**3GPP TSG-RAN WG3 Meeting #112-e  *R3-212652***

**E-Meeting, 17th May - 28th May, 2021**

**Agenda Item: 21.3**

**Source: Samsung**

**Title: Summary of Offline Discussion on New QoS Parameters for NR IIOT**

**Document for: Approval**

# Introduction

**# NRIIOT2-New\_QoS\_Parameters**

**- Open issues from last meeting in R3-211137:**

1. **details of Survival Time e.g. minimum and maximum value of Survival Time?**
2. **whether to include Survival Time for uplink?**
3. **the exact encoding, whether aperiodic type is allowed?**

**- Survival Time does not apply to aperiodic deterministic traffic in Release 17?**

**- The NG-RAN node may fulfil the survival time requirements either the uplink or downlink, but can not meet the TSN services in acknowledge mode. An LS to SA2 can be sent if any need?**

**- Capture agreements and open issues in the summary**

**- Agreeable to have BL CRs at this time?**

(Samsung - moderator)

# For the Chairman’s Notes

<TBD>

# Discussion – Phase 1

## Applicability of survival time to aperiodic deterministic traffic

3 companies [Nokia, CATT, Huawei] propose that the Survival Time is not applicable to aperiodic traffic in Rel.17 and there is no other related proposal.

**Q1: Do you agree that the survival time is not applicable to aperiodic deterministic traffic in Rel.17?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Samsung | Yes | RAN2 already agreed that only periodic traffic is considered for survival time work in Rel-17. |
| Huawei | Yes |  |
| CATT | Yes |  |
| ZTE | Yes |  |
| InterDigital | Yes |  |
| Ericsson | Yes |  |
| Nokia | Yes |  |
|  |  |  |

**Moderator’s Summary: All companies have the same understanding.**

**Proposal 1: The survival time is not applicable to aperiodic deterministic traffic in Rel.17.**

## Expression of Survival Time

For the expression of Survival Time, two options are proposed:

* **Option 1: Unit of time**, e.g. INTEGER (0…1920000) in unit of us [ZTE, CATT, Ericsson, Samsung]
* **Option 2: Unit of Periodicity**, e.g. INTEGER (0…3) in unit of Periodicity [Nokia, Huawei]

4 companies support the unit of time and 2 companies support the unit of Periodicity.

**Q2: Do you agree on the expression of Survival Time with the unit of time (Option 1)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Samsung | Yes | We think both options can work.  But option 1 is more aligned with the description in SA2 spec:  “the SMF converts maximum number of messages into time units by multiplying its value by the TSCAI Periodicity, and sets the TSCAI Survival Time to the calculated value.” |
| Huawei |  | We are fine with option1. |
| CATT | Yes | Option 1. The SMF only provide the time unit value. Also lots of survival time is not equal to times of Periodicity.  I add annex in this summary, the table is copied from TS 22.104 v17.5. It is the latest Table 5.2-1: Periodic deterministic communication service performance requirements.  In this table you may find some pair (Periodicity and survival time) like as below.   |  |  | | --- | --- | | ≤ 10 ms | 10 ms | | ≤ 50 ms | 50 ms | |
| ZTE | Yes | Agree with CATT. Based on the fact that the unit of the parameter survival time in SA2 is defined as time, we prefer to express the survival time with unit of time. And although the survival time in Rel-17 is only used for periodic deterministic communication, the possibility that it can be used for aperiodic deterministic communication can not be ignored. For future extension, we prefer to use a general unit (e.g., time value) to define survival time. |
| InterDigital | Yes |  |
| Ericsson | Yes |  |
| Nokia | Yes | We are OK with option 1, although it seems that the Survival Time will always be a multiple of the TSCAI periodicity. |
|  |  |  |

**Moderator’s Summary: All companies don’t have objection of ‘unit of time’ to express the Survival Time.**

**Proposal 2: The Survival Time is expressed as ‘unit of time’, e.g. in unit of 1 us.**

## Minimum and maximum value of Survival Time

All companies proposed the **minimum value** of survival time with **0 (in unit of time or in unit of Periodicity)**.

