

**Key Note Speech**  
**Hexa 2 Workshop**  
**3 June 2025**  
**Enrico Buracchini**



LA FORZA DELLE CONNESSIONI

# Sustainable Future



## DIGITAL IS FOR EVERYONE

Our aim is that everyone be able to use digital to have the opportunities for a better life

- Overcome the digital divide across the Country.
- Spread digital skills to promote social and economic inclusion.
- Ensure data security and protect children.
- Simplify our customers' digital experience.
- Provide tools for solidarity fundraising.
- Create a flexible work environment by means of smartworking and continuous training.

[Read more](#)



## TECHNOLOGY IS RESPONSIBLE

We want to develop technologies capable of promoting sustainable behaviours and lifestyles

- Develop smart services to improve the way we live, work, travel and seek care.
- Offer sustainable products and services.
- Invest in startups and SMEs for sustainable innovation.

[Read more](#)



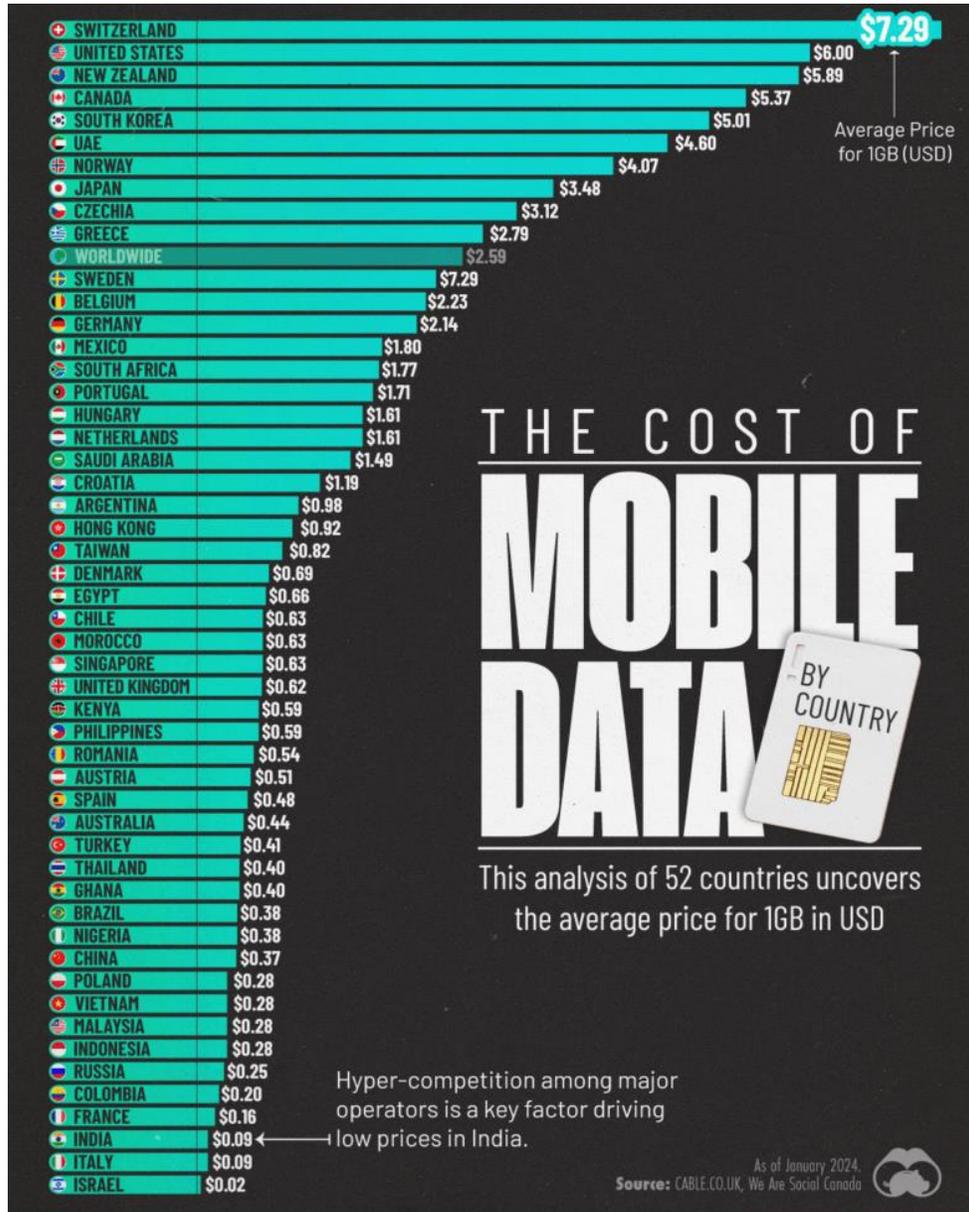
## THE ENVIRONMENT IS PROTECTED

We want to help create a circular economy and achieve zero emissions

- Extend the useful life of resources and products by means of circular economy projects.
- Design infrastructures and offices which are both sustainable, eco-efficient and powered by renewable energy.
- Achieve carbon neutrality.

[Read more](#)

