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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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Introduction

The need to support different kinds of UEs (e.g., for the Internet of Things (IoT)), services, and technologies is driving the technology revolution to a high-performance and highly efficient 3GPP system. The drivers include IoT, Virtual Reality (VR), industrial control, ubiquitous on-demand coverage, as well as the opportunity to meet customized market needs. These drivers require enhancements to the devices, services, and technologies well established by 3GPP. The key objective with the 5G system is to be able to support new deployment scenarios to address diverse market segments.

This document compiles requirements that define a 5G system.

The 5G system is characterised, for example, by:

- Support for multiple access technologies
- Scalable and customizable network
- Advanced Key Performance Indicators (KPIs) (e.g., availability, latency, reliability, user experienced data rates, area traffic capacity)
- Flexibility and programmability (e.g., network slicing, diverse mobility management, Network Function Virtualization)
- Resource efficiency (both user plane and control plane)
- Seamless mobility in densely populated and heterogeneous environment
- Support for real time and non-real time multimedia services and applications with advanced Quality of Experience (QoE)

1 Scope

The present document describes the service and operational requirements for a 5G system, including a UE, NG-RAN, and 5G Core network. Requirements for a 5G E-UTRA-NR Dual Connectivity in E-UTRAN connected to EPC are found in TS 22.278 [5].

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 TS 22.278: "Service requirements for the Evolved Packet System (EPS)".

[6] 3GPP TS 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] 3GPP TR 38.913: "Study on scenarios and requirements for next generation access technologies".

3 Definitions, symbols and abbreviations

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].

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

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

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.

Hosted Service: a service containing the operator's own application(s) and/or trusted 3rd party application(s) in the Service Hosting Environment, which can be accessed by the user.

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 3: 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.

NR: the new 5G radio access technology.

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

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

reliability: in the context of network layer packet transmissions, percentage value of the packets successfully delivered to a given system entity within the time constraint required by the targeted service out of all the packets transmitted.

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

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

NOTE 4: The service area can be indoors.

NOTE 5: 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 6: 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 7: Examples of access changes include the following. For EPS: CS/PS domain change. For EPS and 5G: radio access change.

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.

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**.**

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
AR	Augmented Reality
A/S	Actuator/sensor
E2E	End to End
eFMSS	Enhancement to Flexible Mobile Service Steering
FMSS	Flexible Mobile Service Steering
ICP	Internet Content Provider
ID	Identification
IOPS	Isolated E-UTRAN Operation for Public Safety
IoT	Internet of Things
KPI	Key Performance Indicator
MBB	Mobile BroadBand
MIoT	Massive Internet of Things
MNO	Mobile Network Operator
MPS	Multimedia Priority Service
MVNO	Mobile Virtual Network Operator
NGMN	Next Generation Mobile Networks
QoE	Quality of Experience
SEES	Service Exposure and Enablement Support
SST	Slice/Service Type
UAV	Unmanned Aerial Vehicle
UHD	Ultra High Definition
VR	Virtual Reality

4 Overview

Unlike previous 3GPP systems that attempted to provide a 'one size fits all' system, the 5G system is expected to be able to provide optimized support for a variety of different services, different traffic loads, and different end user communities. Various industry white papers, most notably, the NGMN 5G White Paper [2], describe a multi-faceted 5G system capable of simultaneously supporting multiple combinations of reliability, latency, throughput, positioning, and availability. This technology revolution is achievable with the introduction of new technologies, both in access and the core, such as flexible, scalable assignment of network resources. In addition to increased flexibility and optimization, a 5G system needs to support stringent KPIs for latency, reliability, throughput, etc. Enhancements in the air interface contribute to meeting these KPIs as do enhancements in the core network, such as network slicing, in-network caching and hosting services closer to the end points.

A 5G system also supports new business models such as those for IoT and enterprise managed networks. Drivers for the 5G KPIs include services such as Unmanned Aerial Vehicle (UAV) control, Augmented Reality (AR), and factory automation. Network flexibility enhancements support self-contained enterprise networks, installed and maintained by network operators while being managed by the enterprise. Enhanced connection modes and evolved security facilitate support of massive IoT, expected to include tens of millions of UEs sending and receiving data over the 5G network.

