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Contents

Foreword

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

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1 Scope

This document is related to the technical report for this study item "Scenarios and Requirements for Next Generation Access Technologies" [1]. The objective of the study item is to identify the typical deployment scenarios associated with attributes such as carrier frequency, inter-site distance, user density, maximum mobility speed, etc, and to develop requirements for next generation access technologies for the identified deployment scenarios taking into account, but not limited to, the ITU-R discussion on IMT-2020 requirements.

This document contains scenarios and requirements for next generation access technologies, which can be used as not only guidance to the technical work to be performed in 3GPP RAN WGs, but also input for ITU-R to take into account when developing IMT-2020 technical performance requirements.

2 References

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

[1] 3GPP SID FS_NG_SReq: "Scenarios and Requirements for Next Generation Access Technologies" RP-152257, “New Study Item Proposal - Study on Scenarios and Requirements for Next Generation Access Technologies”, CMCC, RAN#70, Sitges, Spain, Dec. 7 - 11, 2015.

[2] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[3] 3GPP TR 22.891: "Feasibility Study on New Services and Markets Technology Enablers".

[4] Recommendation ITU-R M.2083: IMT Vision - "Framework and overall objectives of the future development of IMT for 2020 and beyond" (September 2015).

[5] ITU-R report M.2135, Guidelines for evaluation of radio interface technologies for IMT-Advanced.

[6] 3GPP TR 36.878: "Study on performance enhancements for high speed scenario in LTE".

[7] 3GPP TR 23.799: " Study on Architecture for Next Generation System".

[8] 3GPP TS 23.303: " Proximity-based services (ProSe); Stage 2".

[9] 3GPP TS 22.179: "Mission Critical Push To Talk (MCPTT) over LTE; Stage 1".

[10] 3GPP TS 22.468: "Group Communication System Enablers for LTE (GCSE_LTE)".

[11] 3GPP TR 36.890: "Evolved Universal Terrestrial Radio Access (E-UTRA); Study on single-cell point-to-multipoint transmission for E-UTRA".

[12] 3GPP TS 22.101: "Service aspects; Service principles".

[13] 3GPP TS 22.071 "Location Services (LCS); Service description; Stage 1".

[14] 3GPP TS 22.153: "Multimedia priority service".

[15] 3GPP TS 22.268: "Public Warning System (PWS) requirements".

[16] 3GPP TS 33.106: "3G security; Lawful interception requirements".

[17] 3GPP TS 22.185: "Service requirements for V2X services".

[18] 3GPP TS 22.886: "Study on enhancement of 3GPP Support for 5G V2X Services".

[19] 3GPP TR 33.899: "Study on the security aspects of the next generation system".

[20] 3GPP TS 22.280: "Mission Critical Services Common Requirements (MCCoRe); Stage 1".

[21] 3GPP TS 22.281: "Mission Critical Video services over LTE".

[22] 3GPP TS 22.282: "Mission Critical Data services over LTE".

[23] 3GPP TS 22.346: "Isolated Evolved Universal Terrestrial Radio Access Network (E-UTRAN) operation for public safety; Stage 1".

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].

Transmission Reception Point (TRxP): Antenna array with one or more antenna elements available to the network located at a specific geographical location for a specific area.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

t_gen The time during which data or access request is generated
t_sendrx The time during which data or access request is sent or received

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [2] 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 [2].

ARPU	Average Revenue Per User
BBU	Baseband Unit
BS	Base Station
CAPEX	Capital Expenditure
CDF	Cumulative Distribution Function
CN	Core Network
D2D	Device to Device
DL	Downlink
DRX	Discontinuous Reception
EE	Energy Efficiency
eMBB	enhanced Mobile BroadBand
EMF	Electric and Magnetic Fields
eNB	evolved Node B
eV2X	enhanced Vehicle to Everything
FDD	Frequency Division Duplex
GCSE_LTE	Group Communication System Enablers for LTE
GEO	Geostationary orbit
GNSS	Global Navigation Satellite System
HEO	High Earth Orbit
IMT	International Mobile Telecommunicationss
InH	Indoor Hotspot
ISD	Inter-Site Distance
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union Radiocommunication Sector
KPI	Key Performance Indicator
LEO	Low Earth Orbit
MEO	Medium Earth Orbit
MBB	Mobile BroadBand

