

The Standards People



A GLOBAL INITIATIVE

ETSI and 3GPP work on 5G standards

Presented by:

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3GPP Marketing and Communications Officer

CYS briefing at https://infocomcy.com

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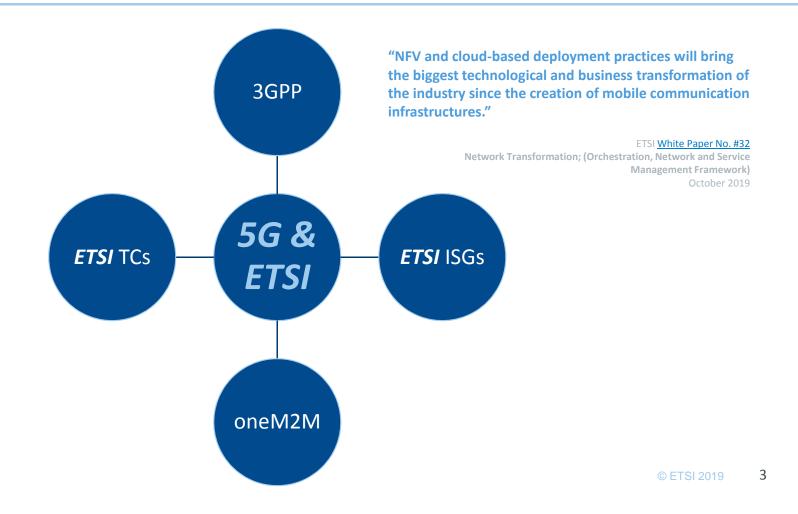


ETSI's Role & Reputation in 5G standardization



- ETSI is at the forefront of emerging technologies
- Direct participation & consensus based
 - ✓ ETSI has over 850 member companies and organizations
 - ✓ 436 ETSI members are active in 3GPP out of 683 members in total





5G Related Activities in ETSI (1/4 - non-exhaustive list)

ISG NFV – Network Functions Virtualisation

Standard IT servers, switches and storage are at the base of the NFV infrastructure.

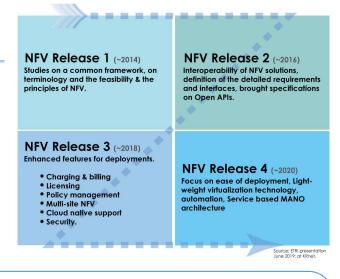
The ETSI ISG NFV community has evolved through several phases, moving from defining the initial framework and pre-standardization studies to detailed specifications over three 'Releases'.

While NFV was originally conceived to help network service providers find cost reduction and agility, it has proven to be an essential tool to enhance how these services are requested and consumed by users of 5G.

ISG MEC – Multi-Access Edge Computing

An enabler for 5G use cases, key in fixed-mobile integration. ETSI MEC enables applications to be hosted in a multi-vendor multi-access edge computing environment.

Offers a cloud computing capability at the edge of the network and is a step towards convergence of IT and telecommunications networking. The MEC Server provides RAN API services for the development of network optimization applications: Radio Network Information Service (RNIS); Location Information Service; and Bandwidth Manager Service.



Group Report		
MEC 001	Terminology	
MEC 002	Phase 2: Use Cases and Requirements	
MEC 003	Framework and Reference Architecture	
MEC 005	Proof of Concept Framework	
MEC 009	General principles for MEC Service APIs	
MEC 010-1	Mobile Edge Management; Part 1: System, host and platform management	
MEC 010-2	Mobile Edge Management; Part 2: Application lifecycle, rules and requirements management	ent
MEC 011	Mobile Edge Platform Application Enablement	
MEC 012	Radio Network Information API	
MEC 013	Location API	
MEC 014	UE Identity API	
MEC 015	Bandwidth Management API	
MEC 016	UE application interface	
MEC 017	Deployment of Mobile Edge Computing in an NFV environment	
MEC 018	End to End Mobility Aspects	
MEC 022	Study on MEC Support for V2X Use Cases	
MEC 026	Support for regulatory requirements	
MEC 029	Fixed Access Information API	
MEC-DEC 025	MEC Testing Framework	
MEC-IEG 004	Service Scenarios	
MEC-IEG 005	Proof of Concept Framework	
MEC-IEG 006	Market Acceleration; MEC Metrics Best Practice and Guidelines	4



5G Related Activities in ETSI (2/4)

ISG ZSM - Zero touch network and Service Management

Goal: To provide a framework that enables zero-touch automated network and service management in a multivendor environment. This holistic end-to-end network and service management concept enables the integration of ETSI ENI, NFV and MEC management demands.

ZSM supports enablers for closed loop automation and for data-driven management algorithms that can be based on machine learning and artificial intelligence.

ISG ENI – Experiential Networked Intelligence

The assessment of Networked Experience using Artificial Intelligence in 5G communications systems.

ISG mWT – mm Wave Transmission

Facilitating the use of the V-band (57-66 GHz) for Fixed Wireless Access, E-band (71-76 & 81-86 GHz) and in the future higher frequency bands above 100 GHz (i.e. W/D-Band) for large volume applications in the back-hauling and front-hauling to support 5G deployment; Identification of spectrum regulations and licensing scheme more suitable and sustainable with respect to current ones in order to better match the challenging requirements of 5G mainly in terms of capacity increase; technical analysis and reports on the benefits of new features (phase array, interference cancellers, ...) that may require upgrade of the harmonized standards.

ISG ZSM recent Group Specifications (GS) :

ETSI **GS ZSM 001** (10/2019): Requirements based on documented scenarios ETSI **GS ZSM 002** (08/2019): Reference Architecture ETSI **GS ZSM 006** (05/2018): Proof of Concept Framework ETSI **GS ZSM 007** (08/2019): Terminology concepts in ZSM

Experiential Networked Intelligence OUTPUT IN 2019:

- ✓ Group Report (GR) on definition of networked intelligence categorization
- \checkmark $\,$ Revision to Group Specification (GS) on ENI PoC framework
- ✓ GS on ENI system architecture
- ✓ Revision to GR on terminology for main concepts in ENI
- ✓ Revision to GSs on ENI requirements and use cases

ISG MWT WORK IN PROGRESS:

- ✓ Group Specification (GS) on Definition of a Wireless Transport Profile for Standard SDN Northbound Interfaces
- ✓ Group Report (GR) on FS RF frequency ranges above 174,8 GHz
- ✓ GR on current status of standards and activities in RF bands above D-band
- ✓ GR on W-Band Performance Management overview, covering metrics needed to describe error performance related aspects in radio equipment used for FS
- ✓ Miscellaneous Work Item survey of E-Band deployments and status of international and national regulation worldwide

5G related activities in ETSI (3/4)

ISG ARF – Augmented Reality Framework

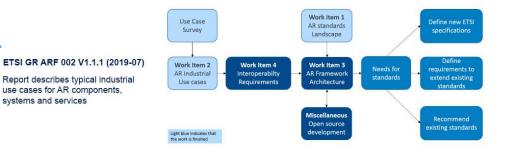
Developing an interoperability framework for Augmented Reality components, systems and services and 5G will significantly improve network performance for cloud services in particular in terms of bandwidth and latency

Image (right): Two Work Items completed...

systems and services

ETSI GR ARF 001 V1.1.1 (2019-04)

Looks at AR work in ISO/IEC, W3C, Khronos, IEEE, IETF, OGC, ...



TC CYBER

To ensure the security of the 5G network, devices and infrastructure from inception, service, improvement and end of life including detailed security work within 5G groups.

