**3GPP TSG-SA1 Meeting #94e *S1-211016***

**Electronic Meeting, 10-20 May 2021** *(revision of S1-211xxx)*

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **22.261** | **CR** | **0507** | **rev** | - | **Current version:** | **18.2.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network | **x** |

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| ***Title:*** | 5G timing resiliency | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | SA1 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 5TRS | | | | |  | ***Date:*** | | | 10.05.2021 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | SA1 has completed the study on 5G timing resilience and identified a number of system requirements to support the capability. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | References are added in clause 2.  Definition of holdover is added to 3.1  Abbreviations are added in clause 3.2.  Requirements are introduced in clause 6.x.  KPIs are added in 7.x.  Security requirements are added in new clause 8.x.  Charging requirements are added in clause 9.x | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The 5G system will not have the resiliency to be used as a replacement or backup for other timing sources. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.1, 3.2, 6.x (new), 7.x (new), 8.x (new), 9.x (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*First change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] NGMN 5G White Paper v1.0, February 2015.

[3] 3GPP TS 22.011: "Service accessibility".

[4] NGMN, "Perspectives on Vertical Industries and Implications for 5G, v2.0", September 2016.

[5] 3GPP TR 22.278: "Service requirements for the Evolved Packet System (EPS)".

[6] 3GPP TR 22.101: "Service aspects; Service principles".

[7] 3GPP TS 22.146: "Multimedia Broadcast/Multicast Service (MBMS)".

[8] 3GPP TS 22.246: "Multimedia Broadcast/Multicast Service (MBMS) user services".

[9] 3GPP TS 22.186: "Enhancement of 3GPP support for V2X scenarios".

[10] NGMN, "Recommendations for NGMN KPIs and Requirements for 5G", June 2016

[11] 3GPP TS 22.115: "Service aspects; Charging and billing".

[12] Communication network dependability engineering. IEC 61907:2009.

[13] Soriano, R., Alberto, M., Collazo, J., Gonzales, I., Kupzo, F., Moreno, L., & Lorenzo, J. OpenNode. Open Architecture for Secondary Nodes of the Electricity Smartgrid. In Proceedings CIRED 2011 21st International Conference on Electricity Distribution, CD1. June 2011.

[14] North American Electric Reliability Council. Frequently Asked Questions (FAQs) Cyber Security Standards CIP–002–1 through CIP–009–1. Available: http://www.nerc.com/docs/standards/sar/Revised\_CIP-002-009\_FAQs\_06Mar06.pdf. 2006.

[15] McTaggart, Craig, et al. "Improvements in power system integrity protection schemes". Developments in Power System Protection (DPSP 2010). Managing the Change, 10th IET International Conference on. IET, 2010.

[16] IEEE Power Engineering Society – Power System Relaying Committee – System Protection Subcommittee Working Group C-6. Wide Area Protection and Emergency Control.

[17] Begovic, Miroslav, et al. "Wide-area protection and emergency control". Proceedings of the IEEE 93.5, pp. 876-891, 2005.

[18] ITU-T Recommendation G.1000 "Communications quality of service: A framework and definitions".

[19] IEC 61907, "Communication network dependability engineering".

[20] NIST, "Framework for Cyber-Physical Systems", 2016.

[21] 3GPP TS 22.104: "Service requirements for cyber-physical control applications in vertical domains".

[22] 3GPP TS 22.262: "Message Service within the 5G System".

[23] 3GPP TS 22.289: "Mobile Communication System for Railways".

[24] 3GPP TS 22.071: " Location Services".

[25] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

[26] 3GPP TS 22.125: "Unmanned Aerial System (UAS) support in 3GPP ".

[27] 3GPP TS 22.468: "Group Communication System Enablers (GCSE) ".

[28] 3GPP TS 22.263: "Service requirements for Video, Imaging and Audio for Professional Applications (VIAPA)".

[29] 3GPP TS 22.263: "Service requirements for Video, Imaging and Audio for Professional Applications".

[30] 3GPP TS 22.179: "Mission Critical Push to Talk (MCPTT)".

[a] IEEE 1588-2019, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.

[b] IEC 61850-9-3-2016 - IEC/IEEE International Standard - Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation.

