3GPP

Do utilities need to be involved?

What is the purpose of this briefing?

3GPP is the body which drives the standards and specification underpinning the technology which forms the basis of 3G, 4G, 5G and now 6G standardisation[1] both for commercial carrier as well as the increasing number of private cellular networks around the world. We have become accustomed to travelling throughout the world with a smart phone in our pocket or handbag, taking for granted that when we step off the aeroplane, our phone will instantly connect to the local mobile telephone network and we will be connected to a global voice and data network, capable of talking to friends and colleagues while surfing the internet with ease. In addition, there is growing interest in private cellular networks specifically in 4G and 5G focused on critical infrastructure. This includes utilities which face the need for the digitalisation of their power grids as well as public safety. It is testament to the success of 3GPP that few people have heard of the organisation and even less know what it does.

This paper aims to provide some background on:

- What is 3GPP?
- How does 3GPP work?
- What is 3GPP's organisational approach?
- How is 3GPP is involved in identifying radio spectrum bands for mobile networks?
- Why do utilities need to be involved in 3GPP?
- What are some of the features utilities are seeking in 3GPP?
- What are the timescales involved?

What is 3GPP?

The 3rd Generation Partnership Project (3GPP) joins the efforts of seven telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC) from around the world to provide a stable environment to produce the Reports and Specifications that define 3GPP technologies.

3GPP Working Group Meeting in San Diego, USA

[1] https://www.itu.int/en/mediacentre/Pages/PR-2023-12-01-IMT-2030-for-6G-mobile-technologies.aspx?utm_source=ITU+News+Newsletter&utm_campaign=be7bbb235a-EMAIL_CAMPAIGN_28_11_2023_ITU-NEWSLETTER_COPY_02&utm_medium=email&utm_term=0_-2f420cccc6-%5BLIST_EMAIL_ID%5D&ct=t(EMAIL_CAMPAIGN_28_11_2023_ITU-NEWSLETTER_INT_COPY_)&mc_cid=be7bbb235a&mc_eid=134776c27c

3GPP specifications cover cellular telecommunications technologies, including radio access, core network and service capabilities, which provide a complete system description for mobile telecommunications. The 3GPP specifications also provide hooks for non-radio access to the core network, and for interworking with non-3GPP networks.

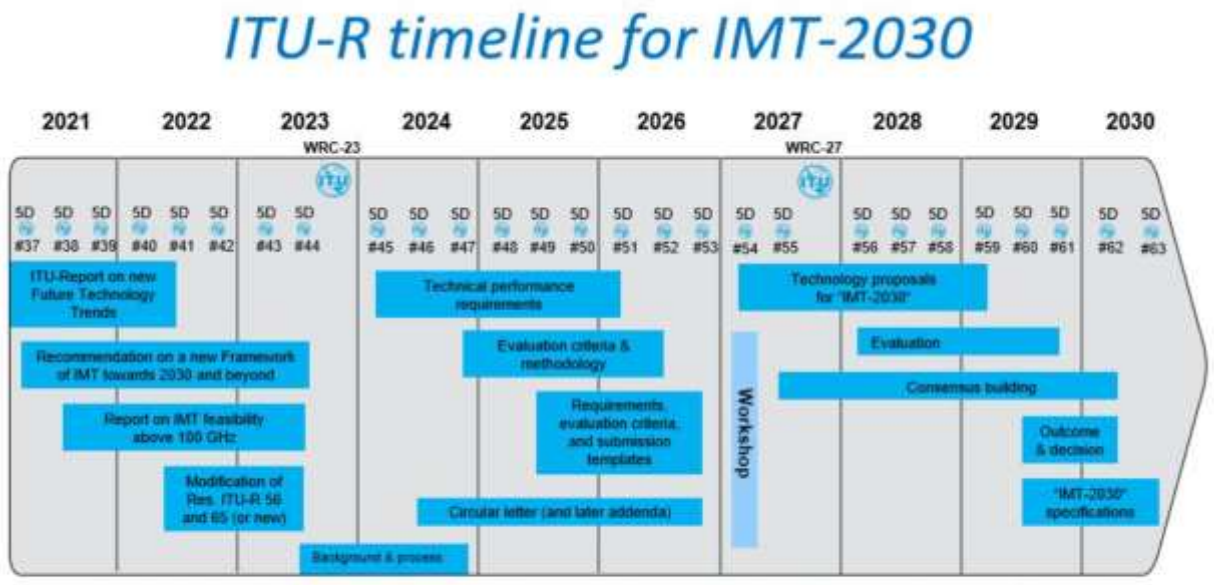
The original scope of 3GPP (1998) was to produce Technical Specifications and Technical Reports for a 3G Mobile System based on the earlier 2G/GSM core networks and the radio access technologies that they support (i.e., Universal Terrestrial Radio Access (UTRA) both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes).