TC CYBER QSC – Quantum Safe Cryptography

Creating and selecting cryptographic techniques that are resistant to attack by nextgeneration quantum computers. QSC is fundamentally the security approach to nextgeneration computing. QSC is extremely appropriate for certain components of the new 5G architecture.

ISG Securing Artificial Intelligence

Securing AI from attack, Mitigating against AI where AI is the 'problem' and Using AI to enhance security measures against attack from other things – as part of the 'solution'.

TC LI – Lawful Interception

Development of a suite of standards allowing ETSI standards to support industry compliance to the requirements of national and international law. This touches many 5G aspects.

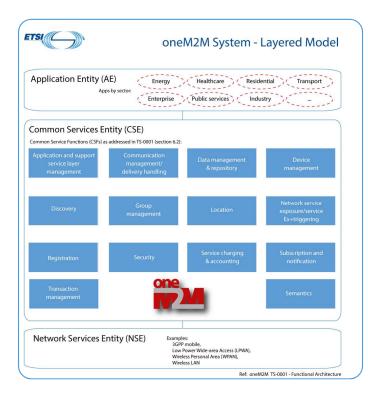




5G related Activities in ETSI (4/4)

TC ITS – Intelligent Transport Systems

Vehicle connectivity with the capability of using a 5G infrastructure



Intelligent Transport Systems NEW TS output in 2019:

- ✓ Technical Specification (TS) on GeoNetworking extensions for MCO
- ✓ TS on Multi-Channel Operation (MCO) for ITS; covering definition of MCO architecture, channel management mechanisms and interfaces
- ✓ TS on Communication Architecture for MCO
- ✓ TS on OSI cross-layer topics
- ✓ TS on security management messages
- ✓ TS on interoperability test specifications for security
- ✓ TS on manoeuvre coordination service basic set of applications
- $\checkmark\,$ TS on conformance test specifications for ITS PKI management
- ✓ TS on awareness service for Vulnerable Road Users (VRU)
- ✓ TS on Access Layer / ITS Performance Analysis Framework and 5,9 GHz Channel Models
- ✓ TS on Multimedia Content Dissemination (MCD) basic service specification
- \checkmark TS on facilities layer protocol for communication congestion control

oneM2M (Partnership)

oneM2M specifications address the need for a common IoT Service Layer that can be readily embedded within various hardware and software, and relied upon to connect devices in the field.

A critical objective of oneM2M is to attract organizations from M2M-related business domains such as: telematics and intelligent transportation, healthcare, utilities,

industrial automation, smart homes.

http://www.onem2m.org





The 3GPP perspective on 5G

3GPP Overview

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Content

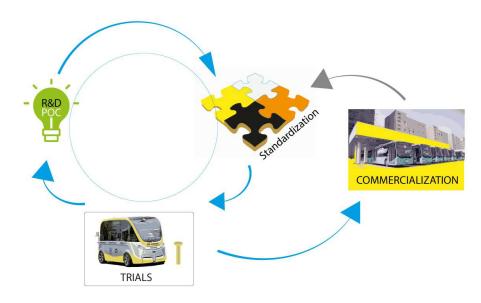


- The role of 3GPP
- The Partners & their members
- Organizing the work
- Sour role in 5G
- Release 15 NR to meet market needs
- Release 16 5G use cases
- Release 17 An early look
- Conclusions

The role of 3GPP

- 3GPP is part of the invention, proof of concept, standardization, trials, commercialization ...cycle
- Its role is to specify and maintain a complete system description for mobile telecommunications
- The system description is characterized by a number of standardized interfaces, not a description of standardized deployment
- This standardization approach enables an interoperable, multi-vendor approach to deployment and generates mass market economies of scale, without stifling innovation





Evolution ... thanks to GSM



Generation	Systems
1G	Analogue technology, from the 1980s onwards (NMT, AMPS, TACS, A-Netz to E-Netz, Radiocom 2000, RTMI, JTACS and TZ-80n)
2G	First digital systems, deployed in the 1990s introducing voice, SMS and data services (GSM/GPRS & EDGE, CDMAOne, PDC, iDEN, IS-136 or D-AMPS).
3G	3GPP evolved Global System for Mobile communication (GSM) with the evolution of General Packet Radio Service (GPRS) and Enhanced Data rates for GSM Evolution (EDGE), as well as further developments with the Universal Mobile Telecommunications System (UMTS) and High Speed Packet data Access (HSPA). 3G brought a global vision to the evolution of mobile networks, with the creation of the ITU's family of IMT-2000 systems which included EDGE, CDMA2000 1X/EVDO and UMTS-HSPA+ radio access technologies.
3G/4G	LTE and LTE-Advanced have crossed the "generational boundary" with high speed data, significant spectral efficiencies and adoption of advanced radio techniques, their emergence Evolution to LTE has been the direction of travel for [a]] new mobile systems from Release 8 onwards.
5G	5G brings another major technology step, with the creation of a 'New Radio' (NR), slated to be used alongside LTE- Advanced Pro in early 5G network launches.

Why Standards?



"Modems are the embodiment of the wireless standards developed by the industry body 3GPP (3rd Generation Partnership Project). **3GPP adopts the best technologies** among numerous proposals from its members into standards. If one wants to be modem leaders, they've got to be leaders in standardization.

Standards leadership allows companies to incorporate their technology into standards, which gives them a significant head start against the competition in productizing that technology. Such leadership requires not just modem competence, but end-to-end systems expertise, built over

many years with large, sustained investments. Additionally, it requires close collaboration

with other 3GPP members to build trust through open sharing of ideas, intentions,

objectives, and aspirations."

Prakash Sangam, September 6, 2019 Article "<u>Apple Will Be Hard-Pressed to Build a Rock Star 5G Modem</u>"



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3GPP Overview

Why 3GPP?



"With so many players within the IoT space, from device makers to network providers and even traditional enterprises adopting technical solutions, **it has been difficult to establish a standard for connectivity**, creating a "wild west" of different standards that had held back interoperability of devices/sensors and the growth of the IoT overall.

But the advent of 5G, and the 3GPP standards that are part of the next generation of mobile wireless' development, might be a way to tame the IoT and unlock new value and innovation...

We stand at a critical juncture. As costs have come down, and the advent of **5G provides an opportunity for consistent standards** as well as reliable, secure and low-latency

connections, the wilds of the IoT can be tamed and great leaps in innovation unlocked. ''

Daniel Elizalde, September 24, 2019 Article: <u>The Wild West of Connections – how 5G standards could supercharge the IoT</u>



3GPP Overview

3GPP standards eco-system



- The 3GPP Organizational Partners (OP) are the seven Standards Developing Organizations (SDOs) - from China, Europe, India, Japan, Korea and the United States.
- Participation in 3GPP is made possible by companies and organizations becoming <u>Individual Members (IM)</u> of one of the OPs.
- Specific inputs, in the form of market requirements may also come in to the Project via any of the twenty <u>Market Representation Partners (MRP)</u> in 3GPP. These organizations have all signed up to the 3GPP Project scope and objectives.
- Lots of external cooperation with other standards bodies and a broad variety of other groups, by way of formal Liaisons.

