Security Conference 2022

Overview of the direction of mobile standards

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3GPP has a clear focus on 5G and its further evolution

- The complete set of 3GPP 5G specifications has been submitted by 3GPP Organizational Partners to the ITU. The ITU has confirmed that the complete set meets the requirements of IMT-2020
- 3GPP **Release 15** and **Release 16** are now the basis of 5G commercial deployments worldwide
- **214** commercial 5G networks have already been launched worldwide (May 2022: source GSA)
- The majority of deployments are non-standalone mode
- Widespread standalone deployment is taking more time than first predicted…..

3GPP timeline for 5G-Advanced and beyond

- Rel-17 is now complete (Stage 3, with some minor exceptions)
- 3GPP Rel-18 normative work is underway and is scheduled for completion at the end of 2023
- 3GPP has decided to brand 3GPP Release 18 and beyond as **5G-Advanced**
- 3GPP Rel-19 informative work (studies) are underway with no defined completion date yet
- There is no 3GPP agreed timeline for 6G yet, but there are lot of corridor discussions!

Where is 3GPP heading with Release 17 and Release 18?

5G industrial expansion e.g.,

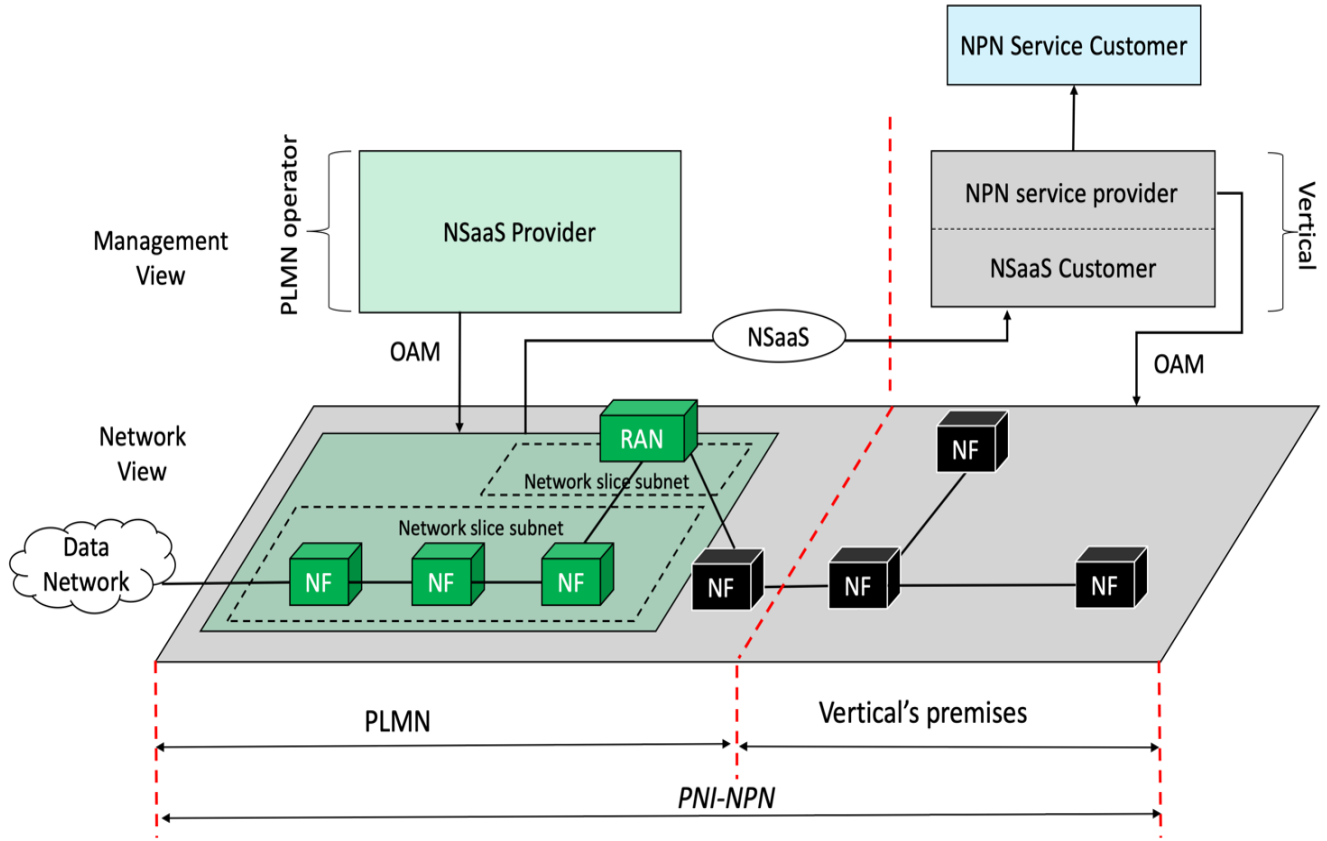
- Smart energy & infrastructure
- Health Sector
- Maritime
- Asset tracking
- Factory automation
- Wearables

