";

i) the Discovery Entry ID set to a 0 if the discoverer request is a new request, and set to the Discovery Entry ID received from the 5G DDNMF if the discoverer request is to update a previously sent discoverer request; and

j) optionally the Announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for transmitting the query for the target RPAUID(s).

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY\_REQUEST message for different discovering requests (e.g., for different applications), and receive corresponding <restricted-discoverer-response> element or <response-reject> element in a DISCOVERY\_RESPONSE message for each respective transaction. In the following description of the discoverer request procedure, only one transaction is included.

Figure 6.2.7.2.1 illustrates the interaction of the UE and the 5G DDNMF in the discoverer request procedure.



Figure 6.2.7.2.1: Discoverer request procedure for restricted ProSe direct discovery model B

#### 6.2.7.3 Discoverer request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY\_REQUEST message, the 5G DDNMF shall check that the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is authorised for restricted ProSe direct discovery model B discoverer operation. If the application is authorised for restricted ProSe direct discovery model B discoverer operation, the 5G DDNMF shall check whether there is an existing context for the UE.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorised for restricted ProSe direct discovery model B discoverer operation as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorised, the 5G DDNMF creates a UE context that contains the UE's subscription parameters obtained from the UDM. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered.

If the UE context exists, the 5G DDNMF shall check whether the UE is authorized for restricted ProSe direct discovery model B discoveree operation in the currently registered PLMN or the local PLMN identified by the Announcing PLMN ID included in the DISCOVERY\_REQUEST message.

If the UE is authorized and the Discovery Entry ID included in the DISCOVERY\_REQUEST message is set to 0 then:

a) the 5G DDNMF uses the procedure described in 3GPP TS 29.343 [19] to pass the Application Level Container included in the DISCOVERY\_REQUEST message to the ProSe Application Server and obtain a list of PDUID(s) corresponding to the authorised target RPAUID(s) from the ProSe Application Server;

Editor's Note: The referenced specification for interaction between 5G DDNMF and ProSe Application Sever (TS 29.343, PC2 interface) can be updated if CT3 decides to create new TS for PC2a interface.

b) for each of the PDUIDs corresponding to an authorised target RPAUID:

1) if the PLMN ID of the PDUID is not the same as that of the PLMN to which the 5G DDNMF belongs, then the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to obtain the ProSe Query Code, the ProSe Response Code, the associated validity timer T5070, and optionally metadata associated with this target RPAUID. Otherwise, the 5G DDNMF shall locate the discoveree UE context and retrieve the corresponding ProSe Query Code and ProSe Response Code and the validity timer T5070, and optionally metadata associated with this RPAUID. Then, the 5G DDNMF in the HPLMN builds one or more Discovery Response Filter(s) based on the respective ProSe Response Code, and associate the Discovery Response Filter(s) and ProSe Query Code with a new validity timer T5071 based on the remaining value of T5071.

NOTE 1: If the 5G DDNMF cannot retrieve the corresponding discoveree UE context for a target RPAUID, e.g. the target RPAUID has not yet been requested to be discovered by Model B in a discoveree request procedure, or the discoveree UE context expires, the 5G DDNMF can skip the processing of this target RPAUID.

NOTE 2: The 5G DDNMF can choose the value of T5070 to be longer than the remaining value of T5069, so that the discoverer UE sends a new discoverer request for renewing the query-related information no earlier than the discoveree UE renewing its own ProSe Response Code with the 5G DDNMF.

2) the 5G DDNMF associates the ProSe Query Code and corresponding Discovery Response Filter(s), target RPAUID, and optionally metadata associated with the target RPAUID with a new discovery entry in the discoverer UE's context; and

c) the 5G DDNMF starts timer T5071 assigned for each ProSe Query Code and Discovery Response Filter(s) (of each target RPAUID) under this discovery entry of the discoverer UE context. For a given ProSe Query Code and the corresponding Discovery Response Filter(s), timer T5071 shall be longer than timer T5070. By default, the value of timer T5071 is 4 minutes greater than the value of timer T5070.

If the Discovery Entry ID included in the DISCOVERY\_REQUEST message is not set to 0 and if there is an existing discovery entry for this Discovery Entry ID value in the UE's context, the 5G DDNMF shall still process the above steps, but update the discovery entry instead of creating a new discovery entry.

If the Discovery Entry ID contained in the DISCOVERY\_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the Discovery Entry ID included in the DISCOVERY\_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero Discovery Entry ID for this entry.

If a new UE context was created or an existing UE context was updated, the UE is currently roaming or the Announcing PLMN ID is included in the DISCOVERY\_REQUEST message, the 5G DDNMF checks with the 5G DDNMF of the VPLMN or the local PLMN indicated by the Announcing PLMN ID whether the UE is authorised for restricted ProSe direct discovery model B discoverer operation as described in 3GPP TS 29.555 [9].

The 5G DDNMF shall then send a DISCOVERY\_RESPONSE message containing a <restricted-discoverer-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY\_REQUEST message from the UE;

b) one or more Subquery Result information elements, each of which includes:

1) a target RPAUID;

2) the ProSe Query Code set to the ProSe Query Code for the target RPAUID;

3) one or more the Discovery Response Filters IE which are set to include the Discovery Response Filter(s) used to match a potential ProSe Response Code responding to the ProSe Query Code.;

4) a validity timer T5070 set to the T5070 timer value assigned by the 5G DDNMF to the ProSe Query Code and the Discovery Response Filter(s); and

5) optionally, the metadata associated with the target RPAUID;

6) the Restricted Security IE containing the security key(s) needed to be used with Discovery Response Filter(s) for restricted discovery monitoring;

c) the Discovery Entry ID set to the ID of the discovery entry associated with this announce request in the UE context; and

If T5071 expires, the 5G DDNMF shall remove the corresponding ProSe Query Code and ProSe Response Filter(s) from the discovery entry associated with the discoverer UE's context.

#### 6.2.7.4 Discoverer request procedure completion by the UE

Upon receipt of the DISCOVERY\_RESPONSE message, if the transaction ID contained in the <restricted-discoverer-response> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "query" and the Discovery Model set to "Model B", the UE shall, process as follow:

a) If the DISCOVERY\_RESPONSE creates a new discovery entry, start the validity timer T5070 with the received value for the ProSe Query Code and the corresponding Discovery Response Filter(s) included for each SubQuery-Result information element received in the DISCOVERY\_RESPONSE message and the PLMN ID of the intended announcing PLMN if included in the DISCOVERY\_REQUEST message;

b) If the DISCOVERY\_RESPONSE updates an existing discovery entry, the UE shall:

1) stop the timer T5070 of any ProSe Query Code(s) and Discovery Response Filter(s) in this discovery entry which are no longer authorized by the 5G DDNMF, ask lower layers to stop announcing the ProSe Query Code(s) and monitoring ProSe Response Filter(s), and remove the ProSe Query Code(s) and Discovery Response Filter(s) from the existing discovery entry;

2) restart the T5070 timer(s) for those remain eligible;

3) start the T5070 timer(s) for any new ProSe Query Codes and their corresponding Discovery Response Filter(s); and

4) update the PLMN ID of the intended announcing PLMN for this discovery entry if included in the DISCOVERY\_REQUEST message.

Otherwise the UE shall discard the DISCOVERY\_RESPONSE message and shall not perform the discoverer UE procedure for 5G ProSe direct discovery as described in clause 6.2.14.2.2.2.

For each ProSe Query Code in this discovery entry, the UE performs the discoverer UE procedure for 5G ProSe direct discovery to announce the ProSe Query Code in the PC5 interface, as described in clause 6.2.14.2.2.2.

#### 6.2.7.5 Discoverer request procedure not accepted by the 5G DDNMF

If the DISCOVERY\_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY\_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY\_REQUEST message is not authorised for restricted ProSe direct discovery Model B discoverer operation, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY\_REQUEST message is unknown to the 5G DDNMF or ProSe Application Server, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #9 "Unknown RPAUID".

If the RPAUID contained in the DISCOVERY\_REQUEST message does not match the stored RPAUID for the requested Discovery Entry ID, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorised for restricted ProSe direct discovery model B discoverer operation, the 5G DDNMF shall send the DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorisation failure".

If the RPAUID contained in the DISCOVERY\_REQUEST message is not associated with a PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #3 "UE authorisation Failure".

If the 5G DDNMF fails to retrieve any valid target PDUIDs from ProSe Application Server based on the Application Level Container contained in the DISCOVERY\_REQUEST message, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #11 "Invalid discovery target".

If the 5G DDNMF fails to retrieve any valid discoveree UE contexts for the valid target RPAUIDs contained in the Application Level Container contained in the DISCOVERY\_REQUEST message, the 5G DDNMF shall send a DISCOVERY\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #11 "Invalid discovery target".

#### 6.2.7.6 Abnormal cases

##### 6.2.7.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_REQUEST message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the discoverer request procedure.

b) No response from the 5G DDNMF after the DISCOVERY\_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY\_REQUEST message)

The UE shall retransmit the DISCOVERY\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to discover the target RPAUID(s) is no longer in place after sending the DISCOVERY\_REQUEST message, but before the discoverer request procedure is completed

The UE shall acknowledge the DISCOVERY\_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the discoverer request procedure is completed, the procedure shall be aborted. If the UE is authorized to perform restricted ProSe direct discovery discoverer operation Model B in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

##### 6.2.7.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5071, if running.

### 6.2.8 Match report procedure for open ProSe direct discovery

#### 6.2.8.1 General

The purpose of the Match report procedure for open ProSe direct discovery is to allow a UE to send a ProSe Application Code that was matched during the monitoring operation and receive the corresponding ProSe Application ID or the updated metadata, if there is no such a mapping stored locally or the Metadata Index in the ProSe Application Code indicates the metadata is updated.

The UE shall only initiate the match report procedure if it has been authorized for open ProSe direct discovery monitoring in the monitored PLMN based on the service authorization procedure.

As a result of the match report procedure completing successfully, the UE obtains a ProSe Application ID and potentially other information, which the UE may store locally and pass to the upper layers.

#### 6.2.8.2 Match report procedure initiation

The UE shall meet the following pre-conditions before initiating this procedure:

a) a request from upper layers to monitor for the ProSe Application ID, which resulted in the matched ProSe Application Code, is still in place;

b) the lower layers have provided a "Monitored PLMN ID" value, and UTC time information, along with the discovery message containing a ProSe Application Code; and

c) the TTL timer T5064 associated with the Discovery Filter, which resulted in a match event of the ProSe Application Code, has not expired.

If the UE is authorized to perform open ProSe direct discovery monitoring in the monitored PLMN, it should initiate a match report procedure:

a) when there is a match event of one of the ProSe Application Codes received from the lower layers, and the UE does not have a corresponding ProSe Application ID already locally stored;

b) when the UE has a locally stored mapping for the ProSe Application Code that resulted in a match event, but the validity timer T5072 of the ProSe Application Code has expired;

c) when the UE has a locally stored mapping for the ProSe Application Code that resulted in a match event, but the match report refresh timer T5074 of the ProSe Application Code has expired; or

d) when there is a match event of one of the ProSe Application Codes received from the lower layers, and the UE has a locally stored ProSe Application Code excluding the Metadata Index portion located by the locally stored Metadata Index Mask.

The UE initiates the match report procedure for open ProSe direct discovery by sending a MATCH\_REPORT message with a new transaction ID and shall set the message contents as follows:

a) the UE shall set the ProSe Application Code to the ProSe Application Code for which there was a match event;

b) the UE shall set the UE identity to the UE's SUPI;

c) the UE shall set the UTC-based counter as follows:

1) the UE shall generate two UTC-based counters with:

i) the first counter composed of:

A) the 27 most significant bits of the UTC-based counter set to the 27 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Application Code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 28th most significant bit of the UTC-based counter set to '0'; and

C) the 4 least significant bits of the UTC-based counter shall be set to the 4 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe Application Code for which there was a match event, as specified in 3GPP TS 33.yyy [33yyy]; and

ii) the second counter composed of:

A) the 27 most significant bits of the UTC-based counter set to the 27 most significant bits of the UTC time provided by the lower layers for the PC5\_DISCOVERY message that contained the ProSe Application Code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 28th most significant bit of the UTC-based counter set to '1'; and

C) the 4 least significant bits of the UTC-based counter set to the 4 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe Application Code for which there was a match event, as specified in 3GPP TS 33.yyy [r33yyy]; and

2) then the UE shall select, among the two counters described above, the counter that is nearest to the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Application Code for which there was a match event encoded as specified in clause 11.2.2.18, and set the UTC-based counter in the MATCH\_REPORT message to that counter;

Editor's Note: Security aspect will be updated upon SA3 normative requirement is available.

d) the UE shall set the MIC to the MIC of the PROSE PC5 DISCOVERY message that contained the ProSe Application Code for which there was a match event;

e) the UE shall set the Message Type to the value of Message Type field of the PROSE PC5 DISCOVERY message that contained the ProSe Application Code for which there was a match event;

f) the UE shall set the Monitored PLMN ID to the PLMN ID of the PLMN where the PROSE PC5 DISCOVERY message was received, as provided by the lower layers;

g) if the UE was roaming when the match event occurred, the UE shall set the VPLMN ID to the PLMN ID of the PLMN in which the UE was registered when the match event occurred; and

h) the UE shall set the Metadata Flag to indicate whether or not it wishes to receive metadata information associated with the ProSe Application ID in the MATCH\_REPORT\_ACK message from the 5G DDNMF.

NOTE 1: A UE can include one or multiple transactions in one MATCH\_REPORT message for different ProSe Application Codes, and receive corresponding <match-ack> element or <match-reject> element in the MATCH\_REPORT\_ACK message for each respective transaction. In the following description of match report procedure, only one transaction is included.

NOTE 2: The value of the Metadata Flag is determined through an indication from upper layers in the original request to monitor for a ProSe Application ID.

Figure 6.2.8.2.1 illustrates the interaction between the UE and the 5G DDNMF in the match report procedure.



Figure 6.2.8.2.1: Match report procedure

#### 6.2.8.3 Match report procedure accepted by the 5G DDNMF

Upon receiving a MATCH\_REPORT message, the 5G DDNMF shall check whether there is an existing context for the UE identified by its SUPI. If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for open ProSe direct discovery monitoring as described in 3GPP TS 29.503 [10].

The 5G DDNMF shall also check the PLMN ID in the ProSe Application Code received from the UE. If the PLMN ID in the ProSe Application Code is not the same of that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF shall execute the procedures defined in 3GPP TS 29.555 [9]. Otherwise, the 5G DDNMF shall check whether the received ProSe Application Code is authorized to be transmitted on the monitored PLMN indicated in the Monitored PLMN ID in the received message.

If the ProSe Application Code is PLMN-specific, the 5G DDNMF shall verify if the PLMN ID in the ProSe Application Code is the same as the PLMN of the 5G DDNMF. If so, the 5G DDNMF shall map the ProSe Application Code to the corresponding ProSe Application ID from the PLMN-specific database. If the ProSe Application Code is country-specific, as specified in clause 24.3 of 3GPP TS 23.003 [4], the 5G DDNMF shall check whether the MCC of the PLMN ID part of the ProSe Application Code corresponds to the country of the 5G DDNMF. If so, the 5G DDNMF shall map the ProSe Application Code to the corresponding ProSe Application ID from the country-specific database. If the ProSe Application Code is global as specified in clause 24.3 of 3GPP TS 23.003 [4], the 5G DDNMF shall map the ProSe Application Code to the corresponding ProSe Application ID from the global database. If the ProSe Application Code contains a ProSe Application Code Prefix, the 5G DDNMF maps the ProSe Application Code Prefix to the corresponding ProSe Application ID.

The 5G DDNMF shall analyze the ProSe Application Code received from the UE and determine the validity of the ProSe Application Code.

NOTE: This might require the 5G DDNMF to execute procedures defined in 3GPP TS 29.555 [9].

The 5G DDNMF shall check if the MIC value and its corresponding UTC-based counter are valid, as defined in 3GPP TS 33.yyy [r33yyy].

If the VPLMN ID is included in the MATCH\_REPORT message, the 5G DDNMF uses it for charging purposes as specified in 3GPP TS 32.277 [r32277].

Editor's Note: Charging aspect will be updated upon stage-2 normative requirement is available.

If the outcome of above processing is successful, the 5G DDNMF shall send a MATCH\_REPORT\_ACK message containing a <match-ack> element with:

a) the transaction ID set to the value of the transaction ID received in the MATCH\_REPORT message from the UE;

b) the ProSe Application ID set to the ProSe Application ID provided by the 5G DDNMF and corresponding to the ProSe Application Code contained in the MATCH\_REPORT message;

c) the Validity Timer T5072 set to indicate for how long this ProSe Application Code is valid; and

d) the Match Report Refresh Timer T5074 set to indicate for how long the UE will wait before sending a new Match Report for this ProSe Application Code.

If the UE has set the Metadata Flag to indicate that it wishes to receive metadata information associated with the ProSe Application ID, the 5G DDNMF shall set the Metadata to the metadata information associated with the ProSe Application Code received in the MATCH\_REPORT message and set the Metadata Index Mask to the Metadata Index Mask allocated by the 5G DDNMF for the ProSe Application Code received in the MATCH\_REPORT message.

#### 6.2.8.4 Match report procedure completion by the UE

Upon receipt of the MATCH\_REPORT\_ACK message, if the transaction ID contained in the <match-ack> element matches the value sent by the UE in a MATCH\_REPORT message, the UE shall store the mapping between the ProSe Application Code and ProSe Application ID locally, start timers T5072 and T5074, and may inform the upper layers of this match of the ProSe Application ID. If the Metadata Index Mask is contained in the MATCH\_REPORT\_ACK message, the UE shall also store the Metadata Index Mask with the ProSe Application Code and the ProSe Application ID locally. If there is a locally stored mapping between the ProSe Application ID and a ProSe Application Code, the UE shall delete the old mapping. Otherwise the UE shall discard the MATCH\_REPORT\_ACK message.

Upon receipt of the MATCH\_REPORT\_ACK message, if the transaction ID contained in the <match-reject> element matches the value sent by the UE in a MATCH\_REPORT message and if the received PC3a Control Protocol cause value is #5 "Invalid MIC", as specified in clause 6.2.8.5, the UE shall stop timer T5072 if it is running.

NOTE 1: It is an implementation specific choice whether the UE informs the upper layers every time a ProSe Application ID triggers a match event, or only the first time this match occurs.

NOTE 2: The UE can also inform the upper layers if a ProSe Application ID is no longer matched, because the validity timer T5072 of the corresponding ProSe Application Code expires.

NOTE 3: The UE can also inform the upper layers if a ProSe Application ID is no longer matched, because the validity timer T5072 of the corresponding ProSe Application Code is stopped upon receiving MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #5 "Invalid MIC".

#### 6.2.8.5 Match report procedure not accepted by the 5G DDNMF

If the MATCH\_REPORT message is not accepted by the 5G DDNMF, the 5G DDNMF sends a MATCH\_REPORT\_ACK message with a <match-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If the ProSe Application Code contained in the MATCH\_REPORT message is unknown by the 5G DDNMF, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #4 "Unknown ProSe Application Code".

If the check of the MIC contained in the MATCH\_REPORT message fails, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH\_REPORT message fails, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #6 "Invalid UTC-based counter".

If the UE is not authorized for open ProSe direct discovery monitoring in the monitored PLMN contained in the MATCH\_REPORT message, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

#### 6.2.8.6 Abnormal cases

##### 6.2.8.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of MATCH\_REPORT message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the match report procedure.

b) No response from the 5G DDNMF after the MATCH\_REPORT message has been successfully delivered (e.g. TCP ACK has been received for the MATCH\_REPORT message)

If the TTL timer T5064 associated with the Discovery Filter which resulted in a match event has not expired, the UE shall retransmit the MATCH\_REPORT message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Change of PLMN

If a PLMN change occurs before the match report procedure is completed, the procedure shall be aborted.

### 6.2.9 Match report procedure for restricted ProSe direct discovery model A

#### 6.2.9.1 General

The purpose of the match report procedure is to allow a UE to send a ProSe Restricted Code that was matched during the monitoring operation and receive the corresponding RPAUID, if there is no such a mapping stored locally.

The UE shall only initiate the match report procedure if it has been authorized for restricted ProSe direct discovery monitoring model A in the monitored PLMN based on the service authorization procedure.

As a result of the match report procedure completing successfully, the UE obtains a RPAUID and potentially other information, which the UE may store locally and pass to the upper layers.

#### 6.2.9.2 Match report procedure initiation

The UE shall meet the following pre-conditions before initiating this procedure:

a) a request from upper layers to monitor for the target RPAUID, which resulted in the matched ProSe Restricted Code, is still in place;

b) the lower layers have provided UTC time information, along with the discovery message containing the ProSe Restricted Code; and

c) the TTL timer T5066 associated with the Restricted Discovery Filter, whose use resulted in a match event of the ProSe Restricted Code, has not expired.

If the UE is authorized to perform restricted ProSe direct discovery monitoring model A in the monitored PLMN, it should initiate a match report procedure:

a) when there is a match event after applying one of the Restricted Discovery Filter(s) to a ProSe Restricted Code received from the lower layers, and the UE does not have a corresponding RPAUID already locally stored;

b) when the UE has a locally stored mapping for the ProSe Restricted Code that resulted in a match event, but the validity timer T5076 of the ProSe Restricted Code has expired;

c) when the UE has a locally stored mapping for the ProSe Restricted Code that resulted in a match event, but the match report refresh timer T5077 of the ProSe Restricted Code has expired;

d) when the UE desires to obtain the metadata associated with the discovered ProSe Restricted Code; or

e) when the UE has a locally stored mapping for the ProSe Restricted Code that resulted in a match event, but the UE does not have a running match report refresh timer T5077 for this ProSe Restricted Code and the UE is directed by the 5G DDNMF to perform the required MIC check via the match report procedure.

NOTE 1: The 5G DDNMF directs the UE to use the match report procedure to perform the MIC check by including the MIC Check Indicator parameter in the DISCOVERY\_RESPONSE message.

The UE initiates the match report procedure by sending a MATCH\_REPORT message with a new transaction ID and shall set the message contents as follows:

a) the RPAUID set to the UE's RPAUID which has requested the corresponding monitoring operation that resulted this match event;

b) the ProSe Restricted Code set to the ProSe Restricted Code for which there was a match event;

c) the UE identity set to the UE's SUPI;

d) the Discovery Type set to "Restricted discovery";

e) the Application Identity set to the Application Identity of the upper layer application that triggered the monitoring operation;

f) optionally, the UTC-based counter set as follows if the MIC is checked via the match report procedure:

1) the UE shall generate two UTC-based counters with:

i) the first counter composed of:

A) the 23 most significant bits of the UTC-based counter set to the 23 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Restricted Code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 24th most significant bit of the UTC-based counter set to '0'; and

C) the 8 least significant bits of the UTC-based counter set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe Restricted Code for which there was a match event, as specified in 3GPP TS 33.yyy [r33yyy]; and

ii) the second counter composed of:

A) the 23 most significant bits of the UTC-based counter set to the 23 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Restricted Code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 24th most significant bit of the UTC-based counter set to '1'; and

C) the 8 least significant bits of the UTC-based counter set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe Restricted Code for which there was a match event, as specified in 3GPP TS 33.yyy [r33yyy]; and

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2) then the UE shall select, among the two counters described above, the counter that is nearest to the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Restricted Code for which there was a match event encoded as specified in clause 11.2.2.18, and set the UTC-based counter in the MATCH\_REPORT message to that counter;

g) optionally, the Message Type set to the value of Message Type field of the PROSE PC5 DISCOVERY message that contained the ProSe Restricted Code for which there was a match event, if the MIC is checked via the match report procedure;

h) optionally, the MIC set to the MIC of the PROSE PC5 DISCOVERY message that contained the ProSe Restricted Code for which there was a match event if the MIC is checked via the match report procedure; and

i) the Metadata Flag set to indicate whether or not the UE wishes to receive the latest metadata information associated with the RPAUID in the MATCH\_REPORT\_ACK message from the 5G DDNMF.

NOTE 2: A UE can include one or multiple transactions in one MATCH\_REPORT message for different ProSe Restricted Codes, and receive a corresponding <restricted-match-ack> element or <match-reject> element in the MATCH\_REPORT\_ACK message for each respective transaction. In the following description of match report procedure, only one transaction is included.

Figure 6.2.9.2.1 illustrates the interaction between the UE and the 5G DDNMF in the match report procedure.



Figure 6.2.9.2.1: Match report procedure for restricted discovery model A

#### 6.2.9.3 Match report procedure accepted by the 5G DDNMF

Upon receiving a MATCH\_REPORT message, the 5G DDNMF shall check whether there is an existing context for the UE identified by its SUPI.

The 5G DDNMF shall analyze the ProSe Restricted Code received from the UE in the MATCH\_REPORT message. If the MIC value and its corresponding UTC-based counter are included, the 5G DDNMF shall check whether the MIC value and the UTC-based counter are valid and within the acceptable range respectively as defined in 3GPP TS 33.yyy [r33yyy]. The 5G DDNMF shall then check in the UE context if the ProSe Restricted Code matches any Restricted Discovery Filter(s) allocated for the particular application identified by the Application Identity received in the MATCH\_REPORT message. If such a discovery filter exists, the target RPAUID associated with the filter(s) shall be identified as the corresponding RPAUID for this code. Optionally, the 5G DDNMF may further invoke the procedure defined in 3GPP TS 29.503 [10] to verify if the target RPAUID is allowed to be discovered by the RPAUID of the requesting UE that has sent the MATCH\_REPORT message, or to retrieve metadata associated for the target RPAUID if Metadata Flag is set to "True" in the MATCH\_REPORT message and the 5G DDNMF does not have the latest metadata.

Editor's Note: Security aspect will be updated upon SA3 normative requirement is available.

If the outcome of the above processing is successful, the 5G DDNMF shall send a MATCH\_REPORT\_ACK message containing a <restricted-match-ack> element with the transaction ID set to the value of the transaction ID received in the MATCH\_REPORT message from the UE, the RPAUID set to the target RPAUID retrieved from the UE context at the 5G DDNMF which corresponds to the ProSe Restricted Code contained in the MATCH\_REPORT message, and the Validity Timer T5076 set to indicate for how long this ProSe Restricted Code is valid. The 5G DDNMF shall set the Match Report Refresh Timer T5017 to indicate for how long the UE will wait before sending a new Match Report for this ProSe Restricted Code if the MIC value and the UTC-based counter are included in the MATCH\_REPORT message. If there exists metadata information associated with this target RPAUID and the Metadata Flag is set to "True" in the MATCH\_REPORT message, the 5G DDNMF shall set the Metadata to the associated metadata information.

If the corresponding PDUID of the target RPAUID does not belong to the HPLMN of the requesting UE, the 5G DDNMF may optionally invoke the procedure defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF of the announcing UE about the match event.

#### 6.2.9.4 Match report procedure completion by the UE

Upon receipt of the MATCH\_REPORT\_ACK message, if the transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH\_REPORT message, the UE shall store the mapping between the ProSe Restricted Code and RPAUID locally, start timers T5076 and T5077, and may inform the upper layers of this match of the RPAUID. Otherwise the UE shall discard the MATCH\_REPORT\_ACK message.

Upon receipt of the MATCH\_REPORT\_ACK message, if the transaction ID contained in the <match-reject> element matches the value sent by the UE in a MATCH\_REPORT message and if the received PC3a Control Protocol cause value is #5 "Invalid MIC", as specified in clause 6.2.9.5, the UE shall stop timer T5016 if it is running.

NOTE 1: It is an implementation specific choice whether the UE informs the upper layers every time an RPAUID triggers a match event, or only the first time this match occurs.

NOTE 2: The UE can also inform the upper layers if an RPAUID is no longer matched, because the validity timer T5076 of the corresponding ProSe Restricted Code expires.

NOTE 3: The UE can also inform the upper layers if a ProSe Restricted Code is no longer matched, because the validity timer T5016 of the corresponding ProSe Restricted Code is stopped upon receiving MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #5 "Invalid MIC".

#### 6.2.9.5 Match report procedure not accepted by the 5G DDNMF

If the MATCH\_REPORT message is not accepted by the 5G DDNMF, the 5G DDNMF sends a MATCH\_REPORT\_ACK message with a <match-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If there is no associated UE context for the SUPI contained in the MATCH\_REPORT message, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #16 "Invalid Match Event".

If the ProSe Restricted Code contained in the MATCH\_REPORT message does not match any Restricted Discovery Filter(s) allocated for the requesting UE for the corresponding application, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #16 "Invalid Match Event".

If the check of the MIC contained in the MATCH\_REPORT message fails, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH\_REPORT message fails, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #6 " Invalid UTC-based counter".

If the UE is not authorized for restricted ProSe direct discovery monitoring, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

#### 6.2.9.6 Abnormal cases

##### 6.2.9.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of MATCH\_REPORT message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the match report procedure.

b) No response from the 5G DDNMF after the MATCH\_REPORT message has been successfully delivered (e.g. TCP ACK has been received for the MATCH\_REPORT message)

If the TTL timer T5066 associated with the Restricted Discovery Filter which resulted in a match event has not expired, the UE shall retransmit the MATCH\_REPORT message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

### 6.2.10 Match report procedure for restricted ProSe direct discovery model B

#### 6.2.10.1 General

The purpose of the Match report procedure is to allow a UE to send a ProSe Response Code that was matched during the restricted ProSe direct discovery Model B discoverer operation and receive the corresponding RPAUID, if there is no such a mapping stored locally.

The UE shall only initiate the match report procedure if it has been authorized for restricted ProSe direct discovery model B discoverer operation in the monitored PLMN based on the service authorization procedure.

As a result of the match report procedure completing successfully, the UE obtains a RPAUID and potentially other information, which the UE may store locally and pass to the upper layers.

#### 6.2.10.2 Match report procedure initiation

The UE shall meet the following pre-conditions before initiating this procedure:

a) a request from upper layers to discover the target RPAUID with restricted discovery model B, which resulted in the matched ProSe Response Code, is still in place;

b) the lower layers have provided UTC time information, along with the discovery message containing the ProSe Response Code; and

c) the TTL timer T5070 associated with the Discovery Response Filter, whose use resulted in a match event of the ProSe Response Code, has not expired.

If the UE is authorized to perform restricted ProSe direct discovery model B discoverer operation in the monitored PLMN, it should initiate a match report procedure:

a) when there is a match event when applying one of the Discovery Response Filter(s) to one of the ProSe Response Codes received from the lower layers, and the UE does not have a corresponding RPAUID already locally stored;

b) when the UE has a locally stored mapping for the ProSe Response Code that resulted in a match event, but the validity timer T5076 of the ProSe Response Code has expired;

c) when the UE has a locally stored mapping for the ProSe Response Code that resulted in a match event, but the match report refresh timer T5077 of the ProSe Response Code has expired;

d) when the UE desires to obtain the metadata associated with the discovered ProSe Response Code; or

e) when the UE has a locally stored mapping for the ProSe Response Code that resulted in a match event, but the UE does not have a running match report refresh timer T5077 for this ProSe Response Code and the UE is directed by the 5G DDNMF to perform the required MIC check via the match report procedure.

NOTE 1: The 5G DDNMF directs the UE to use the match report procedure to perform the MIC check by including the MIC Check Indicator parameter in the DISCOVERY\_RESPONSE message.

The UE initiates the match report procedure by sending a MATCH\_REPORT message with a new transaction ID and shall set the message contents as follows:

a) the RPAUID set to the UE's RPAUID which has requested the corresponding restricted discovery model B discoverer operation that resulted this match event;

b) the ProSe Response Code set to the ProSe Response Code for which there was a match event;

c) the UE identity set to the UE's SUPI;

d) the Discovery Type set to "Restricted discovery";

e) the Application Identity set to the Application Identity of the upper layer application that triggered the restricted direct discovery Model B discoverer operation;

f) optionally, the UTC-based counter set as follows if the MIC is checked via the match report procedure:

1) the UE shall generate two UTC-based counters with:

i) the first counter composed of:

A) the 27 most significant bits of the UTC-based counter set to the 27 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Response Code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 24th most significant bit of the UTC-based counter set to '0'; and

C) the 8 least significant bits of the UTC-based counter shall be set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe Response Code for which there was a match event, as specified in 3GPP TS 33.303 [6]; and

ii) the second counter composed of:

- the 23 most significant bits of the UTC-based counter set to the 23 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Response Code for which there was a match event encoded as specified in clause 11.2.2.18;

- the 24th most significant bit of the UTC-based counter set to '1'; and

- the 8 least significant bits of the UTC-based counter set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe Response Code for which there was a match event, as specified in 3GPP TS 33.yyy [r33yyy]; and

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2) then the UE shall select, among the two counters described above, the counter that is nearest to the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe Response Code for which there was a match event encoded as specified in clause 11.2.2.18, and set the UTC-based counter in the MATCH\_REPORT message to that counter;

g) optionally, the Message Type set to the value of Message Type field of the PROSE PC5 DISCOVERY message that contained the ProSe Response Code for which there was a match event, if the MIC is checked via the match report procedure;

h) optionally, the MIC to the MIC of the PROSE PC5 DISCOVERY message that contained the ProSe Response Code for which there was a match event if the MIC is checked via the match report procedure; and

i) the Metadata Flag set to indicate whether or not the UE wishes to receive the latest metadata information associated with the RPAUID in the MATCH\_REPORT\_ACK message from the 5G DDNMF.

NOTE 2: A UE can include one or multiple transactions in one MATCH\_REPORT message for different ProSe Response Codes, and receive corresponding <restricted-match-ack> element or <match-reject> element in the MATCH\_REPORT\_ACK message for each respective transaction. In the following description of match report procedure, only one transaction is included.

Figure 6.2.10.2.1 illustrates the interaction between the UE and the 5G DDNMF in the match report procedure.



Figure 6.2.10.2.1: Match report procedure for restricted discovery model B

#### 6.2.10.3 Match report procedure accepted by the 5G DDNMF

Upon receiving a MATCH\_REPORT message, the 5G DDNMF shall check whether there is an existing discoverer UE context for the UE identified by its SUPI.

The 5G DDNMF shall analyze the ProSe Response Code received from the UE in the MATCH\_REPORT message. If the MIC value and its corresponding UTC-based counter are included, the 5G DDNMF shall check whether the MIC value and the UTC-based counter are valid and within the acceptable range respectively, as defined in 3GPP TS 33.yyy [r33yyy]. The 5G DDNMF shall then check in the UE context if the ProSe Response Code matches any Discovery Response Filter(s) allocated for the particular application identified by the Application Identity received in the MATCH\_REPORT message. If such a discovery filter exists, the target RPAUID associated with the filter(s) shall be identified as the corresponding RPAUID for this code. Optionally, the 5G DDNMF may further invoke the procedure defined in 3GPP TS 29.503 [10] to verify if the target RPAUID is allowed to be discovered by the RPAUID of the requesting UE that has sent the MATCH\_REPORT message, or to retrieve metadata associated for the target RPAUID if Metadata Flag is set to "True" in the MATCH\_REPORT message and the 5G DDNMF does not have the latest metadata.

Editor's Note: Security aspect will be updated upon SA3 normative requirement is available.

If the outcome of the above processing is successful, the 5G DDNMF shall send a MATCH\_REPORT\_ACK message containing a <restricted-match-ack> element with the transaction ID set to the value of the transaction ID received in the MATCH\_REPORT message from the UE, the RPAUID set to the target RPAUID retrieved from the UE context at the 5G DDNMF which corresponds to the ProSe Response Code contained in the MATCH\_REPORT message, the Validity Timer T5076 set to indicate for how long this ProSe Response Code is valid. The 5G DDNMF shall set the Match Report Refresh Timer T5077 to indicate for how long the UE will wait before sending a new Match Report for this ProSe Response Code if the MIC value and the UTC-based counter are included in the MATCH\_REPORT message. If there exists metadata information associated with this target RPAUID, the 5G DDNMF shall set the Metadata to the associated metadata information.

If the corresponding PDUID of the target RPAUID does not belong to the HPLMN of the requesting UE, the 5G DDNMF may optionally invoke the procedure defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF of the discoveree UE about the match event.

#### 6.2.10.4 Match report procedure completion by the UE

Upon receipt of the MATCH\_REPORT\_ACK message, if the transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH\_REPORT message, the UE shall store the mapping between the ProSe Response Code and the RPAUID locally, start timers T5076 and T5077, and may inform the upper layers of this match of the RPAUID. Otherwise the UE shall discard the MATCH\_REPORT\_ACK message.