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3GPP Membership

TSG RAN Radia Access Retwork	TSG CT Core Network & Terrelaak	TSG SA Sendoe & Systems Aspect
RANV WIGS Radio Layer 1 spec	CT W50 MM/CC/SM (Na)	SA WG1 Services
Radio Laper 2 spec Radio Laper 2 spec Radio Laper 3 RR spec	CT W53 Interviewing with external	SA WG2 Architecture
RAN WG3 Jub spec, for spec, la spec UTBAN GSM execution sector	CT 505.6 MAASCPHICADS	SA WG3 Security
(Kallo Di Interface) RAN WOL	protocols within the DN) CT 9956	SA WG4 Speech, audia, video, and multimedia Coders
Radio Performance Protocol aspects	Shurt Card Application Aspects	SA W05 Teleson Management
RAN WIGS Mubble Terminal Conformance Terting		SA WCC Mining Critical Andreation

3GPP Member Companies (2019 list)

450cnnect, TLAYERS, Academy of Broadcasting Science, AccelerComm, Accuris, Acer, Acorn, Adare, Adran, Adva Optical Networking, Aeroflex, Affirmed Networks, Airbus, Airwave, Alcatel-Lucent, Alibaba, Altan Redes, Altostar, Amdosc, Analog Devices, Andrew Wireless Systems, Anemone, Anritsu, Apple, Applied Communication Sciences, AGSACOM, ARCEP (FR), AREA, ArgoNET, Aselsan, Asia Pacific Telecom, Asiainfo, ASTRI (HK), ASTRID, Asustek, AT&T, AT4, Australian Government, Austrian Federal Ministry for Transport, Innovation and Technology, Autotalks, Avanti, Azimuth, BAE, BanklD Norge, BBC, B-Com, BDBOS (DE), Beijing Jiaotong University, Bell Mobility, BfV (DE), Bharti Airtel, JBittium, BKA (DE), BlackBerry, Bluetest, BMWI (DE), Bolloré, De Sottwana Communications Regulatory Authority, Bouygues, Broadcast Networks Europe, Broadcom, Brocade, BT, BTL, Bull, BUHPT (CN), Bureasu Veritas (TW), C Spire, CableLabs, Cadence, Cambium, Canon, Carnegie, Casa Systems, Catapult, China Academy of Telecommunication Research of MIIT, C-DOT (IN), Cellnex, Center for Internet Security (US), Centre tecnologic de Telecomunications Technology, China Academy of Telecommunication Technology, China Mobile, China Scuttern Power Grid, China Telecom, China Unicom, Chongqing University, CHTTL (TW), CIST (CN), CISCA (CN)

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Conversant, Cr		"ech Telecommun"		nting, Daimler, Dek		'gital, Culture, Media and Sport (UK),
Departmen [†]		'rom, DFH Sate'		nt des Usages №		つOCOMO, Dolby, DSPG Edinburgh,
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ETS-Lindg	n, European	n, Europea	cations Offic	Patent Or	.uropean Spa	utelsat, EVE Compliancy
Solution	abasoft, Facebu	on, rairspectrum, Fa	(USA), Federa	ss, FG Innc	rhome, FICOF	eccanica, Finnish Transport and
Commu	ency, FirstNet, F	rance Brevets, Fraun	rich-Alex-Un	dan University, Fuj	itsu, Futurewei, (nband, Georgia Tech Research
Corpora	ke & Devrient, G	igaset, Gilat, Globalst.	Data Netwo	،, Google, HangZhou	H3C, Hansung	arman, Harris, Harting, HCL, Head,
Hepta 7	He [,]	`¬terprise, Hisense, H.	shi P	,UK), HTC, Huawei, Hu	ighes, Huser	Hyundai, IBM, Idaho National
Labora		f Technology, Infine		stitut Mines-Telecom (F	R), Ins	cion Industry (TW), Institute
Vedecc		ertek, IPCom, Irdeto		`*altel, ITL (KR), Itochu, ITRI	(TW)	hio, Jetflow, JMA Wireless, John Deere,
Johns F	.y, Junip⊾	hrein, KDDI, K		rch Institute, Korea Te	sting	niversity, KPN, KT, Kymeta, Kyocera,
Legran	ວvo, Leonarc	, Linkteste	.sachsen,	`artin, Marben, Mat	rixx, Mavenu, .	diaTek, Meizu, Metaswitch,
Microe	crosoft, MINE	ETAD (ES	de l'Economi	trie et du Numeri	que (FR), Ministe	ur (FR), Ministère Economie
et Finar	isterio de Indu	inistry	Affairs (NL), Mi	nsport, Construc	tion and Regional ι	t (SK), Mitel, MITRE, Mitsubishi,
Mobi, N	Motorola, MTC	, Mult	ta, MVG, Nation		ational Cyber Secu	UK), National Defence Radio
Establish	lational Institu	ation a	ications Technol	tional Institute	'andards and Tec), National Instruments,
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NextNav,	Nokia, Nor	, Nordic S	r, Nordic Te ^r	s, Novam	chnologies	T DOCOMO, Nubia, Nufront, NXP,
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Operational		, Oracle, Oran⊾		.W Global, PCTL		، laboratory, Perspecta Labs,
Peter-Service, F.		.ommware, Polaran,		⊿rlands, Polisen, Poli≥.		Jourg, Potevio, Prisma, Proximus,
PT Portugal, Public	અ	noo 360, Qorvo, Qualcomm,	·	ys, Rakuten, Ranzure, RED 1	ec	.e, Reliance Jio, Republic Telecommunication
Agency (RS) RN-CL	(CA). Robert Bos	h Rogers Robde & Schwarz	Ruckus RunFL St	aankhva Lahs Sagemoom S	aguna SAICT (CN)	Samsung Sandvine Sanechins Sasken

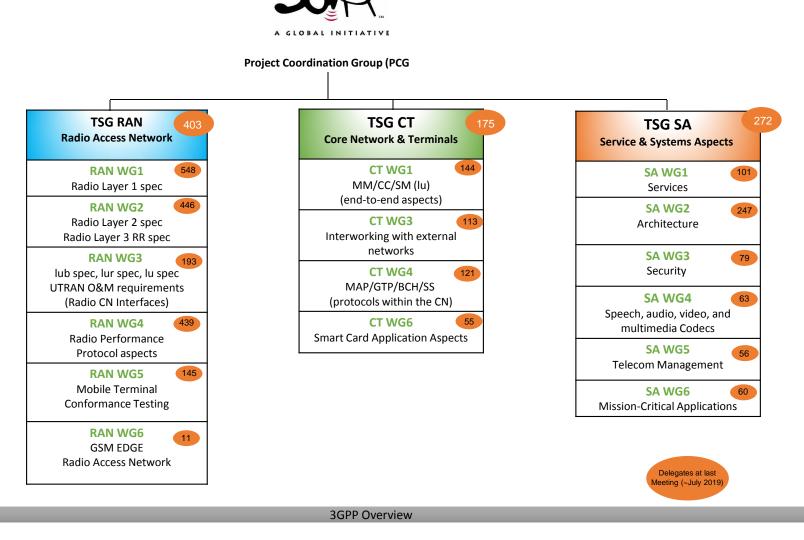
Agency (RS), RN-C1 (CA), Robert Bosch, Rogers, Rohde & Schwarz, Ruckus, RunEL, Saankhya Labs, Sagemcom, Saguna, SAICT (CN), Samsung, Sandvine, Sanechips, Sasken, Scerkerait de fehreira de la Défense et de la Sécurité Nationale (FR), Semtech Neuchate), Sennheiser, Senus, Sepura, Sequans, SES, SS Wireless, Shanghai Jiao Tong University, Sharp, Shenyang Institute of Automation (CN), Siemens, Sierra, Sigfox, Sigos, Sisvel, SK Telecom, Skyworks, Slovenian Institute for Standardisation, SoftBank, Softel, Softil, Sony, SouthernUNC, Southwest Jiaotong university, SP Technical Research, SpaceX, SpiderCloud, Spirent, Sporton, Spreadtrum, Sprint, SKG Research and Consulting, SRTC (CN), Starpoint, STMicroelectronics, Sumitomo Elece, Suomen vinverkko, Swedish Post and Telecom Authority, Swedish Security Service, Swiscom, Syniverse, Sysoco, Taipei University, Tait, Taiwan University, TCL Communication, TCT Mobile, TD Tech, TDF, Tech Mahindra, Technicolor, Telas, Tejet Com, Telecom Italia, Telefonica, Telekom, Telenor, Teleske, Telia, TeliaSonera, Teiti, Telekom, Telstra, Telus, Tenore, Teasa Instruments, Thales, Tianjin Samsung, T-Mobile, TNO, Tongil University, Toshiba, Toyata, Trafikverket, Tsofun, Turk telecom, Turkcell, TU V SUD British Approvals Board for telecom, LOS. Department of Commerce, U.S. Department of Transport, Uangel, Ubiwhere Lda (UW), u-blox, UL VS, Union Internationale des Chemins de Fer (UIC), Union Telephone Company, University of Electronic Science and Technology of China, University of Surrey – ICS, University of Tokyo, UPV/EHU (ES), US Cellular, Utimaco, Valeo, Valid Soluciones Tecnologicas, Vasona, Vencore Labs, Veolia, Verint, Verizon, Yiaw, Virtuosys, vivo, VMware, Voddone, VoiceAge, Volkswagen, Volvo, VT IDirect, VTT Technical Research Centre of Finland, WE Certification, Wilus, Xiaomi, Xidian University, Yiaw, Xiara, Yanas, Yonsei University, YG Tokenag, Wolkov, YT IDirect, UTT Technical Research Centre of Finland, WE Certification, Wilus, Xiaomi, Xidian University, Yaana, Yonsei Uni