5G capability/efficiency improvements e.g.,

- Non-public networks
- Non-terrestrial networks
- Time-sensitive networks
- Coverage enhancements
- Positioning accuracy
- Reduced capability

5G public and private networks

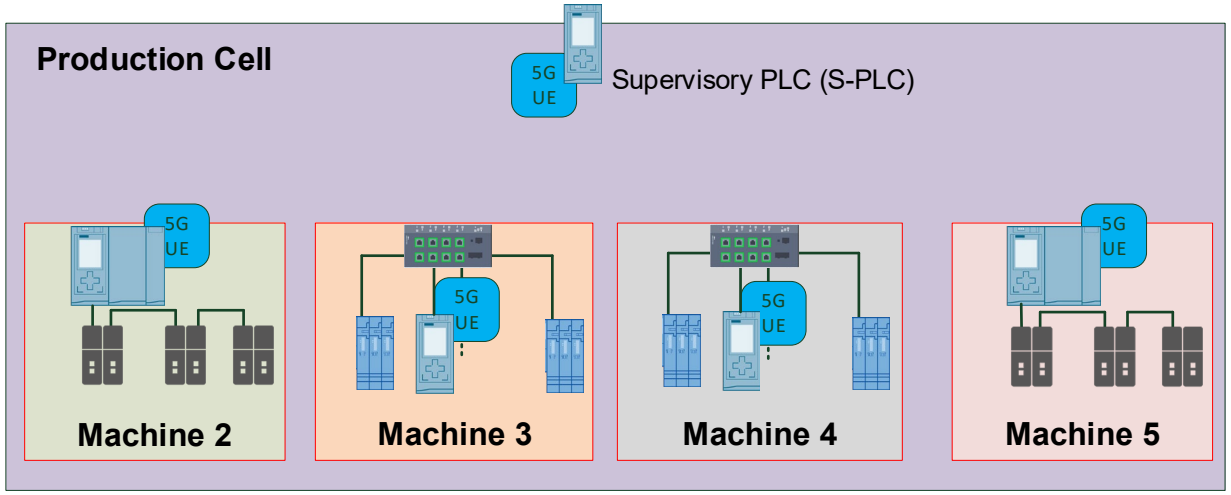
- A Non-public network (NPN) may be deployed in a variety of configurations, using both virtual and physical network functions. Specifically, a NPN may be deployed as:
  - a Stand-alone Non-Public Network (SNPN), i.e. operated by an NPN operator and not relying on network functions provided by a PLMN; or
  - a Public network integrated NPN (PNI-NPN), i.e. a non-public network deployed with the support of a PLMN (see 3GPP TR 28.807)
- 626 organisations are deploying LTE or 5G private mobile networks (Source: GSA)
- TS 22.501 and TR 33.819 address access, authentication and security requirements



NSaaS =Network Slice as a Service

5G control applications in vertical domains

- A vertical domain is a particular industry or group of enterprises in which similar products or services are developed, produced, and provided.
- Automation refers to the control of processes, devices, or systems in vertical domains by automatic means with sensors, transmitters, controllers, and actuators



3GPP TS 22.104 (Release 18)

Service requirements for cyber-physical control applications in vertical domains:

CyberCAV control applications in various vertical domains, especially in industrial automation and energy automation. 5G ultra-reliable ultra-low-latency communication (URLLC) is needed for sharing real-time information, for example, between machines at various steps in a production cycle.