# Business sustainability: extreme competition at least in some EUs/ITALY + OTT pressure



**SOURCE**  
[The Cost of 1 GB of Mobile Data Worldwide - Visual Capitalist Licensing](#) (end of JAN2024)



**#1. Israel**

With three-quarters of Israelis owning a smartphone, Israel boasts a higher smartphone market penetration than the United States of America. Multiple providers offer huge data allowances with extensive 4G LTE and 5G network coverage.



**#2. Italy**

A dozen or so popular providers in Italy collectively offer some of the cheapest data in the world. 5G is now available to around 95% of the population, alongside ubiquitous 4G.



**#3. Fiji**

Despite being a remote island nation, Fiji has two mobile networks, both of which provide 4G and growing 5G coverage across the island, along with a broad range of large data deals.



**#4. San Marino**

Italy's tiny neighbour was the first European state to have a 5G network, established by Italian network TIM. San Marino benefits from 100% 5G coverage.

[Worldwide Mobile Data Pricing 2023 | 1GB Cost in 237 Countries](#)  
 (End of 2023)



**Release 15**  
Enhanced Mobile Broadband

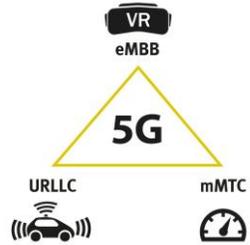


### 5G Phase 1 (Q3 2018)

- Enhanced Mobile Broadband (eMBB)
- Basic URLLC
- Deployment options (opt.3 NSA and opt2 SA)



**Release 16**  
Massive & Industrial IoT,  
Private Networks, V2X



### 5G Phase 2 (Q2 2020)

- Expansion to **new vertical markets**
- Capacity enhancements
- Operational efficiency



