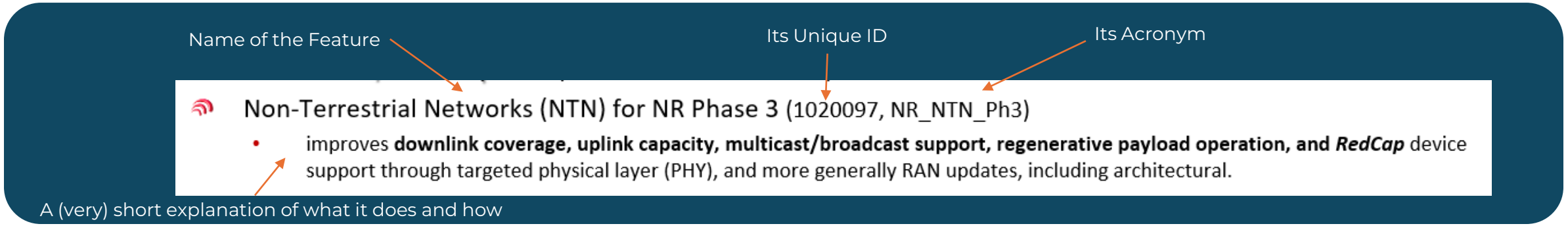
3GPP Rel-19 Summary

A presentation version of 3GPP TR 21.919

Source: All 3GPP Rapporteurs, MCC Work Plan Manager (Alain Sultan, MCC)

Introduction

- This slide set is a comprehensive overview of all the 3GPP Rel-19 Features, as summarised in TR 21.919.
  - It follows the same Feature ordering and structure as TR 21.919.
  - This ordering and grouping is not performed by 3GPP. It is provided by the 3GPP Work Plan Manager, to ease the presentation of 3GPP's results. It does not reflect any relative "importance" of the different Features.
  - For each slide/group, an explanatory introduction, produced by the 3GPP Work Plan Manager, provides some background.
- Rel-19 was finalised in Sept. 2025 (Stage 3/RAN) and March 2026 (RAN4 Performance)
- Most Rel-19 Features are improvements of features introduced in previous 3GPP Releases.
  - In the titles of following slides: "Rel-19" stands for "Rel-19 improvements of"
  - In the Features' names: for a given Feature, "Phase n" refers to nth iteration of the Feature, across successive Releases.
- Major Acronyms are expanded in the final slides
- Feature-reporting format used in the next slides:



3GPP Rel-19 topics – Highlight

All items below are “Rel-19 improvements of XXX”, except for Ambient power-enabled IoT (new).

- Satellite (5GSAT) Phase 3, NTN Phase 3, UAS, Aerial
  - Includes enhancements related to NTN IoT support, positioning, new NTN bands, NTN PWS, etc.
- IoT and RedCap UE
- Ambient power-enabled IoT (new)
- Artificial Intelligence (AI)/Machine Learning (ML)
  - Includes “Network for AI” and “AI for Network”.
- Energy Efficiency, Energy Saving
- Verticals and Non-Public Network (NPN)
- Communication services
- XR, AR, Metaverse, Edge Computing
- RAN improvements (for NR and/or LTE): topology (femtocell, sidelink,...), MIMO, new frequency bands, etc.
- CN improvements: slicing, SBA, QoS, Multi-Access, etc.
- Mission Critical, eCall, Emergency
- Etc.

Satellite (5GSAT) Ph3, NTN Ph3, UAS, Aerial (1/3)

3GPP satellite access (5GSAT) was introduced in Rel-17. Rel-19 is thus its “Phase 3”. It contains a series of rather independent improvements listed here. Satellite aspects are referred to as “NTN” in RAN.

Overall 5GSAT/NTN aspects (see also slide on IoT):

Non-Terrestrial Networks (NTN) for NR Phase 3 (1020097, NR_NTN_Ph3)

- improves downlink coverage, uplink capacity, multicast/broadcast support, regenerative payload operation, and RedCap device support through targeted physical layer (PHY), and more general RAN updates, including architectural aspects.

Satellite access Phase 3 (1020058, 5GSAT_Ph3)

- new capabilities to support IoT and broadband services via NTN, such as: Store-and-Forward communication for intermittent connectivity, direct UE-to-UE communication via satellite, GNSS-independent operation and enhanced positioning. System-wide aspects are specified: system architecture, application enablers, protocols, Security (1060065, 5GSAT_Ph3_SEC) and Charging (1070014, 5GSAT_Ph3-CH).

NTN for Internet of Things (IoT) Phase 3 (for LTE) (1020096, IoT_NTN_Ph3)

- introduces Store-and-Forward satellite operation with regenerative eNB payloads, uplink capacity enhancements, NB-IoT public warning broadcast support.

Introduction of IoT-NTN TDD mode (1050123, IoT_NTN_TDD)

- introduces TDD mode for NB-IoT NTN that enables half-duplex operation in satellite systems, extending NB-IoT NTN beyond legacy FDD operation to support additional NGSO Satellite deployments using Mobile-Satellite Service (MSS) spectrum.

Enhanced requirements and test methodology for NR NTN and IoT NTN (1030086, NR_IoT_NTN_req_test_enh)

- enables high-power UEs in FR1-NTN through new RF requirements and by supporting sub-5 MHz (down to 3 MHz) channel bandwidths via updates to system parameters, UE/SAN RF, RRM, and performance requirements .

Satellite (5GSAT) Ph3, NTN Ph3, UAS, Aerial (2/3)

Positioning-related items:

- On-demand broadcast of *GNSS* assistance data (1050078, TEI19_OBGAD)
  - enables on-demand broadcasting of *RTK GNSS* assistance data, with the *LMF* triggering specific posSIB broadcasts
- Introduction of BDS (BeiDou Navigation Satellite System) B2b Signal in A-GNSS for *LTE* and *NR* (1050121, LCS_BDS_B2b_LTE_NR)
  - introduces the B2b signal of BDS in A-GNSS in both E-UTRA and NR systems to increase the positioning accuracy.
- Introduction of *A-GNSS* support for NavIC (Navigation with Indian Constellation) L1 SPS (Standard Positioning Service) in *NR* & *LTE* (1050122, LCS_NAVIC_L1_SPS_NR_LTE)
  - extends A-GNSS positioning in NR and LTE by adding NavIC L1 band SPS assistance data within the existing framework, improving positioning speed, sensitivity, and UE power efficiency.

NTN band-related items (no summary):

Introduction of Ku bands for NR NTN; Introduction of additional operating NR bands for HAPS (High Altitude Platform Station); Introduction of another NR NTN S-band (MSS band 2000-2020 MHz UL and 2180-2200 MHz DL); New NR NTN bands to support Extended L-band and combined MSS L-band and Extended L-band ranges; Introduction of another IoT-NTN S-band (MSS band 2000-2020 MHz UL and 2180-2200 MHz DL); New LTE band for 5G broadcast for region 3 utilizing a geosynchronous satellite (1070064, LTE_band_5G_bcast_GSO) (defines a new standalone downlink-only LTE band for 5G Broadcast over geosynchronous satellites in ITU's Region 3, specifying corresponding UE and satellite access node RF requirements for 10 MHz PMCH operation based on E-UTRA NTN.)

