**3GPP TSG RAN2 #116-e R2-21xxxxx**

**Online, 1 – 12 November 2021**

**Agenda Item:**  **8.13.2.3 Other WID related SON features**

**Source: Huawei (email rapporteur)**

**Title:** **Report of [Post115-e][897][SON/MDT] Modeling aspects related to information required by SN/SCG (Huawei)**

**Document for: Discussion and Decision**

### 1 Introduction

This is the email report of [Post115-e][897] Modeling of SN and SCG information reporting:

* [Post115-e][897][SON/MDT] Modeling aspects related to information required by SN/SCG (Huawei)

 Scope:

 Progress on the open issues in 8.13.2.3

 Progress on ASN.1 modeling which will help us understand the overhead issue.

 Intended outcome: Report

 Deadline: October 21th, 0900 UTC

It is proposed to set the following deadlines for this email discussion:

* Phase 1: collect companies’ opinions. Deadline: October 18th, 0900 UTC
* Phase 2: finalize the summary. Deadline: October 21th, 0900 UTC

Please add company contact details into the following table.

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email Address** |
| Intel | Candy | Candy.yiu@intel.com |
| Qualcomm | Rajeev | rkum@qti.qualcomm.com |
| Nokia, Nokia Shanghai Bell | Gosia | malgorzata.tomala@nokia.com |
| Samsung | Sangbum Kim | Sb07.kim@samsung.com |
| vivo | Ming WEN  | ming.wen@vivo.com |
| Huawei, HiSilicon | Jun Chen | jun.chen@huawei.com |
| CATT | Jie Shi | shijie@catt.cn |
| Lenovo | Lianhai Wu | Wulh5@lenovo.com |
| Ericsson | Pradeepa Ramachandra | pradeepa.ramachandra@ericsson.com |
| ZTE | Qiu Zhihong | qiu.zhihong@zte.com.cn |
| NTTDOCOMO | Tianyang Min | tianyang.min.ex@nttdocomo.com |
| ITRI | Nai-Lun Huang | NellenHuang@itri.org.tw |

### 2 Discussion

#### 2.1 Background of report of SCG Failure Information

RAN2#115-e agreements are:

***Report and Content of SCG Failure Information:***

6 RAN2 confirms that the 5 information requested by RAN3 LS ‎ R3-211332 ‎ are needed, and how to report them to the network could be further discussed.

The parameters are listed as below:

RAN3 discussed the solution for the optimization of PScell change failure for MRO in case of MR-DC. RAN3 agreed it is beneficial for the NG-RAN node to receive the list of information as shown below for the purpose of PSCell failure analysis:

1) CGI of the Source PSCell: the source PSCell of the last SN change. The source PSCell could be E-UTRA cell or NR cell.

2) CGI of the Failed PSCell: the PSCell in which SCG failure is detected or the target PSCell of the failed PScell change. The Failed PSCell could be E-UTRA cell or NR cell.

3) timeSCGFailure: the time elapsed since the last PSCell change initialization until SCG failure.

4) connectionFailureType: radio link failure or SN change failure.

5) random-access related information set by the PSCell

One company had strong concerns on re-using existing SCG failure messages because of overhead issues. Among all parameters, the overhead and the need of RA related information are controversial. While other parameters did not have large overhead.

* random-access related information set by the PSCell: 7 companies (7/11) support to report this information, and 4 companies (4/11) think it is open or not needed, and we should first decide if SgNB RACH report could include SCG failure scenario which can cover the RA failure case.

To be more detailed, here is a rough calculation about the relevant parameters:

|  |  |
| --- | --- |
| Needed parameters (due to RAN3 LS R3-211332) | Rough calculations |
| CGI of the Source PSCell(NR cell is assumed here) | Total: at most 84 bitsIf following CGI-Info-Logging-r16:* PLMN id (24 bits)
* Cell id (36 bits)
* TAC (24 bits) optional
 |
| CGI of the Failed PSCell(NR cell is assumed here) | Total: at most 84 bits |
| timeSCGFailure | Total: 10 bitsIf followingtimeConnFailure-r16: (actual value=field value\*100ms)* 10 bits
 |
| connectionFailureType | Total: 1 bit |
| RA information | Total: dependsIf following RA-InformationCommon-r16:* Couple of fields, and PerRAInfoList-r16 may be large as it may include at most 200 entries
 |

In general, the first 4 parameters are around 179 bits, and the size of RA information may be very large.

