3GPP TSG-RAN WG2 Meeting #116bis-e R2-210xxxx

Electronical meeting, 17 – 25 January 2022

Source: Qualcomm Incorporated

Title: RAN visible QoE

Agenda Item: 8.14 NR QoE

Document for: Discussion and Decision

# 1 Introduction

This document aims at gathering and summarizing companies views for the following offline discussion:

* [AT116bis-e][029][QoE] RAN Visible QoE (Qualcomm)

      Scope: Determine what RAN2 need to do to support RAN3 decisions in LS in R2-2200110, Take into account documents in subclause 8.14.2. and make the corresponding decisions to such level that it is possible to make corresponding Stage-3 updates.

      Intended outcome: Report, with discussion and agreements

      Deadline: Friday W1

# 2 Company contact details

|  |  |  |
| --- | --- | --- |
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# 3 Discussion

### 3.0 RAN3 agreements

In the incoming LS from RAN3, the following agreements were achieved by RAN3. This email discussion intends to discuss RAN2 impact based on RAN3 agreements.

**RVQoE metrics**

Interaction latency or comparable quality viewport switching latency metric is NOT considered as a RAN visible QoE metric in Rel-17

Buffer level is confirmed as a RAN visible QoE metric for DASH and VR service types

Playout delay for media startup is confirmed as a RAN visible QoE metric for DASH and VR service types

**RVQoE configuration**

RAN Visible QoE and legacy QoE can be configured together or separately. In case RAN visible QoE is configured separately, it can be configured only after configuring legacy QoE.

NG-RAN can release a list of RAN visible QoE configurations while not releasing the corresponding legacy QoE configurations

If the legacy QoE configuration is released, the corresponding RAN visible QoE configuration is released as well

RAN visible QoE configuration can include at least the RAN visible QoE metrics to be reported, service type and a measurement ID for the RAN visible QoE. Whether existing IEs can be reused for service type and measurement ID and the signaling design is up to RAN2

There is no need to consider Start Time, Duration and Sample Percentage in the RAN Visible QoE configuration in Rel-17

**RVQoE reporting**

RAN3 should discuss whether the existing identified RAN visible QoE metrics (or values if agreed) justifies the need of a separate reporting periodicity for RAN visible QoE

RAN3’s decision on whether to have a different reporting periodicity for RAN visible QoE is independent of RAN2’s decision on which SRB to use for RAN visible QoE

**Misc proposals**

NG-RAN can configure RAN visible QoE for only a subset of those metrics which are already configured as part of legacy QoE configuration.

The OAM sends a list of the available RAN visible QoE metrics to the RAN node, outside the legacy QoE configuration container.

### 3.1 RVQOE configuration

**Issue 1: RVQOE configuration**

RAN3 has the following agreements for RVQoE configuration, these agreements descript the relationship between legacy QoE configuration and RVQoE configuration.

**RVQoE configuration**

RAN Visible QoE and legacy QoE can be configured together or separately. In case RAN visible QoE is configured separately, it can be configured only after configuring legacy QoE.

NG-RAN can release a list of RAN visible QoE configurations while not releasing the corresponding legacy QoE configurations

If the legacy QoE configuration is released, the corresponding RAN visible QoE configuration is released as well

RAN visible QoE configuration can include at least the RAN visible QoE metrics to be reported, service type and a measurement ID for the RAN visible QoE. Whether existing IEs can be reused for service type and measurement ID and the signaling design is up to RAN2

One issue needed to be discussed in RAN2 is whether the existing legacy QoE RRC IEs (i.e. service type and measConfigAppLayerId). Some contributions [propose to use the same configuration framework for legacy QoE and RVQoE configuration, and [5][6][10] show the detailed ASN.1 example to explain how the RVQoE can be configured using the share service type and measConfigAppLayerId RRC IEs.