Satellite (5GSAT) Ph3, NTN Ph3, UAS, Aerial (3/3)

Other 5GSAT/NTN/UAS/Aerial items:

- Support for Public Warning System (PWS) in Satellite E-UTRAN and Satellite NG-RAN (1070009, PWS_NTN)
  - also includes Earthquake and Tsunami Warning System (ETWS) geo-fencing and duplicate detection for shared MCCs.
- Enhancements for Air-To-Ground (ATG) network for *NR* (1030083, NR_ATG_enh)
  - enables higher throughput and more efficient use of fragmented spectrum by introducing downlink carrier aggregation and uplink/downlink *MIMO*, through comprehensive *UE*, base station, and performance (RF and *RRM*) requirements.
- Inter-RAT mode mobility support from E-UTRAN TN to NR *NTN* (1030076, LTE_TN_NR_NTN_mob)
  - enables idle-mode mobility from *LTE* TN to NR NTN by defining RAN2 signalling that allow E-UTRA cells to broadcast NR satellite assistance information and priorities, supporting cell reselection and redirection toward NR NTN.
- Uncrewed Aerial System Phase 3 (1020059, UAS_Ph3)
  - several enhancements to support Uncrewed Aerial Vehicle (UAV) and Urban Air Mobility operations, including pre-flight planning, in-flight monitoring, Command and Control (C2) reliability, multi-UAS Service Supplier coordination, network-assisted detect-and-avoid, no-transmit zones, altitude reporting, analytics updates, NEF and UDM enhancements; security mechanisms for USS changeover.
- Management Aspects of Rel-18's NTN Phase 2 (1060016, NTN_OAM_Ph2)
  - specifies management support for *IoT* and NR over NTN by addressing satellite-specific capabilities, mobility coordination, system management integration, and secure operation across all NTN cell types. Note the offset in Releases: the Feature "NTN Phase 2" is a Rel-18 feature but its management aspects are defined only in Rel-19 (meaning its management is proprietary/non-existent in Rel-18). Similarly, "NTN Phase 3" management is proprietary/non-existent in Rel-19 since no "NTN Phase 3" management solution defined in Rel-19.

Rel-19 IoT and RedCap UE

Support of Internet of Things (IoT) devices (sensors, meters,…) by 3GPP system refer to a series of independent system improvements, started in Rel-10, to improve the efficiency of supporting these devices with very specific traffic characteristics. RedCap (Reduced Capability NR) is a 5G radio/device profile to connect some types of IoT devices efficiently over 5G. A previous slide refers to IoT over satellite. This slide is for non-satellite IoT.

- NAS layer overhead reduction for data transfer using Control Plane Cellular IoT (1060018, NORDAT_CP)
  - introduces the EMM TRANSPORT NAS message, replacing the legacy CONTROL PLANE SERVICE REQUEST to reduce NAS overhead while preserving existing Stage 2 procedures and functionality
- Management Aspects of RedCap features (1060008, NR_RedCap_OAM)
  - extends the Network Resource Model and Performance Measurements to control RedCap UE access, support multi-initial BWP operation in coexistence scenarios, and enable RedCap-specific performance monitoring.
- See also in other slides:
  - NTN for IoT Phase 3 (for LTE) (1020096, IoT_NTN_Ph3)
  - Introduction of IoT-NTN TDD mode (1050123, IoT_NTN_TDD)
  - Enhanced requirements and test methodology for NR NTN and IoT NTN (1030086, NR_IoT_NTN_req_test_enh)
  - No summary for “NR power class 2 RedCap UE in FR1”

Ambient power-enabled IoT

Ambient IoT refers to IoT devices that rely on ambient energy harvesting and ultra-low-power communication, enabling massive, battery-free or near-battery-free deployments. The (efficient) support of Ambient IoT by 3GPP system is a new Feature in Rel-19

- Ambient power-enabled IoT (AIoT) [for SA and CT aspects] (1020055, AmbientIoT)
  - introduces in 5GS the support of extremely low-power IoT devices that operate on harvested ambient energy rather than conventional batteries. An AIoT device has very limited energy storage (or is battery-less) and may harvest power from sources such as radio waves, light, motion, or heat.
  - AIoT is targeted at isolated private network deployments (e.g., SNPN)
  - The feature provides a controlled way to identify AIoT devices, discover them in a given area, and exchange application data with them despite their intermittent, energy-constrained operation.

- Solutions for Ambient IoT in NR [for RAN aspects] (1060084, Ambient_IoT_Solutions)
  - This covers the RAN aspects. It enables ultra-low-power, backscatter-based passive devices with a simplified PHY/MAC interface for indoor inventory and command use cases integrated into the 5G system architecture.

Rel-19 Artificial Intelligence (AI)/Machine Learning (ML) (1/2)

There are two aspects of AI/ML in 3GPP. The first is to enable optimisations for transporting the AI-related data ("network for AI"), and the second is to use AI to maximise the efficiency of network operation ("AI for the network").
Related Rel-19 features are:

AI for network

- AI/ML for NR air interface (1020093, NR_AIML_air)
  - standardizes a normative framework for one-sided AI/ML models at the gNB or UE—covering beam management, positioning, and CSI prediction—along with a generic lifecycle-management framework and detailed use-case enhancements. Two-sided CSI compression and UE training-data collection is deferred to Rel-20.
- Enhancements for AI/ML for NG-RAN (1050124, NR_AIML_NGRAN_enh)
  - specifies new AI/ML-based use cases for network slicing and coverage/capacity optimization. Finalizes Rel-18 "leftovers" by defining data collection/prediction/coordination procedures across split architectures, NR-DC mobility, and continuous MDT for more intelligent, continuous, and end-to-end RAN optimization.
- Core Network Enhanced Support for AIML (1050047, AIML_CN)
  - enhances the 5G Core by integrating AI/ML capabilities to improve network automation, positioning, federated learning, QoS optimization, and abnormal behavior detection.

Rel-19 Artificial Intelligence (AI)/Machine Learning (ML) (2/2)

Network for AI

- AI/ML Model Transfer Phase 2 (1000030, AIML_MT_Ph2)
  - adds requirements to support operator-controlled UE participation in AI/ML task execution, including sidelink and network-assisted operation, service continuity under poor coverage, QoS assurance, UE selection, and charging.
- Application enablement for AI/ML services (1050044, AIML_App)
  - introduces AIML Enablement, a new SEAL service and ML repository that support ML model lifecycle management, federated learning and coordination between application entities to enable advanced AIML operations for vertical and edge applications.
- Protocol for AI Data Collection from UPF (1040005, PAIDC_UPF)
  - enhances UPF event exposure mechanisms to improve the efficiency and scalability of AI/ML data collection over SBIs by reducing unnecessary reporting, enabling report bundling, and supporting RAT-specific analytics.
- Other: “AI/ML Management Phase 2”; SA-led study on 3GPP-wide AI/ML consistency alignment “Study on 3GPP AI/ML Consistency Alignment” (1040084, FS_AIML_CAL)

Rel-19 Energy Efficiency, Energy Saving

Energy efficiency is a 6G design goal, not limited to the Features shown here. See TR 21.919 for multiple references to “energy”, highlighting its importance across the full set of Features.

- Enhancements of Network energy savings for NR (1020095, Netw_Energy_NR_enh)
  - introduces on-demand SSB and SIB1 transmissions and adaptive common signal/channel configurations (SSB, PRACH, paging), enabling reduced energy consumption while preserving network performance for idle/inactive/connected UEs.
- Low-power wake-up signal and receiver for NR (LP-WUS/WUR) (1020094, NR_LPWUS)
  - specifies procedures and RF/RRM requirements that enable UE power savings across IDLE/INACTIVE and CONNECTED modes through efficient paging, PDCCH monitoring, synchronization, and relaxed measurements.
- Energy Efficiency as Service Criteria (1020060, EnergyServ)
  - provides means (e.g., energy information collection, policy use, KPIs, exposure via APIs) to monitor and enforce services so they meet their intended service behavior while respecting defined energy constraints, without degrading performance.

Rel-19 Verticals and Non-Public Network (NPN)

"Verticals" refers to non-telecom industry sectors (automotive, railways, energy,…) whose communication requirements are considered by 3GPP. This is performed by a series of improvements over Releases (started in Rel-13).

