



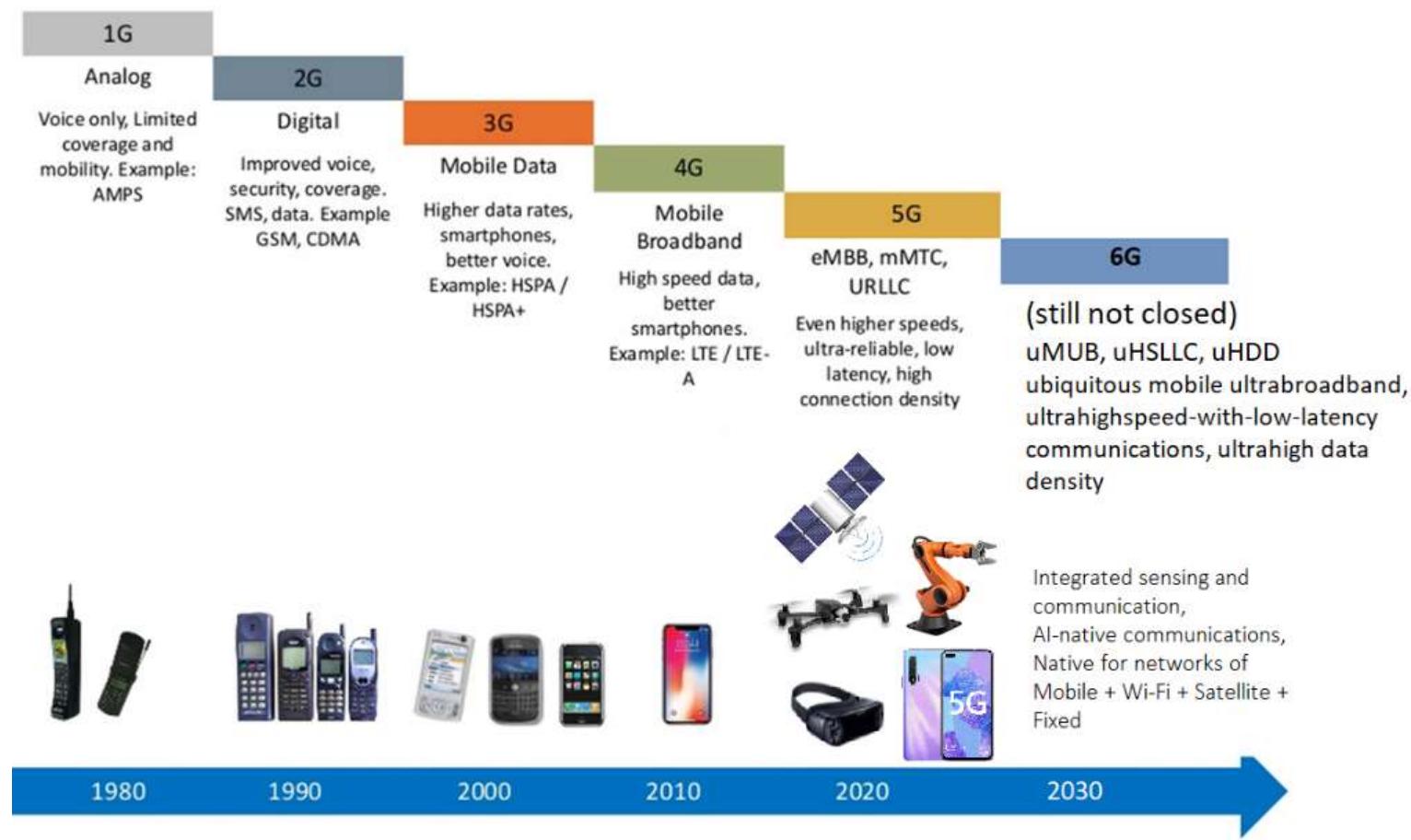
Mobile networks shutdown

Presentation @ Universidade Aveiro

16/11/2023

Confidential

Mobile technology evolution



Source: <https://blog.3g4g.co.uk/> edited & others

1st Generation shutdown

1G refers to the first generation of cellular network (wireless) technology.

The **first commercial cellular network was launched in Japan** by Nippon Telegraph and Telephone (NTT) **in 1979**, initially in the metropolitan area of Tokyo. The first phone that used this network was called TZ-801 built by Panasonic. Before the network in Japan, **Bell Laboratories built the first cellular network around Chicago in 1977 and trialled it in 1978.**

1G standards

Analog cellular technologies that were used were:^[6]

- Advanced Mobile Phone System (AMPS)^[9]
- Nordic Mobile Telephone (NMT)
- Total Access Communication System (TACS) developed in the United Kingdom and also some other parts of the world
- C-450 developed in West Germany and also adopted in Portugal and South Africa
- Radiocom 2000 in France (France Telecom only)
- RTMI in Italy
- MCS-L1 and MCS-L2 (developed by NTT) in Japan^[10]
- JTACS (a variant of TACS operated by Daini Denden Planning, Inc. (DDI)) in Japan^[10]

In the early to mid 1990s, 1G was superseded by newer 2G (second generation) cellular technologies such as GSM and cdmaOne

Source: <https://en.wikipedia.org/wiki/1G#Bibliography>

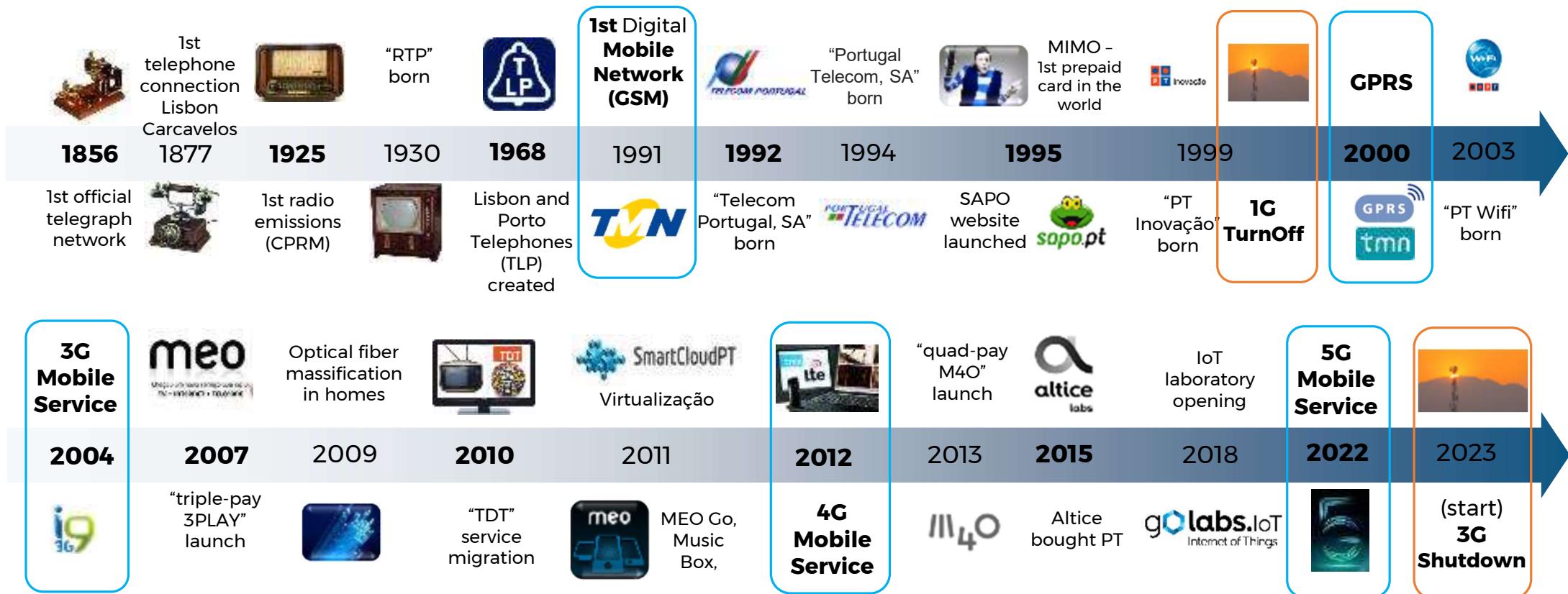


Dr. Martin Cooper @ 3 of April of 1973.

