

3GPP-A MOBILE CONNECTED WORLD

December 2021

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The role of 3GPP technologies for our mobile world

Executive summary

5G - the new generation in mobile communication, was released in 2019, and as of October 2021, 140 countries around the globe have begun to invest in this technology. 5G networks are the latest 3GPP standard – with its speed between 10 and 100 times faster than 4G.* Largely thanks to this massive increase in speed, 5G is expected to revolutionize mobile communication and enables the digitalization of many new aspects of everyday life. Perhaps most important aspect for future innovation of 5G technology is the ability to transfer massive amounts of data in real-time. 5G could serve as the basis for a "Fourth Industrial Revolution" and provide the connectivity required for smart cities of the future. In addition to these macro-level benefits, this technology will bring ease and efficiency to the lives of countless individuals around the world.

But are we boasting about this technology, or are there tangible effects of 3GPP that could be measured?

This Statista report quantifies the impact of 3GPP mobile standards (commonly known as 3G, 4G & 5G **) on today's connected society, starting from the time that these technologies entered the market and

providing insight into their future development; described in six dimensions:

1. Constantly evolving technology timeline
2. Growing penetration (adoption by end users) of the technology
3. Increasing affordability
4. Fast time to market reflecting the popularity of the services
5. Benefits/opportunities enabled by the 3GPP standard for other digital services
6. Digital Transformation enabled by 5G

What is 3GPP?

3GPP technologies cover cellular telecommunication technologies, which include radio access, core network and service capabilities, and provide a complete system description for mobile telecommunications. The association was founded in 1998 and started with introducing the 3G technology.

3GPP or the third-generation partnership project, consists of **seven*** standard organizations** which develop **protocols for mobile telecommunication**.

3GPP is a **global** and **open** standard ensuring **interoperable** equipment and devices.

Note(s): * actual download speeds will depend on a number of factors including location and network traffic **2G is not a part of 3GPP standard, however included in this report figures & stats ***ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, and TTC. For more information see also: <https://www.3gpp.org/about-3gpp/partners>

Sources: GSA

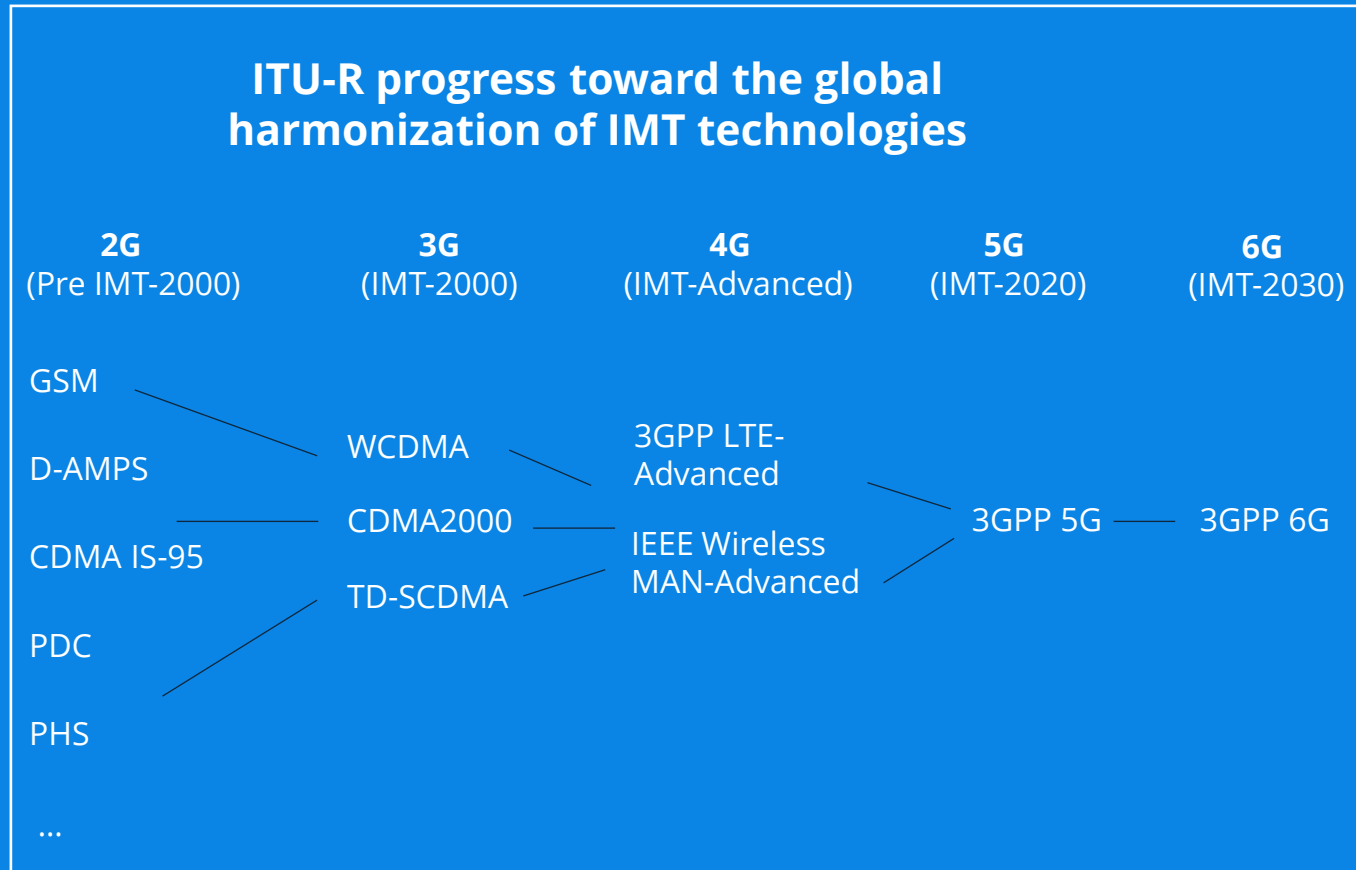


01 A unique standard

- Technical background
- Historical timeline
- 3GPP partners ecosystem

How 3GPP “G” standards lays the foundation for a successful global mobile internet ecosystem

Technical background: 3GPP Standard Development



Technical Development from 2G to 6G:

For the past 30 years, the ITU Radiocommunication sector (ITU-R) has been coordinating efforts with governments and industries to develop unified global broadband multimedia international mobile telecommunications systems, also known as IMT.