[c] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN"

[d] ATIS-0900005: "Technical Report on GPS Vulnerability", https://access.atis.org/apps/group\_public/download.php/36304/ATIS-0900005.pdf

[e] Regulatory Technical Standard 25. Level of accuracy of business clocks  
<https://ec.europa.eu/finance/securities/docs/isd/mifid/rts/160607-rts-25_en.pdf>

[f] Annex to Regulatory Technical Standard 25, <https://ec.europa.eu/finance/securities/docs/isd/mifid/rts/160607-rts-25-annex_en.pdf>

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Second change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**5G enhanced positioning area:** a subset of the 5G positioning service area that is assumed to be provided with additional infrastructure or deploy a particular set of positioning technologies to enhance positioning services.

NOTE 1: The enhanced positioning service area represents for example a factory plant, a dense urban area, an area along a road or railway track, a tunnel and covers both indoor and outdoor environments.

**5G LAN-type service**: a service over the 5G system offering private communication using IP and/or non-, i.e. UEs that are members of the same 5G LAN-VN IP type communications.

**5G LAN-virtual network**: a virtual network capable of supporting 5G LAN-type service.

**5G satellite access network**: 5G access network using at least one satellite.

**5G positioning service area:** a service area where positioning services would solely rely on infrastructures and positioning technologies that can be assumed to be present anywhere where 5G is present (e.g. a country-wide operator-supplied 5G network, GNSS, position/motion sensors).

NOTE 2: This includes both indoor and any outdoor environments.

**active communication:** a UE is in active communication when it has one or more connections established. A UE may have any combination of PS connections (e.g. PDP contexts, active PDN connections).

**activity factor:** percentage value of the amount of simultaneous active UEs to the total number of UEs where active means the UEs are exchanging data with the network.

**area traffic capacity:** total traffic throughput served per geographic area.

**communication service availability**: percentage value of the amount of time the end-to-end communication service is delivered according to an agreed QoS, divided by the amount of time the system is expected to deliver the end-to-end service according to the specification in a specific area.

NOTE 3: The end point in "end-to-end" is assumed to be the communication service interface.

NOTE 4: The communication service is considered unavailable if it does not meet the pertinent QoS requirements. If availability is one of these requirements, the following rule applies: the system is considered unavailable if an expected message is not received within a specified time, which, at minimum, is the sum of maximum allowed end-to-end latency and survival time.

**direct device connection:** the connection between two UEs without any network entity in the middle.

**direct network connection:** one mode of network connection, where there is no relay UE between a UE and the 5G network.

**Disaster Condition:** This is the condition that a government decides when to initiate and terminate, e.g. a natural disaster. When this condition applies, users may have the opportunity to mitigate service interruptions and failures.

**Disaster Inbound Roamer:** A user that (a) cannot get service from the PLMN it would normally be served by, due to failure of service during a Disaster Condition, and (b) is able to register with other PLMNs.

**Disaster Roaming:** This is the special roaming policy that applies during a Disaster Condition.

**end-to-end latency:** the time that takes to transfer a given piece of information from a source to a destination, measured at the communication interface, from the moment it is transmitted by the source to the moment it is successfully received at the destination.

**holdover:** A clock A, previously synchronized/syntonized to another clock B (normally a primary reference or a Master Clock) but whose frequency is determined in part using data acquired while it was synchronized/syntonized to B, is said to be in holdover or in the holdover mode as long as it is within its accuracy requirements.

NOTE 5: holdover is defined in [a]

**Holdover time:** the time period that is available to repair the first priority timing source when it is lost (e.g., when the primary GNSS reference is lost). During this period the synchronization accuracy requirement should be guaranteed, e.g., by means of defining multiple synchronization references.

**Hosted Service:** a service containing the operator's own application(s) and/or trusted third-party application(s) in the Service Hosting Environment, which can be accessed by the user.

**indirect network connection:** one mode of network connection, where there is a relay UE between a UE and the 5G network.

**IoT device:** a type of UE which is dedicated for a set of specific use cases or services and which is allowed to make use of certain features restricted to this type of UEs.