In [3], regarding how to report the information, the rapporteur’s summary is as below:

|  |
| --- |
| **Rapporteur summary and suggested WF**Almost all companies think P9/P10/P11/P12/P15 acceptable, and one company has strong concern on reusing existing SCG failure information messages to carry MRO related measurements, and suggests to use a separate message other than existing SCG failure messages. One company thinks P5 may not be needed. For P14, since it is for separate message, most companies do not support it.As these have been discussed multiple times and these proposals got support by great majority, and it is unclear how further discussions would help to find a even better WF. Therefore Rapporteur suggests checking if the following could be agreeable.  |

#### 2.2 Discussion how to report SCG Failure Information

It is understood that the strong concern is about the negative impacts of introducing more parameters for the existing SCG failure messages, especially about RA information. It seems that the first 4 parameters can be put to the existing SCG failure message, and for RA information, the overhead depends on the the actual RA behaviours. So there may be the following candidate options:

* Option 1: put RA information in the existing SCG failure message
* Option 2: put RA information in RA report. At RAN2#115-e, it was agreed to extend RA report for both successful and failure on-demand SI request, and option 2 can follow the same way as for on-demand SI reporting, i.e. extend RA report for Pscell change failure scenario

The examples of ASN.1 changes of option 1 and option 2 are provided in section 5 Annex.

**Question 1: Which of options is preferred? If you have another option, please add it in the table below and also add ASN.1 changes in section 5 Annex if needed.**

|  |  |  |
| --- | --- | --- |
| **Company name** | **Preferred option** | **Comments** |
| Intel | Option 2 | It seems reasonable to put the RA information (due to large size) in the RA report.  |
| Qualcomm | Option 2 | Agree with Intel |
| Nokia, Nokia Shanghai Bell | Option 1 | If option 2 is used, the node that is responsible from the SCG failure (e.g. source/last serving SN or MN) would need to receive both SCG failure message and RA report from the UE to perform MRO / SON optimizations each time an SCG failure occurs. Instead, option 1 can be used, and RA information can be included to the report by the UE only when necessary, e.g., the UE would not include RA information to the SCG failure message in case of too late handover failure. That way, RA information would not be unnecessarily transmitted.  |
| Samsung | Option 1 | We prefer a simple way.If go for the option 2, we may need to also update the field raPurpose with a new cause value to indicate the PSCell change failure. |
| vivo | Option 1 | The difference between on-demand SI reporting and SCG failure message is that:* for the former feature the successful and failure reports can be separated received by the NW (because it’s literally two different events);
* while for the latter feature the RA information is part of the SCG failure information and must be correlated each time the event occurs (since the two parts of information are created due to a single event), so that the NW can have a full picture of the failure.

Thus it is more straight-forward to include the RA information to the same message together with other elements.This is actually very similar to the SHR case where we are discussing the need of including the ra-InformationCommon of RA report (on top of existing RA report mechanism). A unified solution should be adopted for both cases.Our preference for the SHR case is that the RA information can be included conditionally instead of being mandatory present, so here we would like to go for Option 1  |
| Huawei, HiSilicon | Option 2 | We slightly prefer option 2 because we would like to avoid signaling impacts due to RA report in SCG failure information message.For option 2, one concern is that the network has to merge SCG failure information message and RA report to perform MRO/SON optimization, our views are normally similar measurements should be grouped in one functionality (e.g. for RA report) and the measurements can be flexibly combined with other measurements for the network. So we do not see a big issue for network to correlate these measurements.In addition, we are open for option 1. As mentioned by some companies, some means can be considered in order to minimize the overhead impacts, and one alternative could be that the network can indicate to the UE whether RA information is allowed to be included in the SCG failure information. |
| Sharp  | Option 1 | RA information is part of the falure information, then option 1 is preferred. We donot see any overhead issue for this. |
| CATT | Option 1 | SCG failure is an immediate procedure, the SCG failure message will be transmitted to network once the SCG failure is occurred at UE, but the RA report is a UE triggered NW request procedure, and the RA report can be stored in UE and requested by the NW after some hours. We think it is hard to merge them together considering the specific content in the RA report and SCG failure message to perform the MRO/SON optimizations, it may need large memory to store all the information in the gNB before merging. |
| Lenovo | Option 1 | In option 2, network has to correlate with two message. We prefer to have a simple way that the information related with one failure can be merged to one single message. |
| Ericsson | Option 2 or a new message altogether or RLF report | We do not want to increase the size of a mandatory message like SCGFailureInformation and the size of RA-InformationCommon is not small at all. Consdiering there will be CPC/CPAC related SCG faiure enhancements, if one wants to make our work future proof, we should think of including a new message that can carry the RA related information in Rel-17 and it can carry further information related to CPAC/CPC failures in Rel-18. We request companies to give a thought regarding the Rel-18 work on the decision we take now!  |
| ZTE | Option 1 | It is hard to link RA-report with SCG failure information considering RA-report is retrieved later and might be deleted. RA information is not required at all time, it only needs to be included in case of RA problem/BFR resulted RLF and HOF, thus the overhead shall be bearable. |
| NTTDOCOMO | Option1 or a new message | Option1 is straightforward. while considering CPAC related enhancements in rel-18, a new SCG failure info message for SON purpose may be more reasonable. For option2, correlating SCG failure info and RA information may not be an easy work for the network. |
| ITRI | Option 1 | Option 1 collects falure information in one message while option 2 puts RA related information and other information in two separate messages. We prefer the former as it is simpler and the network need not receive and correlate with two messages for MRO/SON optimization. Moreover, we agree with Nokia, vivo, and ZTE that RA information is not mandatory present. It can be included in SCG failure message only when necessary. |