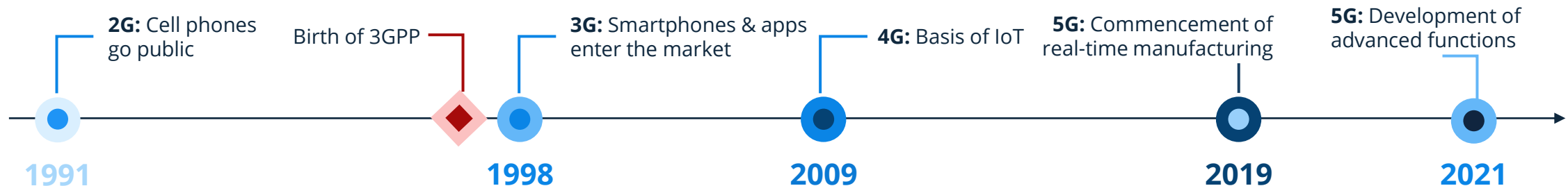
Global operation and economies of scale are key requirements for the success of mobile telecommunication systems.

In order to achieve this goal, ITU-R established the concept of IMT, which includes a harmonized timeframe for future development, taking into account technical, operational, and spectrum-related aspects.

Since then, ITU-R has been striving for harmonized global standards all through the process of IMT-2000, IMT-Advanced and the to-be IMT-2030.

History shows us that 3GPP mobile standards are a key driver for technical inventions and social evolution

Constantly evolving mobile data timeline



- **Key difference:** Phone calls to cellphones (regardless of the location) made possible
- **Reach:** Enables voice calls & texting via mobile phones for the public
- **Security:** Digital signals instead of analogue, phone conversations became encrypted & more secure

- **3GPP:** The first standard introduced by the 3GPP association
- **Rise of Smartphone:** Use of the smartphone for the wider public, data-based apps
- **More devices:** Mobile modems for laptops made possible

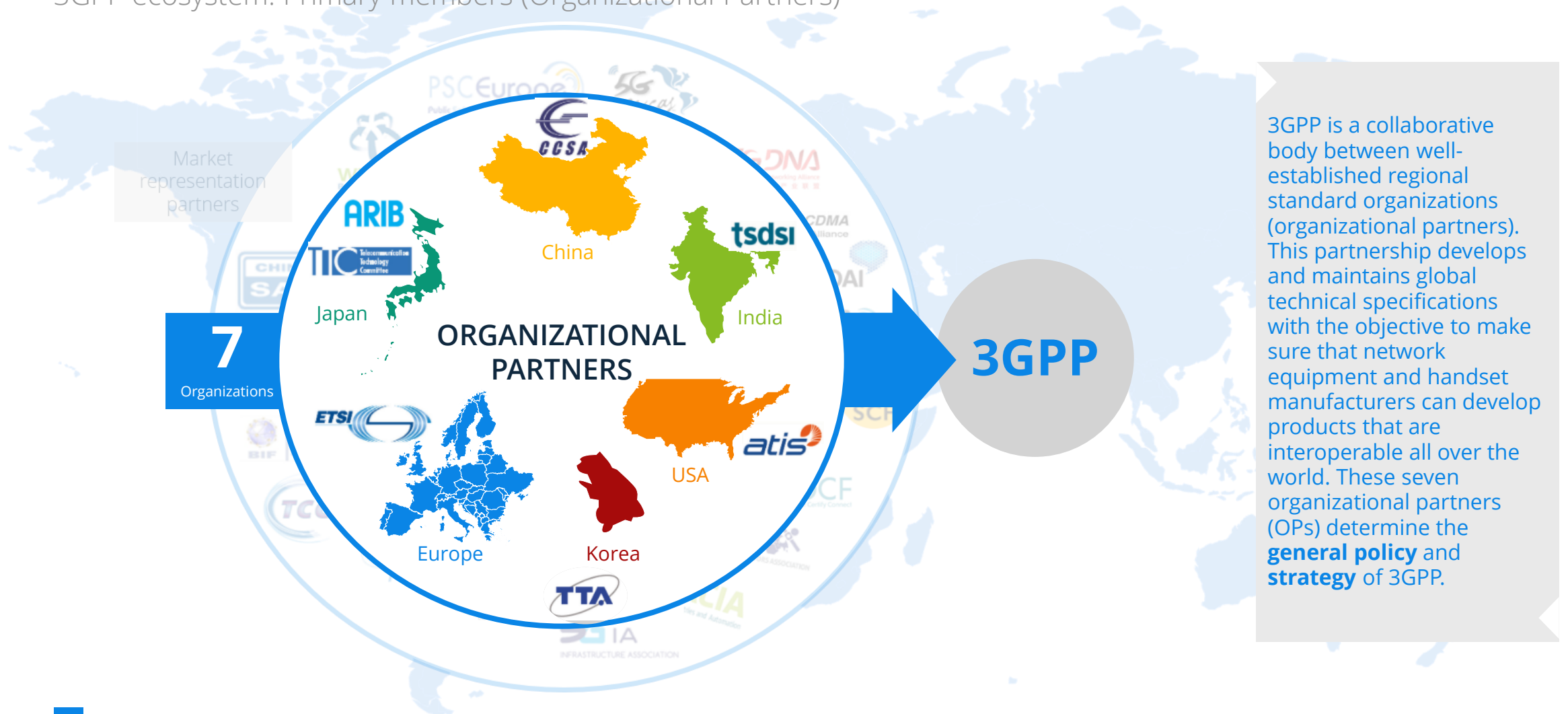
- **More Media:** Real time streaming of videos & faster gaming
- **IoT NB:** Enabling IoT narrow-band → transferring small amounts of data for a long time, providing energy saving for IoT device.
- **All-IP standard:** uses a standard communications protocol → data can be sent without being corrupted