Regarding the **maximum value** of survival time, the following options are proposed:

* **Option 1: 3 times of maximum periodicity value or Periodicity** [ZTE, Samsung, Nokia]
  + Option 1-1: 1920000 us (3 times of max Periodicity) [ZTE, Samsung]
  + Option 1-2: 3 in unit of Periodicity [Nokia]
* **Option 2: 16 times of Periodicity** [Huawei]
* **Option 3: 10 times of maximum periodicity value** (6400000 us) [Ericsson]
* **Option 4: 180000 ms and larger** [CATT]

3 companies support 3 times of Periodicity and other 3 companies propose different values.

**Q3: Do you agree on setting the minimum value of Survival Time to 0 and the maximum value of survival time to 3 times of Periodicity or maximum periodicity value?** (The encoding of the maximum value for survival time depends on the agreement of sect 3.2 Q3.)

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Samsung |  | In TS 22.104, the performance requirement of the survival time is >= 3 times of the transfer interval. So we’re ok with Option 1, 2 and 3, and have no strong preference. |
| Huawei | Yes for minimum value;  No for maximum value | In TS 22.204, the maximum value can be set as three numbers of periodicity or the TBD. So a larger number (larger than 3 times or 1920000 us) should be considered. Also for future purpose, we should allow a larger value at this stage. We may suggest we can mark this FFS if no agreement is made at this meeting. |
| CATT | Yes for minimum value  No for the maximum | You may find in the Annex table which I add.  The maximum Transfer interval(Periodicity) is  **100 ms to 60 s (note 7)**  And the survival time is **≥ 3 x transfer interval value**  So the maximum survival time is ≥180s |
| ZTE | Yes | We prefer **Option 1-1** or **Option 4**.  Considering that the periodicity in the *TSCAI* is equal to the message transmission interval, we can find that the range of periodicity (0..640000,...) us in *TSCAI* can not meet the requirements of the maximum transmission interval(e.g., the plant asset management scenario: 100 ms to 60s) in table 5.2-1 of TS 22.104. Therefore, it is necessary to extend the maximum periodicity of *TSCAI* to 60s. Furthermore, based on the assumption that the survival time value should be larger than or equal to three times the periodicity of *TSCAI*, the maximum survival time should be at least **180 s**. However, if the issue of periodic in TSCAI mentioned above is not considered at this stage, we think that the range of survival time can be three times that of the periodicity in TSCAI, that is, (0. 1920000, …)us. |
| Ericsson |  | Better to use n\* Periodicity value. |
| Nokia | Yes | Option 1-1 seems sufficient. If we consider larger values, then perhaps separate IE should be used with coarser granularity. |
|  |  |  |
|  |  |  |

**Moderator’s Summary: All companies agree on the minimum value for the Survival Time, but the maximum value seems to not be agreeable in this meeting. So the moderator suggests the following proposals**

**Proposal 3: The minimum value for the Survival Time is 0.**

**Proposal 4: The maximum value and the time unit granularity for the Survival Time are FFS (to be continued in the next meeting)**

**And to make some progress, the moderator suggests including the following in the BL CRs.**

#### x.x.x.x Survival Time

This IE indicates the Survival Time as defined in TS 23.501 [21].

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Survival Time | M |  | INTEGER (0..<FFS>, …) | Survival time expressed in units of 1 us<FFS>. |

Editor’s note: The maximum value and the time unit granularity for the Survival Time are FFS.

One company, CATT, proposes the extension of the maximum value of the Periodicity and introduces the new IE:

9.3.1.132 Periodicity

This IE indicates the Periodicity of the TSC QoS flow as defined in TS 23.501 [9].

