**3GPP TSG RAN #88-e RP-20xxxx**

e-Meeting, June 29th – July 3rd, 2020

Source: Moderator (NTT DOCOMO, INC.)

Title: Summary on [R15\_R16\_UE\_features]

Agenda Item: 9.12

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the NR Rel-15 and Rel-16 UE capabilities related discussions in AI 9.12 according to following chairman’s guidance.

Goal: Determine a combined way forward for the different elements of Re15 and R16 UE capabilities in the form of a single set of slides for endorsement.

Input contributions covered: 868, 883, 1119, 1120, 1050, 915, 1051, 1121, 1122, 1054

Moderator: Hiroki Harada

# **Discussion on Rel-15 mandatory features without capability signaling**

In [3], Nokia, Nokia Shanghai Bell and Orange propose to capture all Rel-15 features including mandatory features without capability signaling in TS38.306 as below. The proponents have a concern on ambiguity on the UE behavior since some features cannot be implied directly as mandatory support in specifications.

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| It is assumed that the features that are not associated with a capability signalling and corresponding capability definition in TS38.306 are, by definition, mandatory. In a number of cases this approach works well, e.g. it is fairly clear that any UE needs to support demodulation and decoding of PDCCH and PDSCH to operate in an NR network. However, for some features the mandatory support cannot be implied directly, creating ambiguity on the UE behaviour. The list of features which do not have any capability signalling and which should be captured in technical specifications is provided in the Annex, taken from TR38.822 [3]. TR38.822 addresses this concern to some extent by capturing a snapshot of the Rel-15 UE features groups at the time of its creation. However, the TR itself is not specification text and it is not kept up to date, and hence a solution is needed to ensure the expected UE behaviour is clear from the NR specifications. In fact, RAN2 has agreed to CRs [4, 5] that introduces clarifications in specifications on the support of a mandatory feature group without capability signalling, further underlining the need for capturing such FGs in specifications. **Proposal 1: All NR UE features are to be captured in 38.306, including the mandatory Rel-15 feature groups without associated capability signalling.** In RAN#87e some concerns have been raised on potential non-backward compatibility issues arising once the Rel-15 FGs are captured in specification text. First of all, such situation should not happen given that all those FGs are already mandatory for all Rel-15 UEs. In case there is any conflict between the information captured in the Rel-15 FGs that are subject of this contribution and the remainder of the FGs then it is indeed critical that such conflicts are resolved to ensure smooth introduction of all NR Rel-15 features in the market. Hence, we make the additional proposal below:**Proposal 2: In case of any conflicts are identified between the mandatory Rel-15 FGs without associated capability signalling and the other FGs, the RAN WGs are tasked to resolve such conflicts ensuring no NBC changes are required in the specifications.**  |

In [2], KT also proposes to include all mandatory features without capability signaling into TS38.306 because of the same concern as described in [3].

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| Most of the UE feature without capability signaling seems obvious that these features are supported as default for NR network. However, still there are some ambiguity exists for the specification readers for some UE features and we propose to include all mandatory without capability signaling features into Annex A.3 of TS 38.306. We have listed UE features for mandatory without capability signaling in Annex for information.***Proposal: Include list of UE feature of mandatory without capability signalling into Annex A.3 of TS 38.306*** |

On the other hand, in [1], Qualcomm proposes not to copy the texts from TR38.822 to TS38.306 since there are many limitations and other clarifications that would be also need to be made if it is decided that text from 38.822 should be copied to 38.306. Qualcomm also proposes that the capability reporting by a UE shall modify and override the minimum capability defined for mandatory features without capability signaling.

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| At RAN#87e, the following proposal was made [2]* + - *“TS 38.306 specifies that the capability reporting by a UE cannot be in contradiction with the minimum capability defined for mandatory features without signaling”*

This proposal would be generally wrong because there are a number of dependencies of various components in FGs that are mandatory with capability signaling on other capabilities. Eliminating or changing these other capabilities would lead to non-backward compatibility issues. Instead of the proposal in [2], we propose the following: * + - *TS 38.306 specifies that the capability reporting by a UE shall modify and override the minimum capability defined for mandatory features without signaling, whenever*
			* + *otherwise the capability signaling would have no function, or*
				+ *otherwise independent optional FGs would become mandatory*

Examples 1-6 are given below for various dependencies of features that are mandatory without capability signaling on other optional capabilities. **Example 1:** Optional CA band combination capability indicating no SA support overrides FG 1-1 Compnent-3, even though FG 1-1 is mandatory without capability signaling**Example 2:** FG 5-6a (PDSCH scheduling type B) capability signaling overrides FG 2-6 even though FG 2-6 is mandatory without capability signaling**Example 3:** PUCCH format capability (FG 4-5, 4-6, 4-7) overrides Component 6 in FG 2-32, even though 2-32 is mandatory without capability signaling.**Example 4:** Optional CA band combination capability overrides the following component of FG 3-1: “For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot”, even though FG 3-1 is mandatory without capability signaling.**Example 5:** Optional CA band combination capability overrides the following component of FG 5-1: “For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, interleaving for VRB-to-PRB mapping for PDSCH” and “For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, PDSCH mapping type A with {4-14} OFDM symbols and type B with {2, 4, 7} OFDM symbols“, even though 5-1 is mandatory without capability signaling.**Example 6:** CA band combination capability overrides Component-5 of FG 2-35. The values of 5 and above only apply to CA capabilities of 5 CCs and above.**Proposal 1: Agree on the following:** * + - ***TS 38.306 specifies that the capability reporting by a UE shall modify and override the minimum capability defined for mandatory features without signaling, whenever***
			* ***otherwise the capability signaling would have no function, or***
			* ***otherwise independent optional FGs would become mandatory***