**Summary:**

Option 1: 9 (can be included in SCG failure message only necessary)

* Condition 1: the UE would not include RA information to the SCG failure message in case of too late handover failure.
* Condition 2: it only needs to be included in case of RA problem/BFR resulted RLF and HOF

Option 2: 4

New message: 2

**Summary proposal 1: Put RA information in the existing SCG failure message when some conditions are met, e.g. the UE would not include RA information to the SCG failure message in case of too late handover failure, and the UE only needs to include RA information in case of RA problem/BFR resulted RLF and HOF.**

#### 2.3 Discussion on details for new parameters

There are some FFSes captured in the minutes, and P10 has been covered by Q1. For P11 and P12, both proposals are about the parameter details, so it is proposed to collect companies’ opinions.

**FFS:**

**Proposal 10 Reuse existing SCG failure messages to transfer the SCG failure information for PSCell ‎failure analysis requested by RAN3.‎**

**Proposal 11 If reuse existing SCG failure messages, add new fields for the first 3 information (i.e., ‎CGI of the Source PSCell, CGI of the Failed PSCell, and timeSCGFailure) requested in RAN3 LS R3-211332.**

**Proposal 12 If reuse existing SCG failure messages, reuse existing field of failureType for the 4th information (i.e., ‎connectionFailureType‎) requested in RAN3 LS R3-211332 ‎.**

**Proposal 15 Check with RAN3 first about whether EN-DC and NG-EN-DC scenarios are in the consideration of RAN3 LS R3-211332 for the SCG failure recording for the purpose of PSCell failure analysis.**

For the first 4 parameters, possible ASN.1 changes are listed is in the following table:

|  |  |
| --- | --- |
| Needed parameters (due to RAN3 LS R3-211332) | Possible ASN.1 changes (based on TS 38.331 v16.5.0) |
| 1) CGI of the Source PSCell | New parameter and optional. The filed could refer to CGI-Info-Logging-r16.CGI-Info-Logging-r16 ::= SEQUENCE { plmn-Identity-r16 PLMN-Identity, cellIdentity-r16 CellIdentity, trackingAreaCode-r16 TrackingAreaCode OPTIONAL}In Rel-16, RAN3 sent a LS R2-2000028/R3-197668 to ask about adding TAI for MRO, and then RAN2 agreed to add TAC into CGI info. Whether TAC is needed for parameter 1) may need to be checked by RAN3. |
| 2) CGI of the Failed PSCell | New parameter and optional. The filed could refer to CGI-Info-Logging-r16. TAC part may need to be checked by RAN3.CGI-Info-Logging-r16 ::= SEQUENCE { plmn-Identity-r16 PLMN-Identity, cellIdentity-r16 CellIdentity, trackingAreaCode-r16 TrackingAreaCode OPTIONAL} |
| 3) timeSCGFailure | New parameter and optional. The definition can reference timeConnFailure-r16timeConnFailure-r16 INTEGER (0..1023)Field description: Actual value = field value \* 100ms. The maximum value 1023 means 102.3s or longer. |
| 4) connectionFailureType | New parameter and optional. The defintion can reference connectionFailureType-r16.connectionFailureType-r16 ENUMERATED {rlf, hof}, |