Chairs of the technical groups:

TSG Core & Terminals	СТ		Lionel	Morand	Orange
	СТ	1	Peter	Leis	Nokia
	СТ	2	lan	Harris	
	СТ	3	Susana	Fernandez	Ericsson
	СТ	4	Peter	Schmitt	Huawei
	СТ	6	Heiko	Kruse	IDEMIA
TSG Radio Access					
Networks	RAN		Balazs	Bertenyi	Nokia
	RAN	1	Wanshi	Chen	Qualcomm
	RAN	2	Richard	Burbidge	Intel
	RAN	3	Gino	Masini	Ericsson
	RAN	4	Xutao	Zhou	Samsung
	RAN	5	Jacob	John	Motorola
	RAN	6	Juergen	Hofmann	Nokia
TSG - Services and System			0	B.4	
Aspects	SA		Georg	Mayer	HuaWei
	SA	1	Jose Luis	Almodovar Chico	TNO
	SA	2	Puneet	Jain	Intel
	SA	3	Noamen	Ben Henda	Ericsson
	SA	4	Frederic	Gabin	Ericsson
	SA	5	Thomas	Tovinger	Ericsson
	SA	6	Suresh	Chitturi	Samsung
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3GPP Overview

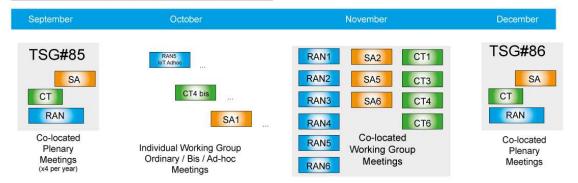


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Schedule driven by meetings

- New work initiated by member companies via Work Items as Tdocs at meetings
- Work Items prioritised and allocted time for discussions in meetings
- 3GPP member companies contribute on equal terms to any work item
- 3GPP seeks consensus on all technical matters (but has mechanisms if consensus cannot be reached)
- Release deadline respected, unfinished work deferred to a later release

3GPP's Meeting Cycle (Q4 example)

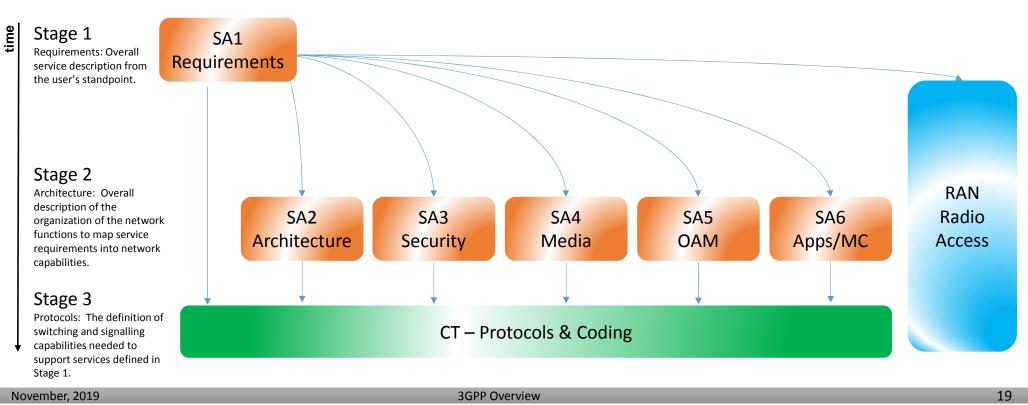


These examples are to demonstrate the principle and are not based an actual meeting dates.



Three stage approach





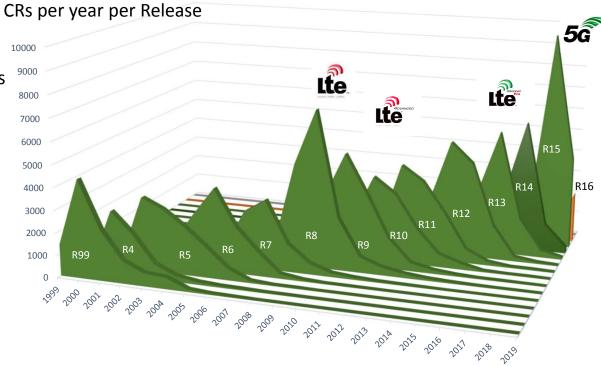
3GPP Work Plan

Release-based work

- Releases are major packages of Features (new Release ~ every 15 – 24 months)
- Strong commitment to time-lines guarantees reliable planning and time-to-market
- Work plan built using Work Items that deliver the Features
- Work Item Description exists for each of these
 - WI may cover more than one specification
 - WI may cover more than one TSG or WG
 - WI Description document exists for each WI
- Multiple releases maintained in parallel

SGPP WorkPlan:

<u>http://www.3gpp.org/Work-Plan</u>







3GPP Overview

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5G – brings new growth

Perfect storm of Multiple breakthrough technologies:

- Low latency radio with fully flexible network
- Artificial Intelligence and Automation
- Device revolution for AR/VR P
- Vertical industries going cellular

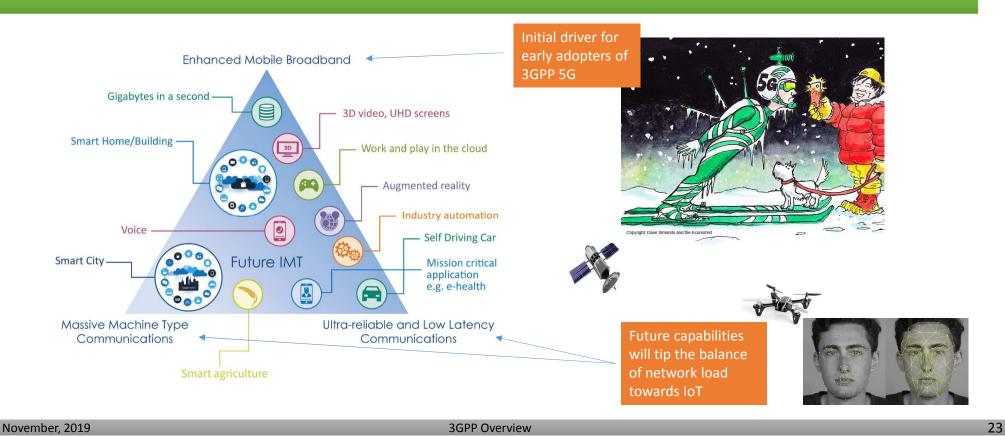


3GPP Overview



The IMT vision: towards IoT





Bringing the work in to the groups





· Enable new business

 Greater Efficiency (lower cost per bit for capital investment, operations & energy)