Another proposal made at RAN#87e in [2] was the following* *The UE features which are mandatory without capability signalling as captured in TR 38.822 are captured in TS 38.306 for Rel-15, including feature group 2-32*

As it was mentioned in the discussions, and also earlier related to [3], there are many limitations and other clarifications that would be also need to be made if it is decided that text from 38.822 should be copied to 38.306. Examples 7-11 for these are given below. Note that these examples are not exhaustive. **Example 7:** It is missing from the pecification that only the rate matching aspects of TRS are mandatory for FG 2-50, even though FG 2-50 is mandatory without capability signaling. **Example 8:** It is missing from the description that the UE is not required to support SRS in every BWP**Example 9:** Specification is missing the restriction that only one of Components 1, 2, or 3 of FG 4-1 is required in a slot. **Example 10:** Restriction to same SCS for DL and UL active BWP is missing from the description. **Example 11:** Following text would be needed to be added to 38.306: “Support of SRS set usage configured as for codebook does not imply UE support of codebook based PUSCH MIMO transmission.”As it was mentioned in the discussions related to [3], if the mandatory capabilities are copied to TS 38.306 then so should be other missing clarifications of relaxations that are currently missing from the normative specifications. Examples 12-19 for these are given below. Note that these examples are not exhaustive. **Example 12:** 38.306 is missing that ‘per slot’ is defined as 15kHz SCS for FG 1-13 and FG 1-14**Example 13:** Following text is missing from 38.306: “Some relaxations to this requirement may be applicable in the future (including in Rel-15).”**Example 14:** Following text is missing from 38.306: “UE is required to track only the active TCI states”**Example 15:** The specification in 38.306 is missing the following text for FG 2-36: “for the purpose component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings”**Example 16:** The specification in 38.306 is missing the following text for FG 2-40: “for the purpose component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings”**Example 17:** The specification in 38.306 is missing the following text for FG 2-41: “for the purpose component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings”**Example 18:** The specification in 38.306 is missing the following text for FG 2-43: “for the purpose component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings”**Example 19:** Specification is missing the restriction that all search space, including initial BWP / CORESET#0 must be included in the same 3-symbol span as USS for FG 3-2 **Proposal 2: No need to copy text from TR 38.822 to TR 38.306. However, if it is decided that text should be copied then also include at least text corresponding to Examples 7-11 and Examples 12-19. These examples are not exhaustive.**  |

Based on above contributions and proposals, the moderator identifies following possible alternatives to conclude the issue.

### **Proposal 1 for Rel-15 mandatory features without capability signaling:**

* **Alt.1: Capture all Rel-15 features including mandatory without capability signaling in TS38.306 by copying the texts from TR38.822 with necessary clarifications**
* **Alt.2: Not copy the texts from TR38.822 to TS38.306 and any potential ambiguity issue will be solved individually in RAN WGs as for FG2-32**

Companies are encouraged to check above summary on contributions/alternatives and to provide feedback if any in below.

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| Company | Comment |
| Futurewei | Alt.1, in which text in TR38.822 is used as baseline for the addition to TS 38.306. It is good practice to clearly specify UE mandatory features in a TS with continuous maintenance.If any necessary clarification is needed, it’d be needed to reach common understanding of R15 implementation, which would be needed anyway even without the exercise of capturing in TS 38.306 the Rel-15 mandatory features without capability signaling.  |
| T-Mobile USA | We agree with Futurewei. We think it would be better to document the features that are mandatory without capability signaling in a TS rather than just in a TR.  |
| vivo | We are ok with either alternatives. However, if the group agrees with Alt1 item by item clarification is necessary in order to avoid conflicting capability reporting for “mandatory with capability” and “optional” features. |
| CATT | We slightly prefer Alt2. There is nothing broken with Alt. 1, as it is open to add clarification when needed, which may then address concerns from [1]. But our concern is mainly that it would take much effort/time, which is not quite desirable at this stage.  |
| Huawei, HiSilicon | We slightly prefer Alt1 and to add it as Annex in 38.306 might easy the work (to avoid much discussion on how to translate from 38.822 to 38.306). It should be noted that there could be some features which are not listed in the feature list, but also no capability signaling, and in this case this should also be regarded as mandatory without capability signaling. We want to also understand if we go with Alt1, whether it means for Rel-16 capability, we should use same way to capture these mandatory without capability signaling features if any.We are not convinced on the examples listed in [1], we understand the optional capabilities should not override the original features mandatory without capability signaling instead. |
| Intel | Our preference is on Alt 1. When we capture it to 38.306, we can further discuss how to clarify some exception cases resulting from ‘incapability’ signaling or the combination with other optional capabilities. |
| Qualcomm | We prefer Alt.2We can accept Alt.1 if all the proposed clarifications are also discussed and handled. However, this will require additional time that may be significant.  |
| Ericsson | We prefer Alt.2We think Qualcomm’s contribution is indicative of the analysis that is needed for Alt.1 which would require significant working group effort for what we see as minor benefit.  |
| LG | We prefer Alt 2. We think Alt1 results in another problem, e.g. frequent discussions on identifying real mandatory feature, and frequent update of specifications based on the findings. As either way has problem, we want to stick to the current handling.  |
| Nokia, NSB | Our preference is Alt 1, which is aligned with our proposal in [3] as well. We do not think the work is significant, and it is a well-spent effort that will pay off as it ensures the new functionality for NR is built on a solid and well-maintained basis. |
| OPPO | We can accept alt1. But in case there is any compatibility issue then RAN2 should discuss them case by case. |
| MediaTek | We prefer Alt. 2, which is current exercise.The problem is originated from 38.822 text, so copying text does not help. Such discussion requires serious discussion and not likely to be shot cut. |
| Moderator (NTT DOCOMO) | Based on feedbacks so far, following is the situation.* Alt.1 is supported/preferred by Futurewei, T-mobile USA, vivo, Huawei, HiSilicon, Intel, Nokia, NSB, OPPO (9)
* Alt.2 is supported/preferred by vivo, CATT, Qualcomm, Ericsson, LG, MediaTek (6)
* Some of companies supporting Alt.2 can accept Alt.1 if all necessary clarifications/modifications for texts in TR38.822 are made to capture them in TS38.306 although main concern for Alt.1 is a significant effort/time necessary for such clarifications/modifications.