NOTE 6: An IoT device may be optimized for the specific needs of services and application being executed (e.g. smart home/city, smart utilities, e-Health and smart wearables). Some IoT devices are not intended for human type communications.

**network slice:** a set of network functions and corresponding resources necessary to provide the required telecommunication services and network capabilities.

**NG-RAN:** a radio access network connecting to the 5G core network which uses NR, E-UTRA, or both.

**non-public network:** a network that is intended for non-public use.

**NR:** the new 5G radio access technology.

**positioning service availability:** percentage value of the amount of time the positioning service is delivering the required position-related data within the performance requirements, divided by the amount of time the system is expected to deliver the positioning service according to the specification in the targeted service area.

**positioning service latency:** time elapsed between the event that triggers the determination of the position-related data and the availability of the position-related data at the system interface.

**priority service:** a service that requires priority treatment based on regional/national or operator policies.

**private communication**: a communication between two or more UEs belonging to a restricted set of UEs**.**

**private network:** an isolated network deployment that does not interact with a public network.

**private slice:** a dedicated network slice deployment for the sole use by a specific third-party.

**relative positioning:** relative positioning is to estimate position relatively to other network elements or relatively to other UEs.

**reliability**: in the context of network layer packet transmissions, percentage value of the amount of sent network layer packets successfully delivered to a given system entity within the time constraint required by the targeted service, divided by the total number of sent network layer packets.

**satellite**: a space-borne vehicle embarking a bent pipe payload or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO) typically at an altitude between 300 km to 2 000 km, Medium-Earth Orbit (MEO) typically at an altitude between 8 000 to 20 000 k m, or Geostationary satellite Earth Orbit (GEO) at 35 786 km altitude.

**satellite access:** direct connectivity between the UE and the satellite.

**satellite NG-RAN:** a NG-RAN which uses NR in providing satellite access to UEs.

**service area:** geographic region where a 3GPP communication service is accessible.

NOTE 7: The service area can be indoors.

NOTE 8: For some deployments, e.g. in process industry, the vertical dimension of the service area can be considerable.

**service continuity:** the uninterrupted user experience of a service that is using an active communication when a UE undergoes an access change without, as far as possible, the user noticing the change.

NOTE 9: In particular service continuity encompasses the possibility that after a change the user experience is maintained by a different telecommunication service (e.g. tele- or bearer service) than before the change.

NOTE 10: Examples of access changes include the following. For EPS: CS/PS domain change. For EPS and 5G: radio access change, switching between a direct network connection and an indirect network connection.

**Service Hosting Environment:** the environment, located inside of 5G network and fully controlled by the operator, where Hosted Services are offered from.

**survival time:** the time that an application consuming a communication service may continue without an anticipated message.

**Time to First Fix (TTFF):** time elapsed between the event triggering for the first time the determination of the position-related data and the availability of the position-related data at the positioning system interface.

**User Equipment:** An equipment that allows a user access to network services via 3GPP and/or non-3GPP accesses.

**user experienced data rate:** the minimum data rate required to achieve a sufficient quality experience, with the exception of scenario for broadcast like services where the given value is the maximum that is needed.

**wireless backhaul:** a link which provides an interconnection between 5G network nodes and/or transport network using 5G radio access technology**.**

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Third change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