· Flexibility (not one-size fits all system)

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Use Case

- 🛓 Higher User Mobility
- Highly variable data rates
- Diverse Deployments
- Improved Coverage

	Project Coordination Group (PCC	
TSG RAN Radio Access Network	TSG CT Core Network & Terminals	TSG SA Service & Systems Aspects
RAN WG1 Radio Layer 1 spec	CT WG1 MM/CC/SN (lu) (end-to-end aspects)	SA WG1 Services
RAN WG2 Radio Layer 2 spec Radio Layer 3 RR spec	CT WGI Interworking with external	SA WG2 Architecture
RAN WG3 lub spec, lur spec, lu spec JTRAN Q&M requirements	networks CT WGI MAP/GTP/BCH/S5	SA WG3 Security
(Radio CN Interfaces)	(protocols within the CN)	SA WG4 Speech, audio, video, and
RAN WG4 Radio Performance Protocol aspects	CT WG6 Smart Card Application Aspects	multimedia Codecs SA WGS
RAN WG5 Mobile Terminal Conformance Testing		Telecom Management SA WG6 Mission-Critical Applications

200

3GPP Specifications and Reports:

De su das ser estes	
Requirements	21 series
Service aspects ("stage 1")	22 series
Technical realization ("stage 2")	23 series
Signalling protocols ("stage 3") - user	
equipment to network	24 series
Radio aspects	25 series
CODECs	26 series
Data	27 series
Signalling protocols ("stage 3") -(RSS-CN)	
and OAM&P and Charging (overflow from	
32 range)	28 series
Signalling protocols ("stage 3") - intra-fixed-	
network	29 series
Programme management	30 series
Subscriber Identity Module (SIM / USIM), IC	
Cards. Test specs.	31 series
OAM&P and Charging	32 series
Security aspects	33 series
UE and (U)SIM test specifications	34 series
Security algorithms	35 series
LTE (Evolved UTRA), LTE-Advanced, LTE-	
Advanced Pro radio technology	36 series
Multiple radio access technology aspects	
	37 series
Radio technology beyond LTE	38 series
	Service aspects ("stage 1") Technical realization ("stage 2") Signalling protocols ("stage 3") - user equipment to network Radio aspects CODECs Data Signalling protocols ("stage 3") - (RSS-CN) and OAM&P and Charging (overflow from 32 range) Signalling protocols ("stage 3") - intra-fixed- network Programme management Subscriber Identity Module (SIM / USIM), IC Cards. Test specs. OAM&P and Charging Security aspects UE and (U)SIM test specifications Security algorithms LTE (Evolved UTRA), LTE-Advanced, LTE- Advanced Pro radio technology Multiple radio access technology aspects

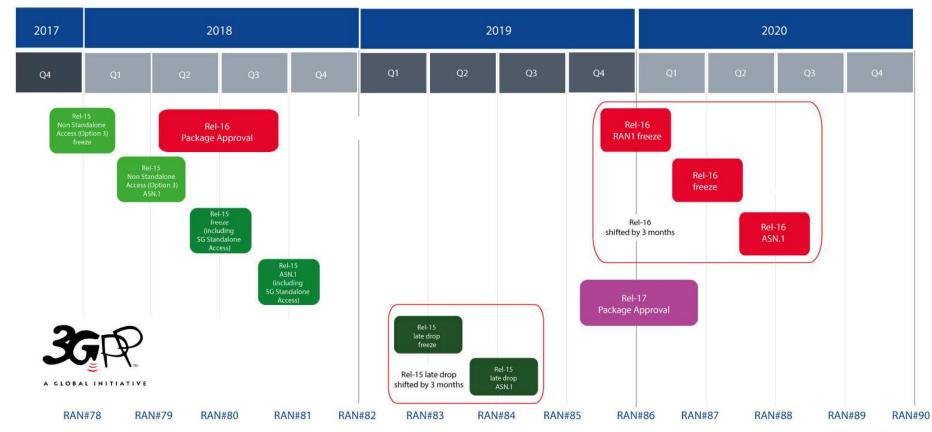
Where are we now on 5G?

- 3GPP continues to expand the LTE platform to improve its efficiency to meet the mobile broadband demand
- 3GPP is on schedule with the standardization of 5G, addressing the expanded connectivity needs of the future (eMBB, mMTC, IoT, URLLC, 'verticls')
- Phases for the normative 5G work
 - Phase 1 (Rel-15): Addresses the more urgent subset for commercial deployments
 - Phase 2 (Rel-16): Completes the IMT 2020 submission, addresses all identified use cases & requirements





The three 5G Releases...



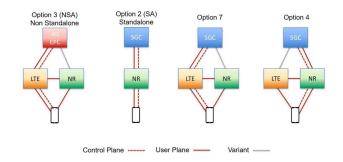
(C) 3GPP, December 2018.

Release 15 – NR to meet market needs



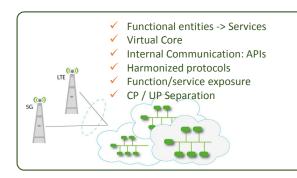
SGPP 5G NR

- Operation from low to very high bands: 0.4 –100Ghz
- Ultra wide bandwidth (Up to 100MHz in <6GHz, Up to 400MHz in >6GHz)
- Set of different numerologies for optimal operation in different frequency ranges
- Native forward compatibility mechanisms
- New channel coding
- Native support for Low Latency and Ultra Reliability
- Flexible and modular RAN architecture: split fronthaul, split control- and user-plane
- Native end-to-end support for Network Slicing



SG Services and Systems capabilities

- 5G Core Network
- 5G Security Architecture (SA3)
- 5G Media codecs (SA4)
- 5G Charging and Management (SA5)
- New 'Vertical' Applications (SA6)



$3G \mathbb{R}$ Release 15

- NR
- The 5G System Phase 1
- Massive MTC and Internet of Things (IoT)
- Vehicle-to-Everything Communications (V2x) Phase 2
- Mission Critical (MC) interworking with legacy systems
- WLAN and unlicensed spectrum use
- Slicing logical end-2-end networks
- API Exposure –
 3rd party access to 5G services
- Service Based Architecture (SBA)
- Further LTE improvements
- Mobile Communication System for Railways (FRMCS)

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3GPP Overview

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	ngent Coundination Group (PCG	
TSG RAN Radio Access Network	TSG CT Gree Heliwark & Terminals	TSG SA Sendoe & Systems Aspect
RAN WG1 Radio Laper 1 spec	CT MISS MM/COSM (but Intelligenced asserbl)	SA WOI Services
Radio Laper 2 spec Radio Laper 2 spec Radio Laper 3 RR spec	CT W53 Interviewing with external	SA WG2 Architecture
RAN WG3 Jub spec, for spec, la spec UTBAN GSM execution sector	CT 505.6 MAASCPHICADS	SA WG3 Security
(Kallo Di Interface)	protocols within the CND CT WISE	SA WG4 Speech, audia, video, and multimedia Coders
Radio Performance Protocol aspects	Smart Card Application Aspects	SA W05 Teleson Management
RAIN WIGS Mubble Terminal Cenformance Teeting		SA WCE Mission Critical Applicatio