Upon receipt of the MATCH\_REPORT\_ACK message, if the transaction ID contained in the <match-reject> element matches the value sent by the UE in a MATCH\_REPORT message and if the received PC3a Control Protocol cause value is #5 "Invalid MIC", as specified in clause 6.2.10.5, the UE shall stop timer T5076 if it is running.

NOTE 1: It is an implementation specific choice whether the UE informs the upper layers every time a RPAUID triggers a match event, or only the first time this match occurs.

NOTE 2: The UE can also inform the upper layers if an RPAUID is no longer matched, because the validity timer T5076 of the corresponding ProSe Response Code expires.

NOTE 3: The UE can also inform the upper layers if a ProSe Response Code is no longer matched, because the validity timer T5076 of the corresponding ProSe Response Code is stopped upon receiving MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #5 "Invalid MIC".

#### 6.2.10.5 Match report procedure not accepted by the 5G DDNMF

If the MATCH\_REPORT message is not accepted by the 5G DDNMF, the 5G DDNMF sends a MATCH\_REPORT\_ACK message with a <match-reject> element to the UE including an appropriate PC3a Control Protocol cause value.

If there is no associated UE context for the SUPI contained in the MATCH\_REPORT, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #16 "Invalid Match Event".

If the ProSe Response Code contained in the MATCH\_REPORT message does not match any Discovery Response Filter(s) allocated for the requesting UE for the corresponding application,, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #16 "Invalid Match Event".

If the check of the MIC contained in the MATCH\_REPORT message fails, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH\_REPORT message fails, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #6 " Invalid UTC-based counter".

If the UE is not authorized for restricted ProSe direct discovery model B discoverer operation, the 5G DDNMF shall send the MATCH\_REPORT\_ACK message with a <match-reject> element with PC3a Control Protocol cause value #3 "UE authorization failure".

#### 6.2.10.6 Abnormal cases

##### 6.2.10.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of MATCH\_REPORT message (e.g. after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the match report procedure.

b) No response from the 5G DDNMF after the MATCH\_REPORT message has been successfully delivered (e.g. TCP ACK has been received for the MATCH\_REPORT message)

If the TTL timer T5070 associated with the Discovery Response Filter which resulted in a match event has not expired, the UE shall retransmit the MATCH\_REPORT message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

### 6.2.11 Direct discovery update procedure for open discovery

#### 6.2.11.1 General

The direct discovery update procedure is used to update or revoke a previously allocated ProSe Application Code, or Discovery Filter(s) as specified in 3GPP TS 23.304 [2].

#### 6.2.11.2 Direct discovery update procedure initiation

When triggered to revoke a previously allocated ProSe Application Code for an announcing UE or revoke Discovery Filter(s) for a monitoring UE, the 5G DDNMF in the HPLMN sends a DISCOVERY\_UPDATE\_REQUEST message to the UE with:

a) a new 5G DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI; and

c) the Discovery Entry ID set to the Discovery Entry ID of the corresponding Discovery Entry that contains the ProSe Application Code or the Discovery Filter(s) to be revoked.

When triggered to update a previously allocated ProSe Application Code for an announcing UE, the 5G DDNMF in the HPLMN shall allocate a new ProSe Application Code for the ProSe Application ID with a new validity timer T5060, associate the discovery entry with the new ProSe Application Code and restart timer T5061.Then the 5G DDNMF sends a DISCOVERY\_UPDATE\_REQUEST message to the UE with:

a) a new 5G DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the Discovery Entry ID set to the Discovery Entry ID of the corresponding Discovery Entry that contains the ProSe Application Code to be updated; and

d) the Update Info containing the ProSe Application Code set to the new ProSe Application Code allocated by the 5G DDNMF and a Validity Timer T5060 set to the T5060 timer value assigned by the 5G DDNMF to the new ProSe Application Code.

When triggered to update Discovery Filter(s) for a monitoring UE, the 5G DDNMF in the HPLMN updates the content of Discovery Filter(s), associate the discovery entry with the updated Discovery Filter(s) and restart timer T5063 for each filter. The update of Discovery Filter content includes setting new TTL timer(s) and if necessary, assigning new ProSe Application Code and ProSe Application Mask(s). Then the 5G DDNMF shall send a DISCOVERY\_UPDATE\_REQUEST message to the UE with:

a) a new 5G DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the Discovery Entry ID set to the Discovery Entry ID of the corresponding Discovery Entry that contains the Discovery Filter(s) to be updated; and

d) the Update Info containing the Discovery Filter(s) set to the new Discovery Filter(s) allocated by the 5G DDNMF.

NOTE 1: The 5G DDNMF can include one or multiple transactions in one DISCOVERY\_UPDATE\_REQUEST message for ProSe App Codes or Discovery Filter(s) contained in different discovery entries, and receive corresponding < discovery-update-response> element or <response-reject> element in a DISCOVERY\_UPDATE\_RESPONSE message for each respective transaction. In the following description of direct discovery update request procedure, only one transaction is included.

Figure 6.2.11.2.1 illustrates the interaction of the UE and the 5G DDNMF in the direct discovery update procedure.



Figure 6.2.11.2.1: Direct discovery update procedure for open discovery

NOTE 2: In the figure 6.2.11.2.1, the timers are started only when the procedure is triggered to update a previously allocated ProSe Application Code for an announcing UE or update Discovery Filter(s) for a monitoring UE.

#### 6.2.11.3 Direct discovery update procedure accepted by the UE

Upon receiving a DISCOVERY\_UPDATE\_REQUEST message, the UE shall check if the UE identity contained in the DISCOVERY\_UPDATE\_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check if the Discovery Entry ID contained in the DISCOVERY\_UPDATE\_REQUEST message is known. If the Discovery Entry ID is known, the UE shall proceed with the following direct discovery update procedure.

If the Update Info is not included in the DISCOVERY\_UPDATE\_REQUEST message, the UE shall stop running timers corresponding to the discovery entry and delete the discovery entry corresponding to the Discovery Entry ID contained in the DISCOVERY\_UPDATE\_REQUEST message. The UE informs the lower layers to stop announcing or monitoring corresponding to the Discovery Entry ID contained in the DISCOVERY\_UPDATE\_REQUEST message.

If the Update Info is included in the DISCOVERY\_UPDATE\_REQUEST message, the UE shall replace the existing ProSe Application Code or the Discovery Filter(s) with new ProSe Application Code or the Discovery Filter(s) contained in the Update Info correspondingly. The announcing UE shall stop the timer T5060, start the validity timer T5060 with the received value for the new ProSe Application Code and perform open ProSe direct discovery announcing with the new ProSe Application Code as described in clause 6.2.2.4. The monitoring UE shall stop TTL timer T5062, start TTL timer T5062 with the received value for each new Discovery Filter(s) and perform open ProSe direct discovery monitoring with each new Discovery Filter(s) as described in clause 6.2.5.4.

Then the UE shall send a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-update> element with:

a) the 5G DDNMF transaction ID set to the value of the 5G DDNMF transaction ID received in the DISCOVERY\_UPDATE\_REQUEST message; and

b) the Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY\_UPDATE\_REQUEST message.

#### 6.2.11.4 Direct discovery update procedure completed by the 5G DDNMF

Upon receiving a DISCOVERY\_UPDATE\_RESPONSE message, if the 5G DDNMF transaction ID contained in the <response-update> element does not match the value sent by the 5G DDNMF in a DISCOVERY\_UPDATE\_REQUEST message, the 5G DDNMF shall discard the DISCOVERY\_UPDATE\_RESPONSE message. Otherwise, the 5G DDNMF shall perform the following procedure.

When the UE is an announcing UE and the radio resources that the UE intends to use are operated by a PLMN other than the HPLMN, the 5G DDNMF shall execute the procedures defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF in VPLMN or local PLMN.

When the UE is a monitoring UE and the ProSe Application ID monitored by the UE is PLMN-specific and that PLMN ID indicated by the ProSe Application ID is not the same as that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF in the PLMN indicated by the ProSe Application ID.

For each Discovery Entry ID received in the DISCOVERY\_UPDATE\_RESPONSE message, if the procedure is to revoke a previously allocated ProSe Application Code or Discovery Filter(s), the 5G DDNMF shall delete the discovery entry indicated by the Discovery Entry ID from the UE's context and release the associated resources.

#### 6.2.11.5 Direct discovery update procedure not accepted by the UE

If the DISCOVERY\_UPDATE\_REQUEST message cannot be accepted by the UE, the UE sends a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3a Control Protocol cause value.

If the UE identity contained in the DISCOVERY\_UPDATE\_REQUEST message is not the SUPI of the UE, the UE shall send a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #18 "Invalid UE Identity".

If the Discovery Entry ID contained in the DISCOVERY\_UPDATE \_REQUEST message is unknown, the UE shall send the DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value # 10 "Unknown or Invalid Discovery Entry ID".

#### 6.2.11.6 Abnormal cases

##### 6.2.11.6.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_UPDATE\_REQUEST message (e.g. after TCP retransmission timeout)

The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the DISCOVERY\_UPDATE\_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY\_UPDATE\_REQUEST message)

The 5G DDNMF shall retransmit the DISCOVERY\_UPDATE\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

##### 6.2.11.6.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_UPDATE\_RESPONSE message.

After receiving an indication from lower layer that the DISCOVERY\_UPDATE\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the UE shall abort the procedure.

### 6.2.12 Direct discovery update procedure for restricted discovery

#### 6.2.12.1 General

The discovery update procedure is used to update the discovery filters and/or allocate a new ProSe Restricted Code as defined in 3GPP TS 23.304 [2]. The 5G DDNMF can at any time update/revoke a previously allocated ProSe Application Code, or Discovery Filters.

#### 6.2.12.2 Revocation of restricted discovery filters

##### 6.2.12.2.1 Restricted discovery filters revocation procedure initiation

The 5G DDNMF in the HPLMN shall initiate the restricted discovery filters revocation procedure by sending the DISCOVERY\_UPDATE\_REQUEST to the UE with:

a) a new 5G DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the Discovery Entry ID set to the Discovery Entry ID of the corresponding Discovery Entry that contains the Restricted Discovery Filter to be revoked; and

d) optionally Update Info containing the restricted discovery filters that replace the existing ones, if the 5G DDNMF decides to remove only certain filter(s) and not others.

NOTE: The 5G DDNMF can include one or multiple transactions in one DISCOVERY\_UPDATE\_REQUEST message for different Restricted Discovery Filters, and receive corresponding <response-update> element or <response-reject> element in a DISCOVERY\_UPDATE\_RESPONSE message for each respective transaction. In the following description of the network initiated direct discovery update request procedure, only one transaction is included.

Figure 6.2.12.2.1 illustrates the interaction of the UE and the 5G DDNMF in the restricted discovery filters revocation procedure.



Figure 6.2.12.2.1.1: Restricted discovery filters revocation procedure

##### 6.2.12.2.2 Restricted discovery filters revocation procedure accepted by the UE

Upon receiving a DISCOVERY\_UPDATE\_REQUEST message, the UE shall check if the UE identity contained in the DISCOVERY\_UPDATE\_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check if the Discovery Entry ID contained in the DISCOVERY\_UPDATE\_REQUEST message is valid. If the Discovery Entry ID is valid, the UE shall proceed with the following direct discovery update procedure.

The UE shall remove all the Restricted Discovery Filters corresponding to the Discovery Entry ID if the Update Info is not included in the DISCOVERY\_UPDATE\_REQUEST message or shall remove the old Restricted Discovery Filters and store the Restricted Discovery Filter included in the Update Info in the DISCOVERY\_UPDATE\_REQUEST message. Then the UE shall send a DISCOVERY\_UPDATE\_RESPONSE message to the 5G DDNMF with:

a) the 5G DDNMF transaction ID set to the value of the 5G DDNMF transaction ID received in the DISCOVERY\_UPDATE\_REQUEST message; and

b) Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY\_UPDATE\_REQUEST message.

##### 6.2.12.2.3 Restricted discovery filters revocation procedure completion by the 5G DDNMF

Upon receipt of the DISCOVERY\_UPDATE\_ RESPONSE message by the 5G DDNMF, if the 5G DDNMF transaction ID contained in the <response-update> element does not match the value sent by the 5G DDNMF in a DISCOVERY\_UPDATE\_REQUEST message, the 5G DDNMF shall discard the DISCOVERY\_UPDATE\_RESPONSE message. Upon receipt of the DISCOVERY\_UPDATE\_ RESPONSE message by the 5G DDNMF, if the 5G DDNMF transaction ID contained in the <response-update> element matches the value sent by the 5G DDNMF in a DISCOVERY\_UPDATE\_REQUEST message, the restricted discovery filters revocation procedure is complete.

##### 6.2.12.2.4 Restricted discovery filters revocation procedure not accepted by the UE

If the DISCOVERY\_UPDATE\_REQUEST message cannot be accepted by the UE, the UE sends a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3a Control Protocol cause value.

If the UE identity contained in the DISCOVERY\_UPDATE\_REQUEST message is not the SUPI of the UE, the UE shall send a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #18 "Invalid UE Identity".

If the Discovery Entry ID contained in the DISCOVERY\_UPDATE\_REQUEST message is not found in the UE context, the UE shall send a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

##### 6.2.12.2.5 Abnormal cases

###### 6.2.12.2.5.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_UPDATE\_REQUEST message (e.g. after TCP retransmission timeout)

The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the DISCOVERY\_UPDATE\_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY\_UPDATE\_REQUEST message)

The 5G DDNMF shall retransmit the DISCOVERY\_UPDATE\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

###### 6.2.12.2.5.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_UPDATE\_RESPONSE message.

After receiving an indication from lower layer that the DISCOVERY\_UPDATE\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the UE shall abort the procedure.

#### 6.2.12.3 Allocation of new ProSe restricted code

##### 6.2.12.3.1 New ProSe restricted code allocation procedure initiation

The 5G DDNMF in the HPLMN shall initiate the ProSe restricted code allocation procedure by sending the DISCOVERY\_UPDATE\_REQUEST to the UE with:

a) a new 5G DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the Discovery Entry ID set to the Discovery Entry ID of the corresponding Discovery Entry that contains the ProSe Restricted Code to be replaced; and

d) update Info containing the ProSe Restricted Code set to the ProSe Restricted Code to be replaced and a Validity Timer T5062 set to the T5062 timer value assigned by the 5G DDNMF to the ProSe Restricted Code.

Figure 6.2.12.3.1.1 illustrates the interaction of the UE and the 5G DDNMF in the ProSe restricted code allocation procedure.

NOTE: The 5G DDNMF can include one or multiple transactions in one DISCOVERY\_UPDATE\_REQUEST message for different ProSe Restricted Codes, and receive corresponding <response-update> element or <response-reject> element in a DISCOVERY\_UPDATE\_RESPONSE message for each respective transaction. In the following description of the network initiated direct discovery update request procedure, only one transaction is included.



Figure 6.2.12.3.1.1: New ProSe restricted code allocation procedure

##### 6.2.12.3.2 ProSe restricted code allocation procedure accepted by the UE

Upon receiving a DISCOVERY\_UPDATE\_REQUEST message, the UE shall check if the UE identity contained in the DISCOVERY\_UPDATE\_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check if the Discovery Entry ID contained in the DISCOVERY\_UPDATE\_REQUEST message is valid. If the Discovery Entry ID is valid, the UE shall proceed with the following direct discovery update procedure.

The UE shall replace the ProSe Restricted Code corresponding to the Discovery Entry ID included in the DISCOVERY\_UPDATE\_REQUEST message. The UE shall stop the validity timer T5062 if running and start the validity timer T5062 with the received value. Then the UE shall send a DISCOVERY\_UPDATE\_RESPONSE message to the 5G DDNMF with:

a) the 5G DDNMF transaction ID set to the value of the 5G DDNMF transaction ID received in the DISCOVERY\_UPDATE\_REQUEST message; and

b) Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY\_UPDATE\_REQUEST message.

##### 6.2.12.3.3 ProSe restricted code allocation procedure completion by the 5G DDNMF

Upon receipt of the DISCOVERY\_UPDATE\_ RESPONSE message by the 5G DDNMF, if the 5G DDNMF transaction ID contained in the <response-update> element does not match the value sent by the 5G DDNMF in a DISCOVERY\_UPDATE\_REQUEST message, the 5G DDNMF shall discard the DISCOVERY\_UPDATE\_RESPONSE message. Upon receipt of the DISCOVERY\_UPDATE\_ RESPONSE message by the 5G DDNMF, if the 5G DDNMF transaction ID contained in the <response-update> element matches the value sent by the 5G DDNMF in a DISCOVERY\_UPDATE\_REQUEST message, the ProSe Restricted Code allocation procedure is complete.

##### 6.2.12.3.4 ProSe restricted code allocation procedure not accepted by the UE

If the DISCOVERY\_UPDATE\_REQUEST message cannot be accepted by the UE, the UE sends a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3 Control Protocol cause value.

If the UE identity contained in the DISCOVERY\_UPDATE\_REQUEST message is not the SUPI of the UE, the UE shall send a DISCOVERY\_UPDATE\_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #18 "Invalid UE identity".

If the Discovery Entry ID contained in the DISCOVERY\_UPDATE\_REQUEST message is not found in the UE context, the UE shall send a DISCOVERY\_UPDATE \_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

##### 6.2.12.3.5 Abnormal cases

###### 6.2.12.3.5.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY\_UPDATE\_REQUEST message (e.g. after TCP retransmission timeout)

The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the DISCOVERY\_UPDATE\_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY\_UPDATE\_REQUEST message)

The 5G DDNMF shall retransmit the DISCOVERY\_UPDATE\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

###### 6.2.12.3.5.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY\_UPDATE\_RESPONSE message.

After receiving an indication from lower layer that the DISCOVERY\_UPDATE\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the UE shall abort the procedure.

### 6.2.13 Announcing alert procedure

#### 6.2.13.1 General

The purpose of the Announcing Alert procedure is for the 5G DDNMF in HPLMN to send to the announcing UE the ProSe Restricted Code generated in the announce request procedure for restricted ProSe direct discovery model A as specified in clause 6.2.3.

Before initiating the Announcing Alert procedure, the 5G DDNMF shall determine whether the announcing UE and the monitoring UE are close enough to trigger the Announcing Alert procedure.

The announcing UE includes the ProSe Restricted Code in a PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY message to the lower layers for transmission over the PC5 interface in the registered PLMN or local PLMN as a result of a successful Announcing Alert procedure.

#### 6.2.13.2 Announcing alert procedure initiation

If the UE has initiated an announce request procedure for restricted ProSe direct discovery model A before as specified in clause 6.2.3 and the On Demand Announcing Enabled Indicator associated with the RPAUID in the announcing UE context is set to 1, the 5G DDNMF shall initiate an Announcing Alert procedure:

a) when the 5G DDNMF receives a pair of Target PDUID -Target RPAUID from the ProSe Application Server as described in 3GPP TS 29.503 [10], the Target RPAUID is the same as the RPAUID stored in the announcing UE context, and 5G DDNMF determines the monitoring UE is in the vicinity of the announcing UE; or

b) when the 5G DDNMF receives a pair of Target PDUID -Target RPAUID from other 5G DDNMF as described in 3GPP TS 29.555 [9], the Target RPAUID is the same as the RPAUID stored in the announcing UE context and the 5G DDNMF determines the monitoring UE is in the vicinity of the announcing UE.

NOTE: How the 5G DDNMF in the HPLMN determines whether the announcing UE and the monitoring UE are close enough to trigger the Announcing Alert procedure is left to the implementation of 5G DDNMF.

The 5G DDNMF shall initiate the Announce Alert procedure by sending an ANNOUNCING\_ALERT\_REQUEST message with:

a) a new 5G DDNMF transaction ID;

b) the UE identity set to the UE's SUPI;

c) the RPAUID set to the Target RPAUID received from ProSe Application Server as specified in 3GPP TS 29.503 [10] or from other 5G DDNMF as specified in 3GPP TS 29.555 [9];

d) the ProSe Restricted Code set to the ProSe Restricted Code or the ProSe Restricted Code Prefix, and optionally one or more ProSe Restricted Code Suffix Ranges which contain the suffix(es) for the RPAUID retrieved from the announcing UE context; and

e) the Discovery Entry ID set to the identifier associated with the corresponding discovery entry in the UE's context.

Figure 6.2.13.2.1 illustrates the interaction of the 5G DDNMF and the UE in the Announce Alert procedure.



Figure 6.2.13.2.1: Announcing alert procedure

#### 6.2.13.3 Announcing alert procedure accepted by the UE

Upon receipt of the ANNOUNCING\_ALERT\_REQUEST message, the UE shall check if the UE identity contained in the ANNOUNCING\_ALERT\_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check whether there is an existing discovery entry identified by the Discovery Entry ID included in the ANNOUNCING\_ALERT\_REQUEST message. If the discovery entry exists in the UE, the UE shall send an ANNOUNCE\_ALERT\_RESPONSE message to the 5G DDNMF with a 5G DDNMF transaction ID set to the value of the 5G DDNMF transaction ID received in the ANNOUNCING\_ALERT\_REQUEST message.

Then, the UE may perform restricted ProSe direct discovery model A announcing as described below.

The UE requests the parameters from the lower layers for restricted Prose direct discovery model A announcing (see 3GPP TS 38.331 [13]). The UE shall perform restricted ProSe direct discovery model A announcing only if the lower layers indicate that ProSe direct discovery is supported by the network. If the UE in 5GMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 38.331 [13], the UE shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]. The UE shall obtain the UTC time for the next discovery transmission opportunity for ProSe direct discovery from the lower layers.

If a valid UTC time is obtained, the UE shall generate the UTC-based counter corresponding to this UTC time as specified in clause 11.2.2.18. If the resulting UTC-based counter is within Max Offset of the time shown by the clock used for ProSe by the UE, the UE shall use the UTC-based counter to compute the MIC field for the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.yyy [r33yyy].

Editor's Note: Security aspect will be updated upon SA3 normative requirement is available.

The UE shall either use the ProSe Restricted Code received in the ANNOUNCING\_ALERT\_REQUEST message, or select one ProSe Restricted Code based on the ProSe Restricted Code Prefix and ProSe Restricted Code Suffix Range(s) received in the ANNOUNCING\_ALERT\_REQUEST message as announced ProSe Restricted Code, along with the MIC and the eight least significant bits of the UTC-based counter, in order to construct a PROSE PC5 DISCOVERY message, according to the format defined in clause 10.2.5.

NOTE: The UE can use different codes formed based on different ProSe Restricted Code Suffixes to announce, without having to send a new DISCOVERY\_REQUEST message to the 5G DDNMF, as long as the validity timer T5062 of the ProSe Restricted Code Prefix has not expired.

The UE then passes the PROSE PC5 DISCOVERY message to the lower layers for transmission if:

a) the UE is currently authorized to perform restricted ProSe direct discovery model A announcing in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use;

b) the validity timer T5062 for the corresponding discovery entry allocated ProSe Restricted Code or ProSe Restricted Code Prefix has not expired; and

c) a request from upper layers to announce the RPAUID associated with both the ProSe Restricted Code or ProSe Restricted Code Prefix, and the authorized Application Identity, is still in place.

The UE shall ensure that it keeps on passing PROSE PC5 DISCOVERY messages to the lower layers for transmission until the validity timer T5062 of the ProSe Restricted Code or ProSe Restricted Code Prefix expires. How this is achieved is left up to UE implementation.

During the announcing operation, if one of the above conditions is no longer met, the UE may instruct the lower layers to stop announcing. When the UE stops announcing, if the lower layers indicate that the UE is required to send a discovery indication to the NG-RAN and the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

#### 6.2.13.4 Announcing alert procedure completion by the 5G DDNMF

Upon receipt of the ANNOUNCE\_ALERT\_RESPONSE message with a 5G DDNMF transaction ID set to the value of the 5G DDNMF Transaction ID included in the ANNOUNCING\_ALERT\_REQUEST message, the 5G DDNMF will set the associated On Demand Announcing Enabled Indicator to 0. Then the Announcing Alert procedure is successfully completed.

#### 6.2.13.5 Announcing alert procedure not accepted by the UE

If the ANNOUNCING\_ALERT\_REQUEST message cannot be accepted by the UE, the UE sends a ANNOUNCING\_ALERT\_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3a Control Protocol cause value.

If the UE identity contained in the ANNOUNCING\_ALERT\_REQUEST message is not the SUPI of the UE, the UE shall send a ANNOUNCING\_ALERT\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #18 "Invalid UE Identity".

If the Discovery Entry ID contained in the ANNOUNCING\_ALERT\_REQUEST message is unknown, the UE shall send the ANNOUNCING\_ALERT\_RESPONSE message containing a <response-reject> element with PC3a Control Protocol cause value #10"Unknown or Invalid Discovery Entry ID".

#### 6.2.13.6 Abnormal cases

###### 6.2.13.6.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of ANNOUNCING\_ALERT\_REQUEST message (e.g. after TCP retransmission timeout)

The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the ANNOUNCING\_ALERT\_REQUEST message has been successfully delivered (e.g. TCP ACK has been received for the ANNOUNCING\_ALERT\_REQUEST message)

The 5G DDNMF shall retransmit the ANNOUNCING\_ALERT\_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

###### 6.2.13.6.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of ANNOUNCE\_ALERT\_RESPONSE message.

After receiving an indication from lower layer that the ANNOUNCE\_ALERT\_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the UE shall abort the procedure.

### 6.2.14 5G ProSe direct discovery procedure over PC5 interface

#### 6.2.14.1 General

This clause describes the procedures for 5G ProSe direct discovery procedure over PC5 interface. The purpose of the 5G ProSe direct discovery procedure over PC5 interface is to enable a ProSe-enabled UE to detect and identify another ProSe-enabled UE over PC5 interface.

To perform 5G ProSe direct discovery procedure over PC5 interface, the UE is configured with the related information as described in clause 5.2.3. The following models for 5G ProSe direct discovery procedure over PC5 interface as specified in 3GPP TS 23.304 [2] are supported:

a) Model A uses a single discovery protocol message (Announcement); and

b) Model B uses two discovery protocol messages (Solicitation and Response).

The following procedures are defined for 5G ProSe direct discovery procedure procedure over PC5 interface:

a) 5G ProSe direct discovery procedure over PC5 interface with Model A:

1) Announcing UE procedure for 5G ProSe direct discovery initiation;

2) Announcing UE procedure for 5G ProSe direct discovery completion;

3) Monitoring UE procedure for 5G ProSe direct discovery initiation;

4) Monitoring UE procedure for 5G ProSe direct discovery completion; and

b) 5G ProSe direct discovery procedure over PC5 interface with Model B:

1) Discoverer UE procedure for 5G ProSe direct discovery initiation;

2) Discoverer UE procedure for 5G ProSe direct discovery completion;

3) Discoveree UE procedure for 5G ProSe direct discovery initiation; and

4) Discoveree UE procedure for 5G ProSe direct discovery completion.

#### 6.2.14.2 Procedures

##### 6.2.14.2.1 5G ProSe direct discovery procedure over PC5 interface with model A

###### 6.2.14.2.1.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "announcing UE" and the other UE is called the "monitoring UE".

###### 6.2.14.2.1.2 Announcing UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the announcing UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using announcing procedure when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery using announcing in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

i) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

ii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

iii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed " as specified in 3GPP TS 24.501 [11]; and

2) authorised to perform 5G ProSe direct discovery using announcing when the UE is not served by NG-RAN, and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the announcing UE procedure for 5G ProSe direct discovery.

Figure 6.2.14.2.1.2.1 illustrates the interaction of the UEs in the announcing UE procedure for 5G ProSe direct discovery.



Figure 6.2.14.2.1.2.1: Announcing UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to perform announcing UE procedure for 5G ProSe direct discovery announcing procedur, if the UE is authorised to perform the announcing UE procedure for 5G ProSe direct discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement. In the PROSE PC5 DISCOVERY message for direct discovery announcement, the UE:

1) shall set the type of discovery message to Announcement;

2) shall include either ProSe Application Code or ProSe Restricted Code;

3) may include ProSe Application ID;

4) may include User Info ID;

5) may include security protection element;

6) may include metadata information;

7) shall set the UTC-based counter LSB parameter to include the 8 least significant bits of the UTC-based counter;

Editor’s note: Details of security protection element will be defined by SA WG3.

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303[TBD]; and

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA WG3.

e) shall pass the resulting PROSE PC5 DISCOVERY message along with the Source Layer-2 ID and Destination Layer-2 ID for direct discovery announcement to the lower layers for transmission over the PC5 interface.

In case of open ProSe direct discovery, the UE shall either use the ProSe Application Code received in the DISCOVERY\_RESPONSE message from the 5G DDNMF, or select one ProSe Application Code based on the ProSe Application Code Prefix and ProSe Application Code Suffix Range(s) received in the DISCOVERY\_RESPONSE message from the 5G DDNMF as announced ProSe Application Code, along with the MIC and the four least significant bits of the UTC-based counter.

NOTE 2: The UE can use different codes formed based on different ProSe Application Code Suffixes to announce, without having to send a new request to the 5G DDNMF, as long as the validity timer T5060 of the ProSe Application Code Prefix has not expired.

In case of restricted ProSe direct discovery model A, the UE shall either use the ProSe Restricted Code received in the DISCOVERY\_RESPONSE message, or select one ProSe Restricted Code based on the ProSe Restricted Code Prefix and ProSe Restricted Code Suffix Range(s) received in the DISCOVERY\_RESPONSE message from the 5G DDNMF as announced ProSe Restricted Code, along with the eight least significant bits of the UTC-based counter.

NOTE 3: The UE can use different codes formed based on different ProSe Restricted Code Suffixes to announce, without having to send a new DISCOVERY\_REQUEST message to the 5G DDNMF, as long as the validity timer T5062 of the ProSe Restricted Code Prefix has not expired.

The announcing UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the request from upper layers to perform announcing UE procedure for 5G ProSe direct discovery is still in place, or the validity timer of the ProSe Application Code or ProSe Application Code Prefix in case of open ProSe direct discovery or the validity timer of the ProSe Restricted Code or ProSe Restricted Code Prefix in case of restricted ProSe direct discovery expires. How this is achieved is left up to UE implementation.

###### 6.2.14.2.1.3 Announcing UE procedure for 5G ProSe direct discovery completion

When the request from upper layers to perform announcing UE procedure for 5G ProSe direct discovery is not in place, or the validity timer of the ProSe Application Code or ProSe Application Code Prefix in case of open ProSe direct discovery or the validity timer of the ProSe Restricted Code or ProSe Restricted Code Prefix in case of restricted ProSe direct discovery expires, the UE may instruct the lower layers to stop announcing.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

###### 6.2.14.2.1.4 Monitoring UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the monitoring UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery monitoring in at least one PLMN; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

i) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

ii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

iii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

2) authorised to perform 5G ProSe direct discoveryusing monitoring when the UE is not served by NG-RAN, and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the monitoring UE procedure for 5G ProSe direct discovery procdure.

Figure 6.2.14.2.1.4.1 illustrates the interaction of the UEs in the monitoring UE procedure for 5G ProSe direct discovery procdure.



Figure 6.2.14.2.1.4.1: Monitoring UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to perform monitoring UE procedure for 5G ProSe direct discovery for a ProSe Application ID, and if the UE is authorised to perform the monitoring UE procedure for 5G ProSe direct discovery, then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY message.

Upon reception of a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement for the Destination Layer-2 ID to be monitored, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [TBD]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [TBD]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement.

NOTE 2: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

In case of open 5G ProSe direct discovery, for a ProSe Application ID requested by the monitoring UE, the 5G DDNMF may have assigned one or more Discovery Filters. If application-controlled extension is used, the UE may further apply additional filtering on the part corresponding to the ProSe Application Code Suffix. The UE should apply all assigned Discovery Filters to its monitoring operation. Using these Discovery Filters may result in a match event. The UE shall consider that the ProSe Application ID it seeks to monitor has been discovered if there is a match event as following:

When, for any of the ProSe Application Masks in a Discovery Filter, the output of a bitwise AND operation between the ProSe Application Code contained in the received PROSE PC5 DISCOVERY message and the ProSe Application Mask, matches the output of a bitwise AND operation between the ProSe Application Mask and the ProSe Application Code contained in the same Discovery Filter.

NOTE 3: A ProSe Application Mask with all bits set to "1" is assigned by the 5G DDNMF for full matching.

In case of restricted 5G ProSe direct discovery model A, the UE provides the Application Level Container, which contains the authorized Target RPAUID(s), to the upper layer applications. For each authorized target RPAUID, the 5G DDNMF may have assigned one or more Restricted Discovery Filters. If application-controlled extension is used, the UE may further apply additional filtering on the part corresponding to the ProSe Restricted Code Suffix. The UE should then apply all Restricted Discovery Filters to its monitoring operation. Using these Restricted Discovery Filters may result in a match event. The UE shall consider that the target RPAUID it seeks to monitor has been discovered if there is a match event as follows:

When, for any of the masks in a Restricted Discovery Filter, the output of a bitwise AND operation between the ProSe Restricted Code contained in the received PC5\_DISCOVERY message and the mask, matches the output of a bitwise AND operation between the mask and the code contained in the same Restricted Discovery Filter.

NOTE 4: In a Restricted Discovery Filter, a mask with all bits set to "1" is assigned by the 5G DDNMF for full matching of a ProSe Restricted Code.

Editor’s note: Details of Monitoring UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery announcement are FFS and will be determinated by cooperation with SA WG3.

###### 6.2.14.2.1.5 Monitoring UE procedure for 5G ProSe direct discovery completion

During the monitoring UE procedure for 5G ProSe direct discovery, if the request from upper layers to perform the monitoring UE procedure for 5G ProSe direct discovery is not in place, or if the validity timer of the Discovery Filter or the validity timer of the Restricted Discovery Filter expires, the UE may instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

##### 6.2.14.2.2 5G ProSe direct discovery procedure over PC5 interface with Model B

###### 6.2.14.2.2.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "Discoverer UE" and the other UE is called the "Discoveree UE".

###### 6.2.14.2.2.2 Discoverer UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the discoverer UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery discoverer operation in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

i) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

ii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

iii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

2) authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery use when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the discoverer UE procedure for 5G ProSe direct discovery.

Figure 6.2.14.2.2.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for 5G ProSe direct discovery.



Figure 6.2.14.2.2.2.1: Discoverer UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to query the target RPAUID in restricted discovery Model B, associated with both the ProSe Query Code, and the authorised Application Identity, and

a) if the UE is authorised to perform the discoverer UE procedure for 5G ProSe direct discovery in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use; and

b) if the validity timer T5070 for the ProSe Query Code and corresponding ProSe Response Filter(s) has not expired,

then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time, and if the resulting UTC-based counter is within Max Offset of the time shown by the clock used for ProSe by the UE, the UE shall for each ProSe Query Code in this discovery entry, use the ProSe Query Code to construct a PROSE PC5 DISCOVERY message;

c) shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery solicitation. In the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery solicitation, the UE:

1) shall set the type of discovery message to Solicitation;

2) shall include ProSe Query Code;

3) may include ProSe Application ID;

4) may include User Info ID;

5) may include security protection element; and

6) shall set the UTC-based counter LSB parameter to include the 8 least significant bits of the UTC-based counter;

Editor’s note: Details of security protection element are FFS and will be defined by SA WG3.

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303 [TBD]; and

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA WG3.

e) shall pass the resulting PROSE PC5 DISCOVERY message along with the Source Layer-2 ID and Destination Layer-2 ID for 5G ProSe direct discovery solicitation and the PLMN ID of the intended announcing PLMN if available in the discovery entry to the lower layers for transmission over the PC5 interface, and shall instruct the lower layer to start monitoring.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the validity timer T5070 of the ProSe Query Code expires. How this is achieved is left up to UE implementation.

The UE may apply the Discovery Response Filter(s) received from the 5G DDNMF to its monitoring operation. Using the Discovery Response Filter may result in a match event for the target RPAUID the UE is querying for. There is match event when, for any of the masks in a Discovery Response Filter, the output of a bitwise AND operation between the ProSe Response Code contained in the received PROSE PC5 DISCOVERY message and the mask, matches the output of a bitwise AND operation between the mask and the code contained in the Discovery Response Filter.