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| Periodicity | M |  | INTEGER (0..640000, …) | Periodicity expressed in units of 1 us.  This IE is ignored if the Extended Periodicity IE is included. |
| Extended Periodicity | O |  | INTEGER (640..60000, …) | Extended Periodicity expressed in units of 1 ms. |

**Q4: Do you agree extending the Periodicity and introducing a new IE for the extended Periodicity ?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Samsung | No | When deciding the range of the Periodicity in Rel.16, the maximum periodicity of SPS/CG is considered. If the larger periodicity value is signalled to NG-RAN, it’s not clear how to support the extended periodicity in NG\_RAN and what could be the benefit. |
| Huawei |  | Seems not necessary, unless there are such requirements e.g. from SA1. |
| CATT | Yes | Refer to the answer for Q3  The maximum Transfer interval(Periodicity) is  **100 ms to 60 s (note 7)** |
| ZTE | Yes | Considering that the periodicity in the *TSCAI* is equal to the message transmission interval, we can find that the range of periodicity (0..640000,...) us in *TSCAI* can not meet the requirements of the maximum transmission interval(e.g., the plant asset management scenario: 100 ms to 60s) in table 5.2-1 of TS 22.104. Therefore, it is necessary to extend the maximum periodicity of *TSCAI* to 60s. |
| Ericsson |  | The motivation for the change is not clear. |
| Nokia | No | Agree with Samsung. |
|  |  |  |
|  |  |  |

**Moderator’s Summary: Whether to extend the Periodicity value is not agreeable in this meeting.**

**The proposed company(s) should provide the motivation more clearly, e.g. how can be the extended value used in NG-RAN? what is the benefit?, etc.**

**RAN3 discusses whether to extend the Periodicity in the next meeting by contribution-driven.**

## Whether to support Survival Time for uplink

5 companies agree on supporting Survival Time for downlink and for uplink and one company proposes waiting for RAN2 conclusion further:

* For UL and DL [Nokia, CATT, Huawei, Ericsson, Samsung]
* For UL and DL, but wait further for RAN2 conclusion [ZTE]

So all companies seem to support the Survival Time for UL and DL, but the final decision may would depend on RAN2 conclusion.

**Q5: Do you agree supporting the Survival Time for downlink and uplink?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Samsung | Yes | In our understanding, RAN2 and SA2 consider the survival time for both downlink and uplink. |
| Huawei | Yes | We understand RAN2 already agree to support the survival time for uplink.  Also in our specification, it is very flexible to support downlink only, uplink or both to have survival time. |
| CATT | Yes |  |
| ZTE | No | This question should be set to FFS at this stage.  Per our understanding, for the uplink transmission scenario, RAN2 is discussing how to satisfy the survival time, and no conclusions have been obtained yet and several companies think that the uplink survival time needs to be sent to UE. In other words, in the uplink transmission, there are two choices for the transmission of survival time: (i) transmission to gNB, (ii) transmission to UE. Thus, we think that it is necessary for RAN3 to postpone the the uplink survival time delivery and wait for the RAN2 conclusion. |
| InterDigital | Yes |  |
| Ericsson |  | When the new IE is included in *TSCAI,* basically DL/UL are supported from protocol point of view. |
| Nokia | Yes | Survival Time applies to UL and/or DL depending on the use case. |
|  |  |  |

**Q6: Do you agree on adding the following ‘Editor’s note’ regarding the survival time for uplink and waiting for RAN2 conclusion?**

“Editor’s note: Whether Survival Time should be included in TSC assistance information Uplink.”