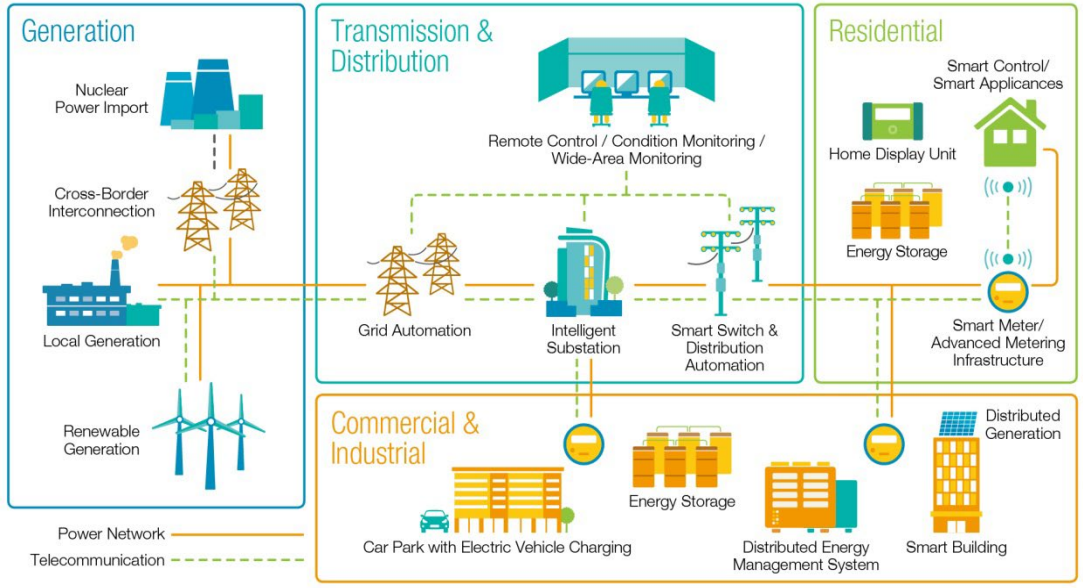
Also contains the service requirements, such as on clock synchronization for time-sensitive networking for cyberCAV using LAN-type services.

Cyber-physical control applications are to be understood as applications that control physical processes. In automation, they follow certain activity patterns (open-loop control, closed-loop control, sequence control, and batch control).

Communication services supporting cyber-physical control applications need to be ultra-reliable, dependable with a high communication service availability, and often require low or (in some cases) very low end-to-end latency.

5G for smart energy and infrastructure

- Communication infrastructure is essential for managing power generation, transmission, distribution, and consumption
- Currently served by a mixture of private networks, 5G presents an opportunity for considerable improvement



3GPP TR 22.867 (Release 18)

Study of potential new service requirements for 5G system to support smart grid including the following topics:

Smart Grid services, e.g. IEC standards, and their communications requirements including capacity, latency, availability, end-to-end QoS, resilience/redundancy and security.

