**3GPP TSG RAN WG2#109-e** **R2-200xxxx**

**Electronic meeting, 24th February - 6th March, 2020**

**Title: [Draft]** Guidelines for UE capability definitions

**Response to: -**

**Release:** Rel-16

**Work Item:** -

**Source:** Ericsson, Intel [RAN2]

**To:** RAN1, RAN4

**Cc:** RAN

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**Attachments:** None

**1. Overall Description:**

The discussion on defining UE features parameters for Rel-16 has started. Based on the experience from Rel-15, RAN2 discussed some additional guidelines that should be used in order to have uniquely defined UE capabilities, and would like to share these guidelines with RAN1 and RAN4.

**1 Avoid defining “incapability” bits as they may cause interpretation issues**

The definition of the capability should not say that “a UE setting the bit does not support Rel-16 feature X”. Such statements caused a lot of problems in Rel-15. One example was the *pucch-F0-2WithoutFH* that indicates that “the UE does **not** support PUCCH formats 0 and 2 without frequency hopping”.

**2 Absence of a capability bit** shall not imply support for something that is not yet defined

One example is “absence of *channelBW* means that the UE supports all BWs”. Since new BWs might be added later (and in a release independent manner) and maybe in some other specification, “all BWs” can become ambiguous. Any legacy UE would suddenly be expected to support the new bandwidth as well.

Another example is the default capability for UE power class and UL duty cycle. From signalling point of view, reducing the overhead is marginal (unless it is reported per-BandCombination or Per-Band-of-a-BandCombination as discussed in bullet 4 below). Instead, gNB faces difficulty in comprehending the implicit capabilities amongst UEs compliant with different versions in a release.

**3 Define baseline feature bits that covers the minimum parts of a feature and use additional bits for parts that can be used together with the baseline feature**

If a feature has a baseline feature, the baseline feature must be clearly defined. It is not enough to write that “if the UE does not set the bit it does not support feature group x-y”. If a capability bit for a certain “feature X” has been defined, all UEs that support “feature X” shall set the bit, and additional parts of the feature may not be supported by all UEs.

Capability signalling and rules to determine whether a UE supports a feature should not be mixed. For example, avoid to say

“In TDD band combinations, only UEs that set the featureX capability bit support feature. In FDD-only band combinations all UEs support feature X even if they do not set the bit.”

If later FDD-only band combinations are defined, where UEs are not required to support the feature, band combinations will not be release independent. An example where this caused problem in Rel-15 was the capability *simultaneousRx-Tx* for EN-DC.

**4 Minimize features “per-BandCombination” and “per-Band-of-a-BandCombination”**

The number of features that require capability signaling with “per-BandCombination” and “per-Band-of-a-BandCombination” (FeatureSetPerCC) differentiation should be minimized. Such features cause an explosion in the size of the capability signaling and are even more severe when it comes to the number of possible configurations, making it impossible for the gNB to take all combinations into account.

It would be of help for RAN2 to be informed of the reasons why “per-BC” or “per-band-of-a-BC” was considered necessary, and whether other alternatives were considered.

**5 Avoid defining functionality that has no RRC configuration but is dependent on capability bits.**

The specification should not be written so that the network determines what configuration it can use for a UE implicitly by the reported UE capabilities. Instead, the gNB should always configure the UE explicitly by DL RRC signalling, respecting the reported capabilities.

A problematic case in Rel-15 was the UL/DL MIMO layers, which resulted in a late-stage introduction of explicit MIMO signalling support by RAN2 (maxLayersMIMO-Indication).

**6 Avoid Mandatory (without capability signalling) features in Rel-16**

We remind that any functionality in Rel-16 defined as Mandatory (without capability signalling) basically means that a UE that sets the AccessStratumRelease in the UE capabilities to “Rel-16” must implement all such features. It also means that a UE cannot implement and IODT any other Rel-16 feature before having successfully IODTed the mandatory features and may not even be possible to upgrade UEs to Rel-16.

**7 UE capabilities defined in specifications must be self-contained**

RAN2 would also like to point out that once the “snapshot” of defined Rel-16 capabilities have been captured in RAN2 TR 38.822, RAN2 does not plan to update this TR. Discussions (on any WG capabilities) should be based on the actual specification text. RAN2 will document the capabilities in TS 3x.306, preferably with references to RAN1/RAN4 specifications and to corresponding RRC configurations (fields and information elements).

RAN2 understands that RAN1 uses the “feature IDs”, since they are the only available definitions during the initial stage of discussions. RAN2 would like to request that once the RRC signalling is in place and can be mapped to each “feature ID”, the actual field names used in the signalling are also utilized in the RAN1/RAN4 capability discussions (to avoid inter-WG confusion e.g. in LSs).

**8 Rationale for necessity of both xDD and FRx differentiations for per-UE capability**

RAN2 did not discuss the RAN1 LS on XDD-FRX Differentiation (R1-1913579/R2-2000013) at the RAN2#109-e meeting, but RAN2 would anyway appreciate to be provided with rationale in case Per-UE capability with both FDD/TDD and FR1/FR2 differentiations is deemed as necessary for a feature.

**2. Actions:**

**To RAN1, RAN4:**

**ACTION:** RAN2 would like to respectfully ask RAN1 and RAN4 to use these guidelines in their work on the Rel-16 UE capability definitions.

**3. Date of Next TSG-RAN WG1 Meetings:**

TSG-RAN2 Meeting #109bis 20th – 24th April 2020 Elbonia (TBC)

TSG-RAN2 Meeting #110 25th – 29th May 2020 Athens, Greece (TBC)