3GPP Releases 17, 18 e 19

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Sumário

1. Introdução;
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Introdução

O que é o 3GPP?

- 3GPP é a abreviatura de The 3rd Generation Partnership Project (3GPP);
- Especificações para tecnologias móveis como o GSM – Rel. 99, UMTS – Rel. 4, LTE – Rel. 8 e 5G – Rel. 15;
- Fundado em dezembro de 1998 como uma colaboração entre várias organizações de padrões de telecomunicações, incluindo:
  - European Telecommunications Standards Institute (ETSI) - Europa;
  - Association of Radio Industries and Businesses (ARIB) - Japão;
  - Alliance for Telecommunications Industry Solutions (ATIS) - Estados Unidos;
  - Telecommunication Technology Committee (TTC) - Japão;
  - China Communications Standards Association (CCSA) - China;
  - Empresas de telecomunicações, fabricantes de equipamentos de rede e dispositivos móveis.

A GLOBAL INITIATIVE

Fonte: https://www.3gpp.org/

1. Interoperabilidade global;
2. Evolução tecnológica;
3. Consolidação de esforços.

Fonte: https://www.etsi.org/

Fonte: https://www.arib.or.jp/english/

Fonte: https://www.atis.org/

Fonte: https://www.ttc.or.jp/e

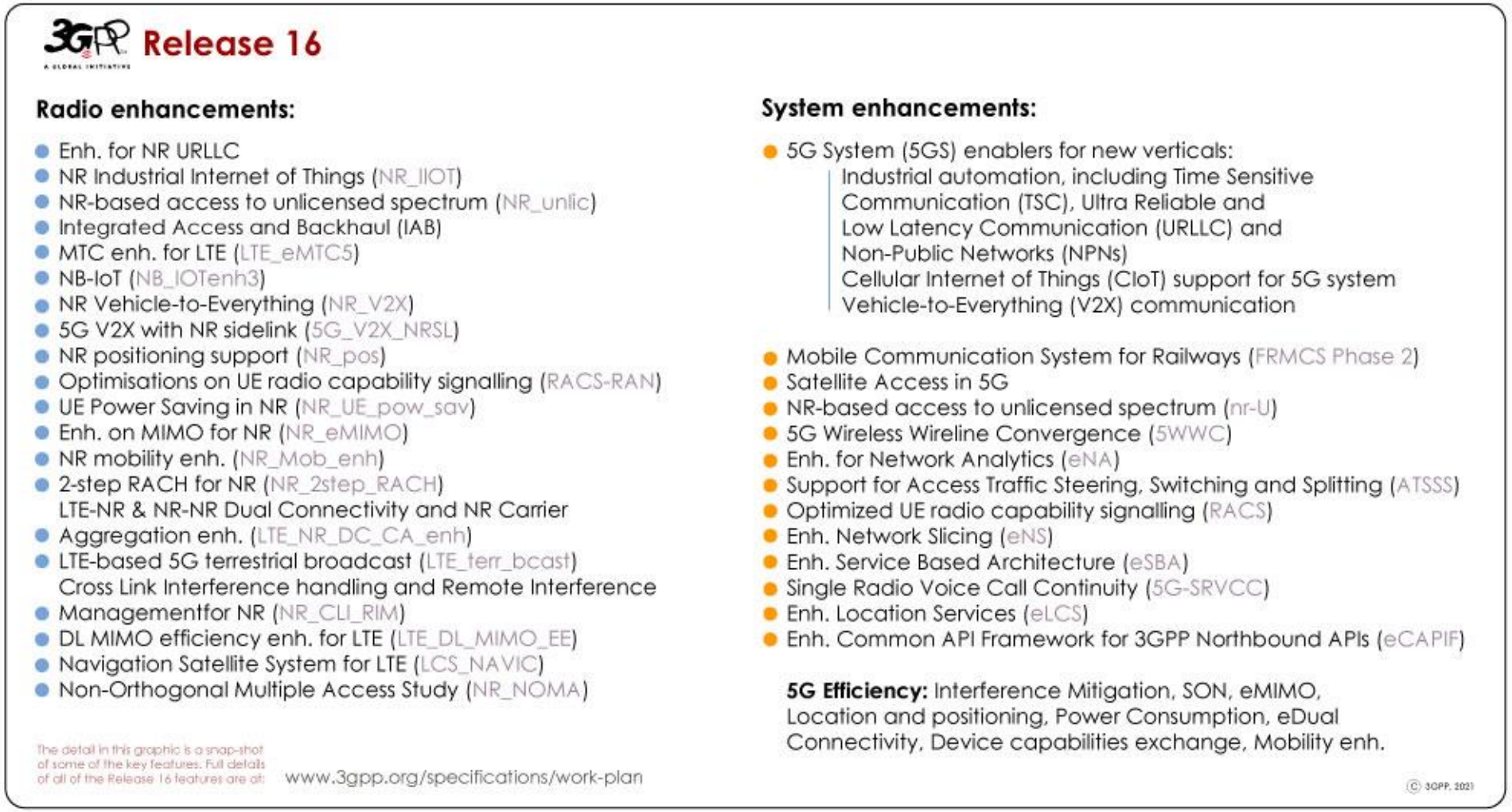
Fonte: https://www.ccsa.org.cn/english/

Lançamentos recentes

Release #	Status [Note 3]	Functional Freeze (Stage 3 complete)	End date (Protocols stable)
Release 19	Open	TBC (Projected SA#109)	TBC (Projected SA#110)
Release 18	Open	2023-12-15 (SA#102)	2024-06 (SA#104)
Release 17	Frozen	2022-03-18 (SA#95)	2022-06-10 (SA#96)
Release 16	Frozen	2020-07-03 (SA#88-e)	2020-07-03 (SA#88-e)
Release 15	Frozen	2019-03-22 (SA#83)	2019-06-07 (SA#84)

