5G (in 20 min!)

Altice Labs
Francisco Fontes
fontes@alticelabs.com

25 Out 2017
Jornadas Comunica+, 7ª Edição
Engª Telecom. e Informática
Universidade do Minho, Guimarães

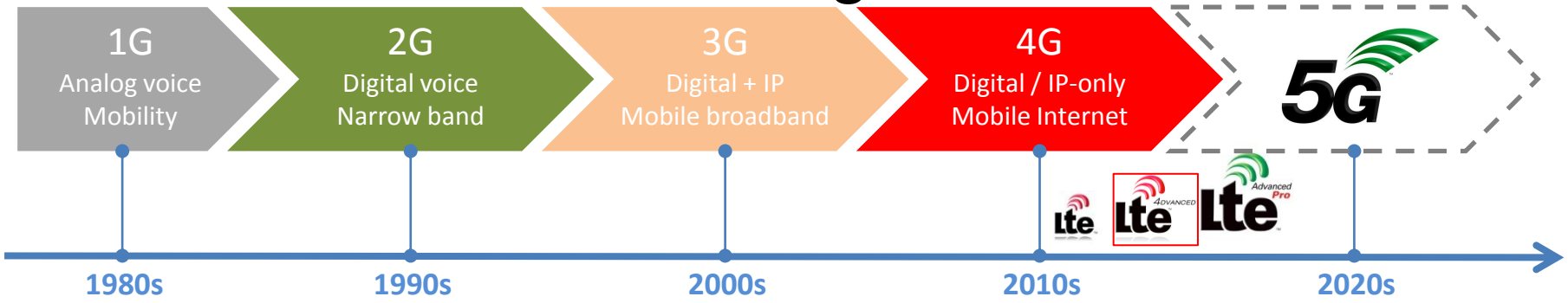
www.alticelabs.com

Agenda

1. 5G definition
2. 5G use cases e key capabilities
3. The need for low latency and slicing
4. 5G architecture and the new radio interface
5. 3GPP calendar for 5G
6. 5G pushing events
7. 5G demonstrations

altice labs

Wireless communications ‘generations’



https://funalive.com/uploads/files/article/images/evolution-phone.jpg

5G definition(s)

- **ITU-R** (*International Telecommunication Union*) - http://www.itu.int/en/about/Pages/default.aspx

"enabling a seamlessly connected society in the 2020 timeframe and beyond that brings together people along with things, data, applications, transport systems and cities in a smart networked communications environment"

- **NGMN** (*Next Generation Mobile Networks*) - http://www.ngmn.org/home.html

"5G is an end-to-end ecosystem to enable a fully mobile and connected society. It empowers value creation towards customers and partners, through existing and emerging use cases, delivered with consistent experience, and enabled by sustainable business models."

- **5G-PPP** (*5G Infrastructure Public Private Partnership*) - https://5g-ppp.eu

"5G is more than an evolution of mobile broadband. It will be a key enabler of the future digital world, the next generation of ubiquitous ultra-high broadband infrastructure that will support the transformation of processes in all economic sectors and the growing consumer market demand."

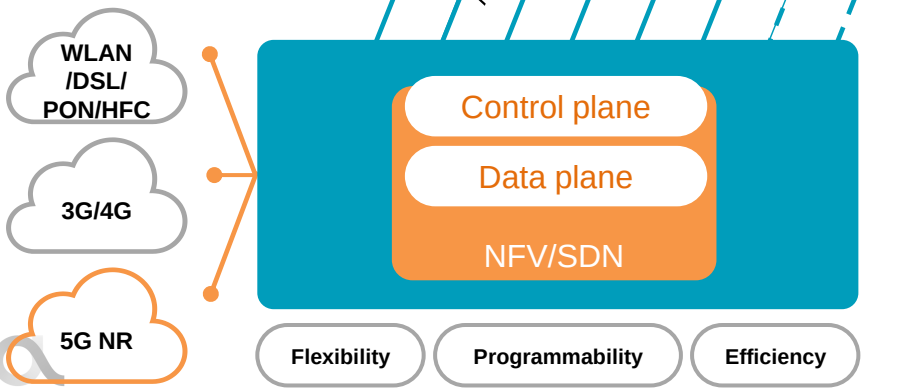
With 5G, wireless/mobile communications will become a GPT (*General Purpose Technology*)

IHS: "GPTs lead to deep and sustained impacts accross a broad range of industries that often redefine economic competiveness and transform societies"

altice labs

What is 5G?