200

Release 16 – 5G use cases

RADIO - 5G NR features:

- **5G Expansion**: Vehicle to everything (V2X), Industrial IoT, Ultra reliable low latancy enhancements, 5G NR Unlicensed spectrum operation
- 5G Efficiencies: Interference Mitigation, SON & Big Data, MIMO enhancements, Location and positioning, Power Consumption, Dual Connectivity, Device capabilities exchange, Mobility enhancements

Services and Systems capabilities in Rel-16:

URLLC support in the 5G Core network, Service requirements for cyber-physical control applications in vertical domains, 5GS Enhanced support of Vertical and LAN Services, LAN support in 5G, Cellular IoT support and evolution for the 5G System, 5G message service, Improvement of V2X service Handling, Application layer support for V2X services, Architecture enhancements for 3GPP support of advanced V2X services, 5G positioning services, Enhancement to the 5GC LoCation Services, Optimisations on UE radio capability signalling, Integration of Satellite Access in 5G, Enablers for Network Automation for 5G, Enhanced Mission Critical Push-to-talk architecture phase 2, Enhancements to Functional architecture and information flows for Mission Critical Data, MBMS APIs for Mission Critical Services, Enhanced Mission Critical System Migration and Interconnection, Mission Critical Services Security Enhancements, Maritime Communication Services over 3GPP System, Enhancement of LTE for Efficient delivery of Streaming Service, Enhancements to Framework for Live Uplink Streaming, Coverage and Handoff Enhancements for Multimedia, Media streaming architecture, Media Handling Extensions for 5G Conversational Services, EVS Floating-point Conformance for Non Bit-Exact, Addition of HLG HDR to TV Video Profiles, User Identities and Authentication, Multi-device and multi-identity, Business Role Models for Network Slicing, Enhancement of performance assurance for 5G networks including network slicing, Enhancements to the Service-Based 5G System Architecture, SBA aspects of enhanced IMS to 5GC integration, Media Handling Aspects of RAN Delay Budget Reporting in MTSI, User data interworking, Coexistence and Migration, Volume Based Charging Aspects for VoLTE, Enhancements to IMS for new real time communication services, Energy efficiency of 5G, New Services and Markets Technology Enablers – Phase 2, 5G Voice Service Continuity, Security Assurance Specification for 5G, 5GS Transfer of Policies for Background Data Transfer, Service Interactivity, Alternative EVS implementation using updated fixed-point basic operators, Usage of CAPIF for xMB API, Policy delivery to UE for background data transfer, QoS Monitoring, Inter-RAT Mobility requirements for real time service, Management of QoE measurement collection, Network policy management for mobile networks based on NFV scenarios, Intent driven management service for mobile network, OAM aspects of LTE and WLAN integration, Methodology for 5G management specifications, Nchf Online and Offline charging services, Charging Enhancement of 5GC interworking with EPC, NRM enhancements, Network Exposure Charging in 5G System Architecture, Charging AMF in 5G System Architecture Phase 1, Discovery of management services in 5G, Lawful Interception Rel-16, Reliable Data Service Serialization Indication, S6b Optional for ePDG connected to 5GS, Self-Organizing Networks (SON) for 5G networks, Integration of ONAP and 3GPP 5G management framework.

3GR Release 16

- The 5G System Phase 2
- V2x Phase 3: Platooning, extended sensors, automated driving, remote driving
- Industrial IoT
- Ultra-Reliable and Low Latency Communication (URLLC) enhancements
- NR-based access to unlicensed spectrum
- 5G Efficiency: Interference Mitigation, SON, eMIMO, Location and positioning, Power Consumption, eDual Connectivity, Device capabilities exchange, Mobility enhancements
- Enhancements for Common API Framework for 3GPP Northbound APIs (eCAPIF)
- FRMCS Phase 2

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Release 17 – IoT driven

SG support for verticals

- Vehicle Communication, Mission Critical Communications, Industrial IoT, Audio Visual Production...
- Enhancements for the system coming:
 - 5G LAN, High Precision Positioning, Cellular IoT for 5G, URLLC capabilities, Fixed and Satellite as 3GPP accesses, ONAP interworking, QoS Monitoring, Network Automation, protocol and core network improvements...
- 5G will span several releases, look out for the Rel-17 work plan soon

3 Release 17 Content Approval

TSG SA Work Areas under discussion at SA#85 (September 2019):

- 5G System Enhancement for Advanced Interactive Services (5G, A(S))
- Cellular IoT enhancement for the 5G System (SG_MCIoT)
 System enhancement for Proximity based Services in
- 5GS (5G_ProSe)
 Enhancement of support for 5G LAN-type service
- (SGLAN_enh)
 Integration of Satellite in 5G Systems (SGSAT_ARCH)
- Architectural enhancements for 5G multicast-broadcast services (5MBS)
- Study on enhancement of support for 5G Wireless and Wireline Convergence (5WWC_enh)
- Application Awareness Interworking between LTE and NR (AAL_LTE_NR)
- Extended Access Traffic Steering, Switch and Splitting support in the 5G system architecture (eATSSS)
- support in the 5G system architecture (eATSSS)
 5G Enhancement for unmanned aerial vehicles UAVs (EAV)
- SG Enhancement for unmanned deridi venicles UAVs (CA Enhanced IMS to 5GC Integration (eIMS5G)
- Enhancement to the 5GC LoCation Services-Phase 2
- (eLCS_ph2)
- Enablers for Network Automation for 5G phase 2 (eNA_Ph2)
- Enhancement of support for Edge Computing in 5GC (enh_EC)
- Enhanced support of Non-Public Networks (eNPN)
 Enhancement of Network Slicing Phase 2 (eNS Ph2)
- Enhancement of Network Slicing Phase 2 (eNS
 Enhancement of 5G UE Policy (eUEPO)
- Architecture enhancements for 3GPP support of advanced V2X services - Phase 2 (eV2XARC_Ph2)
- Supporting Flexible Local Area Data Network (FLADN)
- Supporting Unmanned Aerial Systems Connectivity, Identification and Tracking (ID-UAS)
- Enhanced support of Industrial IoT TSC/URLLC enhancements (IIOT)
- Support for Minimization of service Interruption (MINT)
 Multimedia Priority Service Phase 2 (MPS2)
- Multimedia Priority Service Phase 2 (MP Support for Multi-USIM Devices (MUSIM)
- Support for molification perices (MUSIM)
 System architecture for next generation real time communication
 sections (MC PTC)
- services (NG_RTC) Service-based support for SMS in 5GC (S8_SMS)
- service-based support for SMS in
 Smarter User Plane (SUP)
- UPF enhancement for control and Service Based Architecture (UPCAS)
- Usage of User Identifiers in the 5G System (UUI5)

TSG RAN Work Areas under discussion For final decision at RAN#86 (December 2019):

NR Light

- Small data transfer optimization
- Sidelink enhancements
 NR above 52.6 GHz (inlc 60GHz
- unlicensed)Multi SIM operation
- NR multicast broadcast
- Coverage enhancements
- NB-loT and eMTC enhancements
- Industrial IoT & URLLC enhancements
- MIMO enhancements
- NR for Non Terrestrial Networks
- Integrated Access and Backhaul
- enhancements
- Generic enhancements to NR-U
- Power saving enhancements
- RAN data collection enhancements
- Positioning enhancements

Mainstream ReI-17 specification work will start at the beginning of 2020, with the functional freeze of physical layer aspects scheduled for the second quarter of 2021.