Fonte: https://www.3gpp.org/specifications-technologies/releases

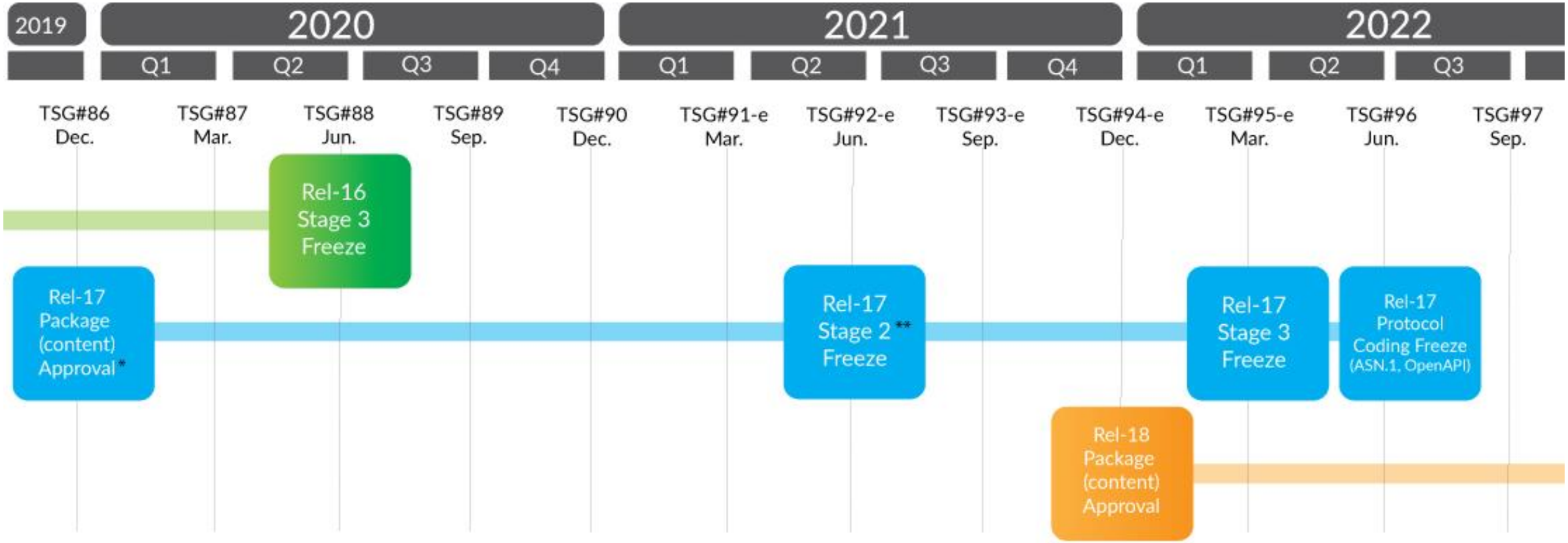
Especificações Release 16 *TR 21.916*



Fonte: https://www.3gpp.org/specifications-technologies/releases/release-16

Release 17

Rel-17 *TR 21.917*



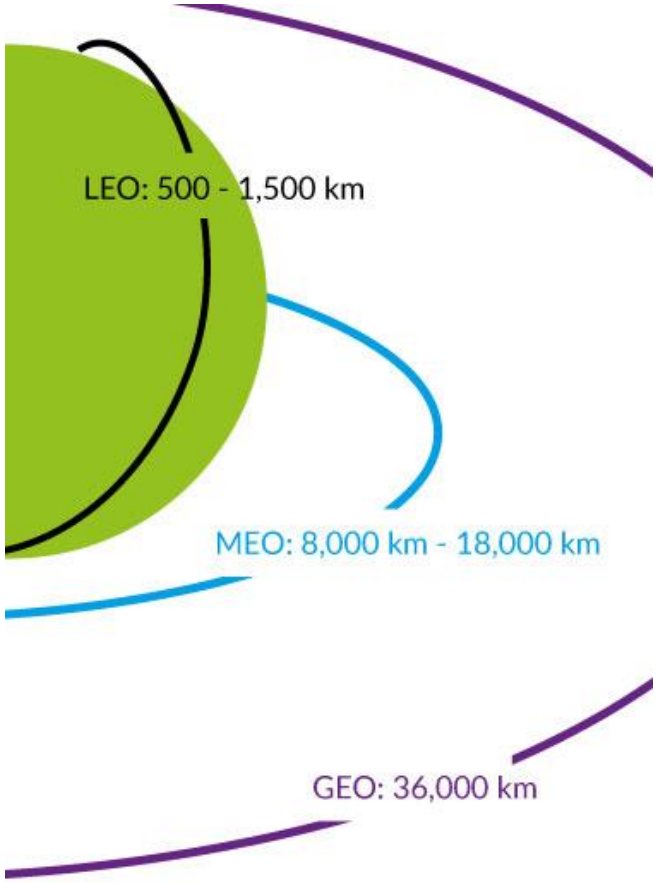
Fonte: https://www.3gpp.org/release-17

Rel-17: Especificações e funcionalidades

- Sidelink enhancements;
- Reduced capability (RedCap) NR devices;
- NR operation extended to 71GHz;
- Further enhancements on MIMO for NR,
- NR over Non terrestrial Networks (NTN);
- IoT over NTN;
- UE power saving enhancements for NR;
- Enhancements to Integrated Access and Backhaul for NR;
- Enhancement of RAN slicing for NR;
- RF requirements enhancement for NR FR1;
- RF requirements for NR FR2;
- Coverage and positioning enhancements;
- NR and slicing QoE;
- Enhanced support of non-public networks;
- Support for uncrewed aerial systems;
- Support for edge computing in 5GC;
- Proximity-based services in 5GS;
- Access traffic steering, switch and splitting (ATSSS);
- Network automation for 5G (Phase 2).

Rel-17: Non Terrestrial Networks (NTN)

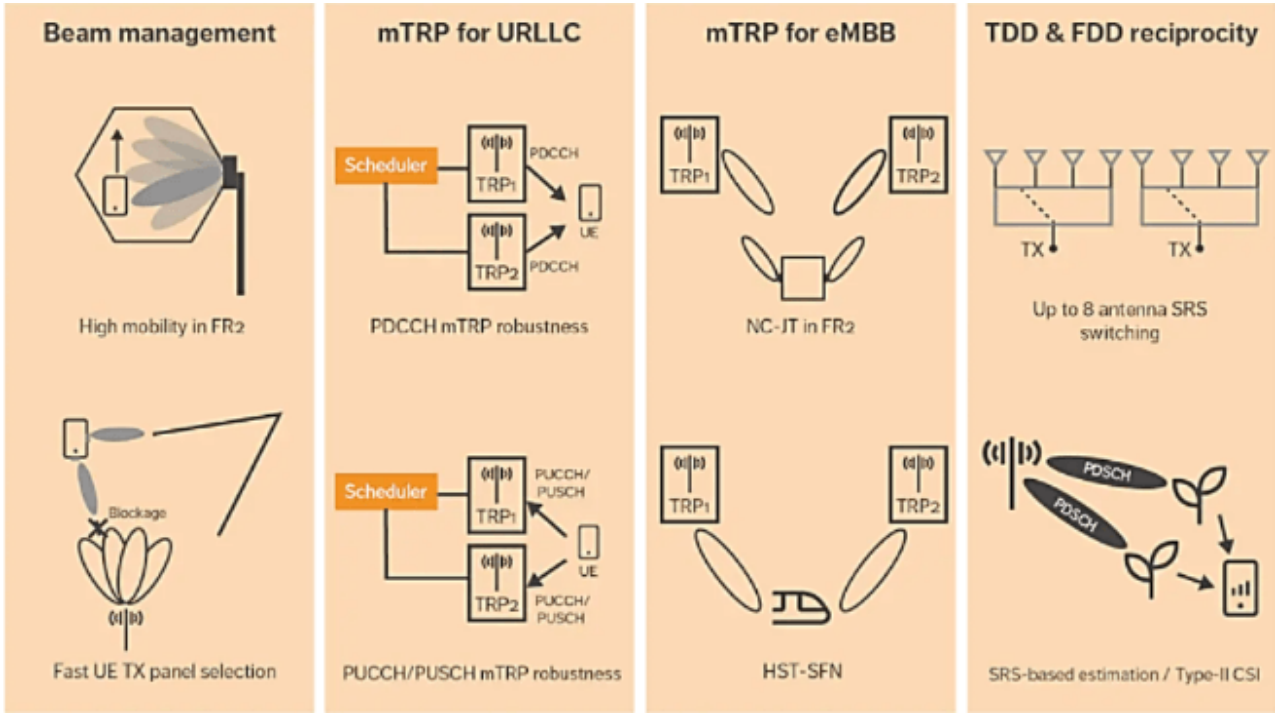
- O NTN (*Non Terrestrial Networks*) na Release 17 introduz novas topologias de rede nas especificações 3GPP. Tais topologias são baseadas em plataformas de baixa órbita terrestre (LEO – *Low Earth Orbit*) e satélites em órbita geossíncrona. O NTN complementa as redes terrestres 5G com cobertura em áreas remotas marítimas e terrestres onde não há a cobertura tradicional;
- A fase normativa inclui a adaptação dos aspectos da camada física e de acesso, da rede de acesso via rádio e da arquitetura do sistema, da gestão dos recursos de rádio e dos requisitos de RF para as redes de satélites que funcionam em órbitas LEO, MEO ou GEO;
- 3GPP Rel-17 suportará o acesso por satélite baseado em NB-IoT e eMTC;
- Deverá estar em vigor em 2022, com a disponibilidade comercial do produto prevista para 2024.



Fonte: https://www.3gpp.org/

Rel-17: MIMO/Beamforming

- O multifeixe melhora o desempenho do usuário em alta mobilidade, simplificando a sinalização e otimizando o desempenho do dispositivo móvel com a utilização de múltiplas antenas.
- As melhorias obtidas com o mTRP (*multiple Transmission and Reception Point*) aumentam a robustez dos canais físicos de controle (PDCCH e PUCCH) e para o canal físico compartilhado de uplink (PUSCH).
- Para a operação baseada em reciprocidade (TDD), os aprimoramentos incluem novos codebooks com overhead reduzido, facilitando a estimação do canal, além de melhorias nos sinais de referência SRSs (*Sounding Reference Signals*).

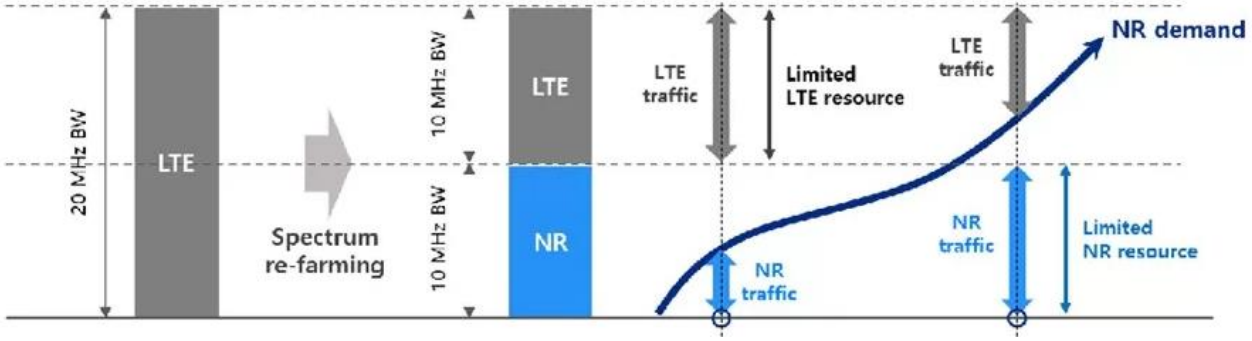


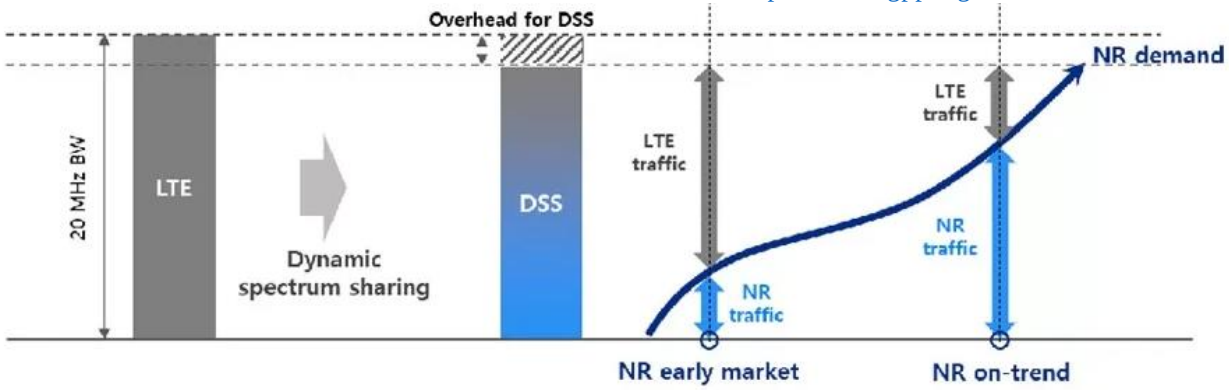
Fonte: https://www.eldorado.org.br

Rel-17: Dynamic Spectrum Sharing (DSS)