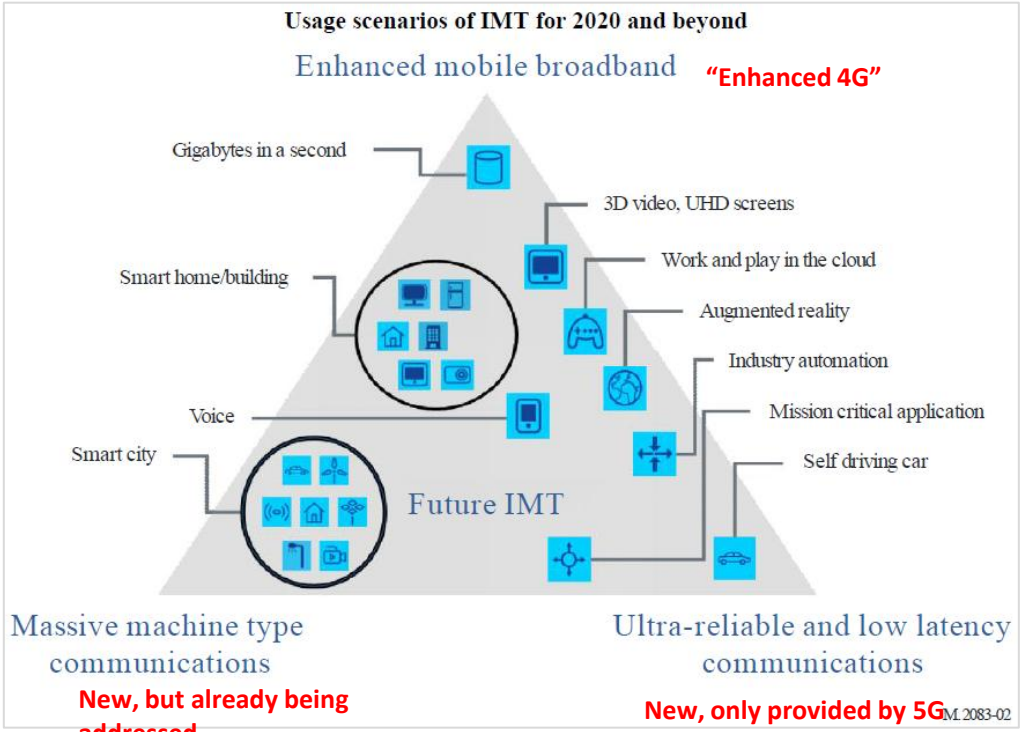
3GPP 5G official logo



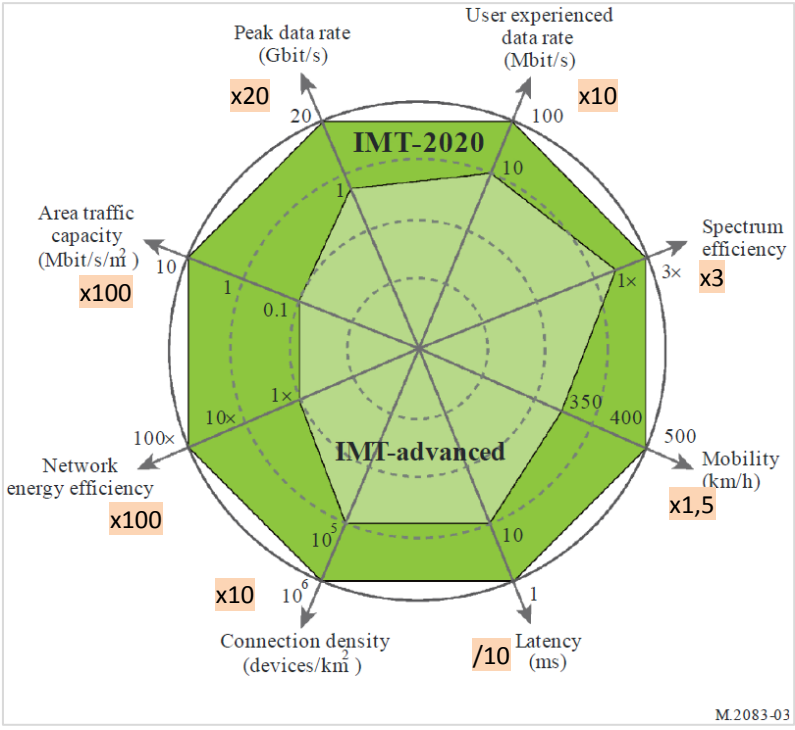
- Next generation communications network and services
- More than a ‘wireless’ network, embracing all sort of wireless/wired accesses, sharing a common core
- Provide significant performance improvements over current (4G) networks (KPI)
- Based on a new radio interface (NR) and a new network architecture (5G CN)
- Presenting a high level of flexibility and programmability
- To start commercial deployments around 2020

altice labs

5G “Usage scenarios” and “Enhancement of key capabilities”



