3GPP TSG RAN WG2 Meeting #111-e R2-200xxxx

**Electronic, 17th – 28th August 2020**

**Agenda item:** 6.1.2

**Source:** Lenovo

**Title:** Report from email discussion [AT111-e][017][NR16] UE cap Beam Switch Timing

**Document for:**  Discussion and decision

# Introduction

This contribution summarizes the discussion and result of the email discussion below that took place during RAN2#111-e:

* [AT111-e][017][NR16] UE cap Beam Switch Timing (Lenovo)

Scope: Treat R2-2006880, R2-2006881, R2-2006882, R2-2007505, R2-2007506 (proponents to drive),

Deadlines: Short NR UE cap

# Discussion

## Rel-15 Clarification on the support of beamSwitchTiming values of 224 and 336 (R2-2006880)

In Rel-15 the capability beamSwitchTiming of type ENUMERATED {sym14, sym28, sym48, sym224, sym336} was introduced in TS 38.331 for FR2 aperiodic CSI-RS beam switching (refers to FG2-28 in RAN1 Rel-15 NR features list), see below. However, the UE behaviour for reporting the higher values (sym224 and sym336) has not been specified in Rel-15 by RAN1.

MIMO-ParametersPerBand ::= SEQUENCE {

...

aperiodicTRS ENUMERATED {supported} OPTIONAL,

...,

[[

dummy6 ENUMERATED {true} OPTIONAL,

beamManagementSSB-CSI-RS BeamManagementSSB-CSI-RS OPTIONAL,

beamSwitchTiming SEQUENCE {

scs-60kHz ENUMERATED {sym14, sym28, sym48, sym224, sym336} OPTIONAL,

scs-120kHz ENUMERATED {sym14, sym28, sym48, sym224, sym336} OPTIONAL

} OPTIONAL,

codebookParameters CodebookParameters OPTIONAL,

...

]]

}

To be aligned with RAN1 specification and to avoid any interoperability issues with regards to aperiodic CSI report triggering, the 38.306 CR in R2-2006880 [1] proposes to clarify in the description of Rel-15 beamSwitchTiming capability that if the UE includes this field for each supported subcarrier spacing, the maximum value that can be signaled is 48 OFDM symbols, see below.

| ***beamSwitchTiming***  Indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission. The number of OFDM symbols is measured from the last symbol containing the indication to the first symbol of CSI-RS. If the UE includes this field for each supported sub-carrier spacing, the maximum value that can be signaled is 48 OFDM symbols. If this field is not included, the beam switch timing is up to 48 OFDM symbols for each supported sub-carrier spacing. | Band | No | N/A | FR2 only |
| --- | --- | --- | --- | --- |

**Question 1:** Do companies agree on the proposed clarification in the description of Rel-15 beamSwitchTiming capability according to the 38.306 CR in R2-2006880?

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| Lenovo | Agree | Proponent |
| Nokia | Disagree, based on our RAN1 feedback better to leave the Rel-15 untouched. | The NOTE in RAN1 feature list says this “48 is used as the beam switching threshold for UEs reporting 224 or 336. When using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI.” |
| Huawei, HiSilicon | Disagree, same view as Nokia |  |
| ZTE | Disagree, same view as Nokia |  |
| Qualcomm Incorporated (Masato) | Proponent | Nokia’s comment is about **release-16** feature list from RAN1, whereas the CR is for release-15.  [Nokia] Correct but the point we wanted to make was the change in 2.1 is a) not needed, and b) could cause issues with the Rel-16 capability (above). So perhaps better just to leave R15 as it was. |
| CATT | Disagree, same view as Nokia |  |
| vivo | Disagree | The proposed change is not aligned with RAN1 intention.  There are extensive discussion in RAN1. The final conclusion on TEI on beamSwitchTiming in RAN1 is not to change anything in Rel-15, either the RRC signaling or the Capability.  Besides, we also agree with Nokia’s comments. |
| OPPO | Disagree | Indeed the note is for Rel-16, yet according to our RAN1 colleagues, in R15, the situation is not to prevent UE to report 224/336, yet just the network behaviour based on the 224/336 is undefined, so that we also tend to keep the R15 spec as it is. |

## Rel-16 Correction on the support of beamSwitchTiming values of 224 and 336 (R2-2006881, R2-2006882, R2-2007505, R2-2007506)

Considering the fact that the UE behaviour for reporting the higher values (sym224 and sym336) of beamSwitchTiming has not been specified in Rel-15, RAN1 agreed on TEI16 feature „Aperiodic CSI-RS triggering for UE reporting beamSwitchTiming values of 224 and 336“. And RAN2 introduced this feature in TS 38.306 by CR214r2 (R2-2001893, RAN2#109-e, Feb/Mar 2020) and by updating the description of beamSwitchTiming in Rel-16. However, in retrospect this was not the right decision due to the fact that RAN1 agreed recently on this feature as an optional feature with capability signaling, see the below description from the RAN1 NR features list in [6].