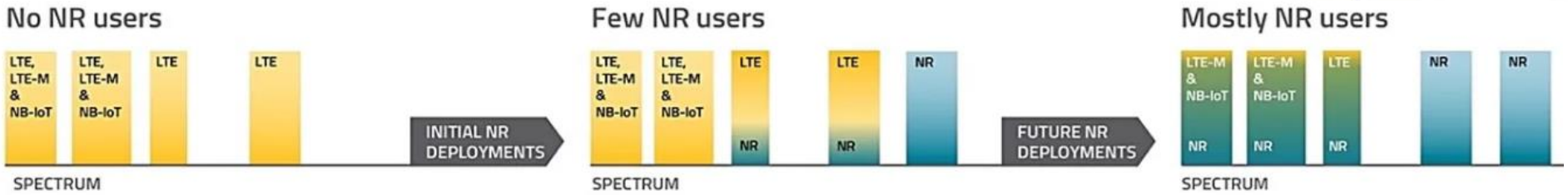
- O DSS – compartilhamento dinâmico do espectro – (incluído na Release 15) permite a implantação antecipada de 5G NR em locais onde a definição do espectro para a tecnologia ainda não foi realizada em totalidade, através do reaproveitamento de bandas de frequência do 4G LTE. Assim como na Release anterior, a Release 17 melhora a capacidade do canal de controle PDCCH, tornando mais fácil superar a escassez de recursos por parte das operadoras, à medida que a quantidade de usuários aumenta.

Fonte: https://www.3gpp.org/





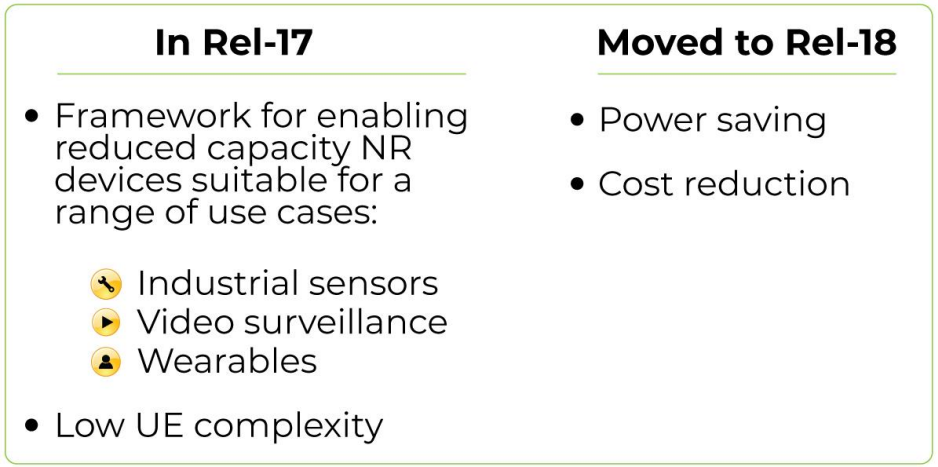
Fonte: https://5ghub.us/



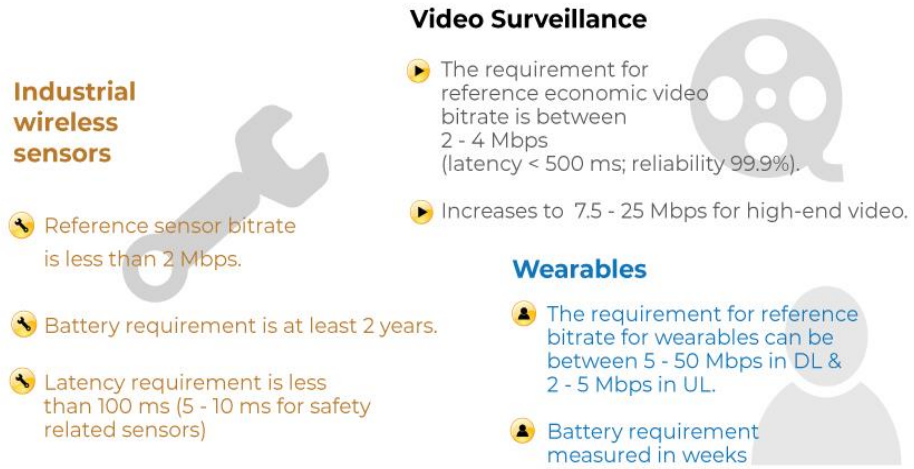
Rel-17: Reduced capability (RedCap)

- URLLC and mMTC;
- FR1 - 410 MHz - 7125 MHz;
- FR2 - 24250 MHz - 52600 MHz - 71000 MHz;
- Radio Resource Management (RRM) measurement relaxation for neighbour cells;
  - When an RSRP/RSRQ-based stationarity criterion is met for a period of time;
  - When both the stationarity criterion and a not-at-cell-edge criterion are met.

- Maximum bandwidth of an FR1 RedCap UE during and after initial access is 20 MHz;
- Maximum bandwidth of an FR2 RedCap UE during and after initial cess is 100 MHz;
- For frequency bands where legacy NR UE is required to be equipped with minimum of 2 RX antenna ports or with minimum of 4 Rx antenna ports, the minimum number of Rx branches supported for a RedCap UE is 1;
- For a RedCap UE with 1 Rx branch, 1 DL MIMO layer is supported;
- For a RedCap UE with 2 Rx branches, 2 DL MIMO layers are supported.



Fonte: https://www.3gpp.org/technologies/nr-redcap-glimpse



Summary of release 17 enhancements to existing features

eMBB feature	
IAB	• Addition of (limited) support for network topology changes • Improved duplexing of access and backhaul links (simultaneous operation on child and parent link, for example) • Routing enhancements
MIMO	• Improvements based on experience from commercial networks focusing on multi-beam operation mainly for frequency range 2 (FR2), support for multi-TRP deployment, SRSs, and CSI measurement and reporting
DSS	• Cross-carrier scheduling enhancements • Other scheduling enhancements
Coverage	• Enhanced wide-area coverage for both FR1 and FR2 (to be studied) • Focus on mobile broadband and voice services use cases, with the exception of the low-power wide area use case
Multi-radio dual connectivity	• More efficient activation/deactivation mechanism of secondary cells • Conditional primary-secondary cell change/addition
UE power saving	• Improved mechanisms in the area of discontinuous reception and blind decoding of control channels
Data collection	• Simplified deployment and enhancements to support self-organizing networks (SON) with improved data-collection mechanisms for SON and minimization of drive tests
QoE management and optimizations for diverse services	• Generic framework for triggering and configuring QoE measurement collection and reporting for various 5G use cases

URLLC feature	
IIoT and URLLC support	• Improved support for factory automation and URLLC, including physical layer feedback enhancements and enhancements for support of time synchronization • Identification of enhancements for URLLC/IIoT operation in controlled environments on unlicensed bands
Positioning	• Higher accuracy (horizontal and vertical) and lower latency, especially for IIoT use cases
Sidelink	• Focus on V2X, public safety and commercial use cases • Resource allocation enhancement • Sidelink discontinuous reception
RAN slicing (also relevant for the mMTC use case)	• Mechanisms to enable UE fast access to the cell supporting the intended slice • Mechanisms to support service continuity for intra-radio-access technology handover service interruption
mMTC feature	
Small data transmissions in inactive state	• Reduced overhead from connection establishment • Use cases: keep-alive messages, wearables and various sensors

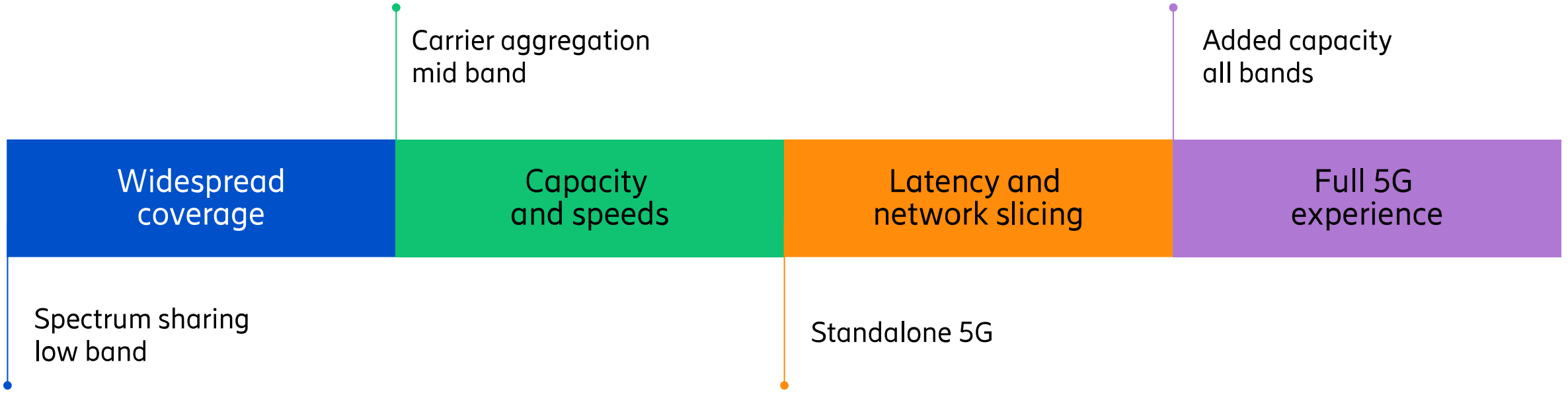
Fonte: https://www.ericsson.com/

Summary of new functionality added in release 17

eMBB feature	
Supporting NR from 52.6GHz to 71GHz	• Extended NR frequency range to allow exploitation of more spectrum, including the 60GHz unlicensed band • Definition of new OFDM (orthogonal frequency-division multiplexing) numerology and channel access mechanism to comply with the regulatory requirements applicable to unlicensed spectrum
Multicast and broadcast services	• Primarily targeted at V2X, public safety, IP multicast, software delivery and Internet of Things (IoT) applications
Support for multi-SIM devices	• Paging collision avoidance • Network notification when a UE switches networks
Support for non-terrestrial networks	• Support for satellites (especially Low Earth orbit and geostationary satellites) and high-altitude platforms as an additional means to provide coverage in rural areas
Sidelink relaying	• L2 versus L3 relaying (study and compare) • Scenarios include single-hop, UE-to-UE and UE-to-network relaying
URLLC feature	
Anything reality (XR) evaluations	• Evaluate needs in terms of simultaneously providing very high data rates and low latency in a resource-efficient manner • Intended to support various forms of augmented reality and virtual reality, collectively referred to as XR
mMTC feature	
Support of reduced-capability NR devices	• Targeted at mid-tier applications such as machine-type communications for industrial sensors, video surveillance, and wearables with data rates between Narrowband IoT/LTE-M data rates and "full" NR data rates • Addresses issues including complexity reduction, UE power saving and battery lifetime enhancement