Flexible network operations are the mainstay of the 5G system. The capabilities to provide this flexibility include network slicing, network capability exposure, scalability, and diverse mobility. Other network operations requirements address the necessary control and data plane resource efficiencies, as well as network configurations that optimize service delivery by minimizing routing between end users and application servers. Enhanced charging and security mechanisms handle new types of UEs connecting to the network in different ways.

Mobile Broadband (MBB) enhancements aim to meet a number of new KPIs. These pertain to high data rates, high user density, high user mobility, highly variable data rates, deployment, and coverage. High data rates are driven by the increasing use of data for services such as streaming (e.g., video, music, and user generated content), interactive services (e.g., AR), and IoT. These services come with stringent requirements for user experienced data rates as well as associated requirements for latency to meet service requirements. Additionally, increased coverage in densely populated areas such as sports arenas, urban areas, and transportation hubs has become essential for pedestrians and users in urban vehicles. New KPIs on traffic and connection density enable both the transport of high volumes of data traffic per area (traffic density) and transport of data for a high number of connections (e.g., UE density or connection density). Many UEs are expected to support a variety of services which exchange either a very large (e.g., streaming video) or very small (e.g., data burst) amount of data. The 5G system will handle this variability in a resource efficient manner. All of these cases introduce new deployment requirements for indoor and outdoor, local area connectivity, high user density, wide area connectivity, and UEs travelling at high speeds.

Another aspect of 5G KPIs includes requirements for various combinations of latency and reliability, as well as higher accuracy for positioning. These KPIs are driven by support for both commercial and public safety services. On the commercial side, industrial control, industrial automation, UAV control, and AR are examples of those services. Services such as UAV control will require more precise positioning information that includes altitude, speed, and direction, in addition to horizontal coordinates.

Support for Massive Internet of Things (MIoT) brings many new requirements in addition to those for the enhanced KPIs. The expansion of connected things introduces a need for significant improvements in resource efficiency in all system components (e.g., UEs, IoT devices, radio, access network, core network).

The 5G system also aims to enhance its capability to meet KPIs that emerging V2X applications require. For these advanced applications, the requirements, such as data rate, reliability, latency, communication range and speed, are made more stringent.

5 High-level requirements

5.1 Migration to 5G

5.1.1 Description

The 5G system supports most of the existing EPS services, in addition to many new services. The existing EPS services may be accessed using the new 5G access technologies even where the EPS specifications might indicate E-UTRA(N) only. Only new or changed service requirements for new or changed services are specified in this TS. The few EPS capabilities that are not supported by the 5G system are identified in clause 5.1.2.2 below.

5.1.2 Requirements

5.1.2.1 Interworking between 5G systems

The 5G system shall support a UE with a 5G subscription roaming into a 5G Visited Mobile Network which has a roaming agreement with the UE's 5G Home Mobile Network.

The 5G system shall enable a Visited Mobile Network to provide support for establishing home network provided data connectivity as well as visited network provided data connectivity.

The 5G system shall enable a Visited Mobile Network to provide support for services provided in the home network as well as provide services in the visited network. Whether a service is provided in the visited network or in the home network is determined on a service by service basis.

The 5G system shall provide a mechanism for a network operator to limit access to its services for a roaming UE, (e.g., based on roaming agreement).

The 5G system shall provide a mechanism for a network operator to direct a UE onto a partnership network for routing all or some of the UE user plane and associated control plane traffic over the partnership network, subject to an agreement between the operators.

5.1.2.2 Legacy service support

The 5G system shall support all EPS capabilities (e.g., from TSs 22.011, 22.101, 22.278, 22.185, 22.071, 22.115, 22.153, 22.173) with the following exceptions:

- CS voice service continuity and/or fallback to GERAN or UTRAN,
- seamless handover between NG-RAN and GERAN,
- seamless handover between NG-RAN and UTRAN, and
- access to a 5G core network via GERAN or UTRAN.

5.1.2.3 Interoperability with legacy 3GPP systems

The 5G system shall support mobility procedures between a 5G core network and an EPC with minimum impact to the user experience (e.g. QoS, QoE).