*14. NR TEI 14-7 New capability for beamSwitchTiming values of 224 and 336*

*1. Indicates the minimum number of required OFDM symbols {224, 336} between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition ‘ON’*

*Candidate values: {224, 336}*

*Agreements:*

*・48 is used as the beam switching threshold for Ues reporting 224 or 336*

*ØWhen using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI.*

*Optional with capability signaling*

The decision was made based on contribution R1-2004831 as discussed in [101-e-NR-TEIs-03] and the agreements below (copied from RAN1#101-e draft report):

* *Introduce a new capability signaling for aperiodic CSI-RS triggering with beam switching timing (FG14-7 in UE features list)*
  + *Followings are clarified for FG14-7 (beamSwitchTiming-r16) in the UE features list*
    - *Candidate values of beamSwitchTiming-r16 include {224, 336}*
* *An RRC configuration parameter is added to indicate the UE behavior for AP-CSI-RS beam switching in Rel-16*
  + *When provided, the UE behavior agreed in Rel-16 TEI is performed, with beamSwitchTiming-r16 as input*
  + *Otherwise, the UE behavior specified in Rel-15 is performed, with beamSwitchTiming as input*

Note: the “RRC configuration parameter” refers to parameter “enableBeamSwitchTiming-r16” that was introduced in IE ServingCellConfig in TS 38.331.

In order to capture the RAN1 agreements properly, changes to TS 38.331 and TS 38.306 need to be made, and two sets of CRs were submitted to this meeting to do so:

1. **Set 1: CRs in R2-2006881 and R2-2006882 [2], [3]**

* In 38.306 new capability beamSwitchTiming-r16 has been introduced. Furthermore, the description on the higher values (sym224 and sym336) has been removed from Rel-15 beamSwitchTiming. In addition, in the description of Rel-15 beamSwitchTiming capability it has been clarified that the maximum value that can be signaled is 48 OFDM symbols.

| ***beamSwitchTiming***  Indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission. The number of OFDM symbols is measured from the last symbol containing the indication to the first symbol of CSI-RS. The UE includes this field for each supported sub-carrier spacing. The maximum value that can be signaled is 48 OFDM symbols.‘’ | Band | No | N/A | FR2 only |
| --- | --- | --- | --- | --- |
| ***beamSwitchTiming-r16***  Indicates the minimum number of required OFDM symbols(sym224, sym336) between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition ‘ON’. | Band | No | N/A | FR2 only |

* In TS 38.331, in IE MIMO-ParametersPerBand new capability beamSwitchTiming-r16 of type ENUMERATED {sym224, sym336} has been introduced.

...

beamSwitchTiming SEQUENCE {

scs-60kHz ENUMERATED {sym14, sym28, sym48, sym224, sym336} OPTIONAL,

scs-120kHz ENUMERATED {sym14, sym28, sym48, sym224, sym336} OPTIONAL

} OPTIONAL,

...

codebookParametersPerBand-r16 CodebookParameters-v1610 OPTIONAL

]],

[[

beamSwitchTiming-r16 ENUMERATED {sym224, sym336} OPTIONAL

]]

}

1. **Set 2: CRs in R2-2007505 and R2-2007506 [4], [5]**

* In 38.306, in the description of beamSwitchTiming capability the value (sym224 or sym336) is referred now to the Rel-16 extended version.

| ***beamSwitchTiming***  Indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission. The number of OFDM symbols is measured from the last symbol containing the indication to the first symbol of CSI-RS. The UE includes this field for each supported sub-carrier spacing.  *beamSwitchTiming-v16xy* of value (*sym224* or *sym336*) indicates the minimum number of required OFDM symbols between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition ‘ON’ | Band | No | N/A | FR2 only |
| --- | --- | --- | --- | --- |

* In TS 38.331, in IE MIMO-ParametersPerBand an extended Rel-16 capability beamSwitchTiming-v16xy with the value (sym224 or sym336) for each supported subcarrier spacing has been introduced.