According to the explanation of ASN.1 example in [5][6][10] (please note this is only example, not ASN.1 agreements), companies please reply to the question:

**Q1: Whether companies agree RVQoE configuration can share the same measConfigAppLayerId and service type RRC IEs with legacy QoE configuration?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | Yes | RAN3 has agreed that RAN visible QoE metrics collection can be configured only if QoE measurements are configured for the same service type, so both IEs can be used for RAN visible QoE purpose. |
| Ericsson | Yes | Agree with Huawei. |
| Nokia | See comment | In general, to identify two QoE configurations (either container or RAN-visible) a “dedicated” ids might be useful for the separate network configuration. Otherwise, the context of the configurations will be difficult to manage. We see also dependency on the decision for UE capabilities, if a separate capability is defined for RAN visible QoE, from RRC procedures and signalling perspective it would be desired to keep the configuration parameters separate. However, it depends on the RAN visible modelling – if the framework assumes that most sensible is to configure RAN-visible only if the QoE container configuration is provided to RAN and/or the QoE container configuration is configured to UE , then the two parameters (ID and serviceType) can be considered as “shared” for the two configurations. The option to have the parameters shared should be then possible and resolved by ASN.1, but it has further impacts on the handling of “joint” QoE configurations. See answer to Q3  |
| T-Mobile, USA | See comment | Agree with Nokia that flexibility is better. Not opposed in sharing the same IE. |
| CMCC | Yes | Sharing the same IEs is the most straight-forward approach which requires the least extra standardized work. |
| Qualcomm | Yes | RAN visible QoE configuration has dependency on legacy QoE configuration, share the same IE is more easy for specification description and implementation. Otherwise, UE and the RAN node need to maintain the mapping of the two different **measConfigAppLayerIds** allocating to the legacy QoE configuration and RVQoE configuration. |
| vivo | Yes | Even there is a separate capability, the capability of supporting RVQoE shall be associated with the prerequisite to support the legacy QoE. |
| CATT | Yes | Reuse the legacy framework and IEs for RVQOE is efficient and easy to handle the relation between RVQoE and legacy QoE |
| ZTE | Yes | Same view with HW |

**Issue 2: RVQoE modification**

Contribution [6] proposes to support RVQoE modification which provides gNB flexibility to configure RVQoE, e.g. change RVQoE metrics. Rapporteur thinks it reasonable and technically feasible to support modification from RRC message point of view.

Companies please reply to the question:

**Q2: Whether RVQoE modification can be supported from RRC layer point of view?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | Yes | Our understanding on modification handling is that, gNB can modify RAN visible QoE specific configurations, i.e.:* From “visible metric A” to “visible metric B”
* From “visible metric A” to “visible metric A, B”
* From “visible metric A, B” to “visible metric A”

For this handling, firstly it is initiated by gNB so it is reasonable for gNB to have a possibility to modify the configuration. Secondly, it does not impact container based QoE handling.If RAN visible QoE modification is not allowed, there may be extra complexities, e.g. only setup/release handling is allowed. |
| Ericsson | Yes | RRC parameters should be possible to modify as usual. No reason to add extra complexity to not allow it.  |
| Nokia | No | For gNB (and RRC signalling) we believe the simplest option should support change by releasing and adding new configuration.  The question is rather which entity would trigger a change of configuration of RVQoE ? This would depend on which node is aware of the QoE / RVQoE configuration and is able to change it.   |
| T-Mobile, USA | Yes |  |
| CMCC | Yes | RVQoE configuration is controlled by NG-RAN, so there’s no reason not supporting modification.And we do not think release and setup is a good approach since it introduces extra overhead compared to modification. |
| Qualcomm | Yes | RVQoE is generated by RAN node, and modification can be supported as usual. |
| vivo | Depends on stage3 design | If only limit IE in RVQoE configuration or most of the IE are static, add and release is enough. Otherwise, modification can provide flexibility. |
| CATT |  | We are open for the modification. Either use modification message or use release/add message as legacy QoE |
| ZTE | Yes |  |

**Issue 3: RVQOE configuration release**

RAN3 has agreement for RVQoE release as following,

NG-RAN can release a list of RAN visible QoE configurations while not releasing the corresponding legacy QoE configurations

If the legacy QoE configuration is released, the corresponding RAN visible QoE configuration is released as well

Contribution [5][10] provides ASN.1 example to show how to support the above RAN3 agreements from RRC layer. And it is technically feasible.

