**SA WG2 Meeting #140e *S2-2005756r01***

**Aug 19 – Sep 01, 2020, Electronic, Elbonia** **(revision of S2-XXXXXX)**

**Source: Philips International B.V.**

**Title: KI#3, New Solution: Network assisted relay selection.**

**Document for: Approval**

**Agenda Item: 8.8**

**Work Item / Release: FS\_5G\_ProSe / Rel-17**

*Abstract: This document provides a solution for network assisted relay selection.*

# 1. Discussion

This document proposes a solution in which the network assists the Remote UE in selecting the most suitable UE-to-Network Relay amongst multiple UE-to-Network Relays being in discovery range of the Remote UE. The Remote UE is unlikely to have sufficient information to make an informed decision on which UE-to-Network relay to choose amongst multiple discovered UE-to-Network relays and which UE-to-Network relay is likely the most suitable to perform the relay service that it desires. Hence, the Remote UE may only find out after connecting to the UE-to-Network relay that the UE-to-Network fails to meet its desired performance and/or other requirements. This may lead to a possibly lengthy trial-and-error process.

In this solution the network assists the Remote UE in relay selection based on a number of information sources. For example, the network can take into account information such as the number of sidelink connections and/or number of Remote UEs already being served by a UE-to-Network relay, the number of PDU sessions already running on the UE-to-Network relay and their QoS flows, the capabilities of the UE-to-Network relay, and possibly other types of information typically not available to the Remote UE.

The benefits of this solution is that it avoids the trial and error that could occur when the Remote UE would be solely responsible for the UE-to-Network relay selection, and also reduces the amount of PC5 messaging. It also allows to distribute the load amongst the various UE-to-Network relay devices and not let all Remote UEs connect to the same UE-to-Network relay.

# 2. Text Proposal

It is proposed to capture the following solution in TR 23.752.

\* \* \* \* First change \* \* \* \*

## 6.0 Mapping of Solutions to Key Issues

Table 6.0-1: Mapping of Solutions to Key Issues

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Key Issues | | | | | | | |
| Solutions | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | X |  |  |  |  |  |  | X |
| 2 | X |  |  |  |  |  |  | X |
| 3 | X |  |  |  |  |  |  |  |
| 4 | X | X |  |  |  |  |  |  |
| 5 |  | X |  |  |  |  |  |  |
| 6 |  |  | X |  |  |  |  |  |
| 7 |  |  | X |  |  |  |  | X |
| 8 |  |  |  | X |  |  |  |  |
| 9 |  |  |  | X |  |  |  |  |
| 10 |  |  |  | X |  |  |  |  |
| 11 |  |  |  | X |  |  |  |  |
| 12 |  |  |  |  | X |  |  |  |
| 13 |  |  |  |  |  |  | X |  |
| 14 |  |  |  |  |  |  | X |  |
| 15 |  |  |  |  |  |  | X |  |
| 16 |  |  |  |  |  |  |  | X |
| 17 |  |  |  |  |  |  |  | X |
| 18 | X |  |  |  |  |  |  |  |
| 19 | X |  | X |  |  |  |  |  |
| 20 |  | X |  |  |  |  |  |  |
| 21 |  | X |  |  |  |  |  |  |
| 22 | X | X |  |  |  |  |  |  |
| … | … | … | … | … | … | … | … | … |
| X | X |  | X |  |  |  |  |  |

\* \* \* \* Second change \* \* \* \*

6.x Solution #x: Network assisted relay selection.