The moderator thinks that such necessary clarifications/modifications should be discussed in WGs but WGs in Q3 should focus on solving Rel-16 remaining issues in terms of UE capabilities.Therefore, possible way forward is as below.* If all proposed clarifications in [1] are already reviewed and fine for all, RAN can agree on Alt.1 now.
* Otherwise, this discussion can be revisited in September meeting with further analysis on necessary clarifications/modifications by each company.

Assuming companies would require more time to consider necessary clarifications, the moderator suggests to revisit this discussion in September and companies are encouraged to provide their analysis on necessary clarifications in September. |

# **Discussion on non-SFN-sync NR-DC support**

In [5], Huawei and HiSilicon propose that all Rel-16 UEs and Rel-15 UEs based on September 2020 or later version of specifications shall not be allowed to report *sfn-SyncNRDC*. This proposal is based on the decision made at RAN#85 where the exact timing to mandate the support of slot aligned non-SFN-sync DC for UE supporting NR-NR DC was not decided.

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In [10], ZTE and Sanechips also propose that all Rel-16 UEs and Rel-15 UEs based on June 2020 or later version of specifications shall not be allowed to report *sfn-SyncNRDC*. The difference from the proposal in [5] is just the timing (i.e., from which version of specifications) to mandate the support of slot aligned non-SFN-sync DC for UE supporting NR-NR DC.

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| ***Proposal 2****: RAN reconfirms that**All Release-16 UEs supporting sync NR-DC are required to support both SFN sync-DC and non-SFN sync-DC (i.e. Rel-16 UEs will not be allowed to set the incapability bit defined in Rel-15).**Release-15 UEs supporting NR-DC are mandated to support slot aligned non-SFN-sync DC from RAN#88e (i.e. from June 2020 version of the specs, also Rel-15 UEs will not be allowed to set the incapability bit).* |

Based on above contributions and proposals, the moderator provides following proposal based on [5] since CRs submitted to RAN#88-e meeting do not address this issue and hence adopting the proposal from September version of specifications would be reasonable.

### **Proposal 2 for non-SFN-sync NR-DC support:**

* **All Rel-16 UEs and Rel-15 UEs based on September 2020 or later version of specifications shall not be allowed to report *sfn-SyncNRDC*.**
	+ **RAN WGs are tasked to prepare CRs addressing this issue in RAN#89-e.**

Companies are encouraged to check above summary on contributions/proposal from moderator and to provide feedback if any in below.

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| Company | Comment |
| Futurewei | Support the proposal, as it reflects the agreement of RAN#85 when the (in)capability indication was introduced as temporary solution for UE not supporting non-SFN-sync DC. |
| Vivo | Support the proposal |
| CATT | We agree with the proposal.  |
| Huawei, HiSilicon | Support as the proponent. |
| Intel | In our understanding, there is no new Rel-15 UE capability to be introduced in June (possibly September as well). If we mandate UE not to report *sfn-SyncNRDC* for Rel-15 from September version, this will be the only capability to change signaling nature. In addition, our understanding has been that network may not be able to induce UE’s supportable spec version (but network can know UE’s supportable release). Therefore, we don’t think mandating UE not to report *sfnSyncNRDC* from Rel-15 would be useful (i.e. UE can always underreport based on previous version).We are okay to mandate UE not to report *sfnSyncNRDC* from Rel-16. |
| Qualcomm | We agree with the proposal for Rel-16 UEs. We disagree with the proposal for Rel-15 UEs. Rel-15 UEs can signal incapability in any case, so spending time on this discussion for Rel-15 is not useful.In addition, such proposals for Rel-15 should be discussed after RAN5 has confirmed that the necessary tests have been developed. Given that the definition of what slot alignment means in the non-SFN sync case was decided only in November, the readiness of those tests is doubtful.  |
| Ericsson | We do not have a strong view. Since the network must be able handle UEs both supporting this and not supporting this, so from a network point of view it is OK to leave this optional also in Rel-16.  |
| Nokia, NSB | Support the proposal |
| OPPO | We agree with the proposal for Rel-16 UE but not for Rel15 UE. |
| MediaTek | We agree with the proposal for R-16 UEs, but do not want to reopen the discussion for R-15 UE. |
| Moderator (NTT DOCOMO) | Based on feedbacks so far, following is the situation.* The proposal is supported by almost all companies providing feedbacks so far.
* There are some companies that the proposal for Rel-16 UEs is ok but the proposal for Rel-15 UEs are not ok.
* There is an argument that the proposal for Rel-15 should be discussed after RAN5 has confirmed that necessary tests have been developed.