Source: ITU-T, M.2083



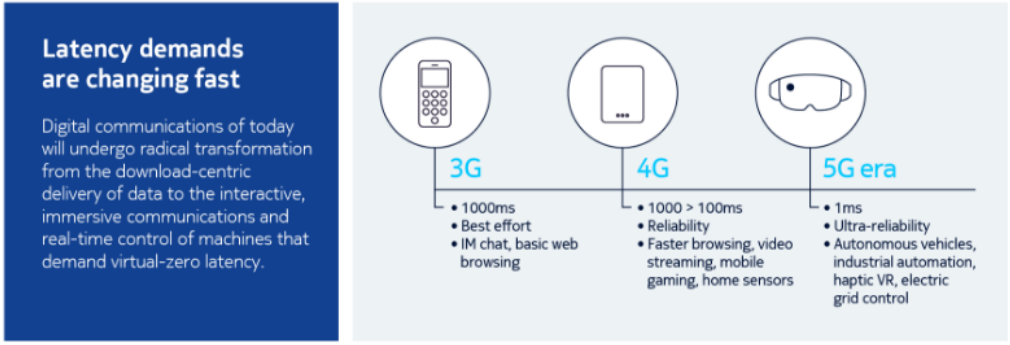
Source: ITU-T, M.2083

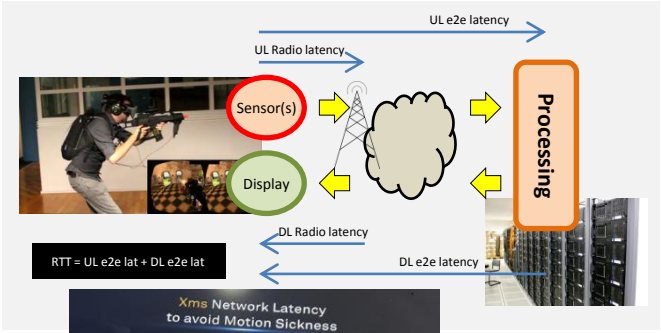
- “IMT-Advanced” and “IMT-2020” (ITU-U) establish the requirements for ‘4G’ and ‘5G’, respectively
- Only systems compliant with 3GPP Rel-10 (LTE-A) are ‘4G’
- ‘5G’ requirements shall be fulfilled by 3GPP Rel-16 (4Q19)

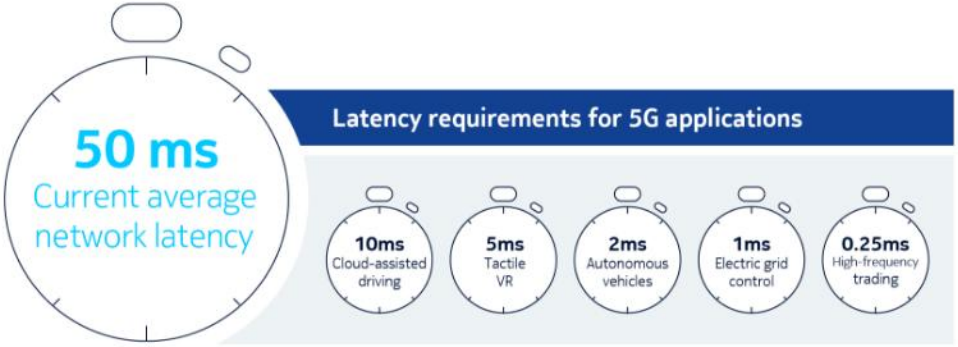
The need for low latency

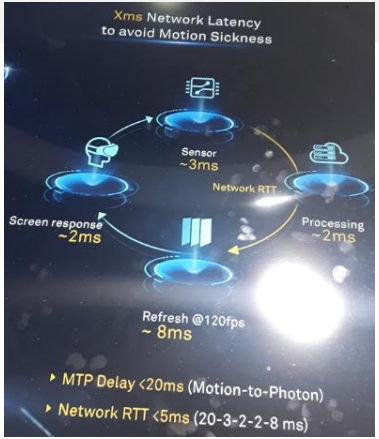
Latency: The contribution by the radio network to the time from when the source sends a packet to when the destination receives it (in ms). (Rec. ITU-R M.2083-0)