Most 1G networks had been discontinued by the early 2000s. Some regions especially Eastern Europe continued running these networks for much longer.
In Portugal, tmn' 1G (C-450) network was shutdown in 1999.
The last operating 1G network was closed down in Russia in 2017.

Altice Portugal

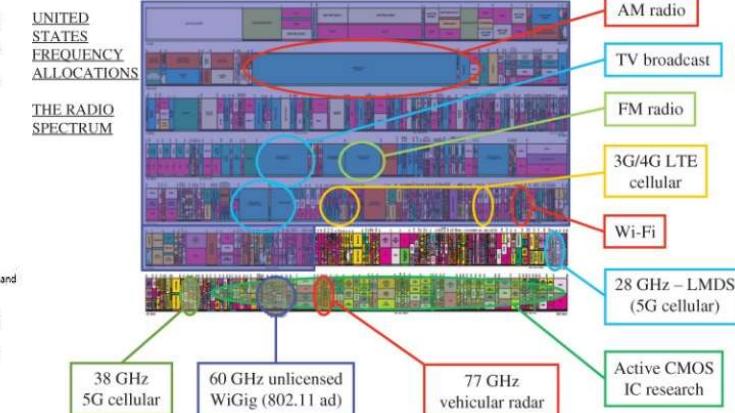
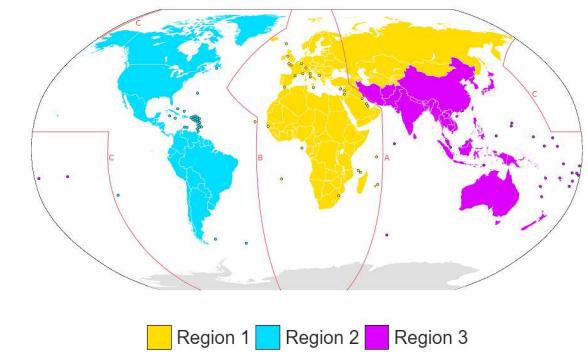
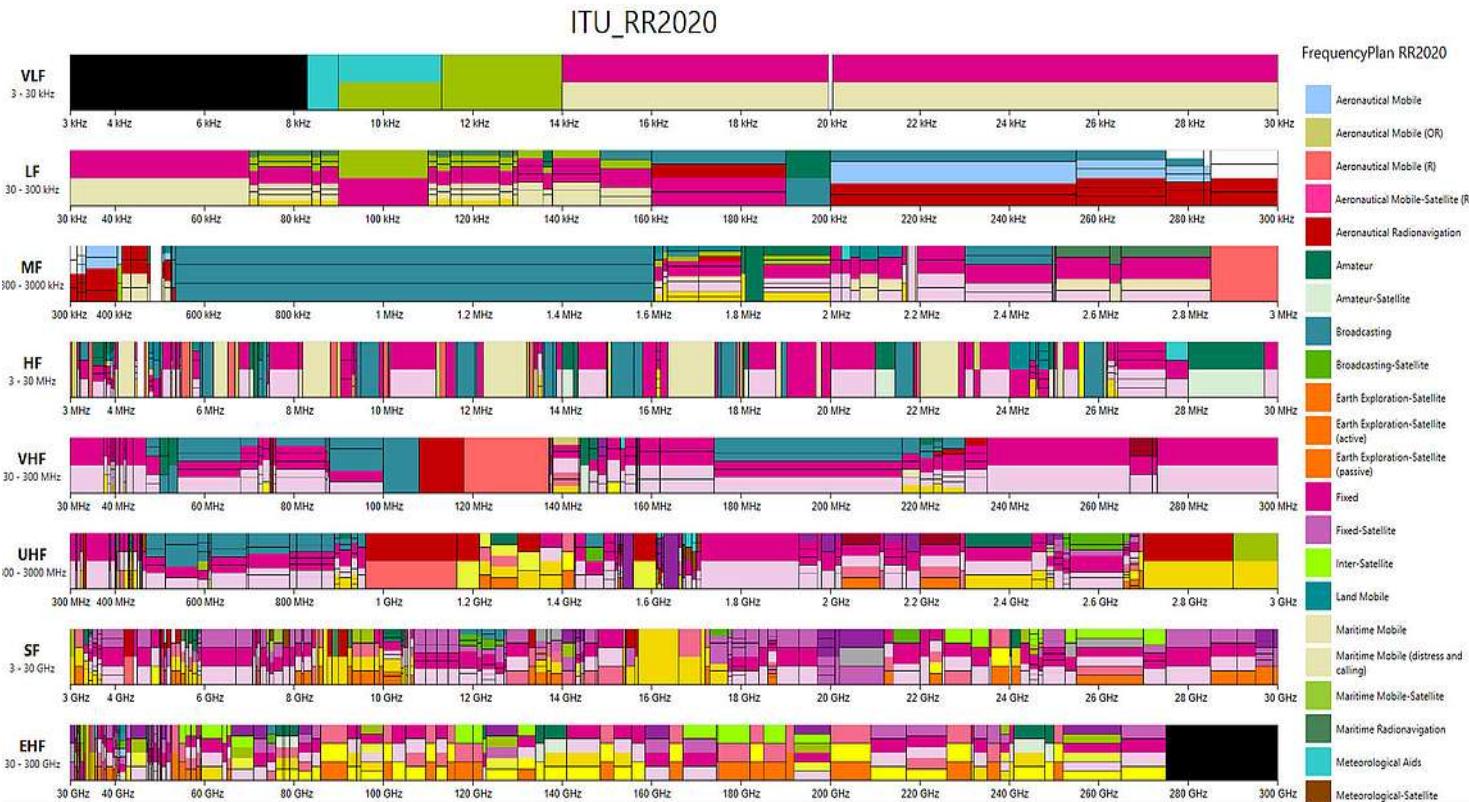
❑ Altice journey (some relevant historic achievements):



Source: <https://www.altice.pt/pt/altice-portugal/historia> & others

Global frequency spectrum

- Frequency spectrum is a precious asset, much desired:



<https://www.informit.com/articles/article.aspx?p=2249780>

ITU' World Radiocommunication Conferences (WRC)

- WRC are held every 3 to 4 years to review, and, if necessary, revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits.

WRC-19 (22/11/2019 @ Egito) made available several frequency bands to 5G:

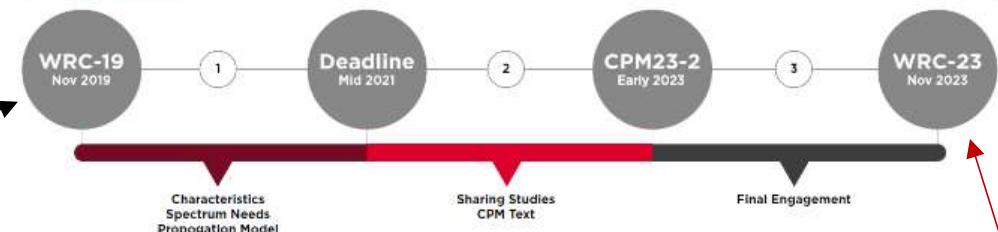
Additional bands identified to enable 5G deployment

While identifying the frequency bands for the deployment of 5G networks

- 24.25-27.5 GHz,
- 37-43.5 GHz,
- 45.5-47 GHz,
- 47.2-48.2
- 66-71 GHz

In total, 17.25 GHz of spectrum has been identified for IMT by the Conference, in comparison with 1.9 GHz of BW available before WRC-19.