MaxCL	Maximum Coupling Loss
MCPTT	Mission-Critical Push-To-Talk
mMTC	massive Machine Type Communications
NR	New Radio
OPEX	Operational Expenditure
ProSe	Proximity Services
QoE	Quality of Experience
QoS	Quality of Service
RAN	Radio Access Network
RAT	Radio Access Technology
RF	Radio Frequency
RMa	Rural Macro
RRH	Remote Radio Head
RSU	Roadside Unit
RTT	Round Trip Time
Rx	Receiver
SA	Service and System Aspect
SC-PTM	Single-Cell Point-to-Multipoint transmission
SDU	Service Data Unit
SFN	Single Frequency Network
SINR	Signal-to-Interference-plus-Noise Ratio
SON	Self Organized Network
TDD	Time Division Duplex
TR	Technical Report
TRxP	Transmission Reception Point
Tx	Transmitter
UE	User Equipment
UL	Uplink
UMa	Urban Macro
UMi	Urban Micro
URLLC	Ultra-Reliable and Low Latency Communications
V2X	Vehicle to Everything
WG	Working Group
WLAN	Wireless Local Area Network
WRC	World Radiocommunication Conference

4 Introduction

At the 3GPP TSG RAN #70 meeting, the Study Item description on "Scenarios and Requirements for Next Generation Access Technologies" was approved [1].

The justification of the Study Item was that a fully mobile and connected society is expected in the near future, which will be characterized by a tremendous amount of growth in connectivity, traffic volume and a much broader range of usage scenarios. Some typical trends include explosive growth of data traffic, great increase of connected devices and continuous emergence of new services. Besides the market requirements, the mobile communication society itself also requires a sustainable development of the eco-system, which produces the needs to further improve system efficiencies, such as spectrum efficiency, energy efficiency, operational efficiency and cost efficiency. To meet the above ever-increasing requirements from market and mobile communication society, next generation access technologies are expected to emerge in the near future. A study item to identify typical deployment scenarios for next generation access technologies and the required capabilities in each corresponding deployment scenarios should be considered.

5 Objectives

In order to meet the deployment scenarios and requirements, studies for next generation access technologies should be carried out in at least, but not limited to, the following areas, designs for next generation access technologies RAN should strive for enough flexibility to support current envisaged and future requirements for the different use cases, e.g., from SA1 3GPP TR 22.891 [3], i.e., to support for wide range of services.

6 Scenarios

6.0 General

This subsection briefly introduces the three usage scenarios defined by ITU-R IMT for 2020 and beyond [4] is envisaged to expand and support diverse families of usage scenarios and applications that will continue beyond the current IMT. Furthermore, a broad variety of capabilities would be tightly coupled with these intended different usage scenarios and applications for IMT for 2020 and beyond. The families of usage scenarios for IMT for 2020 and beyond include:

- eMBB (enhanced Mobile BroadBand)
- mMTC (massive Machine Type Communications)
- URLLC (Ultra-Reliable and Low Latency Communications)

6.1 Deployment scenarios

Deployment scenarios for eMBB, mMTC and URLLC are described in this TR. Other deployment scenarios related to eV2X (enhanced Vehicle to Everything) services are also described in this TR. Not all requirements apply to all deployment scenarios described in the TR. The mapping between requirements and deployment scenarios is described per KPI in Chapter 7.However, some of eMBB deployment scenarios may possibly be reused to evaluate mMTC and URLLC, or some specific evaluation tests (e.g., link-level simulation) can be developed to check whether the requirements can be achieved.

High-level descriptions on deployment scenarios including carrier frequency, aggregated system bandwidth, network layout / ISD, BS / UE antenna elements, UE distribution / speed and service profile are proposed in this TR. It is assumed that more detailed attributes and simulation parameters, for example, the channel model, BS / UE Tx power, number of antenna ports, etc. should be defined in the new RAT study item.

6.1.1 Indoor hotspot

The indoor hotspot deployment scenario focuses on small coverage per site/TRxP (transmission and reception point) and high user throughput or user density in buildings. The key characteristics of this deployment scenario are high capacity, high user density and consistent user experience indoor.