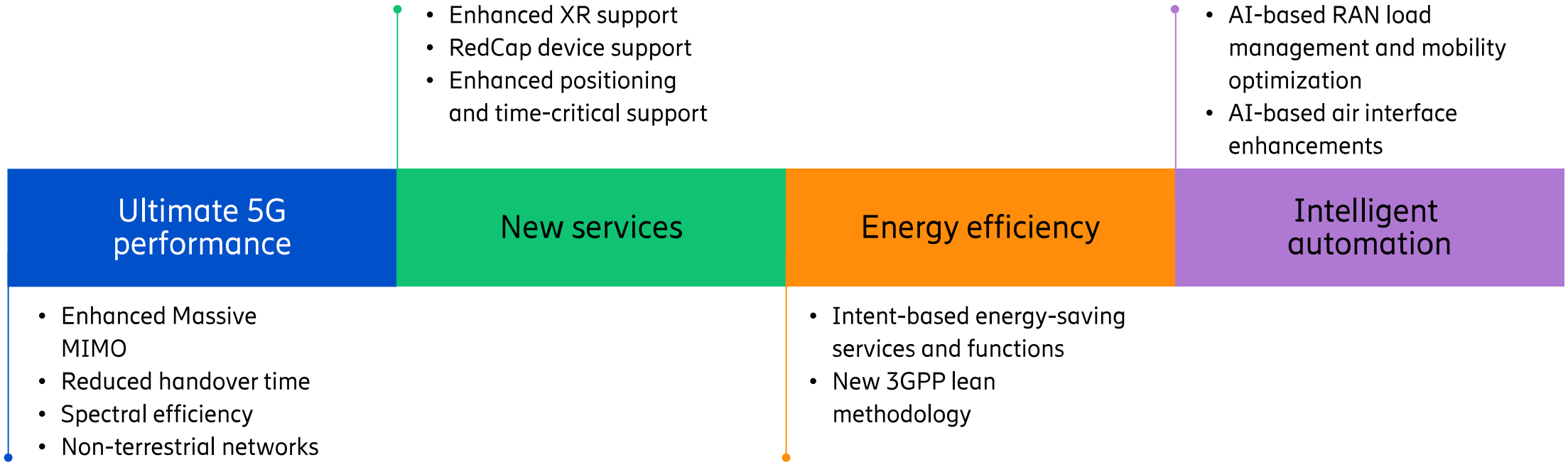
Fonte: https://www.ericsson.com/

5G first wave



Fonte: https://www.ericsson.com/en/5g/5g-networks/5g-advanced

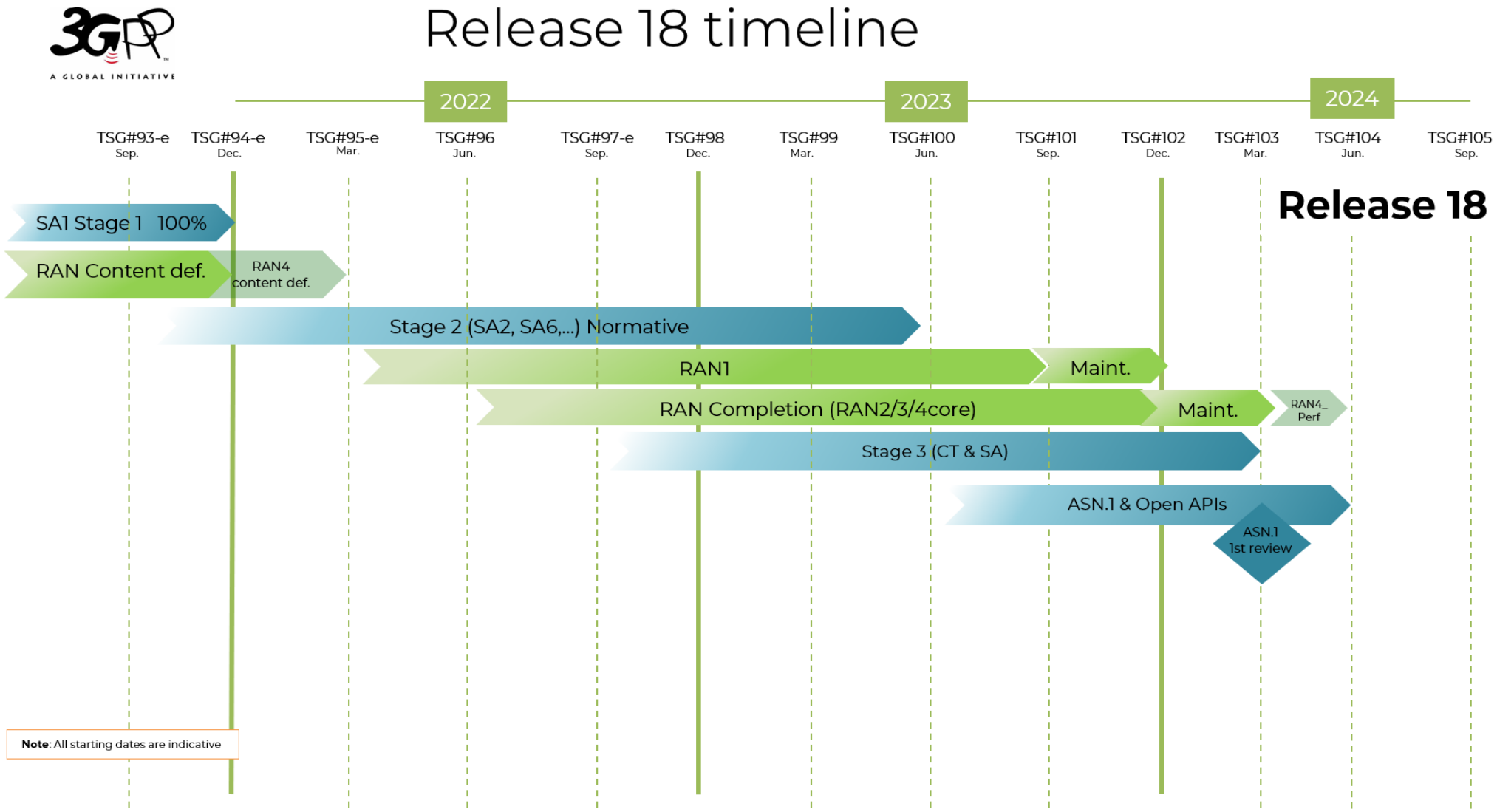
5G Advanced



Fonte: https://www.ericsson.com/en/5g/5g-networks/5g-advanced

Release 18

Rel-18 *TS 21.918*



Fonte: https://www.3gpp.org/release-18

Rel-18: Especificações e funcionalidades

- MIMO Evolution for Downlink and Uplink;
- Uplink enhancements (such as coverage enhancements);
- Additional Topology Improvements – Smart Repeater;
- Sidelink enhancements;
- RedCap Evolution;
- Expanded and Improved Positioning;
- Evolution of duplex operation;
- AI/ML for Air Interface;
- Network energy savings;
- Mobility Enhancements;
- Enhancements for XR;
- Sidelink Relay Enhancements;
- NTN evolution;
- Evolution for Broadcast/Multicast Services;
- Uncrewed Aerial Vehicle: UAV in NR;
- Multiple SIM Enhancements;
- In-Device Co-existence: IDC Enhancements;
- Additional Topology Improvements – Integrated Access and Backhaul: IAB and Vehicle Mounted;
- Relay: VMR;
- AI/ML for RAN;
- Self-Organized Networks: SON and Minimization of Drive Tests: MDT Enhancements;
- Quality of Experience: QoE enhancements;
- Inter-gNB coordination;
- UE aggregation;
- High-speed packetization;
- Small Data Transmission;
- Carrier Aggregation: CA and Dual-Connectivity: DC Enhancements;
- Passive IoT.

Rel-18 *TS 21.918*

3GPP A GLOBAL INITIATIVE

The 5G standard

5G ADVANCED

Since the completion of 3GPP Release 15 – the first phase of 5G specifications - the cellular industry is expanding the capability of the network to deliver on the full promise of the Internet of Everything. Release 18 will deliver 5G-Advanced, as the mid-point of 5G standardization.