Therefore, possible way forward is to agree on following updated proposal 2.**Updated proposal 2 for non-SFN-sync NR-DC support:** * **All Rel-16 UEs shall not be allowed to report *sfn-SyncNRDC*.**
	+ **RAN WGs are tasked to prepare CRs addressing this issue in RAN#89-e.**
* **Note that for Rel-15 UEs supporting NR-DC, the discussion on mandating non-SFN-sync NR-DC support will be revisited after RAN5 has confirmed that necessary tests have been developed.**
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# **Discussion on finalizing Rel-16 UE capabilities**

In [6], CATT proposes some aspects for completion of Rel-16 UE capabilities by September. It is suggested to have a certain time plan for August meeting across WGs and to accept NBC changes for UE capabilities in September version of specifications.

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| **2.2 Timeliness of RAN1/4 feature lists in RAN2 for specification inclusion**There are still a considerable number of FFS in the RAN1/4 parameter list. And current time plan for the Q3 WG meetings seem to be that there is no offset between RAN1/4 and RAN2 as used in May/June meetings. Therefore, it is suggested to have guidance to RAN1/4 on their planning of UE feature list discussions in the next WG meetings. One possibility is to send a joint time plan across WGs so that the UE capabilities are finalized on an efficient and timely manner. The following proposal is made in this regard.**Proposal 3 If there is no time offset/gap between WG meetings in Q3, it is suggested to discuss how to ensure timeliness of RAN1/4 feature lists in RAN2 for specification inclusion.****2.3 On NBC changes in the September spec version**Normally after ASN.1 frozen (which was agreed to be June for this release) no NBC change is allowed, but this seems to be a topic that can be further discussed specifically given the current status of Rel-16 finalization. In the May/June WG meeting there were still some open issues. Those were not captured in the July specification and will then need to be capture later for example in September spec version. From a practical perspective it seems more likely Rel-16 5G network and terminals will only roll out widely based on a later spec version than those approved in this RP. In this sense to approve NBC CRs to some extend in the September RP seems possible. Of course this is only feasible with certain restriction, i.e., these changes are not functional and they are based on consensus in the related RAN WG or RP.Based on these discussions, we have the following proposal:**Proposal 4 NBC changes to Rel-16 UE capabilities specifications are possible based on consensus in the RP#89. For Rel-16 specification approved later than RP#89, NBC changes are not allowed as a general rule.** |

In [7], Huawei and HiSilicon also propose to complete Rel-16 UE capabilities by September and to provide a time line for August WG meetings that RAN1 and RAN4 are tasked to solve all remaining FFS on UE capabilities by the end of the first meeting week.

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Based on above contributions and proposals, the moderator provides following proposal based on [6] and [7].

### **Proposal 3 for finalizing Rel-16 UE capabilities:**

* **RAN1 and RAN4 shall strive to complete all FFS on Rel-16 UE capabilities impacting RAN2 specification by the end of their first week of August e-meeting**
	+ **NBC changes to Rel-16 UE capabilities specifications are possible based on consensus in the RAN#89-e. For Rel-16 specification approved later than RAN#89-e, NBC changes are not allowed as a general rule.**

Companies are encouraged to check above summary on contributions/proposal from moderator and to provide feedback if any in below.

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| Company | Comment |
| Futurewei | It is a sensible recommendation. |
| T-Mobile USA | We agree.  |
| Vivo | Support the proposal |
| CATT | We agree with Proposal 3.  |
| Huawei, HiSilicon | Support as the proponent. |
| Intel | We agree the proposal 3. |
| Qualcomm | Agree that in August, NBC changes can be expected. Detailed scheduling of the work can be left to the RAN1 and RAN4 Chairs.  |
| Ericsson | We are fine with the proposal.  |
| LG Electronics | Agree. |
| Nokia, NSB | Support the proposal in general, with the understanding that the handling of potential NBC changes in the future would be handled according to usual 3GPP procedures.  |
| OPPO | We agree |
| MediaTek | Agree to allow NBC for UE capability in August meeting. |
| Moderator (NTT DOCOMO) | Since the proposal is supported by all the companies providing feedback so far, the possible way forward is to agree on the proposal 3.**Proposal 3 for finalizing Rel-16 UE capabilities:** * **RAN1 and RAN4 shall strive to complete all FFS on Rel-16 UE capabilities impacting RAN2 specification by the end of their first week of August e-meeting**
	+ **NBC changes to Rel-16 UE capabilities specifications are possible based on consensus in the RAN#89-e. For Rel-16 specification approved later than RAN#89-e, NBC changes are not allowed as a general rule.**
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# **Discussion on basic feature groups for certain scenario/purpose**

In [6], CATT proposes to postpone the discussion on basic feature groups for certain scenario/purpose until UE capability signaling is completed. It is observed that some intermediate outcome of such discussion in RAN1 UE features list causes potential confusion in RAN2 so that capability signaling for FGs with FFS on whether it is basic feature group for certain scenario/purpose or not were not implemented in CRs for June version of specifications.

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| The following informative summary were captured in [1], based on discussions in the previous RP meeting.