3D Three Dimensional

5G Fifth Generation

5G LAN-VN 5G LAN-Virtual Network

AR Augmented Reality

A/S Actuator/Sensor

E2E End to End

eFMSS Enhancement to Flexible Mobile Service Steering

eV2X Enhanced V2X

FMSS Flexible Mobile Service Steering

GEO Geostationary satellite Earth Orbit

ICP Internet Content Provider

ID Identification

IMU Inertial Measurement Unit

IOPS Isolated E-UTRAN Operation for Public Safety

IoT Internet of Things

KPI Key Performance Indicator

LCS Location Services

LEO Low-Earth Orbit

MBB Mobile Broadband

MBS Metropolitan Beacon System

MCS Mission Critical Services

MCX Mission Critical X, with X = PTT or X = Video or X = Data

MEO Medium-Earth Orbit

MIoT Massive Internet of Things

MMTEL Multimedia Telephony

MNO Mobile Network Operator

MPS Multimedia Priority Service

MSGin5G Message Service Within the 5G System

MVNO Mobile Virtual Network Operator

NGMN Next Generation Mobile Networks

NPN Non-Public Network

QoE Quality of Experience

RSTP Rapid Spanning Tree Protocol

SEES Service Exposure and Enablement S

URLLC Ultra Reliable Low Latency Communication Support

SST Slice/Service Type

TBS Terrestrial Beacon System

TTFF Time To First Fix

UAV Unmanned Aerial Vehicle

UHD Ultra High Definition

UTC Coordinated Universal Time

VR Virtual Reality

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Fourth change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 6.35.3 Service Function Management

- The service function management shall allow the operator to create, modify, and delete a service function based on operator’s service function chaining policies.

- The service function management shall allow the operator to create, configure, and control a chain of service functions per application and its users on per UE basis based on operator’s policy or request from third parties.

- The service function management shall be able to manage service function chaining for deployments where the Hosted Services are provided by the operator and for deployments where the Hosted Services are provided by a third party.

## 6.x 5G Timing Resiliency

### 6.x.1 Overview

5G systems rely on reference precision timing signals for network synchronization in order to operate. These synchronization references are generated by Primary reference Time Clocks that typically get the timing reference from GNSS receivers and in order to meet the relevant synchronization requirements also during failure conditions, the synchronization network designs typically include means to address potential degradation of the GNSS signal performance. Some deployment of 5G involve applications that themselves can be sensitive to any degradation of the timing signal. In such cases it is beneficial for the 5G system to be enhanced to act as a backup for short term loss of their GNSS references. In some implementations, timing resiliency enhancements to the 5G system can work in collaboration with different types of time sources (e.g., atomic clock, time service delivered over the fibre) to provide a robust time synchronization.

5G as a consumer of time synchronization benefits from timing resiliency which enables the support of many critical services within the 5G network even during the event of a loss or degradation of the primary GNSS reference timing. Additionally, for time critical services (e.g. financial sector or smart grid), the 5G system can operate in collaboration with or as backup to other timing solutions. A base of clock synchronization requirements when 5G is providing a time signal, if it is deployed in conjunction with an IEEE TSN network or if it is providing support for IEEE 1588 related protocols, is included in [21] clause 5.6.

The enhancements in this clause build on this to add timing resiliency to the 5G system enabling its use as a replacement or backup for other timing sources.

### 6.x.2 General

[6.x.2-1] The 5G system shall allow a network design that is resilient to temporary loss of the primary timing reference (e.g., GNSS).

[6.x.2-2] The 5G system shall be able to maintain accurate time synchronization as appropriate for the supported applications in the event of degradation or loss of the primary timing reference (e.g., GNSS)..

### 6.x.3 Monitoring and Reporting

[6.x.3-1] The 5G system shall be able to support mechanisms to monitor for timing source failure (e.g., GNSS).

[6.x.3-2] The 5G system be able to detect when reference timing signals (e.g., from GNSS or other timing source) are no longer viable for network time synchronization.

[6.x.3-3] The 5G system shall support a mechanism to determine if there is degradation of the 5G time synchronization.

[6.x.3-4] The 5G system shall be able to support mechanisms to indicate to devices (e.g., UEs, applications) that there is an alternate time source available for use (e.g., 5G system internal holdover capability, atomic clock, Sync over Fiber, TBS, GNSS), taking into account the holdover capability of the devices.

[6.x.3-5] The 5G system shall be able to detect when a timing source fails or is restored for network time synchronization.

[6.x.3-6] The 5G system shall support mechanisms to monitor different time sources and adopt the most appropriate.

[6.x.3-7] The 5G system shall support a mechanism to report timing errors such as divergence from UTC and time sync degradation to UEs and 3rd party applications.

### 6.x.4 Service Exposure

[6.x.4-1] The 5G system shall support a mechanism for a 3rd party application to request resilient timing with specific KPIs (e.g., accuracy, interval, coverage area).

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Fifth change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## 7.7 KPIs for UE to network relaying in 5G system

In several scenarios, it can be beneficial to relay communication between one UE and the network via one or more other UEs. The functional requirements related to relaying can be found in clause 6.9.2. Performance requirements for relaying in different scenarios can be found in table 7.7-1.