**Release 17**  
En. IIoT, Drones, Satellites,  
Multicast/Broadcast,  
Public Safety



### 5G expansion (1H 2022)

- Even **more vertical markets**
- Continuous enhancements



**Rel.18 onwards**



### 5G Advanced

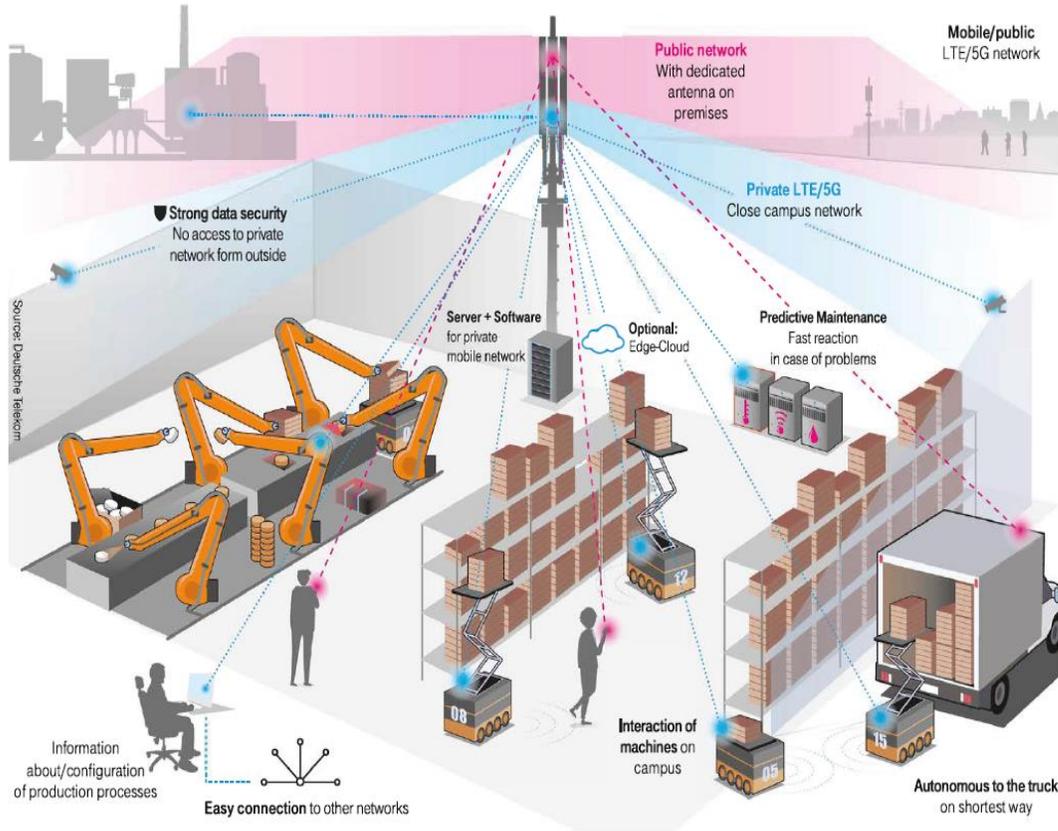
- **AI/ML**
- **NES**
- Continuous enhancements

# 3Gpp features & 14.0



Source:  
QUALCOMM

# Private nets/UCs /verticals



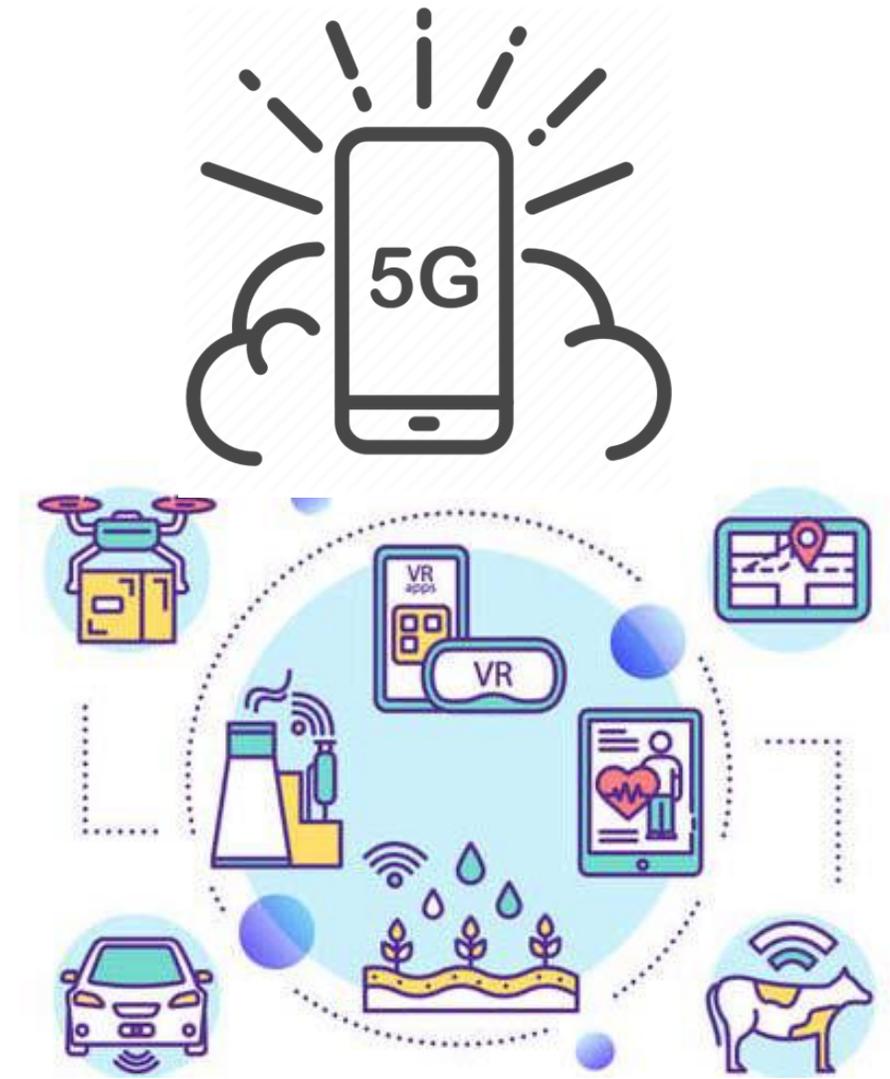
**Airports/ports, oil and gas, mining, energy utilities, smart grids, related Ucs and potential future ones emerging in 5G&beyond R&D arena**