WRC-23 timeline:



ITU World Radiocommunication Conference 2023 (WRC-23)
Dubai, United Arab Emirates, 20 November to 15 December 2023

WRC-23 IMT Agenda Items overview (Proposed)



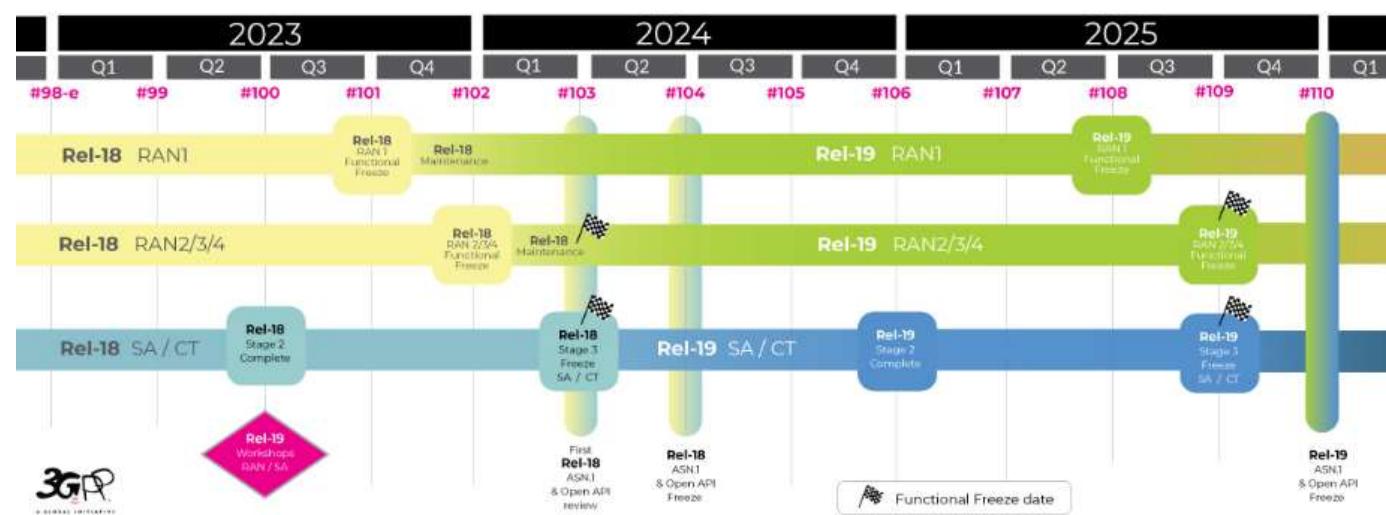
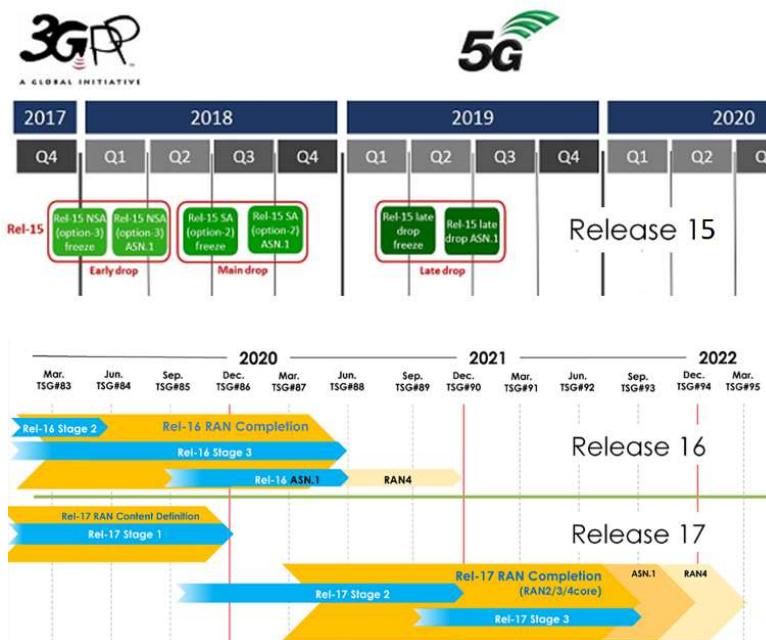
Bands	470-960 MHz	3300-3400 MHz	3600-3800 MHz	4800-4990 MHz	6425-7025 MHz	7025-7125 MHz	10-10.5 GHz
Region 1	AI 1.5 (IMT)	AI 1.2 (IMT)	AI 1.2 (IMT)	AI 1.1 (IMT)	AI 1.2 (IMT)	AI 1.2 (IMT)	
Region 2		AI 1.2 (IMT)	AI 1.2 (IMT)	AI 1.1 (IMT)		AI 1.2 (IMT)	AI 1.2 (IMT)
Region 3				AI 1.1 (IMT)		AI 1.2 (IMT)	

<https://www.itu.int/hub/publication/r-act-arr-1-2022/>

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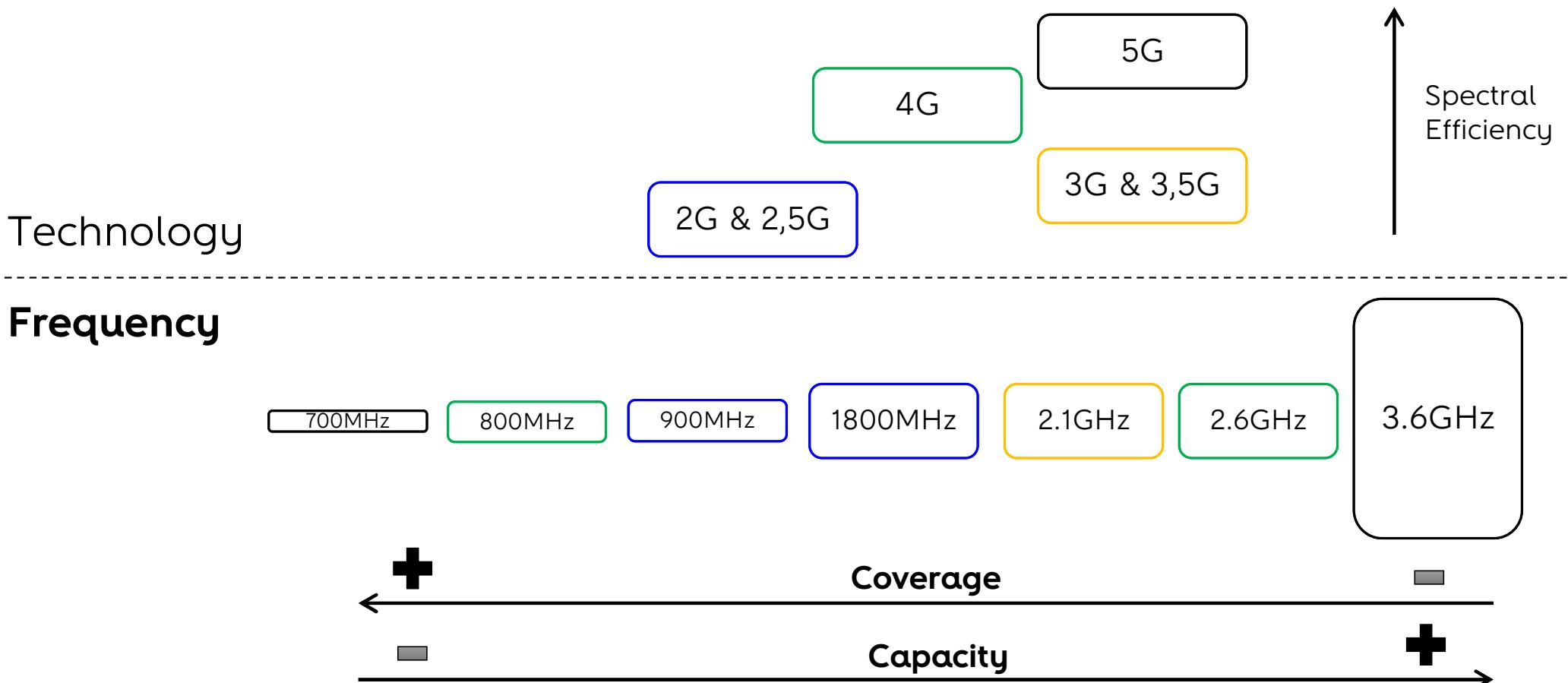
3GPP standards evolution – 5G