The scope was subsequently amended to include the maintenance and development of the Technical Specifications and Technical Reports for evolved 3GPP technologies, extending beyond 3G to 4G/LTE, (Long Term Evolution), 5G, 5G Advanced and now 6G.

The International Telecommunication Union (ITU) publishes the framework for the development of standards and radio interface technologies, including International Mobile Telecommunications (IMT). The sixth generation of these mobile systems, popularly referred to as 6G, is now under development. The details of the 6G framework are contained in Recommendation ITU-R M.2160 on the "IMT-2030 Framework" approved by the ITU Radiocommunication Assembly (RA-23) at its last meeting in Dubai, United Arab Emirates in September 2023.

3GPP builds on these ITU standards to develop specifications and the associated standards required to implement these ITU standards in a practical and interoperable manner. In this way, 3GPP fulfils the objectives of the ITU International Mobile Telecommunications (IMT) programme.

In this way, the latest ITU-R Recommendation represents significant progress in the development and implementation of globally accepted standards for mobile systems using 6G (IMT2030). All the previous mobile telecommunication generations - analogue cellular (1G), digital cellular (2G), IMT - 2000 (3G), IMT- Advanced (4G), and IMT - 2020 (5G) - were also standardized through ITU.



Note 1: WP 5D #59 will additionally organize a workshop involving the Proponents and registered Independent Evaluation Groups (IEGs) to support the evaluation process

Note 2: While not expected to change, details may be adjusted if warranted. Content of deliverables to be defined by responsible WP 5D groups

Note by the ITU-R Radiocommunication Bureaux: *This document is taken from Attachment 2.12 to Chapter 2 of Document 5D/1361 (Meeting report WP 5D #41, June 2022) and adjustments could be made in the future. ITU holds copyright in the information – when used, reference to the source shall be done.*

How does 3GPP work?

3GPP members work together to produce specifications and studies. 3GPP is contribution-driven and organised into three main technical areas:

- Radio Access Networks (RAN)
- Services & Systems Aspects (SA)
- Core Network & Terminals (CT)

Working Groups meet regularly and come together for their quarterly Technical Specification Group (TSG) Plenary meeting, where their work is presented for information, discussion and approval. The last meeting of the week of TSG Plenary meetings is TSG SA, which also has responsibility for the overall coordination of the technical work and for the monitoring of its progress.

Since 3GPP has 862 Organisational Partner Members from across 42 countries participating in 127 meetings per year involving over 24,000 people in these meetings, the pace and complexity is breathtaking.

What is 3GPP's organisational approach?

3GPP Organisational Partners

Our Partners		Country
ARIB	The Association of Radio Industries and Businesses (ARIB) www.arib.or.jp	Japan
atis	The Alliance for Telecommunications Industry Solutions (ATIS) www.atis.org	USA
CCSA	China Communications Standards Association (CCSA) www.ccsa.org.cn	China
ETSI	The European Telecommunications Standards Institute (ETSI) www.etsi.org	Europe
tsdsi	Telecommunications Standards Development Society, India (TSDSI) http://tsdsi.org	India
TTA	Telecommunications Technology Association (TTA) www.tta.or.kr	Korea
TTC	Telecommunication Technology Committee (TTC) www.ttc.or.jp/e	Japan

The 3GPP technologies from these groups are constantly evolving through Generations of commercial cellular / mobile systems. With 4G(LTE) and 5G work, 3GPP has become the focal point for the vast majority of mobile systems beyond 3G.