RTT: *Round-Trip-Time*







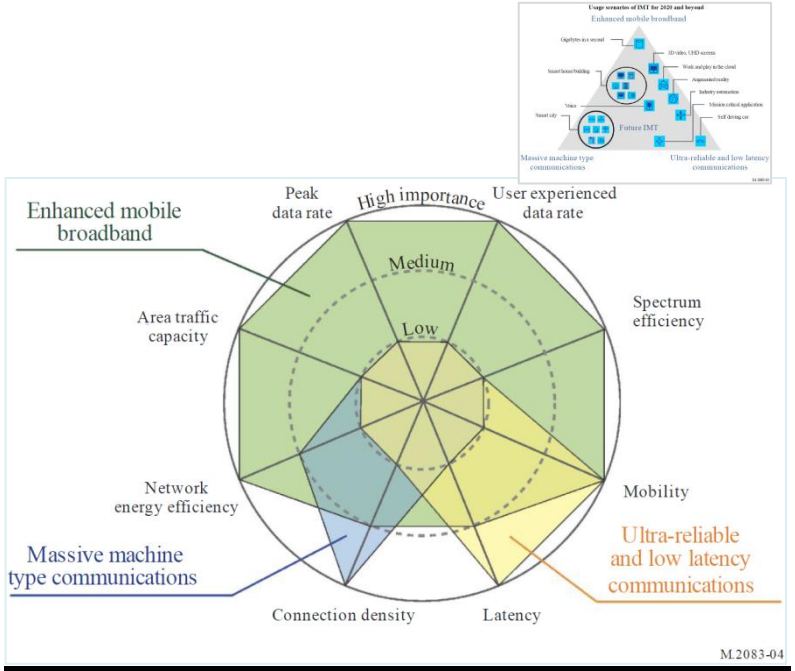


Huawei, MWC 2017

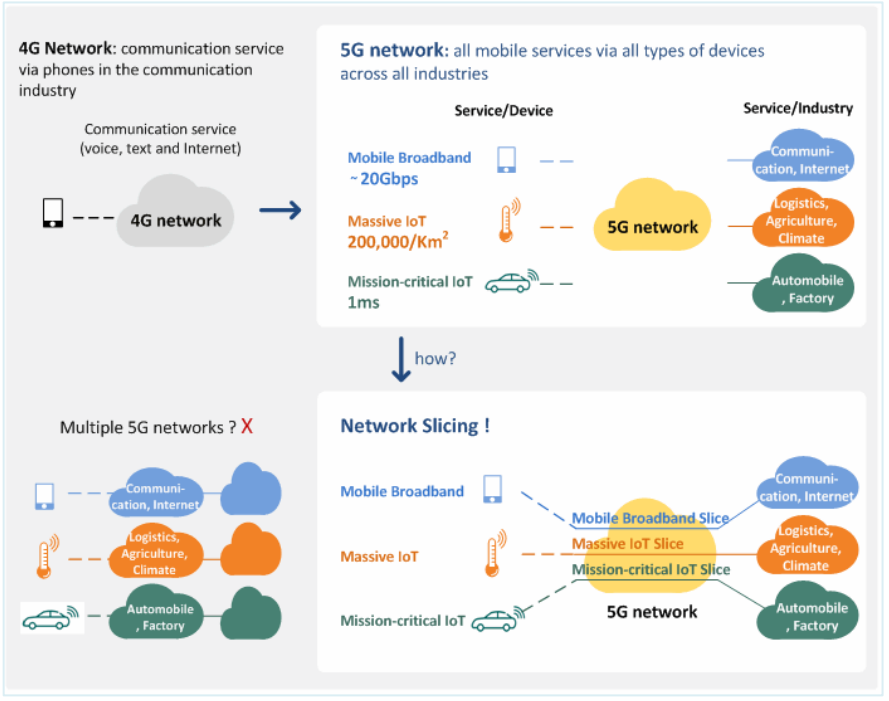
https://tools.ext.nokia.com/asset/201030

The need for network slicing

eMBB, mMTC and URLLC requirements



Source: ITU-T, M.2083



http://3.bp.blogspot.com/-s51UfkTUM8E/Vln42fXI_QI/AAAAAAAAHPc/eI1_YGUQirU/s1600/NetmaniasNetworkSlicing.gif

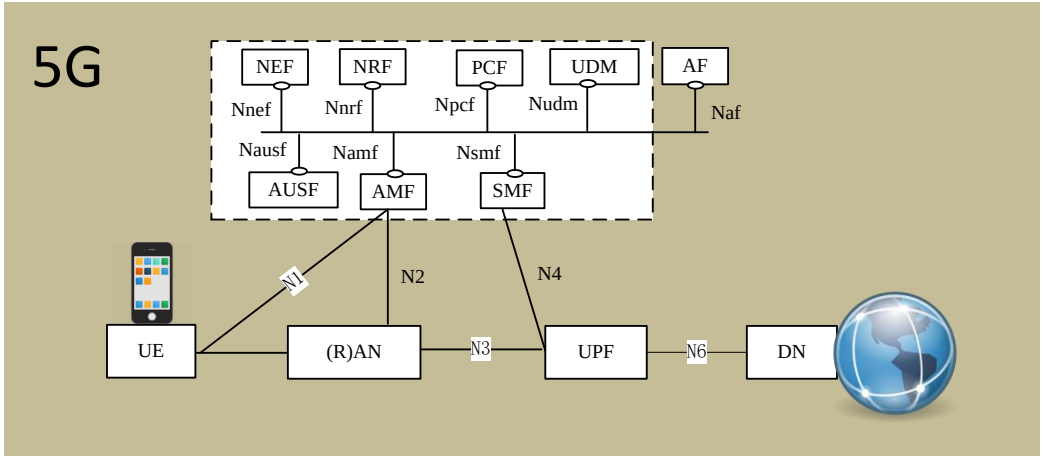
Moving from a "one-size-fits-all" network, where applications adapt to the network, to tailored virtual networks answering to the needs of specific applications by means like NFV, SDN and network slicing

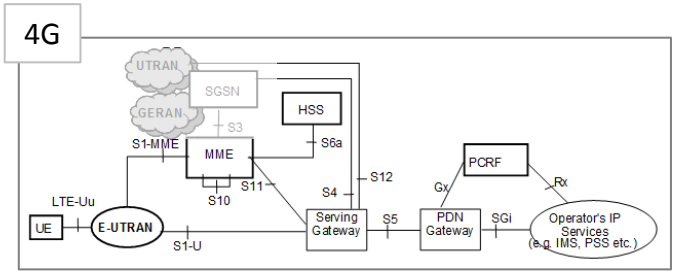
SDN and NFV to play an important role in slicing realization