Companies please reply to the question:

**Q3: Whether companies have concerns from RAN2 point of view to support RAN3 agreements on RVQoE release?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | No | We have no concerns with the agreements, just the ASN.1 signalling has to be designed properly.  |
| Ericsson | No | We should follow the RAN3 agreements.  |
| Nokia | Yes, See comment | In case the measurement ID is shared (as a result of Q1) it is not feasible to release one QoE configuration and keep the other, or the ID should be linked with a configuration that makes RVQoE active or not. This may be a bit complex to handle.  |
| CMCC | No | No concern. We can just follow RAN3 agreements and find a simplest way to support it in RRC signalling. |
| Qualcomm | No | RAN3 agreements can be supported by RRC signalling |
| vivo | No | No issue even with the same ID, the configuration of RVQoE and legacy QoE are in different IEs. |
| CATT | No | We should follow the agreements. If we use the share ID in release, the release type can be added for the different QoE release |
| ZTE | No | We prefer to follow RAN3 agreements.  |

### 3.2 RVQOE metrics

RAN3 has confirmed Buffer level and Playout delay for media startup as RVQoE metrics for DASH and VE service types. RAN2 needs to discuss how to support these two metrics from RRC layer, including format, value range, value definition etc.

**RVQoE metrics**

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Buffer level is confirmed as a RAN visible QoE metric for DASH and VR service types

Playout delay for media startup is confirmed as a RAN visible QoE metric for DASH and VR service types

**Issue 1: Buffer level reporting**

ISO/IEC 23009-1 defines the metrics for buffer level status events, as following. And it allows one measurement contains buffer level entry list.



Some contributions discuss the manner to report buffer level, and several options are raised, e.g. a list of buffer level values, average value, minimum value, maximum value during one report interval. The benefit of reporting a list of buffer level values with the parameter “t” reported could provide gNB more accurate information; one single value could save signalling overhead but cannot provide accurate information to gNB.

Companies please provide view in which manner buffer level should be reported.

**Q4: Companies please provide view in which manner buffer level should be reported**

|  |  |
| --- | --- |
| **Company** | **Views** |
| Huawei, HiSilicon | We are open about the following approaches:* A list of buffer level values
* Average value

Each approach has pros/cons, and we think both are feasible from RAN2 point of view. |
| Ericsson | We think just the current value can be reported, no need to make it more complicated and calculate average or similar. RVQoE is for real-time reporting and then current value is sufficient. For legacy QoE the values are received in a file often after the session and then it is relevant to have a list with time stamp, but not for RVQoE. |
| Nokia | RAN2 should not discuss format of the buffer level but follow configuration provided by RAN (RAN3 decision how the configuration IEs will look like on the NW interfaces). Following the config, the UE should report back what was provided by Application layer. RRC should not change the provided information neither in configuration from gNB nor report from upper layer input |
| T-Mobile, USA | We tend to agree with Ericsson. Realtime value is more meaningful for the scheduler to adapt to the traffic condition of a particular service. Also, it opens the opportunity for the gNB to decide how the data should be processed locally. |
| CMCC | We can start with a list of buffer level which consists of a list of Integer-type levels and possibly a Real-time-type t indicating the start time of the measurement. |
| Qualcomm | What should be reported depends on how the gNB uses the measurement result. If gNB wants to use it in a real-time usage, then very shorter periodicity of reporting should be configured or event-trigger needs to be defined, like today’s immediate MDT reporting. If the gNB wants to use the information for post-processing, then a list of result is helpful, especially when long periodicity is configured.In order to save reporting signalling, RAN2 can specify some limitation on the range scope, granularity, and number of buffer level entries.For range scope, 10min or even 5min is enough. There is no difference for gNB receiving 5min buffer level or 1 hour buffer level, and it is not expected gNB buffers the downlink data more than 5min.For granularity, we understand 1s is enough, from user experience point of view, 1s is very short time, we don’t think buffer level value lower than 1s make much sense; from gNB scheduling point of view, it should avoid the buffer level is lower than 1s.For number of buffer level entries in each result, we can limit it to e.g. 20.So the signalling overhead considering above cases is 9x20=180And if RAN2 decides how and what should be reported, should notify SA4 the decision, application layer should handle the measurement results as RAN2 limitation. |
| vivo | It’s a simple way to follow the current structure as a list. But ok to follow the further guideline of RAN3, if any. |
| CATT | We would like suggest that RAN3 and SA4 to decide the report format and value.If we RAN2 wants to take this responsibility. We may consider the report periodicity of the RVQoE which is also apply to other metrics.We may use the current value App layer can provide and not to introduce more complex. Share with CMCC on this issue |
| ZTE | We are flexible on this question and slightly prefer HW’s suggestion. |