Although these Generations have become an adequate descriptor for the type of network under discussion, real progress on 3GPP standards is measured by the milestones achieved in particular Releases. New features are 'functionality frozen' and are ready for implementation when a Release is completed. 3GPP works on a number of Releases in parallel, starting future work well in advance of the completion of the current Release. Although this adds some complexity to the work of the groups, such a way of working ensures that progress is continuous and stable.

The major focus for all 3GPP Releases is to make the system backwards and forwards compatible where possible, to ensure that the operation of user equipment is uninterrupted.

For 5G, many operators are starting with dual connectivity between LTE and 5G NR (New Radio) equipment – using the 'Non-Standalone' work completed early in 3GPP Release 15. In the process of completing the early drop of 5G NR care has been taken to build 'forward compatibility' into Non-Standalone NR equipment, to ensure that it will be fit for use on Standalone 5G NR systems.

Details of all 3GPP Work Items are in the 3GPP Work Plan, which provides details of the cooperation between all of the 3GPP groups on "Features", defined as 'new or substantially enhanced functionality which represents added value to the existing 3GPP system'.

Although many features and characteristics are adopted into 3GPP standards, it is up to manufacturers precisely which ones are actually incorporated into the final products – smart phones, modules, modems and networks.

How is 3GPP involved in identifying radio spectrum bands for mobile networks?

To ensure interworking between devices connected to networks operating in conformance to 3GPP specifications, 3GPP defines standardised radio frequency bands which can be implemented in devices. Devices cannot physically include all the bands standardised by 3GPP, so manufacturers decide which combinations of bands will be most attractive to customers. 3GPP does not allocate the spectrum bands itself, this is done by national radio spectrum regulators in accordance with guidelines agreed within the International Telecommunication Union (ITU), but most countries will only allocate bands for mobile networks which have been harmonised by 3GPP. There are now almost 100 frequency blocks identified for LTE, with a process currently underway to convert some of these bands to make then suitable for 5G.

The most powerful voice in determining new harmonised frequency bands is the Global Spectrum for Mobile Association (GSMA)[2] which represents Mobile Network Operators (MNOs) and works with national, regional and global spectrum bodies to identify suitable spectrum for the next generation of public mobile networks and ensure access is granted to this spectrum on a timely basis.