5G: new architecture (3GPP TS 23.501)

5G new architecture to “inteconnect everything”: a <u>common core network</u>

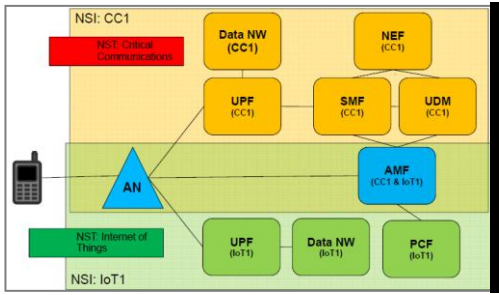
“The new architecture shall support at least the new RAT(s), the Evolved E-UTRA, non-3GPP accesses and minimize access dependencies”
(3GPP TR 23.799)



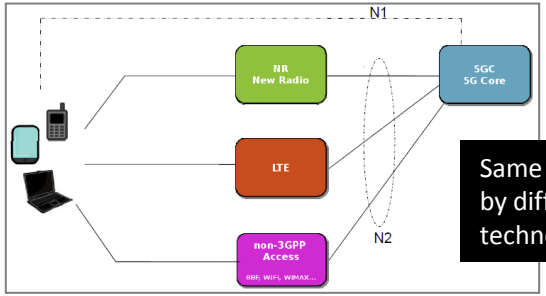


• AF	Application Function
• AMF	Access and Mobility Management Function
• AUSF	Authentication Server Function
• DN	Data network
• DSF	Data Storage network function
• NEF	Network Exposure Function
• NRF	NF Repository Function
• PCF	Policy Control Function
• SMF	Session Management Function
• UDM	Unified Data Management
• UPF	User plane Function
• UE	User Equipment
• (R)AN	(Radio) Access Network

Not represented:
• UDSF: Unstructured Data Storage function (used by any NF)
• SDSF: Structured Data Storage function (used by NEF)



Same functional block is instantiated multiple times, in different slices, sharing some access elements. Partial deployment of arch modules at each slice.



Same core shared by different access technologies.

https://docbox.etsi.org/Workshop/2017/20170406_ETSI_SUMMIT_5G_NWK_INFRASTRUCTURE/01_SESSION_A_CHALLENGES_5G_INFRAST_DEVELOP/5G_INFRASTRUCTURE_WORK_3GPP_MAYER.pdf

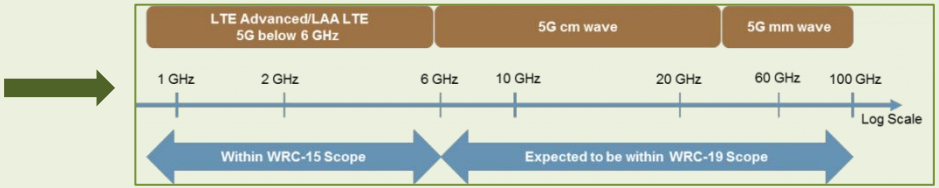
5G: a *New Radio* (NR) is required

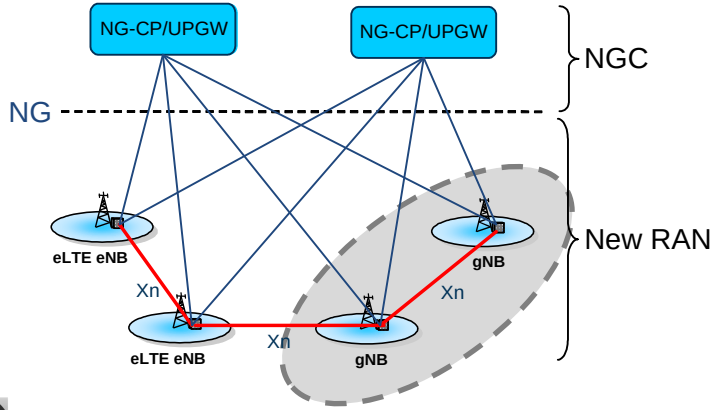
5G New Radio (NR) to "connect everything": a <u>unified</u> air interface

"**You will be seeing 5G NR connectivity in your smartphones, cars, utility meters, wearables and much more**" (Qualcomm)

(some) Characteristics:

- OFDM-based waveforms
- Centimeter and milimeter wave spectrum (>60GHz)
- Massive-MIMO / FD-MIMO (*Full Dimensional*)
- *Sliceable* and *forward* compatible