- **Higher Performance:** Network speed up to 10Gbps, lower latency, much higher response rate
- **IoT:** Realization of the full potential of IoT. Enabler of real time manufacturing & logistics as well as Autonomous cars, smart cities & smart homes

- **Enhancements:** Advancements for uplink and downlink in mobile context
- **Artificial Intelligence:** Providing AI and ML** in air-interface. Providing extended reality services over 5G
- **Energy savings:** 5G networks are more energy efficient in transmitting data than older generations

3GPP is a partnership aiming to ensure the interoperability of network equipment and handsets all over the world

3GPP ecosystem: Primary members (Organizational Partners)



3GPP partnership includes seven regional telecom standard development organizations and twenty associate members

3GPP ecosystem : Associate members (Market representation partners)

MARKET REPRESENTATION
PARTNERS

20
Market
representatives



The twenty Market Representation Partners (MRPs) of 3GPP, together with organizational partners perform tasks such as: maintenance of the 'Partnership Project Agreement', approval of applications for 3GPP partnership and making decisions related to the dissolution of 3GPP. Specific inputs, in the form of market requirements may also come into the project via any these MRPs.

3GPP also has a variety of external cooperation with other standard bodies & different groups in the way of formal liaisons

3GPP ecosystem: External liaisons

STANDARD BODIES



5G PROJECTS



CERTIFICATION BODIES



FORMAL EXTERNAL LIAISONS*

Ecma International	\$GPP2
Expert Group for Emergency Access (EGEA)	450 MHz Alliance
Eurescom	AISG
European Co-operation in the field of Scientific and Technical Research (COST)	Bluetooth
European Radiocommunications Committee (ERC)	Broadband Forum (BBF)
Fixed Mobile Convergence Alliance (FMCA)	CableLabs
Global Certification Forum (GCF)	International Special Committee on Radio Interference (CISPR)
Global TD-LTE Initiative (GTD)	CTIA
GPS Industry Council	DVB project
GSM Association	OMA (Open Mobile Alliance)
HomeRF Forum	Open Networking Foundation (ONF)
IDB Forum	Open IPTV Forum
IEEE	Object Management Group (OMG)
Internet Engineering Task Force (IETF)	O-RAN Alliance
IrDA	PCS Type Certification Review Board (PTCRB)
International Multimedia Telecommunications Consortium (IMTC)	Portable Computer and Communications Association (PCCA)
Internet Streaming Media Alliance	Presence and Availability Management (PAM) Forum
ISO-ITU expert group	RSA Laboratories
ISO MPEG / JPEG	PCS Type Certification Review Board (PTCRB)
ITU-T SG2	Portable Computer and Communications Association (PCCA)
JAIN tm (Javatm APIs for Integrated Networks)	Presence and Availability Management (PAM) Forum
The Java Community Process (JCP)	RSA Laboratories
Liberty Alliance Project	SDR Forum
LTE/SAE Trial Initiative (LSTI)	Sun Micro Systems Inc
Metro Ethernet Forum (MEF)	NGMN (Next Generation Mobile Networks)
NENA	oneM2M

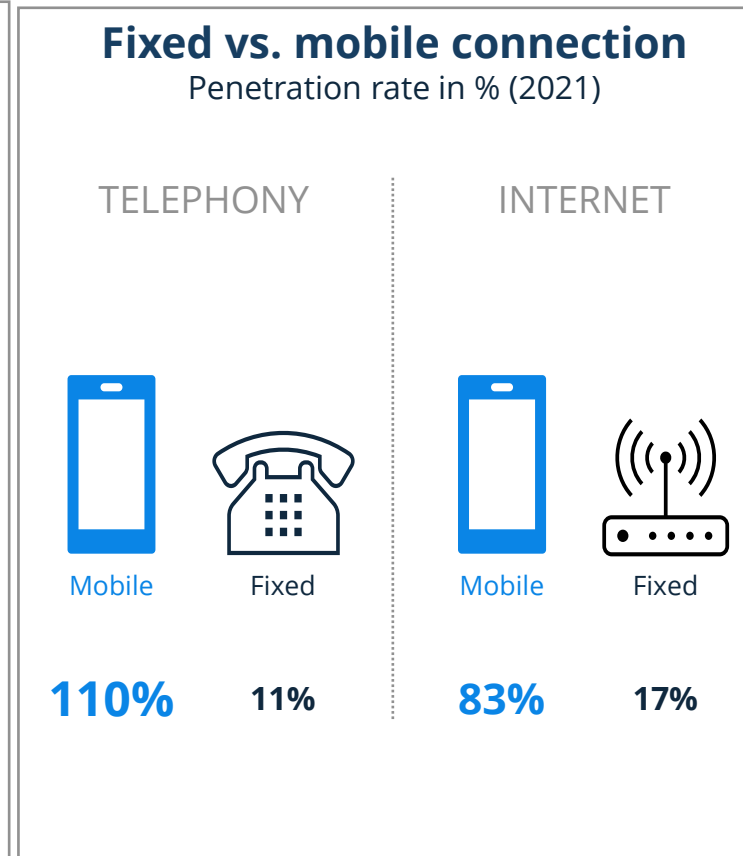
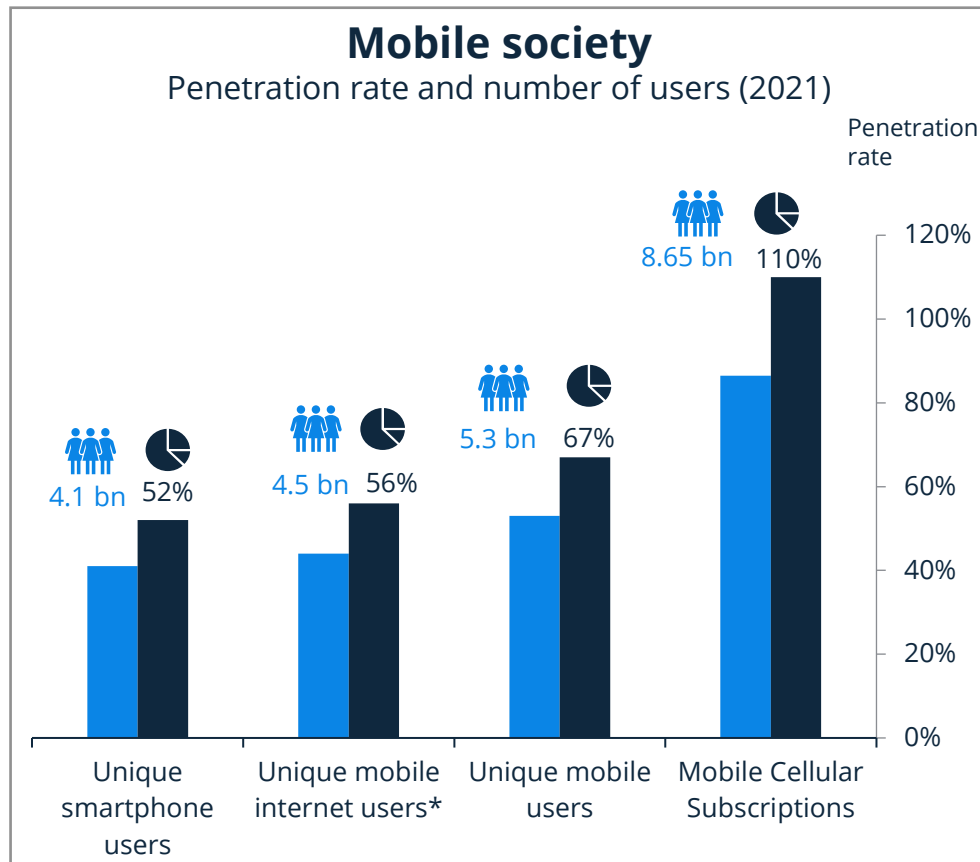


