3GPP TSG-RAN WG2 Meeting #105bis R2-1903747

Xian, China, April 8 - 12, 2019

Agenda Item: 10.4.1.3.11

Source: Qualcomm Incorporated

Title: Summary of email discussion [105#40][NR] UE capability procedure processing delay

Document for: Discussion, Decision

# Introduction

This offline discussion is to discuss the following issue identified in RAN2#105.

Agreements

1 For TS 38.331, RRC processing delay for UE capability transfer is [15-80] ms.

2 For TS 36.331, RRC processing delay for UE capability transfer to report NR band combinations and/or MR-DC band combinations is corrected to [15-80] ms.

3 Not define RRC processing delay for the combined procedure of SecurityModeCommand and RRCConnectionReconfiguration.

4 RRC processing delay for RRCReestablishment is 10 ms

5 Not define RRC processing delay for the combined procedure of RRCReestablishment and RRCConnectionReconfiguration.

=> Offline discussion to progress the UE capability transfre number (Offline discussion 87, Qualcomm)

# What to discuss?

It was pointed out during the discussion that since carrier aggregation is introduced, the filtering of UE capability (e.g. “requested bands”) is getting more and more complex and computation demanding. It was also pointed out that the amount of RRC processing at the UE can vary depending on the form of UE capability filter used to derive the UE capability.

One possible approach may be to discuss whether we can define the condition on how the UE capability is enquired by the network. For example, it may be possible to agree on the form of UE capability filter as a condition to define the UE requirement.

**Q1:** Do companies agree it is a good way to make progress on the issue?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Ericsson |  | We don’t think it is worth spending a lot of effort on trying to predict which filter-component will require how much processing effort in the UE. It will not only depend on the provided filter components but also on the bands and features (and combinations thereof) that a UE supports. We also acknowledge that the UE capability handling is very processing intense and are therefore fine to specify a maximum processing delay of 60ms as suggested by QC originally. If UEs fulfil this requirement for complex filter/capability combinations they will certainly achieve lower latency for simpler combinations. But in RAN2 we don’t need to spend time discussing those details.  Of course, low latency is essential for NR. But the UECapabilityEnquiry fortunately occurs only rarely and hence we don’t consider it the most critical procedure in terms of latency. |
| OPPO | No | Similar view to Ericssion. Full UE capability retrieve is rare. After Rel-16 UE capability optimization, the chance that the UE needs to transfer full capability is even less. There is no need to put any requirement here. |
| Samsung | No | Have same understanding as Ericsson and OPPO. It would be enough to have a single (preferably large) value comfortable for all UEs |
| Nokia, Nokia Shanghai Bell |  | The question itself is unclear: What is the approach being discussed?  From network perspective, we think it’s important to set at least some time limit, and we think any relaxations to LTE requirements needs to be justified: NR should not be less competitive than LTE. What we say now will hold for all future NR releases (which is what 3GPP history would suggest), potentially creating further bottlenecks. |
| Intel |  | We agree with Ericsson, OPPO and Samsung that there is no need to define conditions on UE capability filtering for RRC processing time, and a single value for RRC processing time on UE capability reporting is sufficient.  We also share the view that UE capability reporting is time consuming considering compression/filtering. Therefore we think it’s reasonable to define 80 ms as RRC processing requirement for UE capability report without defining any filtering conditions. |
| Qualcomm Incorporated | Yes | We need a specified condition for the UE capability filter if a lower requirement value needs to be pursued.  It is however acceptable for us to define a large requirement value without any condition. |

# Discussion

* 1. Existing UE capability filters defined in TS36.331

The following UE capability filters are defined currently in TS36.331. The items **A** and **I** are mandatory for requesting MR-DC or NR UE capability.

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|  | **Field name** | **Description** |
| **A** | UE-CapabilityRequest | List of RATs for which UE capability is requested |
| **B** | requestedFrequencyBands-r11 | 1 to 16 frequency bands |
| **C** | requestReducedFormat-r13 | Request to provide supported CA band combinations in the supportedBandCombinationReduced-r13 |
| **D** | requestSkipFallbackComb-r13 | Request to exclude fallback CA band combinations |
| **E** | requestedMaxCCsDL-r13 | 2 to 32 CCs |
| **F** | requestedMaxCCsUL-r13 | 2 to 32 CCs |
| **G** | requestReducedIntNonContComb-r13 | Request to exclude supported intra-band non-contiguous CA band combinations |
| **H** | requestDiffFallbackCombList-r14 | List of CA band combinations for which the UE is requested to provide different capabilities for their fallback band combinations |
| **I** | requestedFreqBandsNR-MRDC-r15 | List of NR and/ or E-UTRA frequency bands for which the UE is requested to provide its supported NR CA and/or MR-DC band combination |
| **J** | requestSTTI-SPT-Capability-r15 | Request to include the short TTI and SPT capabilities |
| **K** | eutra-nr-only-r15 | Request to include EN-DC capability, but not NR standalone capability |

* 1. Existing UE capability filters defined in TS38.331

The following UE capability filters are defined currently in TS38.331. The items **L** and **M** are mandatory for requesting MR-DC or NR UE capability.