For each buffer level measurement entry, there are two parameters: t and level. The parameter “t” denotes the time of the measurement of the buffer level; and the parameter “level” denotes the level of the buffer in milliseconds. If the “level” is reported using a list of buffer level values, then “t” needs to be reported to inform gNB the time for each “level” value and provide more accurate information to gNB.

But as some contribution mentioned, the time is using the XML type xs:dateTime, which is a string representation in the form of "yyyy-mm-ddThh:mm:ss.sssssssssssszzzzzz". So if it is included in each buffer level, the signalling overhead could be large.

**Q5: Companies please provide view on whether parameter “t” in the buffer level measurement entry should be reported.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | FFS | We would like to understand more about benefits regarding the following sentence:The benefit of reporting a list of buffer level values with the parameter “t” reported could provide gNB more accurate informationThe overhead may be further discussed, e.g. considering multiple entries and long bits for UTC time definition.[QC] that means “t” will tell the gNB the time for each measured level, and the gNB can know the scheduling or configuration situation at the time “t”. If no “t” received, the gNB will not know what happens for each buffer level. But we are open whether to include that. |
| Ericsson | No | RVQoE is for real-time reporting and the time is not needed as the gNB knows the time when it gets it. For legacy QoE the values are received in a file often after the session and then it is relevant to have a list with time stamp, but not for RVQoE. |
| Nokia | No | See answer to Q4 |
| CMCC | FFS | Our understanding is that it is unnecessary to report every t associated with each integer level. But the start time of the buffer level measurement should be reported to NG-RAN so that NG-RAN knows the exact time the measurement begins. And how to encode the start time can be FFS. |
| Qualcomm | FFS | The t value is about 40bit-length (to second), actually, the main issue is we don’t know how the gNB use the measurements. |
| vivo | Yes if the format of report is a list for Q4 | If the buffer level is a list, then the t is essential to identify each buffer value. As to the overhead issue, the t can be reformulated to a format of MM:SS, which are about 16 bits. |
| CATT | FFS | Looks it is needed. We need study how to encode it or ask SA4 whether can use other format for this. For example, use the relative time  |

As ISO/IEC 23009-1 defined, the parameter “level” is defined in milliseconds. In order to save reporting signalling, it is worthy to define a value range for “level” reporting. it is understood the buffer level value will assist gNB schedule for downlink data, and it is expected the gNB will not buffer the downlink data for a long time. From user experience point of view, it is enough if the maximum buffer level is about 10 minutes and more larger value does not provide additional useful information to gNB.

Another issue is what is the denotation for each integer value, that means value 1 corresponds to 1 millisecond, 10 millisecond, 100 millisecond, or 1 second. With more larger granularity, the signalling overhead is more less.

**Q6: Companies please provide view on the RRC value range and denotation of each integer value for parameter “level”.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| Huawei, HiSilicon | We are open about the values, and we think that the maximum buffer level should be corresponding to a certain granularity, which can reduce the overhead. For different combinations, we have some calculations on the overhead: Max buffer level granulartiy overheadValues 10min 1ms 20 bitsValues 10min 10ms 16 bits Values 10min 100ms 13 bitsValues 10min 1000ms 10 bitsWe slightly prefer 10min+10ms as it can provide enough information and reasonable overhead. |
| Ericsson | We think the granularity can be ms, a few bits don’t matter so much. |
| Nokia | Wait for configuration details provided by RAN3. Furthermore, the value will be given by Application Layer, and AS is only forwarding it to the Network.  |
| T-Mobile, USA | Granularity is more important than the max. buffer level. If trade-offs have to be made, we prefer greater granularity. |
| CMCC | The detailed signalling, including the granularity and overhead are within the scope of RAN2.We support 1ms granularity, and 10ms granularity is also acceptable. |
| Qualcomm | We think 1s granularity is enough, and maximum level value can be 10min or 5min, then allow more level values to be reported. But we are fine with finer granularity if that is majority view. |
| vivo | 10ms – 1s is acceptable. But ok to follow the further guideline of RAN3, if any. |
| CATT | We may study the granularity impact on how the gNB use the mertics |
| ZTE | We think both granularity and max are important.  |