02 End user benefits

- Penetration
- Time to market
- Affordability

The spread of 3GPP communication technologies has resulted in unprecedented global penetration today ...

Mobile Technology as a part of our society (1/2)



3GPP cellular technologies are an integral part of our society, unique mobile subscribers reached 67% of population.

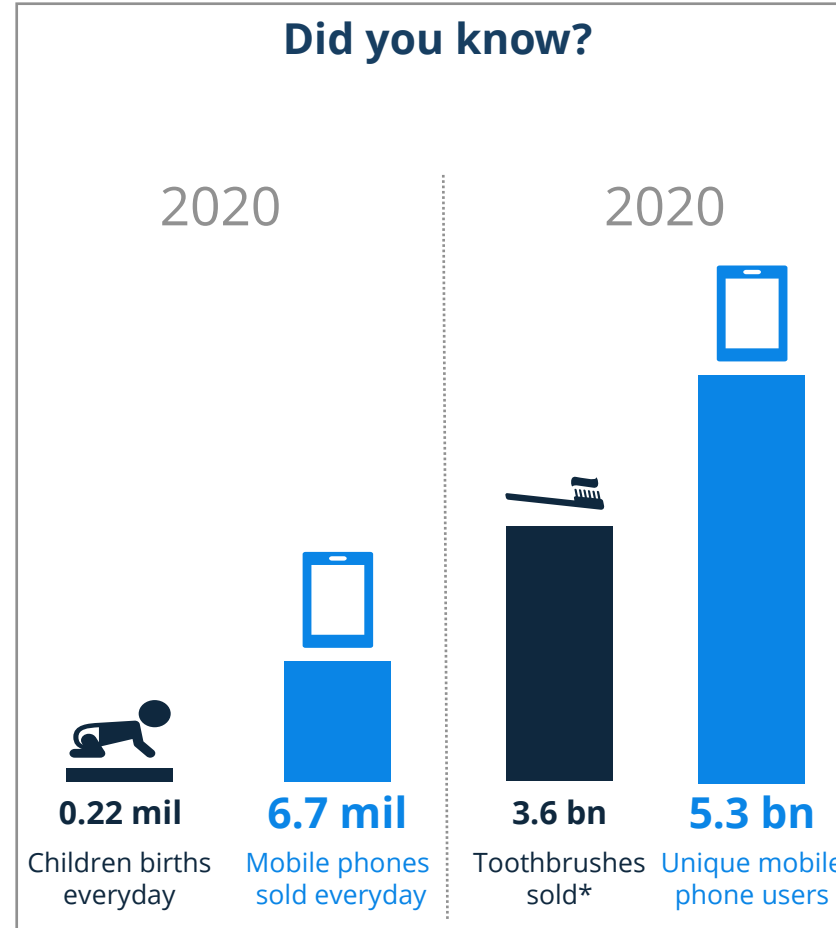
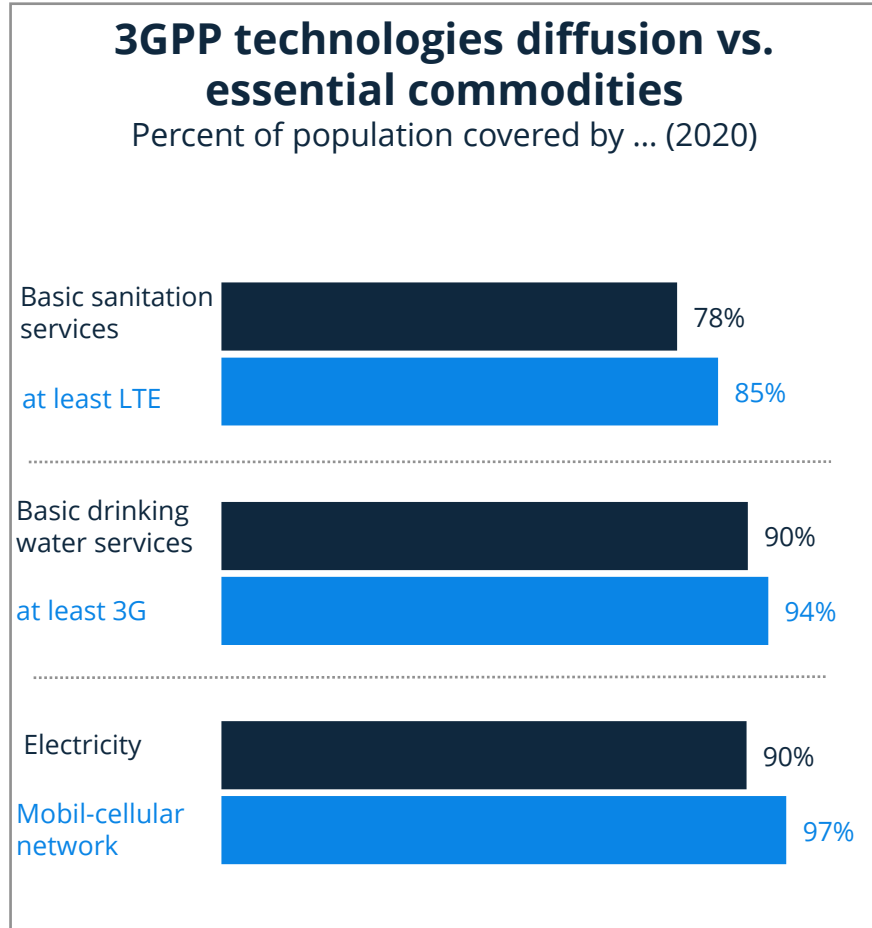
3GPP mobile networks enable access to mobile communication technology in regions where other communication technologies such as fixed telephony and fixed broadband failed to establish itself (e.g., in Asia and Africa).