On the Raodmap: new LTE Band at 380 – 400 MHz and 5G for the existing bands

[2] GSMA | GSMA

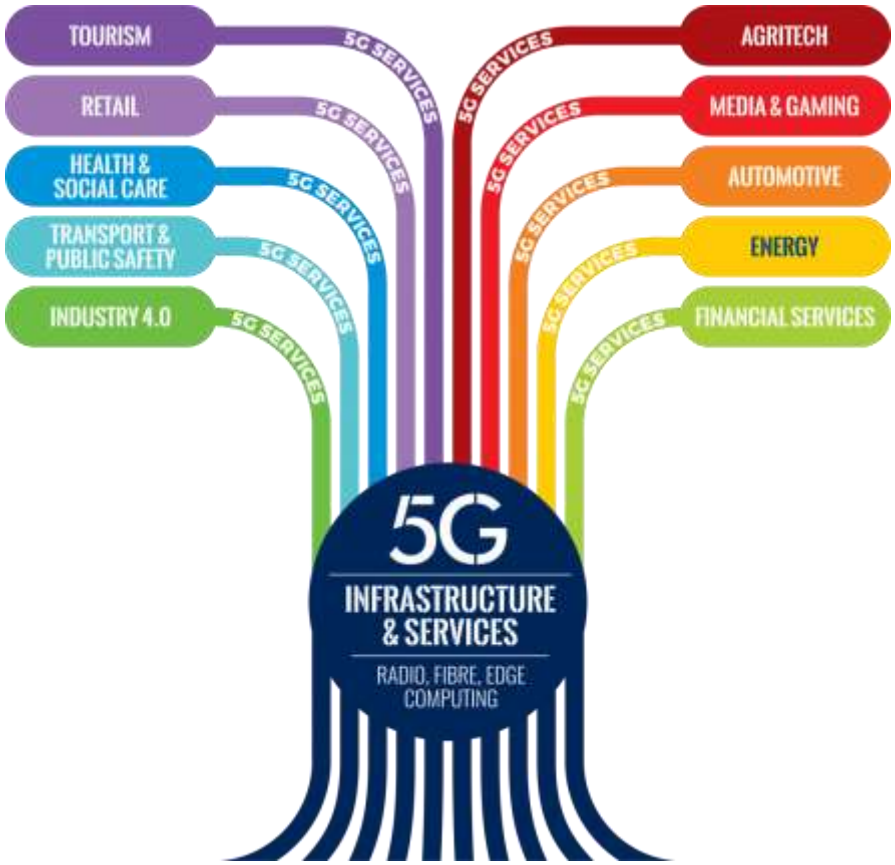
Against this background, the voice of utilities carries less weight and is an uphill struggle to obtain suitable and sufficient spectrum in appropriate bands to meet their operational needs. Most utility focus is currently on spectrum bands around the 400 MHz region as this part of the radio spectrum offers the optimum combination of coverage and capacity, the qualities most sought after by utilities needing to provide critical operational control over large geographic areas.

Why do utilities need to be involved in 3GPP?

As pointed out earlier, 3GPP is contribution driven. Initially, that meant that Mobile Network Operators (MNOs) and vendors drove the process to ensure interoperability and to stimulate market growth. Their focus was quite legitimately on their own needs and on consumer markets which were driving growth.

As the consumer market has matured, the focus of the industry has shifted to what are commonly called 'vertical markets', drawing in representation of interests beyond the MNOs.

In order to ensure that 'their' requirements are incorporated into emerging specifications for 4G/LTE, 5G and 6G, key vertical players such as the automotive sector, railways and health-care have organised themselves into groups to participate in 3GPP working groups. Some sectors, such as Public Safety have benefited from government support in organising their participation.



Vendors understandably devote their Research and Development (R&D) efforts in the areas in which they perceive the greatest benefits. Thus even when features of interest to utilities are incorporated into 3GPP specifications, vendors will not include these features in their products unless they perceive a market demand for them. The presence of utilities in 3GPP can underline the importance of features and facilities which might otherwise be overlooked.

A further, more fundamental element revolves around exposure of the mobile network parameters. In managing mission critical telecoms networks, utilities may need access to information on network performance and parameters of little interest to the vendor or MNOs., but crucial to utilities. In order that these parameters are accessible externally and possibly remotely, utilities need to be engaged in the detailed discussions in 3GPP.

As there is limited space on silicon chips to incorporate all the features sought, and competition in working groups for the time needed to develop specifications, only those industrial sectors willing to contribute effort to the process will obtain the features and facilities they require in future generations of mobile network technology. Others have to make do with what they are offered.

As the standards process is global and the meetings are hosted world-wide, it is important for utilities to present unified global representation and contributions to the process since nobody but the utilities themselves can accurately reflect their specialist requirements. Once the requirements of utilities have been incorporated in 3GPP standards the telecommunications manufacturers will develop product accordingly and the eco system will evolve. This process will not be started by the mobile industry or any other party without the involvement of the utilities.

What are some of the features utilities are seeking in 3GPP?

- **Monitoring and supervision of end devices by the network**

Although end devices communicate with base stations in order to optimise their communication pathway, this data is not available to the network controller in order to enable utility network operators to supervise the tens or hundreds of thousands of end user devices connected to a smart grid. Facilities are required to enable the utility to access this data, especially signal quality and signal strength measurement so that the control room is aware of the status of end devices remotely.