Some of its attributes are listed in Table 6.1.1-1.

Table 6.1.1-1: Attributes for indoor hotspot

Attributes	Values or assumptions
Carrier Frequency NOTE1	Around 30 GHz or Around 70 GHz or Around 4 GHz
Aggregated system bandwidth NOTE2	Around 30GHz or Around 70GHz: Up to 1GHz (DL+UL) NOTE3 Around 4GHz: Up to 200MHz (DL+UL)
Layout	Single layer: - Indoor floor (Open office)
ISD	20m (Equivalent to 12TRxPs per 120m x 50m)
BS antenna elements NOTE4	Around 30GHz or Around 70GHz: Up to 256 Tx and Rx antenna elements Around 4GHz: Up to 256 Tx and Rx antenna elements
UE antenna elements NOTE4	round 30GHz or Around 70GHz: Up to 32 Tx and Rx antenna elements Around 4GHz: Up to 8 Tx and Rx antenna elements
User distribution and UE speed	100% Indoor, 3km/h, 10 users per TRxP
Service profile	NOTE: Whether to use full buffer traffic or non-full-buffer traffic depends on the evaluation methodology adopted for each KPI. For certain KPIs, full buffer traffic is desirable to enable comparison with IMT-Advanced values.

NOTE1: The options noted here are for evaluation purpose, and do not mandate the deployment of these options or preclude the study of other spectrum options. A range of bands from 24.25 GHz – 52.6 GHz identified for WRC-19 are currently being considered and around 30 GHz is chosen as a proxy for this range. A range of bands from 66 GHz – 86 GHz identified for WRC-19 are currently being considered and around 70 GHz is chosen as a proxy for this range. A range of bands from 3300 – 4990MHz identified for WRC-15 are currently being considered and around 4GHz is chosen as a proxy for this range.

NOTE2: The aggregated system bandwidth is the total bandwidth typically assumed to derive the values for some KPIs such as area traffic capacity and user experienced data rate. It is allowed to simulate a smaller bandwidth than the aggregated system bandwidth and transform the results to a larger bandwidth. The transformation method should then be described, including the modelling of power limitations.

NOTE3: "DL + UL" refers to either of the following two cases:

1. FDD with symmetric bandwidth allocations between DL and UL.

2. TDD with the aggregated system bandwidth used for either DL or UL via switching in time-domain.

NOTE4: The maximum number of antenna elements is a working assumption. 3GPP needs to strive to meet the target with typical antenna configurations.

6.1.2 Dense urban

The dense urban microcellular deployment scenario focuses on macro TRxPs with or without micro TRxPs and high user densities and traffic loads in city centres and dense urban areas. The key characteristics of this deployment scenario are high traffic loads, outdoor and outdoor-to-indoor coverage. This scenario will be interference-limited, using macro TRxPs with or without micro TRxPs. A continuous cellular layout and the associated interference shall be assumed.

Some of its attributes are listed in Table 6.1.2-1.

Table 6.1.2-1: Attributes for dense urban

Attributes	Values or assumptions
Carrier Frequency NOTE1	Around 4GHz + Around 30GHz (two layers)
Aggregated system bandwidth NOTE2	Around 30GHz: Up to1GHz (DL+UL) Around 4GHz: Up to 200MHz (DL+UL)
Layout	Two layers: - Macro layer: Hex. Grid - Micro layer: Random drop Step 1 NOTE3: Around 4GHz in Macro layer Step 2 NOTE3: Both Around 4GHz & Around 30GHz may be available in Macro & Micro layers (including 1 macro layer, macro cell only)
ISD	Macro layer: 200m Micro layer: 3micro TRxPs per macro TRxP NOTE4, All micro TRxPs are all outdoor
BS antenna elements NOTE5	Around 30GHz: Up to 256 Tx and Rx antenna elements Around 4GHz: Up to 256 Tx and Rx antenna elements
UE antenna elements NOTE5	Around 30GHz: Up to 32 Tx and Rx antenna elements Around 4GHz: Up to 8 Tx and Rx antenna elements
User distribution and UE speed	Step1 NOTE3: Uniform/macro TRxP, 10 users per TRxP NOTE6, NOTE7 Step2 NOTE3: Uniform/macro TRxP + Clustered/micro TRxP, 10 users per TRxP NoTE6, 80% indoor (3km/h), 20% outdoor (30km/h)
Service profile	NOTE: Whether to use full buffer traffic or non-full-buffer traffic depends on the evaluation methodology adopted for each KPI. For certain KPIs, full buffer traffic is desirable to enable comparison with IMT-Advanced values.