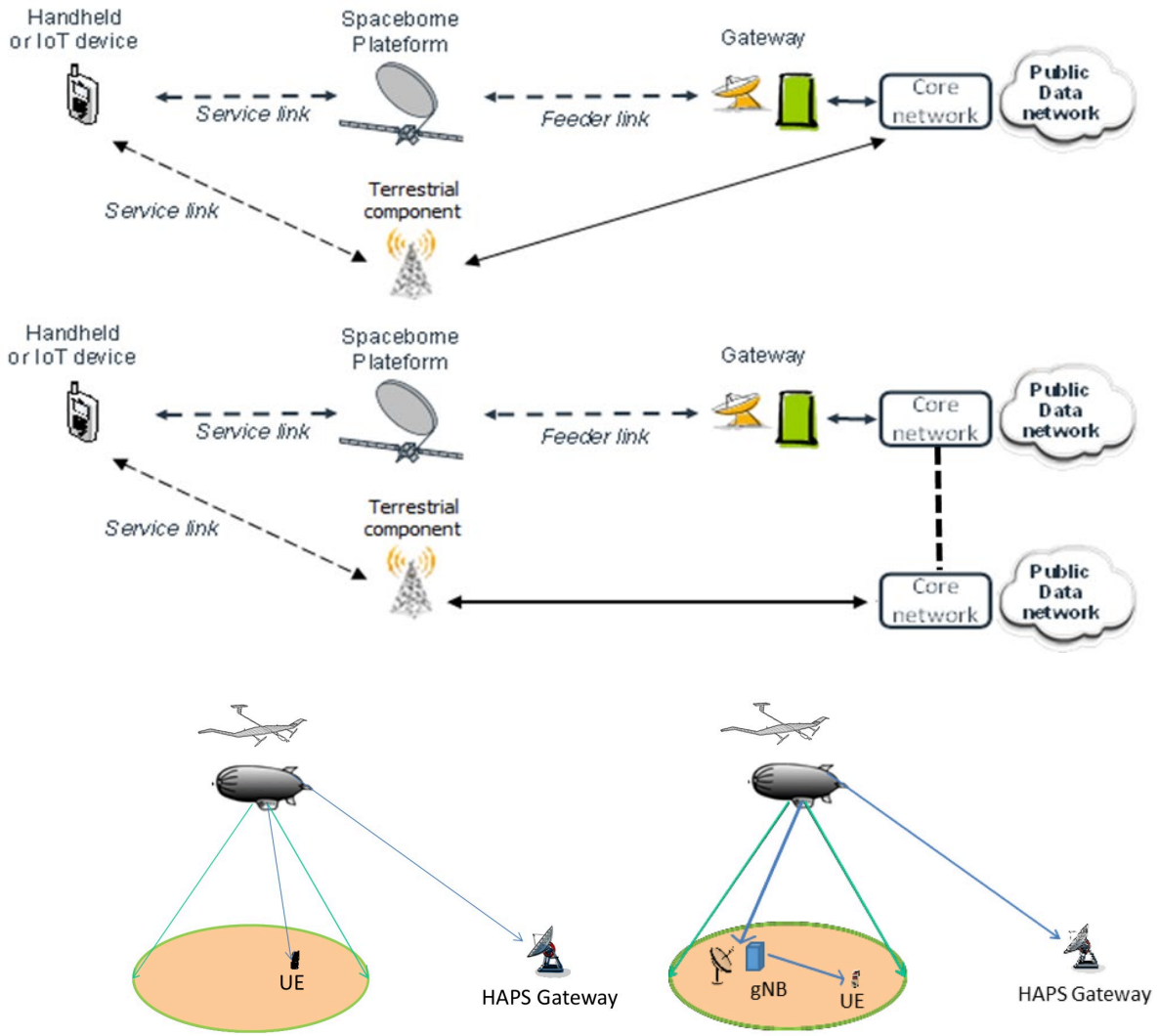
Deployment requirements when considering constraints e.g. service lifetime, coverage (ubiquity), electromagnetic applicability (e.g. penetration, ability to operate in high EM environments,) etc.

Additional requirements due to operational manageability – e.g. the ability to configure and monitor the real (achieved & up to date) availability of virtual network topologies

New Smart Grid use cases and potential service function requirements: e.g. on-demand power supply, distributed power supply system, distribution automation, higher accuracy power load measurement and control, meter automation, etc.

Communication KPI and service requirements for enabling micro-grids, DER and specifically distributed generation (DG) that require 5G wireless communication (e.g. wind and solar energy generation, including scenarios at or near residential / consumer premises, etc.)