# Business and Verticals: 5G as enabler of I4.0 and digital transformation

*5G: Services & Technology ecosystem to enable new markets, AKA VERTICALS.*

**Why 5G is so crucial for enterprises and their digital transformation:**

- **Medium-long term COST REDUCTION, due to SCALE ECONOMY** given by standard solutions at any level (i.e. networks and services) WRT proprietary and fragmented solutions adopted up to NOW
- **PRODUCTIVITY INCREASE**
- **UNIQUE & INTEGRATED SOLUTION** to integrate/connect **OT & IT**, up to now too fragmented when/if NOT ABSENT
- **Medium-long term CABLE REPLACEMENT**, of any kind and in any ambient, including white collars offices



# 5G as enabler of I4.0 and digital transformation

*...some issues:*

- Big «Broadband» markets influencing availability of I-IoT 5G rel16 & onwards features/products/ecosystem
- Few investments on SA solution (e.g. in some Eu countries) and NSA legacy
- Slow Adoption of private networks in some/(several?) countries
  - Financial Gov support: mainly SW (at least in some countries)
- Effective Comprehension by companies of 5G benefits in industrial contest



# Energy Savings prodromic to Sustenaibility since 4G

*Mobile network operators concerned about network energy consumption, **since introduction of 4G:***

- *Dense & different deployments*
- *massive MIMO*
- *large bandwidths & many frequency bands/layers*

*have led to a higher network energy consumption level resulting in increased operating expense and carbon footprint (TIM 2<sup>nd</sup> “ENERGY EATER” after TRENITALIA in ITALY)*