Upon reception of a PROSE PC5 DISCOVERY message for direct discovery response, for the target Destination Layer-2 ID of the direct discovery to be discovered, the UE shall use the associated DUSK, if configured as a part of the Discovery Response Filter, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [TBD]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [TBD]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for direct discovery response. If a MIC Check Indicator parameter is included instead, the UE shall use the match report procedure described in clause 6.2.10 to trigger checking of the MIC of the PROSE PC5 DISCOVERY message containing the ProSe Response Code by the 5G DDNMF.

The UE may notify the upper layer application about the match event of restricted ProSe direct discovery Model B with the corresponding target RPAUID and metadata, if the RPAUID and meta-data are included in the Subquery Result element in the DISCOVERY\_RESPONSE message from the 5G DDNMF.

Editor’s note: Details of Discoverer UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery response are FFS and will be determinated by cooperation with SA WG3.

###### 6.2.14.2.2.3 Discoverer UE procedure for 5G ProSe direct discovery completion

During the discoverer operation, if

a) the validity timer T5070 for the ProSe Query Code and corresponding ProSe Response Filter(s) has expired; and

b) the request from upper layers to query the target RPAUID in restricted discovery Model B, associated with both the ProSe Query Code, and the authorised Application Identity, is not in place, then

the UE may instruct the lower layers to stop the discoverer operation.When the UE stops discoverer operation, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

###### 6.2.14.2.2.4 Discoveree UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the discoveree UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoveree operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery discoverer operation in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

i) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

ii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

iii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

2) authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery use when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the Discoveree UE procedure for 5G ProSe direct discovery.

Figure 6.2.14.2.2.4.1 illustrates the interaction of the UEs in the Discoveree UE procedure for 5G ProSe direct discovery.



Figure 6.2.14.2.2.4.1: Discoveree UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to perform discoveree operation for the RPAUID associated with an authorized Application Identity, and if:

a) the UE is authorised to perform the discoveree UE procedure for 5G ProSe direct discovery; and

b) the UE has obtained the ProSe Response Code and Discovery Query Filter(s) and the respective validity timer T5068 for the corresponding discovery entry has not expired,

then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13].

The UE may apply the Discovery Query Filter(s) received from the 5G DDNMF to its monitoring operation. Using the Discovery Query Filter(s) may result in a match event. There is match event when, for any of the masks in a Discovery Query Filter, the output of a bitwise AND operation between the ProSe Query Code contained in the received PROSE PC5 DISCOVERY message and the mask, matches the output of a bitwise AND operation between the mask and the code contained in the Discovery Query Filter.

Upon reception of a PROSE PC5 DISCOVERY message for the Destination Layer-2 ID which the UE is configured to respond for, with applying a Discovery Query Filter to a received PROSE PC5 DISCOVERY message for the above-mentioned bitwise AND operation, the UE shall use the associated DUSK, if configured in the part of the Discovery Query Filter, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [TBD]. Then, if a DUCK is configured in the part of the Discovery Query Filter, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality protected portion, as described in 3GPP TS 33.303 [TBD]. Finally, if a DUIK is configured in the part of the Discovery Query Filter, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for direct discovery solicitation.

NOTE 2: The UE can look for a match on the unencrypted bits first before applying DUCK, to minimise the amount of processing performed before finding a match.

NOTE 3: The UE needs to verify the MIC field because the match report procedure is not used for checking the MIC of a PROSE PC5 DISCOVERY message containing a ProSe Query Code by the 5G DDNMF.

Once the match of the Discovery Query Filter(s) occurs, the UE process this match event and requests the lower layers to announce the corresponding ProSe Response Code in the PC5 interface as a response, as specified in 3GPP TS 38.331 [13]. If the UE in 5GMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 38.331 [13], the UE shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]. The UE shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time. If the resulting UTC-based counter is within Max Offset of the time shown by the clock used for ProSe by the UE, the UE shall use the ProSe Response Code received in the DISCOVERY\_RESPONSE message from the 5G DDNMF. The UE shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response. In the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response, the UE:

a) shall set the type of discovery message to Response;

b) shall include ProSe Response Code;

c) may include ProSe Application ID;

d) may include User Info ID;

e) may include security protection element;

f) may include metadata information;

g) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter;

Editor’s note: Details of security protection element are FFS and will be defined by SA WG3.

h) shall set the Destination Layer-2 ID to the Source Layer-2 ID of the received message;

i) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303 [TBD]; and

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA WG3.

j) shall pass the resulting PROSE PC5 DISCOVERY message along with the Source Layer-2 ID and Destination Layer-2 ID for 5G ProSe direct discovery response and the PLMN ID of the intended announcing PLMN to the lower layers for transmission over the PC5 interface.

For each match event with the Discovery Query Filter(s), the UE shall at least pass PROSE PC5 DISCOVERY message once to the lower layers for transmission. The UE shall ensure that it keeps on passing PROSE PC5 DISCOVERY messages to the lower layers for transmission as response(s) to the match event(s) of the corresponding Discovery Query Filter(s) until the validity timer T5068 expires. How this is achieved is left up to UE implementation.

###### 6.2.14.2.2.5 Discoveree UE procedure for 5G ProSe direct discovery completion

During the discoveree operation, if

a) the validity timer T5068 for the ProSe Response Code and corresponding Discovery Query Filter(s) has expired; and

b) the request from upper layers to perform discoveree operation for the RPAUID associated with an authorized Application Identity is not in place, then

the UE may instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the lower layers indicate that the UE is required to send a discovery indication to the NG-RAN and the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

### 6.2.15 Group member discovery over PC5 interface

#### 6.2.15.1 General

This clause describes the procedures for group member discovery over PC5 interface. The purpose of the group member discovery procedure over PC5 interface is to enable a ProSe-enabled UE to detect and identify another ProSe-enabled UE that belongs to the same application layer group (e.g. sharing the same Discovery Group ID) over PC5 interface.

To perform group member discovery over PC5 interface, the UE is configured with the related information as described in clause 5.2.b. The following models for group member discovery procedure over PC5 interface as specified in 3GPP TS 23.304 [2] are supported:

a) Model A uses a single discovery protocol message (Announcement); and

b) Model B uses two discovery protocol messages (Solicitation and Response).

The following procedures are defined for group member discovery procedure over PC5 interface:

a) Group member discovery over PC5 interface with Model A:

1) Announcing UE procedure for group member discovery initiation;

2) Announcing UE procedure for group member discovery completion;

3) Monitoring UE procedure for group member discovery initiation;

4) Monitoring UE procedure for group member discovery completion; and

b) Group member discovery over PC5 interface with Model B:

1) Discoverer UE procedure for group member discovery initiation;

2) Discoverer UE procedure for group member discovery completion;

3) Discoveree UE procedure for group member discovery initiation; and

4) Discoveree UE procedure for group member discovery completion.

Editor's note: It is FFS what changes are needed for Group Member Discovery for Public Safety use.

#### 6.2.15.2 Procedures

##### 6.2.15.2.1 Group member discovery over PC5 interface with Model A

###### 6.2.15.2.1.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "announcing UE" and the other UE is called the "monitoring UE".

###### 6.2.15.2.1.2 Announcing UE procedure for group member discovery initiation

The UE is authorised to perform the announcing UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform ProSe direct discovery using announcing procedure when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform ProSe direct discovery using announcing in the PLMN indicated by the serving cell; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed " as specified in 3GPP TS 24.501 [11]; and

ii) authorised to perform ProSe direct discovery using announcing when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID identifying the application layer group to be announced and with the User Info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the announcing UE procedure for group member discovery procedure.

Figure 6.2.15.2.1.2.1 illustrates the interaction of the UEs in the announcing UE procedure for group member discovery.



Figure 6.2.15.2.1.2.1: Announcing UE procedure for group member discovery

When the UE is triggered by an upper layer application to announce availability in a discovery group, if the UE is authorised to perform the announcing UE procedure for group member discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 36.331 [TBD], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for group member discovery announcement. In the PROSE PC5 DISCOVERY message for group member discovery announcement, the UE:

1) shall set the ProSe UE ID to the Layer 2 ID used for unicast communication;

2) shall set the Announcer Info parameter to the User Info ID for the group member discovery parameter; and

3) shall set the Discovery Group ID parameter to the Discovery Group ID parameter identifying the discovery group to be announced;

4) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter;

Editor’s note: Whether other parameters are required or not is FFS.

Editor’s note: Whether Layer-2 ID is sent along with PROSE PC5 DISCOVERY message in group member discovery procedure will be determinated by SA WG2.

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303[TBD]; and

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA WG3.

e) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery announcement to the lower layers for transmission over the PC5 interface.

The announcing UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or until the UE stops being authorised to perform the announcing UE procedure for group member discovery.

###### 6.2.15.2.1.3 Announcing UE procedure for group member discovery completion

When the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or when the announcing UE stops being authorised to perform the announcing UE procedure for group member discovery, the UE shall instruct the lower layers to stop announcing.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [TBD].

###### 6.2.15.2.1.4 Monitoring UE procedure for group member discovery initiation

The UE is authorised to perform the monitoring UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform ProSe direct discovery monitoring in at least one PLMN; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11] ; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

ii) authorised to perform ProSe direct discoveryusing monitoring when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID parameter identifying the discovery group to be monitored;

otherwise, the UE is not authorised to perform the monitoring UE procedure for group member discovery.

Figure 6.2.15.2.1.4.1 illustrates the interaction of the UEs in the monitoring UE procedure for group member discovery.



Figure 6.2.15.2.1.4.1: Monitoring UE procedure for group member discovery

When the UE is triggered by an upper layer application to monitor proximity of other UEs in a discovery group, and if the UE is authorised to perform the monitoring UE procedure for group member discovery, then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY message.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery announcement, for the target Discovery Group ID of the discovery group to be monitored, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [TBD]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [TBD]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for group member discovery announcement.

NOTE 2: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

Then if the Discovery Group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery announcement is the same as the configured Discovery Group ID parameter as specified in clause 5, the UE shall consider that other UE in the discovery group the UE seeks to monitor has been discovered.

Editor’s note: Details of Monitoring UE procedure upon reception of a PROSE PC5 DISCOVERY message for group member discovery announcement are FFS and will be determinated by cooperation with SA WG3.

###### 6.2.15.2.1.5 Monitoring UE procedure for group member discovery completion

When the UE is triggered by an upper layer application to stop monitoring proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the monitoring UE procedure for group member discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [TBD].

##### 6.2.15.2.2 Group member discovery over PC5 interface with Model B

###### 6.2.15.2.2.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

###### 6.2.15.2.2.2 Discoverer UE procedure for group member discovery initiation

The UE is authorised to perform the discoverer UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform ProSe direct discovery discoverer operation in the PLMN indicated by the serving cell; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

ii) authorised to perform ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for ProSe direct discovery use when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID parameter identifying the discovery group to be solicited and with the User Info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the discoverer UE procedure for group member discovery.

Figure 6.2.15.2.2.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for group member discovery.



Figure 6.2.15.2.2.2.1: Discoverer UE procedure for group member discovery

When the UE is triggered by an upper layer application to solicit proximity of other UEs in a discovery group, and if the UE is authorised to perform the discoverer UE procedure for group member discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 36.331 [TBD], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for group member discovery solicitation. In the PROSE PC5 DISCOVERY message for group member discovery solicitation, the UE:

1) shall set the Discoverer Info parameter to the User Info ID for the group member discovery parameter;

2) shall set the Discovery Group ID parameter to the Discovery Group ID parameter identifying the discovery group to be solicited;

3) shall set either the Target User Info parameter or the Target Group Info parameter according to the target information provided by the upper layer application; and

4) shall set the UTC-based counter LSB parameter to include the 8 least significant bits of the UTC-based counter;

Editor’s note: Whether other parameters are required or not is FFS.

Editor’s note: Whether Layer-2 ID is sent along with PROSE PC5 DISCOVERY message in group member discovery procedure will be determinated by SA WG2.

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303 [TBD]; and

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA WG3.

e) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery solicitation to the lower layers for transmission over the PC5 interface.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission with an indication that the message until the UE is triggered by an upper layer application to stop soliciting proximity of other UEs in a discovery group, or until the UE stops being authorised to perform the discoverer UE procedure for group member discovery.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery response, for the target Discovery Group ID of the discovery group to be discovered, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [TBD]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [TBD]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for group member discovery response.

Then if the Discovery Group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery response is the same as the Discovery Group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery solicitation, the UE shall consider that other UE in the discovery group the UE seeks to discover has been discovered.

Editor’s note: Details of Discoverer UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery response are FFS and will be determinated by cooperation with SA WG3.

###### 6.2.15.2.2.3 Discoverer UE procedure for group member discovery completion

When the UE is triggered by an upper layer application to stop soliciting proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the discoverer UE procedure for group member discovery, the UE shall instruct the lower layers to stop discoverer operation.

When the UE stops discoverer operation, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [TBD].

###### 6.2.15.2.2.4 Discoveree UE procedure for group member discovery initiation

The UE is authorised to perform the discoveree UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform ProSe direct discovery discoveree operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform ProSe direct discovery discoveree operation in the PLMN(s) indicated by the serving cell; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

ii) authorised to perform ProSe direct discovery discoveree operation when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID parameter identifying the discovery group to be responded to and with the User Info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the Discoveree UE procedure for group member discovery.

Figure 6.2.15.2.2.4.1 illustrates the interaction of the UEs in the Discoveree UE procedure for group member discovery.



Figure 6.2.15.2.2.4.1: Discoveree UE procedure for group member discovery

When the UE is triggered by an upper layer application to start responding to solicitation on proximity of a UE in a discovery group, and if the UE is authorised to perform the discoveree UE procedure for group member discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 36.331 [TBD], shall perform a service request procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery solicitation, for the Discovery Group ID of the discovery group which the UE is configured to respond for, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [TBD]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality protected portion, as described in 3GPP TS 33.303 [TBD]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for group member discovery solicitation.

Then, if:

a) the Discovery Group ID parameter of the received PROSE PC5 DISCOVERY message is the same as a Discovery Group ID parameter for the discovery group;

b) the Target User Info parameter is not included in the received PROSE PC5 DISCOVERY message or the Target User Info parameter of the received PROSE PC5 DISCOVERY message is the same as the User Info ID for the group member discovery parameter; and

c) the Target Group Info parameter is not included in the received PROSE PC5 DISCOVERY message or the Target Group Info parameter of the received PROSE PC5 DISCOVERY message is the same as the identifier of the targeted group provided by the upper layer application (e.g. ProSe Layer-2 Group ID);

the UE:

a) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

b) shall generate a PROSE PC5 DISCOVERY message for group member discovery response. In the PROSE PC5 DISCOVERY message for group member discovery response, the UE:

1) shall set the ProSe UE ID to the Layer-2 ID used for unicast communication;

2) shall set the Discoveree Info parameter to the User Info ID for the group member discovery parameter;

3) shall set the Discovery Group ID parameter to the Discovery Group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery solicitation; and

4) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter;

Editor’s note: Whether other parameters are required or not is FFS.

Editor’s note: Whether Layer-2 ID is sent along with PROSE PC5 DISCOVERY message in group member discovery procedure will be determinated by SA WG2.

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303 [TBD]; and

Editor’s note: Details of security related content in c) are FFS and will be determinated by SA WG3.

d) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery response to the lower layers for transmission over the PC5 interface.

###### 6.2.15.2.2.5 Discoveree UE procedure for group member discovery completion

When the UE is triggered by an upper layer application to stop responding to solicitation on proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the discoveree UE procedure for group member discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [TBD].

# 7 5G ProSe direct communications

## 7.1 Overview

This clause describes the procedures at the UE, and between UEs, for 5G ProSe direct communication over PC5.

The UE shall support requirements for securing 5G ProSe direct communication over PC5.

The PC5 interface is selected based on the ProSe Application to path preference mapping rules as specified in clause 5.2.4 before 5G ProSe direct communication.

For unicast mode 5G ProSe direct communication, the following data unit types are supported: IPv4, IPv6, Ethernet, and Unstructured.

For broadcast and groupcast mode 5G ProSe communication, the following data unit types are supported: IPv4, IPv6, Ethernet, Unstructured, and Address Resolution Protocol (see RFC 826 [xx]).

Editor's note: Whether the data unit type of Address Resolution Protocol is supported needs to be coordinated with RAN WG.

5G ProSe direct communication over NR-PC5 supports broadcast mode, groupcast mode, and unicast mode. If the upper layer of the UE indicates the mode of communication, the UE shall set the mode of communication based on the request of the upper layer. Otherwise, the UE shall set the mode of communication based on the mapping rules between the 5G ProSe Application identifiers and the default mode of communication defined in clause 5.2.4.

NOTE: Further details about whether broadcast, unicast or groupcast can be used over PC5 are described in 3GPP TS 23.304 [3] clause 5.3.

## 7.2 Unicast mode 5G ProSe direct communication over PC5

### 7.2.1 Overview

This clause describes the PC5 signalling protocol procedures between two UEs for one-to-one (i.e. unicast) mode of ProSe direct communication. The following PC5 signalling protocol procedures are defined:

a) 5G ProSe direct link establishment;

b) 5G ProSe direct link modification;

c) 5G ProSe direct link release;

d) 5G ProSe direct link identifier update; and

e) 5G ProSe direct link keep-alive.

### 7.2.2 5G ProSe direct link establishment procedure

#### 7.2.2.1 General

Depending on the type of the 5G ProSe direct link establishment procedure (i.e. UE oriented Layer-2 link establishment or ProSe Service oriented Layer-2 link establishment in 3GPP TS 23.304 [2]), the 5G ProSe direct link establishment procedure is used to establish a 5G ProSe direct link between two UEs or to establish multiple 5G ProSe direct links. The UE sending the request message is called the "initiating UE" and the other UE is called the "target UE". If the request message does not indicate the specific target UE (i.e. target user info is not included in the request message), and multiple target UEs are interested in the ProSe application(s) indicated in the request message, then the initiating UE shall handle corresponding response messages received from those target UEs. The maximum number of NR 5G ProSe direct links established in a UE at a time shall not exceed an implementation-specific maximum number of established NR 5G ProSe direct links.

NOTE: The recommended maximum number of established NR PC5 unicasts link is 8.

#### 7.2.2.2 5G ProSe direct link establishment procedure initiation by initiating UE

The initiating UE shall meet the following pre-conditions before initiating this procedure:

a) a request from upper layers to transmit the packet for ProSe application over PC5;

b) the communication mode is unicast mode (e.g. pre-configured as specified in clause 5.2.4 or indicated by upper layers);

c) the link layer identifier for the initiating UE (i.e. layer-2 ID used for unicast communication) is available (e.g. pre-configured or self-assigned) and is not being used by other existing 5G ProSe direct links within the initiating UE;

d) the link layer identifier for the destination UE (i.e. the unicast layer-2 ID of the target UE or the broadcast layer-2 ID) is available to the initiating UE (e.g. pre-configured, obtained as specified in clause 5.2 or known via prior ProSe direct communication);

NOTE 1: In the case where different ProSe applications are mapped to distinct default destination layer-2 IDs, when the initiating UE intends to establish a single unicast link that can be used for more than one ProSe application identifiers, the UE can select any of the default destination layer-2 ID for unicast initial signalling.

e) the initiating UE is either authorised for ProSe direct communication over PC5 in NR-PC5 in the serving PLMN, or has a valid authorization for ProSe direct communication over PC5 in NR-PC5 when not served by NG-RAN. The UE considers that it is not served by NG-RAN if the following conditions are met:

1) not served by NR and not served by E-UTRA for ProSe direct communication over PC5;

2) in limited service state as specified in 3GPP TS 23.122 [14], if the reason for the UE being in limited service state is one of the following;

i) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

ii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

iii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; or

3) in limited service state as specified in 3GPP TS 23.122 [14] for reasons other than i), ii) or iii) above, and located in a geographical area for which the UE is provisioned with "non-operator managed" radio parameters as specified in clause 5.2;

f) there is no existing 5G ProSe direct link for the pair of peer application layer IDs, or there is an existing 5G ProSe direct link for the pair of peer application layer IDs and:

1) the network layer protocol of the existing 5G ProSe direct link is not identical to the network layer protocol required by the upper layer in the initiating UE for this ProSe application; or

2) the security policy (either signalling security policy or user plane security policy) corresponding to the ProSe application identifier is not compatible with the security policy of the existing PC5 unicast link; and

g) the number of established 5G ProSe direct links is less than the implementation-specific maximum number of established NR 5G ProSe direct links allowed in the UE at a time.

After receiving the service data or request from the upper layers, the initiating UE shall derive the PC5 QoS parameters and assign the PQFI(s) for the PC5 QoS flows(s) to be established as specified in clause ABCD.

In order to initiate the 5G ProSe direct link establishment procedure, the initiating UE shall create a PROSE DIRECT LINK ESTABLISHMENT REQUEST message. The initiating UE:

a) shall include the source user info set to the initiating UE's application layer ID received from upper layers;

b) shall include the ProSe application identifier(s) received from upper layer;

c) shall include the target user info set to the target UE's application layer ID if received from upper layers or if the destination layer-2 ID is the unicast layer-2 ID of target UE;

Editor's note: The following steps d) till i) are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

d) shall include the Key establishment information container if the UE PC5 unicast signalling integrity protection policy is set to "signalling integrity protection required" or "signalling integrity protection preferred", and may include the Key establishment information container if the UE PC5 unicast signalling integrity protection policy is set to "signalling integrity protection not needed";

NOTE 2: The Key establishment information container is provided by upper layers.

e) shall include a Nonce\_1 set to the 128-bit nonce value generated by the initiating UE for the purpose of session key establishment over this 5G ProSe direct link if the UE PC5 unicast signalling integrity protection policy is set to "signalling integrity protection required" or "signalling integrity protection preferred";

f) shall include its UE security capabilities indicating the list of algorithms that the initiating UE supports for the security establishment of this PC5 unicast link;

g) shall include the Most Significant 8 Bits (MSB) of KNRP-sess ID chosen by the initiating UE as specified in 3GPP TS 33.CCC if the UE PC5 unicast signalling integrity protection policy is set to "signalling integrity protection required" or "signalling integrity protection preferred";

h) may include a KNRP ID if the initiating UE has an existing KNRP for the target UE; and

i) shall include its UE PC5 unicast signalling security policy. In the case where the different ProSe applications are mapped to the different PC5 unicast signalling security policies, when the initiating UE intends to establish a single unicast link that can be used for more than one ProSe application, each of the signalling security polices of those ProSe applications shall be compatible, e.g. "signalling integrity protection not needed" and "signalling integrity protection required" are not compatible.

After the PROSE DIRECT LINK ESTABLISHMENT REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the destination layer-2 ID used for unicast initial signaling, and start timer T5080. The UE shall not send a new PROSE DIRECT LINK ESTABLISHMENT REQUEST message to the same target UE identified by the same application layer ID while timer T5080 is running. If the target user info IE is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message (i.e. ProSe application oriented 5G ProSe direct link establishment procedure), the initiating UE shall handle multiple PROSE DIRECT LINK ESTABLISHMENT ACCEPT messages, if any, received from different target UEs for the establishment of multiple 5G ProSe direct links before the expiry of timer T5080.

NOTE 3: In order to ensure successful 5G ProSe direct link establishment, T5080 should be set to a value larger than the sum of Tyyyy and Tzzzz.



Figure 7.2.2.2.1: UE oriented 5G ProSe direct link establishment procedure



Figure 7.2.2.2.2: ProSe service oriented 5G ProSe direct link establishment procedure

#### 7.2.2.3 5G ProSe direct link establishment procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK ESTABLISHMENT REQUEST message, if the target UE accepts this request, the target UE shall uniquely assign a PC5 link identifier, create a 5G ProSe direct link context and assign a layer-2 ID for this PC5 unicast link. The newly assigned layer-2 ID replaces the target layer-2 ID as received on the PROSE DIRECT LINK ESTABLISHMENT REQUEST message. Then the target UE shall store this assigned layer-2 ID and the source layer-2 ID used in the transport of this message provided by the lower layers in the 5G ProSe direct link context. The target UE may initiate 5G ProSe direct link authentication procedure as specified in clause XYZZ and shall initiate 5G ProSe direct link security mode control procedure as specified in clause ABCD.

Editor's note: The 5G ProSe direct link security mode control procedure and 5G ProSe direct link authentication procedure are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

NOTE: It is possible for the target UE to reuse the target UE’s layer-2 ID used in the transport of the PROSE DIRECT LINK ESTABLISHMENT REQUEST message provided by the lower layers in case that the target UE’s layer-2 ID has been used in previous 5G ProSe direct link with the same peer.

If:

a) the target user info IE is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and this IE includes the target UE’s application layer ID; or

b) the target user info IE is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and the target UE is interested in the ProSe application(s) identified by the ProSe application identifier IE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message;

Editor's note: The following steps a) and b), and the 5G ProSe direct link security mode control procedure are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

then the target UE shall either:

a) identify an existing KNRP based on the KNRP ID included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; or

b) if KNRP ID is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, the target UE does not have an existing KNRP for the KNRP ID included in PROSE DIRECT LINK ESTABLISHMENT REQUEST message or the target UE wishes to derive a new KNRP, derive a new KNRP. This may require performing one or more 5G ProSe direct link authentication procedures as specified in clause XYZZ.

NOTE: How many times the 5G ProSe direct link authentication procedure needs to be performed to derive a new KNRP depends on the authentication method used.

After an existing KNRP was identified or a new KNRP was derived, the target UE shall initiate a 5G ProSe direct link security mode control procedure as specified in clause ABCD.

Upon successful completion of the 5G ProSe direct link security mode control procedure, in order to determine whether the PROSE DIRECT LINK ESTABLISHMENT REQUEST message can be accepted or not, in case of IP communication, the target UE checks whether there is at least one common IP address configuration option supported by both the initiating UE and the target UE.

If the target UE accepts the 5G ProSe direct link establishment procedure, the target UE shall create a PROSE DIRECT LINK ESTABLISHMENT ACCEPT message. The target UE:

a) shall include the source user info set to the target UE’s application layer ID received from upper layers;

b) shall include PQFI(s), the corresponding PC5 QoS parameters and the ProSe application identifier(s) that the target UE accepts;

c) shall include an IP address configuration IE set to one of the following values if IP communication is used:

1) "DHCPv4 server" if only IPv4 address allocation mechanism is supported by the target UE, i.e., acting as a DHCPv4 server; or

2) "IPv6 router" if only IPv6 address allocation mechanism is supported by the target UE, i.e. acting as an IPv6 router; or

3) "DHCPv4 server & IPv6 Router" if both IPv4 and IPv6 address allocation mechanism are supported by the target UE; or

4) "address allocation not supported" if neither IPv4 nor IPv6 address allocation mechanism is supported by the target UE;

NOTE: The UE doesn't include an IP address configuration IE nor a link local IPv6 address IE, if Ethernet or Unstructured data unit type is used for communication.

d) shall include a link local IPv6 address IE formed locally based on IETF RFC 4862 [16] if IP address configuration IE is set to "address allocation not supported" and the received PROSE DIRECT LINK SECURITY MODE COMPLETE message included a link local IPv6 address IE; and

e) shall include the configuration of UE PC5 unicast user plane security protection based on the agreed user plane security policy, as specified in 3GPP TS 33.CCC.

After the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication, and shall start timer Taaaa if at least one of ProSe application identifiers for the 5G ProSe direct links satisfies the privacy requirements as specified in clause 5.2.

After sending the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the target UE shall provide the following information along with the layer-2 IDs to the lower layer, which enables the lower layer to handle the coming PC5 signalling or traffic data:

a) the PC5 link identifier self-assigned for this PC5 unicast link;

b) PQFI(s) and its corresponding PC5 QoS parameters; and

c) an indication of activation of the PC5 unicast user plane security protection for the PC5 unicast link, if applicable.

If the target UE accepts the 5G ProSe direct link establishment request, then the target UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 7.2.7.

#### 7.2.2.4 5G ProSe direct direct link establishment procedure completion by the initiating UE

If the Target user info IE is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, upon receipt of the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the initiating UE shall stop timer T5080. If the Target user info IE is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message the initiating UE may keep the timer T5080 running and continue to handle multiple response messages (i.e. the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message) from multiple target UEs.

For each of the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message received, the initiating UE shall uniquely assign a PC5 link identifier and create a 5G ProSe direct link context for each of the PC5 unicast link(s). Then the initiating UE shall store the source layer-2 ID and the destination layer-2 ID used in the transport of this message provided by the lower layers in the 5G ProSe direct link context(s) to complete the establishment of the 5G ProSe direct link with the target UE(s). From this time onward the initiating UE shall use the established link(s) for ProSe direct communication over PC5 and additional PC5 signalling messages to the target UE(s).

Editor's note: The requirements for security context and its preservation are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

After receiving the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the initiating UE shall delete the old security context it has for the target UE and shall provide the following information along with the layer-2 IDs to the lower layer, which enables the lower layer to handle the coming PC5 signalling or traffic data:

a) the PC5 link identifier self-assigned for this PC5 unicast link;

b) PQFI(s) and its corresponding PC5 QoS parameters; and

c) an indication of activation of the PC5 unicast user plane security protection for the PC5 unicast link, if applicable.

The initiating UE shall start timer Taaaa if at least one of ProSe application identifiers for the 5G ProSe direct links satisfies the privacy requirements as specified in clause 5.2.

In addition, the initiating UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 7.2.7.

Upon expiry of the timer T5080, if the DIRECT\_LINK\_ESTABLISHMENT REQUEST message did not include the Target User Info IE, and the initiating UE received at least one PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, it is up to the UE implementation to consider the 5G ProSe direct link establishment procedure as complete or to restart the timer T5080.

#### 7.2.2.5 5G ProSe direct direct link establishment procedure not accepted by the target UE

If the PROSE DIRECT LINK ESTABLISHMENT REQUEST message cannot be accepted, the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message. The PROSE DIRECT LINK ESTABLISHMENT REJECT message contains a PC5 signalling protocol cause IE set to one of the following cause values:

#1 direct communication to the target UE not allowed;

#3 conflict of layer-2 ID for unicast communication is detected;

#5 lack of resources for PC5 unicast link; or

#111 protocol error, unspecified.

If the target UE is not allowed to accept the PROSE DIRECT LINK ESTABLISHMENT REQUEST message.e.g. based on operator policy or configuration parameters for ProSe direct communication over PC5 as specified in clause 5.2, the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #1 "direct communication to the target UE not allowed".

For a received PROSE DIRECT LINK ESTABLISHMENT REQUEST message from a layer-2 ID (for unicast communication), if the target UE already has an existing link established to a UE using this layer-2 ID or is currently processing a PROSE DIRECT LINK ESTABLISHMENT REQUEST message from the same layer-2 ID, and with one of following parameters different from the existing link or the link for which the link establishment is in progress:

a) the source user info;

b) type of data (e.g. IP or non-IP); or

c) security policy,

the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #3 "conflict of layer-2 ID for unicast communication is detected".

NOTE: The type of data (e.g. IP or non-IP) is indicated by the optional IP address configuration IE included in the corresponding DIRECT LINK SECURITY MODE COMPLETE message, i.e the type of data for the requested link is IP type if this IE is included, and the type of data for the requested link is non-IP if this IE is not included.

If the 5G ProSe direct link establishment fails due to the congestion problems, the implementation-specific maximum number of established NR 5G ProSe direct links has been reached, or other temporary lower layer problems causing resource constraints, the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #5 "lack of resources for PC5 unicast link". If the 5G ProSe direct link establishment fails due to other reasons, the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #111 "protocol error, unspecified".

After sending the PROSE DIRECT LINK ESTABLISHMENT REJECT message, the target UE shall provide the following information along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication to the lower layer:

a) an indication of deactivation of the PC5 unicast security protection and deletion of security context for the PC5 unicast link, if applicable.

Upon receipt of the PROSE DIRECT LINK ESTABLISHMENT REJECT message, the initiating UE shall stop timer T5080 and abort the 5G ProSe direct link establishment procedure. If the PC5 signalling protocol cause value in the PROSE DIRECT LINK ESTABLISHMENT REJECT message is #1 "direct communication to the target UE not allowed" or #5 "lack of resources for PC5 unicast link", then the UE shall not attempt to start the 5G ProSe direct link establishment procedure with the same target UE at least for a time period T.

NOTE: The length of time period T is UE implementation specific and can be different for the case when the UE receives PC5 signalling protocol cause value #1 "direct communication to the target UE not allowed" or when the UE receives PC5 signalling protocol cause value #5 "lack of resources for 5G ProSe direct link".

After receiving the PROSE DIRECT LINK ESTABLISHMENT REJECT message, the initiating UE shall provide the following information along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication to the lower layer:

a) an indication of deactivation of the PC5 unicast security protection and deletion of security context for the 5G ProSe direct link, if applicable.

Editor's note: The requirements for security context are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 7.2.2.6 Abnormal cases

##### 7.2.2.6.1 Abnormal cases at the initiating UE

If timer T5080 expires and the Target user info IE is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, the initiating UE shall retransmit the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and restart timer T5080. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link establishment procedure and may notify the upper layer that the target UE is unreachable.

Upon expiry of the timer T5080, if the DIRECT\_LINK\_ESTABLISHMENT REQUEST message did not include the Target User Info IE and the initiating UE did not receive any PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the initiating UE may retransmit the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and restart timer T5080. If the DIRECT\_LINK\_ESTABLISHMENT REQUEST message did not include the Target User Info IE and the initiating UE did not receive any PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, then after reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link establishment procedure and may notify the upper layer that no target UE is available.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

If the need to establish a link no longer exists before the procedure is completed, the initiating UE shall abort the procedure.

When the initiating UE aborts the 5G ProSe direct link establishment procedure, the initiating UE shall provide the following information along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication to the lower layer:

a) an indication of deactivation of the PC5 unicast security protection and deletion of security context for the PC5 unicast link, if applicable.

Editor's note: The requirements for security context are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

##### 7.2.2.6.2 Abnormal cases at the target UE

For a received PROSE DIRECT LINK ESTABLISHMENT REQUEST message from a source layer-2 ID (for unicast communication), if the target UE already has an existing link established to the UE known to use the same source layer-2 ID, the same source user info, the same type of data (IP or non-IP) and the same security policy, the UE shall process the new request. However, the target UE shall only delete the existing link context after the new link establishment procedure succeeds.

NOTE: The type of data (e.g. IP or non-IP) is indicated by the optional IP address configuration IE included in the corresponding DIRECT LINK SECURITY MODE COMPLETE message, i.e the type of data for the requested link is IP type if this IE is included, and the type of data for the requested link is non-IP if this IE is not included.

### 7.2.3 5G ProSe direct link modification procedure

#### 7.2.3.1 General

The purpose of the 5G ProSe direct link modification procedure is to modify the existing ProSedirect link to:

a) add new PC5 QoS flow(s) to the existing 5G ProSe direct link;

b) modify existing PC5 QoS flow(s) for updating PC5 QoS parameters of the existing PC5 QoS flow(s);

c) modify existing PC5 QoS flow(s) for associating new ProSe Application(s) with the existing PC5 QoS flow(s);

d) modify existing PC5 QoS flow(s) for removing the associated ProSe Application(s) from the existing PC5 QoS flow(s); or

e) remove existing PC5 QoS flow(s) from the existing 5G ProSe direct link.

In this procedure, the UE sending the PROSE DIRECT LINK MODIFICATION REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

#### 7.2.3.2 5G ProSe direct link modification procedure initiated by initiating UE

The initiating UE shall meet the following pre-conditions before initiating this procedure for adding a new ProSe Application to the existing 5G ProSe direct link:

a) there is a 5G ProSe direct link between the initiating UE and the target UE;

b) the pair of Application Layer IDs and the network layer protocol of this 5G ProSe direct link are identical to those required by the application layer in the initiating UE for this ProSe Application; and

c) the security policy corresponding to the ProSe Application identifier is aligned with the security policy of the existing 5G ProSe direct link.

Editor's note: Details of security policy will be determined by SA3 WG.

After receiving the service data or request from the upper layers, the initiating UE shall perform the PC5 QoS flow match as specified in clause 7.x.b. If there is no matched PC5 QoS flow, the initiating UE shall derive the PC5 QoS parameters and assign the PQFI(s) for the PC5 QoS flows(s) to be established as specified in clause 7.2.9.

