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IPv6-Based 5G Mobile Wireless Internet; Deployment of IPv6-Based 5G Mobile Wireless Internet

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Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) IPv6 Integration (IP6).

Modal verbs terminology

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1 Scope

The present document outlines the motivation for the deployment of IPv6-based 5G Mobile Internet, the objectives, the technology guidelines, the step-by-step process, the benefits, the risks, the challenges and the milestones.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

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3 Abbreviations

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

3GPP	Third Generation Partnership Project
5G	5th Generation
5G-PPP	5G Infrastructure Public Private Partnership
AMF	Access and Mobility Function
APN	Access Point Names
APNIC	Asia Pacific Network Information Centre
AUSF	AUthentication Server Function
BGP	Border Gateway Protocol
CDN	Content Delivery Network
CGN	Carrier Grade NAT
CG-NAT	Carrier-Grade NAT (Network Address Translation)
CLAT	Customer-side transLATor
CORE	Core Network
CP	Control Plane
CSFB	Circuit Switched FallBack
DN	Data Network
DNS	Directory Name Server
DS	Dual-Stack
EPS	Evolved Packet System

FG	Focus Group
FTTH	Fiber To The Home
GET	HTTP GET used to request data from a specified resource
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
HLR	Home Location Register
H-PCF	Home-PCF
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICT	Information and Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IMT	International Mobile Telecommunications
IoT	Internet of Things
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IPVS	IP Virtual Server
ISP	Internet Service Provider
ITU-R	International Telecommunication Union - Radiocommunication Sector
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
LAN	Local Area Network
MAN	Metropolitan Area Network
MN	Mobile Node
MNG	Mobile Network Gateway
MNO	Mobile Networks Operator
NAT	Network Address Translation
NEO	Network Operations
NGMN	Next Generation Mobile Network
OAM	Operations, Administration, and Maintenance
PCF	Policy Control Function
PDN	Packet Data Network
PDP	Packet Data Protocol
PGW	Packet data network GateWay
PLAT	Provider-side transLATor
PLT	Page Load Time
PPP	Point to Point Protocol
RAT	Radio Access Technologies
RFC	Request For Comments
RTT	Round Trip Time
RUM	Real User Monitoring
SDN	Software Defined Networking
SGSN	Serving GPRS Support Node
SMF	Session Management Function
TCP	Transmission Control Protocol
TD	Temporary Document
TM Forum	Tele Management Forum
TSG RAN	Technical Specifications Group Radio Access Network
TWAG	Trusted Wireless LAN Access Gateway
UDM	Unified Data Management
UE	User Equipment
UP	User Plane
VoIP	Voice over IP
VoLTE	Voice over Long Term Evolution
V-PCF	Visited-PCF
VPN	Virtual Private Network
WI	Work Item
WLAN	Wireless Local Area Network

4 IPv6-based 5G Mobile Wireless Internet

4.0 Introduction

The fifth generation of mobile technology (5G) will address the demands and business contexts of 2020 and beyond. Moreover, it is expected that:

1) the future European society and economy will strongly rely on 5G infrastructure;

2) its impact will go far beyond existing wireless access networks with the aim for communication services, reachable everywhere, all the time, and faster; and

3) 5G technology will be adopted and deployed globally in alignment with developed and emerging markets' needs.

According to [i.47], several key drivers and disruptive capabilities will help the adoption and deployment of 5G globally.

In particular, regarding the key drivers, 5G will ensure user experience continuity in challenging situations such as high mobility (e.g. in trains), and very dense or sparsely populated areas, and journeys covered by heterogeneous technologies. At the same time 5G will be the key enabler for the Internet of Things (IoT) by providing a platform to connect a massive number of sensors, rendering devices and actuators with stringent energy and transmission constraints, see Figure 1. In addition, new mission critical services will be deployed, requiring very high reliability, global coverage and/or very low latency, which are up to now handled by specific networks, typically public safety, will become natively supported by the 5G infrastructure.

Moreover, it is expected that 5G will integrate networking, computing and storage resources into one programmable and unified infrastructure, which will allow for an optimized and more dynamic usage of all distributed resources, and the convergence of fixed, mobile and broadcast services. This unification will also enable 5G to support multi tenancy models, enabling operators and other players to collaborate in new ways.

5G will leverage on the cloud computing concepts and will stimulate paving the way for virtual pan European operators relying on nationwide infrastructures.

Another important key driver is that 5G is being designed to be a sustainable and scalable technology. This can be realized by firstly, the telecom industry will stimulate and work towards a drastic energy consumption reduction and energy harvesting. Moreover, sustainable business models for all Information and Communication Technology (ICT) stakeholders will be enabled by cost reductions through human task automation and hardware optimization.