- Self-driving Cars
- Smart Cities
- Work & Play in the Cloud
- 3D Video, UHD Screens
- Industry Automation
- Smart Homes
- Augmented Reality
- Gigabytes per second

5.1B Mobile Subscribers, 10B IoT Connections, 2018 → Source: GSMA → 5.8B Mobile Subscribers, 25B IoT Connections, 2025

Fonte: https://www.3gpp.org/

Specification Groups

TSG CT Core Network and Terminals

- CT1 User Equipment – Core Network Protocols
- CT3 Interworking with External Networks & Policy and Charging Control
- CT4 Core Network Protocols
- CT6 Smart Card Application Aspects

TSG RAN Radio Access Network

- RAN1 Radio Layer 1 (Physical Layer)
- RAN2 Radio Layer 2 and Radio Layer 3 Radio Resource Control
- RAN3 UTRAN/E-UTRAN/ NG-RAN Architecture and Related Network Interfaces
- RAN4 Radio Performance and Protocol Aspects
- RAN5 Mobile Terminal Conformance Testing

TSG SA Service and System Aspects

- SA1 Services
- SA2 System Architecture and Services
- SA3 Security & Privacy
- SA4 Multimedia Codecs, Systems and Services
- SA5 Management, Orchestration and Charging
- SA6 Application Enablement and Critical Communication Applications

Rel-18 *TS 21.918*

SA2 led - System Architecture & Services

XR (Extended Reality) & media services
Edge Computing Phase 2
System Support for AI/ML-based Services
Enablers for Network Automation for 5G Phase 3
Enh. support of Non-Public Networks Phase 2
Network Slicing Phase 3
5GC LoCation Services Phase 3
5G multicast-broadcast services Phase 2
Satellite access Phase 2
5G System with Satellite Backhaul
5G Timing Resiliency and TSC & URLLC enh.
Evolution of IMS multimedia telephony service
Personal IoT Networks
Vehicle Mounted Relays
Access Traffic Steering, Switching & Splitting support in the 5G system architecture Phase 3
Proximity-based Services in 5GS Phase 2
UPF enh. for Exposure & SBA
Ranging based services & Sidelink positioning
Generic group management, exposure & communication enh.
5G UE Policy Phase 2
UAS, UAV & UAM Phase 2
5G AM Policy Phase 2
RedCap Phase 2
Support for 5WWC Phase 2
System Enabler for Service Function Chaining
Extensions to TSC Framework to support DetNet
Seamless UE context recovery
MPS when access to EPC/5GC is WLAN

SA3 led - Security & Privacy

Privacy of identifiers over radio access
SECAM and SCAS for 3GPP virtualized network products and Management Function (MnF)
Mission critical security enhancements Phase 3
Security and privacy aspects of RAN & SA features

SA4 led - Multimedia Codecs, Systems and Services

Systems & Media Architecture:
5G Media, Service Enablers
Split-Rendering
5G AR Experiences Architecture

Media:
Video codec for 5G
Media Capabilities for Augmented Reality Glasses
AI / ML Study

Real-Time Communications:
XR conversational services
WebRTC-based services and collaboration models

Immersive Voice & Audio:
EVS Codec Extension for Immersive Voice and Audio Services (IVAS_Codec)
Terminal Audio quality performance and Test methods for Immersive Audio Services (ATIAS)

Streaming & Broadcast Services:
5GMS Enh. (Network slicing, Low latency, Background traffic, 5GMS Uplink)
Further MBS Enh. (Free to air, Hybrid unicast/ broadcast)

SA5 led - Management, Orchestration & Charging

Intelligence and Automation:
Self-Configuration of RAN NEs, Enh. and evaluation of autonomous
network levels, Enh. intent driven management services,
AI/ ML management, Enh. of the management aspects related to NWDAF, Enh. of MDA, Fault supervision volution, Management support of RAN intelligence

Management Architecture and Mechanisms:
Network slicing provisioning rules, Enh. service based management architecture, URLLC/5GLAN/ Cloud native VNF/MOCN/IOT NTN/Edge computing management, 5G PM and KPIs; QoE, MDT/Trace, Data collection management

Support of New Services:
Enh. Energy Efficiency for 5G Phase 2, Network slice management capability exposure, Enh. management of Non-Public Networks, Network and Service Operations for Energy Utilities, Key Quality Indicators (KQIs) for 5G service experience, Deterministic Communication Service Assurance

Charging Management:
Enhancement of Network Slicing Phase 2, Nchf charging services phase 2, 5G roaming charging architecture for wholesale and retail scenarios, Enhanced support of Non-Public Networks,
Time Sensitive Networking

https://bit.ly/3GPP-Work-Plan

Fonte: https://www.3gpp.org/

Rel-18 *TS 21.918*

SA6 led - Application Enablement & Critical Communication Applications

Critical Communications:

MCX Enhancements – MC over 5GS (5MBS, ProSe) Adhoc group comm., MCPTT Enh.

Railways - Gateway UE, Interworking

Service Frameworks:

Edge App Architecture Enh., SEAL Enh., Subscriber-Aware API (CAPIF Enh.)

Fused location, Application Data Analytics, App Layer NW Slicing

Enablers for Vertical Applications:

Enhancements to V2X, UAS application-enablement, 5G Messaging, Future Factories, Personal IoT networks, Capability exposure for IoT platforms

RAN1 led - Radio Layer 1 (Physical layer)

MIMO Evolution for Downlink and Uplink

Study on Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface

Study on Evolution of NR Duplex Operation

NR sidelink evolution

Study on expanded and improved NR positioning

Further NR RedCap UE complexity/cost reduction

Study on network energy savings

Further NR coverage enhancements

NR Network-Controlled Repeaters

Enh. of NR Dynamic spectrum sharing (DSS)

Study on low-power Wake-up Signal and Receiver for NR

Multi-carrier enhancements for NR

RAN2 led - Radio Layer 2 & Layer 3 Radio Resource Control

NR Mobility Enh.

Study on XR Enh. for NR

NR sidelink relay enh.

NR NTN (Non-Terrestrial Networks) enh.

IoT NTN enh.

NR Support for UAV

Dual Tx/Rx MUSIM

In-Device Co-existence (IDC) enh. for NR and MR-DC

Mobile Terminated-Small Data Transmission (MT-SDT) for NR

Enh. of NR Multicast and Broadcast Services

RAN3 led - UTRAN/E-UTRAN/ NG-RAN Architecture & Related Network Interfaces

Mobile IAB

Artificial Intelligence (AI)/Machine Learning (ML) for NG-RAN Further enh. of data collection for SON (Self-Organising Networks)/MDT (Minimization of Drive Tests) in NR and EN-DC

Enh. on NR QoE management and optimizations for diverse services

Study on enh. for resiliency of gNB-CU

RAN4 led - Radio Performance & Protocol Aspects*

Further RF requirements enh. for NR Frequency Range 1 (FR1)

NR RF requirements enh. for Frequency Range 2 (FR2), Phase 3

Req. for NR Frequency Range 2 (FR2) multi-Rx chain DL reception RRM enh. for NR and MR-DC

Enh. on NR and MR-DC Measurement Gaps and Measurements without Gaps

NR demodulation performance evolution

Study on simplification of band combination specification

Study on enh. for 700/800/900MHz band combinations

NR BS RF requirement evolution

Study on NR Frequency Range 2 (FR2) Over-the-Air (OTA) testing enh.

Support of intra-band non-collocated EN-DC/NR-CA deployment

Enh. NR support for high-speed train scenario in frequency range 2 (FR2)

BS/UE EMC enh.

Air-to-ground network for NR

NR support for dedicated spectrum less than 5MHz for FR1

* There are other approved items related to Rel-17 continuation; more spectrum-related items are expected to be approved later.

TSG CT Stage 3 work

CT will wait for stable output from the stage 2 work in SA and RAN before initiating the stage 3 work on Rel-18 - expected by TSG#99, March 2023.

In parallel, CT will work on technical improvements and enhancements to APIs and protocols under the CT remit, to add new capabilities, improve efficiency and flexibility.

Completion of stage 3 work is targeted for **TSG#103** March 2024.