If the 5G ProSe direct link modification procedure is to add new PC5 QoS flow(s) to the existing 5G ProSe direct link, the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, initiating UE:

a) shall include the PQFI(s) and the corresponding PC5 QoS parameters, including the ProSe Application identifier(s); and

b) shall include the link modification operation code set to "Add new PC5 QoS flow(s) to the existing 5G ProSe direct link ".

If the 5G ProSe direct link modification procedure is to modify the PC5 QoS parameters for existing PC5 QoS flow(s) in the existing 5G ProSe direct link, the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s) and the corresponding PC5 QoS parameters, including the ProSe Application identifier(s); and

b) shall include the link modification operation code set to "Modify PC5 QoS parameters of the existing PC5 QoS flow(s)".

If the 5G ProSe direct link modification procedure is to associate new ProSe Application(s) with existing PC5 QoS flow(s), the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s) and the corresponding PC5 QoS parameters, including the ProSe Application identifier(s); and

b) shall include the link modification operation code set to "Associate new ProSe Application(s) with existing PC5 QoS flow(s)".

If the PC5 5G ProSe direct link modification procedure is to remove the associated ProSe Application(s) from existing PC5 QoS flow(s), the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s) and the corresponding PC5 QoS parameters including the ProSe Application identifier(s); and

b) shall include the link modification operation code set to "Remove ProSe Application(s) from existing PC5 QoS flow(s)".

If the direct link modification procedure is to remove any PC5 QoS flow(s) from the existing 5G ProSe direct link, the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s); and

b) shall include the link modification operation code set to "Remove existing PC5 QoS flow(s) from the existing 5G ProSe direct link".

After the PROSE DIRECT LINK MODIFICATION REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's Layer-2 ID for 5G ProSe direct communication and the target UE's Layer-2 ID for 5G ProSe direct communication, and start timer T5081. The UE shall not send a new PROSE DIRECT LINK MODIFICATION REQUEST message to the same target UE while timer T5081 is running.



Figure 7.2.3.2.1: 5G ProSe direct link modification procedure

#### 7.2.3.3 5G ProSe direct link modification procedure accepted by the target UE

If the PROSE DIRECT LINK MODIFICATION REQUEST message is accepted, the target UE shall respond with the DIRECT LINK MODIFICATION ACCEPT message.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to add a new ProSe Application, add new PC5 QoS flow(s) or modify any existing PC5 QoS flow(s) in the 5G ProSe direct link, the target UE shall include in the PROSE DIRECT LINK MODIFICATION ACCEPT message:

a) the PQFI(s), the corresponding PC5 QoS parameters and the ProSe Application identifier(s) that the target UE accepts.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove an existing ProSe Application from the 5G ProSe direct link, the target UE shall delete the ProSe Application identifier received in the PROSE DIRECT LINK MODIFICATION REQUEST message and the corresponding PQFI(s) and PC5 QoS parameters from the profile associated with the 5G ProSe direct link.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove existing PC5 QoS flow(s) from the PC5 5G ProSe direct link, the target UE shall delete the PQFI(s) and the corresponding PC5 QoS parameters from the profile associated with the 5G ProSe direct link.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to add a new ProSe Application, add new PC5 QoS flow(s) or modify any existing PC5 QoS flow(s) in the 5G ProSe direct link, after sending the PROSE DIRECT LINK MODIFICATION ACCEPT message, the target UE shall provide the added or modified PQFI(s) and corresponding PC5 QoS parameters along with PC5 link identifier to the lower layer.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove an existing ProSe Application or to remove the existing PC5 QoS flow(s) from the 5G ProSe direct link, after sending the PROSE DIRECT LINK MODIFICATION ACCEPT message, the target UE shall provide the removed PQFI(s) along with the PC5 link identifier to the lower layer.

If the target UE accepts the 5G ProSe direct link modification request, then the target UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 7.2.7 and perform the PC5 QoS flow match over 5G ProSe direct link as specified in clause 7.2.8.

#### 7.2.3.4 5G ProSe direct link modification procedure completion by the initiating UE

Upon receipt of the PROSE DIRECT LINK MODIFICATION ACCEPT message, the initiating UE shall stop timer T5081.

Upon receipt of the PROSE DIRECT LINK MODIFICATION ACCEPT message, if the PROSE DIRECT LINK MODIFICATION REQUEST message is to add a new ProSe Application, add new PC5 QoS flow(s) or modify any existing PC5 QoS flow(s) in the 5G ProSe direct link, the initiating UE shall provide the added or modified PQFI(s) and corresponding PC5 QoS parameters along with PC5 link identifier to the lower layer.

Upon receipt of the PROSE DIRECT LINK MODIFICATION ACCEPT message, if the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove an existing ProSe Application or to remove the existing PC5 QoS flow(s) from the 5G ProSe direct link, the initiating UE shall provide the removed PQFI(s) along with the PC5 link identifier to the lower layer.

In addition, the initiating UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 7.2.7.

#### 7.2.3.5 5G ProSe direct link modification procedure not accepted by the target UE

If the 5G ProSe direct link modification request cannot be accepted, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message. The PROSE DIRECT LINK MODIFICATION REJECT message contains a PC5 signalling protocol cause IE set to one of the following cause values:

#a lack of resources for 5G ProSe direct link;

#b required service not allowed;

#c security policy not aligned; or

#d protocol error, unspecified.

If the target UE is not allowed to accept this request, e.g. because the ProSe Application to be added is not allowed per the operator policy or configuration parameters for ProSe communication over PC5 as specified in clause 5.2.b, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #b "required service not allowed".

If the 5G ProSe direct link modification fails due to the congestion problems or other temporary lower layer problems causing resource constraints, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #a "lack of resources for 5G ProSe direct link".

If the link modification operation code is set to "Associate new ProSe Application(s) with existing PC5 QoS flow(s)", and the security policy corresponding to the ProSe Application identifier(s) (e.g. ITS-AID of the new ProSe Application) is not aligned with the security policy applied to the existing 5G ProSe direct link, then the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #c "security policy not aligned".

For other reasons causing the failure of link modification, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #d "protocol error, unspecified".

Upon receipt of the PROSE DIRECT LINK MODIFICATION REJECT message, the initiating UE shall stop timer T5081 and abort the 5G ProSe direct link modification procedure. If the PC5 signalling protocol cause value in the PROSE DIRECT LINK MODIFICATION REJECT message is #b "required service not allowed" or #a "lack of resources for 5G ProSe direct link" or #c "security policy not aligned", then the initiating UE shall not attempt to start 5G ProSe direct link modification with the same target UE to add the same ProSe Application, or to add or modify the same PC5 QoS flow(s) at least for a time period T.

NOTE: The length of time period T is UE implementation specific and can be different for the case when the UE receives PC5 signalling protocol cause value #b "required service not allowed" or when the UE receives PC5 signalling protocol cause value #a "lack of resources for 5G ProSe direct link" or when the UE receives PC5 signalling protocol cause value #c "security policy not aligned". The length of time period T is not less than 30 minutes.

#### 7.2.3.6 Abnormal cases at the initiating UE

The following abnormal cases can be identified:

a) If timer T5081 expires, the initiating UE shall retransmit the PROSE DIRECT LINK MODIFICATION REQUEST message and restart timer T5081. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link modification procedure and may notify the upper layer that the target UE is unreachable.

NOTE 1: The maximum number of allowed retransmissions is UE implementation specific.

NOTE 2: After reaching the maximum number of allowed retransmissions, whether the initiating UE releases this 5G ProSe direct link depends on its implementation.

b) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK RELEASE REQUEST message after the initiation of UE-requested 5G ProSe direct link modification procedure, the initiating UE shall stop the timer T5081 and abort the 5G ProSe direct link modification procedure and proceed with the 5G ProSe direct link release procedure.

c) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK MODIFICATION REQUEST message during the 5G ProSe direct link modification procedure, the initiating UE shall stop the timer T5081 and abort the 5G ProSe direct link modification procedure. Following handling is implementation dependent, e.g., the initiating UE waits for an implementation dependent time for initiating a new 5G ProSe direct link modification procedure, if still needed.

NOTE 3: The implementation dependent timer value needs to be set to avoid further collisions (e.g. random timer value).

### 7.2.4 5G ProSe direct link identifier update procedure

#### 7.2.4.1 General

The 5G ProSe direct link identifier update procedure is used to update and exchange the new identifiers (e.g. Application Layer ID, Layer-2 ID, security information and IP address/prefix) between two UEs for a 5G ProSe direct link before using the new identifiers. The UE sending the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

#### 7.2.4.2 5G ProSe direct link identifier update procedure initiation by initiating UE

The initiating UE shall initiate the procedure if:

a) the initiating UE receives a request from upper layers to change the Application Layer ID and there is an existing 5G ProSe direct link associated with this Application Layer ID; or

b) the privacy timer (see clause 5.2.4) of the initiating UE's Layer-2 ID expires for an existing 5G ProSe direct link.

If the 5G ProSe direct link identifier update procedure is triggered by a change of the initiating UE’s Application Layer ID, the initiating UE shall create a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message. In this message, the initiating UE:

a) shall include the initiating UE’s new Application Layer ID received from upper layer;

b) shall include the initiating UE’s new Layer-2 ID assigned by itself;

c) shall include the new MSB of KNRP-sess ID; and

d) shall include the new IP address/prefix if IP communication is used.

Editor's note: Detail of security related content in c) is FFS and will be determined by SA3 WG.

If the 5G ProSe direct link identifier update procedure is triggered by the expiry of the initiating UE's privacy timer T5091 as specified in clause 5.2.4, the initiating UE shall create a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message. In this message, the initiating UE:

a) shall include the initiating UE's new Layer-2 ID assigned by itself;

b) shall include the new MSB of KNRP-sess ID;

c) may include the initiating UE’s new Application Layer ID if received from upper layer; and

d) shall include the new IP address/prefix if IP communication is used and changed.

Editor's note: Detail of security related content in b) is FFS and will be determined by SA3 WG.

After the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's old Layer-2 ID for 5G ProSe direct communication and the target UE's Layer-2 ID for 5G ProSe direct communication, and start timer T5082. The UE shall not send a new PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message to the same target UE while timer T5082 is running.



Figure 7.2.4.2.1: 5G ProSe direct link identifier update procedure

#### 7.2.4.3 5G ProSe direct link identifier update procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message, if the target UE determines:

a) the 5G ProSe direct link associated with this request message is still valid; and

b) the timer T5083 for the 5G ProSe direct link identified by this request message is not running,

then the target UE accepts this request, and responds with a PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message.

The target UE shall create the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message. In this message, the target UE:

a) shall include the target UE's new Layer-2 ID assigned by itself;

b) shall include the new LSB of KNRP-sess ID;

c) shall include the initiating UE's new MSB of KNRP-sess ID;

d) shall include the initiating UE's new Layer-2 ID;

e) shall include the target UE’s new Application Layer ID if received from upper layer;

f) shall include the initiating UE's new IP address/prefix if received from the initiating UE and IP communication is used;

g) shall include the initiating UE's new Application Layer ID if received from the initiating UE; and

h) shall include the target UE's new IP address/prefix if IP communication is used and changed.

Editor's note: Details of security related content in b) and c) are FFS and will be determined by SA3 WG.

After the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's old Layer-2 ID for 5G ProSe direct communication and the target UE's old Layer-2 ID for 5G ProSe direct communication, and start timer T5083. The UE shall not send a new PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message to the same initiating UE while timer T5083 is running.

Before target UE receives the traffic using the new Layer-2 IDs, the target UE shall continue to receive the traffic with the old Layer-2 IDs (i.e. initiating UE’s old Layer-2 ID and target UE’s old Layer-2 ID) from initiating UE.

Before target UE receives the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message from initiating UE, the target UE shall keep sending traffic to the initiating UE using the old Layer-2 IDs (i.e. initiating UE’s old Layer-2 ID for 5G ProSe direct communication and target UE’s old Layer-2 ID for 5G ProSe direct communication).

#### 7.2.4.4 5G ProSe direct link identifier update procedure acknowledged by the initiating UE

Upon receipt of the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message, the initiating UE shall stop timer T5082 and respond with a PROSE DIRECT LINK IDENTIFIER UPDATE ACK message. In this message, the initiating UE:

a) shall include the target UE's new Layer-2 ID;

b) shall include the target UE's new LSB of KNRP-sess ID;

c) shall include the target UE's new Application Layer ID, if received; and

d) shall include the target UE's new IP address/prefix, if received.

Editor's note: Detail of security related content in b) is FFS and will be determined by SA3 WG.

After the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's old Layer-2 ID for 5G ProSe direct communication and the target UE's old Layer-2 ID for 5G ProSe direct communication and shall stop timer T5091 if running and start a timer T5091 as configured if at least one of ProSe Application identifiers for the 5G ProSe direct link satisfying the privacy requirements as specified in clause 5.2.4.

Upon sending the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message, the initiating UE shall update the associated 5G ProSe direct link context with the new identifiers and pass the new Layer-2 IDs (i.e. initiating UE's new Layer-2 ID for 5G ProSe direct communication and target UE's new Layer-2 ID for 5G ProSe direct communication) along with the PC5 link identifier down to the lower layer. Then the initiating UE shall use the new Layer-2 IDs (i.e. initiating UE's new Layer-2 ID for 5G ProSe direct communication and target UE’s new Layer-2 ID for 5G ProSe direct communication) to transmit the PC5 signalling message and PC5 user plane data.

The initiating UE shall continue to receive traffic with the old Layer-2 IDs (i.e. initiating UE's old Layer-2 ID for 5G ProSe direct communication and target UE's old Layer-2 ID for 5G ProSe direct communication) from the target UE until it receives traffic with the new Layer-2 IDs (i.e. initiating UE's new Layer-2 ID and target UE's new Layer-2 ID) from the target UE.

#### 7.2.4.5 5G ProSe direct link identifier update procedure completion by the target UE

Upon receipt of the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message, the target UE shall update the associated 5G ProSe direct link context with the new identifiers, pass the new Layer-2 IDs (i.e. initiating UE's new Layer-2 ID and target UE's new Layer-2 ID) down to the lower layer, stop timer T5083 and timer T5091 if running and start a timer T5091 as configured if at least one of ProSe Application identifiers for the 5G ProSe direct link satisfying the privacy requirements as specified in clause 5.2.4. Then the target UE shall use the new Layer-2 IDs (i.e. initiating UE's new Layer-2 ID for 5G ProSe direct communication and target UE's new Layer-2 ID for 5G ProSe direct communication) to transmit the PC5 signalling message and PC5 user plane data.

#### 7.2.4.6 5G ProSe direct link identifier update procedure not accepted by the target UE

If the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message cannot be accepted, the target UE shall send a PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message. The PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message contains a PC5 signalling protocol cause IE set to one of the following cause values:

#aa conflict of Layer-2 ID for 5G ProSe direct communication is detected; or

#bb protocol error, unspecified.

For a received PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message from a Layer-2 ID (for 5G ProSe direct communication), if the target UE already has an existing link using this Layer-2 ID or is currently processing a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message from the same Layer-2 ID, but with user info different from the user info IE included in this new incoming message, the target UE shall send a PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message with PC5 signalling protocol cause value #aa "conflict of Layer-2 ID for 5G ProSe direct communication is detected".

NOTE: After receiving the PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message, whether the initiating UE initiates the 5G ProSe direct link release procedure or initiates another 5G ProSe direct link identifier update procedure with a new Layer-2 ID depends on UE implementation.

For other reasons causing the failure of link identifier update, the target UE shall send a PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message with PC5 signalling protocol cause value #bb "protocol error, unspecified".

Upon receipt of the PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message, the initiating UE shall stop timer T5082 and abort this 5G ProSe direct link identifier update procedure.

#### 7.2.4.7 Abnormal cases

##### 7.2.4.7.1 Abnormal cases at the initiating UE

The following abnormal cases can be identified:

a) If timer T5082 expires, the initiating UE shall retransmit the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message and restart timer T5082. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link identifier update procedure and may notify the upper layer that the target UE is unreachable.

NOTE 1: The maximum number of allowed retransmissions is UE implementation specific.

NOTE 2: After reaching the maximum number of allowed retransmissions, whether the initiating UE releases this 5G ProSe direct link depends on its implementation.

b) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message during the 5G ProSe direct link identifier update procedure, the initiating UE shall stop the timer T5082 and abort the 5G ProSe direct link identifier update procedure. Following handling is implementation dependent, e.g., the initiating UE waits for an implementation dependent time for initiating a new 5G ProSe direct link identifier update procedure, if still needed.

NOTE 3: The implementation dependent timer value needs to be set to avoid further collisions (e.g. random timer value).

c) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK REKEYING REQUEST message after initiating the 5G ProSe direct link identifier update procedure, the initiating UE shall ignore the PROSE DIRECT LINK REKEYING REQUEST message and proceed with the 5G ProSe direct link identifier update procedure.

d) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK RELEASE REQUEST message after the initiation of 5G ProSe direct link identifier update procedure, the initiating UE shall stop the timer T5082 and abort the 5G ProSe direct link identifier update procedure and proceed with the 5G ProSe direct link release procedure.

##### 7.2.4.7.2 Abnormal cases at the target UE

The following abnormal cases can be identified:

a) If timer T5083 expires, the target UE shall retransmit the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message and restart timer T5083. After reaching the maximum number of allowed retransmissions, the target UE shall abort the 5G ProSe direct link identifier update procedure and may notify the upper layer that the initiating UE is unreachable.

NOTE 1: The maximum number of allowed retransmissions is UE implementation specific.

NOTE 2: After reaching the maximum number of allowed retransmissions, whether the target UE releases this 5G ProSe direct link depends on its implementation.

b) If PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST is received when the timer T5083 is running, the target UE shall stop the timer T5083 and abort the ongoing 5G ProSe direct link identifier update procedure. The target UE shall handle the new PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST as specified in clause 7.2.y.3.

c) After sending the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message to the target UE, if another PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message from the target UE is received before the traffic from the target UE with the new Layer-2 IDs is received, the initiating UE shall retransmit the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message along with the initiating UE's old Layer-2 ID and the target UE's old Layer-2 ID.

NOTE 3: It is up to implementation to handle the failure of traffic delivery for new Layer-2 IDs if such traffic has been sent before the initiating UE retransmits the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message.

d) After sending the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message to the target UE, if the initiating UE keeps receiving traffic from the target UE with the old Layer-2 IDs and traffic from the target UE with the new Layer-2 IDs is not received during an implementation specific time which is greater than the value of timer T5083, the initiating UE shall abort the 5G ProSe direct link identifier update procedure and may release the 5G ProSe direct link.

### 7.2.5 5G ProSe direct link keep-alive procedure

#### 7.2.5.1 General

The 5G ProSe direct link keep-alive procedure is used to maintain a 5G ProSe direct link between two UEs, i.e., check that the link between the two UEs is still valid. The UE sending the PROSE DIRECT LINK KEEPALIVE REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

The 5G ProSe direct link keep-alive procedure can be initiated by only one UE or both UEs in the established 5G ProSe direct link.

NOTE: Whether the 5G ProSe direct link keep-alive procedure is initiated by only one UE or both UEs in the established 5G ProSe direct link is UE implementation specific.

#### 7.2.5.2 5G ProSe direct link keep-alive procedure initiation by the initiating UE

The initiating UE shall meet the following pre-condition before initiating the 5G ProSe direct link keep-alive procedure:

a) there is a 5G ProSe direct link between the initiating UE and the target UE.

The initiating UE shall manage a keep-alive timer T5084 and a keep-alive counter for the 5G ProSe direct link keep-alive procedure. Timer T5084 is used to trigger the periodic initiation of the 5G ProSe direct link keep-alive procedure. The UE shall start or restart timer T5084 whenever the UE receives a PC5 signalling message or PC5 user plane data from the target UE over this 5G ProSe direct link. The UE shall set the keep-alive counter to an initial value of zero after 5G ProSe direct link establishment.

The initiating UE shall initiate the 5G ProSe direct link keep-alive procedure when:

a) timer T5084 for this link expires;

b) optionally, a request from the lower layers to check the viability of the 5G ProSe direct link is received; or

NOTE 1: Whether the lower layers can request the initiation of the 5G ProSe direct link keep-alive procedure, and what the triggers for the lower layers are to request the initiation of the 5G ProSe direct link keep-alive procedure, are UE implementation specific.

c) optionally, a request from the upper layers to check the viability of the 5G ProSe direct link is received.

NOTE 2: Whether the upper layers can request the initiation of the 5G ProSe direct link keep-alive procedure, and what the triggers for the upper layers are to request the initiation of the 5G ProSe direct link keep-alive procedure, are UE implementation specific.

In order to initiate the 5G ProSe direct link keep-alive procedure, the initiating UE shall stop timer T5084, if running, and shall create a PROSE DIRECT LINK KEEPALIVE REQUEST message. In this message, the initiating UE:

a) shall include the keep-alive counter for the 5G ProSe direct link; and

b) may include a maximum inactivity period to indicate the maximum inactivity period of the initiating UE over this 5G ProSe direct link.

NOTE 3: The value chosen for the maximum inactivity period of the initiating UE is UE implementation specific with the objective to minimize the number of keep-alive procedures as much as possible. It is desirable to have the maximum inactivity period value to be slightly higher than the value of keep-alive timer T5084.

After the PROSE DIRECT LINK KEEPALIVE REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's Layer-2 ID for 5G ProSe direct communication and the target UE's Layer-2 ID for 5G ProSe direct communication, and start timer T5085. The UE shall not send a new PROSE DIRECT LINK KEEPALIVE REQUEST message to the same target UE while timer T5085 is running.



Figure 7.2.5.2.1: 5G ProSe direct link keep-alive procedure

#### 7.2.5.3 5G ProSe direct link keep-alive procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK KEEPALIVE REQUEST message, the target UE shall create a PROSE DIRECT LINK KEEPALIVE RESPONSE message. In this message, the target UE:

a) shall include the keep-alive counter set to the same value as that received in the PROSE DIRECT LINK KEEPALIVE REQUEST message.

After the PROSE DIRECT LINK KEEPALIVE RESPONSE message is generated, the target UE shall pass this message to the lower layers for transmission along with the target UE's Layer-2 ID for 5G ProSe direct communication and the initiating UE's Layer-2 ID for 5G ProSe direct communication.

If a maximum inactivity period is included in the PROSE DIRECT LINK KEEPALIVE REQUEST message, the target UE shall stop T5086, if running, and start T5086 with its value set to the maximum inactivity period. The target UE shall restart T5086 whenever the target UE receives a PC5 signalling message or PC5 user plane data from the initiating UE over this 5G ProSe direct link.

#### 7.2.5.4 5G ProSe direct link keep-alive procedure completion by the initiating UE

Upon receipt of a PROSE DIRECT LINK KEEPALIVE RESPONSE message, the initiating UE shall stop timer T5085, start timer T5084 and increment the keep-alive counter for the 5G ProSe direct link.

#### 7.2.5.5 Abnormal cases

##### 7.2.5.5.1 Abnormal cases at the initiating UE

a) Timer T5085 expires.

The initiating UE shall retransmit the PROSE DIRECT LINK KEEPALIVE REQUEST message with the last used value of the keep-alive counter and restart timer T5085. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link keep-alive procedure and locally release the 5G ProSe direct link.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

b) The need to use this 5G ProSe direct link no longer exists before the 5G ProSe direct link keep-alive procedure is completed.

The initiating UE shall abort the 5G ProSe direct link keep-alive procedure and initiate a 5G ProSe direct link release procedure.

c) The initiating UE receives a PROSE DIRECT LINK KEEPALIVE RESPONSE message with a keep-alive counter value different from the value which the initiating UE had included in the last sent PROSE DIRECT LINK KEEPALIVE REQUEST message.

The initiating UE shall discard the PROSE DIRECT LINK KEEPALIVE RESPONSE message.

d) The initiating UE receives a PC5 signalling message other than a PROSE DIRECT LINK KEEPALIVE RESPONSE message or PC5 user plane data from the target UE over this 5G ProSe direct link while timer T5085 is running.

The initiating UE shall stop timer T5085, abort the 5G ProSe direct link keep-alive procedure, start timer T5084 and increment the keep-alive counter for the 5G ProSe direct link.

e) The initiating UE receives a PROSE DIRECT LINK KEEPALIVE RESPONSE message when T5085 is not running.

The initiating UE shall discard the PROSE DIRECT LINK KEEPALIVE RESPONSE message.

##### 7.2.5.5.2 Abnormal cases at the target UE

a) Timer T5086 expires.

The target UE shall:

1) initiate a 5G ProSe direct link keep-alive procedure to check the link; or

2) initiate the 5G ProSe direct link release procedure.

Whether the UE chooses 1) or 2) is left to UE implementation.

b) The target UE receives a PROSE DIRECT LINK KEEPALIVE REQUEST message with a keep-alive counter value lower than the value which the target UE had included in the last sent PROSE DIRECT LINK KEEPALIVE RESPONSE message.

The target UE shall discard the PROSE DIRECT LINK KEEPALIVE REQUEST message.

c) The target UE receives a PROSE DIRECT LINK KEEPALIVE REQUEST message if there is a pending PC5 signaling message or PC5 user plane data to be sent to the initiating UE over this 5G ProSe direct link.

The target UE:

1) shall pass this PC5 signalling message to the lower layers for transmission along with the target UE's Layer-2 ID for 5G ProSe direct communication and the initiating UE's Layer-2 ID for 5G ProSe direct communication, or perform the data transmission over 5G ProSe direct link as specified in clause 7.2.m; and

2) shall consider transmission of this PC5 signalling message or PC5 user plane data to be an implicit PROSE DIRECT LINK KEEPALIVE RESPONSE message and skip generating a PROSE DIRECT LINK KEEPALIVE RESPONSE message. If a maximum inactivity period is included in the PROSE DIRECT LINK KEEPALIVE REQUEST message, the target UE shall stop T5086, if running, and start T5086 with its value set to the maximum inactivity period.

### 7.2.6 5G ProSe direct link release procedure

#### 7.2.6.1 General

The 5G ProSe direct link release procedure is used to release a secure 5G ProSe direct link between two UEs. The link can be released from either end point. The UE sending the PROSE DIRECT LINK RELEASE REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

If the UE receives an indication of radio link failure from the lower layer, the UE shall release the 5G ProSe direct link locally and may delete the KNRP ID associated with this link after an implementation specific time.

#### 7.2.6.2 5G ProSe direct direct link release procedure initiation by initiating UE

The initiating UE shall initiate the procedure if a request from upper layers to release a 5G ProSe direct link with the target UE which uses a known layer-2 ID (for unicast communication) is received and there is an existing 5G ProSe direct link between these two UEs.

The initiating UE may initiate the procedure if the target UE has been non-responsive, e.g. no response in the PC5 unicast direct link modification procedure, PC5 unicast direct link identifier update procedure, PC5 unicast direct link re-keying procedure or PC5 unicast direct link keep-alive procedure.

The initiating UE may initiate the procedure to release an established 5G ProSe direct link if the UE has reached the maximum number of established 5G ProSe direct links and there is a need to establish a new 5G ProSe direct link. In this case, which 5G ProSe direct link is to be released is up to UE implementation.

The initiating UE may initiate the procedure to release an established 5G ProSe direct link upon expiry of the timer T5084.

In order to initiate the 5G ProSe direct link release procedure, the initiating UE shall create a PROSE DIRECT LINK RELEASE REQUEST message with a PC5 signalling protocol cause IE indicating one of the following cause values:

#1 direct communication to the target UE not allowed;

#2 direct communication to the target UE no longer needed;

#4 direct connection is not available anymore;

#5 lack of resources for PC5 unicast link; or

#111 protocol error, unspecified.

The initiating UE shall include the new MSB of KNRP ID in the PROSE DIRECT LINK RELEASE REQUEST message.

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

After the PROSE DIRECT LINK RELEASE REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication, and shall stop T5091 if running. The initiating UE shall start timer T5087.



Figure 7.2.6.2.1: 5G ProSe direct link release procedure

#### 7.2.6.3 5G ProSe direct direct link release procedure accepted by the target UE

Upon receiving a PROSE DIRECT LINK RELEASE REQUEST message, the target UE shall stop all running timers for this 5G ProSe direct link and abort any other ongoing PC5 signalling protocol procedures on this PC5 unicast link. The target UE shall respond with a PROSE DIRECT LINK RELEASE ACCEPT message. The target UE shall include the new LSB of KNRP ID in the PROSE DIRECT LINK RELEASE ACCEPT message. After the message is sent, the target UE shall release the 5G ProSe direct link by performing the following behaviors:

a) inform the lower layer along with the PC5 link identifier that the 5G ProSe direct link has been released; and

b) delete the 5G ProSe direct link context of the 5G ProSe direct link after an implementation specific time.

The target UE shall form the new KNRP ID from the new MSB of KNRP ID received in the PROSE DIRECT LINK RELEASE REQUEST message and the new LSB of KNRP ID included in the PROSE DIRECT LINK RELEASE ACCEPT message. The target UE shall replace the existing KNRP ID with the new KNRP ID. The target UE may include the new KNRP ID in PROSE DIRECT LINK ESTABLISHMENT REQUEST message with the initiating UE as specified in clause 7.2.2.2.

#### 7.2.6.4 5G ProSe direct direct link release procedure completion by the initiating UE

Upon receipt of the PROSE DIRECT LINK RELEASE ACCEPT message, the initiating UE shall stop timer T5087 and shall release the 5G ProSe direct link by performing the following behaviors:

a) inform the lower layer along with the PC5 link identifier that the 5G ProSe direct link has been released; and

b) delete the 5G ProSe direct link context of the 5G ProSe direct link after an implementation specific time.

The initiating UE shall form the new KNRP ID from the MSB of KNRP ID included in the PROSE DIRECT LINK RELEASE REQUEST message and the LSB of KNRP ID received in the PROSE DIRECT LINK RELEASE ACCEPT message. The initiating UE shall replace the existing KNRP ID with the new KNRP ID. The initiating UE may include the new KNRP ID in PROSE DIRECT LINK ESTABLISHMENT REQUEST message with the target UE as specified in clause 7.2.2.2.

#### 7.2.6.5 Abnormal cases

##### 7.2.6.5.1 Abnormal cases at the initiating UE

If retransmission timer T5087 expires and the PC5 signalling protocol cause included in the PC5 signalling protocol cause IE in the PROSE DIRECT LINK RELEASE REQUEST message was #4 "direct connection is not available anymore", the initiating UE shall release the 5G ProSe direct link locally and delete the KNRP ID associated with this link. From this time onward the initiating UE shall no longer send or receive any messages via this link.

If retransmission timer T5087 expires and the PC5 signalling protocol cause included in the PC5 signalling protocol cause IE in the PROSE DIRECT LINK RELEASE REQUEST message was not #4 "direct connection is not available anymore", the initiating UE shall initiate the transmission of the PROSE DIRECT LINK RELEASE REQUEST message again and restart timer T5087.

If no response is received from the target UE after reaching the maximum number of allowed retransmissions, the initiating UE shall release the 5G ProSe direct link locally and delete the KNRP ID associated with this link. From this time onward the initiating UE shall no longer send or receive any messages via this link.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

### 7.2.7 PC5 QoS flow establishment over 5G ProSe direct link

In order to establish a PC5 QoS flow establishment over 5G ProSe direct link, the UE shall derive the PC5 QoS parameters based on the ProSe application requirements provided by the upper layers (if available) and the ProSe application identifier(s) according to the PC5 QoS mapping rules defined in clause 5.2.4. The UE shall create the PC5 QoS flow(s) based on the derived PC5 QoS parameters. For each PC5 QoS flow to be created, the UE shall perform the following operations:

Editor's note: It is FFS which filter combination the ProSe Packet Filter Set is based on, e.g. Source/Destination Layer-2 ID, ProSe Application ID, etc, hence the usage of packet filters;in this clause is subject to change.

Editor's note: How packet filters are used for Ethernet packets is FFS.

a) self-assign a PQFI;

b) create a PC5 QoS flow context, which contains:

1) the PQFI;

2) the ProSe application identifier(s); and

3) the derived PC5 QoS parameters;

c) create a new PC5 QoS rule which contains:

1) a PC5 QoS rule identifier;

2) the PQFI;

3) a set of packet filters; and

4) a precedence value; and

d) pass the following parameters to the lower layers:

1) the PQFI;

2) the PC5 QoS parameters;

3) the PC5 link identifier; and

4) optionally, the source and destination layer-2 IDs.

Two types of packet filters are supported for ProSe direct communication over PC5, i.e. the ProSe IP packet filter set and the ProSe packet filter set. A PC5 QoS Rule contains either the ProSe IP packet filter set or the ProSe packet filter set.

The ProSe IP packet filter set is defined as content of the packet filter contents field specified in 3GPP TS 24.501 [11] figure 9.11.4.13.4 and table 9.11.4.13.1.

The ProSe packet filter set shall support packet filters based on at least any combination of:

a) ProSe application identifier;

b) the source layer-2 ID and the destination layer-2 ID; and

c) application layer ID (e.g. Station ID).

### 7.2.8 PC5 QoS flow match over 5G ProSe direct link

When service data or request from the upper layers is received, the UE determines if there is any existing PC5 QoS flow(s) matching the service data or request, i.e. based on the PC5 QoS rules for the existing PC5 QoS flow(s).

If there is no PC5 QoS rules for the existing PC5 QoS flow(s) matching the service data or request, the UE shall derive the PC5 QoS parameters based on the ProSe application requirements provided by the upper layers (if available) and the ProSe application identifier(s) according to the PC5 QoS mapping rules defined in clause 5.2.4 and shall perform the following:

a) if there is no existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall create a new PC5 QoS flow as specified in clause 7.2.x;

b) if there is an existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall update the PC5 packet filter set in the PC5 QoS rule of this PC5 QoS flow, e.g. add the new packet filter in the PC5 QoS rule of this existing PC5 QoS flow; and

c) the UE shall use the new PC5 QoS flow created as described in bullet a) or the existing PC5 QoS flow with the updated PC5 QoS rules as described in bullet b) to perform the transmission of ProSe direct communication over PC5 as specified in clause 7.2.9.

If there is a PC5 QoS rule for the existing PC5 QoS flow matching the service data or request, the UE shall use this existing PC5 QoS flow to perform transmission of ProSe direct communication over PC5 as specified in clause 7.2.9.

### 7.2.9 Data transmission over 5G ProSe direct link

#### 7.2.9.1 Transmission

When receiving user data from upper layers to be sent over 5G ProSe direct link to a specific UE, the transmitting UE shall determine the 5G ProSe direct link context corresponding to the application layer ID, and then shall tag each outgoing protocol data unit with the following information before passing it to the lower layers for transmission:

a) a layer-3 protocol data unit type (see 3GPP TS 38.323 [16]) set to:

1) IP packet, if the ProSe message contains IP data; or

2) non-IP packet, if the ProSe message contains Ethernet or Unstructured data unit types;

b) the PC5 link identifier associated with the 5G ProSe direct link context;

c) optionally, the source layer-2 ID set to the source layer-2 ID associated with the 5G ProSe direct link context;

d) optionally, the destination layer-2 ID set to the destination layer-2 ID associated with the 5G ProSe direct link context; and

e) the PQFI set to the value corresponding to the ProSe application identifier and the optional ProSe application requirements according to the mapping rules specified in clause 5.2.4.

#### 7.2.9.2 Procedure for UE to use provisioned radio resources for ProSe communication over PC5

The procedures described for using NR-PC5 in clause 7.3.2.3 apply.

## 7.3 Broadcast mode 5G ProSe direct communication over PC5

### 7.3.1 Overview

This clause describes the 5G ProSe communication over PC5 reference point in broadcast mode operation. The UE is configured with the related information as described in clause 5.2.4.

### 7.3.2 Transmission of broadcast mode 5G ProSe communication over PC5

#### 7.3.2.1 Initiation

##### 7.3.2.1.1 Broadcast mode 5G ProSe communication over PC5 triggered by upper layers

When the UE is requested by upper layers to send data unit(s) of a ProSe Application identified by a ProSe Application identifier using 5G ProSe communication over PC5, the request from the upper layers includes:

a) the data unit(s) of the ProSe Application;

b) the ProSe Application identifier of the ProSe Application for the data unit(s);

c) the type of data in the data unit(s) (i.e. IP or non-IP);

d) optionally the communication mode which is set to broadcast mode; and

e) optionally the 5G ProSe application requirements (e.g. priority requirement, reliability requirement, delay requirement).

Editor’s note: Details of whether specific parameters need to be set for the non-IP packet handling are FFS.