6 Basic capabilities

6.1 Network slicing

6.1.1 Description

Network slicing allows the operator to provide customised networks. For example, there can be different requirements on functionality (e.g., priority, charging, policy control, security, and mobility), differences in performance requirements (e.g., latency, mobility, availability, reliability and data rates), or they can serve only specific users (e.g., MPS users, Public Safety users, corporate customers, roamers, or hosting an MVNO).

A network slice can provide the functionality of a complete network, including radio access network functions and core network functions (e.g., potentially from different vendors). One network can support one or several network slices.

6.1.2 Requirements

The 5G system shall allow the operator to create, modify, and delete a network slice.

The 5G system shall allow the operator to define and update the set of services and capabilities supported in a network slice.

The 5G system shall allow the operator to configure the information which associates a UE to a network slice.

The 5G system shall allow the operator to configure the information which associates a service to a network slice.

The 5G system shall allow the operator to assign a UE to a network slice, to move a UE from one network slice to another, and to remove a UE from a network slice based on subscription, UE capabilities, the access technology being used by the UE, operator's policies and services provided by the network slice.

The 5G system shall support a mechanism for the VPLMN to assign a UE to a network slice with the needed services and authorised by the HPLMN, or to a default network slice.

The 5G system shall enable a UE to be simultaneously assigned to and access services from more than one network slice of one operator.

Traffic and services in one network slice shall have no impact on traffic and services in other network slices in the same network.

Creation, modification, and deletion of a network slice shall have no or minimal impact on traffic and services in other network slices in the same network.

The 5G system shall support scaling of a network slice, i.e., adaptation of its capacity.

The 5G system shall enable the network operator to define a minimum available capacity for a network slice. Scaling of other network slices on the same network shall have no impact on the availability of the minimum capacity for that network slice.

The 5G system shall enable the network operator to define a maximum capacity for a network slice.

The 5G system shall enable the network operator to define a priority order between different network slices in case multiple network slices compete for resources on the same network.

The 5G system shall support means by which the operator can differentiate policy control, functionality and performance provided in different network slices.

The serving 5G network shall support providing connectivity to home and roaming users in the same network slice.

In shared 5G network configuration, each operator shall be able to apply all the requirements from this clause to their allocated network resources.

The 5G system shall support a mechanism to configure a specific geographic area in which a network slice is accessible, i.e., a UE shall be within the geographical area in order to access the network slice.

6.2 Diverse mobility management

6.2.1 Description

A key feature of 5G is support for UEs with different mobility management needs. 5G will support UEs with a range of mobility management needs, including UEs that are

- stationary during their entire usable life (e.g., sensors embedded in infrastructure),
- stationary during active periods, but nomadic between activations (e.g., fixed access),
- mobile within a constrained and well-defined space (e.g., in a factory), and
- fully mobile.

Moreover, some applications require the network to ensure seamless mobility of a UE so that mobility is hidden from the application layer to avoid interruptions in service delivery while other applications have application specific means to ensure service continuity. But these other applications may still require the network to minimize interruption time to ensure that their application-specific means to ensure service continuity work effectively.

With the ever-increasing multimedia broadband data volumes, it is also important to enable the offloading of IP traffic from the 5G network onto traditional IP routing networks via an IP anchor node close to the network edge. As the UE moves, changing the IP anchor node may be needed in order to reduce the traffic load in the system, reduce end-to-end latency and provide a better user experience.

The flexible nature of a 5G system will support different mobility management methods that minimize signalling overhead and optimize access for these different types of UEs.

6.2.2 General requirements

The 5G network shall allow operators to optimize network behaviour (e.g., mobility management support) based on the mobility patterns (e.g., stationary, nomadic, spatially restricted mobility, full mobility) of a UE or group of UEs.

The 5G system shall enable operators to specify and modify the types of mobility support provided for a UE or group of UEs.

The 5G system shall optimize mobility management support for a UE or group of UEs that use only mobile originated communications.

6.2.3 Service continuity requirements

The 5G system shall enable packet loss to be minimized during inter- and/or intra- access technology changes for some or all connections associated with a UE.

For applications that require the same IP address during the lifetime of the session, the 5G system shall enable maintaining the IP address assigned to a UE when moving across different cells and access technologies for connections associated with a UE.

The 5G system shall enable minimizing impact to the user experience (e.g., minimization of interruption time) when changing the IP address and IP anchoring point for some or all connections associated with a UE.