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| * In case that a set of feature groups/components is necessary to be supported by UE (and NW) for a certain purpose,
	+ There are at least two possible approaches below to define the set of feature groups for a purpose.
		- Approach 1: A basic feature group(s), which is a set of components that are viewed necessary to provide a minimum level of support for the feature. Defining a basic feature group(s) is not always possible or necessary for a given feature.
		- Approach 2: A set(s) of feature groups necessary to be supported for the purpose is defined somewhere in specification(s).
	+ Each WG is responsible on whether/how to define the basic feature group(s) or the set(s) of feature groups, and it is possible to take different decision on approaches (including possibility to not define any basic feature group or set) for different purposes/features. It is preferable to take common approach across WGs for same feature/purpose.
		- The Plenary guidance may be requested, if needed after WG discussions, on whether defining a set of feature groups based on Approach 2 for some feature, either in addition or instead of approach 1. There has been no conclusion in previous discussions, including RAN 87e, that it would be necessary.
	+ Irrespective of defining a set of feature groups for a purpose, capability bit(s) should be defined for each of feature groups independently.
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While the whole concept of basic feature group may be well motivated, there seems to be practical difficulties in its realization when handling the Rel-16 NR UE capabilities.*Different procedures in WGs*In RAN1 it seems some discussions were carried out on how to define such basic feature group. This takes time and from the next part of this section we observe that it is certainly not a simple discussion. In short the ‘flavors’ seem to differ even across different WIs in the same WG of RAN1, and for each topic it requires much effort.In RAN2 such effort was not even officially taken. There were discussions in the past RAN2 meeting on the possible handling of basic feature group but majority do not find this an urgent or critical task at this stage. Similar understanding seems to be in RAN4.Given this situation, it takes even more time/effort to achieve the target ‘to take common approach across WGs for same feature/purpose’ as in the informative summary cited above.*Difficulty in reaching consensus on technical solutions*In the past WG meetings in both RAN1 and RAN2, there are split views in terms of how basic feature groups are actually specified.For example, in RAN2 there are different views, where some think it is sufficient to reflect the mapping in the field descriptions in the spec, while the others suggest a separate section in the TS 38.306 for a clear definition. There are even proposal to have a separate document for this purpose, to avoid impact to the finalization of Rel-16 capabilities. More discussions can be found in [2].In RAN1 the controversy seems to be on the more detailed level. The output in many cases can be confusing to the other WG, which may be partially due to such controversy. In detail, in [3] we observe some examples.* + [10-x] NR-unlicensed related FGs. The multiple FGs are described as *may be a part of basic operation for a particular scenario*, which basicaly is considered as FFS by RAN2.
	+ [15-x] Sidelink related FGs. There are multiple FFS (e.g., 15-2/5/14, etc.) on whehter a FG is basic or not.

Therefore, it seems clear that to implement the basic feature group it still requires much effort and the process can be time consuming. It is of course possible to continue as has been done in each of the WGs, and basically it is finally up to RAN2 how exactly given features are captured in the Rel-16 capability specification. But that way might not be efficient. As discussed it takes much effort/time in some WG, which then compromise the overall quality of Rel-16 specification given the pressing time budget. And, due to the potential ambiguity in the feature list provide to RAN2, there is not even guaranty the basic feature group is captured exactly the way as intended by the other WG. As anyway in RAN2 the current version of specification is done based on existing signaling framework, and capability bit(s) are defined for each of feature groups independently, it seems not so urgent to implement the concept of basic feature group at this stage. With these discussions, we’d suggest the following RP level guidance to better re-focus the remaining WG discussions on Rel-16 NR capabilities. **Proposal 1** **No extra effort is taken on specifying basic feature group in Q3, and RAN2 finalize the UE capabilities specification based on the existing signaling framework.** **Proposal 2 It can be decided later whether or how the basic feature groups are reflected in the specification.** |

In [7], Huawei and HiSilicon propose to confirm that each (potential) basic feature group defined by RAN1 has its own capability bit as for any FG. This clarification may solve the potential confusion in other WGs pointed in [6] above.

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| The basic FG definition is not clear so basic FGs are not currently reflected in RAN2 specifications* RAN1 responded to RAN2 with LS R1-2005096 (See below).
* RAN1 also followed the summary of RAN#87e discussion in RP-200502: “*Irrespective of defining a set of feature groups for a purpose, capability bit(s) should be defined for each of feature groups independently*”
* The RAN1 response is general across basic and non-basic features groups, and RAN1’s intent is that each FG has its own capability bit, whether basic or not.

**Confirm that each basic Feature Group (FG) defined by RAN1 has its own capability bit, as for any FG** |

On the other hand, in [4], [8] and [9], Nokia and Nokia Shanghai Bell propose to make a high-level decision on basic feature groups for URLLC, NR-U and Mobility enhancements.