Upon a request from upper layers to send data unit(s) of a ProSe Application identified by a ProSe Application identifier using 5G ProSe communication over PC5, if:

a) the UE is configured with ProSe Application identifier to ProSe NR frequency mapping rules for 5G ProSe communication over PC5 as specified in clause 5.2.4; and

b) there are one or more ProSe NR frequencies associated with the ProSe Application identifier of the ProSe Application for the data unit(s) in the current geographical area,

then the UE passes the one or more ProSe NR frequencies associated with the ProSe Application identifier of the ProSe Application and the communication mode which is set to broadcast mode for the data unit(s) to the lower layers.

Then, if any of the following conditions are met:

a) the following conditions are met:

1) the UE is served by NG-RAN for 5G ProSe communication;

2) the UE intends to use the radio resources (i.e. carrier frequency) provided by a serving cell;

3) the registered PLMN is in the list of PLMNs in which the UE is authorized to use 5G ProSe communication over PC5 when the UE is served by NG-RAN for 5G ProSe communication over PC5 as specified in clause 5.2.4; and

4) the ProSe Application identifier of the ProSe Application is included in the list of ProSe Applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4 or the UE is configured with a default Destination Layer-2 ID for 5G ProSe communication over PC5 as specified in clause 5.2.4; or

b) the following conditions are met:

1) the UE is:

i) not served by NG-RAN for 5G ProSe communication over PC5;

ii) in limited service state as specified in 3GPP TS 23.122 [14], if the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; or

iii) in limited service state as specified in 3GPP TS 23.122 [14] for reasons other than A), B) or C) above, and located in a geographical area for which the UE is provisioned with "non-operator managed" radio parameters as specified in clause 5.2.4;

2) the UE is authorized to use 5G ProSe communication over PC5 when the UE is not served by NG-RAN for 5G ProSe communication as specified in clause 5.2.4; and

3) the ProSe Application identifier of the ProSe Application is included in the list of ProSe Applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4 or the UE is configured with a default Destination Layer-2 ID for 5G ProSe communication over PC5 as specified in clause 5.2.4;

then the UE shall proceed as specified in clause 7.3.2.1.2, else the UE shall not perform transmission of 5G ProSe communication over PC5.

##### 7.3.2.1.2 PC5 QoS flow match and establishment

In order to determine if any existing PC5 QoS flow matches the request from upper layers, UE shall proceed as follows:

a) according to the PC5 QoS mapping rules specified in clause 5.2.4, the UE shall use the PC5 QoS parameters corresponding to the ProSe Application identifier and optionally 5G ProSe application requirements;

b) according to the ProSe Application identifier to Destination Layer-2 ID for broadcast mapping rules specified in clause 5.2.4, the UE shall use the Destination Layer-2 ID corresponding to the ProSe Application identifier;

c) if there is no existing context for the Destination Layer-2 ID, then:

1) build a new context for the Destination Layer-2 ID;

2) self-assign a new Source Layer-2 ID; and

3) pass the Source Layer-2 ID and the Destination Layer-2 ID to lower layers.

d) if in the context for the Destination Layer-2 ID, there is no PC5 QoS rule for the existing PC5 QoS flow(s) matching the service data or request, the UE shall derive the PC5 QoS parameters based on the 5G ProSe application requirements provided by the upper layers (if available) and the ProSe Application identifier according to the PC5 QoS mapping rules defined in clause 5.2.4 and shall perform the following:

1) if there is no existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall create a new PC5 QoS flow by performing the following operations:

i) self-assign a new PQFI;

ii) create a new PC5 QoS flow context which contains:

A) the PQFI;

B) the ProSe Application identifier(s); and

C) the derived PC5 QoS parameters;

iii) create a new PC5 QoS rule which contains:

A) a PC5 QoS rule identifier;

B) the PQFI;

C) a set of packet filters; and

D) a precedence value; and

iv) pass the following parameters to the lower layers:

A) the PQFI;

B) the PC5 QoS parameters; and

C) the Source Layer-2 ID and the Destination Layer-2 ID;

2) if there is an existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall update the PC5 packet filter set in the PC5 QoS rule of this PC5 QoS flow, e.g. add the new packet filter in the PC5 QoS rule of this existing PC5 QoS flow; and

3) the UE shall use the new PC5 QoS flow created as described in bullet 1) or the existing PC5 QoS flow with the updated PC5 QoS rules as described in bullet 2) to perform the transmission of 5G ProSe communication over PC5 as specified in clause 7.3.2.2; and

e) if in the context for the Destination Layer-2 ID, there is a PC5 QoS rule for the existing PC5 QoS flow matching the service data or request, the UE shall use this existing PC5 QoS flow to perform transmission of 5G ProSe communication over PC5 as specified in clause 7.3.2.2.

Two types of packet filters are supported for 5G ProSe communication over PC5, i.e. the IP packet filter set and the 5G ProSe packet filter set. A PC5 QoS Rule contains either the IP packet filter set or the 5G ProSe packet filter set.

The IP packet filter set is defined as content of the packet filter contents field specified in 3GPP TS 24.501 [11] figure 9.11.4.13.4 and table 9.11.4.13.1.

The 5G ProSe packet filter set shall support packet filters based on at least any combination of:

a) ProSe Application identifier;

b) the Source Layer-2 ID and the Destination Layer-2 ID; and

c) Application Layer ID;

Editor's note: It is FFS which filter combination the ProSe Packet Filter Set is based on, e.g. Source/Destination Layer-2 ID, ProSe Application ID, etc.

#### 7.3.2.2 Transmission

The UE shall include the data unit(s) in a protocol data unit with the following parameters:

a) a layer-3 protocol data unit type (see 3GPP TS 38.323 [16]) set to:

1) IP packet, if the data unit(s) contains IP data; or

2) non-IP packet, if the data unit(s) contains non-IP data;

b) the Source Layer-2 ID set to the Layer-2 ID self-assigned by the UE for 5G ProSe communication over PC5;

c) the Destination Layer-2 ID set to:

1) the Destination Layer-2 ID associated with the ProSe Application identifier of the ProSe Application in this list of ProSe Applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4, if the ProSe Application identifier of the ProSe Application is included in the list of ProSe Applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4; or

2) the default Destination Layer-2 ID configured to the UE for 5G ProSe communication over PC5 as specified in clause 5.2.4, if the ProSe Application identifier of the ProSe Application is not included in the list of ProSe Applications authorized for 5G ProSe communication over PC5 and the UE is configured with a default Destination Layer-2 ID for 5G ProSe communication over PC5;

d) if the data unit(s) contains IP data, the source IP address set to the source IP address self-assigned by the UE for 5G ProSe communication over PC5; and

e) the PQFI set to the value corresponding to the PC5 QoS rules as specified in clause 7.3.2.1,

Editor’s note: Details of whether specific parameters need to be set for the non-IP packet handling are FFS.

then UE shall request radio resources for 5G ProSe communication over PC5 as specified in 3GPP TS 38.300 [21], and pass the data unit(s) on the PC5 QoS Flow identified by the PQFI to lower layers for transmission. The PC5 QoS Rules corresponding to the PQFIs map the data unit(s) with the same ProSe Application identifier and with the same PC5 QoS parameters to the same PC5 QoS Flow, and apply PQFI to the data unit(s);

If the UE is camped on a serving cell indicating that 5G ProSe communication over PC5 is supported by the network, but not broadcasting any carrier frequencies and radio resources for 5G ProSe communication over PC5 as specified in 3GPP TS 38.331 [13], the UE shall request radio resources for 5G ProSe communication over PC5 as specified in 3GPP TS 24.501 [11].

#### 7.3.2.3 Procedure for UE to use provisioned radio resources for 5G ProSe communication over PC5

When the UE is not served by NG-RAN for 5G ProSe communication and is authorized to use 5G ProSe communication over PC5, the UE shall identify the NR-PC5 to be used for 5G ProSe communication over PC5. After identifying NR-PC5 to be used for 5G ProSe communication over PC5, the UE shall select the corresponding radio parameters to be used for 5G ProSe communication over PC5 as follows:

a) if the UE can determine itself located in a geographical area, and the UE is provisioned with radio parameters for the geographical area, the UE shall select the radio parameters associated with that geographical area; or

b) in all other cases, the UE shall not initiate 5G ProSe communication over PC5.

If the UE intends to use "non-operator managed" radio parameters as specified in clause 5.2.4, the UE shall initiate 5G ProSe communication over PC5 with the selected radio parameters.

If the UE intends to use "operator managed" radio parameters as specified in clause 5.2.4, before initiating 5G ProSe communication over PC5, the UE shall check with lower layers whether the selected radio parameters can be used in the current location without causing interference to other cells as specified in 3GPP TS 38.331 [13], and:

a) if the lower layers indicate that the usage would not cause any interference, the UE shall initiate 5G ProSe communication over PC5; or

NOTE: If the lower layers find that there exists a cell operating the provisioned radio resources (i.e., carrier frequency), and the cell belongs to the registered PLMN or a PLMN equivalent to the registered PLMN, and the UE is authorized for 5G ProSe communication over PC5 in this PLMN, the UE can use the radio parameters indicated by the cell as specified in 3GPP TS 38.331 [13].

b) else if the lower layers report that one or more PLMNs operate in the provisioned radio resources (i.e. carrier frequency) then:

1) if the following conditions are met:

i) none of the PLMNs reported by the lower layers is the registered PLMN or equivalent to the registered PLMN;

ii) at least one of the PLMNs reported by the lower layers is in the list of authorized PLMNs for 5G ProSe communication over PC5 and provides radio resources for 5G ProSe communication over PC5 as specified in 3GPP TS 38.331 [13]; and

iii) the UE does not have an emergency PDU session;

then the UE shall:

i) if in 5GMM-IDLE mode, perform PLMN selection triggered by 5G ProSe communication over PC5 as specified in 3GPP TS 23.122 [14]; or

ii) else if in 5GMM-CONNECTED mode, either:

A) perform a Deregistration procedure as specified in 3GPP TS 24.501 [11] and then perform PLMN selection triggered by 5G ProSe communication over PC5 as specified in 3GPP TS 23.122 [14]; or

B) not initiate 5G ProSe communication over PC5.

Whether the UE performs i) or ii) above is left up to UE implementation; or

2) else the UE shall not initiate 5G ProSe communication over PC5.

If the registration to the selected PLMN is successful, the UE shall proceed with the procedure to initiate 5G ProSe communication over PC5 as specified in clause 7.3.2.1.

If the UE is performing 5G ProSe communication over PC5 using radio parameters associated with a geographical area and moves out of that geographical area, the UE shall stop performing 5G ProSe communication over PC5 and then:

a) if the UE is not served by NG-RAN for 5G ProSe communication over PC5 or the UE intends to use radio resources for 5G ProSe communication over PC5 other than those operated by the serving cell, the UE shall select appropriate radio parameters for the new geographical area as specified above; or

b) if the UE is served by NG-RAN for 5G ProSe communication over PC5 and intends to use radio resources for 5G ProSe communication over PC5 operated by the serving cell, the UE shall proceed with the procedure to initiate 5G ProSe communication over PC5 when served by NG-RAN for 5G ProSe communication over PC5.

#### 7.3.2.4 Privacy of 5G ProSe transmission over PC5

Upon initiating transmission of 5G ProSe communication over PC5, if:

a) the ProSe Application identifier of a ProSe Application requesting transmission of 5G ProSe communication over PC5 is in the list of of ProSe Applications which require privacy for 5G ProSe communication over PC5 as specified in clause 5.2.4; and

b) the UE is located in a geographical area in which this ProSe Application requires privacy for 5G ProSe communication over PC5 as specified in clause 5.2.4, or the UE is not provisioned any geographical areas in which this ProSe Applications requires privacy for 5G ProSe communication over PC5,

then the UE shall proceed as follows:

a) if timer T5100 is not running, start timer T5aaa and set its timer value as the privacy timer value as specified in clause 5.2.4;

b) upon:

1) getting an indication from upper layers that the application layer identifier has been changed; or

2) timer T5100 expiry,

then:

1) change the value of the Source Layer-2 ID self-assigned by the UE for the 5G ProSe communication over PC5;

2) if the data unit(s) contains IP data, change the value of the source IP address self-assigned by the UE for 5G ProSe communication over PC5;

3) provide an indication to upper layers that the Source Layer-2 ID, or the source IP address, or both the Source Layer-2 ID and the source IP address are changed;

4) pass the changed Source Layer-2 ID and Destination Layer-2 ID, along with the corresponding PQFI down to the lower layer;

5) restart timer T5100; and

6) upon stopping transmission of the 5G ProSe communication over PC5, stop timer T5100.

### 7.3.3 Reception of broadcast mode 5G ProSe communication over PC5

The UE may be configured by upper layers with one or more Destination Layer-2 ID(s) for reception of data unit(s) over PC5. For each received protocol data unit over PC5, the receiving UE shall check if the Destination Layer-2 ID of the received protocol data unit matches one of the configured Destination Layer-2 IDs. If yes, the UE shall then check whether the protocol data unit type as defined 3GPP TS 38.323 [16] provided by the lower layers for the received packet is set to IP packet or non-IP packet, and pass the protocol data unit to the corresponding upper layer entity.

# 8 5G ProSe UE-to-network relay

## 8.1 Overview

## 8.2 Procedures

### 8.2.1 UE-to-Network relay discovery over PC5 interface

#### 8.2.1.1 General

This clause describes the procedures for both Layer-3 and Layer-2 UE-to-Network relay discovery for public safety use and commercial services at a ProSe-enabled UE over the PC5 interface. The purpose of the UE-to-Network relay discovery procedure over PC5 interface is to enable a ProSe-enabled UE to detect and identify another ProSe-enabled UE over PC5 interface for UE-to-Network relaly communication between a UE and 5GC.

To perform UE-to-Network relay discovery over PC5 interface, the UE is configured with the related information as described in clause 5.2.5. The following models for UE-to-Network relay discovery procedure over PC5 interface as specified in 3GPP TS 23.304 [2] are supported:

a) Model A uses a single discovery protocol message (Announcement); and

b) Model B uses two discovery protocol messages (Solicitation and Response).

The following procedures are defined for UE-to-Network relay discovery procedure over PC5 interface:

a) UE-to-Network relay discovery over PC5 interface with Model A:

1) Announcing UE procedure for UE-to-Network relay discovery initiation;

2) Announcing UE procedure for UE-to-Network relay discovery completion;

3) Monitoring UE procedure for UE-to-Network relay discovery initiation; and

4) Monitoring UE procedure for UE-to-Network relay discovery completion; and

b) UE-to-Network relay discovery over PC5 interface with Model B:

1) Discoverer UE procedure for UE-to-Network relay discovery initiation;

2) Discoverer UE procedure for UE-to-Network relay discovery completion;

3) Discoveree UE procedure for UE-to-Network relay discovery initiation; and

4) Discoveree UE procedure for UE-to-Network relay discovery completion.

#### 8.2.1.2 UE-to-Network relay discovery over PC5 interface with Model A

In this procedure, the UE-to-Network relay acts as an "announcing UE" and the Remote UE acts as a "monitoring UE".

##### 8.2.1.2.1 Announcing UE relay discovery for UE-to-Network relay discovery

###### 8.2.1.2.1.1 General

The purpose of the announcing UE procedure for UE-to-Network relay discovery is:

a) to enable a ProSe-enabled UE to announce availability of a connectivity service provided by a UE-to-network relay of the ProSe-enabled UE to other ProSe-enabled UEs, upon a request from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to enable a ProSe-enabled UE to measure the PROSE PC5 DISCOVERY message signal strength between the ProSe-enabled UE and the ProSe UE-to-network relay UE(s) for relay selection/reselection.

###### 8.2.1.2.1.2 Announcing UE procedure for UE-to-Network relay discovery initiation

The UE is authorised to perform the announcing UE procedure for UE-to-Network relay discovery if:

a) the UE is authorised to act as a UE-to-network relay in the PLMN indicated by the serving cell as specified in clause 5.2.5, and

1) the UE is served by NG-RAN and the UE is authorised to perform ProSe direct discovery in the PLMN as specified in clause 5; or

2) the UE is authorised to perform ProSe direct discovery when not served by NG-RAN as specified in clause 5 and intends to use the provisioned radio resources for UE-to-network relay discovery;

b) the UE is configured with the Relay Service Code parameter identifying the connectivity service to be announced and with the User Info ID for the UE-to-network relay discovery parameter, as specified in clause 5.2.5; and

c) for Layer 3 ProSe UE-to-network relay UE, the UE is configured with PDU Session parameters which is used for relayed traffic for the associated Relay Service Code, as specified in clause 5.2.5.

otherwise the UE is not authorised to perform the announcing UE procedure for UE-to-network relay discovery.

Figure 8.2.1.2.1.2.1 illustrates the interaction of the UEs in the announcing UE procedure for UE-to-network relay discovery.



Figure 8.2.1.2.1.2.1: Announcing UE procedure for UE-to-Network relay discovery

When the UE is triggered by an upper layer application to announce availability of a connectivity service provided by a UE-to-network relay, if the UE is authorised to perform the announcing UE procedure for UE-to-network relay discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages for relay discovery as specified in 3GPP TS 38.331 [13], shall perform a service request procedure or mobility registration procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time as specified in clause 11.2.x.y;

c) shall generate a PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement according to clause 10.2.1. In the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement, the UE:

1) shall set the ProSe Relay UE ID to a ProSe Relay UE ID used for ProSe direct communication for the connectivity service to be announced;

2) shall set the Announcer Info parameter to the User Info ID for the UE-to-network relay discovery parameter, configured in clause 5.2.5;

3) shall set the Relay Service Code parameter to the Relay Service Code parameter identifying the connectivity service to be announced, configured in clause 5.2.5;

4) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter; and

5) shall set the Resource Status Indicator bit of the Status Indicator parameter to indicate whether or not the UE has resources available to provide a connectivity service for additional ProSe-enabled UEs;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.xxx [yyy]; and

e) shall pass the resulting PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement to the lower layers for transmission over the PC5 interface with the Source Layer-2 ID and Destination Layer-2 ID.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message along with the same Source Layer-2 ID and Destination Layer-2 ID to the lower layers for transmission until the UE is triggered by an upper layer application to stop announcing availability of a connectivity service provided by a UE-to-network relay, or until the UE stops being authorised to perform the announcing UE procedure for UE-to-network relay discovery. How this is achieved is left up to UE implementation.

Editor’s note: Details of ProSe Relay UE ID and security aspects of a PROSE PC5 DISCOVERY message for UE-to-Network relay discovery announcement are FFS and will be determinated by cooperation with SA WG2 and SA WG3.

###### 8.2.1.2.1.3 Announcing UE procedure for UE-to-Network relay discovery completion

When the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or when the announcing UE stops being authorised to perform the announcing UE procedure for UE-to-Network relay discovery, the UE shall instruct the lower layers to stop announcing.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

##### 8.2.1.2.2 Monitoring UE relay discovery for UE-to-Network relay discovery

###### 8.2.1.2.2.1 General

The purpose of the monitoring UE procedure for UE-to-network relay discovery is:

a) to enable a ProSe-enabled UE to become aware of proximity of a connectivity service provided by a UE-to-network relay, upon a request from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to enable a ProSe-enabled UE to perform measurements of signal strength of PROSE PC5 DISCOVERY messages from ProSe UE-to-network relay UE(s) for relay selection/reselection.

###### 8.2.1.2.2.2 Monitoring UE procedure for UE-to-Network relay discovery initiation

The UE is authorised to perform the monitoring UE procedure for UE-to-Network relay discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform ProSe direct discovery monitoring in at least one PLMN; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11] ; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

ii) authorised to perform ProSe direct discoveryusing monitoring when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN; and

b) the UE is configured with the Relay Service Code parameter identifying the connectivity service to be monitored and with the IP version(s) to be used for the traffic of the connectivity service to be monitored, as specified in clause 5.2.5;

otherwise, the UE is not authorised to perform the monitoring UE procedure for UE-to-Network relay discovery.

Figure 8.2.1.2.2.2.1 illustrates the interaction of the UEs in the monitoring UE procedure for UE-to-Network relay discovery.



Figure 8.2.1.2.2.2.1: Monitoring UE procedure for UE-to-Network relay discovery

When the UE is triggered by an upper layer application to monitor proximity of a connectivity service provided by a UE-to-network relay; or when the UE has established a direct link with a ProSe UE-to-network relay UE as specified in clause 7.2, and if the UE is authorised to perform the monitoring UE procedure for UE-to-network relay discovery, then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages with the configured Destination layer-2 ID.

Upon reception of a PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement according to clause 10.2.1, for the target Relay Service Code of the connectivity service which the UE is authorized to monitor, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.yyy [xxx]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.yyy [xxx]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement.

NOTE: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

Then if:

a) the Relay Service Code parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement is the same as the Relay Service Code parameter configured as specified in clause 5 for the connectivity service being monitored; and

b) the User Info ID of the UE-to-network relay is not configured as specified in clause 5 for the connectivity service being monitored, or the Announcer Info parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement is the same as the User Info ID of the UE-to-network relay configured as specified in clause 5.2.5 for the connectivity service being monitored,

then the UE shall consider that the connectivity service the UE seeks to monitor has been discovered. In addition, the UE can measure the signal strength of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement for relay selection or reselection.

Editor’s note: Details of security aspects for Monitoring UE procedure upon reception of a PROSE PC5 DISCOVERY message for UE-to-Network relay discovery announcement are FFS and will be determinated by cooperation with SA WG3.

###### 8.2.1.2.2.3 Monitoring UE procedure for UE-to-Network relay discovery completion

When the UE is triggered by an upper layer application to stop monitoring proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the monitoring UE procedure for UE-to-Network relay discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

##### 8.2.1.2.3 Announcing UE procedure for Relay Discovery Additional Information

###### 8.2.1.2.3.1 General

The purpose of the announcing UE procedure for Relay Discovery Additional Information is to announce to the remote UEs additional information about:

a) the NG-RAN Cell serving the ProSe UE-to-network relay,

as defined in 3GPP TS 23.304 [2].

###### 8.2.1.2.3.2 Announcing procedure for Relay Discovery Additional Information

The ProSe UE-to-network relay announces the Relay Discovery Additional Information:

a) if the remote UE requests the ProSe UE-to-network relay to announce the NG-RAN Cell Global ID (NCGI) of the cell serving the ProSe UE-to-network relay, and as a response the ProSe UE-to-network relay acknowledges with the PC5 Cell ID Announcement Response message, then the ProSe UE-to-network relay includes the NCGI of the serving cell in the PROSE PC5 DISCOVERY message for Relay Discovery Additional Information until the timer Tabcd expires (see the subclause XYZ).

Editor's note: The Cell ID Announcement procedure is FFS as it is waiting for stage-2 requirements.

NOTE 1: ProSe UE-to-network relay announces the Relay Discovery Additional Information only when it is in NG-RAN coverage.

Figure 8.2.1.2.3.2.1 illustrates the interaction of the ProSe UE-to-network relay and the remote UE in the announcing UE procedure for Relay Discovery Additional Information.



Figure 8.2.1.2.3.2.1: Announcing procedure for Relay Discovery Additional Information

The ProSe UE-to-network relay UE may start announcing Relay Discovery Additional Information if:

a) the ProSe UE-to-network relay UE is currently authorised to perform ProSe direct discovery Model A announcing in the serving PLMN if the UE is served by NG-RAN; and

1) NCGI announcement for the serving cell of the ProSe UE-to-network relay UE has been requested and responded to remote UEs, the timer Tabcd has not expired.

When the ProSe UE-to-network relay has some additional information to broadcast (i.e NCGI), then the ProSe UE-to-network relay:

a) shall request the parameters from the lower layers for ProSe direct discovery announcing (see 3GPP TS 38.331 [13]). If the ProSe UE-to-network relay in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], the ProSe UE-to-network relay shall perform a service request procedure or mobility registration procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time as specified in subclause XYZA;

c) shall generate PROSE PC5 DISCOVERY message(s) for Relay Discovery Additional Information according to clause 10.2.1. In the PROSE PC5 DISCOVERY message for Relay Discovery Additional Information, the ProSe UE-to-network relay shall:

1) include the Relay Service Code and the ProSe Relay UE ID used for ProSe direct communication which the remote UE used to request for the Relay Discovery Additional Information;

2) set the Announcer Info parameter to the User Info ID parameter, configured in clause 5.2.5;

3) set the Relay Discovery Additional Information contents by the additional information to broadcast; and

4) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.XXX [TBD]; and

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA WG3.

e) shall pass the resulting PROSE PC5 DISCOVERY message for Relay Discovery Additional Information to the lower layers for transmission over the PC5 interface.

The ProSe UE-to-network relay shall ensure that it keeps on passing the PROSE PC5 DISCOVERY messages to the lower layers for transmission until the corresponding timer (i.e. timer Tabcd when the additional information is NCGI) expires.

During the announcing operation, if one of the above conditions is no longer met, the ProSe UE-to-network relay may instruct the lower layers to stop announcing.

##### 8.2.1.2.4 Monitoring UE procedure for Relay Discovery Additional Information

###### 8.2.1.2.4.1 General

The purpose of the monitoring UE procedure for Relay Discovery Additional Information is to enable a remote UE to become aware of the NG-RAN Cell serving the ProSe UE-to-network relay as defined in 3GPP TS 23.304 [2].

###### 8.2.1.2.4.2 Monitoring procedure for Relay Discovery Additional Information

The remote UE monitors Relay Discovery Additional Information:

a) until the NCGI announcement request refresh timer Tzzzz expires if the remote UE has requested the ProSe UE-to-network relay to announce the NCGI of the cell serving the ProSe UE-to-network relay and received the PC5 Cell ID Announcement Response message from the ProSe UE-to-network relay.

Editor's note: The Cell ID Announcement procedure is FFS as it is waiting for stage-2 requirements.

The UE may instruct the lower layers to start monitoring if:

a) a request from upper layers to monitor for Relay Discovery Additional Information is still in place and either:

1) the UE is currently authorised to perform ProSe direct discovery Model A monitoring in at least one PLMN if the UE is served by NG-RAN;

2) the UE is currently authorised to perform ProSe direct discovery Model A monitoring if the UE is not served by NG-RAN; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 36.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed " as specified in 3GPP TS 24.501 [11]; and

ii) authorised to perform ProSe direct discovery Model A monitoring when the UE is not served by NG-RAN and configured with the radio parameters to be used for ProSe direct discovery when not served by NG-RAN.

If the UE is in 5GMM-CONNECTED mode, the monitoring UE shall also trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

During the monitoring operation, if one of the above conditions is no longer met, the UE may instruct the lower layers to stop monitoring. When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

Upon reception of a PROSE PC5 DISCOVERY message for Relay Discovery Additional Information according to clause 10.2.1, for the target Relay Service Code to be monitored, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.XXX [TBD]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality protected portion, as described in 3GPP TS 33.XXX [TBD]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for Relay Discovery Additional Information.

NOTE: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA WG3.

Then, if:

a) the Relay Service Code parameter of the PROSE PC5 DISCOVERY message for Relay Discovery Additional Information is the same as the Relay Service Code parameter configured as specified in clause Y for the connectivity service being monitored; and

b) the ProSe Relay UE ID parameter of the PROSE PC5 DISCOVERY message for Relay Discovery Additional Information is the same as the ProSe Relay UE ID parameter identifying the relay the remote UE intends to communicate with,

then the UE shall consider that the Relay Discovery Additional Information it intends to monitor has been discovered. In addition, the UE can measure the signal strength of the PROSE PC5 DISCOVERY message for Relay Discovery Additional Information for relay selection or reselection.

#### 8.2.1.3 UE-to-Network relay discovery over PC5 interface with Model B

##### 8.2.1.3.1 Discoverer UE procedure for UE-to-Network Relay discovery

###### 8.2.1.3.1.1 General

The purpose of the discoverer UE procedure for UE-to-Network Relay discovery is:

a) to enable a ProSe-enabled UE to solicit proximity of a connectivity service provided by a UE-to-Network Relay, upon a request from upper layers; or

b) to enable a ProSe-enabled UE to measure the PROSE PC5 DISCOVERY message signal strength between the ProSe-enabled UE and the ProSe UE-to-Network Relay UE(s) for relay selection/reselection.

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

###### 8.2.1.3.1.2 Discoverer UE procedure for UE-to-Network Relay discovery initiation

The UE is authorised to perform the discoverer UE procedure for UE-to-Network Relay discovery if:

a) one of the following is true:

1) the UE is not served by NG-RAN, is authorised to act as a remote UE towards a UE-to-Network Relay, and is configured with the radio parameters to be used for ProSe UE-to-Network Relay discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, is authorised to act as a remote UE towards a UE-to-Network Relay; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; and

ii) authorised to act as a Remote UE towards a UE-to-Network Relay when the UE is not served by NG-RAN, and configured with the radio parameters to be used for ProSe UE-to-Network Relay discovery use when not served by NG-RAN; and

b) the UE is configured with the Relay Service Code parameter identifying the connectivity service to be solicited and with the User Info ID for the UE-to-Network Relay discovery parameter, as specified in clause 5.2.5,

otherwise the UE is not authorised to perform the Discoverer UE procedure for UE-to-Network Relay discovery.

Figure 8.2.1.3.1.2.1 illustrates the interaction of the UEs in the Discoverer UE procedure for UE-to-Network Relay discovery.



Figure 8.2.1.3.1.2.1: Discoverer UE procedure for UE-to-Network Relay discovery

For PROSE PC5 DISCOVERY message signal strength measurement, the UE manages a periodic measurement timer T5091, which is used to trigger the periodic PROSE PC5 DISCOVERY message signal strength measurement between the UE and the ProSe UE-to-Network Relay UE with which the UE has a link established. It is started whenever the UE has established a direct link with a ProSe UE-to-Network Relay UE and restarted whenever the UE receives the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response from the ProSe UE-to-Network Relay UE with which the UE has a link established.

When the UE is triggered by an upper layer application to solicit proximity of a connectivity service provided by a UE-to-Network Relay, or when the periodic measurement timer T5091 expires, and if the UE is authorised to perform the discoverer UE procedure for UE-to-Network Relay discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages for relay discovery as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation. In the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation, the UE:

1) shall set the Discoverer Info parameter to the User Info ID for the UE-to-Network Relay discovery parameter, configured in clause 5.2.5;

2) shall set the Relay Service Code parameter to the Relay Service Code parameter identifying the connectivity service to be solicited, configured in clause 5.2.5;

3) optionally, set the ProSe Relay UE ID to the ProSe Relay UE ID used for ProSe direct communication for the connectivity service;

Editor's Note: It is FFS whether the use of Relay UE ID should be made in line with V2X design approach (i.e. using source and destination layer-2 IDs) and will be determinated by SA2.

4) if the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation is used to trigger the signal strength measurement for the PROSE PC5 DISCOVERY message from a specific ProSe UE-to-Network Relay UE with which the UE has a link established, shall set the ProSe Relay UE ID parameter to the ProSe Relay UE ID of that ProSe UE-to-Network Relay UE; and

5) shall set the UTC-based counter LSB parameter to include the four least significant bits of the UTC-based counter;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.xxx [rxxx]; and

Editor’s note: Details of security related content in d) are FFS and will be determinated by SA3.

e) shall pass the resulting PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation along with the Source Layer-2 ID and Destination Layer-2 ID to the lower layers for transmission over the PC5 interface.

If the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation is used to solicit proximity of a connectivity service provided by a UE-to-Network Relay, the UE shall ensure that it keeps on passing the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation for transmission until the UE is triggered by an upper layer application to stop soliciting proximity of a connectivity service provided by a UE-to-Network Relay, or until the UE stops being authorised to perform the discoverer UE procedure for UE-to-Network Relay discovery. How this is achieved is left up to UE implementation.

If the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation is used to trigger the PROSE PC5 DISCOVERY message signal strength measurement between the UE and the ProSe UE-to-Network Relay UE with which the UE has a link established, the UE shall start the retransmission timer T5090. If retransmission timer T5090 expires, the UE shall retransmit the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation and restart timer T5090. If no response is received from the ProSe UE-to-Network Relay UE with which the UE has a link established after reaching the maximum number of allowed retransmissions, the UE shall trigger relay reselection procedure.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

Upon reception of a PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response, for the target Relay Service Code of the connectivity service which the UE is authorized to discover, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.xxx [rxxx]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.xxx [rxxx]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response.

Editor’s note: Details of Discoverer UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery response are FFS and will be determinated by cooperation with SA WG3.

Then if:

a) the Relay Service Code parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response is the same as the Relay Service Code parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation; and

b) the User Info ID of the UE-to-Network Relay is not configured as specified in clause 5.2.5 for the connectivity service being solicited, or the Discoverer Info parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response is the same as the User Info ID of the UE-to-Network Relay configured as specified in clause 5.2.5 for the connectivity service being solicited,

then the UE shall consider that the connectivity service the UE seeks to discover has been discovered. In addition, the UE can measure the signal strength of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response for relay selection or reselection. If the UE has received the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response from the ProSe UE-to-Network Relay UE with which the UE has a link established, the UE shall stop the retransmission timer T5090, and start the periodic measurement timer T5091.

###### 8.2.1.3.1.3 Discoverer UE procedure for UE-to-Network Relay discovery completion

When the UE is triggered by an upper layer application to stop soliciting for proximity of a connectivity service provided by a UE-to-Network Relay, or when the UE stops being authorised to perform the Discoverer UE procedure for UE-to-Network Relay discovery, the UE shall instruct the lower layers to stop the discoverer operation.

When the UE stops discoverer operation, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

##### 8.2.1.3.2 Discoveree UE procedure for UE-to-Network Relay discovery

###### 8.2.1.3.2.1 General

The purpose of the discoveree UE procedure for UE-to-Network Relay discovery is to enable a ProSe-enabled UE with a UE-to-Network Relay to respond to solicitation from other ProSe-enabled UEs on proximity of a connectivity service provided by the UE-to-Network Relay, upon a request from upper layers.

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

###### 8.2.1.3.2.2 Discoveree UE procedure for UE-to-Network Relay discovery initiation

The UE is authorised to perform the discoveree UE procedure for UE-to-Network Relay discovery if:

a) the UE is authorised to act as a UE-to-Network Relay in the PLMN indicated by the serving cell, and

1)- the UE is served by NG-RAN; or

2)- the UE is not served by NG-RAN, and intends to use the provisioned radio resources for UE-to-Network Relay discovery; and

b) the UE is configured with the Relay Service Code parameter identifying the connectivity service to be responded to and with the User Info ID for the UE-to-Network Relay discovery parameter, as specified in clause 5.2.5;

otherwise the UE is not authorised to perform the discoveree UE procedure for UE-to-Network Relay discovery.

Figure 8.2.1.3.2.2.1 illustrates the interaction of the UEs in the discoveree UE procedure for UE-to-Network Relay discovery.



**Figure 8.2.1.3.2.2.1: Discoveree UE procedure for UE-to-Network Relay discovery**

When the UE is triggered by an upper layer application to start responding to solicitation on proximity of a connectivity service provided by the UE-to-Network Relay, and if the UE is authorised to perform the discoveree UE procedure for UE-to-Network Relay discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages.

Upon reception of a PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation, for the Relay Service Code of the connectivity service which the UE is authorized to respond, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.xxx [rxxx]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.xxx [rxxx]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation.

Editor’s note: Details of Discoverer UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery response are FFS and will be determinated by cooperation with SA WG3.

Then, if:

a) the Relay Service Code parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation is the same as the Relay Service Code parameter configured as specified in clause 5.2.5 for the connectivity service; and

b) one of the following is true:

1) the ProSe Relay UE ID parameter is not included; or

2) the included ProSe Relay UE ID parameter is the same as the ProSe Relay UE ID associated with the Relay Service Code parameter configured as specified in clause 5.2.5,

then the UE:

a) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

b) shall generate a PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response. In the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response, the UE:

1) shall set the ProSe Relay UE ID to a ProSe Relay UE ID used for ProSe direct communication for the connectivity service;

Editor's Note: It is FFS whether the use of Relay UE ID should be made in line with V2X design approach (i.e. using source and destination layer-2 IDs) and will be determinated by SA2.

2) shall set the Discoveree Info parameter to the User Info ID for the UE-to-Network Relay discovery parameter, configured in clause 5.2.5;

Editor's note: Whether User Info ID (i.e. Announcer Info, Discoverer Info, Discoveree Info) can be used for both public safety and commercial purpose is FFS and will be determinated by SA2.