5G non-terrestrial networks



TR 38.811 (Release 15)

Non-Terrestrial Networks are expected to

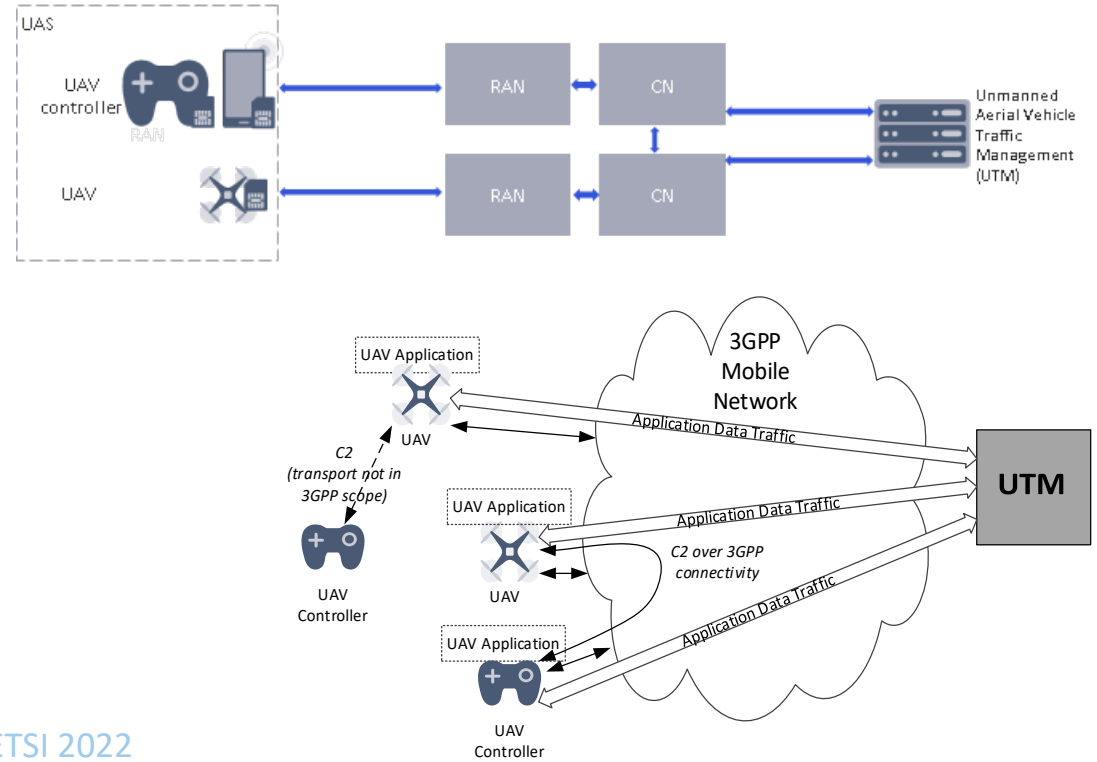
- foster the roll out of 5G service in un-served areas that cannot be covered by terrestrial 5G network (isolated/remote areas, on board aircrafts or vessels) and underserved areas (e.g. sub-urban/rural areas) to upgrade the performance of limited terrestrial networks in cost effective manner,
- reinforce the 5G service reliability by providing service continuity for M2M/IoT devices or for passengers on board moving platforms (e.g. passenger vehicles-aircraft, ships, high speed trains, bus) or ensuring service availability anywhere especially for critical communications, future railway/maritime/aeronautical communications, and to
- enable 5G network scalability by providing efficient multicast/broadcast resources for data delivery towards the network edges or even user terminal.

The benefits relate to either Non-Terrestrial networks operating alone or to integrated terrestrial and Non-Terrestrial networks. They will impact coverage, user bandwidth, system capacity, service reliability or service availability, energy consumption, connection density.