One of the most important key drivers is that 5G will create an ecosystem for technical and business innovation. This will be enabled by the fact that network services will rely more and more on software, the creation and growth of start-ups in the sector will be encouraged. Furthermore, the 5G infrastructures will provide network solutions and involve vertical markets such as automotive, energy, food and agriculture, city management, government, healthcare, smart manufacturing, public transportation, water management.

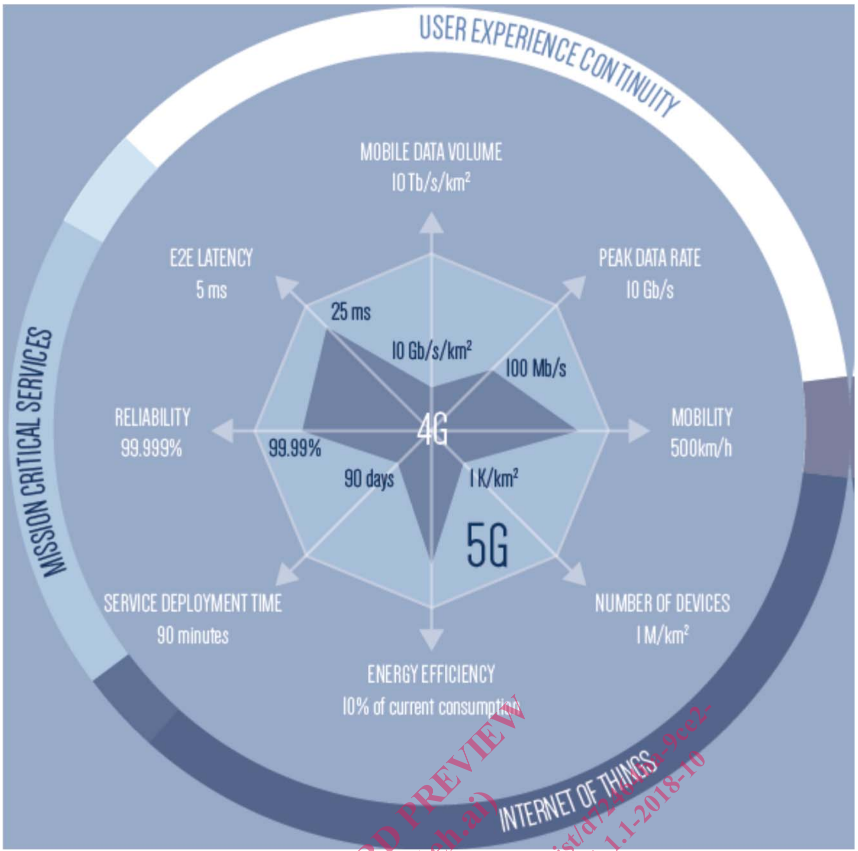

Figure 1: 5G Key drivers and disruptive capabilities, copied from [i.47]

Moreover, with the rapid development of the 5G network infrastructure, and as well as other technology enablers such as IoT, mobile Internet, cloud computing, Software Defined Networking (SDN), virtualization, smart home and Internet of vehicles, there is a consensus between different stakeholders that the demand of Internet is no longer limited to the exhausting IP address, but extends to the end-to-end interconnection and permanently stable IP address. Moreover, it has a higher requirement for the security, management, maintenance as well as the operation of the next generation Internet. One of the main challenges associated with the above is associated with how gradually to stop IPv4, deploy IPv6 in full scale and start using the Internet of the 21st century.

4.1 IPv6 Transition Strategies in Mobile Networks

Currently several IPv6 transition strategies can be identified. The main IPv6 transition strategies that are being discussed by Mobile Network Operators (MNOs), see e.g. [i.1] are listed below. More details on mobile networks considerations for IPv6 deployment are described in [i.2], see also clause 4.2.5 of the present document.

- **IPv4 only:** delays the introduction of IPv6 to a later date and remain an all-IPv4 network. Over the long term, it is expected that this transition strategy will lead to problems and increased costs for the MNO. Due to the increase in traffic, see 5G requirements, there will be an increased demand for IP addresses and on using NAT in the carriers' network, denoted as Carrier Grade Network Address Translation (CG-NAT). In particular, all traffic to and from the Internet will have to pass CG-NAT. Furthermore, growth in bandwidth demand can only be handled with increased CG-NAT capacity, which has a higher cost. It means that the MNO is unable to benefit from the increasing ratio of IPv6-to-IPv4 Internet traffic. This mechanism works only for DNS-based applications and IPv4-only.

- **Coexistence of IPv4 and IPv6:** requires the use of a dual-stack, introducing IPv6 in the network next to IPv4. For a MNO, this approach is a less desirable option because dual-stack networks are more complex to deploy, operate, and manage. Furthermore, this option also requires an address management solution for both IPv4 and IPv6 addresses.