**Issue 2: Playout delay for media startup reporting**

For playout delay for media startup, the following is defined in TS 23.347, and the value is integer type with milliseconds.

|  |  |  |
| --- | --- | --- |
| Key | Type | Description |
| PlayoutDelayforMediaStartup | Integer | The playout delay for media start-up is measured as the time in milliseconds from the time instant of DASH player receives play-back-start trigger to the instant of media playout.- If the MPD has been delivered earlier before the user clicks, it may include the process time of MPD, the fetch time of some media segments which are required for media presentation, the process time of segments, and the time for media decode and render to the user.- If no MPD has been fetched earlier, it also needs to add the fetch time of MPD. |

The maximum value defined to be reported should be the maximum value the user can be tolerant of. Contribution [8] proposes the maximum value 30 second, rapporteur thinks this is a reasonable value and can be used as baseline.

Companies please reply to the question:

**Q7: Whether value 30 second can be defined as the maximum value for playout delay for media startup reporting?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | Yes |  |
| Ericsson | Yes | We assume that if the value is larger than 30, the UE will report 30. Maybe that needs to be captured. |
| Nokia | No | See answer to Q4 |
| CMCC | Yes | Agree with Ericsson. |
| Qualcomm | Yes |  |
| vivo | Yes | But ok to follow the further guideline of RAN3, if any. |
| CATT | Yes |  |
| ZTE | Yes |  |

If we assume 30 second is the maximum value defined for playout delay for media startup reporting, and one integer value is for one millisecond, then 15-bit signalling overhead is needed.

Similar with buffer level, in order to save signalling overhead, using more larger granularity for each integer value can be considered, e.g. integer value 1 corresponds to 10 millisecond, 100 millisecond or 1 second.

**Q8: Companies please provide view on denotation of each integer value for playout delay for startup.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| Huawei, HiSilicon | For different combinations, we have some calculations on the overhead: Max playout delay granulartiy overheadValues 30s 1ms 15 bitsValues 30s 10ms 12 bits Values 30s 100ms 9 bitsValues 30s 1000ms 5 bitsUnlike buffer level, the playout delay is just a value (not a list, and it is event triggered), so we slightly prefer 20ms+1ms as 15 bits overhead is very low. |
| Ericsson | We think 1ms is fine. |
| Nokia | See answer to Q4 |
| T-Mobile, USA | Agree with Ericsson.  |
| CMCC | Agree with HW. |
| Qualcomm | This is playout delay, not traffic delay, we understand 1s or 100ms is enough. But can be fine with majority view. |
| vivo | 1ms – 1s is acceptable. But ok to follow the further guideline of RAN3, if any. |
| CATT | 1ms is fine |

### 3.3 RVQoE reporting

When RRC layer receives the RVQoE measurement from application layer, RRC layer should report RVQoE measurements to gNB. Some contributions propose to include the RVQoE measurements into *MeasReportAppLayer,* and please note this is irrespective of the SRB to transmit RVQoE reporting.

**Q9: Whether companies agree RVQoE measurements should be included into *MeasReportAppLayer* message?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | Depends | We have a different view from “and please note this is irrespective of the SRB to transmit RVQoE reporting”. If we use another SRB, a separate message will be much easier. If we use the same SRB, it is reasonable to put all QoE measurements in the same RRC message. |
| Ericsson | Yes | We agree with QC that it is irrespective of which SRB to transmit the message on. There are other examples of messages being transmitted on different SRBs depending on the case, e.g. *ULDedicatedMessageSegment* where we just introduced such differentiation in the running CR. |
| Nokia | Yes | Makes the RAN-visible QoE as a feature complementary to regular QoE  |
| CMCC | Depends | We are fine with either the same message or separate messages. But we agree that even with the same message, the reports for legacy QoE and RVQoE can be transmitted via different SRBs. |
| Qualcomm | Yes |  |
| vivo | Yes | Agree with QC that it is irrespective of the SRB issue. Some existing RRC messages can be sent via different SRBs and different RRC messages can be sent via the same SRB. |
| CATT | Yes |  |
| ZTE | Yes |  |

If RVQoE configuration and legacy QoE configuration share the same measConfigAppLayerId and service type RRC IEs, MeasConfigAppLayerId can be used to identify both of associated legacy QoE report and RVQoE report. And please note this can be applied for both cases that RVQoE is reported along with the legacy QoE report or independently.