Fonte: https://www.3gpp.org/

AI/ML for RAN enhancements

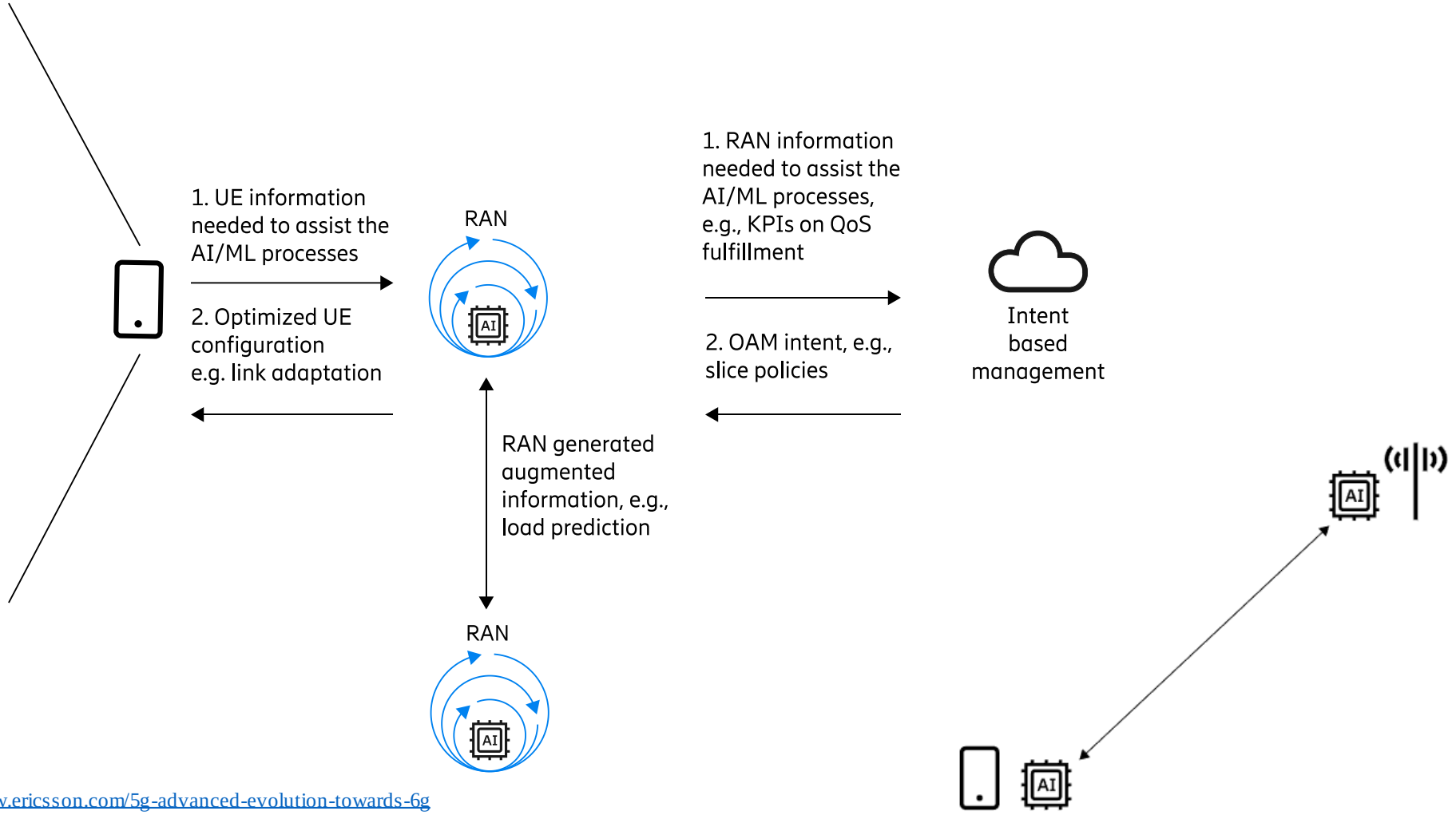
Device data sources

Capabilities:
Battery power, memory, processing or computational capacity

Radio data:
Signal quality measurement, interference, time-of-arrival, angle-of-arrival

Sensor:
Accelerometers, pressure sensors, light sensors etc.

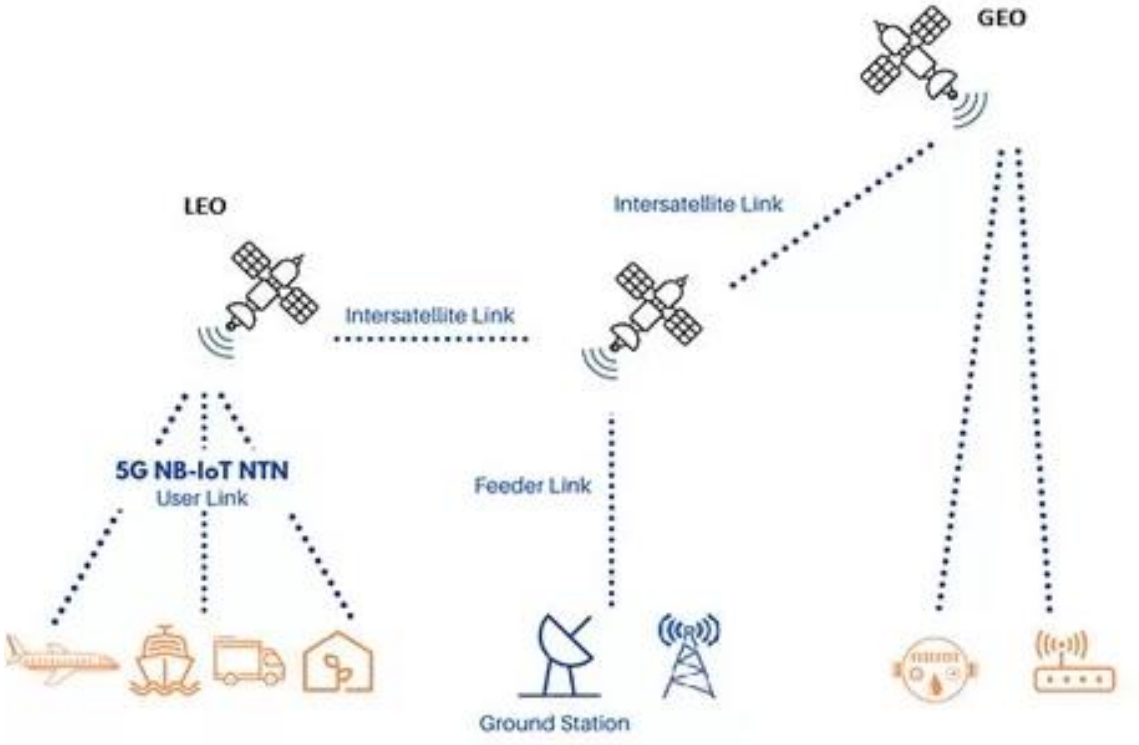
Physical environment:
Cameras, lidars, GNSS



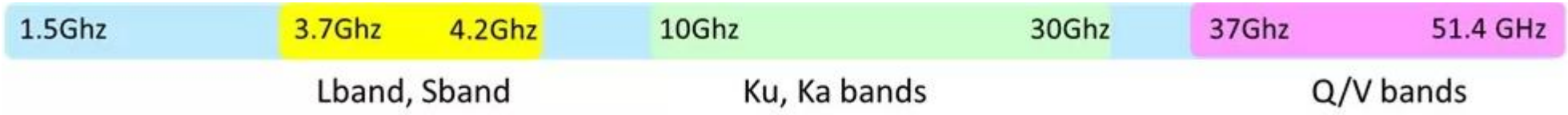
Fonte: https://www.ericsson.com/5g-advanced-evolution-towards-6g

Rel-18: Non Terrestrial Networks (NTN)

- Support for Half-Duplex in FDD Bands;
- Regulatory Compliance for UE Location;
- Enhanced Mobility for IoT Devices;
- Throughput Improvements;
- Optimized GNSS Operation;
- Specification of Core and Performance Requirements;
- Include the development of sophisticated algorithms for handover and cell re-selection;
- Very Small Aperture Terminal (VSAT) devices.

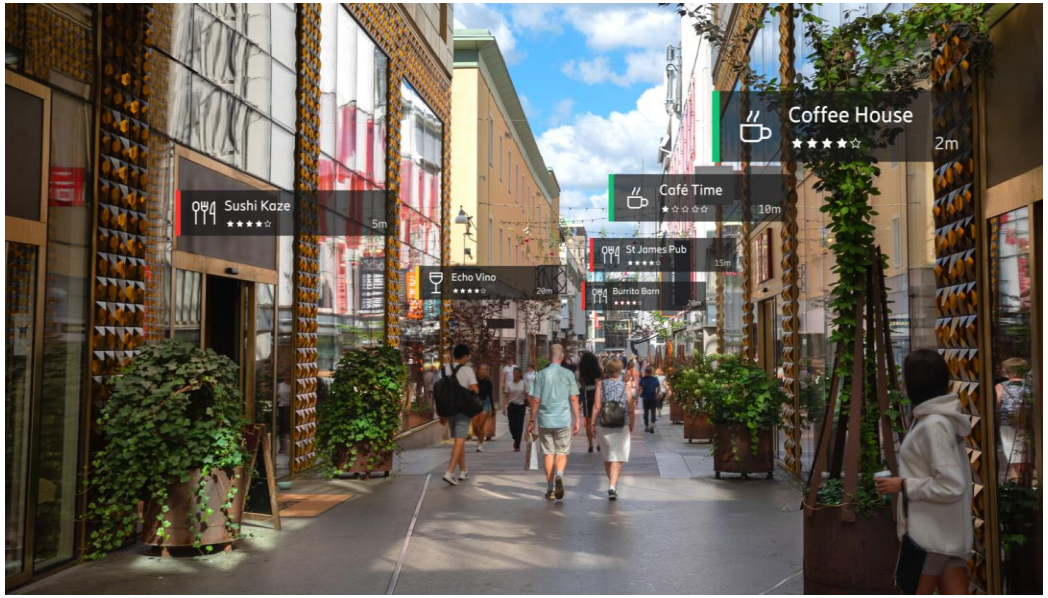


Fonte: https://5ghub.us/

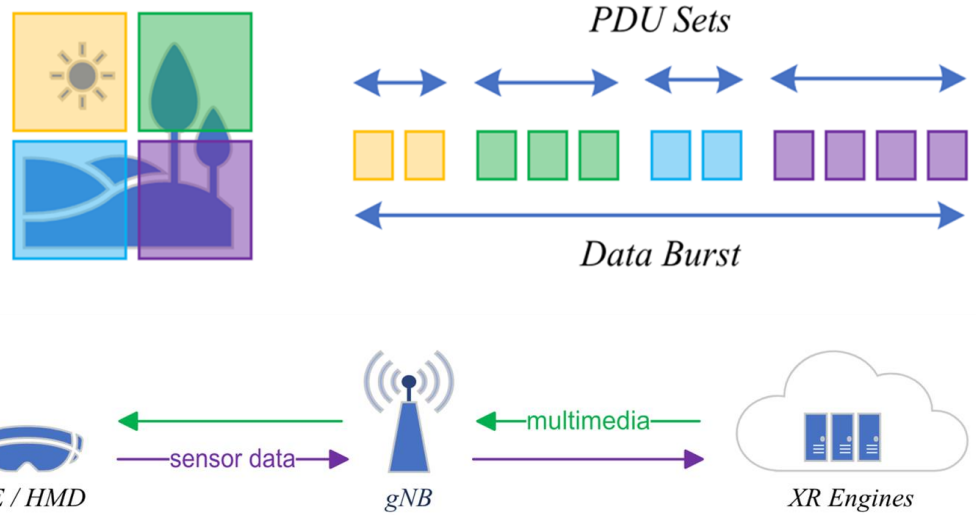


Rel-18: eXtended Reality

- Working groups (RAN1, RAN2, SA2, SA4);
- XR = Virtual reality (VR) + Augmented Reality (AR) + Mixed Reality (MR);
- XR experience requires frame rates:
  - Acceptable: of at least 60fps and 2K resolution;
  - Immersive: one requires 90 or even 120fps with resolutions up to 8K;
- Latency in the order of 10ms;