It would be advantageous if this data could be obtained utilising a passive mechanism to monitor end devices without establishing additional communication links between the end device and the control room. If data about end devices could be obtained directly from the base station and could be provided via an API from the core network towards the utility network, it would be possible to ensure that an end device is still connected to the network and record its signal quality without generating additional communication traffic at the edge of the network.

- **Exchange of data between telecoms networks and energy networks**

Utilities are pressing for the next generation of 3GPP specifications which define the characteristics of 4G/5G/6G telecoms networks to include functionality to enable utility and telecoms network operators privileged network availability data on each others' networks (but not controls) to understand the extent of unplanned network interruptions and facilitate co-ordination of responses to mitigate the impact on customers of both networks.[3]

Thus, when a telecoms network fails, the utility would be able to understand the nature and extent of the problem, and take mitigating action such as migrating connections from one telco network to another where dual network connections have been enabled. The energy network may also be able to assess how much demand management capability may have been lost and for what likely period of time by the interruption to the telecoms network.

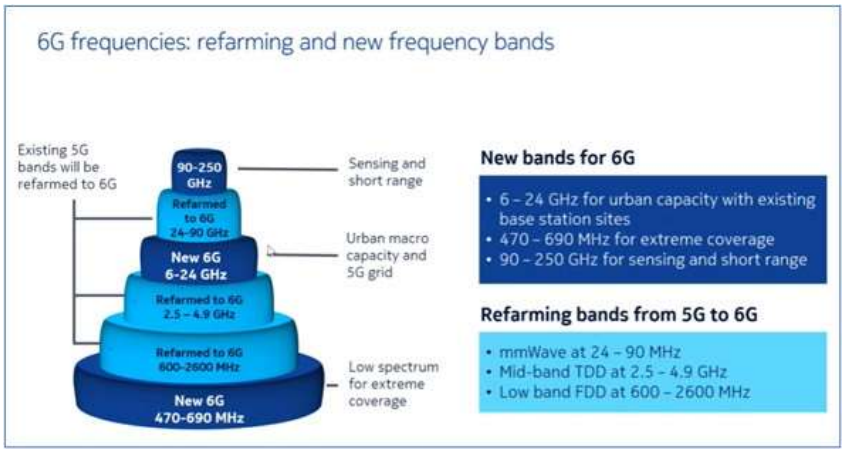
Correspondingly, in the event of an unplanned power outage, if the telco can see into the energy network, they can form an opinion of the potential duration and extent of the electricity outage, enabling them to optimise their response by for example restricting services on base stations to conserve back-up power supplies, reducing or enhancing overlapping coverage, or deploying portable generators.

[3] Specification # 28.829 (3gpp.org)

Detailed information is available in the 3GPP Technical Report 3GPP TR 28.829 V1.2.0 (2023-05).[4]

- **Extending 3GPP into 380-400 MHz bands.**

As highlighted above, for utilities the 'sweet spot' for coverage and capacity is the 400 MHz bands. The main reason is the favourable propagation characteristics which allow large cells for a cost effective implementation of the network. In addition, the indoor coverage is much improved when compared to the propagation of higher radio frequencies. In contrast, commercial network operators are extending up to 26 GHz for 5G, and looking to reach up to 250 GHz with 6G. In contrast, utilities and public safety operators are trying to push 5G down to 380 MHz, but without a coalition of mission critical users to drive standardisation down to lower frequencies, it will not happen.



- **High power end User Equipment (UEs)**

Currently, vendors are focused on the consumer market where light-weight hand-held user devices with long battery life and with low enough radio transmitter power can be safely used for long periods in close proximity to the human body. This restricts the range over which devices can communicate with base stations, effectively meaning that smart phone networks incorporate a high density of base stations to ensure good coverage and capacity.

For professional users, such as public safety, utilities and transportation, reliable and resilient wide area coverage is more important than massive data-rates, often in sparsely populated areas. In these situations, the coverage area is usually limited by the uplink communications leg, hence higher power end user devices facilitate secure and extensive network coverage in the most cost-effective manner.