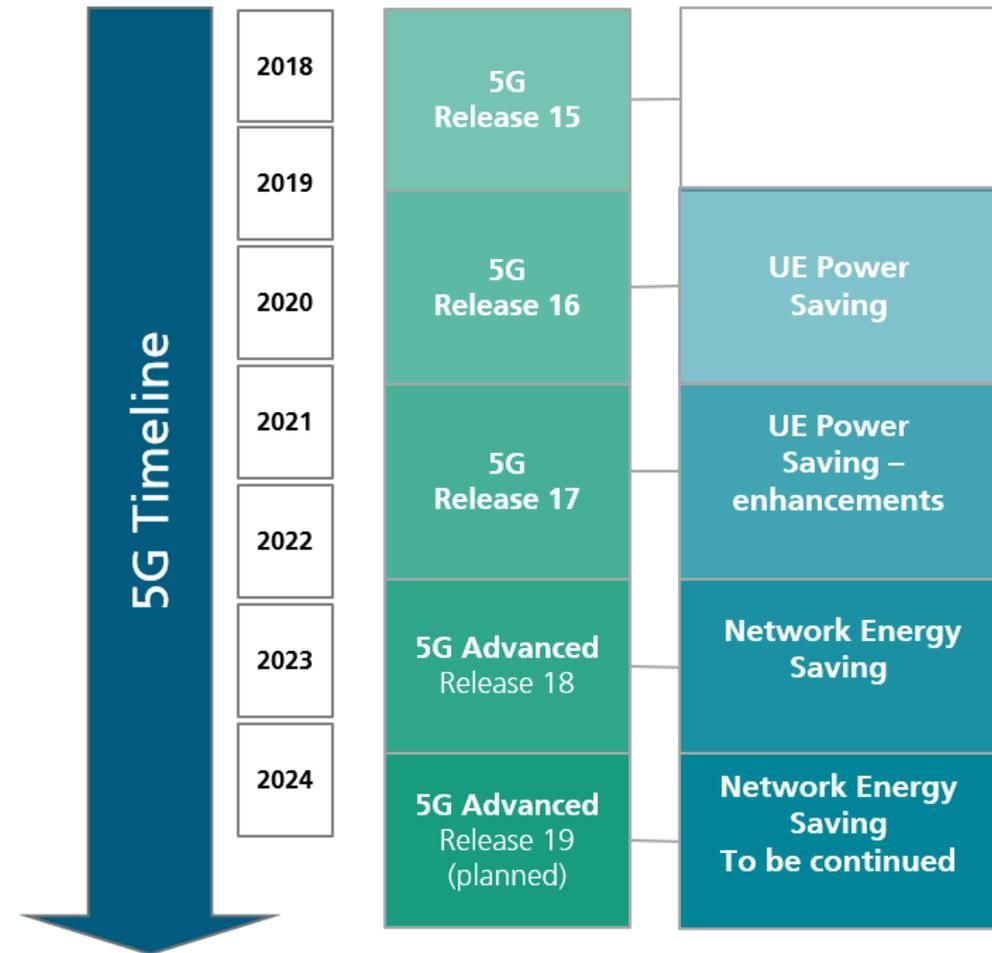
*TIM activities in EU project EARTH, one of the first dedicated to Energy Saving*

- *USE CASES*
- *TRAFFIC MODELS*
- *ENERGY CONSUMPTION MODEL OF NODE B and RF AMPLIFIERS*

*TIM STARTS to FOLLOW ETSI EE group since the beginning*

## Energy Savings in 5G & related activities (1/3)

Energy efficiency *has been a key design target since the inception of 5G. For example, NR minimizes the always-on signals such as cell-specific reference signals that are always present in LTE. Over the releases, 3GPP has worked to further improve 5G energy efficiency and reduce power consumption for both gNB and UE.*



Source: NGMN WP on Energy Savings



## Energy Savings in 5G & related activities (2/3)

**NGMN**

***(operator based  
community)***

***Press release and White  
paper***

***On Green Future  
Networks***

**Green Future  
Networks:  
A Roadmap to  
Energy Efficient  
Mobile Networks**

—  
v1.0

[www.ngmn.org](http://www.ngmn.org)



**TIM RAPPOREUR in ETSI EE of ES203228 dedicated to energy efficiency in mobile networks, giving main inputs to ITU-T SG5 Q6/5 L.1331rev.**

*Draft revised Recommendation ITU-T L.1331  
Assessment of mobile network energy efficiency*