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Samsung |  | We don’t have strong objection on adding the editor’s note at this time. |
| Huawei |  | This note seems not necessary, since RAN2#113 already agreed the survival time for uplink.  RAN2 confirms that specification enhancement for survival time support may only needed for uplink. Downlink is addressed by implementation and no specification impacts. |
| CATT | No |  |
| ZTE | Yes | The details can be seen in the comments for Q5. |
| Ericsson |  | See answer to Q5. No need for FFS. |
| Nokia | No | No need for Editor’s Note, considering existing RAN2/SA2 agreements. |
|  |  |  |
|  |  |  |

**Moderator’s Summary for Q5 & Q6: Only one company has objection on including the Survival Time for uplink. So the moderator suggests the following proposal.**

**Proposal 5: RAN3 agrees on the following WA and it could be challenged in the next meeting.**

**WA: Supporting the Survival Time for both downlink and uplink.**

**And we don’t need to include the Editor’s note in the BL CRs, but it can be further discussed and modified by contribution-driven.**

## Others

One company[Huawei] proposes that RAN3 discusses TSN services in acknowledgement mode:

“Proposal 1: Discuss the TSN servces in acknowledgment mode. Typically, The NG-RAN node may fulfil the survival time requriements either the uplink or downlink, but can not meet the TSN services in acknowledge mode. An LS "to SA2 can be sent if any need.”

**Q7: Do you agree on discussing TSN services in acknowledgement mode in RAN3?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Samsung | No | We don’t find a reason that RAN3 discusses this issue first and provides the input to SA2. We think it should be contributed and discussed in SA2 first. |
| Huawei |  | As the proponent company, the intention of this part is to collect initial views (if any) on this issue. |
| CATT |  | Contribution driven is ok |
| ZTE | No | Agree with Samsung. |
| Ericsson |  | Support the view that it is needed to be discussed in SA2 first. |
| Nokia | No | Should be discussed first in SA2. |
|  |  |  |
|  |  |  |

**Moderator’s Summary: Based on the input form the companies, RAN3 doesn’t need any action for TSN services in acknowledgement mode in this meeting. However, this issue can be discussed further in the next RAN3 meetings by contribution driven.**

# Discussion – Phase 2

## Agreements after Phase 1 discussion

The following proposals can be agreeable:

**Proposal 1: The survival time is not applicable to aperiodic deterministic traffic in Rel.17.**

**Proposal 2: The Survival Time is expressed as unit of time, e.g. in unit of 1 us.**

**Proposal 3: The minimum value for the Survival Time is 0.**

If you have other opinion or update for the proposal, please provide your comments:

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | Regarding the granularity of Survival Time, it seems sensible to use the same granularity that was agreed in R15 for TSCAI Periodicity (i.e. 1us). |
| Huawei | Agree with Nokia, the “e.g.” can be removed from proposal 2. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Maximum value for the Survival Time

The maximum value can’t be agreeable in this meeting.

**Proposal 4: The maximum value and the time unit granularity for the Survival Time are FFS (to be continued in the next meeting)**

But to make some progress and develop the BL CRs, the moderator suggests the following to be included in the BL CRs.

#### x.x.x.x Survival Time

This IE indicates the Survival Time as defined in TS 23.501 [21].

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Survival Time | M |  | INTEGER (0..<FFS>, …) | Survival time expressed in units of 1 us<FFS>. |

Editor’s note: The maximum value and the time unit granularity for the Survival Time are FFS.

If you have, please provide your opinion or update on moderator’s suggestion:

|  |  |
| --- | --- |
| Company | Comment |
| Nokia | Regarding the minimum value, it is unclear what the “0” value means (or any value less than the TSCAI Periodicity). Although we acknowledge that the 0 value appears in the table in TS 22.104… is this a mistake? How much credence do we give this table? Perhaps we could include an Editor’s Note, e.g. “meaning of Survival Time less than Periodicity is FFS”. |
| Huawei | We agree with moderator’s proposal above.  The case 0< survival time value< periodicity is not considered as valid, given TS 23.501 already give clear specifications:   * the SMF converts maximum number of messages into time units by multiplying its value by the TSCAI Periodicity, and sets the TSCAI Survival Time to the calculated value   For “0” value, we understand that no packet loss is allowed for the TSC flow. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Whether to support Survival Time for uplink