Note(s): * cellular or Wi-Fi. Data points are based on estimations for the year 2021 by ITU or Statista calculation of unique number of users -> Penetration rate defines as the number of subscribers over the World Population in 2021, unless it is mentioned as unique number of subscribers. World population is assumed to be 7.89 billion by end of 2021

Source(s): [GSMA](#), [ITU](#), [Datareportal](#)

... and has even overtaken some long-established basic commodities in our society

Mobile Technology as a part of our society (2/2)



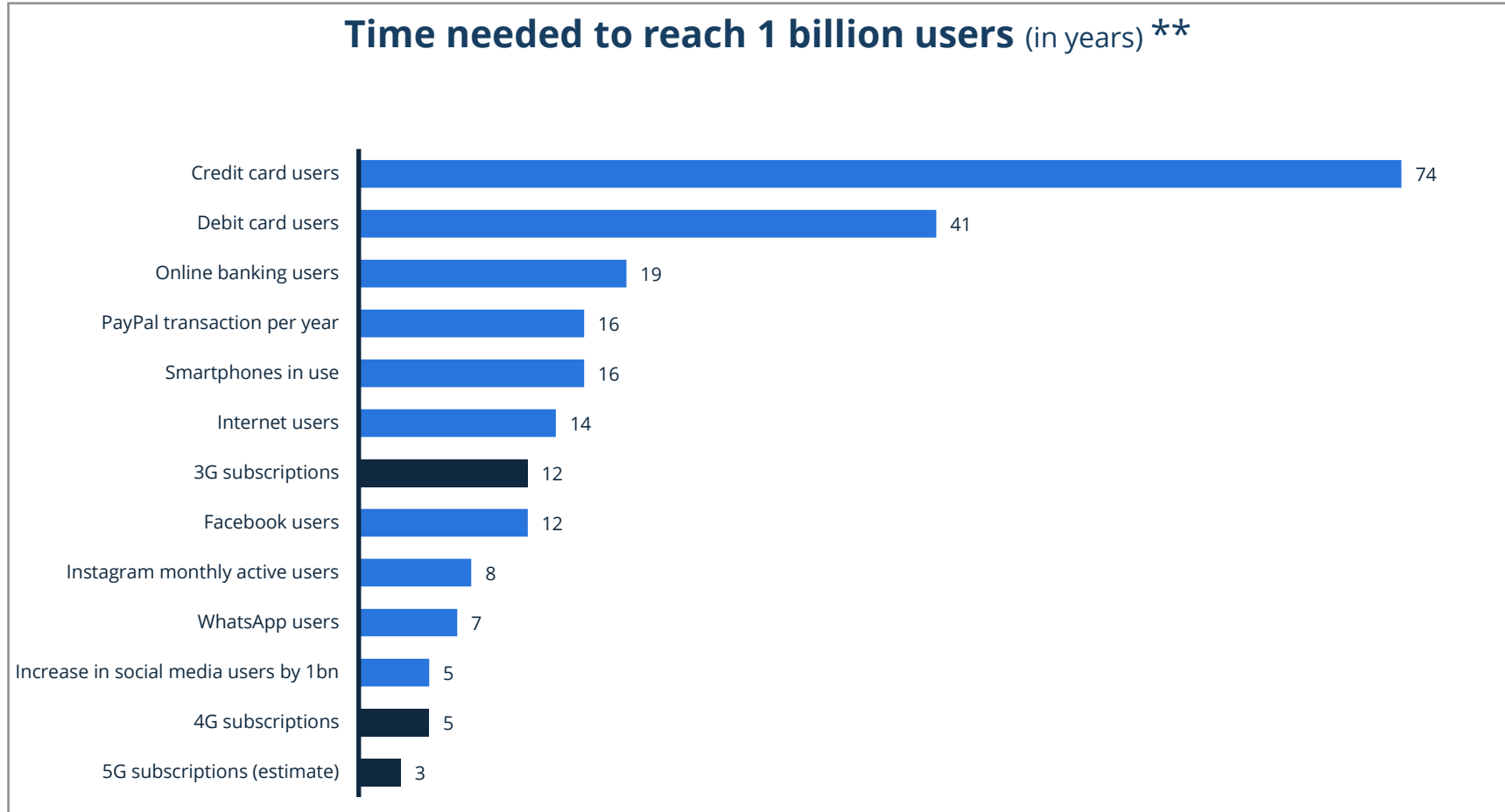
3GPP network providers are offering unprecedented levels of coverage for telecommunications technology, even in comparison to other basic needs.