A role for Non-Terrestrial Network components in the 5G system is expected for the following verticals: transport, Public Safety, Media and Entertainment, eHealth, Energy, Agriculture, Finance, Automotive

UAV connectivity, identification and tracking

- Uncrewed Aerounautical Vehicles will support many differing applications, including Mission Critical
- UAV identification, authorization and revocation procedures must be standardized robustly



3GPP TR 23.754 (Release 17)

- Identifying the architecture and system aspects related to supporting UAS command and control functions according to use cases described in TR 22.825, including studying solutions for enabling according to the requirements in TS 22.125:
  - UAV controller and UAV(s) identification and tracking, including studying the extent to which the 3GPP system is involved
  - UAV controller and UAV(s) authorization and authentication by UTM
  - Identify whether enhancements to existing mechanisms is needed to provide connectivity for exchange of traffic between UAV controller(s) and UAV(s) as well as to provide connectivity to the UTM, considering both line of sight connectivity and non-line of sight connectivity
- Identify whether and what enhancements are needed to enable UAV(s) and a UAV Controller to establish connectivity in the 3GPP system with the UTM for UAV operation
- Re-use of solutions in existing specifications to the maximum extent possible, where applicable.

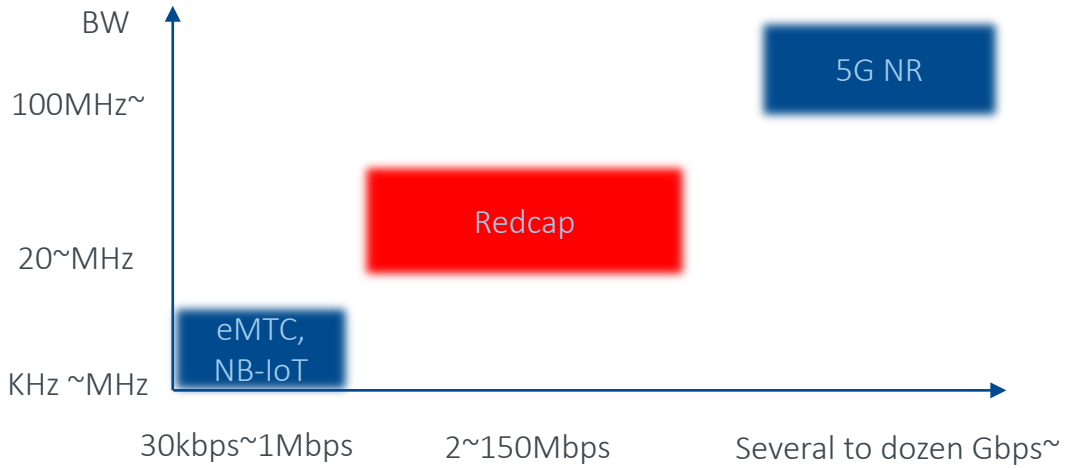
The study item will analyze how mechanisms to support UAS in the 3GPP system according to SA WG1 requirements are applicable to 5GS and possibly EPS.

The semantics and content of UAV controller to UAV(s) communications are outside the scope of this study.

Use of PC5 for UAV to UAV communications and aspects related to detection and reporting of unauthorized UAVs towards UTM are outside the scope of this release.

5G reduced capability

- Main motivation is to lower device cost and complexity as compared to high-end eMBB and URLLC devices, and compact device form factor. Reduced capabilities include:
  - Reduced number of UE Rx/Tx antennas, UE bandwidth reduction, Half-duplex FDD operation, Relaxed UE processing time, Relaxed maximum number of MIMO layers, Relaxed maximum modulation order.



TR 38.875 (Release 17)

The study includes identification and study of potential UE complexity reduction techniques and UE power saving and battery lifetime enhancements for reduced capability UEs in applicable use cases, functionality that will enable the performance degradation of such complexity reduction to be mitigated or limited, principles for how to define and constrain such reduced capabilities, and functionality that will allow devices with reduced capabilities to be explicitly identifiable to networks and networks operators and allow operators to restrict their access if desired.