- Rel-19 Enhancements of 3GPP Northbound and Application Layer Interfaces and APIs (1040009, NBI19)
  - continuous stage-3 enhancements of northbound interfaces and application-enabler APIs to improve efficiency, reliability, flexibility, and specification quality for securely exposing and monetizing 3GPP network capabilities to external applications.
- Service Enabler Architecture Layer Data Delivery Phase 2 (1050071, SEALDD_Ph2)
  - enhances Rel-18's data-delivery framework by adding Non-3GPP access support, improved configuration and reporting capabilities, client-initiated connections, congestion control using 5GC L4S exposure, and advanced uplink delivery control.
- Common API Framework (CAPIF) Phase 3 (1060040, CAPIF_Ph3)
  - adds finer-grained and collective authorization; expanded roaming and UE-centric access control, revocation and discovery capabilities; improved interconnection and security mechanisms; support for converged charging of northbound API usage.
- Security for PLMN hosting a NPN (Stage 1: 1000027, SecNPN; Stages 2 and 3: 1060067, PLMNNPN)
  - ensures the security of a PLMN hosting a Public Network Integrated NPN by reducing risks from customer-deployed dedicated network functions through proxy-based controls and enhanced security mechanisms.
- Interconnect of Standalone NPN (SNPN) (1030041, ISN)
  - enables scalable, secure connectivity between SNPNs and identity providers by supporting SNPN grouping and dynamic cellular hotspots for vertical services.
- ProSe support in NPN (1050080, TEI19_ProSe_NPN)
  - extends ProSe to NPN by adding identification, access control, relay selection, and protocol enhancements needed to support ProSe operation in SNPN environments while explicitly excluding roaming and inter-SNPN scenarios.
- See also "Application enablement for AI/ML services (1050044, AIML_App)"; "Enhanced OAM for management service exposure to external consumers through CAPIF" (no summary)

Rel-19 communication services (1)

These two slides group all improvements related to real-time and non-real time (mostly messaging) communications.

- Media Messaging Enhancements (1080048, MeME-MED)
  - updates TS 26.143 by aligning messaging service capabilities with Rel-19 Media Service Enabler concepts, adding APIs, call flows, and examples, and closing key RCS gaps through enhanced media format, codec, and profile support.
- Terminal Audio quality performance and Test methods for Immersive Audio Services, Phase 2 (1050113, ATIAS_Ph2)
  - refines and expands immersive-audio testing by enhancing UE configuration rules, introducing new methods for echo control, head-tracking evaluation, ambient sound-field transmission, and higher-resolution spatial capture, resulting in updated and industry-relevant specifications in TS 26.260 and TS 26.261.
- EVS Codec Extension for Immersive Voice and Audio Services, Phase 2 (1040021, IVAS_Codec_Ph2)
  - adds a fixed-point reference implementation to the IVAS codec, updates conformance testing, and provides characterization and interoperability between the floating-point (TS 26.258) and new fixed-point (TS 26.251) code.
- 5G Message Services (5GMSG) Service phase 3 (1060051, 5GMARCH_Ph3)
  - adds deferred delivery, group messaging, QoS-aware delivery, client APIs, and message topic subscription procedures

Rel-19 communication services (2)

- Video Operating Points - Harmonization and Stereo (1030002, MV-HEVC)
  - unifies SA4 video operation points into TS 26.265, introducing standardized HD, HDR, and stereoscopic formats (including MV-HEVC-based stereo), aligned with ITU-R and MPEG, and defines concrete AVC/HEVC operation points with a complete conformance framework of test vectors, reference tools, and validators.
- Advanced Media Delivery (1030006, AMD)
  - introduces architectural, protocol, and API enhancements across 5GMS and MBS to improve media reliability, efficiency, security, QoS, and multi-access delivery through features such as multi-source streaming, CMCD reporting, unicast repair, DRM workflows, network slicing support, and time synchronization.
- 5G Real-time Transport Protocol Configurations, Phase 2 (1060021, 5G_RTP_Ph2)
  - optimizes real-time XR media and metadata transport for 5G conversational services over WebRTC and IMS, including PDU importance handling, multiplexing, burst characterization, and UPF treatment guidelines.
- Next Generation Real time Communication services Phase 2 (1050066, NG_RTC_Ph2)
  - enhances IMS Data Channel-based communications by extending architecture, security, and charging to support standalone data channels, event exposure, third-party identities, and advanced services such as avatar communication.
- Application enablement aspects for MMTel (1070036, MMTel_App)
  - enables application-level support for the MMTel service using IMS Data Channel capabilities. It covers application management, controlled downloading, and extended MMTel usage scenarios for service providers and verticals.

Rel-19 XR, AR, Metaverse, Edge Computing (1/2)

Extended Reality (XR), Augmented Reality (AR) and Metaverse are very demanding services for the supporting network: extremely low latency, high volume of data, etc. One way to support them is “edge computing”, i.e. the placement of application and cloud computing capabilities at the network edge, close to the user.

- Localized Mobile Metaverse Services (1020056, Metaverses)
  - enhances 3GPP support for Metaverse services by providing XR-oriented performance and energy control, spatial anchors and mapping, precise localization, digital asset and avatar support, immersive multi-user communication, standardized security and charging mechanisms.
- Extended Reality and Media Phase 2 (1040032, XRM_Ph2)
  - introduces more adaptive PDU Set–based QoS, improved support for encrypted and multiplexed flows, dynamic traffic control, broader access support, and stronger security, resulting in more efficient and robust network performance.
- XR (eXtended Reality) for NR Phase 3 (1020098, NR_XR_Ph3)
  - improves handling of XR traffic in RAN while reducing device power consumption. It introduces capacity and QoS-oriented enhancements, such as cancellable measurement gaps, improved uplink and downlink rate adaptation, optimized RLC/PDCP handling, enriched network interfaces, and tighter 5GC coordination.
- Avatar Communications in Augmented Reality (AR) Calls (1070056, AvCall-MED)
  - extends IMS-based AR real-time communication by specifying avatar call functionality in TS 26.264, including 2D/3D avatars, data-channel–based animation, SDP negotiation, flexible rendering activation, and base avatar management via a Base Avatar Repository service.
- Split rendering over IMS (1030003, SR_IMS)
  - specifies the architecture, codecs, metadata, metrics, and end-to-end procedures for IMS-based split rendering, enabling network-supported XR services (including industrial, enterprise, educational, and entertainment use cases) with QoE monitoring across uplink and downlink.

Rel-19 XR, AR, Metaverse, Edge Computing (2/2)

- Edge Computing Considering the Operational Needs of Service Hosting Environment (1010022, EdgeOpNeeds)
  - introduces requirement for support of selection of user-plane paths based on SHE usage information (stage 2 covered by “eEDGE_5GC_Ph3”).
- Enhancement of support for Edge Computing in 5G Core network - Phase 3 (1040036, eEDGE_5GC_Ph3)
  - reduces control-plane deployment impact and enables latency-aware selection of local UPFs and edge application resources through lightweight local offloading and N6 delay–based mechanisms.
- Edge Computing for Industrial Scenarios (990050, EDGINDUS)
  - clarifies mobile robot privacy/security needs and adds a digital-twin quality inspection use case with local edge processing.
- Enabling Edge Applications Phase 3 (1040081, EDGEAPP_Ph3)
  - enhances the Edge Enabler Layer (EEL) to support improved discovery, selection, and service continuity of common and bundled Edge Application Servers (EAS), including federation, roaming, and ENS scenarios.
- See also “Management Data Analytics phase 3 (1060014, eMDAS_Ph3)” and “5G Advanced NRM features phase 3 (1020027, AdNRM_Ph3)”

Rel-19 High Power UEs (HPUE)

This specific class of UEs, with high transmission power, has been introduced since the very beginning of the system. Improvements are carried over from Release to Release.

All the Rel-19 related work items relate to frequency bands and are therefore not subject to summary.