### *Summary*

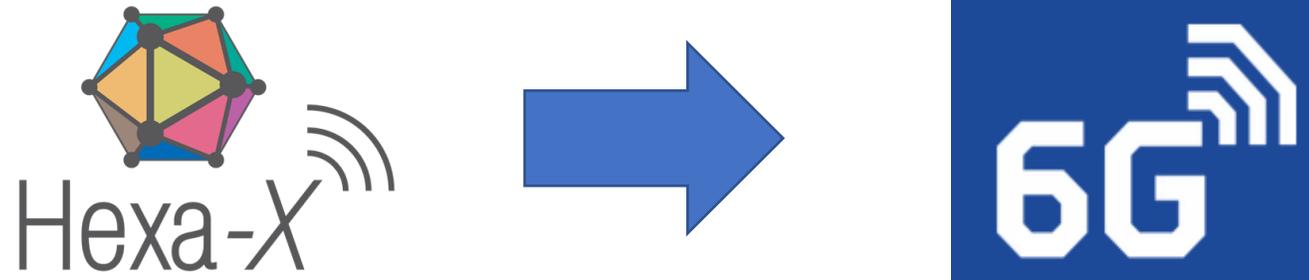
*Recommendation ITU-T L.1331 aims to provide a better understanding of the energy efficiency of mobile networks. The focus of this Recommendation is on the metrics and methods of assessing energy efficiency in operational networks.*

*The networks considered are those whose size and scale could be defined by topologic, geographic or demographic boundaries.*

*This Recommendation explains how to extrapolate the measurements made on partial networks to the level of the total network. Such a simplified approach is proposed as a way of making approximate energy efficiency evaluations at the level of network elements and cannot therefore be considered sufficient for the entire network operation including, for example, transport.*

# EU R&D and 6G: Hexa X I & II flagship

Hexa-X followed by further research initiatives paving the way to subsequent standardisation phase



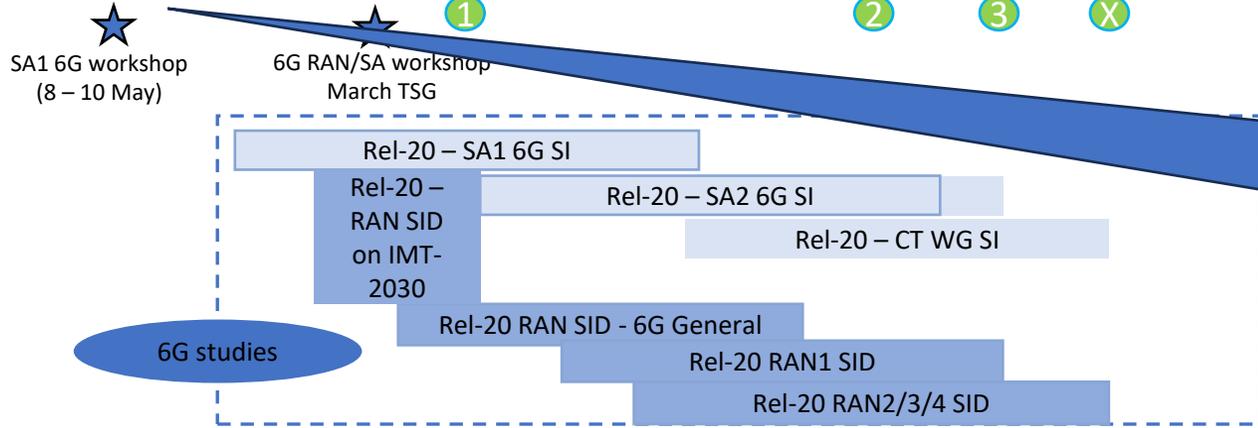
A “**human-centric**” approach is needed to drive technology exponential evolution  
Both 6G and SDGs are anticipated to address the 2030 timescale: 6G shall respond to future societal needs such as **sustainability**, digital inclusion, resiliency, security, ...