Based on the 1st phase discussion, the moderator proposes the following:

**Proposal 5: RAN3 agrees on the following WA and it could be challenged in the next meeting.**

**WA: Supporting the Survival Time for both downlink and uplink.**

**And we don’t need to include the Editor’s note in the BL CRs, but it can be further discussed and modified by contribution-driven.**

If you have, please provide your opinion or update on proposal:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei | This seems be agreement given the SA2/RAN2 progress. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Extending the Periodicity value

Whether to extend the Periodicity value seems not be agreeable in this meeting. And the motivation for the proposal need to be further clarified, e.g. how can be the extended value used in NG-RAN? what is the benefit?, etc. So the moderator proposes the following:

**Moderator’s Summary: RAN3 discusses whether to extend the Periodicity in the next meeting by contribution-driven. And the motivation needs to be clarified.**

If you have, please provide your opinion or update on the Moderator’s summary:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei | OK |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## TSN services in acknowledgement mode

Based on the 1st phase discussion, the moderator provides the following summary:

**Moderator’s Summary: Based on the input form the companies, RAN3 doesn’t need any action for TSN services in acknowledgement mode in this meeting. However, this issue can be discussed further in the next meeting by contribution-driven.**

If you have, please provide your opinion on the Summary:

|  |  |
| --- | --- |
| Company | Comment |
| Huawei | OK |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## BL CRs

Based on the final agreements for sect 4.1, 4.2 and 4.3 of 2nd phase discussion and the agreements in the previous meeting

Introduce Survival Time at NG/Xn/E1/F1 interface.

The survival time is part of the TSCAI parameter

the following BL CRs could be developed and agreeable in this RAN3 meeting:

* TS 38.413 NGAP [CATT] (Rev of R3-211992? Or new CR?)
* TS 38.423 XnAP [E///] (New CR?)
* TS 38.463 E1AP [ZTE] (New CR?)
* TS 38.473 F1AP [Huawei] (Rev of R3-211906? Or new CR?)

Stage 2 CR may be discussed later.

If you have, please provide your opinion on the BL CRs.

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# Conclusion, Recommendations [if needed]

After 1st phase discussion, the followings are proposed by the moderator.

**Proposal 1: The survival time is not applicable to aperiodic deterministic traffic in Rel.17.**

**Proposal 2: The Survival Time is expressed as ‘unit of time’, e.g. in unit of 1 us.**

**Proposal 3: The minimum value for the Survival Time is 0.**

**Proposal 4: The maximum value and the time unit granularity for the Survival Time is FFS (to be continued in the next meeting)**

**Proposal 5: RAN3 agrees on the following WA and it could be challenged in the next meeting.**

**WA: Supporting the Survival Time for both downlink and uplink.**

**And RAN3 discusses the following issues in the next meeting by contribution-driven:**

* **The extension of the Periodicity**
* **TSN services in acknowledgement mode**