**Question 2: Do you agree with the above ASN.1 analysis on the first 4 parameters?**

|  |  |  |
| --- | --- | --- |
| **Company name** | **Yes/No** | **Comments** |
| Intel | Yes |  |
| Qualcomm | Yes |  |
| Nokia, Nokia Shanghai Bell | No | We do not support (4). In our view, failureType IE inside SCGFailureInformation message already contains the necessary information, and extra field for indicating RLF and HOF is not needed. |
| Samsung | Yes |  |
| vivo | Yes |  |
| Huawei, HiSilicon | Yes | For (4), RAN3 mentioned in their LS that the parameter is beneficial for the NG-RAN, and then RAN2 may need to discuss how to capture it, e.g. a new IE, or rely on existing failureType IE. |
| Sharp  | Yes for 1~3 | For (4), we share Nokia’s view. |
| CATT | Yes |  |
| Lenovo | Yes for 1-3.  | Regarding 4, we agree with Nokia. RLF information has been included in SCGfailureinformation message. |
| Ericsson | NO to all (see comments for reasoning) | Firstly, we would like to get some clarification regarding which message is used to carry these fields.If it is the existing *SCGFailureInformation*, then we think none of the above four fields are needed at all. Here are the reasoning.1. If the *failureType* in *SCGFailureInformation* message is set to *synchReconfigFailureSCG* then the *connectionFailureType* is *HOF*, otherwise *connectionFailureType* is *RLF*. Therefore *connectionFailureType* is not required in *SCGFailureInformation*.
2. As the *SCGFailureInformation* message is sent immediately to the MN, the value of *timeSCGFailure* is expected to be 0 most of the times if not all of the times. Therefore, *timeSCGFailure* is also not required in *SCGFailureInformation* message.
3. If the *failureType* in *SCGFailureInformation* message is set to *synchReconfigFailureSCG* then this is a HOF and as the *SCGFailureInformation* is sent to the MN immediately and as the UE context is still present in the network side (both at MN and SN), the network should be able to figure out that the failed PSCell is the target cell of the PSCell change procedure and also the previous PSCell that sent the PSCell change command to the UE. Thus including *failedPSCell* and *previousPSCell* is not required in the *SCGFailureInformation* message when *failureType* in *SCGFailureInformation* message is set to *synchReconfigFailureSCG*.
4. If the *failureType* in *SCGFailureInformation* message is set to a value other than *synchReconfigFailureSCG* then this is a RLF on SCG and as the *SCGFailureInformation* is sent to the MN immediately and as the UE context is still present in the network side (both at MN and SN), the network should be able to figure out that the failed PSCell is the current PSCell. Thus including *failedPSCell* and *previousPSCell* is not required in the *SCGFailureInformation* message when *failureType* in *SCGFailureInformation* message is set to a value other than *synchReconfigFailureSCG*.

**Based on the above analysis, sending the listed four information elements in the *SCGFailureInformation* message is redundant and thus we do not support the inclusion of these four fields in the *SCGFailureInformation* message as this increases the size of a mandatory message without bringing any value.**So, we are not fine with option-1 or option-2 provided in the Annex. |
| ZTE | Yes for 1-3, and further discussion on 4 | As for (4), since there are alreay failureType included in SCG Failure message which is mandatory thus to have a new failureType simply to differentiate HOF from RLF seems a bit redundant. As commented in previous discussion, we think one issue to purely rely on the existing failureType is that UE will miss categorized an reconfigurationWithSyncFailure(will be classified as HOF) as RandomAccessProblem(will be classified as RLF), because when deciding SN failure cause, UE will not check T304 status. Therefore in respect of the principle that reuse as much as possible the existing field, we also agree we can reuse failureType, but with a small enhancement that one indication can be included to indicate whether T304 is running. Then based on this indication together with failureType NW can deduce the failure type correctly.  |
| NTTDOCOMO | Yes |  |
| ITRI | Yes for 1~3 | For (4), we share the same view with Nokia. |

**Summary:**

Agree to put parameter 1, 2 and 3 (new parameter and optional) in UL RRC message:

* Yes: 11
* No: 1 (Ericsson provided some analysis to explain why all 3 parameters are not needed)

For parameter 4:

* Introduce a new parameter (like existing connectionFailureType-r16): 7
* Rely on existing failureType: 6
	+ Nokia/Sharp/Lenovo/ITRI: failureType IE inside SCGFailureInformation message already contains the necessary information, and extra field for indicating RLF and HOF is not needed.
	+ Ericsson: if it is the existing *SCGFailureInformation*, then we think none of the above four fields are needed at all.
	+ ZTE: we can reuse failureType, but with a small enhancement that one indication can be included to indicate whether T304 is running. Then based on this indication together with failureType NW can deduce the failure type correctly.