3) shall set the Relay Service Code parameter to the Relay Service Code parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation;

4) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter; and

5) optionally, set Relay TAI bit of Tracking Area Identity of the serving cell to indicate the Tracking Area Identity corresponding to the serving cell of the Layer-3 UE-to-Network Relay for discoveree UEs supporting N3IWF discovery procedure;

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g. integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.xxx [rxxx]; and

Editor’s note: Details of security related content in c) are FFS and will be determinated by SA3.

d) shall pass the resulting PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response along with the Source Layer-2 ID and Destination Layer-2 ID, and with an indication that the message is for relay discovery to the lower layers for transmission over the PC5 interface.

###### 8.2.1.3.2.3 Discoveree UE procedure for UE-to-Network Relay discovery completion

When the UE is triggered by an upper layer application to stop responding to solicitation on proximity of a connectivity service provided by a UE-to-Network Relay, or when the UE stops being authorised to perform the discoveree UE procedure for UE-to-Network Relay discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

### 8.2.2 UE-to-network relay selection procedure

#### 8.2.2.1 General

The purpose of the UE-to-network relay selection procedure is to enable a remote UE to select a suitable ProSe UE-to-network relay UE to obtain a connectivity service to 5GC.

#### 8.2.2.2 UE-to-network relay selection procedure initiation

The remote UE shall trigger the UE-to-network relay selection procedure if the following conditions are met:

a) the UE is authorised to act as a remote UE towards a ProSe UE-to-network relay UE as specified in clause 5.2.5;

b) the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling ProSe layer criteria with the monitoring procedure for UE-to-network relay discovery as specified in clause 8.2.1.2.2 or the discoverer procedure for UE-to-network relay discovery as specified in clause 8.2.1.3.1; and

c) the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling lower layers criteria as specified in 3GPP TS 38.331 [13].

#### 8.2.2.3 UE-to-network relay selection procedure completion

If there exists only one ProSe UE-to-network relay candidate satisfying the conditions in clause 8.2.2.2, then that ProSe UE-to-network relay UE is selected. If there exist more than one ProSe UE-to-network relay candidate satisfying the conditions in clause 8.2.2.2, any relay candidates not satisfying the non-radio related ProSe layer criteria shall be discarded, and out of the remaining relay candidates, the relay candidate with the highest ranking of the lower layer criteria shall be selected. The UE may take the value of the Resource Status Indicator bit of the Status Indicator parameter of the PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Announcement or PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Response into account when deciding which ProSe UE-to-network relay to select. It is up to the UE implementation whether the ProSe layer or the lower layers takes the final selection on which ProSe UE-to-network relay UE to select.

### 8.2.3 UE-to-network relay reselection procedure

#### 8.2.3.1 General

The purpose of the UE-to-network relay reselection procedure is to enable a remote UE to reselect a ProSe UE-to-network relay UE to obtain a connectivity service to 5GC when the serving ProSe UE-to-network relay UE is no longer suitable.

#### 8.2.3.2 UE-to-network relay reselection procedure initiation

The remote UE shall trigger the UE-to-network relay reselection procedure if one of the following conditions is met:

a) the UE has received a lower layers indication that the serving ProSe UE-to-network relay UE no longer fulfills the lower layers criteria as specified in 3GPP TS 38.331 [13];

b) the parameters related to ProSe UE-to-network relay in the ProSe direct discovery service authorisation (e.g., Relay Service Code, User Info ID, etc.) have been updated and the serving ProSe UE-to-network relay UE no longer fulfills the conditions specified in clause 8.2.1.2.2;

c) the UE has received a PROSE DIRECT LINK ESTABLISHMENT REJECT message from the ProSe UE-to-network relay UE with the cause value "direct communication to the target UE not allowed";

d) the UE has received a PROSE DIRECT LINK RELEASE REQUEST message from the ProSe UE-to-network relay UE with the cause value "direct communication to the target UE not allowed";

e) the UE has received a PROSE DIRECT LINK RELEASE REQUEST message from the ProSe UE-to-network relay UE with the cause value "direct connection is not available anymore";

f) the UE has not received any response from the ProSe UE-to-network relay UE after M consecutive retransmissions of PROSE DIRECT LINK ESTABLISHMENT REQUEST or PROSE DIRECT LINK KEEPALIVE REQUEST messages; or

g) the UE has not received any response from the ProSe UE-to-network relay UE after M consecutive retransmissions of PROSE PC5 DISCOVERY message for UE-to-Network Relay Discovery Solicitation used to trigger the PROSE PC5 DISCOVERY message signal strength measurement between the UE and the ProSe UE-to-network relay UE with which the UE has a link established.

NOTE: The value of M is implementation specific and is less than or equal to the maximum number of retransmissions allowed for PC5 Signalling protocol.

In cases c) and d), the remote UE shall exclude the ProSe UE-to-network relay UE which sent the message specified in cases c) or d) from the UE-to-network relay reselection process described below.

To conduct UE-to-network relay reselection process, the UE shall first initiate one of the following procedures or both depending on UE's service authorisation for ProSe direct discovery:

a) monitoring procedure for UE-to-network relay discovery as specified in clause 8.2.1.2.2; or

b) discoverer procedure for UE-to-network relay discovery as specified in clause 8.2.1.3.1.

After the execution of the above discovery procedure(s), the remote UE performs the UE-to-network relay selection procedure as specified in clause 8.2.2.

# 9 Handling of unknown, unforeseen, and erroneous protocol data

## 9.1 General

The procedures specified in the present document apply to those PC3a or PC5 messages which pass the checks described in this clause.

This clause also specifies procedures for the handling of unknown, unforeseen, and erroneous protocol data by the receiving entity. These procedures are called "error handling procedures", but in addition to providing recovery mechanisms for error situations they define a compatibility mechanism for future extensions of the protocols.

Detailed error handling procedures in the network are implementation dependent and may vary from PLMN to PLMN. However, when extensions of this protocol are developed, networks will be assumed to have the error handling that is indicated in this clause as mandatory ("shall") and that is indicated as strongly recommended ("should").

Also, the error handling of the network is only considered as mandatory or strongly recommended when certain thresholds for errors are not reached during a dedicated connection.

## 9.2 Handling of unknown, unforeseen, and erroneous protocol data in messages sent over the PC3a interface

### 9.2.1 Unforeseen message type

If the UE receives a PC3a message with a message type corresponding to a ProSe discovery mechanism that the UE is not authorised to use by the network, the UE shall discard the message.

If the DDNMF receives a PC3a message whose message type indicates that this is a ProSe discovery mechanism the sending UE is not authorised to support, the DDNMF shall discard the message.

## 9.3 Handling of unknown, unforeseen, and erroneous protocol data in messages sent over the PC5 interface

### 9.3.1 Message too short or too long

#### 9.3.1.1 Message too short

When a message is received that is too short to contain a complete message type information element, that message shall be ignored, cf. 3GPP TS 24.007 [20].

#### 9.3.1.2 Message too long

The maximum size of a PC5 signalling message is 65535 octets.

### 9.3.2 Unknown or unforeseen message type

If the UE receives a PC5 signalling message with message type not defined for the PC5 signalling protocol or not implemented by the receiver, it shall ignore the PC5 signalling message.

NOTE: A message type not defined for the PC5 signalling protocol in the given direction is regarded by the receiver as a message type not defined for the PC5 signalling protocol, see 3GPP TS 24.007 [20].

If the UE receives a message not compatible with the PC5 signalling protocol state, the UE shall ignore the PC5 signalling message.

### 9.3.3 Non-semantical mandatory information element errors

When on receipt of a message,

a) an "imperative message part" error; or

b) a "missing mandatory IE" error

is diagnosed or when a message containing:

a) a syntactically incorrect mandatory IE;

b) an IE unknown in the message, but encoded as "comprehension required" (see 3GPP TS 24.007 [20]); or

c) an out of sequence IE encoded as "comprehension required" (see 3GPP TS 24.007 [20]) is received,

the UE shall ignore the PC5 signalling message.

### 9.3.4 Unknown and unforeseen IEs in the non-imperative message part

#### 9.3.4.1 IEIs unknown in the message

The UE shall ignore all IEs unknown in a message which are not encoded as "comprehension required" (see 3GPP TS 24.007 [20]).

#### 9.3.4.2 Out of sequence IEs

The UE shall ignore all out of sequence IEs in a message which are not encoded as "comprehension required" (see 3GPP TS 24.007 [20]).

#### 9.3.4.3 Repeated IEs

If an information element with format T, TV, TLV, or TLV-E is repeated in a message in which repetition of the information element is not specified in clause 11.3, the UE shall handle only the contents of the information element appearing first and shall ignore all subsequent repetitions of the information element. When repetition of information elements is specified, the UE shall handle only the contents of specified repeated information elements. If the limit on repetition of information elements is exceeded, the UE shall handle the contents of information elements appearing first up to the limit of repetitions and shall ignore all subsequent repetitions of the information element.

### 9.3.5 Non-imperative message part errors

#### 9.3.5.1 General

This category includes:

a) syntactically incorrect optional IEs; and

b) conditional IE errors.

#### 9.3.5.2 Syntactically incorrect optional IEs

The UE shall treat all optional IEs that are syntactically incorrect in a message as not present in the message.

#### 9.3.5.3 Conditional IE errors

When upon receipt of a PC5 signalling message the UE diagnoses a "missing conditional IE" error or an "unexpected conditional IE" error, or when it receives a PC5 signalling message containing at least one syntactically incorrect conditional IE, the UE shall ignore the message.

### 9.3.6 Messages with semantically incorrect contents

When a message with semantically incorrect contents is received, the UE shall perform the foreseen reactions of the procedural part of clause 7.2. If, however no such reactions are specified, the UE shall ignore the message.

# 10 Message functional definitions and contents

## 10.1 Overview

This clause contains the definition and contents of the messages used in the procedures described in the present document.

## 10.2 5G ProSe direct discovery messages

### 10.2.1 Message definition

This message is sent by the UE over the PC5 interface for open ProSe direct discovery and restricted ProSe direct discovery. See table 10.2.1.1, table 10.2.1.2, table 10.2.1.3, table 10.2.1.4 and table 10.2.1.5.

Editor's note: The IEs related to security are FFS and depend on SA3 requirements.

Editor's note: The condition of the optional IEs is FFS.

Table 10.2.1.1: PROSE PC5 DISCOVERY message content for open ProSe direct discovery announcement

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | Message Type (NOTE) | Message Type  11.2.1 | M | V | 1 |
|  | ProSe Application Code | ProSe Application Code  11.2.2 | M | V | 23 |
|  | MIC | MIC  11.2.4 | M | V | 4 |
|  | UTC-based Counter LSB | Binary  11.2.5 | M | V | 1 |
| xx | ProSe Application ID | ProSe Application ID  11.2.x | O | TLV | x |
| xx | User Info ID | User Info ID  11.2.7 | O | TV | 7 |
| xx | Metadata | Metadata  11.2.x | O | TLV | x |
| NOTE: The Discovery Type is set to "Open discovery" and the Content Type is set to "Announcement". | | | | | |

Table 10.2.1.2: PROSE PC5 DISCOVERY message content for restricted ProSe direct discovery announcement

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | Message Type (NOTE) | Message Type  11.2.1 | M | V | 1 |
|  | ProSe Restricted Code | ProSe Restricted Code  11.2.3 | M | V | 23 |
|  | MIC | MIC  11.2.4 | M | V | 4 |
|  | UTC-based Counter LSB | Binary  11.2.5 | M | V | 1 |
| xx | ProSe Application ID | ProSe Application ID  11.2.x | O | TLV | x |
| xx | User Info ID | User Info ID  11.2.7 | O | TV | 7 |
| xx | Metadata | Metadata  11.2.x | O | TLV | x |
| NOTE: The Discovery Type is set to "Restricted discovery" and the Content Type is set to "Announcement". | | | | | |

Table 10.2.1.3: PROSE PC5 DISCOVERY message content for restricted ProSe direct discovery solicitation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | Message Type (NOTE) | Message Type  11.2.1 | M | V | 1 |
|  | ProSe Query Code | ProSe Restricted Code  11.2.3 | M | V | 23 |
|  | MIC | MIC  11.2.4 | M | V | 4 |
|  | UTC-based Counter LSB | Binary  11.2.5 | M | V | 1 |
| xx | ProSe Application ID | ProSe Application ID  11.2.x | O | TLV | x |
| xx | User Info ID | User Info ID  11.2.7 | O | TV | 7 |
| xx | Metadata | Metadata  11.2.x | O | TLV | x |
| NOTE: The Discovery Type is set to "Restricted discovery" and the Content Type is set to "Solicitation". | | | | | |

Table 10.2.1.4: PROSE PC5 DISCOVERY message content for restricted ProSe direct discovery response

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | Message Type (NOTE) | Message Type  11.2.1 | M | V | 1 |
|  | ProSe Response Code | ProSe Restricted Code  11.2.3 | M | V | 23 |
|  | MIC | MIC  11.2.4 | M | V | 4 |
|  | UTC-based Counter LSB | Binary  11.2.5 | M | V | 1 |
| xx | ProSe Application ID | ProSe Application ID  11.2.x | O | TLV | x |
| xx | User Info ID | User Info ID  11.2.7 | O | TV | 7 |
| xx | Metadata | Metadata  11.2.x | O | TLV | x |
| NOTE: The Discovery Type is set to "Restricted discovery" and the Content Type is set to "response". | | | | | |

Table 10.2.1.5: PROSE PC5 DISCOVERY message for Group Member Discovery Announcement

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | Message Type (NOTE) | Message Type  11.2.1 | M | V | 1 |
|  | Discovery Group ID | Discovery Group ID  11.2.3 | M | V | 3 |
|  | Announcer Info | User Info ID  11.2.7 | M | V | 6 |
|  | MIC | MIC  11.2.4 | M | V | 4 |
|  | UTC-based Counter LSB | Binary  11.2.5 | M | V | 1 |
| NOTE: The Discovery Type is set to "Restricted discovery", the Content Type is set to "Group member discovery announcement/group member discovery response" and the Discovery Model is set to "Model A". | | | | | |

Table 10.2.1.6: PROSE PC5 DISCOVERY message for Group Member Discovery Solicitation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | Message Type (NOTE 1) | Message Type  11.2.1 | M | V | 1 |
|  | Discovery Group ID | Discovery Group ID  11.2.6 | M | V | 3 |
|  | Discoverer Info | User Info ID  11.2.7 | M | V | 6 |
|  | GMDS Composition | GMDS Composition  11.2.8 | M | V | 1 |
|  | Target User Info | Target User Info  11.2.9 | C  (NOTE 2) | V | 6 |
|  | Target Group Info | Target Group Info  11.2.10 | C  (NOTE 2) | V | 3 |
|  | MIC | MIC  11.2.4 | M | V | 4 |
|  | UTC-based Counter LSB | Binary  11.2.5 | M | V | 1 |
| NOTE 1: The Discovery Type is set to "Restricted discovery", the Content Type is set to "Group member discovery solicitation" and the Discovery Model is set to "Model B".  NOTE 2: Presence of the Target User Info and of Target Group Info is indicated by the GMDS Composition. | | | | | |

Table 10.2.1.7: PROSE PC5 DISCOVERY message for Group Member Discovery Response

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | Message Type (NOTE) | Message Type  11.2.1 | M | V | 1 |
|  | Discovery Group ID | Discovery Group ID  11.2.3 | M | V | 3 |
|  | Discoveree Info | User Info ID  11.2.7 | M | V | 6 |
|  | MIC | MIC  11.2.4 | M | V | 4 |
|  | UTC-based Counter LSB | Binary  11.2.5 | M | V | 1 |
| NOTE: The Discovery Type is set to "Restricted discovery", the Content Type is set to "Group member discovery announcement/group member discovery response" and the Discovery Model is set to "Model B". | | | | | |

## 10.3 PC5 signalling messages

### 10.3.1 ProSe direct link establishment request

#### 10.3.1.1 Message definition

This message is sent by a UE to another peer UE to establish a direct link. See table 10.3.1.1.1.

Message type: PROSE DIRECT LINK ESTABLISHMENT REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.1.1.1: PROSE DIRECT LINK ESTABLISHMENT REQUEST message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | PROSE DIRECT LINK ESTABLISHMENT REQUEST message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | ProSe application identifiers | ProSe application identifier  11.3.3 | M | LV | 5-253 |
|  | Source user info | Application layer ID  11.3.4 | M | LV | 3-253 |
|  | UE security capabilities | UE security capabilities  11.3.14 | M | LV | 3-9 |
|  | UE PC5 unicast signalling security policy | UE PC5 unicast signalling security policy  11.3.15 | M | V | 1 |
| 74 | Key establishment information container | Key establishment information container  11.3.12 | O | TLV-E | 4-n |
| 53 | Nonce\_1 | Nonce  11.3.13 | O | TV | 17 |
| 54 | MSB of KNRP-sess ID | MSB of KNRP-sess ID  11.3.16 | O | TV | 2 |
| 28 | Target user info | Application layer ID  11.3.4 | O | TLV | 4-254 |
| 52 | KNRP ID | KNRP ID  11.3.17 | O | TV | 5 |

#### 10.3.1.2 Target user info

The UE shall include this IE if it has received the target UE's application layer ID from upper layers or if the destination layer-2 ID is the unicast layer-2 ID of target UE.

#### 10.3.1.3 Key establishment information container

The UE shall include this IE if the UE PC5 unicast signalling security policy is set to "signalling integrity protection required" or "signalling integrity protection preferred".

#### 10.3.1.4 Nonce\_1

The UE shall include this IE if the UE PC5 unicast signalling security policy is set to "signalling integrity protection required" or "signalling integrity protection preferred".

#### 10.3.1.5 MSB of KNRP-sess ID

The UE shall include this IE if the UE PC5 unicast signalling security policy is set to "signalling integrity protection required" or "signalling integrity protection preferred".

#### 10.3.1.6 KNRP ID

The UE may include this IE if it has an existing KNRP for the target UE.

### 10.3.2 ProSe direct link establishment accept

#### 10.3.2.1 Message definition

This message is sent by a UE to another peer UE to accept the received PROSE DIRECT LINK ESTABLISHMENT REQUEST message. See table 10.3.2.1.1.

Message type: PROSE DIRECT LINK ESTABLISHMENT ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.2.1.1: PROSE DIRECT LINK ESTABLISHMENT ACCEPT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | PROSE DIRECT LINK ESTABLISHMENT ACCEPT message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | Source user info | Application layer ID  11.3.4 | M | LV | 3-253 |
|  | QoS flow descriptions | PC5 QoS flow descriptions  11.3.5 | M | LV-E | 5-65537 |
|  | Configuration of UE PC5 unicast user plane security protection | Configuration of UE PC5 unicast user plane security protection  11.3.23 | M | V | 1 |
| 57 | IP address configuration | IP address configuration  11.3.6 | O | TV | 2 |
| 58 | Link local IPv6 address | Link local IPv6 address  11.3.7 | O | TV | 17 |

#### 10.3.2.2 IP address configuration

The UE shall include this IE if IP communication is used.

#### 10.3.2.3 Link local IPv6 address

The UE shall include this IE if IP communication is used and the IP address configuration is set to "IPv6 address allocation not supported".

### 10.3.3 ProSe direct link establishment reject

#### 10.3.3.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link establishment request is not accepted. See table 10.3.3.1.1.

Message type: PROSE DIRECT LINK ESTABLISHMENT REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.3.1.1: PROSE DIRECT LINK ESTABLISHMENT REJECT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **IEI** | **Information Element** | **Type/Reference** | **Presence** | **Format** | **Length** |
|  | PROSE DIRECT LINK ESTABLISHMENT REJECT message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | PC5 signalling protocol cause | PC5 signalling protocol cause  11.3.9 | M | V | 1 |

### 10.3.4 ProSe direct link release request

#### 10.3.4.1 Message definition

This message is sent by the UE to another peer UE to initiate the direct link release procedure. See table 10.3.x.1.1.

Message type: PROSE DIRECT LINK RELEASE REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.4.1.1: PROSE DIRECT LINK RELEASE REQUEST message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK RELEASE REQUEST message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | PC5 signalling protocol cause | PC5 signalling protocol cause  11.3.9 | M | V | 1 |
|  | MSB of KNRP ID | MSB of KNRP ID  11.3.20 | M | V | 2 |

### 10.3.5 ProSe direct link release accept

#### 10.3.5.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link release request is accepted. See table 10.3.y.1.1.

Message type: PROSE DIRECT LINK RELEASE ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.5.1.1: PROSE DIRECT LINK RELEASE ACCEPT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK RELEASE ACCEPT message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | LSB of KNRP ID | LSB of KNRP ID  11.3.21 | M | V | 2 |

### 10.3.6 ProSe direct link modification request

#### 10.3.6.1 Message definition

This message is sent by the UE to another peer UE to initiate the direct link modification procedure. See table 10.3.6.1.1.

Message type: PROSE DIRECT LINK MODIFICATION REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.6.1.1: PROSE DIRECT LINK MODIFICATION REQUEST message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK MODIFICATION REQUEST message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | Link modification operation code | Link modification operation code  11.3.19 | M | V | 1 |
|  | QoS flow descriptions | PC5 QoS flow descriptions  11.3.5 | M | LV-E | 5-65537 |

### 10.3.7 ProSe direct link modification accept

#### 10.3.7.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link modification request is accepted. See table 10.3.7.1.1.

Message type: PROSE DIRECT LINK MODIFICATION ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.7.1.1: PROSE DIRECT LINK MODIFICATION ACCEPT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK MODIFICATION ACCEPT message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
| 79 | QoS flow descriptions | PC5 QoS flow descriptions  11.3.5 | O | TLV-E | 6-65538 |

#### 10.3.7.2 QoS flow descriptions

The UE shall include this IE if the PC5 unicast link modification procedure is to:

a) add new PC5 QoS flow(s) to the existing 5G ProSe direct link;

b) modify PC5 QoS parameters of the existing PC5 QoS flow(s);

c) associate new ProSe Application(s) with existing PC5 QoS flow(s); or

d) remove ProSe Application(s) from existing PC5 QoS flow(s).

### 10.3.8 ProSe direct link keepalive request

#### 10.3.8.1 Message definition

This message is sent by a UE to another peer UE when a PC5 unicast link keep-alive procedure is initiated. See table 10.3.8.1.1.

Message type: PROSE DIRECT LINK KEEPALIVE REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.8.1.1: PROSE DIRECT LINK KEEPALIVE REQUEST message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK KEEPALIVE REQUEST message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | Keep-alive counter | Keep-alive counter  11.3.20 | M | V | 4 |
| 55 | Maximum inactivity period | Maximum inactivity period  11.3.21 | O | TV | 5 |

#### 10.3.8.2 Maximum inactivity period

The UE may include this IE to indicate its maximum inactivity period to the peer UE.

### 10.3.9 ProSe direct link keepalive response

#### 10.3.9.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK KEEPALIVE REQUEST message. See table 10.3.9.1.1.

Message type: PROSE DIRECT LINK KEEPALIVE RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.3.9.1.1: PROSE DIRECT LINK KEEPALIVE RESPONSE message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK KEEPALIVE RESPONSE message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | Keep-alive counter | Keep-alive counter  11.3.20 | M | V | 4 |

### 10.3.10 ProSe direct link authentication request

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 10.3.10.1 Message definition

This message is sent by a UE to another peer UE when a PC5 unicast link authentication procedure is initiated. See table 10.3.10.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.10.1.1: PROSE DIRECT LINK AUTHENTICATION REQUEST message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK AUTHENTICATION REQUEST message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | Key establishment information container | Key establishment information container  11.3.9 | M | LV-E | 3-n |

### 10.3.11 ProSe direct link authentication response

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 10.3.11.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK AUTHENTICATION REQUEST message. See table 10.3.11.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.3.11.1.1: PROSE DIRECT LINK AUTHENTICATION RESPONSE message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK AUTHENTICATION RESPONSE message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | Key establishment information container | Key establishment information container  11.3.9 | M | LV-E | 3-n |

### 10.3.12 ProSe direct link authentication reject

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 10.3.12.1 Message definition

This message is sent by a UE to another peer UE to reject a PROSE DIRECT LINK AUTHENTICATION REQUEST message. See table 10.3.12.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.12.1.1: PROSE DIRECT LINK AUTHENTICATION REJECT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK AUTHENTICATION REJECT message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | PC5 signalling protocol cause | PC5 signalling protocol cause  11.3.8 | M | V | 1 |

### 10.3.13 ProSe direct link security mode command

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 10.3.13.1 Message definition

This message is sent by a UE to another peer UE when a PC5 unicast link security mode control procedure is initiated. See table 10.3.13.1.1.

Message type: PROSE DIRECT LINK SECURITY MODE COMMAND

Significance: dual

Direction: UE to peer UE

Table 10.3.13.1.1: PROSE DIRECT LINK SECURITY MODE COMMAND message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK SECURITY MODE COMMAND message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | Selected security algorithms | Selected security algorithms  11.3.22 | M | V | 1 |
|  | UE security capabilities | UE security capabilities  11.3.11 | M | LV | 3-9 |
| 59 | UE PC5 unicast signalling security policy | UE PC5 unicast signalling security policy  11.3.12 | O | TV | 2 |
| 55 | Nonce\_2 | Nonce  11.3.10 | O | TV | 17 |
| 52 | LSB of KNRP-sess ID | LSB of KNRP-sess ID  11.3.15 | O | TV | 2 |
| 74 | Key establishment information container | Key establishment information container  11.3.9 | O | TLV-E | 4-n |
| 62 | MSBs of KNRP ID | MSBs of KNRP ID  11.3.16 | O | TV | 3 |

#### 10.3.13.2 Nonce\_2

The UE shall include this IE if the selected integrity protection algorithms is not the null integrity protection algorithm.

#### 10.3.13.3 LSB of KNRP-sess ID

The UE shall include this IE if the selected integrity protection algorithms is not the null integrity protection algorithm.

#### 10.3.13.4 Key establishment information container

The UE shall include this IE if the UE has derived a new KNRP and the authentication method used to generate KNRP requires sending information to complete the authentication procedure.

#### 10.3.13.5 MSBs of KNRP ID

The UE shall include this IE if the UE has derived a new KNRP.

#### 10.3.13.6 UE PC5 unicast signalling security policy

The UE shall include this IE if the PROSE DIRECT LINK SECURITY MODE COMMAND message is triggered by the PROSE DIRECT LINK ESTABLISHMENT REQUEST message. The content of the IE is the same as the content of UE PC5 unicast signalling security policy IE in the received PROSE DIRECT LINK ESTABLISHMENT REQUEST message in order to provide protection against bidding down attacks.

### 10.3.14 ProSe direct link security mode complete

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 10.3.14.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK SECURITY MODE COMMAND message. See table 10.3.14.1.1.

Message type: PROSE DIRECT LINK SECURITY MODE COMPLETE

Significance: dual

Direction: UE to peer UE

Table 10.3.14.1.1: PROSE DIRECT LINK SECURITY MODE COMPLETE message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK SECURITY MODE COMPLETE message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | QoS flow descriptions | PC5 QoS flow descriptions  11.3.5 | M | LV-E | 6-n |
|  | UE PC5 unicast user plane security policy | UE PC5 unicast user plane security policy  11.3.23 | M | V | 1 |
| 57 | IP address configuration | IP address configuration  11.3.6 | O | TV | 2 |
| 58 | Link local IPv6 address | Link local IPv6 address  11.3.7 | O | TV | 17 |
| 52 | LSBs of KNRP ID | LSBs of KNRP ID  11.3.17 | O | TV | 3 |

#### 10.3.14.2 IP address configuration

The UE shall include this IE if IP communication is used and the PC5 unicast link security mode control procedure was triggered during a PC5 unicast link establishment procedure.

#### 10.3.14.3 Link local IPv6 address

The UE shall include this IE if IP communication is used, the IP address configuration is set to "IPv6 address allocation not supported" and the PC5 unicast link security mode control procedure was triggered during a PC5 unicast link establishment procedure.

#### 10.3.14.4 LSBs of KNRP ID

The UE shall include this IE if a new KNRP was derived.

### 10.3.15 ProSe direct link security mode reject

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 10.3.15.1 Message definition

This message is sent by a UE to another peer UE to reject a PROSE DIRECT LINK SECURITY MODE COMMAND message. See table 10.3.15.1.1.

Message type: PROSE DIRECT LINK SECURITY MODE REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.15.1.1: PROSE DIRECT LINK SECURITY MODE REJECT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK SECURITY MODE REJECT message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | PC5 signalling protocol cause | PC5 signalling protocol cause  11.3.8 | M | V | 1 |

### 10.3.16 ProSe direct link rekeying request

#### 10.3.16.1 Message definition

This message is sent by a UE to another peer UE when a PC5 unicast link re-keying procedure is initiated. See table 10.3.16.1.1.

Message type: PROSE DIRECT LINK REKEYING REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.16.1.1: PROSE DIRECT LINK REKEYING REQUEST message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK REKEYING REQUEST message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | UE security capabilities | UE security capabilities  11.3.11 | M | LV | 3-9 |
| 74 | Key establishment information container | Key establishment information container  11.3.9 | O | TLV-E | 4-n |
| 53 | Nonce\_1 | Nonce  11.3.10 | O | TV | 17 |
| 54 | MSB of KNRP-sess ID | MSB of KNRP-sess ID  11.3.13 | O | TV | 2 |
| 56 | Re-authentication indication | Re-authentication indication  11.3.24 | O | TV | 2 |

#### 10.3.16.2 Key establishment information container

The UE shall include this IE if the null integrity protection algorithm is not in use.

#### 10.3.16.3 Nonce\_1

The UE shall include this IE if the null integrity protection algorithm is not in use.

#### 10.3.16.4 MSB of KNRP-sess ID

The UE shall include this IE if the null integrity protection algorithm is not in use.

#### 10.3.16.5 Re-authentication indication

The UE shall include this IE if the UE wants to derive a new KNRP.

### 10.3.17 ProSe direct link rekeying response

#### 10.3.17.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK REKEYING REQUEST message. See table 10.3.17.1.1.

Message type: PROSE DIRECT LINK REKEYING RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.3.17.1.1: PROSE DIRECT LINK REKEYING RESPONSE message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK REKEYING RESPONSE message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |

### 10.3.18 ProSe direct link identifier update request

#### 10.3.18.1 Message definition

This message is sent by a UE to another peer UE to initiate the direct link identifier procedure. See table 10.3.18.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.18.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | MSB of KNRP-sess ID | MSB of KNRP-sess ID  11.3.13 | M | V | 1 |
|  | Source layer-2 ID | Layer-2 ID  11.3.25 | M | V | 3 |
| 57 | Source user info | Application layer ID  11.3.4 | O | TLV | 4-254 |
| 58 | Source link local IPv6 address | Link local IPv6 address  11.3.7 | O | TV | 17 |

#### 10.3.18.2 Source user info

This IE is included when the initiating UE receives a new application layer ID.

#### 10.3.18.3 Source link local IPv6 address

This IE is included when the link local IPv6 address changes at the initiating UE.

### 10.3.19 ProSe direct link identifier update accept

#### 10.3.19.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link identifier update request is accepted. See table 10.3.19.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.19.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | LSB of KNRP-sess ID | LSB of KNRP-sess ID  11.3.15 | M | V | 1 |
|  | MSB of KNRP-sess ID | MSB of KNRP-sess ID  11.3.13 | M | V | 1 |
|  | Source layer-2 ID | Layer-2 ID  11.3.25 | M | V | 3 |
|  | Target layer-2 ID | Layer-2 ID  11.3.25 | M | V | 3 |
| 28 | Target user info | Application layer ID  11.3.4 | O | TLV | 4-254 |
| 59 | Target link local IPv6 address | Link local IPv6 address  11.3.7 | O | TV | 17 |
| 57 | Source user info | Application layer ID  11.3.4 | O | TLV | 4-254 |
| 58 | Source link local IPv6 address | Link local IPv6 address  11.3.7 | O | TV | 17 |

#### 10.3.19.2 Target user info

This IE is included if the target UE receives the Source user info IE in the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message.

#### 10.3.19.3 Target link local IPv6 address

This IE is included if the target UE receives the Source link local IPv6 address IE in the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message.

#### 10.3.19.4 Source user info

This IE is included when the application layer ID changes at the target UE and the target UE receives a new application layer ID from the upper layers.

#### 10.3.19.5 Source link local IPv6 address

This IE is included when the link local IPv6 address changes at the target UE and the target UE receives a new Link local IPv6 address from the upper layers.

### 10.3.20 ProSe direct link identifier update ack

#### 10.3.20.1 Message definition

This message is sent by the initiating UE to target UE to indicate that the initiating UE has received target UE’s accept message. See table 10.3.20.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE ACK

Significance: dual

Direction: UE to peer UE

Table 10.3.20.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE ACK message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK IDENTIFIER UPDATE ACK message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | LSB of KNRP-sess ID | LSB of KNRP-sess ID  11.3.15 | M | V | 1 |
|  | Target layer-2 ID | Layer-2 ID  11.3.25 | M | V | 3 |
| 28 | Target user info | Application layer ID  11.3.4 | O | TLV | 4-254 |
| 59 | Target link local IPv6 address | Link local IPv6 address  11.3.7 | O | TV | 17 |

#### 10.3.20.2 Target user info

This IE is included when the initiating UE receives the Source user info IE in the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message.

#### 10.3.20.3 Target link local IPv6 address

This IE is included when the initiating UE receives the Source link local IPv6 address IE in the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message.

### 10.3.21 ProSe direct link identifier update reject

#### 10.3.21.1 Message definition

This message is sent by the target UE to initiating UE to indicate that the link identifier update request is not accepted. See table 10.3.21.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.21.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | PC5 signalling protocol cause | PC5 signalling protocol cause  11.3.8 | M | V | 1 |

### 10.3.22 ProSe direct link modification reject

#### 10.3.22.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link modification request is not accepted. See table 10.3.22.1.1.

Message type: PROSE DIRECT LINK MODIFICATION REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.22.1.1: PROSE DIRECT LINK MODIFICATION REJECT message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK MODIFICATION REJECT message identity | ProSe PC5 signalling message type  11.3.1 | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
|  | PC5 signalling protocol cause | PC5 signalling protocol cause  11.3.8 | M | V | 1 |

### 10.3.23 ProSe direct link authentication failure

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

#### 10.3.23.1 Message definition

This message is sent by a UE to another peer UE to reject a PROSE DIRECT LINK AUTHENTICATION RESPONSE message. See table 10.3.23.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION FAILURE

Significance: dual

Direction: UE to peer UE

Table 10.3.23.1.1: PROSE DIRECT LINK AUTHENTICATION FAILURE message content

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IEI | Information Element | Type/Reference | Presence | Format | Length |
|  | PROSE DIRECT LINK AUTHENTICATION FAILURE message identity | ProSe PC5 signalling message type  11.3.1. | M | V | 1 |
|  | Sequence number | Sequence number  11.3.2 | M | V | 1 |
| 74 | Key establishment information container | Key establishment information container  11.3.9 | O | TLV-E | 4-n |

#### 10.3.23.2 Key establishment information container

The UE shall include this IE if it is provided by upper layers.

## 10.4 Provisioning of 5G ProSe configuration information signalling messages

### 10.4.1 UE policy provisioning request

The UE POLICY PROVISIONING REQUEST message is sent by the UE to the PCF to request the PCF to manage ProSeP, see 3GPP TS 24.587 [18] clause 7.2.1 for the message definition.

### 10.4.2 UE policy provisioning reject

The UE POLICY PROVISIONING REJECT message is sent by the PCF to the UE to report that the PCF rejects the request to manage ProSeP, see 3GPP TS 24.587 [18] clause 7.2.2 for the message definition.

# 11 Information elements coding

## 11.1 Overview

This clause contains general message format and information elements coding for the messages used in the procedures described in the present document.

## 11.2 5G ProSe direct discovery message formats

### 11.2.1 Message Type

This parameter is used to indicate the type of ProSe direct discovery.