Table 7.7-1: Key Performance for UE to network relaying

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | Max. data rate (DL) | Max. data rate (UL) | End-to-end latency  (note 7) | Area traffic capacity  (DL) | Area traffic capacity  (UL) | Area user density | Area | Range of a single hop  (note 8) | Estimated number of hops |
| InHome Scenario  (note 1) | 1 Gbit/s | 500 Mbit/s | 10 ms | 5 Gbit/s/ home | 2 Gbit/s /home | 50 devices /house | 10 m x 10m – 3 floors | 10 m indoor | 2 to 3 |
| Factory Sensors  (note 2) | 100 kbit/s | 5 Mbit/s | 50 ms to 1 s | 1 Gbit/s /factory | 50 Gbit/s /factory | 10000 devices /factory | 100 m x 100 m | 30 m indoor / metallic | 2 to 3 |
| Smart Metering  (note 3) | 100 bytes / 15 mins | 100 bytes / 15 mins | 10 s | 200 x 100 bytes / 15 mins /hectare | 200 x 100 bytes / 15 mins /hectare | 200 devices /hectare | 100 m x 100 m | > 100 m indoor / deep indoor | 2 to 5 |
| Containers  (note 4) | 100 bytes / 15 mins | 100 bytes / 15 mins | 10 s | 15000 x 100 bytes / 15 mins /ship | 15000 x 100 bytes / 15 mins /ship | 15000 containers /ship | 400 m x 60 m x 40 m | > 100 m indoor / outdoor / metallic | 3 to 9 |
| Freight Wagons | 100 bytes / 15 mins | 100 bytes / 15 mins | 10 s | 200 x 100 bytes / 15 mins /train | 200 x 100 bytes / 15 mins /train | 120 wagons /train | 1 km | > 100 m outdoor / tunnel | 10 to 15 |
| Public Safety  (note 5) | 12 Mbit/s | 12 Mbit/s | 30 ms | 20 Mbit/s /building | 40 Mbit/s /building | 30  devices  /building | 100 m x 100 m – 3 floors | > 50 m indoor (floor or stairwell) | 2 to 4 |
| Wearables  (note 6) | 10 Mbit/s | 10 Mbit/s | 10 ms | 20 Mbit/s per 100 m2 | 20 Mbit/s per 100 m2 | 10 wearables per 100 m2 | 10 m x 10 m | 10 m indoor / outdoor | 1 to 2 |
| NOTE 1: Area traffic capacity is determined by high bandwidth consuming devices (e.g. ultra HD TVs, VR headsets), the number of devices has been calculated assuming a family of 4 members.  NOTE 2: Highest data rate assumes audio sensors with sampling rate of 192 kHz and 24 bits sample size.  NOTE 3: Three meters (gas, water, electricity) per house, medium density of 50 to 70 houses per hectare.  NOTE 4: A large containership with a mix of 20 foot and 40 foot containers is assumed.  NOTE 5: A mix of MCPTT, MCVideo, and MCData is assumed. Average 3 devices per firefighter / police officer, of which one video device. Area traffic based on 1080 p, 60 fps is 12 Mbit/s video, with an activity factor of 30% in uplink (30% of devices transmit simultaneously at high bitrate) and 15% in downlink.  NOTE 6: Communication for wearables is relayed via a UE. This relay UE may use a further relay UE.  NOTE 7: End-to-end latency implies that all hops are included.  NOTE 8: 'Metallic' implies an environment with a lot of metal obstructions (e.g. machinery, containers). 'Deep indoor' implies that there may be concrete walls / floors between the devices.  NOTE 9: All the values in this table are example values and not strict requirements. | | | | | | | | | |

## 7.x KPIs for 5G Timing Resiliency

The 5G system shall be able to support a holdover time capability with timing resiliency performance requirements defined in table 7.x-1.