6.3 Multiple access technologies

6.3.1 Description

The 5G system will support 3GPP access technologies, including one or more NR and E-UTRA as well as non-3GPP access technologies. Interoperability among the various access technologies will be imperative. For optimization and resource efficiency, the 5G system will select the most appropriate 3GPP or non-3GPP access technology for a service, potentially allowing multiple access technologies to be used simultaneously for one or more services active on a UE. New technology such as satellite and wide area base stations will increase coverage and availability. This clause provides requirements for interworking with the various combinations of access technologies.

6.3.2 Requirements

6.3.2.1 General

Based on operator policy, the 5G system shall enable the UE to select, manage, and efficiently provision services over the 3GPP or non-3GPP access.

Based on operator policy, the 5G system shall support steering a UE to select certain 3GPP access network(s).

Based on operator policy, the 5G system shall be able to dynamically offload part of the traffic (e.g. from 3GPP RAT to non-3GPP access technology), taking into account traffic load and traffic type.

Based on operator policy, the 5G system shall be able to provide simultaneous data transmission via different access technologies, (e.g., NR, E-UTRA, non-3GPP), to access one or more 3GPP services.

When a UE is using two or more access technologies simultaneously, the 5G system shall be able to select between access technologies in use, taking into account e.g., service, traffic characteristics, radio characteristics, and UE's moving speed.

The 5G system shall be able to support data transmissions optimized for different access technologies (e.g., 3GPP, non-3GPP) for UEs that are simultaneously connected to the network via different accesses.

Based on operator policy, the 5G system shall be able to add or drop the various access connections for a UE during a session.

The 5G system shall be able to support mobility between the supported access networks (e.g., NG-RAN, WLAN).

The 5G system shall support UEs with multiple radio and single radio capabilities.

The 5G system shall support dynamic and static network address allocation of a common network address to the UE over all supported access types.

The 5G system shall support a set of identities for a single user in order to provide a consistent set of policies and a single set of services across 3GPP and non-3GPP access types.

The 5G system shall support the capability to operate in licensed and/or unlicensed bands.

6.3.2.2 E-UTRA access

The 5G system shall be able to support seamless handover between NR and E-UTRA.

The 5G system shall support UEs with dual radio capability (i.e., a UE that can transmit on NR and E-UTRA simultaneously) as well as UEs with single radio capability (i.e., a UE that cannot transmit on NR and E-UTRA simultaneously).

6.3.2.3 Void

6.3.2.4 Void

6.4 Resource efficiency

6.4.1 Description

5G introduces the opportunity to design a system to be optimized for supporting diverse UEs and services. While support for IoT is provided by EPS, there is room for improvement in efficient resource utilization that can be designed into a 5G system whereas they are not easily retrofitted into an existing system. Some of the underlying principles of the potential service and network operation requirements associated with efficient configuration, deployment, and use of UEs in the 5G network include bulk provisioning, resource efficient access, optimization for UE originated data transfer, and efficiencies based on the reduced needs related to mobility management for stationary UEs and UEs with restricted range of movement.

As sensors and monitoring UEs are deployed more extensively, the need to support UEs that send data packages ranging in size from a small status update in a few bits to streaming video increases. A similar need exists for smart phones with widely varying amounts of data. Specifically, to support short data bursts, the network should be able to operate in a mode where there is no need for a lengthy and high overhead signalling procedure before and after small amounts of data are sent. The system will, as a result, avoid both a negative impact to battery life for the UE and wasting signalling resources.

For small form factor UEs it will be challenging to have more than 1 antenna due to the inability to get good isolation between multiple antennas. Thus these UEs need to meet the expected performance in a 5G network with only one antenna.

Cloud applications like cloud robotics perform computation in the network rather than in a UE, which requires the system to have high data rate in the uplink and very low round trip latency. Supposed that high density cloud robotics will be deployed in the future, the 5G system need to optimize the resource efficiency for such scenario.

Additional resource efficiencies will contribute to meeting the various KPIs defined for 5G. Control plane resource efficiencies can be achieved by optimizing and minimizing signalling overhead, particularly for small data transmissions. Mechanisms for minimizing user plane resources utilization include in-network caching and application