This parameter is coded as shown in figure 11.2.1.1 and table 11.2.1.1.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | | 5 | 4 | 3 | 2 | | 1 |  | |
| Discovery type | | | Content Type | | | | | Discovery model | | | octet 1 | |
|  | | | | |

Figure 11.2.1.1: Message Type parameter

Table 11.2.1.1: Message Type parameter

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Discovery type value (octet 1): | | | | | | | | | |
| Bit | | | | | | | | | |
| 8 | | 7 | |  | |  | |  | |
| 0 | | 0 | |  | |  | | Reserved | |
| 0 | | 1 | |  | |  | | Open discovery | |
| 1 | | 0 | |  | |  | | Restricted discovery | |
| 1 | | 1 | |  | |  | | Reserved | |
|  | | | | | | | | | |
| Content type value (octet 1): | | | | | | | | | |
| Bit | | | | | | | | | |
| **6** | | **5** | | **4** | | **3** | |  | |
| 0 | | 0 | | 0 | | 0 | | Announcement/response | |
| 0 | | 0 | | 0 | | 1 | | Solicitation | |
| 0 | | 1 | | 0 | | 0 | | UE-to-Network Relay discovery announcement/UE-to-Network Relay discovery response | |
| 0 | | 1 | | 0 | | 1 | | UE-to-Network Relay discovery solicitation | |
| 0 | | 1 | | 1 | | 0 | | Group member discovery announcement/group member discovery response | |
| 0 | | 1 | | 1 | | 1 | | Group member discovery solicitation | |
| 1 | | 0 | | 0 | | 0 | | Relay discovery additional information | |
| The other values are reserved. | | | | | | | | | |
|  | | | | | | | | | |
| Discovery model value (octet 1): | | | | | | | | | |
| Bit | | | | | | | | | |
| **2** | | **1** | |  | |  | |  | |
| 0 | | 0 | |  | |  | | Reserved | |
| 0 | | 1 | |  | |  | | Model A | |
| 1 | | 0 | |  | |  | | Model B | |
| 1 | | 1 | |  | |  | | Reserved | |

NOTE 1: Content Type '0000' (announce/response) is used for model A announcing and for model B discoveree operation.

NOTE 2: Content Type '0100' (UE-to-Network Relay Discovery Announcement or UE-to-Network Relay Discovery Response) is used for model A announcing and for model B discoveree operation.

NOTE 3: Content Type '0110' (Group Member Discovery Announcement or Group Member Discovery Response) is used for model A announcing and for model B discoveree operation.

### 11.2.2 ProSe Application Code

This parameter is used to contain a ProSe Application Code. The format of the ProSe Application Code is as follows:

a) if the ProSe Application Code is included in a PROSE PC5 DISCOVERY message and application-controlled extension is used, the ProSe Application Code is encoded as a 184 bitstring composed of:

1) the ProSe Application Code Prefix; and

2) the ProSe Application Code Suffix; or

b) in all other cases, the ProSe Application is encoded as a 184 bitstring as defined in 3GPP TS 23.003 [12].

### 11.2.3 ProSe Restricted Code

This parameter is used to contain a ProSe Restricted Code. The format of the ProSe Restricted Code is as follows:

a) if the ProSe Restricted Code is included in a PROSE PC5 DISCOVERY message and application-controlled extension is not used, the ProSe Restricted Code is encoded as a 184 bitstring composed of:

1) the ProSe Restricted Code in the 64 most significant bits; and

2) the remaining 120 bits set to zero;

b) if the ProSe Restricted Code is included in a PROSE PC5 DISCOVERY message and application-controlled extension is used, the ProSe Restricted Code is encoded as a 184 bitstring composed of

1) the ProSe Restricted Code Prefix in the 64 most significant bits;

2) the ProSe Restricted Code Suffix; and

3) any remaining unused least significant bits set to zero; or

c) in all other cases, the ProSe Restricted Code is encoded as a 64 bitstring as defined in 3GPP TS 23.003 [12].

### 11.2.4 MIC

This parameter is used to carry the MIC (Message Integrity Check) associated with the ProSe Application Code contained in a PROSE PC5 DISCOVERY message.

### 11.2.5 UTC-based counter

This parameter is used to indicate the UTC time associated with the discovery transmission opportunity in which a PROSE PC5 DISCOVERY message is sent. It is expressed in unit of seconds and coded in binary format as the 32 least significant bits of the Coordinated Universal Time as defined in 3GPP TS 38.331 [13].

### 11.2.6 Discovery Group ID

The Discovery Group ID parameter carries an identifier of a discovery group that the UE belongs to. The value of the Discovery Group ID parameter is a 24-bit long bit string. The format of the Discovery Group ID parameter is out of scope of this specification.

### 11.2.7 User Info ID

The User Info ID parameter carries a User Info ID as specified in 3GPP TS 23.304 [2]. The value of the User Info ID parameter is a 48-bit long bit string. The format of the User Info ID parameter is out of scope of this specification.

NOTE: Depending on operation, User Info ID is indicated as the Announcer Info parameter, the Discoverer Info parameter or the Discoveree Info parameter.

### 11.2.8 GMDS Composition

This parameter is used to indicate the content of the PROSE PC5 DISCOVERY message for Group Member Discovery Solicitation.

This parameter is coded as shown in figure 11.2.13.1 and table 11.2.13.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| TUII | TGII | Spare | | | | | | octet 1 |

Figure 11.2.13.1: GMDS Composition parameter

Table 11.2.13.1: GMDS Composition parameter

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TUII (octet 1 bit 8) | | | | | |
| Bit | | | | | |
| 8 | |  |  |  |  |
| 0 | |  |  |  | Target User Info is not included (see NOTE 1) |
| 1 | |  |  |  | Target User Info is included (see NOTE 1) |
|  | | | | | |
| TGII (octet 1 bit 7) | | | | | |
| Bit | | | | | |
| 7 | |  |  |  |  |
| 0 | |  |  |  | Target Group Info is not included (see NOTE 1) |
| 1 | |  |  |  | Target Group Info is included (see NOTE 1) |
| Bits 1 to 6 of octet 1 are spare and shall be coded as zero. | | | | | |
| NOTE 1: The TUII and TGII shall not be set to the same value. | | | | | |

### 11.2.9 Target User Info

The Target User Info parameter is used to provide the User Info ID of the targeted discoveree user. The value of the Target User Info parameter is a 48-bit long bit string.

### 11.2.10 Target Group Info

The Target Group Info parameter is used to provide the identifier of the targeted group (e.g. ProSe Layer 2 Group ID). The value of the Target Group Info parameter is 24-bit long bit string.

## 11.3 PC5 signalling message formats

Editor's note: The security related aspects are FFS as they are waiting for the definitions in SA3 specification by SA3 working group.

### 11.3.1 ProSe PC5 signalling message type

The purpose of the ProSe PC5 signalling message type information element is to indicate the type of messages used in ProSe PC5 signalling protocol.

The value part of the ProSe PC5 signalling message type information element used in the ProSe PC5 signalling messages is coded as shown in table 11.3.1.1.

The ProSe PC5 signalling message type is a type 3 information element, with the length of 1 octet.

Table 11.3.1.1: ProSe PC5 signalling message type

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bits | | | | | | | | | | | | | | | |  | |  | |
| 8 | | 7 | | 6 | | 5 | | 4 | | 3 | | 2 | | 1 | |  | |  | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 1 | |  | | PROSE DIRECT LINK ESTABLISHMENT REQUEST | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 0 | |  | | PROSE DIRECT LINK ESTABLISHMENT ACCEPT | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 1 | |  | | PROSE DIRECT LINK ESTABLISHMENT REJECT | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | |  | | PROSE DIRECT LINK MODIFICATION REQUEST | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 0 | | 1 | |  | | PROSE DIRECT LINK MODIFICATION ACCEPT | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 0 | |  | | PROSE DIRECT LINK MODIFICATION REJECT | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 1 | |  | | PROSE DIRECT LINK RELEASE REQUEST | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | |  | | PROSE DIRECT LINK RELEASE ACCEPT | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | 1 | |  | | PROSE DIRECT LINK KEEPALIVE REQUEST | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 0 | | 1 | | 0 | |  | | PROSE DIRECT LINK KEEPALIVE RESPONSE | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 0 | | 1 | | 1 | |  | | PROSE DIRECT LINK AUTHENTICATION REQUEST | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 0 | | 0 | |  | | PROSE DIRECT LINK AUTHENTICATION RESPONSE | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 0 | | 1 | |  | | PROSE DIRECT LINK AUTHENTICATION REJECT | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 1 | | 0 | |  | | PROSE DIRECT LINK SECURITY MODE COMMAND | |
| 0 | | 0 | | 0 | | 0 | | 1 | | 1 | | 1 | | 1 | |  | | PROSE DIRECT LINK SECURITY MODE COMPLETE | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | | 0 | |  | | PROSE DIRECT LINK SECURITY MODE REJECT | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | | 1 | |  | | PROSE DIRECT LINK REKEYING REQUEST | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | 1 | | 0 | |  | | PROSE DIRECT LINK REKEYING RESPONSE | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 0 | | 1 | | 1 | |  | | PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 1 | | 0 | | 0 | |  | | PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 1 | | 0 | | 1 | |  | | PROSE DIRECT LINK IDENTIFIER UPDATE ACK | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 1 | | 1 | | 0 | |  | | PROSE DIRECT LINK IDENTIFIER UPDATE REJECT | |
| 0 | | 0 | | 0 | | 1 | | 0 | | 1 | | 1 | | 1 | |  | | PROSE DIRECT LINK AUTHENTICATION FAILURE | |
|  | | | | | | | | | | | | | | | | | | | |

### 11.3.2 Sequence number

The purpose of the Sequence number information element is to uniquely identify a ProSe PC5 signalling message being sent or received. The sending UE will increment the sequence number for each outgoing new ProSe PC5 signalling message.

The Sequence number information element is an integer in the 0-255 range.

The Sequence number is a type 3 information element, with a length of 1 octet.

### 11.3.3 ProSe application identifier

The purpose of the ProSe application identifier parameter is to carry the identifier of a ProSe application.

The ProSe application identifier information element is coded as shown in figure 11.3.3.1 and table 11.3.3.1.

The ProSe application identifier is a type 4 information element with a minimum length of 6 octets.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |  | |
| ProSe application identifier IEI | | | | | | | | | octet 1 | |
| Length of ProSe application identifier contents | | | | | | | | | octet 2 | |
| ProSe application identifier 1 | | | | | | | | | octet 3  octet 6 | |
| ProSe application identifier 2 | | | | | | | | | octet 7\*  octet 10\* | |
| … | | | | | | | | | octet 11\*  octet 4n-2\* | |
| ProSe application identifier n | | | | | | | | | octet 4n-1\* | |
| octet 4n+2\* | |

Figure 11.3.3.1: ProSe application identifier information element

Table 11.3.3.1: ProSe application identifier information element

|  |
| --- |
| ProSe application identifier:  The ProSe application identifier field contains a binary coded ProSe application identifier. The format of ProSe application identifier is out of scope of this specification. |

### 11.3.4 Application layer ID

The purpose of the Application layer ID parameter information element carries an application layer ID as specified in 3GPP TS 23.304 [2].

The Application layer ID information element is coded as shown in figure 11.3.4.1 and table 11.3.4.1.

The Application layer ID is a type 4 information element.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |  | |
| Application layer ID IEI | | | | | | | | | octet 1 | |
| Length of Application layer ID contents | | | | | | | | | octet 2 | |
| Application layer ID contents | | | | | | | | | octet 3 | |
| octet m | |

Figure 11.3.4.1: Application layer ID information element

Table 11.3.4.1: Application layer ID information element

|  |
| --- |
| The length of Application layer ID contents field contains the binary coded representation of the length of the Application layer ID contents field.  The Application layer ID contents field contains the octets indicating the Application layer ID. The format of the Application layer ID parameter is out of scope of this specification. |

### 11.3.5 PC5 QoS flow descriptions

The purpose of the PC5 QoS flow descriptions information element is to indicate a set of PC5 QoS flow descriptions to be used by the UE over the direct link, where each PC5 QoS flow description is a set of parameters as described in clause 5.7 of 3GPP TS 23.304 [2].

The PC5 QoS flow descriptions is a type 6 information element with a minimum length of 6 octets. The maximum length for the information element is 65538 octets.

The PC5 QoS flow descriptions information element is coded as shown in figure 11.3.5.1, figure 11.3.5.2, figure 11.3.5.3, figure 11.3.5.4, and table 11.3.5.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| PC5 QoS flow descriptions IEI | | | | | | | | octet 1 |
| Length of PC5 QoS flow descriptions contents | | | | | | | | octet 2  octet 3 |
| PC5 QoS flow description 1 | | | | | | | | octet 4  octet u |
| PC5 QoS flow description 2 | | | | | | | | octet u+1  octet v |
| ... | | | | | | | | octet v+1  octet w |
| PC5 QoS flow description n | | | | | | | | octet w+1  octet x |

Figure 11.3.5.1: PC5 QoS flow descriptions information element

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | | 6 | | 5 | | 4 | | 3 | 2 | | 1 |  |
| 0  Spare | | 0  Spare | PQFI | | | | | | | | | | octet 4 |
| Operation code | | | | 0  Spare | | 0  Spare | | 0  Spare | | 0  Spare | 0  Spare | | octet 5 |
| 0  Spare | | E | Number of parameters | | | | | | | | | | octet 6 |
| Associated ProSe application identifiers | | | | | | | | | | | | | octet 7\*  octet k\* |
| Parameters list | | | | | | | | | | | | | octet k+1\*  octet u\* |

Figure 11.3.5.2: PC5 QoS flow description

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Parameter 1 | | | | | | | | octet k+1  octet m |
| Parameter 2 | | | | | | | | octet m+1  octet n |
| ... | | | | | | | | octet n+1  octet o |
| Parameter n | | | | | | | | octet o+1  octet u |

Figure 11.3.5.3: Parameters list

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Parameter identifier | | | | | | | | octet k+1 |
| Length of parameter contents | | | | | | | | octet k+2 |
| Parameter contents | | | | | | | | octet k+3  octet m |

Figure 11.3.5.4: Parameter

Table 11.3.5.1: PC5 QoS flow descriptions information element

|  |
| --- |
| PC5 QoS flow identifier (PQFI) (bits 6 to 1 of octet 4)  PQFI field contains the PC5 QoS flow identifier.  Bits  6 5 4 3 2 1  0 0 0 0 0 1 PQFI 1  to  1 1 1 1 1 1 PQFI 63  The UE shall not set the PQFI value to 0. |
| Operation code (bits 8 to 6 of octet 5)  Bits  8 7 6  0 0 1 Create new PC5 QoS flow description  0 1 0 Delete existing PC5 QoS flow description  0 1 1 Modify existing PC5 QoS flow description  All other values are reserved. |
| E bit (bit 7 of octet 6)  For the "create new PC5 QoS flow description" operation, the E bit is encoded as follows:  Bit 7  0 reserved  1 parameters list is included  For the "Delete existing PC5 QoS flow description" operation, the E bit is encoded as follows:  Bit 7  0 parameters list is not included  1 reserved  For the "modify existing PC5 QoS flow description" operation, the E bit is encoded as follows:  Bit 7  0 extension of previously provided parameters  1 replacement of all previously provided parameters  If the E bit is set to "parameters list is not included", the number of parameters field has zero value. If the E bit is set to "parameters list is included", the number of parameters field has non-zero value. If the E bit is set to "extension of previously provided parameters" or "replacement of all previously provided parameters", the number of parameters field has non-zero value. If the E bit is set to "extension of previously provided parameters" and one of the parameters in the new parameters list already exists in the previously provided parameters, the parameter shall be set to the new value.  Number of parameters (bits 6 to 1 of octet 6)  The number of parameters field contains the binary coding for the number of parameters in the parameters list field. The number of parameters field is encoded in bits 6 through 1 of octet 6 where bit 6 is the most significant and bit 1 is the least significant bit.  Associated ProSe application identifiers (octet 7 to k)  The associated ProSe application identifiers field contains a variable number of ProSe application identifiers associated with the PC5 QoS flow. Associated ProSe application identifiers field is coded as the length and value part of ProSe application identifier information element as specified in clause 11.3.3 starting with the second octet.  Parameters list (octets k+1 to u)  The parameters list contains a variable number of parameters.  Each parameter included in the parameters list is of variable length and consists of:  - a parameter identifier (1 octet);  - the length of the parameter contents (1 octet); and - the parameter contents itself (variable amount of octets).  The parameter identifier field is used to identify each parameter included in the parameters list and it contains the hexadecimal coding of the parameter identifier. Bit 8 of the parameter identifier field contains the most significant bit and bit 1 contains the least significant bit. In this version of the protocol, the following parameter identifiers are specified:  - 01H (PQI); - 02H (GFBR); (see NOTE)  - 03H (MFBR); (see NOTE)  - 04H (Averaging window) ;  - 05H (Resource type);  - 06H (Default priority level);  - 07H (Packet delay budget);  - 08H (Packet error rate);  - 09H (Default maximum data burst volume).  If the parameters list contains a parameter identifier that is not supported by the receiving entity the corresponding parameter shall be discarded.  The length of parameter contents field contains the binary coded representation of the length of the parameter contents field. The first bit in transmission order is the most significant bit.  When the parameter identifier indicates PQI, the parameter contents field contains the binary representation of PQI that is one octet in length.  PQI:  Bits  8 7 6 5 4 3 2 1  0 0 0 0 0 0 0 0 Reserved  0 0 0 0 0 0 0 1  to Spare  0 0 0 1 0 1 0 0  0 0 0 1 0 1 0 1 PQI 21  0 0 0 1 0 1 1 0 PQI 22  0 0 0 1 0 1 1 1 PQI 23  0 0 0 1 1 0 0 0 PQI 24  0 0 0 1 1 0 0 1 PQI 25  0 0 0 1 1 0 1 0 PQI 26  0 0 0 1 1 0 1 1  to Spare  0 0 1 1 0 1 1 0  0 0 1 1 0 1 1 1 PQI 55  0 0 1 1 1 0 0 0 PQI 56  0 0 1 1 1 0 0 1 PQI 57  0 0 1 1 1 0 1 0 PQI 58  0 0 1 1 1 0 1 1 PQI 59  0 0 1 1 1 1 0 0 PQI 60  0 0 1 1 1 1 0 1 PQI 61  0 0 1 1 1 1 1 0  to Spare  0 1 0 1 1 0 0 1  0 1 0 1 1 0 1 0 PQI 90  0 1 0 1 1 0 1 1 PQI 91  0 1 0 1 1 1 0 0 PQI 92  0 1 0 1 1 1 0 1 PQI 93  0 1 0 1 1 1 1 0  to Spare  0 1 1 1 1 1 1 1  1 0 0 0 0 0 0 0  to Operator-specific PQIs  1 1 1 1 1 1 1 0  1 1 1 1 1 1 1 1 Reserved  The UE shall consider all other values not explicitly defined in this version of the protocol as unsupported.  When the parameter identifier indicates "GFBR", the parameter contents field contains one octet indicating the unit of the guaranteed flow bit rate followed by two octets containing the value of the guaranteed flow bit rate.  Unit of the guaranteed flow bit rate (octet 1)  Bits  8 7 6 5 4 3 2 1  0 0 0 0 0 0 0 0 value is not used  0 0 0 0 0 0 0 1 value is incremented in multiples of 1 Kbps  0 0 0 0 0 0 1 0 value is incremented in multiples of 4 Kbps  0 0 0 0 0 0 1 1 value is incremented in multiples of 16 Kbps  0 0 0 0 0 1 0 0 value is incremented in multiples of 64 Kbps  0 0 0 0 0 1 0 1 value is incremented in multiples of 256 Kbps  0 0 0 0 0 1 1 0 value is incremented in multiples of 1 Mbps  0 0 0 0 0 1 1 1 value is incremented in multiples of 4 Mbps  0 0 0 0 1 0 0 0 value is incremented in multiples of 16 Mbps  0 0 0 0 1 0 0 1 value is incremented in multiples of 64 Mbps  0 0 0 0 1 0 1 0 value is incremented in multiples of 256 Mbps  0 0 0 0 1 0 1 1 value is incremented in multiples of 1 Gbps  0 0 0 0 1 1 0 0 value is incremented in multiples of 4 Gbps  0 0 0 0 1 1 0 1 value is incremented in multiples of 16 Gbps  0 0 0 0 1 1 1 0 value is incremented in multiples of 64 Gbps  0 0 0 0 1 1 1 1 value is incremented in multiples of 256 Gbps  0 0 0 1 0 0 0 0 value is incremented in multiples of 1 Tbps  0 0 0 1 0 0 0 1 value is incremented in multiples of 4 Tbps  0 0 0 1 0 0 1 0 value is incremented in multiples of 16 Tbps  0 0 0 1 0 0 1 1 value is incremented in multiples of 64 Tbps  0 0 0 1 0 1 0 0 value is incremented in multiples of 256 Tbps  0 0 0 1 0 1 0 1 value is incremented in multiples of 1 Pbps  0 0 0 1 0 1 1 0 value is incremented in multiples of 4 Pbps  0 0 0 1 0 1 1 1 value is incremented in multiples of 16 Pbps  0 0 0 1 1 0 0 0 value is incremented in multiples of 64 Pbps  0 0 0 1 1 0 0 1 value is incremented in multiples of 256 Pbps  Other values shall be interpreted as multiples of 256 Pbps in this version of the protocol.  Value of the guaranteed flow bit rate (octets 2 and 3)  Octets 2 and 3 represent the binary coded value of the guaranteed flow bit rate in units defined by the unit of the guaranteed flow bit rate.  When the parameter identifier indicates "GFBR downlink", the parameter contents field contains one octet indicating the unit of the guaranteed flow bit rate for downlink followed by two octets containing the value of the guaranteed flow bit rate for downlink.  When the parameter identifier indicates "MFBR ", the parameter contents field contains the one octet indicating the unit of the maximum flow bit rate followed by two octets containing the value of maximum flow bit rate.  Unit of the maximum flow bit rate (octet 1)  The coding is identical to that of the unit of the guaranteed flow bit rate.  Value of the maximum flow bit rate (octets 2 and 3)  Octets 2 and 3 represent the binary coded value of the maximum flow bit rate in units defined by the unit of the maximum flow bit rate.  When the parameter identifier indicates "averaging window", the parameter contents field contains the binary representation of the averaging window for both uplink and downlink in milliseconds and the parameter contents field is two octets in length. |
| When the parameter identifier indicates "resource type", the parameter contents field contains the binary representation of the resource type that is one octet in length.  Resource type:  Bits  8 7 6 5 4 3 2 1  0 0 0 0 0 0 0 0 Reserved  0 0 0 0 0 0 0 1 Non-GBR  0 0 0 0 0 0 1 0 GBR  0 0 0 0 0 0 1 1 Delay critical GBR  0 0 0 0 0 1 0 0  to Spare  1 1 1 1 1 1 1 1  When the parameter identifier indicates "default priority level", the parameter contents field contains the binary representation of the default priority level that is one octet in length.  Default priority level:  Bits  8 7 6 5 4 3 2 1  0 0 0 0 0 0 0 0 Reserved  0 0 0 0 0 0 0 1 1  0 0 0 0 0 0 1 0 2  0 0 0 0 0 0 1 1 3  0 0 0 0 0 1 0 0 4  0 0 0 0 0 1 0 1 5  0 0 0 0 0 1 1 0 6  0 0 0 0 0 1 1 1 7  0 0 0 0 1 0 0 0 8  0 0 0 0 1 0 0 1  to Spare  1 1 1 1 1 1 1 1  When the parameter identifier indicates "packet delay budget", the parameter contents field contains the binary representation of the packet delay budget for both uplink and downlink in milliseconds and the parameter contents field is two octets in length.  When the parameter identifier indicates "packet error rate", the parameter contents field contains the binary representation of the power of 10-1 for both uplink and downlink and the parameter contents field is one octet in length.  When the parameter identifier indicates "default maximum data burst volume", the parameter contents field contains the binary representation of the default maximum data burst volume for both uplink and downlink in bytes and the parameter contents field is two octets in length. |
| NOTE: The GFBR and MFBR apply to both directions of the 5G ProSe direct link. |

### 11.3.6 IP address configuration

The purpose of the IP address configuration information element is to indicate the configuration options for IP address used by the UE over this direct link.

The IP address configuration is a type 3 information element with the length of 2 octets.

The IP address configuration information element is coded as shown in figure 11.3.6.1 and table 11.3.6.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| IP address configuration IEI | | | | | | | | octet 1 |
| IP address configuration content | | | | | | | | octet 2 |

Figure 11.3.6.1: IP address configuration information element

Table 11.3.6.1: IP address configuration information element

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IP address configuration value (octet 2) | | | | | |
| Bits | | | | | |
| **4** | **3** | **2** | **1** |  |  |
| 0 | 0 | 0 | 1 |  | IPv6 Router |
| 0 | 0 | 1 | 0 |  | address allocation not supported |
| 0 | 0 | 1 | 1 |  | DHCPv4 server |
| 0 | 1 | 0 | 0 |  | DHCPv4 server & IPv6 Router |
|  | | | | | |
| All other values are reserved. | | | | | |
|  | | | | | |
| Bit 5 to 8 of octet 2 are spare and shall be coded as zero. | | | | | |

### 11.3.7 Link local IPv6 address

The purpose of the Link local IPv6 address information element is to indicate the link local IPv6 address.

The Link local IPv6 address is a type 3 information element with the length of 17 octets.

The Link local IPv6 address information element is coded as shown in figure 11.3.7.1 and table 11.3.7.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Link local IPv6 address IEI | | | | | | | | octet 1 |
| Link local IPv6 address content | | | | | | | | octet 2 |
|  | | | | | | | | octet 17 |

Figure 11.3.7.1: Link local IPv6 address information element

Table 11.3.7.1: Link local IPv6 address information element

|  |
| --- |
| Link local IPv6 address value (octet 2 to 17)  This contains the 128-bit IPv6 address. This IPv6 address is encoded as a 128-bit address according to IETF RFC 4291 [15]. |

### 11.3.8 PC5 signalling protocol cause

The purpose of the PC5 signalling protocol cause information element is to indicate the cause used in the PC5 signalling protocol procedures.

The PC5 signalling protocol cause is a type 3 information element with a length of 2 octets.

The PC5 signalling protocol cause information element is coded as shown in figure 11.3.8.1 and table 11.3.8.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| PC5 signalling protocol cause IEI | | | | | | | | octet 1 |
| PC5 signalling cause value | | | | | | | | octet 2 |

Figure 11.3.8.1: PC5 signalling protocol cause information element

Table 11.3.8.1: PC5 signalling protocol cause information element

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PC5 signalling cause value (octet 2) | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | |
| Bits | | | | | | | | | | | | | | | | | | | | | | | | |
| **8** | | **7** | | **6** | | **5** | | **4** | | **3** | | | **2** | | | **1** | | |  | | |  | | |
| 0 | | 0 | | 0 | | 0 | | 0 | | | 0 | | | 0 | | | 1 | | |  | | | Direct communication to the target UE not allowed | | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | | 1 | | | 0 | | |  | | | Direct communication to the target UE no longer needed | | |
| 0 | | 0 | | 0 | | 0 | | 0 | | | 0 | | | 1 | | | 1 | | |  | | | Conflict of layer-2 ID for unicast communication is detected | | |
| 0 | | 0 | | 0 | | 0 | | 0 | | 1 | | | 0 | | | 0 | | |  | | | Direct connection is not available anymore | | |
| 0 | | 0 | | 0 | | 0 | | 0 | | | 1 | | | 0 | | | 1 | | |  | | | Lack of resources for PC5 unicast link | | |
| 0 | | 0 | | 0 | | 0 | | 0 | | | 1 | | | 1 | | | 0 | | |  | | | Authentication failure | | |
| 0 | | 0 | | 0 | | 0 | | 0 | | | 1 | | | 1 | | | 1 | | |  | | | Integrity failure | | |
| 0 | | 0 | | 0 | | 0 | | 1 | | | 0 | | | 0 | | | 0 | | |  | | | UE security capabilities mismatch | | |
| 0 | | 0 | | 0 | | 0 | | 1 | | | 0 | | | 0 | | | 1 | | |  | | | LSB of KNRP-sess ID conflict | | |
| 0 | | 0 | | 0 | | 0 | | 1 | | | 0 | | | 1 | | | 0 | | |  | | | UE PC5 unicast signalling security policy mismatch | | |
| 0 | | 0 | | 0 | | 0 | | 1 | | | 0 | | | 1 | | | 1 | | |  | | | Required service not allowed | | |
| 0 | | 0 | | 0 | | 0 | | 1 | | | 1 | | | 0 | | | 0 | | |  | | | Security policy not aligned | | |
|  | |  | |  | |  | |  | | |  | | |  | | |  | | |  | | |  | | |
|  | |  | |  | |  | |  | | |  | | |  | | |  | | |  | | |  | | |
| 0 | | 1 | | 1 | | 0 | | 1 | | | 1 | | | 1 | | | 1 | | |  | | | Protocol error, unspecified | | |
|  | |  | |  | |  | |  | | |  | | |  | | |  | | |  | | |  | | |
| Any other value received by the UE shall be treated as 0110 1111, "protocol error, unspecified". | | | | | | | | | | | | | | | | | | | | | | | | | |

### 11.3.9 Key establishment information container

The Key establishment information container information element contains information for PC5 unicast link key establishment.

The Key establishment information container is a type 6 information element with a minimum length of 4 octets.

The Key establishment information container information element is coded as shown in figure 11.3.9.1 and table 11.3.9.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Key establishment information container IEI | | | | | | | | octet 1 |
| Length of key establishment information container contents | | | | | | | | octet 2  octet 3 |
| Key establishment information container contents | | | | | | | | octet 4 |
|  | | | | | | | | octet n |

Figure 11.3.9.1: Key establishment information container information element

Table 11.3.9.1: Key establishment information container information element

|  |
| --- |
| Key establishment information container contents (octet 4 to n)  This field contains the key establishment information container. |

### 11.3.10 Nonce

The Nonce information element contains a 128-bit nonce used during PC5 unicast link security establishment.

The Nonce information element is a type 3 information element, with a length of 17 octets.

The Nonce information element is coded as shown in figure 11.3.10.1 and table 11.3.10.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Nonce IEI | | | | | | | | octet 1 |
| Nonce contents | | | | | | | | octet 2 |
|  | | | | | | | | octet 17 |

Figure 11.3.10.1: Nonce information element

Table 11.3.10.1: Nonce information element

|  |
| --- |
| Nonce contents (octet 2 to 17)  This field contains the 128-bit nonce value. |

### 11.3.11 UE security capabilities

The UE security capabilities information element is used to indicate which security algorithms are supported by the UE.

The UE security capabilities is a type 4 information element with a minimum length of 4 octets and a maximum length of 10 octets.

The UE security capabilities information element is coded as shown in figure 11.3.11.1 and table 11.3.11.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| UE security capabilities IEI | | | | | | | | octet 1 |
| Length of UE security capabilities contents | | | | | | | | octet 2 |
| 5G-EA0 | 128-  5G-EA1 | 128-  5G-EA2 | 128-  5G-EA3 | 5G-EA4 | 5G-EA5 | 5G-EA6 | 5G-EA7 | octet 3 |
| 5G-IA0 | 128-  5G-IA1 | 128-  5G-IA2 | 128-  5G-IA3 | 5G-IA4 | 5G-IA5 | 5G-IA6 | 5G-IA7 | octet 4 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |
| Spare | | | | | | | | octet 5\* -10\* |

Figure 11.3.11.1: UE security capabilities information element

Table 11.3.11.1: UE security capabilities information element

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5GS encryption algorithms supported (octet 3) | | | | | |
|  | | | | | |
| 5GS encryption algorithm 5G-EA0 supported (octet 3, bit 8) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 5G-EA0 not supported |
| 1 |  |  |  | 5GS encryption algorithm 5G-EA0 supported |
|  | | | | | |
| 5GS encryption algorithm 128-5G-EA1 supported (octet 3, bit 7) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 128-5G-EA1 not supported |
| 1 |  |  |  | 5GS encryption algorithm 128-5G-EA1 supported |
|  | | | | | |
| 5GS encryption algorithm 128-5G-EA2 supported (octet 3, bit 6) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 128-5G-EA2 not supported |
| 1 |  |  |  | 5GS encryption algorithm 128-5G-EA2 supported |
|  | | | | | |
| 5GS encryption algorithm 128-5G-EA3 supported (octet 3, bit 5) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 128-5G-EA3 not supported |
| 1 |  |  |  | 5GS encryption algorithm 128-5G-EA3 supported |
|  | | | | | |
| 5GS encryption algorithm 5G-EA4 supported (octet 3, bit 4) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 5G-EA4 not supported |
| 1 |  |  |  | 5GS encryption algorithm 5G-EA4 supported |
|  | | | | | |
| 5GS encryption algorithm 5G-EA5 supported (octet 3, bit 3) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 5G-EA5 not supported |
| 1 |  |  |  | 5GS encryption algorithm 5G-EA5 supported |
|  | | | | | |
| 5GS encryption algorithm 5G-EA6 supported (octet 3, bit 2) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 5G-EA6 not supported |
| 1 |  |  |  | 5GS encryption algorithm 5G-EA6 supported |
|  | | | | | |
| 5GS encryption algorithm 5G-EA7 supported (octet 3, bit 1) | | | | | |
| 0 |  |  |  | 5GS encryption algorithm 5G-EA7 not supported |
| 1 |  |  |  | 5GS encryption algorithm 5G-EA7 supported |
|  | | | | | |
| 5GS integrity algorithms supported (octet 4) | | | | | |
|  | | | | | |
| 5GS integrity algorithm 5G-IA0 supported (octet 4, bit 8) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 5G-IA0 not supported |
| 1 |  |  |  | 5GS integrity algorithm 5G-IA0 supported |
|  | | | | | |
| 5GS integrity algorithm 128-5G-IA1 supported (octet 4, bit 7) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 128-5G-IA1 not supported |
| 1 |  |  |  | 5GS integrity algorithm 128-5G-IA1 supported |
|  | | | | | |
| 5GS integrity algorithm 128-5G-IA2 supported (octet 4, bit 6) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 128-5G-IA2 not supported |
| 1 |  |  |  | 5GS integrity algorithm 128-5G-IA2 supported |
|  | | | | | |
| 5GS integrity algorithm 128-5G-IA3 supported (octet 4, bit 5) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 128-5G-IA3 not supported |
| 1 |  |  |  | 5GS integrity algorithm 128-5G-IA3 supported |
|  | | | | | |
| 5GS integrity algorithm 5G-IA4 supported (octet 4, bit 4) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 5G-IA4 not supported |
| 1 |  |  |  | 5GS integrity algorithm 5G-IA4 supported |
|  | | | | | |
| 5GS integrity algorithm 5G-IA5 supported (octet 4, bit 3) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 5G-IA5 not supported |
| 1 |  |  |  | 5GS integrity algorithm 5G-IA5 supported |
|  | | | | | |
| 5GS integrity algorithm 5G-IA6supported (octet 4, bit 2) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 5G-IA6 not supported |
| 1 |  |  |  | 5GS integrity algorithm 5G-IA6 supported |
|  | | | | | |
| 5GS integrity algorithm 5G-IA7 supported (octet 4, bit 1) | | | | | |
| 0 |  |  |  | 5GS integrity algorithm 5G-IA7 not supported |
| 1 |  |  |  | 5GS integrity algorithm 5G-IA7 supported |
|  | | | | | |

### 11.3.12 UE PC5 unicast signalling security policy

The purpose of the UE PC5 unicast signalling security policy information element is to indicate the UE’s configuration for integrity protection and ciphering of PC5 signalling messages.

The UE PC5 unicast signalling security policy is a type 3 information element with a length of 2 octets.