Table 7.x-1: Timing resiliency performance requirements for 5G System

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Use case** | **Holdover time (note 3)** | **Sync target** | **Sync accuracy (note 4)** | **Service area** | **Mobility** | **Remarks** |
| Power grid (5G network) | Up to 24 hour | UTC (note 1) | <250 ns to1000 ns [b] (note2) | < 20 km2 | low | When 5G System provides direct PTP Grandmaster capability to sub-stations |
| Power grid (time synchronization device) | >5 s | UTC (note 1) | <250 ns to1000 ns [b] (note2) | < 20 km2 | low | When 5G sync modem is integrated into PTP grandmaster solution (with 24h holdover capability at sub-stations) |
| NOTE 1: A different synchronization target is acceptable as long as the offset is preconfigured when an alternatively sourced time differs from GNSS. In this case, a 5G end device will provide PPS output which can be used for measuring the difference.  NOTE 2: Different accuracy measurements are based on different configurations needed to support the underlying requirements from IEC [a]. The range is between 250 ns and 1000 ns. The actual requirement depends on the specific deployment.  NOTE 3: This parameter is not a strict requirement for 5G system design.  NOTE 4: RAN will study the feasibility of meeting these requirements. | | | | | | |

Table 7.x-2: Timing resiliency accuracy KPIs for members or participants of a trading venue [e, f]

|  |  |  |
| --- | --- | --- |
| **Type of trading activity** | **Maximum divergence from UTC** | **Granularity of the timestamp (note 1)** |
| Activity using high frequency algorithmic trading technique | 100 µs | ≤1 µs |
| Activity on voice trading systems | 1 s | ≤1 s |
| Activity on request for quote systems where the response requires human intervention or where the system does not allow algorithmic trading | 1 s | ≤1 s |
| Activity of concluding negotiated transactions | 1 s | ≤1 s |
| Any other trading activity | 1 ms | ≤1 ms |
| NOTE 1: Only relevant for the case where the time synchronization assists in configuring the required granularity for the timestamp (for direct use), otherwise it will be configured separately as part of the financial transaction timestamp process. | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Sixth change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## 8.9 Data security and privacy

The 5G system shall support data integrity protection and confidentiality methods that serve URLLC, high data rates and energy constrained devices.

The 5G system shall support a mechanism to verify the integrity of a message as well as the authenticity of the sender of the message.

The 5G system shall support encryption for URLLC services within the requested end-to-end latency.

Subject to regulatory requirements, the 5G system shall enable an MNO to provide end-to-end integrity protection, confidentiality, and protection against replay attacks between a UE and third-party application server, such that the 3GPP network is not able to intercept or modify the data transferred between a UE and third-party application server.

Subject to regulatory requirements and based on operator policy, the 5G system shall provide a mechanism to support data integrity verification service to assure the integrity of the data exchanged between the 5G network and a third-party service provider.

NOTE: This requirement could apply to mechanisms supported over the interface between 5G core network and an external application, with no impact on RAN and UE.

## 8.x 5G Timing Resiliency

[8.x-1] The 5G system shall support a mechanism to verify authorization of a 3rd party application to use 5G timing resiliency.

[8.x-2] The 5G system shall support a mechanism to monitor and verify authenticity of the timing source, where supported by the time source.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Seventh change\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

## 9.2 5G LAN

A 5G core network shall support collection of charging information for a 5G LAN-type service based on resource usage (e.g. licensed or unlicensed spectrum, QoS, applications).

The 5G core network shall support collection of charging information for a 5G LAN-type service when a UE joins or leaves a specific private communication.

The 5G core network shall support collection of charging information for a 5G LAN-type service for both home and roaming UEs based on the UE’s HPLMN.

## 9.x 5G Timing Resiliency

[9.x-1] The 5G system shall be able to collect charging information based on the timing source (e.g., the source in use, start and stop of source usage).

[9.x-2] The 5G system shall be able to collect charging information per UE for use of a timing source (e.g., start/stop time and source used by a UE, timing source used by UE, holdover capability).

[9.x-3] The 5G system shall be able to collect charging information on 5G system timing resiliency (e.g., resiliency KPIs, holdover capability, number of UEs using a certain timing source).

[9.x-4] The 5G system shall be able to collect charging information per application using 5G timing resiliency, including 3rd party application, (e.g., timing resiliency KPIs, holdover capability, number of UEs using a certain timing source).