# Timeline agreed in March 2024 PLENARIES

✓ **Rel-20 (5G-Advanced + 6G studies)**  
 ✓ 5G-Advanced stage 1/2/3 Open API freeze dates → see << ● >> below  
 ✓ SA1/SA2 6G study may continue beyond Stage-1/Stage-2 freeze dates for 5G-Advanced

✓ **Rel-21 (5G-Advanced? + 6G specs)**  
 ✓ Timeline to be decided no later than June 2026  
 ✓ However, ASN.1/OpenAPI freeze date is no earlier than March 2029



**Sustainability  
 (Environmental  
 Societal  
 Economic)**  
 as one of main items  
 in all presentations

## 6G TIMELINE UNCHANGED for the while!!!

**3GPP 6G timeline is endorsed in RP-233985 (TSG#102) and RP-240823 (TSG#103) as per slide 14:**

- Studies for 6G in 3GPP start from **Release 20**
  - Plenary study on 6G: **RAN plenary work split**
    - IMT-2030 discussion in RAN from 09/24 to 12/24
    - **RP SI Rel-20 focusing on ITU-IMT-2030: approval 12/24 until 06/25**
    - **RP SI Rel-20 focusing on 6G General: approval 03/25 (after WS), until 06/26**
  - IMT-2030 submission and normative work for 6G in 3GPP are expected to start from Release 21
    - **Release 21 is expected to produce the 1st set of 3GPP 6G technical specifications**, and will be the release for IMT-2030 submission before 2030
    - Release 21 is expected to be **delivered with a single drop** (i.e., a single code freeze)
    - Release 21 timeline ***is to be decided no later than June 2026***
- **However, ASN.1/OpenAPI freeze date is no earlier than March 2029**

# REL20 5G ADV 1 day workshop @Ran#106 (Madrid, Dec 2024)

- Summary of the workshop in RP-243292
- As a baseline, RAN WG capacity is not expected to increase in Rel-20 due to the parallel tracks of 5G-Advanced and 6G
- RAN WG capacity has to be carefully shared between 5G-Advanced and 6G in Rel-20
  - Sufficient TUs should be given to 6G to ensure successful study for future 6G success
  - Critical to have reasonable amount of TUs accommodating necessary 5G-Advanced items to address commercial needs
  - **There are quite different views on how to split the WG capacity between 5G-Advanced and 6G (ranging from 25% to 67% to be allocated to 5G-Advanced)**
    - Detailed TU split is to be finalized in RAN#107
    - Detailed TU split may be different for each RAN WG
- It is necessary to avoid duplicate scope in 5G-Advanced and 6G in Rel-20
  - As an example, a study planned for 5G-Advanced (with the intention to convert to specifications later in Rel-20) should not conflict or overlap with the corresponding 6G study

## Categorization of topics based on WS contributions

- AI/ML Air Interface
- MIMO Evolution
- Ambient IoT
- AI/ML mobility
- IoT NTN
- AI/ML for NG-RAN
- Additional RAN1-led Candidate Topics
  - Coverage enh. (incl. FR2)
  - NES
- Additional RAN2-led Candidate Topics
  - Mobility Enh.
  - XR
  - UAV/UAM Enh.
  - NR NTN
- Additional RAN3-led Candidate Topics
  - Sensing/ISAC
  - SON/MDTEnh.
- Another candidate topic: Develop channel bandwidth 200MHz considering n104
- Others
  - SBF
  - UE aggregation
  - CA enhancement (incl. faster scell activation)
  - RRC\_inactive enh.
  - UE energy saving (incl. LP-WUS)
  - Sidelink enh. (incl. SL relay)
  - QoE enh.
  - RIS
  - Positioning
  - Topological enh. (NCR, femto, WAB)
  - UE Tx switching enh.
  - Packet priority based access control
  - Xn failure handling enh.
  - Digital twin
  - Ray tracing model
  - Other UL enh. (e.g., PA non-linearity, scheduling)
  - Others

# Guidance: Study Plan (RP-243276)

- **RAN#106**

- SID approval
- Initial discussion on the possible TPRs
  - A corresponding summary as an input for future progress
  - Possible LS to ITU-R, at least to inform them the 3GPP study plan and a first convergence, if possible, of some TPRs (incl. to-dos & not-to-dos)