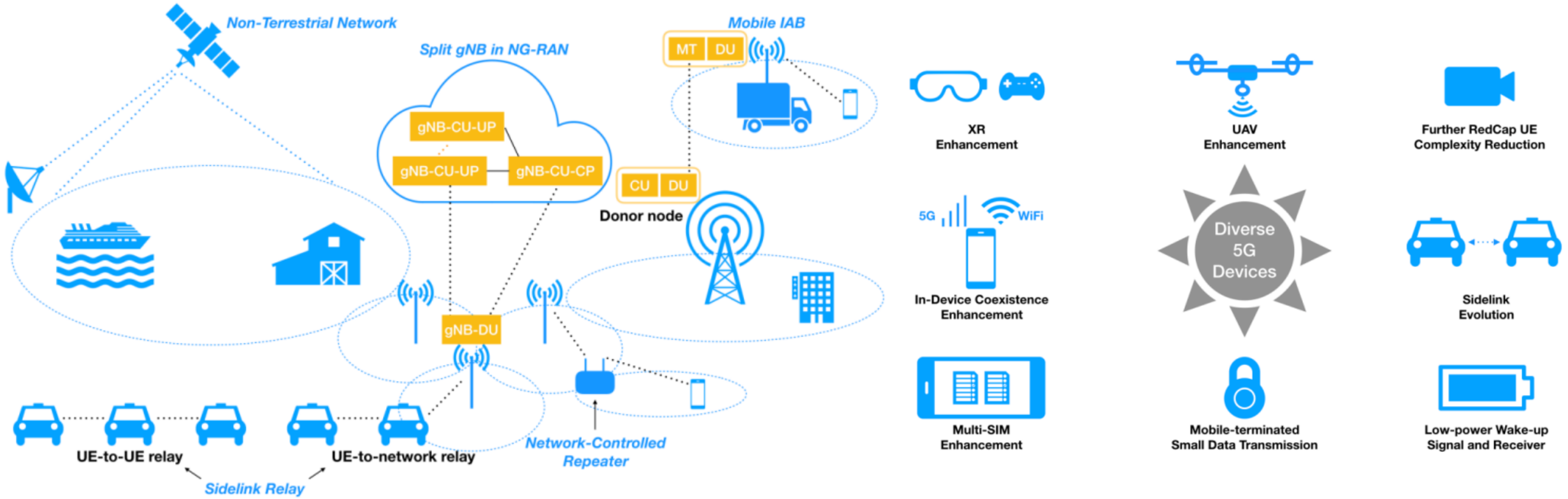


Fonte: https://www.ericsson.com/3gpp-release-19



Fonte: https://www.3gpp.org/technologies/xr-nr

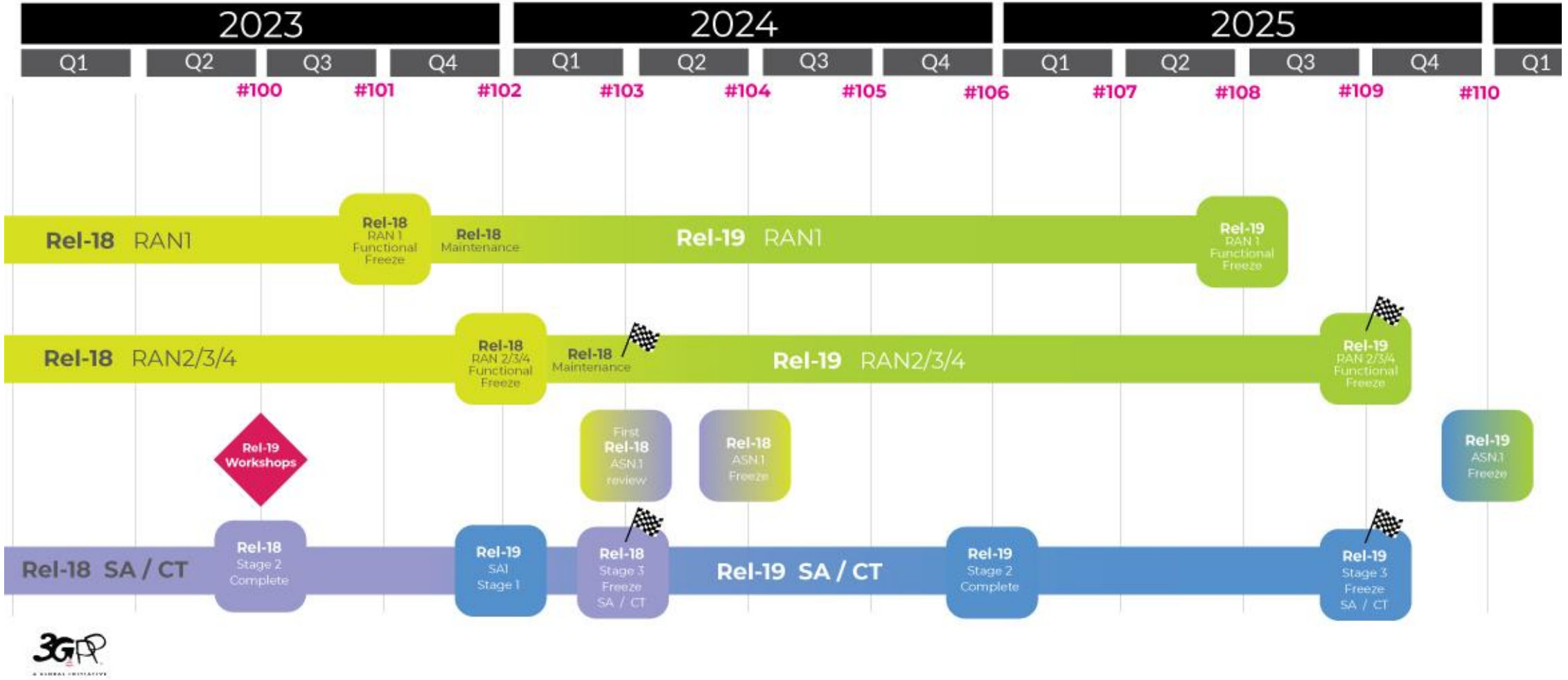
Flexible 5G network topology



Fonte: https://arxiv.org

Release 19

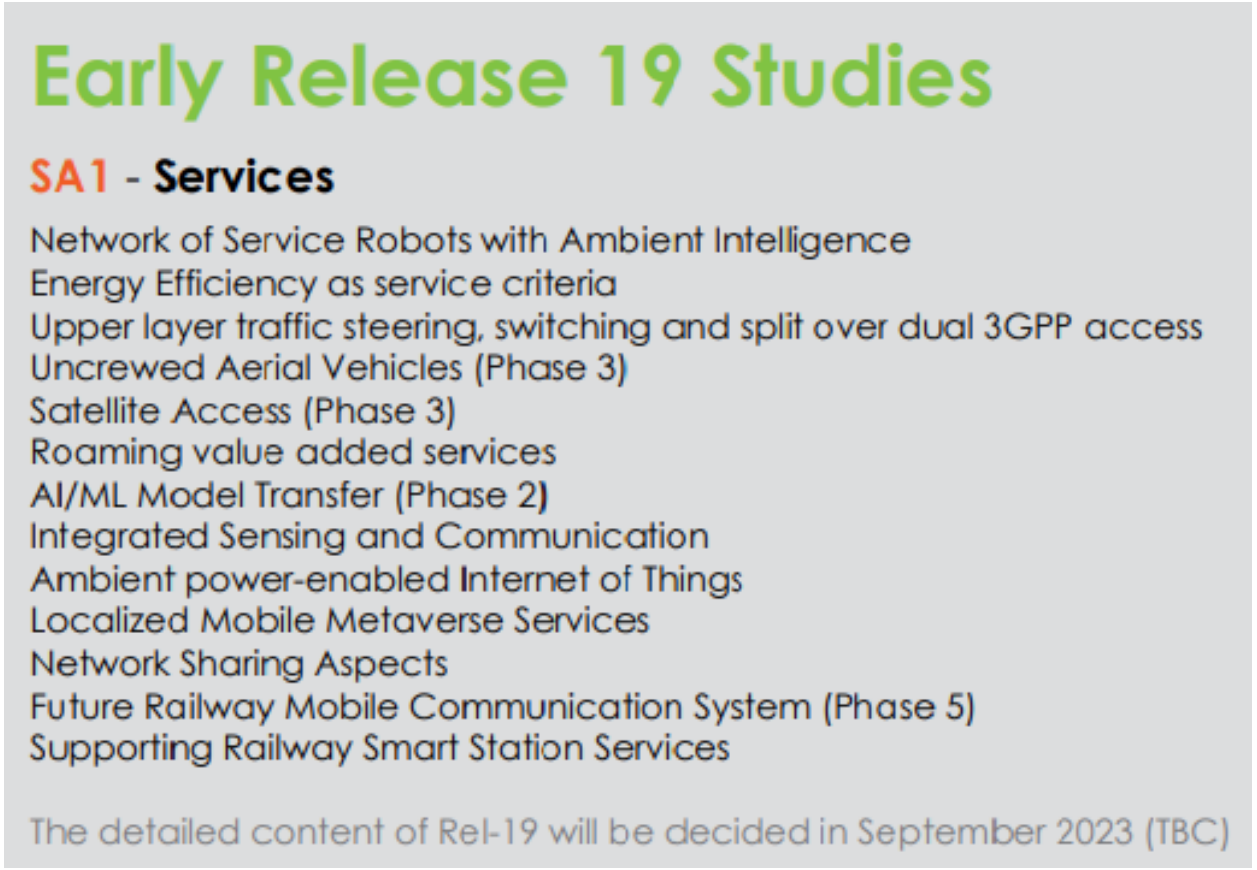
Rel-19



Fonte: https://www.3gpp.org/release-19

Rel-19

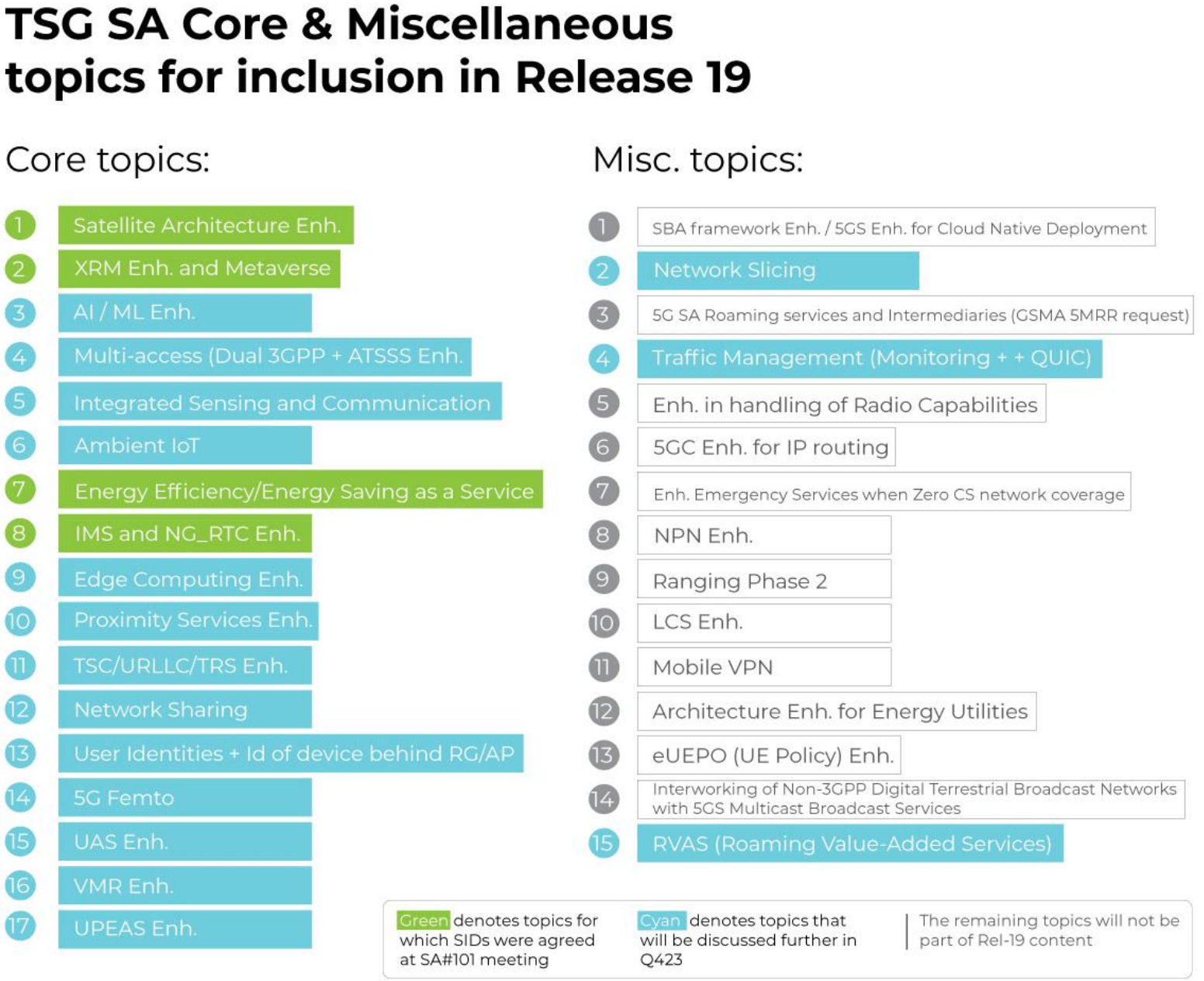
- As discussões sobre os tópicos da Rel-19 estão a decorrer em simultâneo na SA3 (Segurança), SA4 (Codecs, Sistemas e Serviços Multimédia) e SA5 (Gestão, Orquestração e Cobrança) e espera-se que alguns projetos iniciais sejam aprovados no TSG#102;
- O SA#101 também iniciou discussões preliminares sobre o plano de trabalho 6G, motivado por um contato da ITU-R relacionado com a finalização do documento de enquadramento do IMT2030;
- Além disso, estão a considerar novos tópicos como Metaverso Móvel Localizado e Serviços XR, Serviços 5G habilitados para acesso por satélite e Habilitadores de Sensoriamento para Aplicações Verticais no Rel-19.