Fun facts:

1. More cellular phones are sold each day than children are born.
2. Perhaps more surprising, there were more unique mobile phone users than toothbrushes sold globally in 2020.

5G is expected to reach 1 billion subscriptions faster than any other technological phenomenon

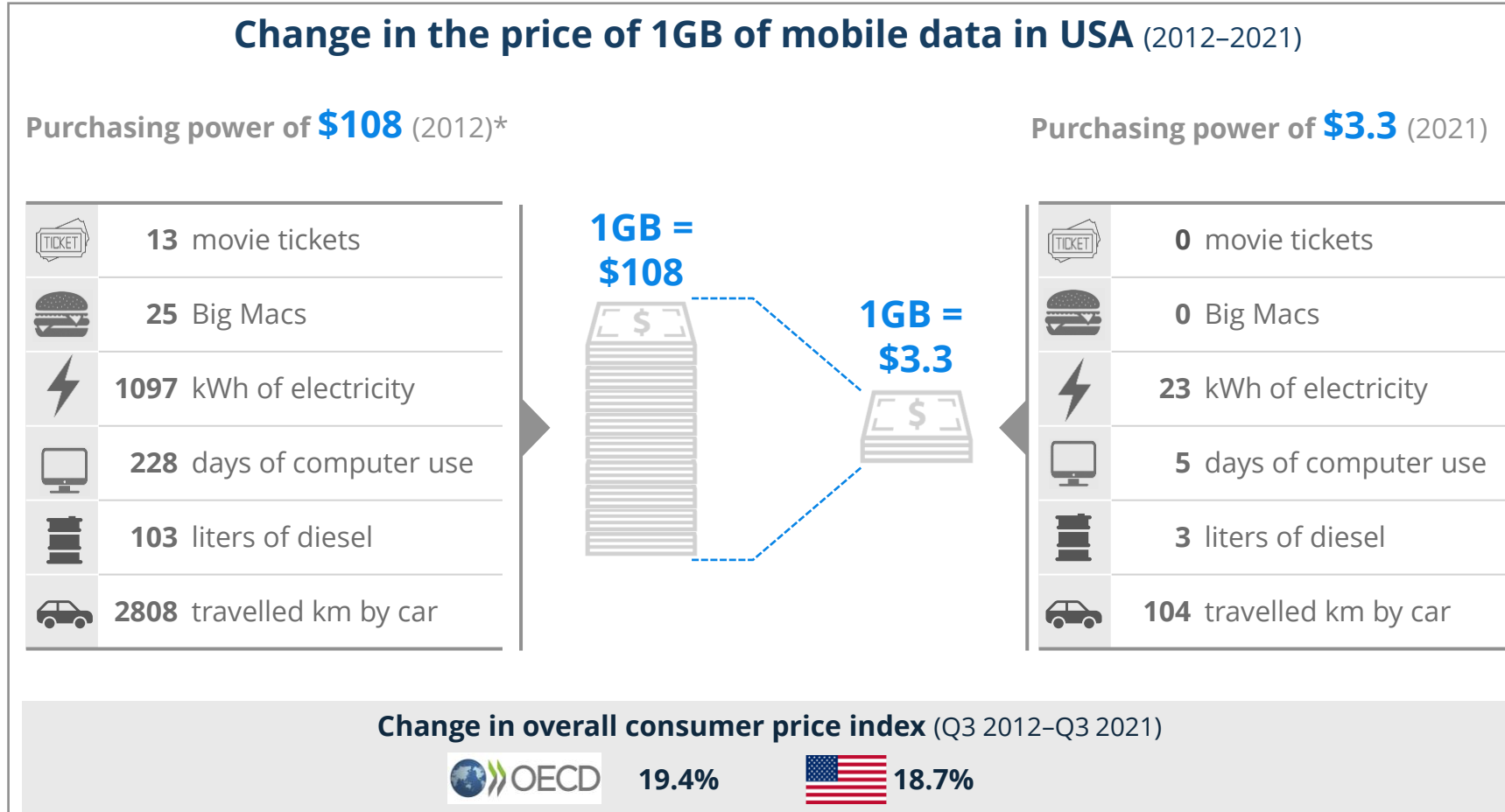
Time to market of 3GPP standards* compared to other technologies



Since the introduction of 2G mobile networks in 1991 and the subsequent introduction of 3GPP, mobile data technology has been adopted faster than many other technologies in the world. Estimates suggest that 5G will have the fastest time to market cycle and will be used by one billion individuals worldwide in 3 years. This rapid adoption forecast is mainly due to its relatively affordable price, ease of building capacity, and its prominent benefits to society.

3GPP – Global scale and efficiency: Mobile data promptly becoming more affordable and more accessible

Change in affordability of mobile data services - USA (1/2)



Data volume is important – and gets increasingly more affordable. In the USA, the price for a 1GB package has decreased by 97% in 9 years. In other words, in 2012, 1GB of mobile data cost consumers the same as using a computer for 228 days, whereas today it would only cost 5 days. Comparing this decline to the general consumer price indexes, although over-all commodity prices have inflated over years, mobile data became significantly more affordable.