...

beamSwitchTiming SEQUENCE {

scs-60kHz ENUMERATED {sym14, sym28, sym48, sym224, sym336} OPTIONAL,

scs-120kHz ENUMERATED {sym14, sym28, sym48, sym224, sym336} OPTIONAL

} OPTIONAL,

...

codebookParametersPerBand-r16 CodebookParameters-v1610 OPTIONAL

]],

[[

beamSwitchTiming-v16xy SEQUENCE {

scs-60kHz-v16xy ENUMERATED {sym224, sym336} OPTIONAL,

scs-120kHz-v16xy ENUMERATED {sym224, sym336} OPTIONAL

} OPTIONAL,

]]

}

**Question 2:** Which set of CRs do companies prefer to capture the RAN1 agreements on TEI16 feature „Aperiodic CSI-RS triggering for UE reporting beamSwitchTiming values of 224 and 336“?

|  |  |  |
| --- | --- | --- |
| **Company** | **Set 1 / Set 2 CRs** | **Additional comments** |
| Lenovo | Set 1 | Proponent of set 1 CRs.  ASN.1 signalling of the higher values of 224 and 336 acc. To set 2 CRs looks odd due to the fact that the values of 224 or 336 are duplicated. Furthermore, RAN1 didn’t indicate that the values of 224 and 336 should be signalled per supported subcarrier spacing. |
| Nokia | Set 2 | We would support the approach in Set 2, but using the original formulation of beamSwitchTiming instead. |
| Huawei, HiSilicon | Set 2 | We understand the same principle applies to Rel-16 signalling that 60k and 120k SCS needs to be differentiated. |
| ZTE | Set 2 | We share the same view as Huawei.  On the comments from Nokia, according to the RAN1 LS on the update Rel-16 NR-parameter List(R2-2006508-R1-2005051), a new element “enableBeamSwitchTiming-r16 ” was added in the TEI part together with the description as below:  Indication of UE behaviour for AP-CSI-RS beam switching in Rel-16. When provided, the UE behavior agreed in Rel-16 TEI is performed, with beamSwitchTiming-r16 as input. Otherwise, the UE behavior specified in Rel-15 is performed, with beamSwitchTiming as input.  After internal confirming with our RAN1 guy, our understanding is that for the Rel16 UE, it can report a value that less than 48 in the legacy beamSwitchTiming field, and meanwhile report 224/336 in the beamSwitchTiming-v16xy.  Then for the UE report the a value less than 48 in the legacy beamSwitchTiming field, and meanwhile report 224/336 in the beamSwitchTiming-v16xy,  if the BeamSwitchTiming-r16 was enabled:  the network shall take 224/336 into consideration, and for the legacy field it will take the 48 into consideration(even it reports less than 48),  otherwise, the network will take the value that in the legacy beamSwitchTiming field into consideration (which can be less than 48) |
| Qualcomm Incorporated | Need further check. | Indeed, RAN1’s release-15 feature list indicated the capability value is function of SCS.  Minimum time between the DCI triggering of AP-CSI-RS and aperiodic CSI-RS transmission shall be at least Kbi symbols. (Symbols measured from last symbol containing the indication to first symbol of CSI-RS), where i is the index of SCS, l=1,2 corresponding to 60,120 kHz SCS.  Their Release-16 feature list however is not clear on this point. |
| CATT | Set2 | We slightly prefer to allow SCS differentiation as legacy is that way. |
| Vivo | Set 2 | First of all, we agree with Huawei that the same principle applies to Rel-16 signalling that 60k and 120k SCS needs to be differentiated.  Secondly, the conclusion in RAN1 is that the values less than 48 in legacy field can be also reported by rel-16 UE. Thus, we should use -v16xy for extension. |
| OPPO | Set 2 | We understand the same principle applies to Rel-16 signalling that 60k and 120k SCS needs to be differentiated. |

# Conclusion

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# Reference

[1] [R2-2006880](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006880.zip), (Rel-15 CR 38.306) Clarification on the support of beamSwitchTiming values of 224 and 336, Lenovo, Motorola Mobility, Qualcomm Incorporated, Ericsson

[2] [R2-2006881](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006881.zip), (Rel-16 CR 38.306) Correction on the support of beamSwitchTiming values of 224 and 336, Lenovo, Motorola Mobility, Qualcomm Incorporated, Ericsson

[3] [R2-2006882](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006882.zip), (Rel-16 CR 38.331) Correction on the support of beamSwitchTiming values of 224 and 336, Lenovo, Motorola Mobility, Qualcomm Incorporated, Ericsson

[4] [R2-2007505](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007505.zip), (Rel-16 CR 38.331) Correction on beamSwitchTiming values of 224 and 336, vivo

[5] [R2-2007506](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007506.zip), (Rel-16 CR 38.306) Correction on beamSwitchTiming values of 224 and 336, vivo

[6] [R2-2006378](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2006378.zip), LS on updated Rel-16 RAN1 UE features lists for NR after RAN1#101-e (R1-2005109; contact: NTT DOCOMO, AT&T), RAN1