As mentioned by Ericsson, the first 4 parameters in the RAN3 LS can be implicitly indicated via existing Ies if using SCGFailureInformation message. In addition, ZTE proposed an enhancement so that NW can deduce the failure type correctly. So it is proposed to discuss the following observations (1) to 4) are from Ericsson, and 5) is from ZTE), and based on the companies’ opinions, we could decide whether new parameters are needed or not.

**Observations:**

1. If the *failureType* in *SCGFailureInformation* message is set to *synchReconfigFailureSCG* then the *connectionFailureType* is *HOF*, otherwise *connectionFailureType* is *RLF*. Therefore *connectionFailureType* is not required in *SCGFailureInformation*.
2. As the *SCGFailureInformation* message is sent immediately to the MN, the value of *timeSCGFailure* is expected to be 0 most of the times if not all of the times. Therefore, *timeSCGFailure* is also not required in *SCGFailureInformation* message.
3. If the *failureType* in *SCGFailureInformation* message is set to *synchReconfigFailureSCG* then this is a HOF and as the *SCGFailureInformation* is sent to the MN immediately and as the UE context is still present in the network side (both at MN and SN), the network should be able to figure out that the failed PSCell is the target cell of the PSCell change procedure and also the previous PSCell that sent the PSCell change command to the UE. Thus including *failedPSCell* and *previousPSCell* is not required in the *SCGFailureInformation* message when *failureType* in *SCGFailureInformation* message is set to *synchReconfigFailureSCG*.
4. If the *failureType* in *SCGFailureInformation* message is set to a value other than *synchReconfigFailureSCG* then this is a RLF on SCG and as the *SCGFailureInformation* is sent to the MN immediately and as the UE context is still present in the network side (both at MN and SN), the network should be able to figure out that the failed PSCell is the current PSCell. Thus including *failedPSCell* and *previousPSCell* is not required in the *SCGFailureInformation* message when *failureType* in *SCGFailureInformation* message is set to a value other than *synchReconfigFailureSCG*.
5. we think one issue to purely rely on the existing failureType is that UE will miss categorized an reconfigurationWithSyncFailure(will be classified as HOF) as RandomAccessProblem(will be classified as RLF), because when deciding SN failure cause, UE will not check T304 status. We can reuse failureType, but with a small enhancement that one indication can be included to indicate whether T304 is running.

**Question 2a: Do you agree with the above observations 1), 2), 3), 4) and 5)?**

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| **Company name** | **Yes/No** | **Comments** |
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For the 5th parameter, possible ASN.1 changes are listed is in the following table.

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| --- | --- |
| Needed parameter (due to RAN3 LS R3-211332) | Possible ASN.1 changes (based on TS 38.331 v16.5.0) |
| 5) random-access related information set by the PSCell | New parameter and optional. The parameter could refer to RA-InformationCommon-r16RA-InformationCommon-r16 ::= SEQUENCE { absoluteFrequencyPointA-r16 ARFCN-ValueNR, locationAndBandwidth-r16 INTEGER (0..37949), subcarrierSpacing-r16 SubcarrierSpacing, msg1-FrequencyStart-r16 INTEGER (0..maxNrofPhysicalResourceBlocks-1) OPTIONAL, msg1-FrequencyStartCFRA-r16 INTEGER (0..maxNrofPhysicalResourceBlocks-1) OPTIONAL, msg1-SubcarrierSpacing-r16 SubcarrierSpacing OPTIONAL, msg1-SubcarrierSpacingCFRA-r16 SubcarrierSpacing OPTIONAL, msg1-FDM-r16 ENUMERATED {one, two, four, eight} OPTIONAL, msg1-FDMCFRA-r16 ENUMERATED {one, two, four, eight} OPTIONAL, perRAInfoList-r16 PerRAInfoList-r16, ...} |