# References

|  |  |  |
| --- | --- | --- |
| [R3-211598](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211598.zip) | Analysis of New QoS Related parameters (ZTE) | discussion |
| [R3-211599](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211599.zip) | CR for TS38.413 on new QoS related parameters (ZTE) | CR0569r, TS 38.413 v16.5.0, Rel-17, Cat. B |
| [R3-211613](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211613.zip) | Further details of Survival Time (Nokia, Nokia Shanghai Bell) | discussion |
| [R3-211614](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211614.zip) | Introduction of Survival Time to NGAP (Nokia, Nokia Shanghai Bell) | CR0570r, TS 38.413 v16.5.0, Rel-17, Cat. B |
| [R3-211845](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211845.zip) | Discussion on new QoS related parameters (CATT) | discussion |
| [R3-211905](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211905.zip) | Introduction of the survival Time (Huawei) | discussion |
| [R3-211906](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211906.zip) | Introduction of the survival Time (Huawei) | CR0751r, TS 38.473 v16.5.0, Rel-17, Cat. B |
| [R3-211907](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211907.zip) | Introduction of the survival Time (Huawei) | draftCRr, TS 38.300 v16.5.0, Rel-17, Cat. B |
| [R3-211967](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211967.zip) | CR to 38.423 on new QoS related parameters for IIOT (CATT) | CR0612r, TS 38.423 v16.5.0, Rel-17, Cat. B |
| [R3-211992](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-211992.zip) | CR to 38.413 on new QoS related parameters for IIOT (CATT) | CR0598r, TS 38.413 v16.5.0, Rel-17, Cat. B |
| [R3-212078](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-212078.zip) | Introducing of further enhanced NR-IIoT (Ericsson) | CR0620r, TS 38.423 v16.5.0, Rel-17, Cat. B |
| [R3-212399](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-212399.zip) | Discussion on Discussion on supporting the survival time (Samsung) | discussion |
| [R3-212401](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-212401.zip) | CR for TS38.413 on including survival time in TSC Assistance Information enhancements (Samsung) | CR0613r, TS 38.413 v16.5.0, Rel-17, Cat. B |
| [R3-212403](file:///E:\RAN3%23112\Inbox\Drafts\CB%20%23%20NRIIOT2-New_QoS_Parameters\Docs\R3-212403.zip) | CR for TS38.423 on including survival time in TSC Assistance Information enhancements (Samsung) | CR0625r, TS 38.423 v16.5.0, Rel-17, Cat. B |