The scope of the study includes support for all FR1/FR2 bands for FDD and TDD and coexistence with Rel-15/16 UEs.

This study focuses on Stand Alone mode and single connectivity. The scope of the study does not include LPWA use cases.

Use cases include:
Industrial wireless sensors
Video Surveillance
Wearables

Technology	Category	BW	DL peak	UL peak
NB-IoT	Cat-NB1	200KHz	62.5kbps	25.3kbps
LTE-M	Cat-M1	1.4MHz	0.8Mbps	1Mbps
NR	NSA	>100MHz	4-10Gbps	4-10Gbps
Redcap	-	20MHz	2-150Mbps	2-50Mbps

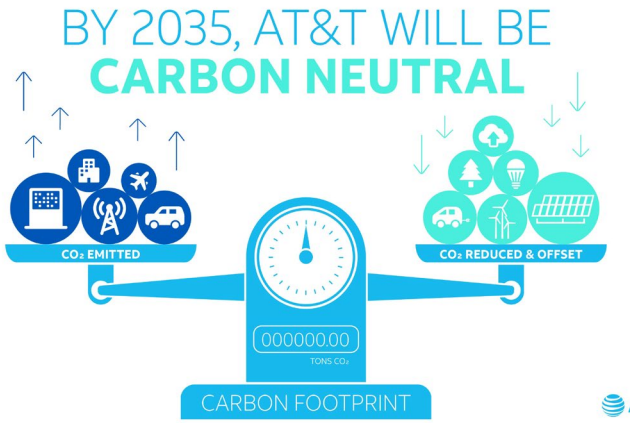
But will the future be more about sustainability?

"Vodafone commits to net zero carbon emissions by 2040"

> *"By 2030, Vodafone will eliminate all carbon emissions from its own activities and from energy it purchases and uses (Scope 1 and 2). Vodafone also pledged that by 2030 it will halve carbon emissions from Scope 3 sources, including joint ventures, all supply chain purchases, the use of products it has sold and business travel."*
>
> https://www.vodafone.com/news-and-media/vodafone-group-releases/news/vodafone-commits-to-net-zero-carbon-emissions-by-2040

"AT&T Commits to be Carbon Neutral by 2035"

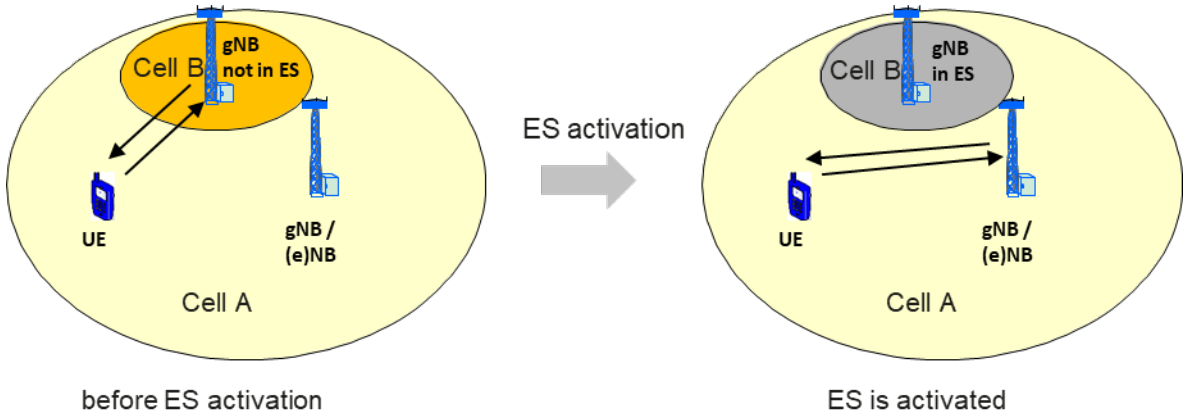
> https://about.att.com/story/2020/att_carbon_neutral.html



[Consider Landauer's principle to understand why processing generates so much heat https://en.wikipedia.org/wiki/Landauer%27s_principle]