**Question 3: Do you agree with the above ASN.1 analysis on the 5th parameter?**

|  |  |  |
| --- | --- | --- |
| **Company name** | **Yes/No** | **Comments** |
| Intel | Yes |  |
| Qualcomm | Yes |  |
| Nokia, Nokia Shanghai Bell | No | Further discussion is needed on which IEs are needed within the current RA-InformationCommon-r16 and which new IEs are needed. It also depends on Q1. |
| Samsung | Yes |  |
| vivo | Yes |  |
| Huawei, HiSilicon | Yes | We agree with Nokia that Q3 depends on Q1, and if option 1 is to be selected in Q1, we think RA-InformationCommon-r16 is a baseline for RA information. |
| Sharp  | Yes  |  |
| CATT | Yes |  |
| Lenovo | Yes |  |
| Ericsson | See comments | We are fine to include the RA-InformationCommon-r16 in the message but we should discuss about message carries it as that will influence the outcome of how much information is acceptable in the RA-InformationCommon-r16 |
| ZTE | Yes | Can be used as a baseline. But we are also wondering if we shall consider use -r17 version, i.e., considering also R17 enhancements on 2stepRA since we just reusing the same IE, the specs impact is limited. |
| NTTDOCOMO | Yes |  |
| ITRI | Yes |  |

**Summary:**

Yes: 11

No: 1

Comments: 1

**Summary proposal 2: RA-InformationCommon-r16 is used as a baseline to indicate random-access related information set by the PSCell.**

The intention of this email is to progress on the open issues in 8.13.2.3 (RAN2#115-e minutes), and if something is missing, please provide your comments in the table below.

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| **Company name** | **Comments** |
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### 3 Conclusion

**Summary proposal 1: Put RA information in the existing SCG failure message when some conditions are met, e.g. the UE would not include RA information to the SCG failure message in case of too late handover failure, and the UE only needs to include RA information in case of RA problem/BFR resulted RLF and HOF.**

**Summary proposal 2: RA-InformationCommon-r16 is used as a baseline to indicate random-access related information set by the PSCell.**

### 4 References

[1] R2-115-e SONMDT HuNan 2021-08-27-0616 UTC

[2] R2-2107825 Report of [Post114-e][852][SON\_MDT] Modeling aspects related to information required by SN/SCG CATT

[3] R2-2108964 Report of [AT115e][871][SON/MDT] Modeling aspects related to information required by SN/SCG (CATT)

[4] R2-2109208 Reply LS on RACH report for SgNB and information needed for MRO in SCG Failure Report

[5] R2-2102639/R3-211332 LS on information needed for MRO in SCG Failure Report

[6] R2-2000028/R3-197668 LS on information needed for MRO in UE RLF Report

[7] TS 38.331 v16.5.0

### 5 Annex

**ASN.1 changes for option 1: (based on TS 38.331 v16.5.0)**

New changes are marked in red.

*– SCGFailureInformation*

The *SCGFailureInformation* message is used to provide information regarding NR SCG failures detected by the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

***SCGFailureInformation* message**

-- ASN1START

-- TAG-SCGFAILUREINFORMATION-START

SCGFailureInformation ::= SEQUENCE {

 criticalExtensions CHOICE {

 scgFailureInformation SCGFailureInformation-IEs,

 criticalExtensionsFuture SEQUENCE {}

 }

}

SCGFailureInformation-IEs ::= SEQUENCE {

 failureReportSCG FailureReportSCG OPTIONAL,

 nonCriticalExtension SCGFailureInformation-v1590-IEs OPTIONAL

}

SCGFailureInformation-v1590-IEs ::= SEQUENCE {

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

FailureReportSCG ::= SEQUENCE {

 failureType ENUMERATED {

 t310-Expiry, randomAccessProblem,

 rlc-MaxNumRetx,

 synchReconfigFailureSCG, scg-ReconfigFailure,

 srb3-IntegrityFailure, other-r16, spare1},

 measResultFreqList MeasResultFreqList OPTIONAL,

 measResultSCG-Failure OCTET STRING (CONTAINING MeasResultSCG-Failure) OPTIONAL,

 ...,

 [[

 locationInfo-r16 LocationInfo-r16 OPTIONAL,

 failureType-v1610 ENUMERATED {scg-lbtFailure-r16, beamFailureRecoveryFailure-r16,

 t312-Expiry-r16, bh-RLF-r16, spare4, spare3, spare2, spare1} OPTIONAL

 ]],

 [[

 field1 CGIOfTheSourcePScell OPTIONAL,

 field2 CGIOfTheFailedPScell OPTIONAL,

 field3 TimeSCGFailure OPTIONAL,

 field4 ConnectionFailureType OPTIONAL,

 field5 RA-InformationCommon-r16 OPTIONAL

]]

}

MeasResultFreqList ::= SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR

-- TAG-SCGFAILUREINFORMATION-STOP

-- ASN1STOP

**ASN.1 changes for option 2: (based on TS 38.331 v16.5.0)**

New changes are marked in red.