These are:

- Rel-19 High power UE (power class 1.5 or 2) for NR intra-band CA or NR inter-band CA/DC band combinations with/without NR Supplementary Uplink (UL)
- Rel-19 high-power UE (power class 1.5 and 2) for NR FR1 TDD/FDD single band for handheld/FWA UEs, and high-power UE operation (power class 1) for FWVM use cases in a single NR band
- Introduction of Power Class 2 and UE 40MHz Channel Bandwidth in NR band n28
- Rel-19 High power UE (power class 1.5 or 2) for DC combinations of LTE band(s) and NR band(s) (for NR and LTE)
- Rel-19 High power UE (power class 2) and high-power operation (power class 1) for FWVM use cases in a single LTE band (for LTE only)

Rel-19 RAN topology

This slide groups specific RAN configurations, namely femtocell (a low-power indoor cell such as Home (e)NodeB) and Vehicle Mounted Relays (VMR), introduced in Rel-18 as a UE-based mobile relay that extends NR coverage to nearby users (e.g. inside a vehicle) by relaying their traffic over its own cellular connection to the network.

- 5G NR Femto (1060048, 5G_Femto)
  - enables plug-and-play deployment of small indoor NR access nodes with controlled user access, enhanced via NEF/UDM support for CAG information and flexible deployment options (including optional Femto GW and local UPF) to improve coverage, offload macro traffic, and support enterprise and private network scenarios.
- Additional topological enhancements for NR (1050125, NR_WAB_5GFemto)
  - defines end-to-end architectural and protocol support for Wireless Access Backhaul, enabling mobile WAB-gNBs to backhaul NG/Xn/OAM traffic and integrate seamlessly into the network, while also supporting 5G NR Femto deployment with optional Femto Gateway architecture and controlled access using existing CAG mechanisms.
- Vehicle Mounted Relays Phase 2 (1050100, VMR_Ph2)
  - extends the original VMR by standardizing a full Mobile gNB with wireless access backhaul (Mobile WAB) that uses a UE-based IP backhaul PDU session to the 5GC, enabling PLMN/SNPN support, OAM-managed configuration, authorization, enhanced location reporting (Additional ULI), and seamless operation over TN/NTN backhaul while remaining transparent to served UEs.

Rel-19 Sidelink, Proximity

Sidelink is a direct UE-to-UE communication interface that enables devices to exchange data without going through a base station. Proximity Services (ProSe) enable nearby UEs to discover each other and communicate directly, with or without network coverage. Both Sidelink and ProSe were introduced in Rel-12 and are being improved since then.

- NR sidelink multi-hop relay (1040114, NR_SL_relay_multihop)
  - Rel-17 and Rel-18's single hop Sidelink is enhanced by introducing up to two additional relay hops.
- UE-to-UE multi-hop relay (1000025, UEMHopRelay)
  - adds requirements for system to support off-network device-to-device communications using multiple relays to extend the coverage
- NR Sidelink: Intra-band CA in ITS band (1030084, NR_SL_intraB_CA_ITS)
  - defines UE RF and RRM requirements to enable sidelink intra-band contiguous and non-contiguous CA in ITS spectrum, including power class 2 and 3 enhancements to improve bandwidth, coverage, and capacity while complying with regional regulations.
- Charging Aspects of Ranging and Sidelink Positioning (1040013, Ranging_SL_CH)
  - specifies converged charging of Ranging and Sidelink Positioning, defining architecture and charging support for 5GC-assisted positioning and service exposure.
- Proximity-based Services in 5GS Phase 3 (1050115, 5G_ProSe_Ph3)
  - extends ProSe by enabling secure, QoS-aware multi-hop UE-to-Network and UE-to-UE relaying with defined discovery, security, and charging support.
- See also "ProSe support in NPN" in other slide and "Multi -path relay" (Stage 1 only, no summary)

NR and *LTE* Dual Connectivity (*DC*)

Dual Connectivity (DC) allows a UE to be simultaneously connected to two radio nodes (a master and a secondary), as to combine radio resources and improve throughput and robustness. It can be intra-RAT (LTE or NR) or inter-RAT (LTE and NR). First introduced in Rel-12 for LTE, improved since then. “DC” appear in many Features (search TR 21.919), main ones:

- UE RF enhancements for NR FR1/FR2 and EN-DC, Phase 4 (1030077, NR_ENDC_RF_Ph4)
  - Introduces high-power and spatially aware capabilities across FR1/FR2, CA and EN-DC, refining MPR, PSD, MSD and SAR handling, enabling higher-Tx and 6Rx operation, and improving realism, alignment, and feasibility of demodulation and MIMO performance requirements.
- Support of intra-band non-collocated EN-DC/NR-CA deployment Phase2: new receiver type(s) (1030082, NonCol_intraB_ENDC_NR_CA_Ph2)
  - enhances the support of Type 4 FWA UEs (using separate receive chains) by defining the RF and RRM requirements (RAN4) together with signalling (RAN2) to support intra-band non-collocated EN-DC and NR-CA operation.
- Data collection for SON (Self-Organising Networks)/MDT (Minimization of Drive Tests) in NR standalone and MR-DC (Multi-Radio DC) Phase 4 (1020092, NR_ENDC_SON_MDT_Ph4)
  - Improves mobility robustness optimization across intra-CU LTM, CHO, CPAC, and MR-DC scenarios, while extending MDT support for NTN mobility, network slicing, SDT optimization, and dual-connectivity operation.
- Band-related work items (no summary):
  - Rel-19 downlink interruption for NR and EN-DC band combinations at dynamic Tx Switching in Uplink
  - Rel-19 DC of x LTE band(s), y NR band(s) (1<=x<6, 1<=y<6, x+y<=6) and single or two NR Supplementary Uplink (SUL) bands
  - Simultaneous Rx/Tx band combinations for NR CA/DC, NR SUL and LTE/NR DC in Rel-19
  - UE Conformance - Rel-19 NR CA and DC; and NR and LTE DC Configurations
  - Adding channel bandwidth(s) support to existing NR bands and CA/ENDC combinations in Rel-19

Rel-19 *NR* Radio (1)

These slides group several, rather independent, NR (5G Radio) improvements.

- NR mobility enhancements Phase 4 (1020091, NR_Mob_Ph4)
  - extends Rel-18 NR mobility by enabling L1/L2-based inter-CU mobility, enhancing CSI-RS and beam-based measurements for LTM, introducing UE-triggered conditional LTM for intra-CU scenarios, and defining supporting RRM requirements across procedures and performance.
- Evolution of NR duplex operation: Sub-band full duplex (SBFD) (1020090, NR_duplex_evo)
  - improves uplink coverage, latency, and capacity by specifying non-overlapping SBFD operation in TDD NR. This enables simultaneous uplink and downlink on separate sub-bands through new sub-band configurations, UE transmission and measurement procedures, random access support, uplink muting, and enhanced gNB and UE cross-link interference measurement and coordination.
- NR Radio Resource Management (RRM) Phase 5 (1030079, NR_RRM_Ph5)
  - defines new RRM requirements to reduce FR2-1 Layer-3 measurement and activation delays by introducing fast Rx beam sweeping, enhanced carrier-specific measurement without gaps in CA/DC scenarios, and fast SCell activation based on Rel-18 early measurement reporting (EMR).
- Multi-carrier enhancements for NR Phase 3 (1050120, NR_MC_enh2)
  - enhances NR multi-carrier operation by enabling a single DCI to schedule multiple cells with the same or different subcarrier spacings and carrier types, and to support one or multiple PDSCH/PUSCH transmissions per scheduled cell, improving efficiency, power savings, and control signaling overhead.
- NR demodulation performance Phase 5 (no summary)

Rel-19 *NR* Radio (2)