Note(s): * The quantities were rounded down after calculation. the value refers to the mobile-broadband basket, prepaid handset-based with a data volume allowance of 500 MB . Kilometers travelled is based on Toyota Corolla 1.4D4D 3,67 liters per 100 km. computer use refers to desktop computer energy take-up







Source(s): [Cable UK](#), [Choose energy](#), [Economist](#), [EIA](#), [Expatistan](#), [ITU](#), [MPAA](#), [Spritmonitor](#), Statista analysis, [Time](#), [USA today](#), [Whole sale solar](#)

Change in affordability is not limited to the USA: Strong price decline is also notable in Europe

Change in affordability of mobile data services - Europe (2/2)

Change in the price of 1GB of mobile data in EU (2012–2021)

Purchasing power of **\$98** (2012)*

	14 Movie tickets
	23 Big Macs
	391 kWh of electricity
	81 days of computer use
	65 Liters of Diesel
	1795 Travelled km by car







1GB =
\$98



1GB =
\$2.6



Purchasing power of **\$2.6** (2021)

	0 Movie tickets
	0 Big Mac
	10 kWh of electricity
	2 days of computer use
	1 Liters of Diesel
	44 Travelled km by car

Change in overall consumer price index (Q3 2012–Q3 2021)



11%



8.2%



14.7%



13%

In Europe, the price of 1 GB mobile data has decreased strongly. The price of 1 GB of mobile data in 2012 cost an equivalent to 65 liters of diesel, which amount to around 1795 km of car travel. Whereas in 2021, 1 GB of mobile data only costs an equivalent 1 liter of Diesel, i.e., 44 km of travel by car. Comparing this decline to consumer price indices in Europe, mobile data has become significantly more affordable. This development enables an increase in purchasing power, from which everyone benefits.

Note(s): *Mobile GB prices are based on data models with the usage of package prices. Europe is based on European Union (27 countries) /Kilometers travelled is based on Toyota Corolla 1.4D4D (one of the most popular cars in the world) 3,67 liters per 100 km. The quantities were rounded after calculation. computer use refers to desktop computer energy take-up

Source(s): [Cable UK](#), [Economist](#), [EEA](#), [Eurostat](#), [ITU](#), [Spritmonitor](#), Statista analysis, [Global petrol prices](#), [Time](#), [UNIC](#), [OECD](#)

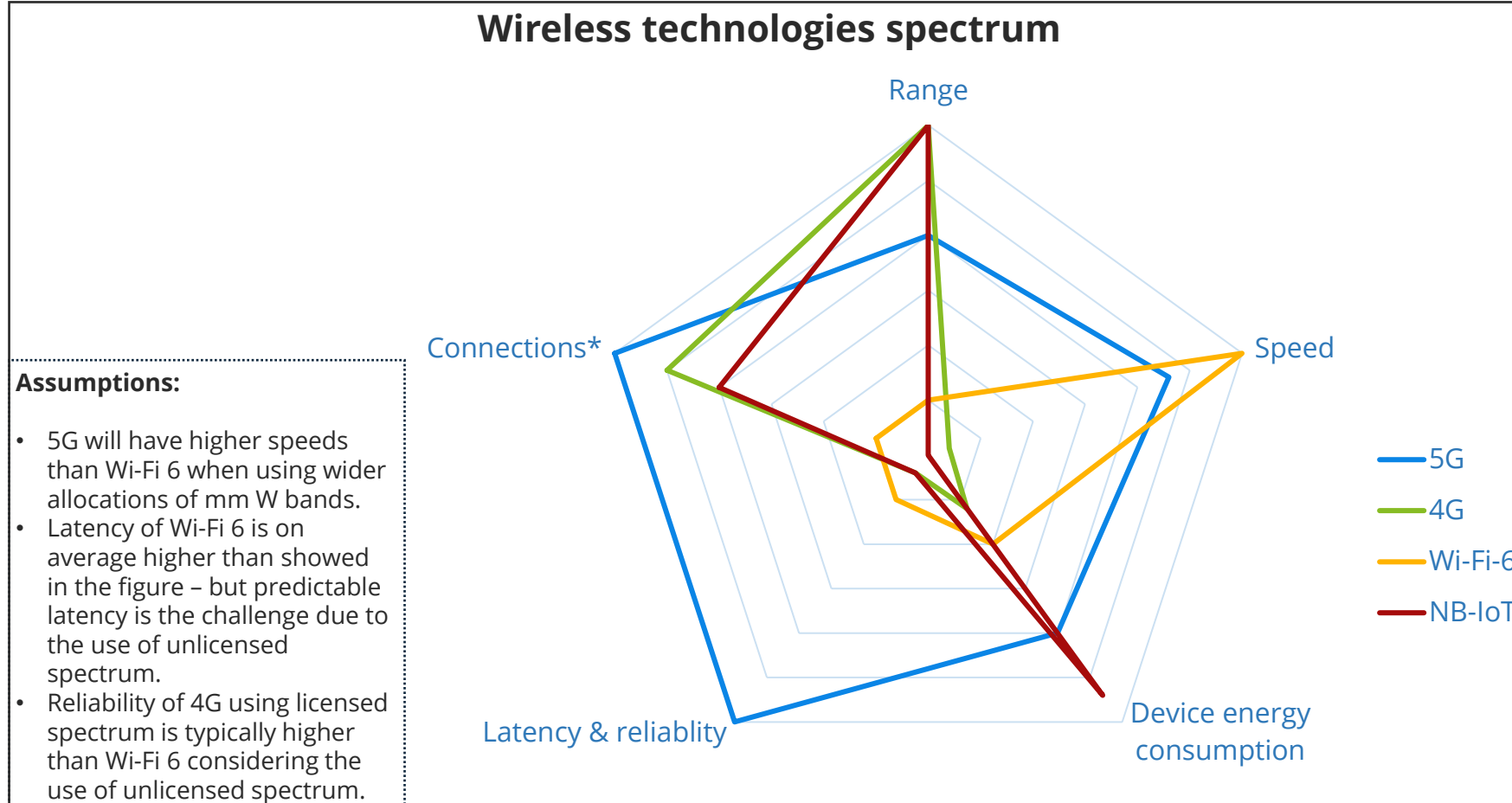


03 5G and future

- 5G vs. other wireless technologies
- Coverage, penetration & commercialization
- 5G operator's geographical expansion
- 5G commercial ecosystem
- 5G vendor options
- 3GPP as a mean to interoperability