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|  | **Field name** | **Description** |
| **L** | rat-Type | List of RATs for which UE capability is requested |
| **M** | frequencyBandList | 1 to 1280 E-UTRA /NR frequency bands, where for each band the items can be requested |
| **N** | ca-BandwidthClassDL-EUTRA  ca-BandwidthClassUL-EUTRA | {a, b, c, d, e, f}: Meant to limit the bandwidth per band: |
| **O** | maxBandwidthRequestedDL  maxBandwidthRequestedUL | 0 to 400MHz |
| **P** | maxCarriersRequestedDL  maxCarriersRequestedUL | 1 to 32 |

**Q2:** Do companies think defining what UE capability filters are used in UE Capability Enquiry will help defining the UE requirement for RRC processing delay?

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| **Company** | **Yes/No** | **Comment** |
| OPPO | Not sure | How capability is derived and filtered within UE is implementation dependent. I do not think any discussion in RAN2 can get a clear understanding on this aspect. As we mentioned previously, we’d better not spend much time on processing delay of UE capability enquiry. |
| Samsung | No | The analysis and classification are very comprehensive and useful. Thanks for that. However, we prefer having a single value. |
| Nokia, Nokia Shanghai Bell | No | We think the aspect requiring most processing is the per-frequency band aspect + maximum number of carriers, in addition to skipping fallbacks. It is true that the capability “tree“ grows quickly according to the number of supported frequency bands and band combinations), but it may be difficult to quantify the number with exact analysis in RAN2. |
| Intel | No | We think a single value for RRC processing time on UE capability reporting is sufficient. |
| Qualcomm Incorporated | Yes | We need a specified condition for the UE capability filter if a lower requirement value needs to be pursued.  It is however acceptable for us to define a large requirement value without any condition. |

**Q4:** Any other conditions that should be defined?

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| **Company** | **Condition / Comment** |
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**Q3:** Companies are requested to provide their proposed requirement number for UE capability transfer processing delay, and proposed conditions (if applicable).

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| **Company** | **Requirement number (ms)** | **Condition / Comment** |
| Ericsson | 60ms | Since the UECapabilityEnquiry occurs only rarely, we believe this procedure is not the one that really impact the NR latency. |
| OPPO | 80ms | By using a large number, we can accommodate different types of UEs. Again, this number is not critical in our view. |
| Samsung | 80ms | This kind of requirement has great importance in UE implementation design. We believe the safer way is to have rather larger value if the requirement is not related with every-day performance. |
| Nokia, Nokia Shanghai Bell | 20ms (2x that of LTE) | We would like to better understand the real-life ramifications to UE processing requirements and would welcome input from UE and chipset vendors on how much processing time would really be required. So far no concrete analysis of why the processing takes so long time has been presented, which would be needed to understand the 6-8x increase of processing time is really needed. |
| Intel | 80ms | The processing time for UE capability reporting is not critical for system performance (e.g. CP latency), therefore we think it’s reasonable to define 80 ms considering that UE capability reporting is time consuming due to e.g. compression/filtering. |
| Qualcomm Incorporated | 80ms | Without a specified condition on the UE capability filter, it makes sense to go for a large value that can accommodate the worst case. We share Intel’s view that this is not critical for system performance.  It should be noted however that RAN5 will need to define the test condition anyway.  To respond to Nokia’s comment:  It should be noted that the current RAN2 requirement and RAN5 test case for LTE have not been changed since release-8. The network (test equipment) merely request rat-Type = eutra, without additional UE capability filtering or whatsoever. Now the problem is that the UE capability filter is mandatory when requesting EN-DC and NR band combination, which causes additional delay due to additional UE processing.  It should also be noted that the number of band combinations supported by the UE is exploding since release-10. UE algorithm to select the right set of band combinations to report is improving over time, but still it is very processing demanding. |

# Conclusion

# Reference