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| [4]~~~It might be difficult to identify a unique set of parameters that will be enough to characterize all possible URLLC type of applications, as some might prioritize latency performance over reliability and vice-versa. In any case, the development of corresponding devices and networks can be significantly simplified if there are agreed sets of features which are expected to be considered together to deliver the expected functionality. Given that defining such sets of features require deep knowledge of 3GPP specifications, it is our understanding that such definition is in the scope of 3GPP work.**Proposal: 3GPP to consider defining set(s) of features in TS38.306 that are expected to be implemented together by devices supporting URLLC-type of functionality.** |
| [8]~~~In RAN1#101-e there was limited discussion on the topic, except for agreeing on potential FGs that are not to be considered basic feature groups, with still 12 FGs remaining as potential basic FGs for some scenarios. The alternatives listed in the agreement above do not imply ASN.1 impact and they are actually related to definition of mandatory/optional feature groups for certain scenarios and on the management of technical specifications, which are topics that fall in scope of RAN Plenary to discuss and make recommendations. Hence, it is beneficial if RAN Plenary can provide guidance to the WGs on how to progress work on this topic to allow RAN1 to use the limited time during August e-meeting to finalize the technical aspects of NR-U and FGs of other WIs. One particular aspect of NR-U feature groups is that there are several dimensions that influence if a certain FG should be considered as “basic”, i.e. mandatory, or not:1. Scenario (e.g. carrier aggregation with licensed carrier, dual connectivity, stand-alone, stand-alone with UL on licensed band)
2. Access mode (dynamic or semi-static)
3. UL carrier (not present, unlicensed, licensed)

This implies a non-trivial mapping of which FGs apply for each scenario, and it is our understanding that such relationship would become clearer if captured directly into one of more tables in TS 38.306. The technical recommendation on the exact mapping should be defined by RAN1. Example definitions of tables and potential mapping of FGs can be found in [2, 3, 4]. **Proposal: The mapping between basic feature groups for NR-U and the different operating scenarios is to be captured explicitly in TS 38.306, e.g. by means of one or more tables.**  |
| [9]~~~RAN1 is debating the following options for a UE supporting DAPS HO:1. Intra- and inter-frequency HO need to be supported
2. At least intra-frequency HO needs to be supported
3. UE can choose which type of HO to support

In general, we understand the concern of UE chipset vendors that intra-frequency DAPS HO is the most complex mode of operation, and that seems to be the key motivation for the proponents of option 3 above. However, whether a handover is intra- or inter-frequency in reality is determined by the network deployment and RRM decisions, and is not something the UE is able to influence significantly. In actual deployments, the most handovers occur when users have no data (in which case DAPS is not useful), and out of the handovers where users have an ongoing data sessions, vast majority are intra-frequency handovers. Inter-frequency handovers are usually not performed unless necessary. This has also been discussed at length during the work item, and it has been clear that intra-frequency is the clear priority target for DAPS HO feature enhancement. Hence, while we would certainly prefer option 1 above, we can accept at least option 2, i.e. at least intra-frequency HO being supported. Without that, the feature may never be deployed as it does not cater for the primary use case of handovers.**Proposal: FG 21-1a (Intra-frequency DAPS HO) is considered a basic feature group for UEs supporting DAPS HO.** |

Also, in [10], ZTE and Sanechips propose to make a high-level decision on basic feature groups for URLLC.

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| In RAN1#100bis-e, a working assumption on defining feature groups based on Approach 2 was reached for NR-U. While, there is no conclusion for Rel-16 URLLC. In our view, clarifying one or more sets of basic UE features for URLLC in the spec can serve the guidance to the industry to strive for a common set of technical components for certain UE type targeting at the same/similar use cases. For example, we can define one set of feature groups for low latency and one set of the feature groups for high reliability. This would help accelerating the application of these technical components in the market if we have such guidance sooner.  ***Proposal 1:*** *Support Approach 2 for Rel-16 URLLC UE features.* |

Based on above contributions and proposals, the moderator provides following proposal based on [6] and [7] that would be reasonable assuming that RAN WGs shall strive for completing UE capability signaling by September as proposed in Proposal 3.

### **Proposal 4 for basic feature groups for certain scenario/purpose:**

* **No extra effort is taken on specifying basic feature groups for certain scenario/purpose in Q3.**
	+ **It is confirmed that each potential basic feature group (FG) has its own capability bit, and RAN2 finalizes UE capabilities specification in Q3 irrespective of whether a FG is part of basic feature groups for certain scenario/purpose or not.**

Companies are encouraged to check above summary on contributions/proposal from moderator and to provide feedback if any in below.