- NR MIMO Phase 5 (1020089, NR_MIMO_Ph5)
  - reduces signaling overhead and latency while improving efficiency and coverage by introducing UE-initiated beam management, extending CSI and CJT support up to 128 ports, enabling 3-transmit-antenna uplink operation, and supporting asymmetric multi-TRP downlink/uplink deployments (“TRP” meaning here “Transmission Reception Points”, as introduced in CJT definition).
- FR1 TRP, TRS and MIMO OTA testing enhancement Phase 3 (1030085, TRP_TRS_MIMO_OTA_Ph3)
  - defines enhanced OTA test methods for FR1 TRP/TRS (“TRP” meaning here “Total Radiated Power” as per TRP definition) and dynamic MIMO OTA, introducing improved Antenna Coupling (AC) and advanced multi-probe methodologies with dynamic channel models to enable realistic end-to-end radiated performance verification for XR, NTN, and multi-antenna UEs.
- Low band CA via switching (1060082, NR_LBCA_Sw)
  - enables low-band CA through a switching-based approach by defining physical-layer procedures, RRM requirements, and UE capabilities that allow efficient use of low-band FDD and SDL spectrum under practical deployment and device constraints.
- NR channel BW less than 5MHz for FR1 Phase 2 (1030081, NR_FR1_lessthan_5MHz_BW_Ph2)
  - defines UE RF and RRM requirements to enable inter-band NR CA and DC involving 3 MHz carriers, improving capacity, coverage, and mobility performance.
- Other (no summary):
  - Rel-19 NR CA/DC for x bands DL with y bands UL (x<7, y<3) and SUL/CA band combinations with a single SUL or two SUL cells
  - mmWave in NR: UE spurious emissions and EESS (Earth Exploration Satellite Service) protection

Rel-19 *NR* Radio (3)

- NR base station (BS) RF requirement evolution for FR1/FR2 and testing (1030078, NR_BS_RF_req_evo)
  - advances NR base station RF requirements by defining Expected Equivalent Isotropic Radiated Power (EEIRP) limits for the upper 6 GHz band to protect satellite services and by assessing OTA testing enhancements and transmitter coexistence spurious emission requirements.
- Other band-related items
  - 7MHz Channel Bandwidth for n26 and n5
  - Introduction of the NR FDD 1.4 GHz band
  - Introduction of NR bands n87 and n88
  - Introduction of NR band n68
  - Additional NR bands for NR features in Rel-19
- See also… most of the other slides: “Rel-19 Energy Efficiency, Energy Saving”; “Rel-19 Satellite (5GSAT), NTN, UAS, Aerial”; “HPUE”; “IoT”; “Ambient IoT”; etc.

Rel-19 *LTE* Radio

This slide groups several, rather independent, LTE (4G Radio) improvements.

- LTE-based 5G Broadcast Phase 2 (1060081, LTE_terr_bcast_Ph2)
  - specifies time- and frequency-domain interleaving for MBMS-dedicated cells, reusing HARQ building blocks to improve robustness against mobility and SFN-induced frequency selectivity while maintaining throughput and minimizing additional memory requirements.
- Band-related items
  - New bands for LTE based 5G terrestrial broadcast for early deployments
  - Introduction of LTE FDD band in 1800–1830 MHz for Canada
- See also slide on HPUE

Rel-19 Mission Critical, eCall, Emergency (1/2)

“Mission Critical” (MC) refers to a set of services, introduced in Rel-13, to be used by public safety and critical communications (police, fire brigades, etc.). MC services offer high reliability, low latency, high availability, etc. “eCall” (“emergency calls”) was first introduced in Rel-8. It is an in-vehicle emergency call service that automatically (or manually) contacts emergency services in the event of a serious road accident.

- Enhanced Mission Critical Architecture (1000039, enhMC)
  - Improves location management, defines the Common Location Service as an independent service decoupled from MCPTT, and introduces HTTP/3-aligned mechanisms for efficient location information exchange.
- Enhanced Mission Critical Location Management (1040045, enhMCLoc)
  - Introduces a common HTTP-based location management protocol that centralizes location handling and improves scalable subscription management across MC services.
- Alignment of eCall over IMS with CEN (1050027, eCallCEN)
  - aligns 3GPP eCall over IMS UE requirements with CEN specifications to meet new EU regulatory mandates and improve service reliability, including enhanced MSD handling, test eCall support, and clarified PSAP interaction procedures
  - UE Conformance - Alignment of eCall over IMS with CEN (1050027, eCallCEN): 3GPP alignment of Release-16 eCall specifications with CEN by enhancing MSD transfer support, clarifying PSAP handling, and refining SIP response behavior to improve service reliability. This was needed yo meet new EU regulations mandating CEN-compliant eCall over IMS from 2026.
- Multiple Location Procedure for Emergency LCS Routing (1030017, TEI19_MLR4RTR)
  - enables multiple emergency call routing entities to receive progressively more accurate device location information within a single emergency session, without delaying call setup, to support efficient and compliant location-based routing

Rel-19 Mission Critical, eCall, Emergency (2/2)

- Multimedia Priority Service (MPS) for Messaging services (1040083, MPS4msg)
  - allows priority treatment of communications (voice, video, data and messaging) for authorized users, typically for emergency and Mission Critical use cases. It applies in LTE, 5G, and IMS-based services
- Mission Critical (MC) services for generic support on Isolated Operation for Public Safety (IOPS) mode of operation (1050036, Generic_IOPS)
  - updates IOPS into an access-agnostic Release-17 service, ensuring continuity of mission-critical communications by enabling limited MCPTT and MCData operation across LTE, 5G, non-3GPP, and future accesses when core connectivity is lost.
- Sharing of administrative configuration between interconnected MC service systems (1000036, MCShAC)
  - introduces optional functional entities and procedures to the Mission Critical (MC) Common Functional Architecture for the secure exchange of administrative configuration across interconnected MC service systems.
- Future Railway Mobile Communication System (FRMCS) Phase 5 (1000031, FRMCS_Ph5)
  - enhances ad hoc group communications and location-based services for railways
- Mission critical security enhancements for release 19 (1020035, MCXSec4)
  - enhances security architecture, procedures, and information flows to protect mission critical services including MCPTT (Push-To-Talk), Video, and Data—covering on-network/off-network use, roaming, interworking, IOPS, and multi-domain scenarios, while complementing existing mission-critical functional architectures for public-safety and commercial use.
- See also in other slides:
  - Support for PWS in Satellite E-UTRAN and Satellite NG-RAN; NTN for IoT Phase 3 (for LTE) (1020096, IoT_NTN_Ph3); slide on Sidelink/UE-to-UE

Rel-19 Network Slicing

This slide groups the Rel-19 improvements of Network slicing (introduced in Rel-15), which is the capability to create multiple logically isolated, end-to-end virtual networks ("network slices") on a shared physical infrastructure, each slice providing specific network capabilities and characteristics tailored to a given service or SLA.

- Network Controlled Network Slice Selection (1070041, TEI19_SliceSel)
  - allows an authorized application to replace one subscribed network slice with another for a user device, under operator control and with notification of the result.
- See also in other slides:
  - Advanced Media Delivery (1030006, AMD)
  - Data collection for SON (Self-Organising Networks)/MDT (Minimization of Drive Tests) in NR standalone and MR-DC (Multi-Radio DC) Phase 4 (1020092, NR_ENDC_SON_MDT_Ph4)
  - Enhancements for AI/ML for NG-RAN (1050124, NR_AIML_NGRAN_enh)

Rel-19 Service-Based Architecture (SBA)

SBA (Service-Based Architecture) was introduced in Rel-15 for 5G Core Network (CN) architecture: the network functions expose their services and consume services of other functions via standardized service-based interfaces (SBIs), enabling a modular (or "cloud-native") CN.