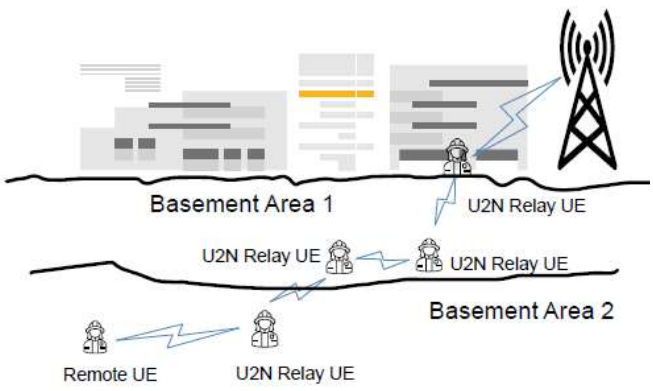
- **Direct device-to-device communication (Side link) for off network communication**

Traditional Private Mobile Radio (PMR) systems embodied high power radio devices able to communicate directly with each other in the absence of a radio network. [Called 'direct mode' in Tetra networks or 'back-to-back' in analogue networks.] This capability provided a fall-back mode of communication when operating in areas outside network coverage, including underground and in tunnels. Conventionally, mobile phones do not have this capability, requiring an intermediate network in order to be able to communicate.

[4] https://www.3gpp.org/ftp/Specs/archive/28_series/28.829/28829-120.zip

As well as providing direct handset to handset communications for off-network coverage, this 'sidelink' feature would facilitate relaying between handsets until the signal reaches a device with network coverage.

Multi-hop relaying for off-network communications



An additional application in areas of poor network coverage is to use a vehicle as a repeater and allow operatives in the area to connect to the network via the vehicle. This can currently be achieved using WiFi, but the range of WiFi is significantly less than would be achievable with the 'sidelink' feature. [Noting that a road vehicle can have a much more sensitive antenna on its roof than a hand-held device, has more battery power available, a potentially higher mounting position and can be located where it has network coverage if needed as a telecoms relay unit. In extreme conditions, a pump-up radio mast can be installed in vehicles.

- **Precise time stamping of packets on entry and exit of the telecoms network**

Electricity networks are increasingly deploying rapidly acting isolation switches to disconnect equipment or transmission lines when faults occur, especially when installing renewable energy generation on weak sections of electricity networks. These technologies require sub one second end-to end co-ordination of their switching action in order to prevent a damaging build-up of energy and isolate the fault. Precision time stamping of packets on entry and exit of the network is essential if 5G and ultimately 6G networks are to be used in support of these services where latency is a critical parameter. Although at present there is time stamping of messages transported through the network, they do not meet the stringent requirements which are needed to facilitate these time critical services.

What are the timescales involved?

3GPP releases overlap so that development is continuous. Items which are developing too slowly may slip from one release to the next, but support from a range of players is still needed if the work is to progress.

Currently, intensive work is underway in release 19 with the content to be included in this release frozen at the 102nd Radio Access Network Plenary (3GPP RAN#102) meeting in December 2023 at Edinburgh in the UK.