Fonte: https://www.3gpp.org/release-19

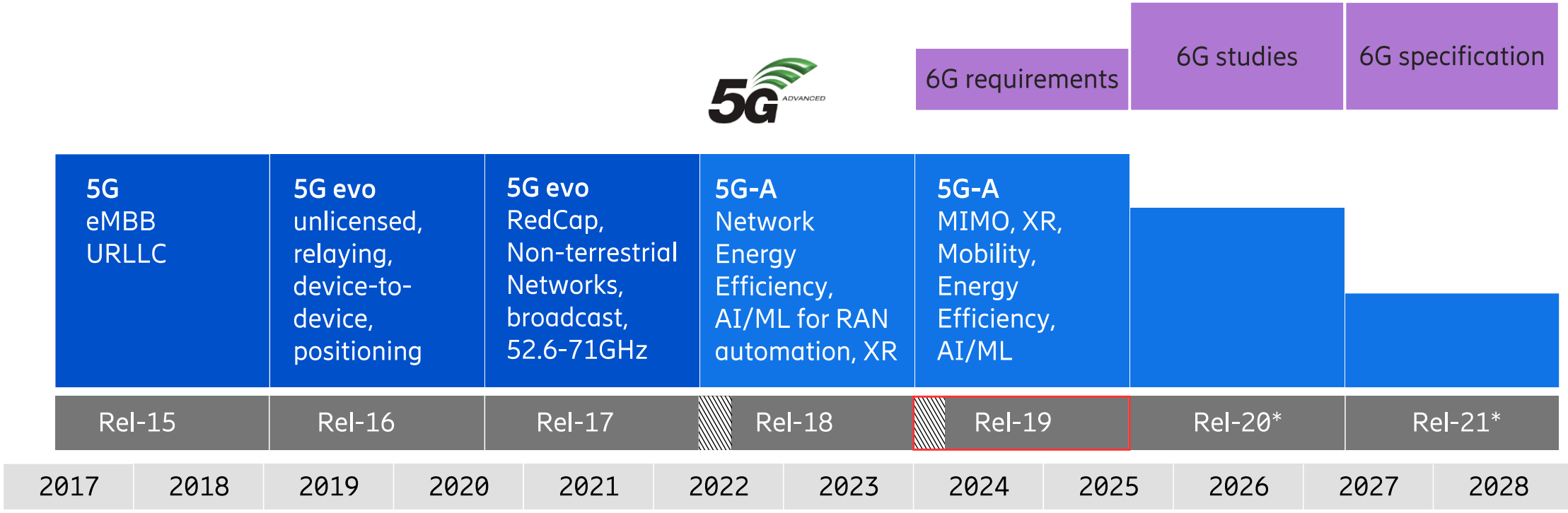
Rel-19 Topics

- **Non-Terrestrial Networks (NTN) for NR Phase 3 (NR_NTN_Ph3)**
  - Optimized performance for terminals;
  - Capacity performance on uplink;
  - Notification of the service area of a Broadcast service;
  - Support for a non-terrestrial network architecture with 5G system functions on board the NTN vehicle (i.e. regenerative payloads);
  - Use of RedCap devices within FR1 NTN.
- **Non-Terrestrial Networks (NTN) for Internet of Things (IoT) Phase 3**
  - Support of Store & Forward (S&F) operation based on regenerative payload, including the support of feeder link switchover;
  - Uplink capacity enhancements.



Fonte: https://www.3gpp.org/release-19

5G Advanced and 6G timeline of 3GPP



*Indicative timeline

Fonte: https://www.ericsson.com/3gpp-release-19

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