6.x.1 Description

In the following solution, the network assists the Remote UE to select which UE-to-Network Relay amongst multiple UE-to-Network Relays being in discovery range of the Remote UE, is best suited to serve the Remote UE. This is helpful because the Remote UE typically does not have all the necessary information to select the UE-to-Network relay that is most suitable to perform the relay service that it desires. For example, one of the discovered UE-to-Network relays may already be serving multiple sidelink connections e.g. serving as relay to other Remote UEs. This may lead to performance issues given that the sidelink resources may need to be shared/divided amongst the various remote UEs, whilst perhaps another discovered UE-to-Network relay is not serving any sidelink communication. Similarly, in case a relay UE is already serving multiple Remote UEs, its uplink/downlink resources over Uu would need to be shared/divided amongst the traffic of various Remote UEs. Also this may lead to performance issues, whilst perhaps another discovered UE-to-Network relay is not serving any Remote UEs, and can be given sufficient uplink/downlink resources to guarantee a required QoS. Also, a discovered UE-to-Network relays may not be able to meet the necessary latency requirements for e.g. URLLC communication, if the UE-to-Network relay has limited capabilities, or is e.g. currently involved in a heavy gaming session requiring a lot of UL/DL communication, whereas another UE-to-Network relay may be “inactive”.

Since the Remote UE does not have all the necessary information for selecting the best UE-to-Network relay amongst multiple discovered UE-to-Network relays, it may only find out after connecting to the UE-to-Network relay that the UE-to-Network fails to meet its desired performance and/or other requirements. This may lead to a possibly lengthy trial-and-error process.

This solution solves this by introducing a new ProSe Relay Selection (PRS) function (that may be combined/integrated with other network functions). Once a Remote UE starts discovering UE-to-Network relays in its vicinity, e.g. based on Model B solicitation or a V2X like Direct Communication Request being broadcasted, the UE-to-Network relays that are discovered report to the ProSe Relay Selection (PRS) function. The PRS can then use a variety of information sources to select one of the UE-to-Network relays amongst the discovered UE-to-Network relays, for example by considering the number of ongoing sidelink connections and/or the number of ongoing PDU sessions from each of the discovered UE-to-Network relay or e.g. the UE capabilities of each of the UE-to-Network relays. By letting the PRS doing the selection based on various sources of information about the different UE-to-Network Relays, it avoids the trial and error that could occur when the Remote UE would be solely responsible for the UE-to-Network relay selection, and also reduces the amount of PC5 messaging. It also allows to distribute the load amongst the various UE-to-Network relay devices and not let all Remote UEs connect to the same UE-to-Network relay. This solution relates to KI#1 and KI#3, and may apply to both Layer-2 (i.e. steps 2, 3 and possibly 4 of solution #7) and Layer-3 relays (i.e. step 2 and 3 of solution #6).

This solution reuses the concept of Relay Service Codes associated with a set of attributes (such as PDU session parameters and/or QoS identifiers, as described in Solutions #16, #24, #28, #35). Relay Service Codes provide a compact way to represent the relay service(s) desired by the Remote UE. For this it is expected that the Remote UE and the PRS are provisioned with a mapping between a set of Relay Service Code and a set of attributes, which may include amongst others one or more of the following:

* + PLMN ID
  + S-NSSAI
  + PDU Session Type
  + 5QI
  + …

For the UE-to-Network relay, depending on other solutions, it should be sufficient to only provision a set of Relay Service Codes, not the entire mapping.

6.x.2 Procedures

SMF

5: Direct Communication Accept or Model B discovery response from the selected UE-to-NW relay

Remote UE

UE-to-NW Relay

NG-RAN

AMF

PRS

UE-to-NW Relay

UE-to-NW Relay

0: Authorization and provisioning of Remote UE and UE-to-Network Relays

1: Direct Communication Request or Model B solicitation request

(incl. requested RSC)

2 Relay Request Report (incl. RSC)

3: PRS selects one of the UE-to-NW relays given the requested RSC, based on e.g. #sidelink connections, #ongoing PDU sessions, UE capabilities, etc. of the UE-to-NW relays.