**Q10: Whether companies agree MeasConfigAppLayerId can be used to identify both of associated legacy QoE report and RVQoE report?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | Yes |  |
| Ericsson | Yes |  |
| Nokia | See comment | For clarity, it would be preferable to have separate, but decision should depend on modelling. See answer to Q1  |
| T-Mobile, USA | Yes |  |
| CMCC | Yes |  |
| Qualcomm | Yes | If we use shared ID for legacy and RVQoE, it is straight-forward. |
| vivo | Yes |  |
| CATT | Yes |  |
| ZTE | Yes | The most straight forward way |

When UE RRC layer receives multiple RVQoE reports simultaneously, it should be possible for UE to report multiple RVQoE reports in the same *MeasReportAppLayer* message to save RRC header overhead and reporting time.

**Q11: Whether companies agree multiple RVQoE reports can be included in one MeasReportAppLayer message?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional explanations** |
| Huawei, HiSilicon | FFS | At RAN2#116-e meeting, there was a FFS:* FFS if to Allow multiple QoE reports in the same RRC message, but leave it to UE implementation when / whether to use this (does not involve additional buffering).

So we think Q11 can wait for the progress of the FFS. |
| Ericsson | Yes | No reason to put restrictions for no reason. |
| Nokia | Yes |  |
| T-Mobile, USA | Yes |  |
| CMCC | Yes |  |
| Qualcomm | Depends | Depends on whether multiple legacy QoE reports can be in one message as Huawei comments, since RVQoE may have dependency on legacy QoE reporting. |
| vivo | FFS | Agree with HW, shall align with the legacy QoE report. |
| CATT | Yes |  |
| ZTE | FFS | Share the same view with HW. Depends on the legacy QoE reporting part. |

### 3.4 Others

The following issues have dependency with other working group or other issues, rapporteur thinks we should wait for other working group or other issues progress.

- RVQoE specific periodicity, depends on RAN3 and SA4

- RVQoE mobility issues, depends on legacy QoE mobility

- RVQoE pause and resume, depends on legacy QoE reporting pause and resume and RAN3 discussion.

- RVQoE SRB, depends on RAN3 feedback on the usage

# 4 Conclusion

**(TBC)**

# 5 References

[1] R2-2200110 RAN3 agreements on RAN visible QoE (R3-216227; contact: Qualcomm) RAN3 LS in Rel-17 NR\_QoE-Core To:RAN2

[2] R2-2200268 Discussion on RAN Visible QoE ZTE Corporation, Sanechips discussion Rel-17

[3] R2-2200546 RAN visible QoE configuration and report Samsung discussion Rel-17

[4] R2-2200558 Discussion on RAN visible QoE configuration OPPO discussion Rel-17 NR\_QoE-Core

[5] R2-2200705 Support of RAN visible QoE and per-slice QoE Qualcomm Incorporated discussion

[6] R2-2200822 RAN visible QoE Huawei, HiSilicon discussion Rel-17 NR\_QoE-Core

[7] R2-2200854 Discussion on Ran visiable QoE CMCC discussion Rel-17 NR\_QoE

[8] R2-2200998 RAN Visible QoE measurements Ericsson discussion Rel-17 NR\_QoE-Core

[9] R2-2201047 RAN visible QoE Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_QoE-Core

[10] R2-2201419 Discussion on NR RAN-visible QoE CATT discussion NR\_QoE-Core

[11] R2-2201594 Discussion on RAN visible QoE measurement in Rel-17 China Unicom discussion NR\_QoE-Core

[12] R2-2201596 Discussion on RAN Visible QoE vivo discussion Rel-17 NR\_QoE-Core

[13] R2-2201626 Discussion on RV QoE LG Electronics discussion Rel-17 NR\_QoE-Core