*– SCGFailureInformation*

The *SCGFailureInformation* message is used to provide information regarding NR SCG failures detected by the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

***SCGFailureInformation* message**

-- ASN1START

-- TAG-SCGFAILUREINFORMATION-START

SCGFailureInformation ::= SEQUENCE {

 criticalExtensions CHOICE {

 scgFailureInformation SCGFailureInformation-IEs,

 criticalExtensionsFuture SEQUENCE {}

 }

}

SCGFailureInformation-IEs ::= SEQUENCE {

 failureReportSCG FailureReportSCG OPTIONAL,

 nonCriticalExtension SCGFailureInformation-v1590-IEs OPTIONAL

}

SCGFailureInformation-v1590-IEs ::= SEQUENCE {

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

FailureReportSCG ::= SEQUENCE {

 failureType ENUMERATED {

 t310-Expiry, randomAccessProblem,

 rlc-MaxNumRetx,

 synchReconfigFailureSCG, scg-ReconfigFailure,

 srb3-IntegrityFailure, other-r16, spare1},

 measResultFreqList MeasResultFreqList OPTIONAL,

 measResultSCG-Failure OCTET STRING (CONTAINING MeasResultSCG-Failure) OPTIONAL,

 ...,

 [[

 locationInfo-r16 LocationInfo-r16 OPTIONAL,

 failureType-v1610 ENUMERATED {scg-lbtFailure-r16, beamFailureRecoveryFailure-r16,

 t312-Expiry-r16, bh-RLF-r16, spare4, spare3, spare2, spare1} OPTIONAL

 ]],

 [[

 field1 CGIOfTheSourcePScell OPTIONAL,

 field2 CGIOfTheFailedPScell OPTIONAL,

 field3 TimeSCGFailure OPTIONAL,

 field4 ConnectionFailureType OPTIONAL

]]

}

MeasResultFreqList ::= SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR

-- TAG-SCGFAILUREINFORMATION-STOP

-- ASN1STOP

RA report is extended to support Pscell change failure scenario, and it may have some impacts:

* For ASN.1, it may need to differentiate among different scenarios, e.g. on-demand SI, Pscell failure
* For the procedural text, it may need some changes, e.g. when the UE occurs PSCell failure, the UE should set RA information and relevant fields

UEInformationResponse-r16-IEs ::= SEQUENCE {

 measResultIdleEUTRA-r16 MeasResultIdleEUTRA-r16 OPTIONAL,

 measResultIdleNR-r16 MeasResultIdleNR-r16 OPTIONAL,

 logMeasReport-r16 LogMeasReport-r16 OPTIONAL,

 connEstFailReport-r16 ConnEstFailReport-r16 OPTIONAL,

 ra-ReportList-r16 RA-ReportList-r16 OPTIONAL,

 rlf-Report-r16 RLF-Report-r16 OPTIONAL,

 mobilityHistoryReport-r16 MobilityHistoryReport-r16 OPTIONAL,

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

RA-ReportList-r16 ::= SEQUENCE (SIZE (1..maxRAReport-r16)) OF RA-Report-r16

RA-Report-r16 ::= SEQUENCE {

 cellId-r16 CHOICE {

 cellGlobalId-r16 CGI-Info-Logging-r16,

 pci-arfcn-r16 SEQUENCE {

 physCellId-r16 PhysCellId,

 carrierFreq-r16 ARFCN-ValueNR

 }

 },

 ra-InformationCommon-r16 RA-InformationCommon-r16 OPTIONAL,

 raPurpose-r16 ENUMERATED {accessRelated, beamFailureRecovery, reconfigurationWithSync, ulUnSynchronized,

 schedulingRequestFailure, noPUCCHResourceAvailable, requestForOtherSI,

 spare9, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1},

 ...

}