4: Send Relay Accepted message to selected UE-to-NW relay

6: Initiate relay communication via selected UE-to-NW relay

PCF

**Figure 6.x.2.x: Illustration of the procedure**

**(NOTE: in this simplified illustration it is assumed that all UE-to-NW relays are registered to the same PLMN)**

1. The Remote UE and UE-to-Network Relay are authorized for PC5 communication and relay discovery, and are provisioned with the respective information as described in Section 6.x.1, using one of the solutions for KI#8 “Support of PC5 Service Authorization and Policy/Parameter Provisioning”. Also, the ProSe Relay Selection (PRS) function is given the respective information as described in Section 6.x.1.
2. The Remote UE can initiate discovery of UE-to-Network Relays by sending a Model B solicitation request or a Direct Communication Request over PC5 as specified in TS 23.287 with one or more requested Relay Service Codes (RSCs).
3. One or more UE-to-Network Relays receive the Model B solicitation request or Direct Communication Request over PC5. If the Relay Service Codes in the Direct Communication Request match with one or more RSCs that are known to the UE-to-Network Relay, the UE-to-Network Relay sends a Relay Request Report (incl. the requested RSCs) over NAS, via the AMF, to the ProSe Relay Selection (PRS) function. In order to prevent draining network resources by a malicious Remote UE resulting in a huge amount of Relay Request Reports, the UE-to-Network relay may (based on a policy) limit per Remote UE the maximum number of different Relay Request messages that it may send within a certain time interval and/or may ignore duplicate requests.

NOTE: Further protection against potential malicious use of this mechanism needs to be analyzed by SA3

NOTE: whether the ProSe Relay Selection (PRS) function is a separate function or can be incorporated/combined with another network function, and whether or not the Relay Request Report can be combined with an existing NAS message can be decided during normative phase.

1. Based on the received Relay Request Reports, the PRS selects one of the UE-to-Network relays given the attribute values associated with the received Relay Service Codes. To do this, it may consider for example:

* the number of sidelink connections and/or number of Remote UEs already being served by a UE-to-Network relay (this may be reported e.g. by the UE-to-Network relay or NG-RAN)
* the number of PDU sessions already running on the UE-to-Network relay and their QoS flows (which may e.g. be fetched from the SMF)
* policy control information for UE-to-Network relay selection from the PCF
* UE capabilities/subscription information of the UE-to-Network relays (such as maximum or average aggregated bitrate that is enabled for a UE-to-Network relay, e.g. using information from UDM, AMF)SLA requirements of a network slice associated with a Relay Service Code (which may be obtained from UDR/OAM)
* UE communication predictions of a UE-to-Network relay (which may be reported by the NWDAF)
* Whether or not the Remote UE and UE-to-Network relay belong to the same PLMN (which may be derived from information in the Relay Request Report)
* …

NOTE: Currently not all above mentioned information is available using existing SBA-based interfaces to the various NFs (such as SMF, PCF) or through existing interfaces with NG-RAN or existing NAS protocol. Hence, some interfaces/protocols may need to be extended. Details can be decided during normative phase. Extensions to the NG-RAN interfaces need to be coordinated with RAN WGs.

1. The PRS sends a Relay Accepted message to the selected UE-to-Network Relay and may inform the other UE-to-Network Relays that have not been selected.

Editor’s Note: It is FFS whether or not a UE-to-Network relay should expose PLMN information in its response message, or that this information will be made available through other means, in order to avoid UE-to-Network relays that are registered to PLMNs that the Remote UE is not interested in (this depends on other solutions in the document),

1. The selected UE-to-Network Relay sends a Direct Communication Accept message or a Model B discovery response message to the Remote UE.
2. The Remote UE can now further initiate relay communication via the selected UE-to-NW relay.

6.7.4 Impacts on Existing Nodes and Functionality

This solution may impact the following entities:

**Remote UE:**

* Support for using Model B solicitation request or Direct Communication Request with Relay Service Codes.
* Support provisioning of Relay Service Codes and related attributes.

**UE-to-Network Relay:**

* Support for using Model B solicitation request or Direct Communication Request with Relay Service Codes.
* Support provisioning of Relay Service Codes.
* Support Relay Request reporting.
* Support Relay Accepted messages.

**ProSe Relay Selection function (PRS):**

* Support configuring the mapping of Relay Service Codes and related attributes.
* Support selection of UE-to-Network Relays based on several information sources.
* Support extended interfaces to various other NFs (such as SMF, PCF)
* Support Relay Request reporting
* Support Relay Accepted messages.

\* \* \* \* End of changes \* \* \* \*