# Annex - Table 5.2-1 in 22.104 v17.5.0

**Table 5.2-1: Periodic deterministic communication service performance requirements**

| **Characteristic parameter** | | | | **Influence quantity** | | | | | |  | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Communica­tion service availability: target value (note 1)** | **Communication service reliability: mean time between failures** | **End-to-end latency: maximum (note 2)** (note 12a) | **Service bit rate: user experienced data rate** (note 12a) | **Message size [byte]** (note 12a) | **Transfer interval: target value** (note 12a) | **Survival time** (note 12a) | **UE  speed** (note 13) | **# of UEs** | **Service area  (note 3)** | **Remarks** | |
| 99.999 % to 99.999 99 % | ~ 10 years | < transfer interval value | – | 50 | 500 μs | 500 μs | ≤ 75 km/h | ≤ 20 | 50 m x 10 m x 10 m | Motion control (A.2.2.1) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < transfer interval value | – | 40 | 1 ms | 1 ms | ≤ 75 km/h | ≤ 50 | 50 m x 10 m x 10 m | Motion control (A.2.2.1) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < transfer interval value | – | 20 | 2 ms | 2 ms | ≤ 75 km/h | ≤ 100 | 50 m x 10 m x 10 m | Motion control (A.2.2.1) | |
| 99.999 9 % | – | < 5 ms | 1 kbit/s (steady state) 1.5 Mbit/s (fault case) | < 1,500 | < 60 s  (steady state) ≥ 1 ms (fault case) | transfer interval | stationary | 20 | 30 km x 20 km | Electrical Distribution – Dis­tributed automated switch­ing for isolation and service restoration (A.4.4); (note 5) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < transfer interval value |  | 1 k | ≤ 10 ms | 10 ms | - | 5 to 10 | 100 m x 30 m x 10 m | Control-to-control in motion control (A.2.2.2); (note 9) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < transfer interval value (note 5) | 50 Mbit/s |  | ≤ 1 ms | 3 x transfer interval | stationary | 2 to 5 | 100 m x 30 m x 10 m | Wired-2-wireless 100 Mbit/s link replacement (A.2.2.4) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < transfer interval value (note 5) | 250 Mbit/s |  | ≤ 1 ms | 3 x transfer interval | stationary | 2 to 5 | 100 m x  30 m x 10 m | Wired-2-wireless 1 Gbit/s link replacement (A.2.2.4) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < transfer interval value |  | 1 k | ≤ 50 ms | 50 ms | - | 5 to 10 | 1,000 m x 30 m x 10 m | Control-to-control in motion control (A.2.2.2); (note 9) | |
| > 99.999 9 % | ~ 10 years | < transfer interval value | – | 40 to 250 | 1 ms to 50 ms (note 6) (note 7) | transfer interval value | ≤ 50 km/h | ≤ 100 | ≤ 1 km2 | Mobile robots (A.2.2.3) | |
| 99.999 9 % to 99.999 999 % | ~ 1 month | < transfer interval value | – | 40 to 250 | 4 ms to 8 ms (note 7) | transfer interval value | < 8 km/h (linear movement) | TBD | 50 m x 10 m x 4 m | Mobile control panels – remote control of e.g. assembly robots, milling machines (A.2.4.1); (note 9) | |
| 99.999 999 % | 1 day | < 8 ms  (note 14) | 250 kbit/s | 40 to 250 | 8 ms | 16 ms | quasi-static; up to 10 km/h | 2 or more | 30 m x 30 m | Mobile Opera­tion Panel: Emer­gency stop (connectivity availability) (A.2.4.1A) | |
| 99.999 99 % | 1 day | < 10 ms  (note 14) | < 1 Mbit/s | <1024 | 10 ms | ~10 ms | quasi-static; up to 10 km/h | 2 or more | 30 m x 30 m | Mobile Operation Panel: Safety data stream (A.2.4.1A) | |
| 99.999 999 % | 1 day | 10 ms to 100 ms  (note 14) | 10 kbit/s | 10 to 100 | 10 ms to 100 ms | transfer interval | stationary | 2 or more | 100 m² to 2,000 m² | Mobile Operation Panel: Control to visualization (A.2.4.1A) | |
| 99.999 999 % | 1 day | < 1 ms  (note 14) | 12 Mbit/s to 16 Mbit/s | 10 to 100 | 1 ms | ~ 1 ms | stationary | 2 or more | 100 m² | Mobile Operation Panel: Motion control (A.2.4.1A) | |
| 99.999 999 % | 1 day | < 2 ms  (note 14) | 16 kbit/s (UL) 2 Mbit/s (DL) | 50 | 2 ms | ~ 2 ms | stationary | 2 or more | 100 m² | Mobile Operation Panel: Haptic feedback data stream (A.2.4.1A) | |
| 99.999 9 % to 99.999 999 % | ~ 1 year | < transfer interval | – | 40 to 250 | < 12 ms (note 7) | 12 ms | < 8 km/h (linear movement) | TBD | typically 40 m x 60 m; maximum 200 m x 300 m | Mobile control panels -remote control of e.g. mobile cranes, mobile pumps, fixed portal cranes (A.2.4.1); (note 9) | |