- UPF enhancement for Exposure And SBA, Phase 2 (1050097, UPEAS_Ph2)
  - adds new N4-capabilities and operator-configurable parameters, improving NAT and packet-inspection reporting, enables richer SMF/UPF event notifications, supports IP-based UPF discovery, and introduces an optional payload-header handling feature that extends end-to-end in-band signalling between applications and the UPF.
- Automatic Certificate Management Environment (ACME) for the SBA (1060066, ACME_SBA)
  - introduces ACME as an optional, automated certificate management protocol for securing the 5G Service-Based Architecture, complementing Rel-18's CMPv2 solution and enabling scalable, multi-vendor certificate lifecycle management.
- See also "UPF enhancement for Exposure And SBA, Phase 2 (1050097, UPEAS_Ph2)" as well as the work items related to protocol enhancements (no summary): Reducing Information Exposure over Service-Based Interface (SBI); Service Based Interface Protocol Improvements Release 19

Rel-19 QoS and Policy

This slide groups all Rel-19 improvements linked to Quality of Service (QoS) and its control (“policy”).

- Rel-19 Enhancements of UE Policy (1060025, UEP19)
  - Improves UE policy provisioning completeness, URSP rule handling and precedence, BDT support, failure and authorization reporting; clarifies and completes previously defined UE policy procedures.
- Rel-19 Enhancements of Session Management Policy (1070005, SMPC19)
  - improvements to SM Policy Control by completing missing requirements, correcting and clarifying procedures, and enhancing signaling efficiency, reliability, and flexibility across stage-2 and stage-3 specifications.
- Minimize the Number of Policy Associations (1030012, TEI19_MINPA)
  - UE and AM Policy Associations are established by the AMF only when relevant policies are required, based on new subscription indicators from the UDM and local configuration.
- Spending Limits for UE Policies in Roaming scenario (1050089, TEI19_SLUPiR)
  - The spending-limit–based policy control to UE policies (URSP) in extended to roaming scenarios, enabling charging-aware policy enforcement for UEs across both home and visited networks.
- Enhancing Parameter Provisioning with static UE IP address and UP security policy (1030015, TEI19_IP_SP_EXP)
  - enhancements to the NEF exposure interface allowing an AF to configure static UE IP addresses and to provision a common User Plane Security Policy for 5G VN groups, with corresponding updates to UDM services.
- Providing per-subscriber VLAN instructions from UDM and DN-AAA (1030022, TEI19_VLANSUB)
  - allows per-subscriber VLAN handling instructions for Ethernet PDU Sessions to be provided from UDM and/or DN-AAA to the SMF, which then instructs the UPF on VLAN tag insertion or removal, with DN-AAA information taking precedence if overlap.
- QoS monitoring enhancement (1050084, TEI19_QME)
  - defines a mechanism for configuring QoS monitoring in the 5GC and ensuring the SMF can determine whether the RAN supports it.

Rel19 multi-access

Multi-Access refers here mostly to Access Traffic Steering, Switching, and Splitting (ATSSS), which allows a UE and the network to distribute traffic across multiple accesses, 3GPP and non-3GPP. It was introduced in Rel-16 and so is now in its 4th phase.

- Upper layer traffic steering and switching over dual 3GPP access (1020031, DualSteer)
  - defines service requirements for DualSteer to enable operator-controlled traffic steering and switching of user data across two 3GPP access networks—potentially spanning different PLMNs, RATs, and terrestrial or satellite access.
- Multi-Access (ATSSS_Ph4) (1050056, MASSS)
  - extends the Rel-18's MPQUIC steering capabilities from UDP traffic to IP and Ethernet traffic, adds MPQUIC-IP and MPQUIC-E functionalities based on IETF CONNECT mechanisms, and updates UE capability negotiation to support scalable integration of these new steering options.
- ATSSS Rule Provisioning via 3GPP access connected to EPC (1080039, TEI19_ARP3E)
  - enables ATSSS rules to be delivered to the UE over 3GPP access anchored in EPC, completing ATSSS support for MA PDU Sessions in EPC–5GC interworking scenarios
- See also “Local traffic routing for multi-access UE” (Stage 1 only, no summary provided)

Other topics (1)

- Lower Selection-priority for PLMN Selection (1090031, LoSePLMN)
  - introduces an operator-controlled lower-priority category for PLMN selection to ensure UEs deprioritize networks with limited capacity or service capability, improving the efficiency and robustness of both automatic
- Deferred 5GC-MT-LR Procedure for Periodic Location Events based NRPPa Periodic Measurement Reports (1060043, TEI19_DLPMR)
  - Location Management Function (LMF) now supports deferred periodic location events by selecting either the Rel-16 UE-based method or the NRPPa-based RAN method. Only CN is impacted (LMF, GMLC, and AMF) since RAN already supports NRPPa periodic report from Rel-16.
- Subscription control for reference time distribution in EPS (1060045, TEI19_TIME_SUB_EPS)
  - extends “timing as a service” to WB-EUTRA by enabling subscription-based control of reference time distribution to individual UEs via EPS subscription, MME signaling, and unicast RRC delivery.
- Rel-19 IMS:
  - PS Data Off for IMS Data Channel Service (990049, IMSDCDataOff)
    - adds the IMS Data Channel as a PS Data Off Exempt Service, allowing operators to control its availability when users disable packet-switched data on the UE.
  - IMS Disaster Prevention and Restoration Enhancement (1080001, IMS_RES-CT)
    - Improves network resilience through control-function bypass, faster session restoration after core network failures, and more flexible registration timer management.
  - IMS Stage-3 IETF Protocol Alignment
  - See also in other slides: “Split rendering over IMS” and “Alignment of eCall over IMS with CEN”; NG_RTC_Ph2; MMTEL_App

Other topics (2)

- Identifying non-3GPP Devices Connecting behind a UE or 5G-RG (1050093, UIA_ARC)
  - enables UEs and 5G-RGs (Residential Gateways) to identify traffic from non-3GPP devices and apply differentiated QoS by signalling device identifiers in NAS-SM procedures, extending subscription data, and allowing the SMF and PCF to retrieve and enforce corresponding QoS parameters.
- Rel-19 Application Data Analytics Enablement Service (1070044, TEI19_ADAES)
  - clarifies analytics input/output metrics, improves IEs for data collection exchanges, and completes IE definitions for analytics storage subscriptions to the A-ADRF.
- Measurement Data Collection (980108, MeasureData)
  - proposes new QoS monitoring requirements (stage 1), without corresponding stage 2 and stage 3 work item.
- Enhanced application layer support for location services (1050053, eLSAPP)
  - adds geofencing, location history tracing, improved location quality, value-added and analytics-based location exposure, ranging/sidelink positioning, and optimized support for multiple UEs or USIMs sharing the same location.
- NF discovery and selection by target PLMN (1050076, TEI19_NFsel_by_tPLMN)
  - enables target-PLMN-controlled NF producer selection for roaming subscribers by allowing the target operator to apply its own policies via indirect 5GC communication based on criteria provided by the source PLMN.
- MSISDN verification operation support to Nnef_UEId Service (1070046, TEI19_MVOSNS)
  - enhances the Nnef_UEId service by adding MSISDN verification, allowing NEF to check whether an MSISDN provided by an authorized AF matches the UE's MSISDN stored in the UDM and return a true/false result.
- Rel-19 Enhancements of Network Automation Enablers (1050010, eNetAE19)
  - completes missing procedures, refine APIs, and improve ML model training, accuracy monitoring, analytics aggregation, and UE behaviour support.
- Enhancement of controlling RAT utilization (1040042, ECRATU)
  - Enhances national roaming by enabling efficient access-technology restrictions to avoid unsupported RATs and reduce signaling and service disruption.
- CT Aspects for IP Domain usage (1070006, IPD)
  - clarifies how IP domain identifiers are used to distinguish private and public IPv4 addressing, including their interpretation as network function identifiers or explicit IP addresses

Other topics (3)

Other topics (cont'd):