Energy efficiency and energy saving

- Energy Efficiency and Energy Saving will become increasingly important over time
- A lot of groundwork has been done to better understand the subject.
- Innovative approaches are now been considered to provide real practical results



before ES activation

ES is activated

3GPP TS 28.310 (Release 17)

The energy efficiency of a mobile network can be defined by its performance divided by its energy consumption, where the definition of performance depends on the network entity it applies to. For a unit of energy consumed by the mobile network, the higher its performance is, the higher its energy efficiency I

Historically, the focus has been put on the Radio Access Network (RAN) since it's commonly agreed that it constitutes the most energy consuming part of the mobile network; its performance is assessed by the traffic data volume carried by base stations (cf. ETSI standard ES 203 228).

Work is now ongoing to define the performance of a 5G core network and of network slices. In the Network Slice as a Service (NSaaS) model, a customer may express requirements to a provider about the energy efficiency of the network slice they want to order. The performance of a network slice is defined in terms of data volume for enhanced Mobile Broadband (eMBB), the reduction of latency for Ultra Reliable Low Latency Communications (URLLC), number of registered subscribers or active user equipment for massive IoT.

As illustrated, an NG-RAN node, which connects with 5GC to provide boost capacity, may enter into energySaving state if there is radio coverage by other radio systems – be another NG-RAN node or an entity of another radio access technology - for the whole coverage area of the NG-RAN node in question.

5G artificial intelligence and machine learning

- Artificial Intelligence (AI) and Machine Learning (ML) will become an integral part of future networks
- AI and ML will enable significant network efficiency gains

3GPP TR 37.817 (Release 17)

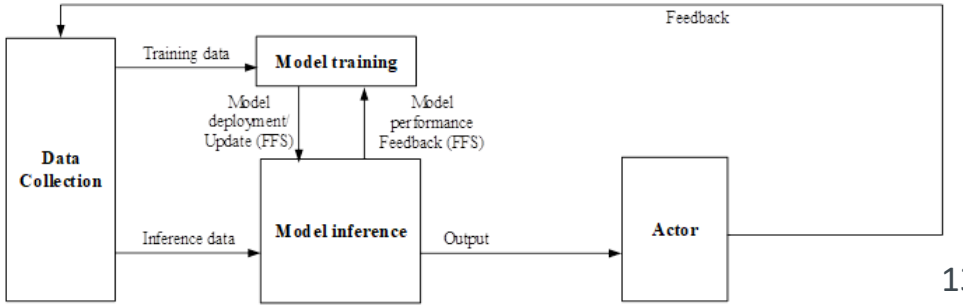
Study high level principles for RAN intelligence enabled by AI, the functional framework (e.g. the AI functionality and the input/output of the component for AI enabled optimization) and identify the benefits of AI enabled NG-RAN through possible use cases e.g. **energy saving**, **load balancing**, **mobility management**, **coverage optimization**, etc.:

a) Study standardization impacts for the identified use cases including: the data that may be needed by an AI function as input and data that may be produced by an AI function as output, which is interpretable for multi-vendor support.

b) Study standardization impacts on the node or function in current NG-RAN architecture to receive/provide the input/output data.

c) Study standardization impacts on the network interface(s) to convey the input/output data among network nodes or AI functions.

One general objective for the work is that the studies should be focused on the current NG-RAN architecture and interfaces to enable AI support for 5G deployments.



Open this, Open that…

- There is a tendency towards more and more use of open source “components” within mobile systems
  - At the device (handset) level, open source “components” represent a significant proportion of the total software package
  - Such open source approaches follow an “agile” rather than “waterfall” development process
- There is also a tendency towards a more “open” approach to the radio access system design
  - Additional interfaces are being specified (outside of 3GPP) to enable a more multi-vendor approach to the radio access network
  - The impact on interoperability and security is currently being debated
- Will 6G be inherently open by design?
- If so, how will that impact the work being done in traditional standards bodies?

Thank you for your attention

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