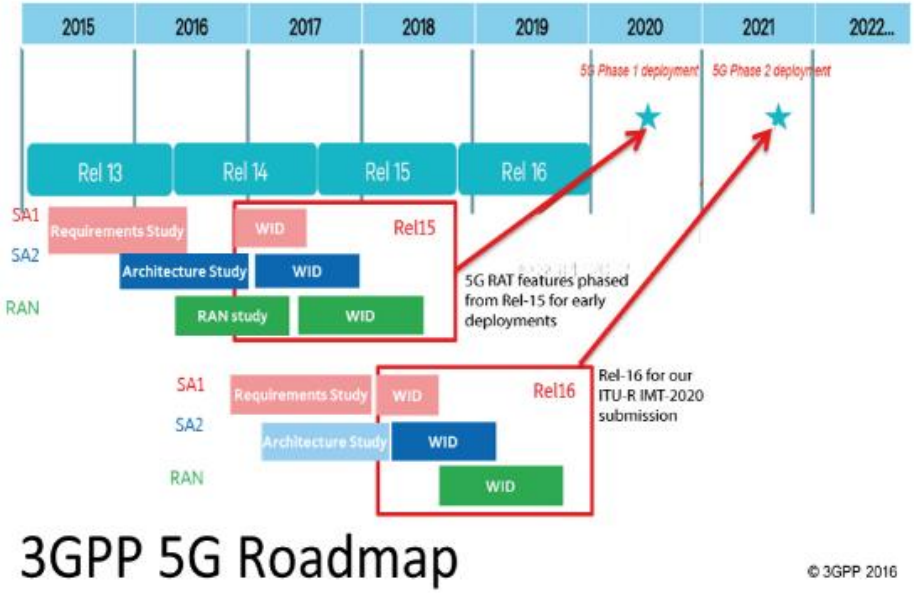
http://www.slideshare.net/ahmed_nasser_ahmed/introduction-to-massive-mimo-42252235

"Jointly Build the Bridge to 5G", Huawei, 5G-PPP Event, Rome, 9/10 Dec 2016

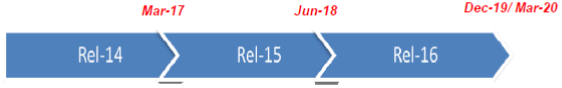
NGC: *Next Generation Core*
NG-CP: *Next Generation Control Plane*
UPGW: *User Plane GateWay*

3GPP Calendar

3GPP standards to be candidates and be accepted as IMT-2020 specifications

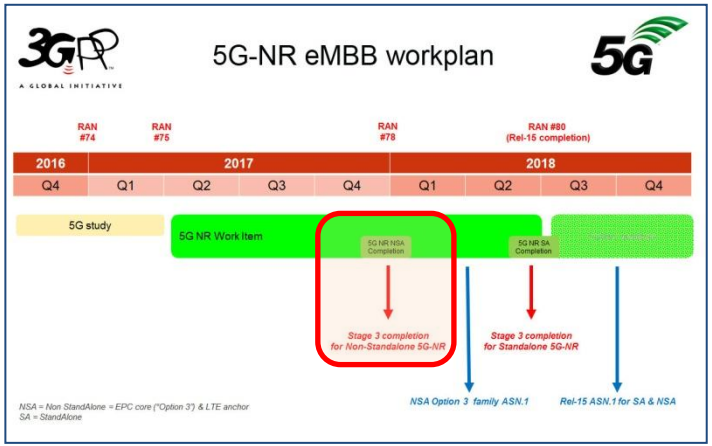


Release timing



Two phases for the normative 5G work

- Phase 1 (Rel-15) to be completed by June 2018
  addresses the more urgent subset for commercial deployments
- Phase 2 (Rel-16) to be completed by March 2020
  IMT 2020 submission, addresses all identified use cases & requirements



Keystone events

2018 Winter Olympics in Pyeongchang

“Presenting 5G service for the first time in the world throughout PyeongChang 2018 will be a triggering point for Korea to lead the 5G industry, which aligns with KT’s goal” says Byeong-Moo Lee of KT

https://www.mobileworldlive.com/wp-content/uploads/2016/08/5G-Olympic-Whitepaper.pdf

2020 Summer Olympics in Tokyo

“Operators in Japan are working aggressively to showcase 5G in time for the Summer Olympics in 2020, when Tokyo hosts the games.”

http://www.fiercewireless.com/tech/ericsson-softbank-5g-trial-tokyo-to-include-mobility-at-28-ghz

2022 Winter Olympics in Beijing

The trial run is likely to happen in 2018 to 2019, and full implementation will "definitely" be ready by the 2022 Winter Olympic Games.

http://usa.chinadaily.com.cn/china/2016-08/19/content_26539973.htm

“***European operators will target launching 5G in at least one city in each of the 28 European Member States by 2020***”

https://ec.europa.eu/digital-single-market/en/news/commissioner-oettinger-welcomes-5g-manifesto

altice labs

Automotive live 5G demo (SKT, Ericsson, BMW)

“SK Telecom and Ericsson conduct first multi-vehicular 5G trials with BMW” – Nov/16

> “The trials showed consistent **Gbps-level throughput with a few millisecond latencies**. Uninterrupted connectivity, using **beam tracking and beam transfer** across the different transmission points at **speeds exceeding 100 kilometers per hour** is also achieved. The performance shown enables multiple connected car use cases such as **augmented and virtual reality**, obstacle control and vehicle to vehicle communication, based on a system solution including radio and core network infrastructure from Ericsson.”