| 99.999 9 % to 99.999 999 % | ≥ 1 year | < transfer interval value | – | 20 | ≥ 10 ms (note 8) | 0 | typically stationary | typically 10 to 20 | typically ≤ 100 m x 100 m x 50 m | Process automation – closed loop control (A.2.3.1) | |
| 99.999 % | TBD | ~ 50 ms | – | ~ 100 | ~ 50 ms | TBD | stationary | ≤ 100,000 | several km2 up to 100,000 km2 | Primary frequency control (A.4.2); (note 9) | |
| 99.999 % | TBD | ~ 100 ms | – | ~ 100 | ~ 200 ms | TBD | stationary | ≤ 100,000 | several km2 up to 100,000 km2 | Distributed Voltage Control (A.4.3) (note 9) | |
| > 99.999 9 % | ~ 1 year | < transfer interval value | – | 15 k to 250 k | 10 ms to 100 ms (note 7) | transfer interval value | ≤ 50 km/h | ≤ 100 | ≤ 1 km2 | Mobile robots – video-operated remote control (A.2.2.3) | |
| > 99.999 9 % | ~ 1 year | < transfer interval value | – | 40 to 250 | 40 ms to 500 ms (note 7) | transfer interval value | ≤ 50 km/h | ≤ 100 | ≤ 1 km2 | Mobile robots (A.2.2.3) | |
| 99.99 % | ≥ 1 week | < transfer interval value | – | 20 to 255 | 100 ms to 60 s (note 7) | ≥ 3 x transfer interval value | typically stationary | ≤ 10,000 to 100,000 | ≤ 10 km x 10 km x 50 m | Plant asset management (A.2.3.3) | |
| >99.999 999 % | > 10 years | < 2 ms | 2 Mbit/s to 16 Mbit/s | 250 to 2,000 | 1 ms | transfer interval value | stationary | 1 | < 100 m2 | Robotic Aided Surgery (A.6.2) | |
| >99.999 9 % | > 1 year | < 20 ms | 2 Mbit/s to 16 Mbit/s | 250 to 2,000 | 1 ms | transfer interval value | stationary | 2 per 1,000 km2 | < 400 km (note 12) | Robotic Aided Surgery (A.6.2) | |
| >99.999 % | >> 1 month  (< 1 year) | < 20 ms | 2 Mbit/s to 16 Mbit/s | 80 | 1 ms | transfer interval value | stationary | 20 per 100 km2 | < 50 km (note 12) | Robotic Aided Diagnosis (A.6.3) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < 0.5 x transfer interval | 2.5 Mbit/s | 250 500 with localisa­tion informa­tion | > 5 ms > 2.5 ms > 1.7 ms (note 10) | 0 transfer interval 2 x transfer interval (note 10) | ≤ 6 km/h (linear movement) | 2 to 8 | 10 m x 10 m x 5 m; 50  m x 5 m x 5 m (note 11) | Cooperative carrying – fragile work pieces; (ProSe communication) (A.2.2.5) | |
| 99.999 9 % to 99.999 999 % | ~ 10 years | < 0.5 x transfer interval | 2.5 Mbit/s | 250 500 with localisa­tion informa­tion | > 5 ms  > 2.5 ms > 1.7 ms (note 10) | 0 transfer interval 2 x transfer interval (note 10) | ≤ 12 km/h (linear movement) | 2 to 8 | 10 m x 10 m x 5 m; 50 m x 5 m x 5 m (note 11) | Cooperative carrying – elastic work pieces; (ProSe communication) (A.2.2.5) | |
| NOTE 1: One or more retransmissions of network layer packets may take place in order to satisfy the communication service availability requirement.  NOTE 2: Unless otherwise specified, all communication includes 1 wireless link (UE to network node or network node to UE) rather than two wireless links (UE to UE).  NOTE 3: Length x width (x height).  NOTE 4: (void)  NOTE 5: Communication includes two wireless links (UE to UE).  NOTE 6: This covers different transfer intervals for different similar use cases with target values of 1 ms, 1 ms to 10 ms, and 10 ms to 50 ms.  NOTE 7: The transfer interval deviates around its target value by < ±25 %.  NOTE 8: The transfer interval deviates around its target value by < ±5 %.  NOTE 9: Communication may include two wireless links (UE to UE).  NOTE 10: The first value is the application requirement, the other values are the requirement with multiple transmission of the same information (two or three times, respectively).  NOTE 11: Service Area for direct communication between UEs. The group of UEs with direct communication might move throughout the whole factory site (up to several km²).  NOTE 12: Maximum straight-line distance between UEs.  NOTE 12a: It applies to both UL and DL unless stated otherwise.  NOTE 13: It applies to both linear movement and rotation unless stated otherwise.  NOTE 14: The mobile operation panel is connected wirelessly to the 5G system. If the mobile robot/production line is also connected wirelessly to the 5G system, the communication includes two wireless links. | | | | | | | | | | |