- Indirect Network Sharing (1030045, TEI19_NetShare)
  - enables multiple operators to efficiently share a single NG-RAN via a hosting operator's core, improving 5G resource utilization, coverage, user experience, and infrastructure efficiency without direct CN connectivity.
- Roaming Value-Added Services (1030046, TEI19_RVAS)
  - Defines "welcome SMS", "Steering of Roaming" during registration, and "subscription-based routing", with enhancements to event exposure and cross-PLMN CN selection.
- Roaming traffic offloading via session breakout in HPLMN (1030018, TEI19_HSBO)
  - enables local handling of home-routed roaming traffic at forward-deployed H-UPFs near the visited network, reducing latency and improving application performance based on operator policy.
- Monitoring of signalling traffic in 5G (1050114, MonSTra)
  - defines secure, low-impact mechanisms for exporting selected 5G Core signalling to external monitoring systems, enabling effective operator-controlled monitoring while preserving confidentiality, integrity, and overall system security.
- Data management regarding subscriptions and reporting (1050033, Data_SREP)
  - Adds Trace Reference uniqueness for multi-consumer use cases, and supports Trace Admin notifications for different scenarios
- PRU Usage Extension supported by Core Network (1070039, TEI19_PRUE)
  - As to enable network-assisted, UE-assisted, and UE-based positioning across different serving Location Management Functions (LMFs) by coordinating Positioning Reference Unit (PRU) and UE measurements, assistance data, and result exchange between the involved LMFs.
- And other items for which no summary was provided (protocol maintenance, test, etc):
  - Stage-3 5GS NAS protocol development 19
  - Stage-3 SAE Protocol Development
  - Interworking of Non-3GPP Digital Terrestrial Broadcast Networks with 5GS Multicast Broadcast Services
  - Minimization of Service Interruption During Core Network Failure Phase 2
  - Harmonization of test case definitions for cross-RAT usability

Rel-19 miscellaneous Security (1/2)

- Security Assurance Specification (SCAS) for maintenance of 5G features (1030029, SCAS_5G_Maint)
  - maintains and enhances NESAS/SCAS specifications and adds Rel-19 test cases based on GSMA feedback.
- 5G Security Assurance Specification (SCAS) for the Unified Data Repository (UDR) (1010010, SCAS_5G_UDR)
  - enables GSMA and BSI's NESAS certification and closes the SCAS coverage gap without impacting system behavior.
- Addition of 256-bit security Algorithms (1010012, 256_Algo)
  - defines in 3GPP Specs the new 256-bit security algorithms "SNOW 5G", "AES", and "ZUC".
- Roaming and interconnect authorization aspects in indirect communication (1080043, SBA_RoamInt-SEC)
  - defines security and authorization handling for roaming and interconnect scenarios with indirect communication in 5G, covering both source- and target-PLMN-controlled NF selection introduced in Release 19.
- Public key distribution and Issuer claim verification of the Access Token (1080046, SBA_KDATV-SEC)
  - introduces a mechanism for an NF Service Producer to fetch the right public key from the appropriate NRF to validate an access token presented to the NF Service Producer.

Rel-19 miscellaneous Security (2/2)

- 3GPP profiles for cryptographic algorithms and security protocols (1020042, CryptoSP)
  - updates cryptographic algorithms and the 3GPP security protocol profiles for security algorithms from other standards bodies (e.g., IETF).
- Mobility over non-3GPP access to avoid full primary authentication (1060054, Non3GPPMob_Sec)
  - enhances security and mobility over non-3GPP access (such as Wi-Fi) by enabling fast re-authentication and security context reuse during access changes, avoiding full primary authentication and improving handover efficiency and user experience.
- And other items for which no summary was provided (protocol maintenance, test, etc):
  - 5G Security Assurance Specification (SCAS) for the Short Message Service Function (SMSF)
  - Addition of Milenage-256 algorithm
  - LI Handling of Protected Services
  - Lawful Interception Rel-19
  - Lawful Interception Guidance Rel-19
  - Specification of example algorithm for alternative f5* (f5**) function

Rel-19 miscellaneous OAM & charging (1)

- Charging aspects for Multi-Operator Core Network (MOCN) Network Sharing (1070020, CH_MOCN_NetShare)
  - allows hosting operators to use performance-based measurements to charge participating operators.
- Service-Based Management Architecture enhancement phase 3 (1060006, SBMA_Ph3)
  - refines model-driven usage guidance, improves Management Service (MnS) registry, discovery and information retrieval capabilities, updates schemas and CRUD-based management guidance, introduces MnS versioning and common notification mechanisms, and adds improved filtering options for alarm conditions.
- Management Data Analytics phase 3 (1060014, eMDAS_Ph3)
  - new capabilities added, e.g.: end-to-end performance analytics including edge computing, data-correlation analytics, ATSSS traffic-steering analytics, UE-throughput congestion analytics, fault-management and failure-prediction analytics.
- Intent driven management services for mobile network phase 3 (1060013, IDMS_MN_Ph3)
  - adds new scenarios, expanded management capabilities, enhanced intent models, and updates interfaces in TS 28.312 to support more autonomous and scalable operation of 5G and 5G-Advanced mobile networks.
- Management aspects of Network Digital Twins (1060005, NDT)
  - defines concepts, use cases, requirements, and standardized management solutions for applying NDT within the 3GPP management system to enable proper network management.
- Management of Network Sharing Phase 3 (1060017, NetShare_OAM_Ph3)
  - enhances management support for “5G network sharing” by enabling secure, service-based management, performance monitoring, and controlled access to shared RAN and CN resources in both MOCN and INS scenarios.

Rel-19 miscellaneous OAM & charging (2)

- Management of planned configurations (1050032, PlanM)
  - allows network changes to be prepared, validated, scheduled, and activated separately from the active configuration.
- Closed Control Loop Management (1060010, CCM)
  - defines the management capabilities required to instantiate, compose, monitor, coordinate, and adapt CCLs to ensure they effectively meet their assigned requirements.
- Data management phase 2 (1020025, MADCOL_Ph2)
  - adds support for discovery and collection of historical and external management data, including standardized reporting, condition-based collection, etc
- 5G performance measurements and KPIs phase 4 (1020026, PM_KPI_5G_Ph4)
  - On top of phase 3: define new and enhanced NG-RAN and 5GC measurements, KPIs, UE-level analytics for AI/ML, and improved PM streaming to support advanced 5G features and performance assurance.
- 5G Advanced NRM features phase 3 (1020027, AdNRM_Ph3)
  - extends NRM to incorporate the following Rel-18 and 19 features: NTN, WAB-gNB, ProSe, ATSSS, network sharing, Ambient IoT, SON features, RedCap, IAB, and Edge computing.
- Management of IAB nodes (1060015, NR_mobile_IAB_OAM)
  - for Integrated Access Backhauling (IAB)-node connectivity to OAM system, and location-based IAB-node configuration.
- CHF Segmentation (1040012, CHFSeg)
  - enables segmented deployment of Charging Function (CHF) instances, allowing network functions to discover and select the appropriate CHF.
- No summary for: Subscriber and Equipment Trace and QoE collection management; Enhancement of Management Aspects Related of NWDAF Phase 2; Subscriber Data Migration

Acronyms

and short overviews of the associated concepts

Acronyms (1)