In detail:

- 28 GHz / 20 Gbps
- ‘few mili-seconds’
- 2 cars at 100 km/s
- Beam tracking and beam transfer
- Multi-site
- Network slices
- ultra-high-definition (UHD) uplink videos taken by 4K cameras and a 360-degree camera installed both inside and outside of the vehicle

https://youtu.be/UOCM_91n90U

altice labs

5G economics

5G will hit 24 million subscriptions worldwide in 2021 (OVUM)

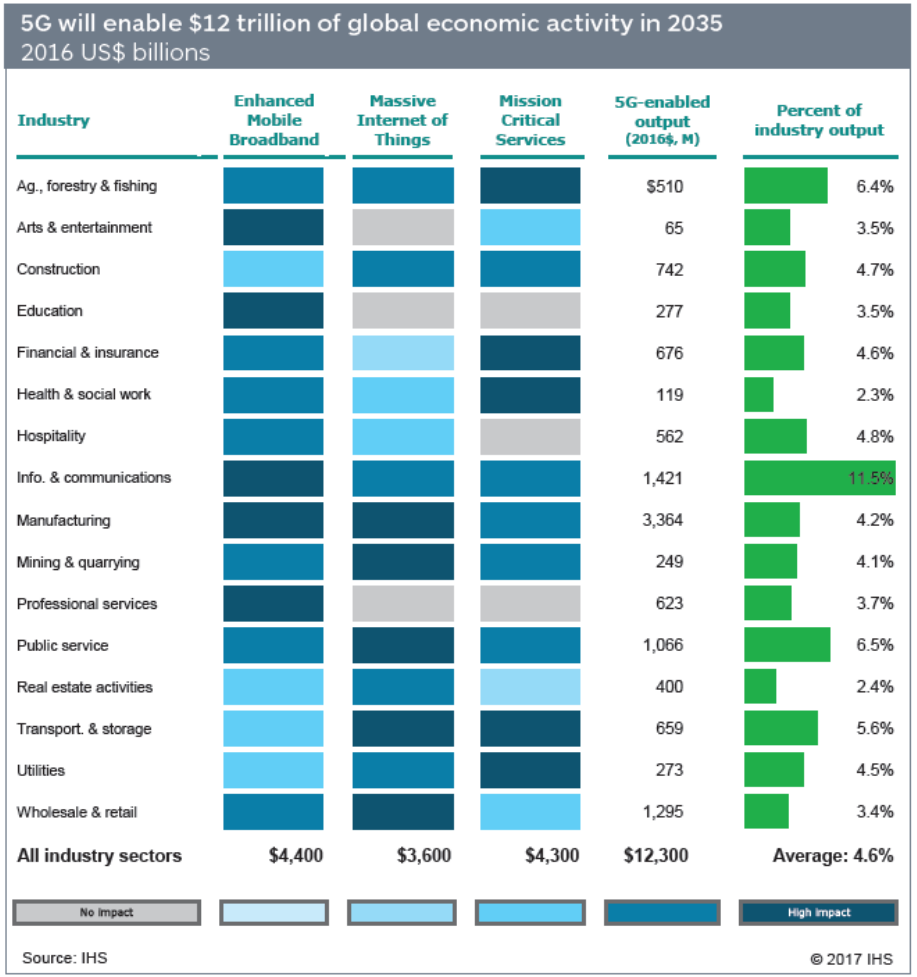
Sales of 5G Smartphones to hit 100 million in 2021 (CCS Insight)

5G to boost annual U.S. GDP by $500 billion through job growth and investments in deploying the new network (Accenture)

In 2035, 5G will enable $12.3 trillion of global economic output (IHS)

The global 5G value chain will generate $3.5 trillion in output and support 22 million jobs in 2035 (IHS)

5G could add 22 million jobs around the world by 2035 (Qualcomm)



IHS Economics & IHS Technology, "The 5G economy: how 5G technology will contribute to the global economy", Jan/2017

✓5G with high expectations regarding its usefulness and impacts for all society and economy sectors

✓Challenges put on 5G are demanding but those enhancements are needed to cover all expected use cases

✓A new technology is needed, made of a new architecture and radio is required

5G is already happening!

altice labs

5G (in 20 min!)

Altice Labs

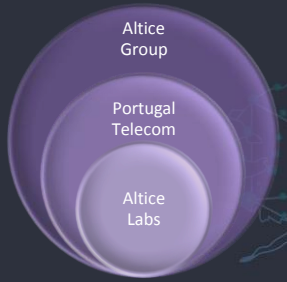
25 Out 2017

Rua Eng. José Ferreira Pinto Basto,
3810 - 106 Aveiro Portugal
T: +351 234 403 200
F: +351 234 424 723
www.alticelabs.com

- **Altice Labs**
- **Antecipando o Futuro**

www.alticelabs.com

WHO WE ARE



We lead the development of new ICT solutions and technologies.