- 5G 3GPP releases: 15 (early drop @dez/2017), 16, 17, 18, 19



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Technology, Frequency, Coverage & Capacity



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3G & 2G shutdowns: GSMA guidelines



The GSMA is a global organization **unifying the mobile ecosystem** (over 1000 mobile operators and businesses across the ecosystem and related industries) to discover, develop and deliver innovation foundational to positive business environments and societal change.

GSMA vision is to unlock the full power of connectivity so that people, industry and society thrive.

Today, the GSMA remains at the forefront of **facilitating protocols and standards in mobile technology, from 4G and 5G, to 6G and what's next**. It also still helps to foster ingenuity and collaboration through the **global MWC series of events**, which brings the mobile ecosystem and related industries together.

Source: <https://www.gsma.com/aboutus/>

2021

2 Challenges

The major challenges (regulation, device, and network) for the industry related to 2/3G sunset are listed hereafter:

Regulation:

1. Regulator's permission: get regulators' support to shut down 2/3G
2. eCall migration toward IMS Voice

Device:

1. 4G Entry level phone: promote entry level phone industry
2. IMS Voice phone: recommend industry to enable IMS Voice by default
3. Migrate 2/3G M2M to 4G MiIoT (LTE-M and NB-IoT) by promoting the migration of legacy 2/3G use case to 4G

Network:

1. Develop IMS Voice in the home network, including postpaid and prepaid offers
2. Promote IMS Voice roaming
3. SIM replacement to offer 4G SIM card, or promote SIM replacement solution
4. Define network sunset initiation criteria: how to make 2G or 3G phase out decision based on the situation of 2/3G network, revenue, user, expenditure and 4G network readiness
5. Migrating 2/3G users to LTE by identifying the user category and develop the migration policy (2G user with no data requirement, 2G user with less data requirement, 2/3G user with 4G phone), offer different promotion
6. Spectrum refarming (partial or full)

Source: 20210603_GSMA_2G-3G Sunset Guidelines_NG.121-v1.0-2.pdf

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Global 3G & 2G Sunsets

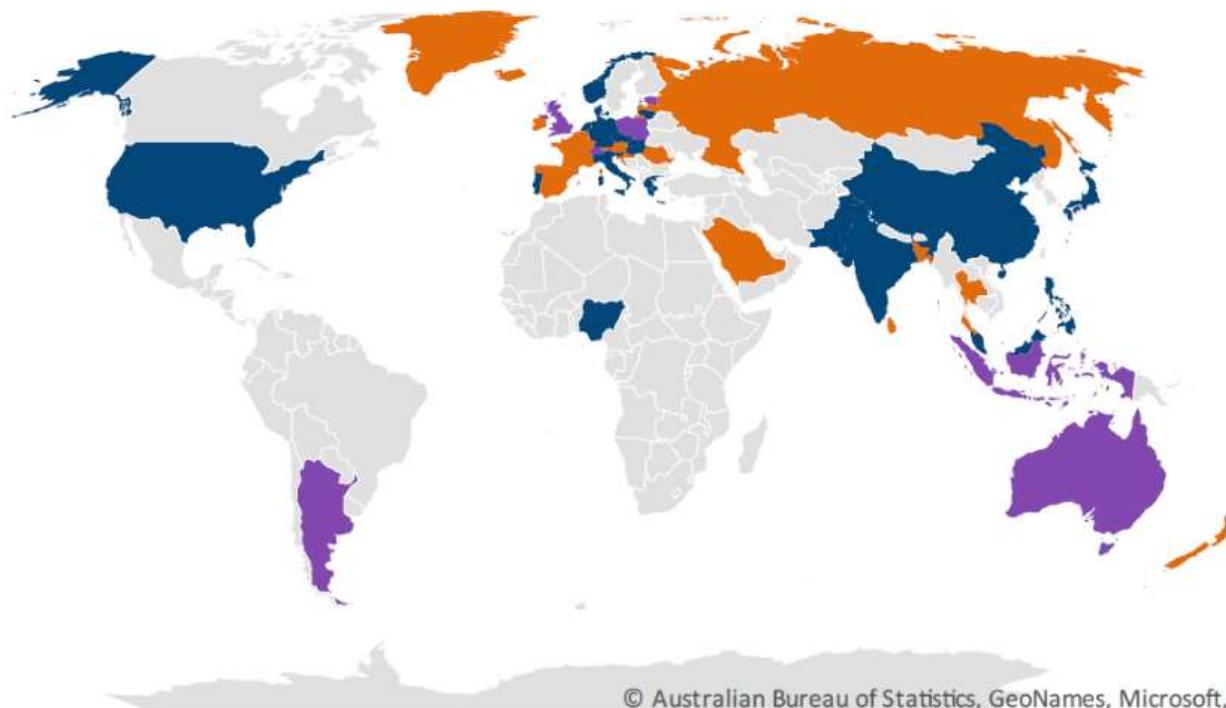


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3G shutdowns: global status

3G switch-offs completed, planned or are in progress

■ Completed ■ Planned ■ In Progress



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Global mobile Suppliers Association