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | Principles and framework taken in current CRs of Rel-16 UE capability (RP-201216/17) should be consistently applied in Q3.We do not share the observations made in [6], and don’t see a need of discouraging further discussions of basic feature groups in WGs, if condition allows. Some RAN level discussions may also help, as indicated by RP-201120/21/22. A pragmatic approach may be to confirm the need of basic feature group or a set of feature groups for certain purpose/scenario/use case, and to proceed it in a way that its designation doesn’t involve ASN.1 impact. |
| vivo | In our understanding, the motivation of this proposal is it use available time in Q3 wisely, that is to say resolving remaining FFSs, items in square brackets etc. In this sense the proposal 3 in section 4 is of utmost important than proposal 4. |
| CATT | We agree with Proposal 4. The subbullet as we understand is already the common understanding and also what R2 has been doing. Regarding Futurewei comments, our main concern as explained in the contribution is the time/effort in Q3 to discuss these aspects. So our preference would be to finalize the Rel-16 capability signaling based on R2’s pragmatic way in Q3. It is also our view that the basic feature group definitions are mainly informative and it is not very urgent to be done or completed in Q3.  |
| Huawei, HiSilicon | We think the bullets under Proposal 4 are two separate bullets. We support second bullet as the proponent. Regarding whether to discuss how to capture basic feature group, we think in the end this would be a case by case discussion. However we see some value on the proposal in [4] and the proposal in [10] which can be considered, as currently eMBB and URLLC capabilities are mixed together and this might add difficulties to understand which capabilities are required for URLLC. We think for this particular point, it is worth having a set of FGs defined together in 38.306. In addition we think V2X capabilities should also be grouped together in 38.306 for the same reason. |
| Intel | We agree Proposal 4. |
| Qualcomm | We agree with Proposal 4. As it was discussed before, there is no need to start UE profiling discussions in 3GPP, which the basic feature group definitions would lead to. In particular, there is no need to introduce UE profile tables in 38.306 for NR-U or any other UE features.  |
| Ericsson | We believe that there are different understandings of what is proposed here. We want to highlight that what Huawei hints towards in their reply seem to relate to a discussion which took place in the previous two RAN2 meetings. Our understanding of that proposal was that 3GPP should summarize/list a set of capabilities which are "useful" in a particular scenario. For example, say that for scenarios where low latency is required, a particular set of features in the specs are useful. That would, in our understanding, be just informative. We do not support such proposal since we think that such informative text is not necessary. The industry will decide by itself which features are used in which scenario. The 3GPP specifications just provides a toolbox which can be used, but should not say that tool X, Y and Z "should" be used when trying to do a task A. As said, this was discussed in the last two RAN2 meetings and RAN2 decided not to add such informative text. We think it would take a lot of time and effort for the WGs to reach consensus on such information, and in the end it would not be useful information. |
| LG Electronics | At least from RAN2 point of view, we agree that RAN2 focus on finalizing UE capabilities in Q3, and consider feature group later.  |
| Nokia, NSB | We agree with Huawei above that the proposal mixes two separate issues. The sub-bullet “It is confirmed that each potential basic feature group (FG) has its own capability bit,…” is definitely agreeable and it is our assumption as well. However we don’t see the need to avoid discussion on the definition of basic feature groups and sets of feature groups, as those are separate issues.Actually, if Proposal 3 is agreed it is clear that RAN1 will have time to discuss these aspects in the second week of August meeting, and hence we don’t see a need to agree a priori that no discussion will take place in Q3 on these matters. |
| OPPO | We agree with proposal4. Considering the tight schedule of Rel16 we don’t think it is something urgent to do.  |
| MediaTek | Agree to Proposal 4 to be able to finalize R-16 UE capability in next meeting.On UE profiling, we think it is too early to discuss UE profiling for URLLC, etc. and 3GPP can find better use of the time. |
| Moderator (NTT DOCOMO) | Based on feedbacks so far, following is the situation.* Some companies pointed that the main bullet and sub-bullet should be two separated proposals.
* The sub-bullet proposal seems agreeable to all.
* The main bullet proposal is controversial and different WGs would have different situation in terms of availability of time/resource to discuss basic feature group aspects.

Therefore, possible way forward is to agree on following updated proposal 4.**Updated proposal 4 for basic feature groups for certain scenario/purpose:** * **No extra effort is taken on specifying basic feature groups for certain scenario/purpose before finalizing UE capabilities in each WG.**
* **It is confirmed that each potential basic feature group (FG) has its own capability bit, and RAN2 finalizes UE capabilities specification in Q3 irrespective of whether a FG is part of basic feature groups for certain scenario/purpose or not.**
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# **Discussion on FG interpretation in case of cross-carrier operation**

In [10], ZTE and Sanechips propose to clarify the interpretation of FGs applicable to cross-carrier operation based on three possible alternatives.

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| During RAN1#98bis meeting, RAN1 discussed the ambiguity of UE L1 capabilities with FDD/TDD and/or FR1/FR2 differentiation [4]. For UE features with FDD/TDD and/or FR1/FR2 differentiation, RAN1 clarified how to interpret the UE feature in case of cross-xDD and/or cross-FRx operation. To address this issue in Rel-15, RAN2 added clarification in section Annex A.1 and A.2 of TS38.306. Besides, RAN2 requested RAN1/RAN4 to discuss the “Capability interpretation for mixture of FDD/TDD and/or FR1/FR2” in the ongoing Rel-16 UE feature discussion [5] to address this issue in Rel-16.However, after further analysis, the ambiguity is not only for UE features with FDD/TDD and/or FR1/FR2 differentiation, but also for UE features without xDD/FRx differentiation. Take the Rel-15 UE capability *aperiodicTRS* as an example. UE capability *aperiodicTRS* is a “per Band” signaling, which is to indicate the network whether the UE supports DCI triggering aperiodic TRS associated with periodic TRS. It is not clear how to interpret the UE capability in case when only one of the triggering cell and triggered cell supports *aperiodicTRS*. For example, if UE indicates support of *aperiodicTRS* for Band A and NOT support of *aperiodicTRS* for Band B. If UE needs to trigger A-TRS for Band B from Band A, it is not clear whether UE supports this kind of operation.