WHERE WE ARE

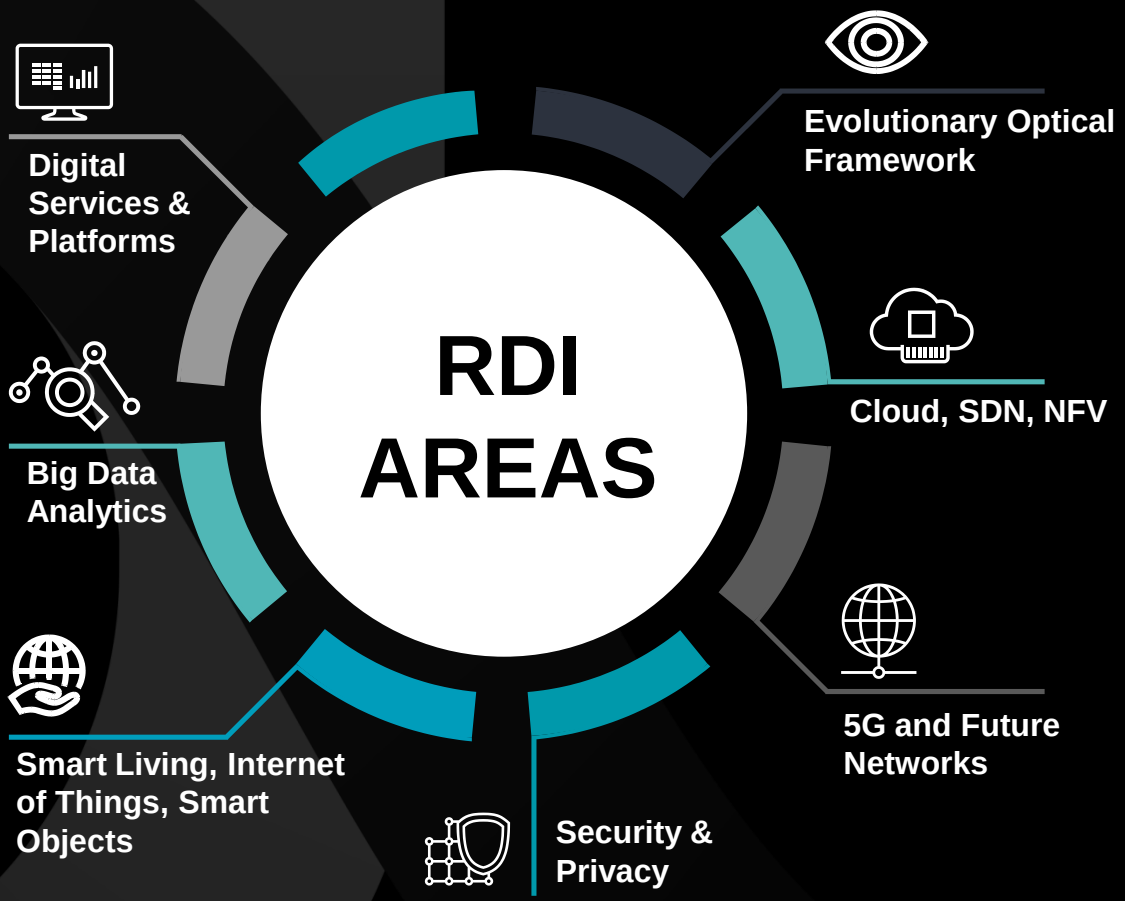
With **1000** engineers worldwide, Altice Labs is headquartered in Aveiro, Portugal with subsidiaries in Brazil and is expanding its presence to France, Israel, Dominican Republic and the United States.

WHAT WE DO

We promote the process of innovation, turning knowledge into competitive advantage in the market.

We transform knowledge into advanced solutions with an innovation approach supported on an ecosystem built around R&D entities, startups and industrial partners.

Altice Labs' commitment is to offer all its customers and partners best-of-breed products and technologies with cutting edge innovation.



OUR RDI AREAS

We play an active role in the Innovation Ecosystem, working in partnership with world class universities, R&D Institutions, suppliers and clients in several projects, based on a risk sharing model, resorting to external funding from the major national and international research and innovation support programs.

Funding Instruments

- European FP7 Programme
- European H2020 Programme
- Portuguese P2020 Programme
- Universities
- Startups, Manufacturers and SMEs

Challenges in ALTICE LABS

- Mobile networks: seamless mobility from legacy techonologies (2G and 3G) to LTE
- Real Time Business Intelligence enriched by patterns detection
- BigData made easy: best tools and their integration with Altice Labs' BI components
- MEO HTML5 apps experimentation and prototyping based on Enyo framework
- Prefetch model for MEO STBs: speeding up automatic recordings based on catch-up TV data

INOVARIA
REDE DE INOVAÇÃO
GENIUS

For more information about these and other innovation projects, access our website:
http://www.alticelabs.com/en/challenges.html

altice labs

- **Visit us!**

altice

labs

www.alticelabs.com