2G and 3G Switch-Off | July 2023

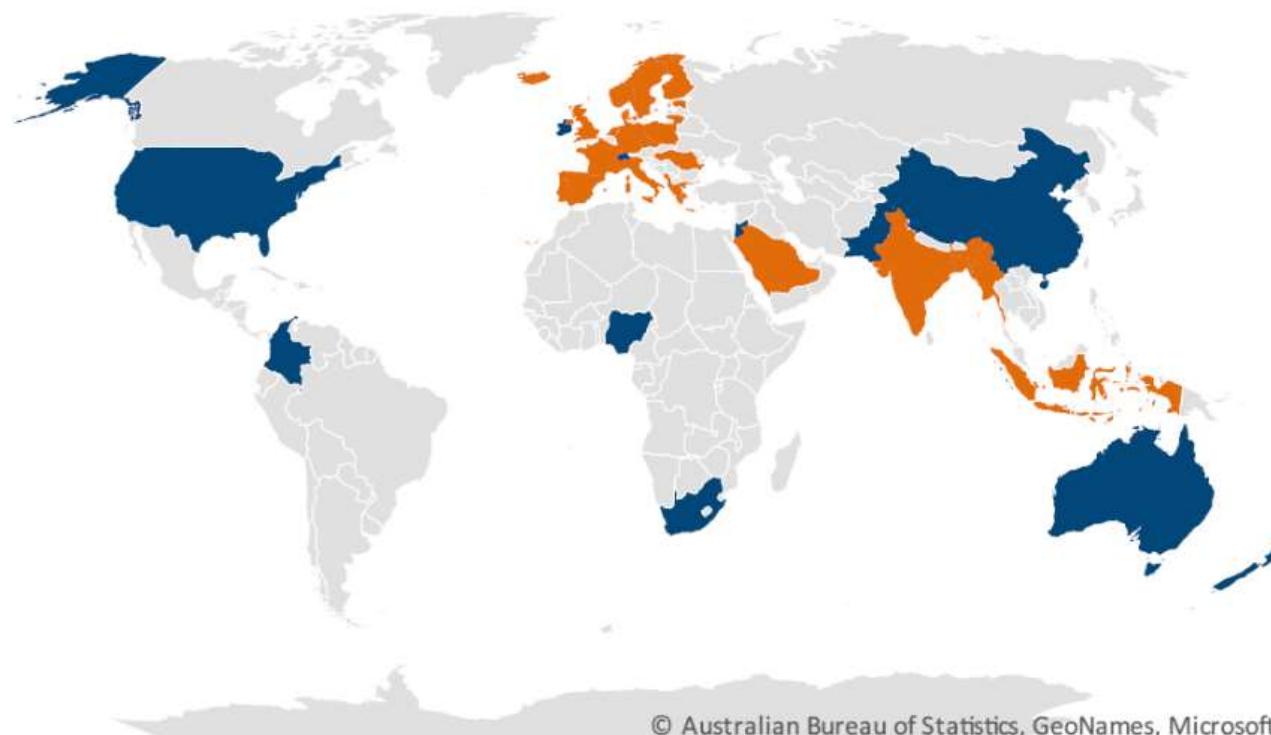
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2G shutdowns: global status

2G switch-offs completed, planned or are in progress

■ Completed ■ Planned



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Global mobile Suppliers Association **2G and 3G Switch-Off** | July 2023

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Lessons Learned from a

successful 3G Sunset

(ex. Middle East MNO)

@ 12 september of 2023

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3G shutdown example: risks, opportunities & strategy



- **Risks**

- ! Brand reputation impact
- ! Loss of revenue
- ! Regulatory issues



- **Strategy**

1. Assess current network **share of 3G devices** and services.
2. Explore tools available to identify 3G zones and areas in need of **improved 4G/5G coverage**.
3. Identify **prerequisites to minimize impact**.
4. Finalize the **dates** and set up a **migration and communication plan**.
5. **Simulate sunsetting** to identify possible issues.
6. **Switch off 3G gradually** until full sunset is complete.



- **Opportunities**

- ✓ Better network experience
- ✓ Optimized CAPEX & OPEX
- ✓ Improved energy efficiency

Source: webinar "Lessons Learned From a Successful 3G Sunset" Ooakla, 12 September 2023

3G shutdown ex.: step-by-step approach

1. Assess current network share of 3G devices and services



Identify type of devices using 3G network

- Mobile handsets
- MiFis
- IoT
- Other devices



List all possible actions for each category to minimize the impact of sunsetting

- Replace device
- User awareness
- SIM replacement
- Setup 4G roaming agreements
- Improve 4G or 5G coverage
- Provision 4G and 5G



Assess the reason why such devices are using 3G network

- SIM related?
- Device capability?
- End user device setting?
- Lack of 4G or 5G coverage?
- Absence of 4G roaming agreement?
- Is it provisioned for 4G/5G?



Quantify the number & revenue impact of those devices

- How many of those devices are in the network?
- Are those using voice and data? or only data?
- What is the revenue impact if those devices are not migrated?

Source: webinar “Lessons Learned From a Successful 3G Sunset” Ooakla, 12 September 2023

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3G shutdown ex.: step-by-step approach

2. Explore tools to identify 3G zones in need of improved 4G/5G coverage

3. Identify prerequisites to minimize impact

Enable VoLTE to all capable handsets

Enhance 2G network coverage to address voice and M2M devices

Range of affordable LTE devices available to replace legacy handsets

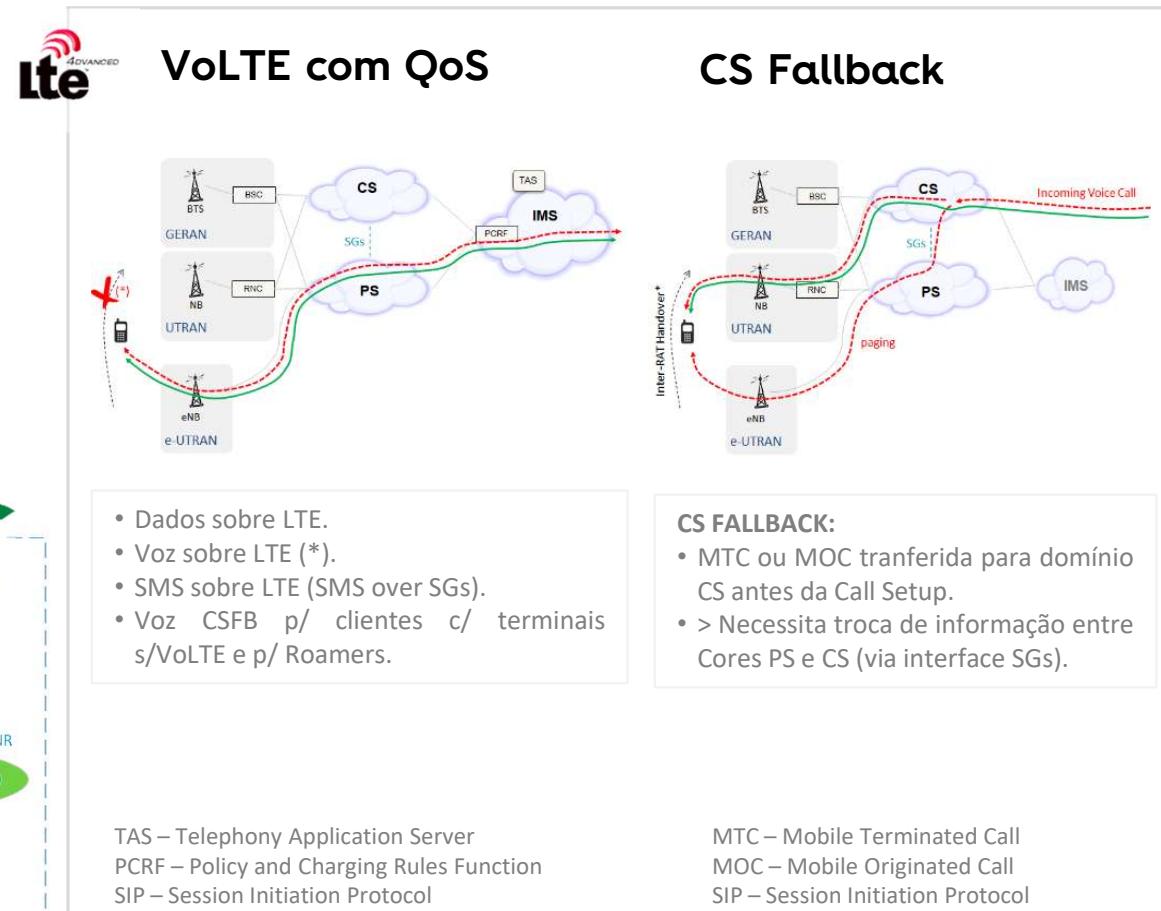
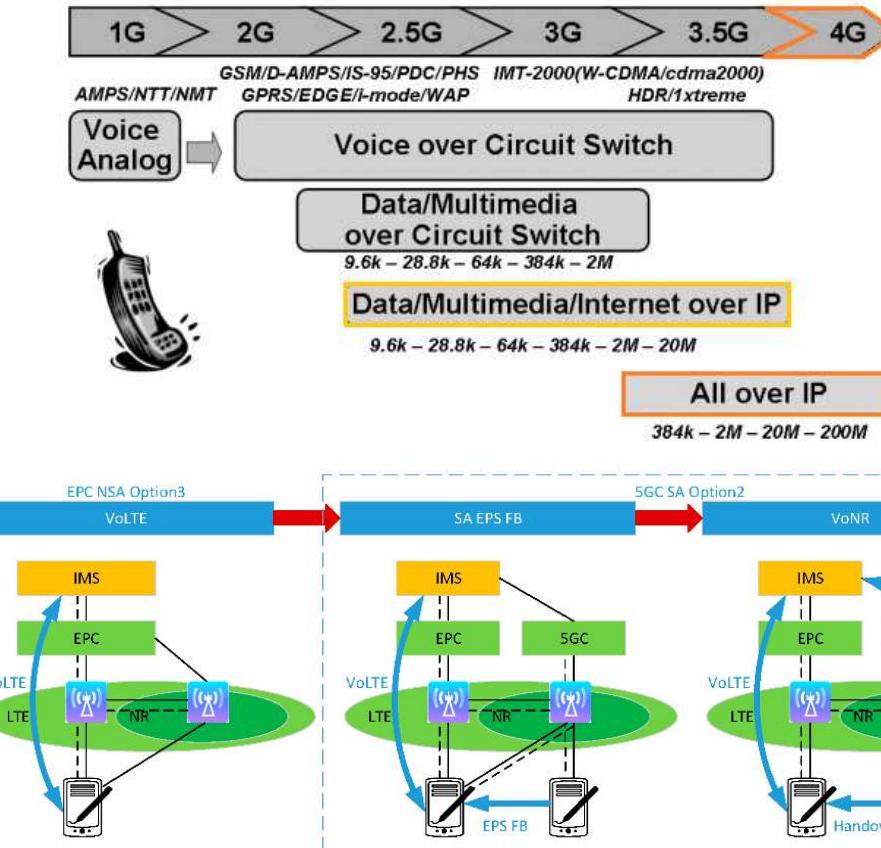
Replace SIM cards that don't support 4G and 5G network