The ASN.1 freeze should follow in September 2021.

There are a large number of work areas to be discussed. Realistically, we will only be able to take on board a sub-set of them within ReI-17.



Joint TSG SA and TSG RAN items under consideration for Rel-17 inclusion (Joint 1/2)

TSG CT	
Core Network & Terminals	TSG SA Senice & Systems Arpe
CT WS1 MM/COSM (but	SA WG1 Servers
CT WG3 Interworking with external	SA WG2 Architecture
CT MOSA MAP/GOP/BCH/05	SA WG3 Security
protocols within the CND CT WIGE	SA WG4 Speech, audin, video, an multimedia Coderi
Smart Card Application Aspects	SA W65 Deleter Management
	SA WC6 Mission Critical Application
	MAVICCIW Ani Ized for and appenh) CT 9653 Interneting with celerand events CT 9654 Maxy/Grigitocytis (postacul with ref cPg)

- TSG#85 In September advanced the discussion on these features.
- The final decisions on what will be in Release 17 will be made in December, at TSG#86.
- 'Downscaling' of some features may be necessary to get the work done in the available Time Units.

Network Slicing:

- Enable UE awareness & access of RAN support of network slice
- Applied for both TDD and FDD.
- Intra-RAT handover service interruption
- POn-demand and dynamic deployment of diverse network slices
- Slice-specific idle and inactive UE access
- Asses Generic Slice Template impact on RAN & 5GS

Industrial IoT and URLLC:

Focus o

- NR Time Sensitive Communications (TSC)
- Enhanced diversity support / Multi-TRP / Multipanel / beam management
- QoS predictability

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- Unlicensed IIoT/URLLC and URLLC FR2 enhancements
- Feedback enhancements for IIoT
- Faster UE processing times
- Interference management for URLLC in mixed URLLC/eMBB network
- 5G Architecture optimization for machine control
- New IIoT channel model
- Alignment with XR for NR

NR coverage:

- Indoor scenario, Rural scenario, Extreme long distance coverage, urban & dense urban considered.
- Services VoIP, eMBB.
- Channels DL and UL to be taken into account, PUSCH enhanced (PDSCH/PDCCH/PRACH also studied).

NB-IoT and eMTC:

- Scheduling and latency
- Peak data rates
- Interference and load management
- Power consumption reduction
- Relaying (UE-based or NW-based)
- Mobility (intra-RAT, to/from NR, Reduced reading of neighbor cells)
- Improved multi-carrier operation
- Connection to NR/5GC

RAN data collection:

- leftovers of R16 RAN centric data collection and utilization SID/WID,
- data collection for new R16 features
- AI/Machine Learning

Joint TSG SA and TSG RAN items under consideration for Rel-17 inclusion (Joint 2/2)

10	Project Coordination Group (PCG	
TSG BAN	TRACT	_
TSG KAN Radia Access Detwork	TS/S CT Core Helwork & Terminals	TSG SA Senice & Systems Aspec
RAN WS1 Radio Laper 1 spec	CT WGS MM/CC/SM Out Tend for and exercise	SA WG1 Services
RAIN 18/52 Radio Layer 2 spec Radio Layer 3 RR spec	CT WG3 Interventing with external	SA WO2 Architecture
RAN WG3 Jub spec, fur spec, fu spec stream GEM sector sector	CT 9054 MANAGEMIRA (0)	SA WG3 Security
(Kado Ot Interfaced)	lonotocits within the CND	SA WG4
Role Technology	CT W56 Short Card Application Appendia	Sprech, audio, video, an multimedia Codecs
Protocol aspects		5A W05 Telesam Management
Mubble Terminal Conformance Teeting		SA WC6 Mission Critical Applicatio
RAN WISS GSW EDGE Radio Journo Nictionali		

Localized User Plane

(LUP): Rel-17 should support RAN architecture enhancements to support Localized User Plane for Public Network Integrated NPN (PNI-NPN)

5G Audio-Visual (AV) Production:

- Multicast
- Easy deployment of SNPN
- Reliable wireless ba ckhaul
- Synchronization
 - Industrial IoT positioning aspects
 "RAT-independent" positioning aspects

• Power, Capacity, Mobility

NR Multicast Broadcast:

Video and Radio distribution, Xreality.

• Limit work to Standalone NR and 5GCore?

Start with Single-Cell Point-To-Multipoint (SC-

single-frequency network (SFN) and study

• FR1 first, FR2 also, but with lower priority

eXtended Reality (XR):

• Use Cases / Deployment Scenarios

General NR Positioning Enhancements

Switching between unicast/multicast should

PTM) and small number of cells operated in a

communications, IoT - Software updates, TV

• Use cases include: V2X. critical

scalability

be supported

Positioning:

V2X positioning

• **NR-U** positioning

Small data:

- Support small data transmission for UL (MO) use case
- Continue discussion on the DL aspects
- Support small data transmissions from RRC_INACTIVE state
- Discussion on IDLE state aspects ongoing
- Applicable to licensed carriers no specific enh. for NR-U

Non-Terrestrial Networks:

- HAPS, LEO, GEO based access scenarios
- cell size for LEO and GEO based access
- transparent or regenerative payload options
- earth fixed or mobile beams
- UE with location determination capability (e.g. GNSS)
- targeted usage scenarios
- UE type (3GPP class 3 or other)
- NB-IoT and LTE-MTC

Sidelink:

- Relay aspects, architecture aspects, related radio interface aspects
- Common functions across the key use cases
- Commonality between commercial, V2X, and Critical

Communication

Power Saving:

- Enh. NR UE Power Saving Features
- Enh. emerging NR use cases
- Study network power saving to improve overall NR energy efficiency

UAV:

- enhancements for reliable UAV remote controlling
- UAV-to-UAV communication
- enhancements on UL throughput
- beam management enhancements

Multi-SIM:

Multi-SIM considers both inter-MNO and intra-MNO cases. the enablers for Dual-USIM should be applicable to more than two USIMs.

Discussions now move to UE types, RAT concurrencies, Use cases and the further Scoping of study objectives.

Integrated Access Backhaul:

- Duplex enhancements
- Potentials for network coding
- Mobile IAB

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TSG RAN Rel-17...content progress

	hejest Coordination Group (PCG	
TSG RAN Radio Assess Network	TSG CT Core Herburk & Terminale	TSG SA Senice & Systems Arge
PMN WG1 Radio Laper 1 spec	CT WS3 MM/CCSM (buil Intellige and exercise)	SA WG1 Servers
Radio Layer 3 spec Radio Layer 3 spec	CT WG3 Interventing with external	Sh WG2 Architecture
RAN WG3 lub spec, for spec, for spec to the spect of the spec	returnis CT 1954 MAA/CIP/IICH/08	SA WG3 Security
(Kado-Ditiviteriace)	protocols within the DN CT WS5	SA WG4 Speech, audin, video, an multimedia Coderi
Radio Performance Protocol aspects	Smart Card Application Aspects	SA W05 Distant Management
RAW WES Mable Terminal Conformance Teeting		SA WCE

Joint SA and RAN items (see previous slides):

[IIoT_URLLC_enh]

Addressing wider use cases [Non_Terrestrial_Networks]

Include NTN-specific positioning

[IAB_enh]

Includes duplexing enhancement Potentials for network coding Mobile IAB

[Unlicensed_enh]

[Powersaving_enh]

Enhancements for powersaving of smartphones Network power saving aspects as a separate subdiscussion

[RAN_datacollection_enh]

Includes SON and MDT, start based on Release 16 scope and status. Data collection to enable AI is part of this discussion

[Positioning_enh]

Factory/campus positioning, IoT, V2X positioning, 3D positioning, cm level accuracy, incl latency and reliability improvements. NR-U positioning aspects Idle and inactive

Multi-RAT Dual Connectivity (MR-DC):

Proposals under discussion: one step HO from NR SA to EN-DC, support lossless HO (even 0ms) between NR and LTE/EN-DC, support 0ms SN change in NSA deployment, support 0ms HO between EN-DC cells, efficient SN activation/deactivation for power saving and signaling latency reduction, potential leftovers from Rel-16 related Wis.