- **AI**: Artificial Intelligence / ML: Machine Learning
- **API**: Application Programming Interface. A set of standardized service interfaces (also called “Northbound APIs”) that expose the 3GPP network capabilities to external applications (operators, verticals, cloud services) in a secure and interoperable way, as to enable applications to consume the mobile network capabilities such location, QoS, or connectivity status.
- **BWP**: Multi-Initial Bandwidth Part. A configured portion of the NR carrier bandwidth used by a UE at a given time for uplink or downlink operation.
- **CA**: Carrier Aggregation. A radio feature that allows a UE to simultaneously transmit and/or receive data over multiple component carriers (CCs), which are combined to form a wider effective bandwidth and increase data throughput. The CCs can be contiguous or not, Intra-band or Inter-band.
- **CAG**: Closed Access Group. An access-control mechanism: in NPN, only UEs that belong to the configured CAG are permitted to select and connect to those cells.
- **CJT**: Coherent Joint Transmission. A downlink transmission technique (introduced in Rel-18) where multiple Transmission Reception Points (TRPs) transmit the same data stream to a UE with tight phase alignment, so that the signals combine coherently (constructively) at the receiver, instead of interfering with each other.
- **CMCD**: Common Media Client Data. A standardized way for media players to report real-time playback information—such as buffer level, bitrate, latency, and session identifiers—to networks and CDNs. It gives operators and content providers better visibility into how streams are performing so they can optimize delivery and improve user experience.
- **CSI**: Channel State Information. Information measured by the UE about the radio channel conditions and reported to the network (gNB) to enable efficient link adaptation and scheduling.
- **DC**: Dual Connectivity. A 3GPP feature that allows a UE to be simultaneously connected to two different radio nodes, called a Master Node (MN) and a Secondary Node (SN), in order to aggregate radio resources and improve performance. It can be inter-RAT (LTE–NR) or intra-RAT (LTE–LTE or NR–NR)

Acronyms (2)

- **DCI**: Downlink Control Information. Control information sent by the eNB/gNB to a UE on the PDCCH to tell the UE how, when, and where to transmit or receive data.
- **DL**: Downlink (Base Station to UE). See also Uplink (UE to Base station).
- **FDD** (Frequency Division Duplexing). A duplexing method where uplink and downlink transmissions occur simultaneously on two separate, paired frequency bands, enabling full-duplex communication between the UE and the network (simultaneous UL and DL using different frequencies). Used in LTE and in NR. See also TDD.
- **FR1**: NR Frequency Range 1 (410 MHz to 7.125 GHz, aka “sub-6 GHz”). Wider coverage as FR2.
- **FR2**: NR Frequency Range 2 (24.25 GHz to 52.6 GHz, aka “mmWave”). Higher high data rates but shorter range than FR1.
- **FWA**: Fixed-Wireless Access. A broadband access over LTE or NR for fixed locations. “Type 4 FWA” is the most stringent FWA variant, providing fully fixed, high-capacity, fiber-like broadband using cellular radio.
- **FWVM**: Fixed-Wireless/Vehicle-Mounted or Frequency-Weighted Vector Magnitude
- **GNSS**: Global Navigation Satellite System (or “A-GNSS” for Assisted-GNSS in the 3GPP context). The satellite-based positioning (GPS, Galileo, GLONASS, BeiDou, etc.) as integrated, assisted, and standardized within cellular systems (LTE and 5G).
- **IMS**: Internet-Protocol (IP) Multimedia Subsystem. The set of CN entities that provides multimedia services in 4G and 5G (such as voice, video, and messaging) over IP networks using the IETF’s Session-Initiation Protocol (SIP).
- **INS**: Indirect Network Sharing. It is a network-sharing architecture in which multiple operators share a common RAN, but the connectivity between the shared RAN and each participating operator’s CN is routed indirectly via the hosting operator’s CN, rather than through direct N2/N3 connections for each operator. See also MOCN.

Acronyms (3)

- **IoT**: Internet of Things. A family of cellular technologies standardized by 3GPP to connect massive numbers of low-cost, low-power devices over licensed mobile networks.
- **ITS**: Intelligent Transport Systems. Refers to 3GPP support for V2X (Vehicle-to-Everything). The “ITS spectrum” or “ITS band” is region-specific (around 5.9 GHz)
- **LMF**: Location Management Function. A 5G CN function that collects and manages positioning-related information.
- **LTE**: “Long Term Evolution” – the name of 3GPP’s 4G radio technology (introduced in Rel-8).
- **LTM**: L1/L2-Triggered Mobility. A 5G NR mobility enhancement (introduced in Rel-18) in which mobility decisions (cell switch / handover execution) are triggered using Layer-1 / Layer-2 measurements and procedures, rather than being driven solely by higher-layer (RRC) control, with the objective of reducing mobility latency and interruption time.
- **MIMO**: Multiple-Input Multiple-Output. The use of multiple transmit and receive antennas to increase data rate, reliability, and spectral efficiency through spatial multiplexing, diversity, and beamforming.
- **MOCN**: Multi-Operator Core Network. It is a network-sharing architecture in which multiple operators share the same RAN (radio equipment and radio resources) while each operator maintains its own independent core network. See also INS.
- **NAS**: Non-Access Stratum. The control-plane signaling between the UE and the CN (independent and carried transparently through the radio access network). Used for mobility, registration/attach, authentication, security and session management.
- **NR**: “New Radio” – the name of 3GPP’s 5G radio technology (introduced in Rel-15).
- **NTN**: Non-Terrestrial Networks (satellite, UAV, etc.)

Acronyms (4)

- **OTA**: Over-The-Air. Refers to radiated transmission, reception, and performance testing of UEs or base stations using antennas, without direct RF cable connections.
- **RedCap**: Reduced Capability. It refers to a specific NR device capability profile (also called NR-Light) with constrained bandwidth, antennas, and complexity, used by certain IoT-like use cases.
- **RF**: Radio Frequency. Refers to the radio transmission, reception, and performance requirements of UEs and base stations, including spectrum, bands, power, emissions, and receiver characteristics.
- **RRM**: Radio Resource Management. Refers to the functions and procedures that control and optimize the use of radio resources—such as power, spectrum, scheduling, mobility, and interference—to meet performance and QoS requirements.
- **RTK**: Real-Time Kinematic. A high-precision positioning technique that improves standard GNSS accuracy from meter level to centimeter level by using real-time correction data.
- **SAN**: Satellite Access Node. A 3GPP-defined node that provides radio access for Non-Terrestrial Networks (NTN), terminating user plane and control plane protocols towards satellite-capable UEs and connecting to the 5G Core via the NG interface.
- **SEAL**: Service Enabler Architecture Layer. A common , modular enabler layer that provides reusable service enablers on top of the 3GPP system, allowing vertical applications and services to interact with the network in a consistent way.
- **SIB1**: SystemInformationBlockType1. The broadcast system information block that tells a UE whether it is allowed to access a cell and provides the scheduling information for acquiring other system information blocks.
- **SSB**: Synchronization Signal Block. The downlink block that enables a UE to find and synchronize to a cell, consisting of the PSS, SSS, and PBCH transmitted together.

Acronyms (5)

- **TDD**: Time Division Duplexing. A duplexing method where uplink and downlink transmissions use the same frequency band, but are separated in time (UL and DL share one frequency and alternate in time). Used in LTE and in NR. See also FDD.
- **TN**: Terrestrial Networks. By opposition to NTN.
- **TRP**: Total Radiated Power. The total transmit power radiated by a device, obtained by integrating the radiated power over all directions and polarizations in free space.
- **TRS**: Total Radiated Sensitivity. A measure of a receiver's sensitivity averaged over all directions and polarizations, defined as the integrated minimum received power required to meet a specified performance criterion in free space.
- **UE**: User Equipment. In the general case, this is the mobile phone together with its SIM card.
- **UL**: Uplink (UE to Base Station). See also Downlink (Base station to UE).
- **URSP**: UE Route Selection Policy. A set of policy rules provisioned by the 5G CN to the UE that determines how application traffic is routed, i.e. which PDU Session, Data Network, and network slice (S-NSSAI) should be used for different types of traffic. The rules are defined by the Policy Control Function (PCF) and delivered to the UE via the AMF.
- **USS**: UAS Service Supplier. A service provider that supports UAV operations by offering functions such as flight planning, in-flight monitoring, regulatory compliance, and coordination with the mobile network and UTM (UAS Traffic Management) systems.
- **WAB**: Wireless Access Backhaul. WAB allows to use 5G NR radio links not only to connect user equipment (UEs) but also to provide wireless connectivity between radio network nodes, avoiding the need for wired (e.g. fiber) backhaul at every site.