Update all roaming agreements to include 4G

Source: webinar "Lessons Learned From a Successful 3G Sunset" Ooakla, 12 September 2023

3G shutdown ex.: step-by-step approach

□ Voice service evolution:



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3G shutdown ex.: a step-by-step approach

4. Finalize the dates and set up migration and communication plan.

5. Simulate plan to identify possible issues:

Test: complaints handling

Test: M2M devices transition from 3G to 4G/2G

Test: 2G network coverage & capacity to support 3G voice traffic

Test: connected devices support either 2G and/or 4G networks

Test: ensure traffic shifts from 3G to either 4G or 2G

Test: ensure CSFB and SRVCC from 4G to 2G

Source: webinar “Lessons Learned From a Successful 3G Sunset” Ooakla, 12 September 2023

3G shutdown ex.: a step-by-step approach

6. Switch off 3G gradually until full sunset is complete.



Finally: assess the impact of sunsetting 3G

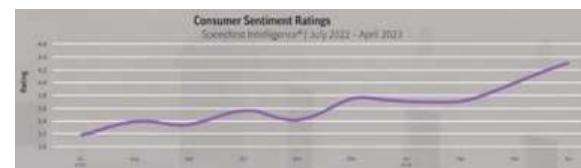
✓ Network Performance



✓ Network Coverage



✓ Customer Experience



Source: webinar "Lessons Learned From a Successful 3G Sunset" Ooakla, 12 September 2023

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Portuguese 3G Sunsets



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3G shutdowns @ Portugal

"MEO was the first operator to start switching off 3G technology, a process that will take at least until the end of January.

NOS and Vodafone will only do so from mid-2024."

Source: <https://eco.sapo.pt/2023/09/04/meo-comeca-hoje-a-desligar-o-3g-saiba-quando-e-a-vez-do-seu-concelho/>

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3G Sunset @ MEO



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MEO' 3G shutdown: advantages for customer

Advantages of the 4G and 5G network

With the switch from 3G to 4G technology, customers can experience download **speeds up to 5x faster, and even more** with the switch to **5G (up to 72x faster)**.

The effective download and upload speed, at any given time, depends on multiple factors including: the speeds supported by the equipment, the coverage in that area or location, the use within buildings, the number of simultaneous users, the number of applications open on the device, the operating system, etc.

Main benefits of the **4G and 5G** network:

- In **voice**:
 - Better audio quality (HD – High Definition, EVS – Enhanced Voice Service)
 - Faster call setup times
- in the **data**:
 - Faster download speeds
 - Lower latency
- on **user equipment (cellular)**:
 - Greater autonomy, due to the lower battery consumption of your mobile device
 - Being able to fully use all the native features of the most advanced cell phones

There is already a **high % of the population covered** with 4G and 5G technologies.

- 99% of the population covered with 4G
- 91% of population covered with 5G

Source: <https://www.meo.pt/ajuda-e-suporte/apoio-tecnico-e-configuracoes/3g/descontinuacao-progressiva#vantagens4ge5g>

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MEO' 3G shutdown: challenges

What happens to my cell phone and SIM card

Cell Phone or Mobile Router

Mobile equipment that has a 2G and 3G network will continue to have access to the mobile network through 2G technology.

To have a better experience when using voice and data services with 4G and 5G technologies, you must have compatible mobile equipment. Check the characteristics of your equipment or check out our suggestions for 5G equipment in the MEO Online Store.

If you have equipment compatible with 4G and 5G technologies, ensure that you have configured the "automatic connection" network mode on your mobile networks so that the best available network is selected.

SIM card

If your card is old and does not allow you to use the 4G and 5G networks, you can exchange it for free at a MEO store. Alternatively, you can request a new SIM card, through the MEO Support Lines (see the tariff) or, if you are a MEO Empresas customer, through the MEO Empresas Support Line (see the tariff), or from your commercial manager.

What happens to business solutions and applications that use the 3G network

Business solutions

Considering this discontinuation and if you have an IoT/M2M or other customized business solution, you should check whether one of the 2G, 4G or 5G technologies is suitable for its operation:

If so, you will only have to ensure the compatibility of the equipment and/or SIM cards with the necessary technologies.

If not, or if you need to use unsupported data transmission rates or features, please contact us.

If replacement SIM cards are necessary, they will be sent to the address registered in our systems.

APNs limited to the 3G network

If your company uses an APN limited to the 3G network, we will update it to 4G/5G. If you need to use 4G/5G technologies, you must ensure that this change is accompanied by an update of equipment and/or SIM cards, if these are limited to the 3G network. If replacement SIM cards are necessary, they will be sent to the address registered in our systems.

Source: <https://www.meo.pt/ajuda-e-suporte/apoio-tecnico-e-configuracoes/3g/descontinuacao-progressiva#telemovel3g>

MEO' 3G shutdown: progressive shutdown

What will happen to the 3G network

We reinforce our commitment to availability, quality and proximity with access to the most advanced technologies throughout the national territory, through 4G and 5G networks, with greater coverage, speed and capacity. Therefore, to bring you the best service and the most innovative solutions, we will **progressively discontinue 3G technology**, in voice and mobile internet services, **between 04-09-2023 and 31-01-2024**.