NOTE1: The options noted here are for evaluation purpose, and do not mandate the deployment of these options or preclude the study of other spectrum options. A range of bands from 24.25 GHz – 52.6 GHz identified for WRC-19 are currently being considered and around 30 GHz is chosen as a proxy for this range. A range of bands from 3300 – 4990MHz identified for WRC-15 are currently being considered and around 4GHz is chosen as a proxy for this range.

NOTE2: The aggregated system bandwidth is the total bandwidth typically assumed to derive the values for some KPIs such as area traffic capacity and user experienced data rate. It is allowed to simulate a smaller bandwidth than the aggregated system bandwidth and transform the results to a larger bandwidth. The transformation method should then be described, including the modelling of power limitations.

NOTE3: Step 1 shall be used for the evaluation of spectral efficiency KPIs. Step2 shall be used for the evaluation of the other deployment scenario dependant KPIs.

NOTE4: This value is the baseline and other number of micro TRxPs per macro TRxP (e.g., 6 or 10) is not precluded.

NOTE5: The maximum number of antenna elements is a working assumption. 3GPP needs to strive to meet the target with typical antenna configurations.

NOTE6: 10 users per TRxP is the baseline with full buffer traffic. 20 users per macro TRxP with full buffer traffic is not precluded.

6.1.3 Rural

The rural deployment scenario focuses on larger and continuous coverage. The key characteristics of this scenario are continuous wide area coverage supporting high speed vehicles. This scenario will be noise-limited and/or interference-limited, using macro TRxPs.

Some of its attributes are listed in Table 6.1.3-1.

Table 6.1.3-1: Attributes for rural scenario

Attributes	Values or assumptions
Carrier Frequency NOTE1	Around 700MHz or Around 4GHz (for ISD 1) Around 700 MHz and Around 2 GHz combined (for ISD 2)
Aggregated system bandwidth NOTE2	Around 700MHz: Up to 20MHz(DL+UL) NOTE3 Around 4GHz: Up to 200MHz (DL+UL)
Layout	Single layer: - Hex. Grid
ISD	ISD 1: 1732m ISD 2: 5000m
BS antenna elements NOTE4	Around 4GHz: Up to 256 Tx and Rx antenna elements Around 700MHz: Up to 64 Tx and Rx antenna elements
UE antenna elements NOTE4	Around 4GHz: Up to 8 Tx and Rx antenna elements Around 700MHz: Up to 4 Tx and Rx antenna elements
User distribution and UE speed	50% outdoor vehicles (120km/h) and 50% indoor (3km/h), 10 users per TRxP
Service profile	NOTE: Whether to use full buffer traffic or non-full buffer traffic depends on the evaluation methodology adopted for each KPI. For certain KPIs, full buffer traffic is desirable to enable comparison with IMT-Advanced values.

NOTE1: The options noted here are for evaluation purpose, and do not mandate the deployment of these options or preclude the study of other spectrum options. A range of bands from 450MHz – 960MHz identified for WRC-15 are currently being considered and around 700MHz is chosen as a proxy for this range. A range of bands from 1427 – 2690MHz identified for WRC-15 are currently being considered and around 2GHz is chosen as a proxy for this range. A range of bands from 3300 – 4990MHz identified for WRC-15 are currently being considered and around 4GHz is chosen as a proxy for this range.

NOTE2: The aggregated system bandwidth is the total bandwidth typically assumed to derive the values for some KPIs such as area traffic capacity and user experienced data rate. It is allowed to simulate a smaller bandwidth than the aggregated system bandwidth and transform the results to a larger bandwidth. The transformation method should then be described, including the modelling of power limitations.

NOTE3: Consider larger aggregated system bandwidth if 20MHz cannot meet requirement.

NOTE4: The maximum number of antenna elements is a working assumption. 3GPP needs to strive to meet the target with typical antenna configurations.