Dynamic Spectrum Sharing:

Improvements on DSS capabilities in Rel-15 and Rel-16 (discussion on-going).

5G Repeaters:

- Develop a core specification and a conformance specification for NR repeaters for FR1 and FR2.
- Add repeater to the NR EMC specification.

NR MIMO:

Discussions around Multibeam operation, Multi-TRP, UL MIMO transmission, Channel state information (CSI) related procedures, CSI FDD, High speed mobility, etc.

NR-U operation:

This work may depend on high frequencies discussion (60GHz band) and left-overs from Rel-

DL 1024QAM in FR1:

Limited to FR1, aimed at no or low mobility which includes FWA/CPE and IAB backhaul in FR1 for the applicable bands. The intention is to reuse RAN1 work (e.g. constellation) on LTE 1024QAM for NR 1024 QAM FR1.

NR above 52.6GHz:

- Early use cases: IAB/backhaul, Factory automation & IIoT, eMBB/Data Offloading, Broadband distribution network.
- Scope: Waveform, Feasibility of existing waveforms, Channelization, Physical channel & signals, MIMO & beam management, Evaluation methodology, Frame structure, Channel access, Tx Power & Antenna configuration.

NR-Light:

- Industrial Wireless Sensors, Video surveillance, Wearables
- UE complexity reduction or lower UE power class, UE power saving and battery lifetime enhancement, System aspects and Support high UE density.

flexible UL/DL resource utilization:

Looking at scenarios: Inter-operator, Inter-band, Inter TRP with same cell ID (Ideal backhaul), Inter gNB with different cell ID (Ideal backhaul).

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TSG SA Rel-17...content progress (SA 1/2)



Edge Computing in 5GC:

- Support for forwarding UE application traffic to the edge computing environment
- Investigate potential impacts on charging and policy control
- provide deployment guidelines for typical edge computing use cases including URLLC, V2X, AR/VR/XR, UAS, 5GSAT and CDN

5G Advanced Interactive Services:

Defining potential QoS requirements for:

- latency for uplink transmission from UE to UPF plus downlink transmission from UPF to UE.
- reliability for uplink sensor/pose data and downlink prerendered/rendered audio/visual data
- data rate in downlink direction related to SA1 agreed KPIs including FPS (frame-per-second) and resolution etc.

UPF enhancement for control and SBA

- Study further the modular design of User Plane (UP) handling.
- Mechanism to support efficient service communication involving the UPF.

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Non-Public Networks:

- Subscription / credentials owned by an entity separate from the Stand-alone Non-Public Network (SNPN).
- UE onboarding and provisioning for non-public networks.
- Service requirements for production of audio-visual.
- Customizations or optimizations of 5GS for NPN in different deployment scenarios.
- Additional exposure capabilities due to support for NPN.
- Support for SNPN and PLMN sharing the same NG-RAN.
- Support for voice/IMS emergency services for SNPN.

Extended Access Traffic Steering, Switch and Splitting support in the 5G system architecture

5G LAN-type service:

- Enhancement of 5G VN group management;
- Enhancement of 5G VN group communication.
- For UEs of a 5G VN group belong to the same HPLMN

Multimedia Priority Service (MPS2)

 MPS for Voice, MPS for Data Transport Service (DTS), MPS for Video

Network Automation:

System enhancements for NWDAF, building on Rel-15 and Rel-16 to allow 5GS to develop new scenarios for network data analytics and NWDAF Deployment Options

Proximity based Services:

5G System needs to be enhanced to support the proximity based services with one common architecture to take advantage of economy of scale, for both public safety and commercial related proximity services, where applicable.

Advanced V2X services - Phase 2:

Architecture enhancements for 3GPP support of advanced V2X services, such as automated driving

5GC LoCation Services-Phase 2:

To further enhance the 5GC LCS architecture and corresponding Network Functions and procedures to meet the full set of 5G use case requirements

Wireless and Wireline convergence:

rusted Non-3GPP access network

- Wireless Wireline convergent network needed
- Improve mobility restriction granularity from TA granularity to a finer granularity.
- Support of L2 Bridge 5G-RG scenario
- Support of MA PDU session for 5G-RG (post ATSSS_Ph2 study).
- Support of QoS for UE connected behind an RG via Untrusted and Trusted Non-3GPP access solution.

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TSG SA Rel-17...content progress (SA 2/2)

<i>≪</i> "In" & "In*"	items should be
broken down	into work tasks by
SA2 in Q4.	

Each work task should be in the form of a headline + an assigned Time Unit estimation.

SA2 will NOT do any downscoping of any items in Q4

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	"In" (worked on in Q4 by SA2)			
	Edge computing in 5GC	[enh_EC]		
	Non-Public Networks	[eNPN]		
	 5G multicast-broadcast services 	[5MBS]		
	 Network Automation for 5G - phase 2 	[eNA_Ph2]		
	 Proximity based Services in 5GS 	[5G_ProSe]		
	 Network Slicing Phase 2 	[eNS_Ph2]		
	 Industrial IoT - TSC/URLLC enhancements 	[IIOT]		
	 5G Advanced Interactive Services 	[5G_AIS]		
	 Support for Multi-USIM Devices 	[MUSIM]		
	 Integration of Satellite in 5G Systems 	[5GSAT_ARCH]		
	 Advanced V2X services - Phase 2 	[eV2XARC_Ph2]		
	 Unmanned Aerial Systems Connectivity, 			
	Identification, and Tracking	[ID-UAS]		
	"In*" (conditionally included and shall not be	worked on in Q4 by SA2)		
	Extended Access Traffic Steering, Switch and Splitting support			
	in the 5G system architecture	[eATSSS]		
	UPF enhancement for control and SBA	[UPCAS]		
	 5GC LoCation Services-Phase 2 	[eLCS_ph2]		
	5G LAN-type service	[5GLAN_enh]]	
	 5G Wireless and Wireline convergence 	[5WWC_enh]]	
	Multimedia Priority Service (MPS) Phase 2	[MPS2]		
3GPP O	verview			



Conclusions

- 3GPP is industry driven Standardization of interfaces enables an interoperable, multi-vendor approach to deployment
- NR remains high focus for RAN groups
- IMT-2020 '5G' process progressing 3GPP leading the way
- The 3GPP processes are necessarily complex, but we need to adapt to bring new sectors in to the work
- Release 17 focus will continue to expand towards new use cases and new sectors...with particular progress on IoT
- SG will be a multi-Release technology (beyond Release 17)

3GPP Overview



Thank you



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ETSI Takeaway...

ETSI <u>White Paper No. #32</u> Network Transformation; (Orchestration, Network and Service Management Framework) October 2019

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3GPP Overview

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...3GPP Takeaway

A full <u>Release Description</u> is produced by the Work Plan manager at the completion of the work. TR 21.914 covers Rel-14 and TR 21.915 is the Rel-15 description document.