The services are now guaranteed by:

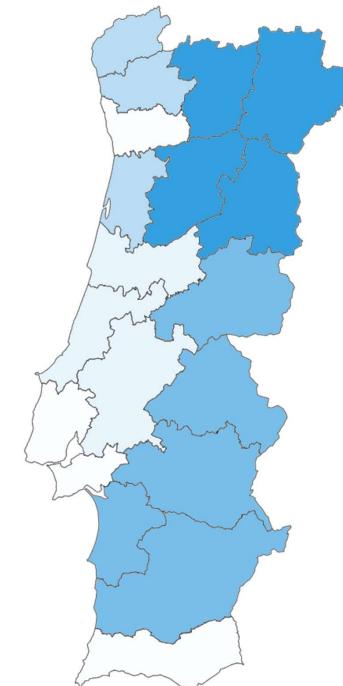
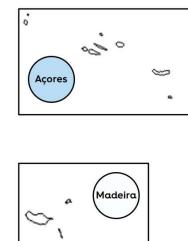
Voice: via 2G or 4G/5G if you have VoLTE

Data: via 4G/5G

On what date will I no longer have access to the 3G network?

The 3G network will be progressively turned off throughout the national territory according to the map.

There are some districts that have municipalities with different dates, to find out in more detail the dates for each municipality, consult the plan by municipality.



Data Desligamento 3G

- 1 4 Setembro 2023
Bragança | Vila Real | Viseu | Guarda
- 2 2 Outubro 2023
Castelo Branco | Portalegre | Évora | Beja
Setúbal (exceto Área Metropolitana de Lisboa)
- 3 31 Outubro 2023
Viana do Castelo | Braga | Açores
Porto + Aveiro (exceto Área Metropolitana do Porto)
- 4 5 Dezembro 2023
Coimbra | Leiria | Santarém |
Alenquer | Arruda dos Vinhos |
Azambuja | Cadaval | Lourinhã
Sobral de Monte Agraço | Torres Vedras
- 5 31 Janeiro 2024
Área Metropolitana do Lisboa
Área Metropolitana do Porto
Faro | Madeira

Source: <https://www.meo.pt/ajuda-e-suporte/apoio-tecnico-e-configuracoes/3g/descontinuacao-progressiva#telemovel3g>

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The life cycle of mobile network generations

- The launch **cycle of new generations of mobile networks has been shortening**, and, if it weren't for a pandemic, it was expected that the ITU-R would have already defined, by today's date, the vision and basic requirements for the **future 6G, which should designate the "IMT (beyond) 2030"**:

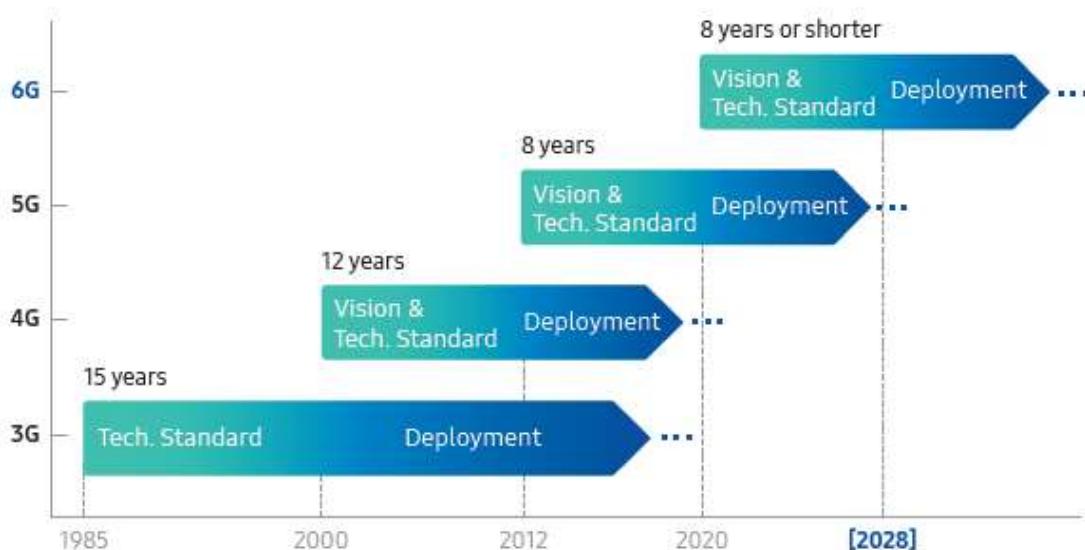
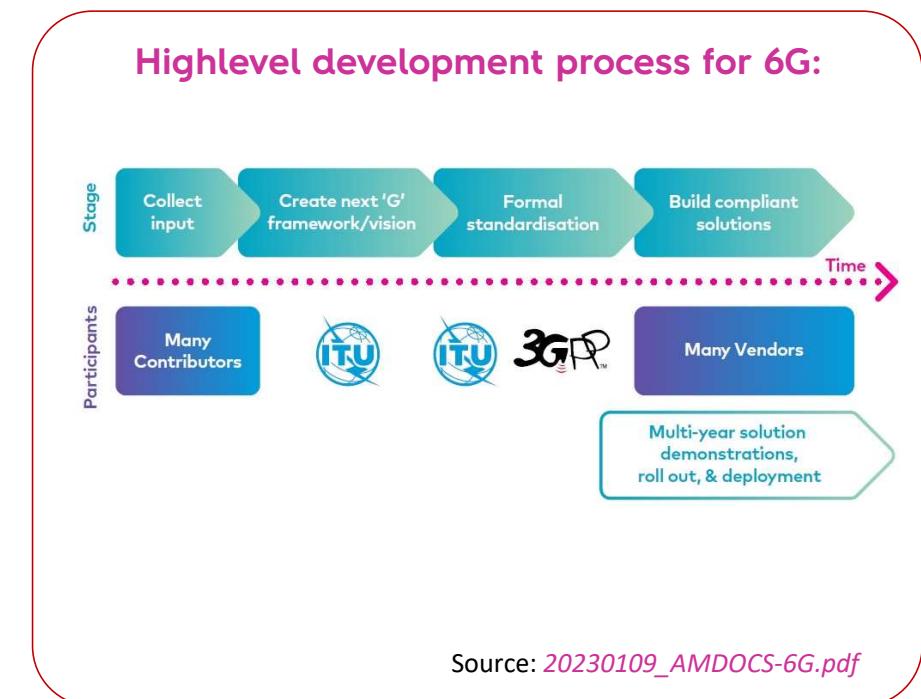


Figure Timeline of different generations. (source: Samsung, "6G Vision", july2020)

Source:<https://news.samsung.com/global/samsungs-6g-white-paper-lays-out-the-companys-vision-for-the-next-generation-of-communications-technology>