The UE PC5 unicast signalling security policy information element is coded as shown in figure 11.3.12.1.1 and table 11.3.12.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| UE PC5 unicast signalling security policy IEI | | | | | | | | octet 1 |
| 0  spare | Signalling ciphering policy | | | 0  spare | Signalling integrity protection policy | | | octet 2 |

Figure 11.3.12.1: UE 5G ProSe direct signalling security policy information element

Table 11.3.12.1: UE PC5 unicast signalling security policy information element

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Signalling integrity protection policy (octet 2, bit 1 to 3) | | | | |
| Bits | | | | |
| **3** | **2** | **1** |  |  |
| 0 | 0 | 0 |  | Signalling integrity protection not needed |
| 0 | 0 | 1 |  | Signalling integrity protection preferred |
| 0 | 1 | 0 |  | Signalling integrity protection required |
| 0 | 1 | 1 |  |  |
| to Spare | | | | |
| 1 | 1 | 0 |  |  |
| 1 | 1 | 1 |  | Reserved |
|  | | | | |
| If the UE receives a signalling integrity protection policy value that the UE does not understand, the UE shall interpret the value as 010 "Signalling integrity protection required".  Signaling ciphering policy (octet 2, bit 5 to 7) | | | | |
| Bits | | | | |
| **7** | **6** | **5** |  |  |
| 0 | 0 | 0 |  | Signalling ciphering not needed |
| 0 | 0 | 1 |  | Signalling ciphering preferred |
| 0 | 1 | 0 |  | Signalling ciphering required |
| 0 | 1 | 1 |  |  |
| to Spare | | | | |
| 1 | 1 | 0 |  |  |
| 1 | 1 | 1 |  | Reserved |
|  | | | | |
| If the UE receives a signalling ciphering policy value that the UE does not understand, the UE shall interpret the value as 010 "Signalling ciphering required".  Bit 4 and 8 of octet 2 are spare and shall be coded as zero. | | | | |
|  | | | | |

### 11.3.13 MSB of KNRP-sess ID

The purpose of the MSB of KNRP-sess ID information element is to carry the 8 most significant bits of the KNRP-sess ID.

The MSB of KNRP-sess ID information element is a type 3 information element with a length of 2 octets.

The MSB of KNRP-sess ID information element is coded as shown in figure 11.3.13.1 and table 11.3.13.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| MSB of KNRP-sess ID IEI | | | | | | | | octet 1 |
| MSB of KNRP-sess ID contents | | | | | | | | octet 2 |

Figure 11.3.13.1: MSB of KNRP-sess ID information element

Table 11.3.13.1: MSB of KNRP-sess ID information element

|  |
| --- |
| MSB of KNRP-sess ID contents (octet 2)  This field contains the 8 most significant bits of KNRP-sess ID. |

### 11.3.14 KNRP ID

The purpose of the KNRP ID information element is to carry the identity of the KNRP held by a UE.

The KNRP ID is a type 3 information element with a length of 5 octets.

The KNRP ID information element is coded as shown in figure 11.3.14.1 and table 11.3.14.1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| KNRP ID IEI | | | | | | | | octet 1 |
| KNRP ID contents | | | | | | | | octet 2 |
|  | | | | | | | | octet 5 |

Figure 11.3.14.1: KNRP ID information element

Table 11.3.14.1: KNRP ID information element

|  |
| --- |
| KNRP ID contents (octet 2 to 5)  This field contains the 32-bit identifier of a KNRP. |

### 11.3.15 LSB of KNRP-sess ID

The purpose of the LSB of KNRP-sess ID information element is to carry the 8 least significant bits of the KNRP-sess ID.

The LSB of KNRP-sess ID is a type 3 information element with a length of 2 octets.

The LSB of KNRP-sess ID information element is coded as shown in figure 11.3.15.1 and table 12.3.15.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| LSB of KNRP-sess ID | | | | | | | | octet 1 |
| LSB of KNRP-sess ID contents | | | | | | | | octet 2 |

Figure 11.3.15.1: LSB of KNRP-sess ID information element

Table 11.3.15.1: LSB of KNRP-sess ID information element

|  |
| --- |
| LSB of KNRP-sess ID contents (octet 2)  This field contains the 8 least significant bits of KNRP-sess ID. |

### 11.3.16 MSBs of KNRP ID

The purpose of the MSBs of KNRP ID information element is to carry the 16 most significant bits of the KNRP ID.

The MSBs of KNRP ID is a type 3 information element with a length of 3 octets.

The MSBs of KNRP ID information element is coded as shown in figure 11.3.16.1 and table 11.3.16.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| MSBs of KNRP ID IEI | | | | | | | | octet 1 |
| MSBs of KNRP ID contents | | | | | | | | octet 2 |
|  | | | | | | | | octet 3 |

Figure 11.3.16.1: MSBs of KNRP ID information element

Table 11.3.16.1: MSBs of KNRP ID information element

|  |
| --- |
| MSBs of KNRP ID contents (octet 2 to 3)  This field contains the 16 most significant bits of KNRP ID. |

### 11.3.17 LSBs of KNRP ID

The purpose of the LSBs of KNRP ID information element is to carry the 16 least significant bits of the KNRP ID.

The LSBs of KNRP ID is a type 3 information element with a length of 3 octets.

The LSBs of KNRP ID information element is coded as shown in figure 11.3.17.1 and table 11.3.17.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| LSBs of KNRP ID IEI | | | | | | | | octet 1 |
| LSBs of KNRP ID contents | | | | | | | | octet 2 |
|  | | | | | | | | octet 3 |

Figure 11.3.17.1: LSBs of KNRP ID information element

Table 11.3.17.1: LSBs of KNRP ID information element

|  |
| --- |
| LSBs of KNRP ID contents (octet 2 to 3)  This field contains the 16 least significant bits of KNRP ID. |

### 11.3.18 Configuration of UE PC5 unicast user plane security protection

The purpose of the configuration of UE PC5 unicast user plane security protection information element is to indicate the agreed configuration for security protection of PC5 user plane data between UEs over the PC5 unicast link.

The configuration of UE PC5 unicast user plane security protection is a type 3 information element with a length of 2 octets.

The configuration of UE PC5 unicast user plane security protection information element is coded as shown in figure 11.3.18.1 and table 11.3.18.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| configuration of UE PC5 unicast user plane security protection IEI | | | | | | | | octet 1 |
| 0  spare | User plane ciphering configuration | | | 0  spare | User plane integrity protection configuration | | | octet 2 |

Figure 11.3.18.1: Configuration of UE PC5 unicast user plane security protection information element

Table 11.3.18.1: Configuration of UE PC5 unicast user plane security protection information element

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| User plane integrity protection configuration (octet 2, bit 1 to 3) | | | | |
| Bits | | | | |
| **3** | **2** | **1** |  |  |
| 0 | 0 | 0 |  | Off |
| 0 | 0 | 1 |  | Off or On |
| 0 | 1 | 0 |  | On |
| 0 | 1 | 1 |  |  |
| to Spare | | | | |
| 1 | 1 | 0 |  |  |
| 1 | 1 | 1 |  | Reserved |
|  | | | | |
| User plane ciphering configuration (octet 2, bit 5 to 7) | | | | |
| Bits | | | | |
| **7** | **6** | **5** |  |  |
| 0 | 0 | 0 |  | Off |
| 0 | 0 | 1 |  | Off or On |
| 0 | 1 | 0 |  | On |
| 0 | 1 | 1 |  |  |
| to Spare | | | | |
| 1 | 1 | 0 |  |  |
| 1 | 1 | 1 |  | Reserved |
|  | | | | |
| Bit 4 and 8 of octet 2 are spare and shall be coded as zero. | | | | |
|  | | | | |

### 11.3.19 Link modification operation code

The purpose of the Link modification operation code information element is to indicate what the operation of the PC5 unicast link modification procedure triggered by initiating UE is.

The Link modification operation code is a type 3 information element, with a length of 2 octets.

The Link modification operation code information element is coded as shown in figure 11.3.19.1 and table 11.3.19.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Link modification operation code IEI | | | | | | | | octet 1 |
| Link modification operation code | | | | | | | | octet 2 |

Figure 11.3.19.1: Link modification operation code information element

Table 11.3.19.1: Link modification operation code information element

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Link modification operation code (octet 2) | | | | | |
| Bits | | | | | |
| 4 | 3 | 2 | 1 |  |  |
| 0 | 0 | 0 | 1 |  | void |
| 0 | 0 | 1 | 0 |  | void |
| 0 | 0 | 1 | 1 |  | Add new PC5 QoS flow(s) to the existing 5G ProSe direct link |
| 0 | 1 | 0 | 0 |  | Modify PC5 QoS parameters of the existing PC5 QoS flow(s) |
| 0 | 1 | 0 | 1 |  | Remove existing PC5 QoS flow(s) from the existing 5G ProSe direct link |
| 0 | 1 | 1 | 0 |  | Associate new ProSe Application(s) with existing PC5 QoS flow(s) |
| 0 | 1 | 1 | 1 |  | Remove ProSe Application(s) from existing PC5 QoS flow(s) |
| 1 | 0 | 0 | 0 |  |  |
| to | | | |  | Spare |
| 1 | 1 | 1 | 0 |  |  |
| 1 | 1 | 1 | 1 |  | Reserved |
|  | | | | | |
| Bit 5 to 8 of octet 2 are spare and shall be coded as zero. | | | | | |

### 11.3.20 Keep-alive counter

The purpose of the Keep-alive counter information element is to indicate the keep-alive counter which is a 32-bit counter used for the PC5 unicast link keep-alive procedure.

The Keep-alive counter is a type 3 information element with a length of 5 octets.

The Keep-alive counter information element is coded as shown in figure 11.3.20.1 and table 11.3.20.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Keep-alive counter IEI | | | | | | | | octet 1 |
| Keep-alive counter contents | | | | | | | | octet 2 |
|  | | | | | | | | octet 5 |

Figure 11.3.20.1: Keep-alive counter information element

Table 11.3.20.1: Keep-alive counter information element

|  |
| --- |
| Keep-alive counter contents (octet 2 to 5)  This field contains the 32-bit keep-alive counter. |

### 11.3.21 Maximum inactivity period

The purpose of the Maximum inactivity period information element is to indicate the maximum inactivity period of the initiating UE during a PC5 unicast link keep-alive procedure.

The Maximum inactivity period is a type 3 information element, with a length of 5 octets.

The Maximum inactivity period information element is coded as shown in figure 11.3.21.1 and table 11.3.21.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Maximum inactivity period IEI | | | | | | | | octet 1 |
| Maximum inactivity period contents | | | | | | | | octet 2 |
|  | | | | | | | | octet 5 |

Figure 11.3.21.1: Maximum inactivity period information element

Table 11.3.21.1: Maximum inactivity period information element

|  |
| --- |
| Maximum inactivity period contents (octet 2 to 5)  This field contains the binary encoding of the maximum inactivity period expressed in units of seconds. |

### 11.3.22 Selected security algorithms

The purpose of the Selected security algorithms information element is to indicate the algorithms to be used for ciphering and integrity protection.

The Selected security algorithms is a type 3 information element with a length of 2 octets.

The Selected security algorithms information element is coded as shown in figure 11.3.22.1 and table 11.3.22.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Selected security algorithms IEI | | | | | | | | octet 1 |
| 0  spare | Type of ciphering algorithm | | | 0  spare | Type of integrity protection algorithm | | | octet 2 |

Figure 11.3.22.1: Selected security algorithms information element

Table 11.3.22.1: Selected security algorithms information element

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type of integrity protection algorithm (octet 2, bit 1 to 3) | | | | |
| Bits | | | | |
| **3** | **2** | **1** |  |  |
| 0 | 0 | 0 |  | 5GS integrity algorithm 5G-IA0 (null integrity protection algorithm) |
| 0 | 0 | 1 |  | 5GS integrity algorithm 128-5G-IA1 |
| 0 | 1 | 0 |  | 5GS integrity algorithm 128-5G-IA2 |
| 0 | 1 | 1 |  | 5GS integrity algorithm 128-5G-IA3 |
| 1 | 0 | 0 |  | 5GS integrity algorithm 5G-IA4 |
| 1 | 0 | 1 |  | 5GS integrity algorithm 5G-IA5 |
| 1 | 1 | 0 |  | 5GS integrity algorithm 5G-IA6 |
| 1 | 1 | 1 |  | 5GS integrity algorithm 5G-IA7 |
|  | | | | |
| Type of ciphering algorithm (octet 2, bit 5 to 7) | | | | |
| Bits | | | | |
| **7** | **6** | **5** |  |  |
| 0 | 0 | 0 |  | 5GS encryption algorithm 5G-EA0 (null ciphering algorithm) |
| 0 | 0 | 1 |  | 5GS encryption algorithm 128-5G-EA1 |
| 0 | 1 | 0 |  | 5GS encryption algorithm 128-5G-EA2 |
| 0 | 1 | 1 |  | 5GS encryption algorithm 128-5G-EA3 |
| 1 | 0 | 0 |  | 5GS encryption algorithm 5G-EA4 |
| 1 | 0 | 1 |  | 5GS encryption algorithm 5G-EA5 |
| 1 | 1 | 0 |  | 5GS encryption algorithm 5G-EA6 |
| 1 | 1 | 1 |  | 5GS encryption algorithm 5G-EA7 |
|  | | | | |
| Bit 4 and 8 of octet 2 are spare and shall be coded as zero. | | | | |
|  | | | | |

### 11.3.23 UE PC5 unicast user plane security policy

The purpose of the UE PC5 unicast user plane security policy information element is to indicate the UE’s configuration for integrity protection and ciphering of PC5 user plane data.

The UE PC5 unicast user plane security policy is a type 3 information element with a length of 2 octets.

The UE PC5 unicast user plane security policy information element is coded as shown in figure 11.3.23.1 and table 11.3.23.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| UE PC5 unicast user plane security policy IEI | | | | | | | | octet 1 |
| 0  spare | User plane ciphering policy | | | 0  spare | User plane integrity protection policy | | | octet 2 |

Figure 11.3.23.1: UE PC5 unicast user plane security policy information element

Table 11.3.23.1: UE PC5 unicast user plane security policy information element

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| User plane integrity protection policy (octet 2, bit 1 to 3) | | | | |
| Bits | | | | |
| **3** | **2** | **1** |  |  |
| 0 | 0 | 0 |  | User plane integrity protection not needed |
| 0 | 0 | 1 |  | User plane integrity protection preferred |
| 0 | 1 | 0 |  | User plane integrity protection required |
| 0 | 1 | 1 |  |  |
| to Spare | | | | |
| 1 | 1 | 0 |  |  |
| 1 | 1 | 1 |  | Reserved |
|  | | | | |
| If the UE receives a user plane integrity protection policy value that the UE does not understand, the UE shall interpret the value as 010 "user plane integrity protection required".  User plane ciphering policy (octet 2, bit 5 to 7) | | | | |
| Bits | | | | |
| **7** | **6** | **5** |  |  |
| 0 | 0 | 0 |  | User plane ciphering not needed |
| 0 | 0 | 1 |  | User plane ciphering preferred |
| 0 | 1 | 0 |  | User plane ciphering required |
| 0 | 1 | 1 |  |  |
| to Spare | | | | |
| 1 | 1 | 0 |  |  |
| 1 | 1 | 1 |  | Reserved |
|  | | | | |
| If the UE receives a user plane ciphering protection policy value that the UE does not understand, the UE shall interpret the value as 010 "user plane ciphering protection required".  Bit 4 and 8 of octet 2 are spare and shall be coded as zero. | | | | |
|  | | | | |

### 11.3.24 Re-authentication indication

The purpose of the Re-authentication indication information element is to indication that KNRP needs to be refreshed.

The Re-authentication indication information element is a type 3 information element, with a length of 2 octets.

The Re-authentication indication information element is coded as shown in figure 11.3.24.1 and table 11.3.24.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Re-authentication indication IEI | | | | | | | | octet 1 |
| Re-authentication indication contents | | | | | | | | octet 2 |

Figure 11.3.24.1: Re-authentication indication information element

Table 11.3.24.1: Re-authentication indication information element

|  |
| --- |
| Re-authentication indication contents (octet 2)  Bits  **1**  0 Reserved  1 KNRP is requested to be refreshed  Bits 2 to 8 of octet 2 are spare and shall be coded as zero. |
|  |

### 11.3.25 Layer-2 ID

The purpose of the layer-2 ID information element is to indicate the layer-2 ID that is used by UE.

The layer-2 ID is a type 3 information element with a length of 4 octets.

The layer-2 ID information element is coded as shown in figure 11.3.25.1 and table 11.3.25.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
| Layer-2 ID IEI | | | | | | | | octet 1 |
| Layer-2 ID | | | | | | | | octet 2 |
|  | | | | | | | | octet 4 |

Figure 11.3.25.1: Layer-2 ID information element

Table 11.3.25.1: Layer-2 ID information element

|  |
| --- |
| Layer-2 ID (octet 2 to 4)  This field contains the 24-bit layer-2 ID. |

# 12 List of system parameters

## 12.1 Overview

## 12.2 Timers of provisioning of parameters for 5G ProSe configuration procedures

Timers of provisioning of parameters for 5G ProSe configuration are shown in table 12.2.1.

NOTE: Timer T5040 is defined in 3GPP TS 24.587 [18].

Table 12.2.1: Timers of provisioning of parameters for 5G ProSe configuration – UE side

| TIMER NUM. | TIMER VALUE | CAUSE OF START | NORMAL STOP | ON  EXPIRY |
| --- | --- | --- | --- | --- |
| T5051 | TBD | Start using the new UE policies for 5G ProSe direct discovery received in MANAGE UE POLICY COMMAND message | Stop using the old UE policies for 5G ProSe direct discovery | Initiate the UE-requested ProseP provisioning procedure  (NOTE 1) |
| T5052 | TBD | Start using the new UE policies for 5G ProSe direct communications received in MANAGE UE POLICY COMMAND message | Stop using the old UE policies for 5G ProSe direct communications | Initiate the UE-requested ProseP provisioning procedure  (NOTE 1) |
| T5053 | TBD | Start using the new UE policies for 5G ProSe UE-to-network relay received in MANAGE UE POLICY COMMAND message | Stop using the old UE policies for 5G ProSe UE-to-network relay | Initiate the UE-requested ProseP provisioning procedure  (NOTE 1) |
| T5054 | TBD | Start using the new UE policies for 5G ProSe Remote UE received in MANAGE UE POLICY COMMAND message | Stop using the old UE policies for 5G ProSe Remote UE | Initiate the UE-requested ProseP provisioning procedure  (NOTE 1) |
| NOTE 1: The timers expire only once. | | | | |

Editor's note: timer values are FFS.

## 12.3 Timers of 5G ProSe direct link management procedures

Table 12.3.1: 5G ProSe direct link management timers

| **TIMER NUM.** | | **TIMER VALUE** | **CAUSE OF START** | **NORMAL STOP** | **ON  EXPIRY** |
| --- | --- | --- | --- | --- | --- |
| T5080 | | 8s  NOTE 1 | Upon sending a PROSE DIRECT LINK ESTABLISHMENT REQUEST message | Upon receiving a PROSE DIRECT LINK ESTABLISHMENT ACCEPT or PROSE DIRECT LINK ESTABLISHMENT REJECT message from the target UE if the Target user info is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message | Retransmission of PROSE DIRECT LINK ESTABLISHMENT REQUEST message if the Target user info is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; or  may abort the ongoing procedure if the Target user info is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message |
| T5081 | | 5s | Upon sending a PROSE DIRECT LINK MODIFICATION REQUEST message | Upon receiving a PROSE DIRECT LINK MODIFICATION ACCEPT or PROSE DIRECT LINK MODIFICATION REJECT or PROSE DIRECT LINK RELEASE REQUEST message from the target UE | Retransmission of PROSE DIRECT LINK MODIFICATION REQUEST message |
| T5082 | | 2s | Upon sending a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message | Upon receiving a PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT or PROSE DIRECT LINK IDENTIFIER UPDATE REJECT or PROSE DIRECT LINK RELEASE REQUEST message from the target UE | Retransmission of the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message |
| T5083 | | 2s | Upon sending a PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message | Upon receiving a PROSE DIRECT LINK IDENTIFIER UPDATE ACK message or PROSE DIRECT LINK RELEASE REQUEST message from the initiating UE | Retransmission of the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message |
| T5084 | | 5s | Upon receiving a PC5 signalling message or PC5 user plane data | Upon PC5 unicast link release or upon initiating the PC5 unicast link keep-alive procedure | Initiate the PC5 unicast link keep-alive procedure |
| T5085 | | 5s | Upon sending a PROSE DIRECT LINK KEEPALIVE REQUEST message | Upon receiving a PC5 signalling message or PC5 user plane data | Retransmission of the PROSE DIRECT LINK KEEPALIVE REQUEST message |
| T5086 | | Default 10m  NOTE 2 | Upon receiving a Maximum inactivity period in a PROSE DIRECT LINK KEEPALIVE REQUEST message, receiving a PC5 signalling message or receiving PC5 user plane data | Upon receiving a PC5 signalling message or PC5 user plane data | Either initiate the PC5 unicast link keep-alive procedure or the PC5 unicast link release procedure |
| T5087 | | 5s | Upon sending a PROSE DIRECT LINK RELEASE REQUEST message | Upon receiving a PROSE DIRECT LINK RELEASE ACCEPT message from the target UE | Retransmission of PROSE DIRECT LINK RELEASE REQUEST message |
|  | |  |  |  |  |
|  | |  |  |  |  |
|  | |  |  |  |  |
| NOTE 1: If the Target user info is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, then the initiating UE may keep the timer T5080 running upon receiving PROSE DIRECT LINK ESTABLISHMENT ACCEPT message.  NOTE 2: The value of this timer is the privacy timer value which is one of the configuration parameters for 5G ProSe direct communication (see clause 5.2.4) and it is specified in 3GPP TS 24.555 [17] clause 5.4. | | | | | |

## 12.4 Timers of 5G ProSe direct discovery procedures over PC3a

Editor’s note: The messages and elements over PC3a interface are FFS.

Table 12.4.1: Timers of 5G ProSe direct discovery procedures over PC3a – UE side

| TIMER NUM. | | TIMER VALUE | | CAUSE OF START | | NORMAL STOP | | ON  EXPIRY | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| T5060 | | NOTE 1 | | Upon receiving a ProSe Application Code with an associated T5060 timer in a DISCOVERY\_RESPONSE message whose transaction ID contained in the <response-announce> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "announce", as described in clause 6.2.2.4.  Upon receiving a ProSe Application Code with an associated T5060 timer in the Update Info in the <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3. | | Upon receiving a new T5060 timer value for the same ProSe Application Code or receiving a new Timer associated with a new ProSe Application Code for the same ProSe Application ID in a DISCOVERY\_RESPONSE message.  When the UE selects a new PLMN.  Upon receiving a <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3. | | Stop announcing the associated ProSe Application Code over the PC5 interface and re-initiate the announce request procedure if the request from upper layers to announce the ProSe Application ID corresponding to the associated ProSe Application Code is still in place. | |
| T5062 | | NOTE 2 | | Upon receiving a ProSe Restricted Code or ProSe Restricted Code Prefix with an associated T5062 timer in a DISCOVERY\_RESPONSE message whose transaction ID contained in the <restricted-announce-response> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "announce" and the Discovery Type set to "Restrict discovery", as described in clause 6.2.3.4.  Upon receiving a ProSe Restricted Code with an associated T5062 timer in the Update Info in the <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2. | | Upon receiving a new T5062 timer value for the same ProSe Restricted Code or ProSe Restricted Code Prefix, or upon receiving a new T5062 timer associated with a new ProSe Restricted Code or ProSe Restricted Code Prefix for the same RPAUID in a DISCOVERY\_RESPONSE message.  When the UE selects a new PLMN.  Upon receiving a ProSe Restricted Code with an associated T5062 timer in the Update Info in the <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2. | | Stop announcing the associated ProSe Restricted Code over the PC5 interface if the ProSe Restricted Code is already allocated; and re-initiate the announce request procedure if the request from upper layers to announce the RPAUID corresponding to the associated ProSe Restricted Code is still in place. | |
| T5064 | | NOTE 3 | | Upon receiving a Discovery Filter with an associated T5064 timer in a DISCOVERY\_RESPONSE message whose transaction ID contained in the <response-monitor> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "monitor", as described in clause 6.2.4.4.  Upon receiving a Discovery Filter in the Update Info in the <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3. | | Upon receiving a new T5064 timer value for the same Discovery Filter in a DISCOVERY\_RESPONSE message.  Upon receiving a <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3. | | Stop using the associated Discovery Filter for ProSe direct discovery monitoring over the PC5 interface and re-initiate the monitor request procedure, if the request from upper layers to monitor the ProSe Application ID corresponding to the associated Discovery Filter is still in place. | |
| T5066 | | NOTE 4 | | Upon receiving a Restricted Discovery Filter with an associated T5066 timer in a DISCOVERY\_RESPONSE message whose transaction ID contained in the <restricted-monitor-response> element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "monitor" and the Discovery Type set to "Restrict discovery", as described in clause 6.2.5.4.  Upon receiving a Restricted Discovery Filter in the Update Info in the <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2. | | Upon receiving one or more new T5066 timer values for the same discovery entry in a DISCOVERY\_RESPONSE message.  Upon receiving a Restricted Discovery Filter in the Update Info in the <discovery-update-request> element in a DISCOVERY\_UPDATE\_REQUEST message and the Discovery Entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2. | | Stop using the associated Restricted Discovery Filter for restricted ProSe direct discovery monitoring over the PC5 interface and re-initiate the monitor request procedure, if the request from upper layers to monitor the corresponding discovery target is still in place. | |
| T5068 | | NOTE 5 | | Upon receiving a ProSe Response Code and Discovery Query Filters with an associated T5068 timer in a DISCOVERY\_RESPONSE message whose transaction ID contained in the < restricted-discoveree-response > element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "response" and the Discovery Type set to "Restrict discovery", as described in clause 6.2.6.4. | | Upon receiving a new T5068 timer value for the same discovery entry in a DISCOVERY\_RESPONSE message.  When the UE selects a new PLMN. | | Stop announcing the associated ProSe Response Code or monitoring with the associated Discovery Query Filter(s) over the PC5 interface and re-initiate the discoveree request procedure if the request from upper layers to announce the RPAUID in Model B is still in place. | |
| T5070 | | NOTE 6 | | Upon receiving a ProSe Query Code and Discovery Response Filters with an associated T5070 timer in a DISCOVERY\_RESPONSE message whose transaction ID contained in the < restricted-discoverer-response > element matches the value sent by the UE in a DISCOVERY\_REQUEST message with the command set to "query" and the Discovery Type set to "Restrict discovery", as described in clause 6.2.7.4. | | Upon receiving a new T5070 timer value for the same discovery entry in a DISCOVERY\_RESPONSE message. | | Stop announcing the associated ProSe Query Code or monitoring with the associated Discovery Response Filter(s) over the PC5 interface and re-initiate the discoverer request procedure if the request from upper layers to query for the same targets in Model B is still in place. | |
| T5072 | | NOTE 7 | | Upon receiving a T5072 timer in a MATCH\_REPORT\_ACK message whose transaction ID contained in the <match-ack> element matches the value sent by the UE in a MATCH\_REPORT message, as described in clause 6.2.8.4. | | Upon receiving a new T5072 timer value for the same ProSe Application Code in a MATCH\_REPORT\_ACK message.  Upon receiving a MATCH\_REPORT\_ACK message with a <match-reject> element containing PC3a Control Protocol cause value is #5. | | The UE may inform the upper layers that the corresponding ProSe Application ID is no longer matched. | |
| T5074 | | NOTE 7 | | Upon receiving a T5074 timer in a MATCH\_REPORT\_ACK message whose transaction ID contained in the <match-ack> element matches the value sent by the UE in a MATCH\_REPORT message, as described in clause 6.2.8.4. | | Upon receiving a new T5074 timer value for the same ProSe Application Code in a MATCH\_REPORT\_ACK message.  When the corresponding T5074 timer for the ProSe Application Code is stopped or expires. | | The UE needs to  send a Match Report on next instance it detects the corresponding ProSe Application Code. | |
| T5076 | | NOTE 8 | | Upon receiving a T5076 timer in a MATCH\_REPORT\_ACK message whose transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH\_REPORTmessage, as described in clause 6.2.9.4 or 6.2.10.4. | | Upon receiving a new T5076 timer value for the same ProSe Restricted Code or ProSe Response Code in a MATCH\_REPORT\_ACK message.  Upon receiving a MATCH\_REPORT\_ACK message with a <match-reject> element containing PC3a Control Protocol cause value #5. | | The UE may inform the upper layers that the corresponding RPAUID is no longer matched. | |
| T5077 | | NOTE 8 | | Upon receiving a T5077 timer in a MATCH\_REPORT\_ACK message whose transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH\_REPORTmessage, as described in clause 6.2.9.4. | | Upon receiving a new T5077 timer value for the same ProSe Restricted Code or ProSe Response Code in a MATCH\_REPORT\_ACK message.  When the corresponding T5076 timer for the ProSe Restricted Code or ProSe Response Code is stopped or expires. | | The UE needs to  send a Match Report on next instance it detects the corresponding ProSe Restricted Code or ProSe Response Code. | |
| NOTE 1: The value of this timer is provided by the 5G DDNMF during the announce request and discovery update procedure for open ProSe direct discovery.  NOTE 2: The value of this timer is provided by the 5G DDNMF during the announce request and discovery update procedure for restricted ProSe direct discovery model A.  NOTE 3: The value of this timer is provided by the 5G DDNMF during the monitor request and discovery update procedure for open ProSe direct discovery.  NOTE 4: The value of this timer is provided by the 5G DDNMF during the monitor request and discovery update procedure for restricted ProSe direct discovery model A.  NOTE 5: The value of this timer is assigned by the 5G DDNMF during the discoveree request procedure for restricted ProSe direct discovery model B.  NOTE 6: The value of this timer is assigned by the 5G DDNMF during the discoverer request procedure for restricted ProSe direct discovery model B.  NOTE 7: The value of this timer is provided by the 5G DDNMF during the match report procedure for open ProSe direct discovery.  NOTE 8: The value of this timer is provided by the 5G DDNMF during the match report procedure for restricted ProSe direct discovery model  A or match report procedure for restricted ProSe direct discovery model B. | | | | | | | | | |

Table 12.4.2: Timers of 5G ProSe direct discovery procedures over PC3a – 5G DDNMF side

| TIMER NUM. | TIMER VALUE | CAUSE OF START | NORMAL STOP | ON  EXPIRY |
| --- | --- | --- | --- | --- |
| T5061 | NOTE 1 | Upon assigning a ProSe Application Code with an associated T5060 value to the UE, as described in clause 6.2.2.3 and clause 6.2.11.2. | Upon receiving a new DISCOVERY\_REQUEST message from the UE with the command set to "announce" for the same ProSe Application ID. | Delete the association between the UE, the requested ProSe Application ID and the corresponding ProSe Application Code allocated by the 5G DDNMF. |
| T5063 | NOTE 3 | Upon assigning a ProSe Restricted Code or ProSe Restricted Code Prefix with an associated T5062 value to the UE, as described in clause 6.2.3.3 and clause 6.2.12.3.1. | Upon receiving a new DISCOVERY\_REQUEST message from the UE with the command set to "announce" for the same RPAUID or discovery entry ID. Set to be the same as the discovery entry in which this timer is running. | Delete the association between the UE, the RPAUID and the corresponding ProSe Restricted Code or ProSe Restricted Code Prefix allocated by the 5G DDNMF. |
| T5065 | NOTE 2 | Upon assigning a Discovery Filter with an associated T5064 value to the UE, as described in clause 6.2.4.3 and clause 6.2.11.2. | Upon receiving a new DISCOVERY\_REQUEST message from the UE with the command set to "monitor" for the same ProSe Application ID | Delete the association between the UE, the requested ProSe Application ID and the corresponding Discovery Filter allocated by the 5G DDNMF. |
| T5067 | NOTE 4 | Upon assigning a Restricted Discovery Filter with an associated T5066 value to the UE, as described in clause 6.2.5.3 and clause 6.2.12.3.1. | Upon receiving a new DISCOVERY\_REQUEST message from the UE with the command set to "monitor" and discovery entry ID set to be the same as the discovery entry in which this timer is running. | Delete the association between the UE, the RPAUID and the corresponding Restricted Discovery Filter allocated by the 5G DDNMF. |
| T5069 | NOTE 5 | Upon assigning a ProSe Query Code, ProSe Response Code and Discovery Query Filter(s) with an associated T5068 value to the UE, as described in clause 6.2.6.3. | Upon receiving a new DISCOVERY\_REQUEST message from the UE with the command set to "response" for the same RPAUID or discovery entry ID. Set to be the same as the discovery entry in which this timer is running. | Delete the discovery entry in discoveree UE context which contains association between the UE, the RPAUID and the corresponding ProSe Query Code, ProSe Response Code, Discovery Query Filter(s) allocated by the 5G DDNMF. |
| T5071 | NOTE 6 | Upon retrieving the ProSe Query Code, ProSe Response Code from discoveree UE context and assigning Discovery Response Filter(s) with an associated T5070 value to the UE, as described in clause 6.2.7.3. | Upon receiving a new DISCOVERY\_REQUEST message from the UE with the command set to "query" and discovery entry ID set to be the same as the discovery entry in which this timer is running. | Delete the discovery entry in discoverer UE context which contains the association between the UE, the RPAUID and the corresponding Discovery Response Filter(s) allocated by the 5G DDNMF. |
| NOTE 1: The value of this timer is assigned by the 5G DDNMF during the announce request and discovery update procedure for open ProSe direct discovery.  NOTE 2: The value of this timer is assigned by the 5G DDNMF during the monitor request and discovery update procedure for open ProSe direct discovery.  NOTE 3: The value of this timer is assigned by the 5G DDNMF during the announce request and discovery update procedure for restricted ProSe direct discovery model A.  NOTE 4: The value of this timer is assigned by the 5G DDNMF during the monitor request and discovery update procedure for restricted ProSe direct discovery model A.  NOTE 5: The value of this timer is assigned by the 5G DDNMF during the discoveree request procedure for restricted ProSe direct discovery model B.  NOTE 6: The value of this timer is assigned by the 5G DDNMF during the discoverer request procedure for restricted ProSe direct discovery model B. | | | | |

NOTE: Multiple timers T5061, T5063, T5065, T5067, T5069 and T5071 can run simultaneously in the 5G DDNMF.

## 12.5 Timers of broadcast mode 5G ProSe communication over PC5 interface

Table 12.5.1: timers of broadcast mode 5G ProSe communication over PC5

| TIMER NUM. | | TIMER VALUE | CAUSE OF START | NORMAL STOP | ON  EXPIRY |
| --- | --- | --- | --- | --- | --- |
| T5100 | | TBD  NOTE 1 | Upon initiating transmission of broadcast mode 5G ProSe communication over PC5, as described in clause 7.3.2.4.  Upon receiving an indication from upper layers that the application layer identifier has been changed while performing transmission of broadcast mode 5G ProSe communication over PC5, as described in clause 7.3.2.4.  Upon T5aaa expiration while performing transmission of broadcast mode 5G ProSe communication over PC5, as described in clause 7.3.2.4. | Upon stopping transmission of broadcast mode V2X communication over PC5, as described in clause 7.3.2.4. | Change the value of the source layer-2 ID self-assigned by the UE for broadcast mode ProSe communication over PC5.  If the data unit(s) of a ProSe Application contains IP data, change the value of the source IP address self-assigned by the UE for broadcast mode 5G ProSe communication over PC5. |
| NOTE 1: The value of this timer is the privacy timer value which is one of the configuration parameters for 5G ProSe communication over PC5 (see clause 5.2). | | | | | |

Editor's note: timer values are FFS.

Annex A (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2021-2 | CT1#128e | C1-211183 |  |  |  | Draft skeleton provided by the rapporteur. | 0.0.0 |
| 2021-2 | CT1#128e | C1-211184 |  |  |  | Implementing the following p-CR agreed by CT1: C1-211184  Editorial change from the rapporteur. | 0.1.0 |
| 2021-4 | CT1#129e |  |  |  |  | Implementing the following p-CR agreed by CT1: C1-212046, C1-212274, C1-212275, C1-212276, C1-212383, C1-212384, C1-212385, C1-212468, C1-212469, C1-212470, C1-212472, C1-212474, C1-212475, C1-212477, C1-212488, C1-212495, C1-212498, C1-212505, C1-212507, C1-212531, C1-212572, C1-212574, C1-212579, C1-212586, C1-212587, C1-212588, C1-212589, C1-212590, C1-212591, C1-212592, C1-212594  Editorial change from the rapporteur.  Correction from the rapporteur. | 0.2.0 |
| 2021-5 | CT1#130e |  |  |  |  | Implementing the following p-CR agreed by CT1: C1-213020, C1-213755, C1-213043, C1-213044, C1-213045, C1-213046, C1-213202, C1-213674, C1-213203, C1-213205, C1-213568, C1-213569, C1-213570, C1-213571, C1-213572, C1-213843, C1-213802, C1-213770, C1-213768, C1-213767, C1-213667, C1-213668, C1-213670, C1-213671, C1-213756  Editorial change from the rapporteur.  Correction from the rapporteur. | 0.3.0 |