- **RAN#107**

- Aim to finalize the candidate set of TPRs
- Initial discussion on the associated values of the identified TPRs
  - A corresponding summary of the values as an input for future progress
- Possible LS to ITU-R as necessary, depending on the progress of the study

- **RAN#108**

- Aim to finalize the associated values of the identified TPRs
- Capture the study outcome into TR
- LS to ITU-R as necessary

- **After RAN#108**

- Any remaining issues on 6G focusing on ITU-R can continue, as needed along with the general 6G study

*Note: The study plan for the 6G study focusing on ITU-R needs to adapt to ITU-R progress/update as needed*

# 6G workshop @Ran107 (March 2025, Seoul, SK)

6GWS-250238

- ☎ Opportunity for 3GPP members to present their **vision & priorities for next generation radio technology, system architecture, core network and protocols.**

- ☎ **1,676 registrations, 748 in-person registrants**

- ☎ **219 input contributions from operators, vendors, academia, and MRPs**

- ☎ Discussions covering **radio, core network, protocols, and more**

## NOT BINDING WORKSHOP

....does not imply any prioritization or ranking of 6G technical areas.

The scope of work within 3GPP is determined by its established working procedures, and there is no assurance that all the potential technical areas mentioned will be pursued as part of 3GPP studies in Release 20.

# 6G @plenary in Incheon (March 2025)

## RP-250810 – RAN-level Study on 6G Scenarios and requirements

### Objectives

- Investigate a candidate set of items for minimum TPRs based on the Recommendation ITU-R M.2160, and, where applicable, the associated target values and key assumptions for the identified minimum TPRs.
  - The outcome is expected to be shared by LS with ITU-R WP5D, as suitable, and used as a baseline for the subsequent study 6G in RAN
- Identify typical and practical deployment scenarios defined by attributes such as carrier frequency, inter-site distance, user density, maximum mobility speed, and other relevant factors.
- Develop 3GPP requirements for 6G Radio for improvement of existing services and for new services.
- Determine the applicability of legacy services to 6G Radio, and define radio requirements for these, as appropriate.
- Develop 3GPP requirements for 6G Radio for these practical deployment scenarios to ensure substantial gains in all relevant bands: overall performance, user experience, TCO reduction including at least:
  - Ensure appropriate set of functionalities, minimize the adoption of multiple options for the same functionality, avoid excessive configurations, excessive UE capabilities and UE capabilities reporting
  - Energy efficiency and energy saving: both for network and device
  - Enhanced spectral efficiency
  - Enhanced overall coverage, focus on cell-edge performance and UL coverage
  - Wider channel bandwidth (at least 200MHz) support for 6G deployments at least above 2 GHz, around 7 GHz
  - Re-use of existing 5G mid-band (~3.5GHz) site grid for 6G deployments in at least around 7 GHz and targeting comparable coverage to 5G mid-band
  - Target scalable and forward compatible design for diverse device types
  - Improved spectrum utilization and operations taking into account diverse spectrum allocations
  - Aim at using common 6G Radio design, which meets mobile broadband service requirements as high priority, to also meet vertical needs
  - Aim at a harmonized 6G Radio design for TN and NTN, including their integration
  - System simplification, including reducing configuration complexity, enabling more efficient Cell/UE management, etc.
- Define a time plan and steer work as appropriate for the RAN WGs during the 6G WG SI to deliver high-level decisions at least on the following areas:
  - Fundamental 6G radio design aspects: waveform, numerology, channel coding, etc...
  - Overall high-level aspects of 5G to 6G migration
  - RAN architecture and interfaces, including RAN-Core interface
  - Coordination of 6G AI/ML framework
- Note: The detailed time plan for the high-level decisions above will be decided at RAN#108 at the approval of the 6G RAN WG SI and is to be aligned with the RAN SI progress.

THANKS!!! 😊

Q&A