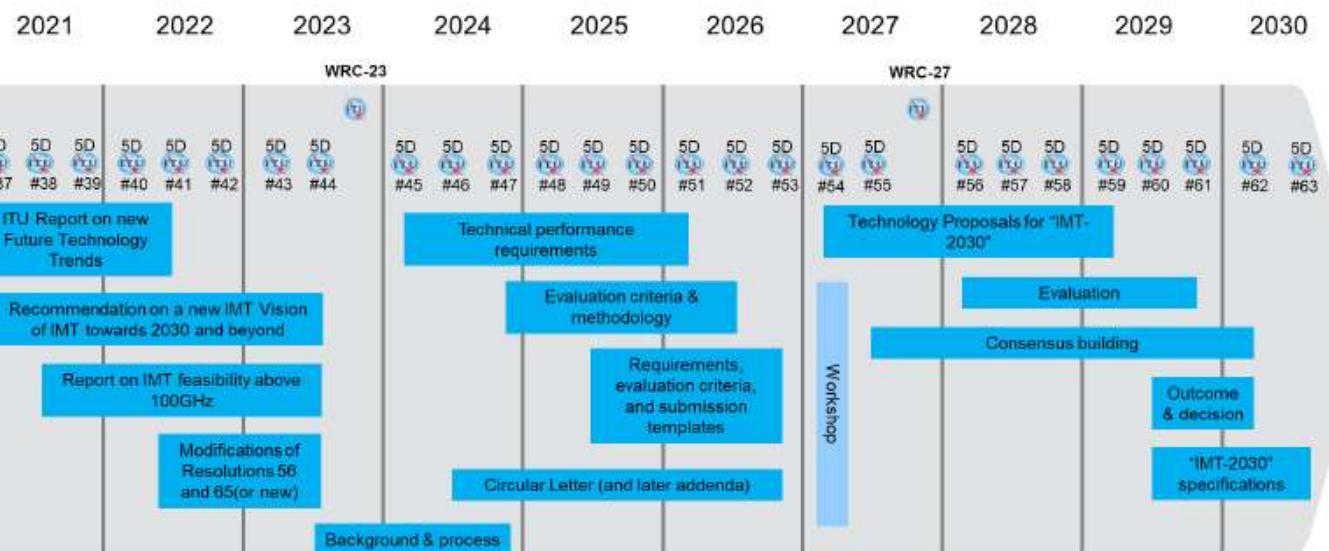


Source: 20230109_AMDOCS-6G.pdf

Timeline to develop 6G (IMT-2030) standards

- ITU' timeline for "IMT towards 2030 and beyond":

WP5D timeline for IMT towards 2030 and beyond



Note 1: Meeting 5D#59 will additionally organize a workshop involving the Proponents and registered 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.

Source: https://www.itu.int/dms_ties/itu-r/oth/0a/06/R0A060000C80001PDFE.pdf

@ 2/nov/23, ITU had not yet finished the document "Vision of IMT beyond 2030"...

The screenshot shows the ITU-R website with the following details:

- Home : ITU-R : WP5D : Contributions : 1662
- ITU Sectors | Newsroom | Events | Publications | Statistics | About ITU
- [1662] Working document towards a preliminary draft new Recommendation ITU-R M.[IMT.VISION] future development of IMT for 2030 and beyond
- Format: Word, Size: 5490303 bytes, Posted: 2023-01-25 [1662]
- Document: ITU-R PSD Contribution 1662
- Title: Working document towards a preliminary draft new Recommendation ITU-R M.[IMT.VISION] 2030 AND 2030 and beyond
- Date: 2023-01-24
- Source: Apple Inc.
- Access: Restricted to TIES users [ITU-R]

Source: <https://www.itu.int/md/R19-WP5D-C-1662/en>

<https://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/Pages/default.aspx>

[IMT towards 2030 and beyond \(itu.int\)](#)

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Asia (usually) leading change: Korea initiative

"..."

In February, the Korean government said it planned to commercialize an **initial 6G network service in 2028**, two years earlier than its initial schedule.

The government had also announced its K-Network 2030 strategy, with the aim of boosting private-public cooperation to develop 6G technologies, innovate around software-based next-generation mobile networks and strengthen the network supply chain.

"..."

Source: <https://www.rcrwireless.com/20231103/6g/korea-announces-development-program-future-6g-networks>

6G use-cases

- Some use-cases pointed to 6G:



FIGURE Use cases of 6G.

Three key 6G services:

Truly Immersive XR



High-Fidelity Mobile Hologram



Digital Replica



Source: 20210126_IIEEE_6G_Ecosystem_Current_Status_and_Future_Perspective.pdf

Source: 2020, Samsung "6G" Vision, wp

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6G requirements

❑ Some requirements suggested to 6G:

In **2019** by "6G Flagship" – Oulu University, Finland:



Figure 1: 6G requirements presented to academic and industry in different fields.

Source: 20190811_6G Research Visions 1-UnivOulu.pdf

In **2020** by Samsung:

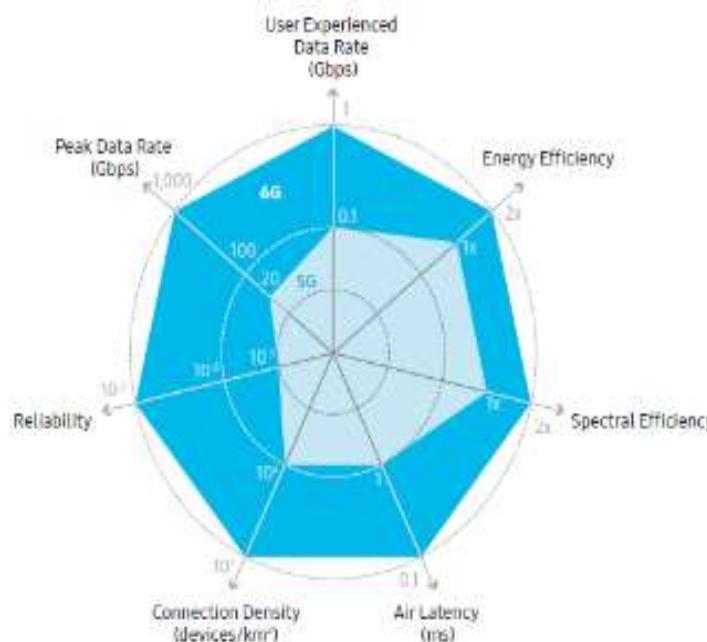


Figure: Comparison of key performance requirements between 5G and 6G.
(source: Samsung, "6G Vision", July 2020)

In **set/2021** by ITU Journal:

- **Throughput/data rate up to 1 Tbit/s,**
- **User-experienced data rate of 1 Gbit/s** (ten times the one targeted by 5G),
- **End-to-end latency less than 1 ms,**
- An 'over-the-air' latency of 10 – 100 µs with mobility up to 1000 km/h
- Very broad bandwidth with freqs upto 1 – 3 THz,
- **"always-ON" terrestrial-aerial-satellite network,**
- Frame error rate (reliability) equal to 1 – 10⁻⁹,
- Very high energy efficiency also supporting "battery free IoT devices" (10-100 times the one of 5G) and especially equal to 1 pJ/bit,
- Connected intelligence,
- Jitter equal to 1 µs,
- Spectrum efficiency > 3 times the one of 5G,
- Receiver sensitivity less than -130 dBm.
- A connectivity density ten times the one provided by 5G, with an area traffic capacity of up to 1 Gbit/s/m² (10 Gbit/s in 3D),
- Density of connected devices greater than 10⁶/km²,
- **Localization precision ~ 1 cm in three dimensions.**

Source: [ITU Journal on Future and Evolving Technologies, Volume 2 \(2021\), Issue 6, 13 September 2021](#)

But Earth seams small for radio communications...



THE PLAN TO GIVE THE MOON DECENT WIRELESS COVERAGE

30 JAN 2022

<https://spectrum.ieee.org/lunar-communications>

Nokia and NASA want to take 4G internet to the Moon

03 of March of 2023

<https://www.tudocelular.com/mercado/noticias/n203162/nokia-e-nasa-querem-levar-internet-para-a-lua.html>

Thanks!
Obrigado!

Carlos Pardelinha

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DEO/ETD/ESR