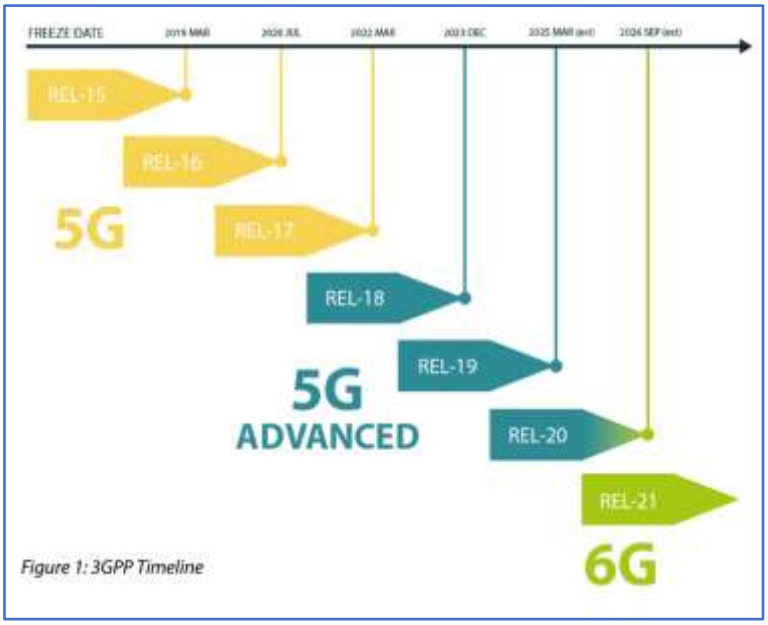
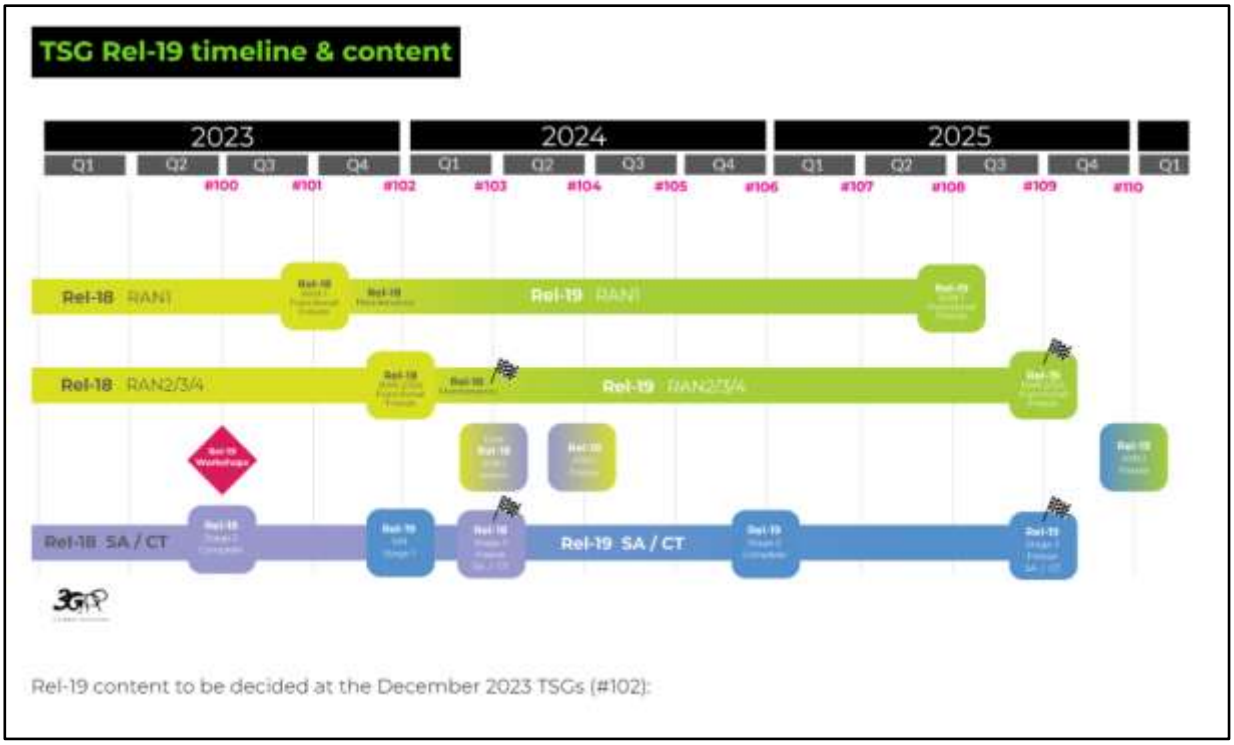


Figure 1: 3GPP Timeline

The subsequent meeting of the 153rd Services & Systems Aspects meeting (3GPP SA5#153) to develop EUTC's proposals will be held in Seville, Spain in early 2024.

EUTC will be represented at these and subsequent meetings in order to ensure the utilities' voice is heard.



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