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| --- | --- | --- | --- | --- |
| Definitions for parameters | Per | M | FDD-TDDDIFF | FR1-FR2DIFF |
| *aperiodicTRS*Indicates whether the UE supports DCI triggering aperiodic TRS associated with periodic TRS. | Band | No | N/A | N/A |

Both Rel-15 UE capability and Rel-16 UE capability have this ambiguity. For Rel-15 UE capability, clarification is needed to align companies’ understanding to facilitate the product implementation. For Rel-16 UE capability under discussion, it seems RAN1 didn’t discuss this issue due to the limited time budget. We’d like to draw companies’ attention to this issue and try to align companies’ understanding on how to interpret UE capability in case of cross-carrier operation. Thus, we propose the following proposal. ***Proposal 3****: For UE feature related to cross-carrier operation (e.g., cross-carrier scheduling/triggering/indication), working group to clarify whether support of this feature should be based on**Alt.1 the support of this feature for both scheduling/triggering/indicating cell and scheduled/triggered/indicated cell.**Alt.2 the support of this feature for the scheduling/triggering/indicating cell only.**Alt.3 the support of this feature for the scheduled/triggered/indicated cell only.**Note: RAN1 has clarified the above issue in Rel-15 for UE features with FDD/TDD and/or FR1/FR2 differentiation. However, in case of cross-carrier operation, clarification for UE features without FDD/TDD or FR1/FR2 differentiation is also needed for both Rel-15 and Rel-16 UE feature.* |

Based on above contribution and proposal, the moderator provides following proposal based on [10].

### **Proposal 5 for FG interpretation in case of cross-carrier operation:**

* **For UE feature related to cross-carrier operation (e.g., cross-carrier scheduling/triggering/indication), working group to clarify whether support of this feature should be based on**
	+ **Alt.1: the support of this feature for both scheduling/triggering/indicating cell and scheduled/triggered/indicated cell.**
	+ **Alt.2: the support of this feature for the scheduling/triggering/indicating cell only.**
	+ **Alt.3: the support of this feature for the scheduled/triggered/indicated cell only.**

Companies are encouraged to check above summary on contribution/proposal from moderator and to provide feedback if any in below.

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| Company | Comment |
| Futurewei | Not sure only one alternative should be taken. Confusions should be identified and clarified in WGs case-by-case.  |
| vivo | Should be discussed on case by case basis |
| CATT | Agree that this is discussed case by case and preferably handled in the corresponding WG. |
| Huawei, HiSilicon | We need to first understand what specific features are under discussion here and it is better to let WG to solve the ambiguity, if any. |
| Intel | Our view is that the clarification should be based on case by case. |
| Qualcomm | We understand Proposal 5 to suggest already that the selection is done for each case individually. We agree with that. We would propose to also add that it is not precluded that for some cases an alternative different from Alt.1, 2, 3 may apply, as long as it is clearly described.  |
| Ericsson | Agree that this can be discussed in working groups on a case-by-case basis. No need for any RAN guidance. |
| LG Electronics | We agree with other companies that the clarification should be discussed in WGs on case-by-case basis. |
| Nokia, NSB | It would be better to take a closer look at the specific cases because the assumptions are not uniform across all R15 and R16 features that could be in scope of this proposal. If anything is to be decided now we would prefer Alt. 1 to minimize the fragmentation and confusion, but that may be controversial as well. |
| OPPO | General rule seems not so helpful without knowing the detail case i.e. we support discuss case by case |
| MediaTek | If each capability is clearly described, then we do not see the need to have Proposal 5. Issues can be identified and handled case by case. |
| Moderator (NTT DOCOMO) | Based on feedbacks so far, majority prefer to have this discussion in WGs on a case-by-case basis.Therefore, there is no need to further discuss on the proposal 5 in RAN#88e. |

# **Conclusion**

**Updated proposal 2 for non-SFN-sync NR-DC support:**

* **All Rel-16 UEs shall not be allowed to report *sfn-SyncNRDC*.**
	+ **RAN WGs are tasked to prepare CRs addressing this issue in RAN#89-e.**
* **Note that for Rel-15 UEs supporting NR-DC, the discussion on mandating non-SFN-sync NR-DC support will be revisited after RAN5 has confirmed that necessary tests have been developed.**

**Proposal 3 for finalizing Rel-16 UE capabilities:**

* **RAN1 and RAN4 shall strive to complete all FFS on Rel-16 UE capabilities impacting RAN2 specification by the end of their first week of August e-meeting**
	+ **NBC changes to Rel-16 UE capabilities specifications are possible based on consensus in the RAN#89-e. For Rel-16 specification approved later than RAN#89-e, NBC changes are not allowed as a general rule.**

**Updated proposal 4 for basic feature groups for certain scenario/purpose:**

* **No extra effort is taken on specifying basic feature groups for certain scenario/purpose before finalizing UE capabilities in each WG.**
* **It is confirmed that each potential basic feature group (FG) has its own capability bit, and RAN2 finalizes UE capabilities specification in Q3 irrespective of whether a FG is part of basic feature groups for certain scenario/purpose or not.**

# **References**

[1] RP-200868 Clarification of Rel-15 mandatory features Qualcomm Incorporated

[2] RP-200883 Handling mandatory features without capability signalling for Release-15 KT Corp.

[3] RP-201119 Mapping of Rel-15 features to TS38.306 Nokia, Nokia Shanghai Bell, Orange

[4] RP-201120 On feature groups for URLLC UEs Nokia, Nokia Shanghai Bell

[5] RP-201050 On the UE (in)capability of slot aligned non-SFN-sync DC Huawei, HiSilicon

[6] RP-200915 On Handling of Rel-16 NR UE Capabilities CATT

[7] RP-201051 On finalizing Rel-16 UE capabilities Huawei, HiSilicon

[8] RP-201121 Basic feature groups for NR-Unlicensed Nokia, Nokia Shanghai Bell

[9] RP-201122 Basic feature groups for Mobility Enhancement Nokia, Nokia Shanghai Bell

[10] RP-201054 Discussion on NR UE Features ZTE, Sanechips