5G is more attractive due to improvements in speed, latency, reliability, and power consumption while supporting more devices

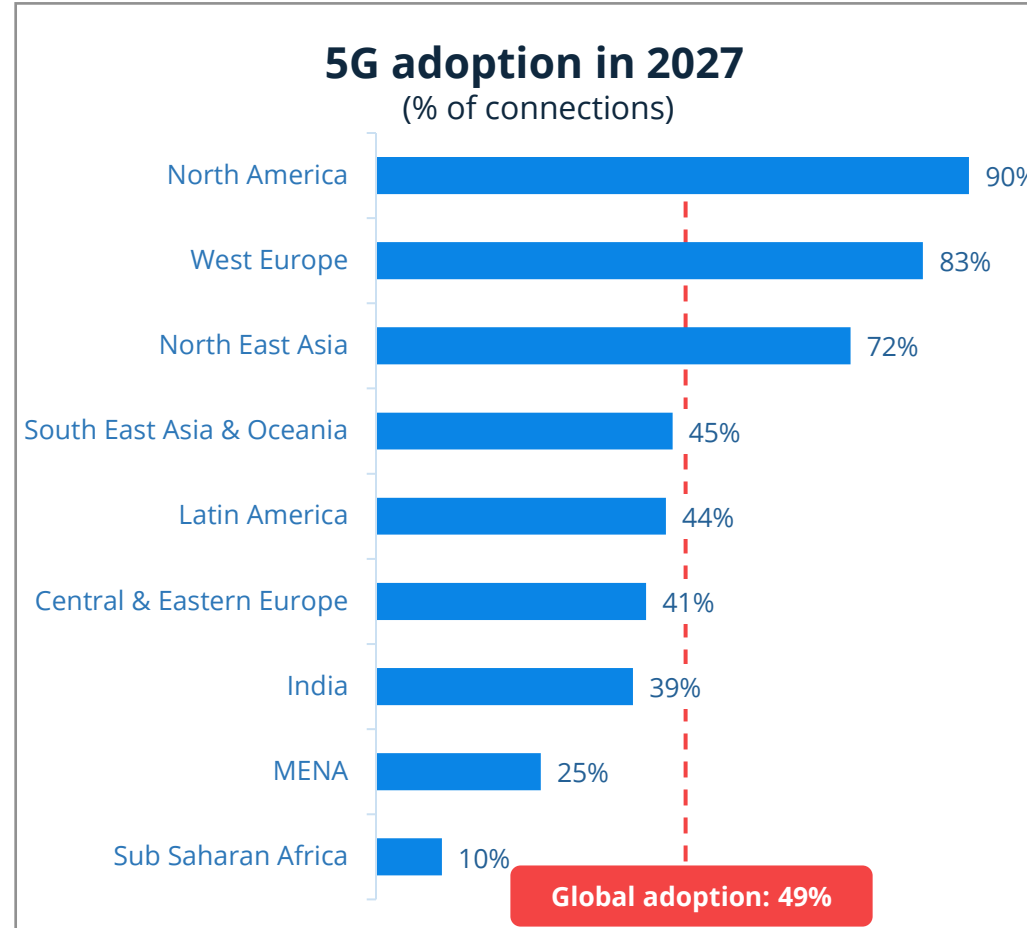
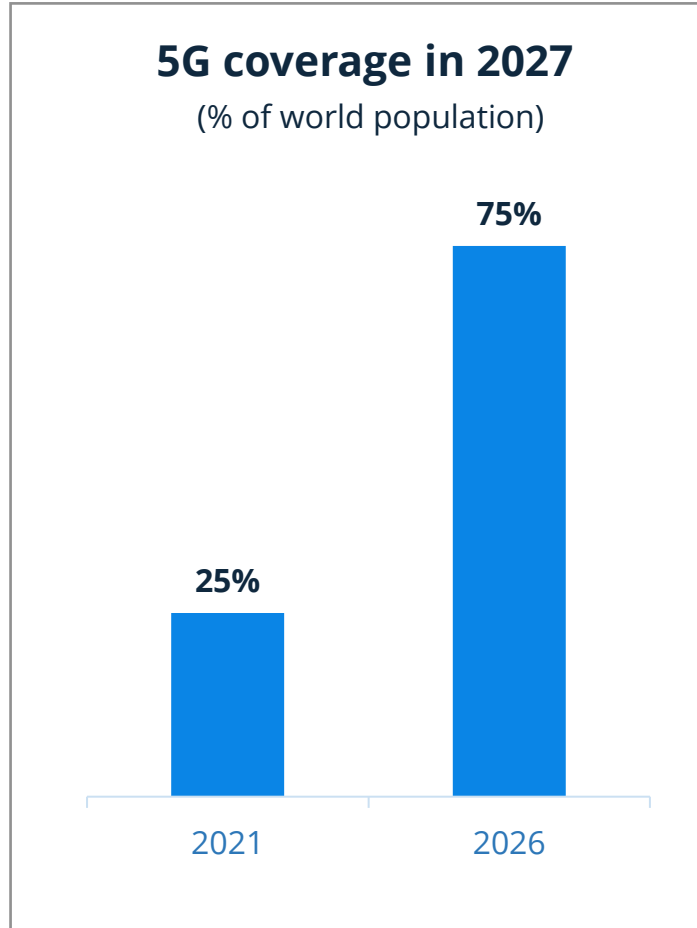
5G vs. other wireless technologies



Although 5G does not yet provide optimal results for all these dimensions simultaneously because of current technological and infrastructure limitations, it will eventually become the technology of choice for critical communications that require extreme reliability and service quality, including those within industrial settings. However, not all performance dimensions can be maximized at the same time. There are trade-offs between speed, range, energy efficiency, and latency.

The 3GPP-5G standard enables a quick roll out: West Europe and North America are the forerunners

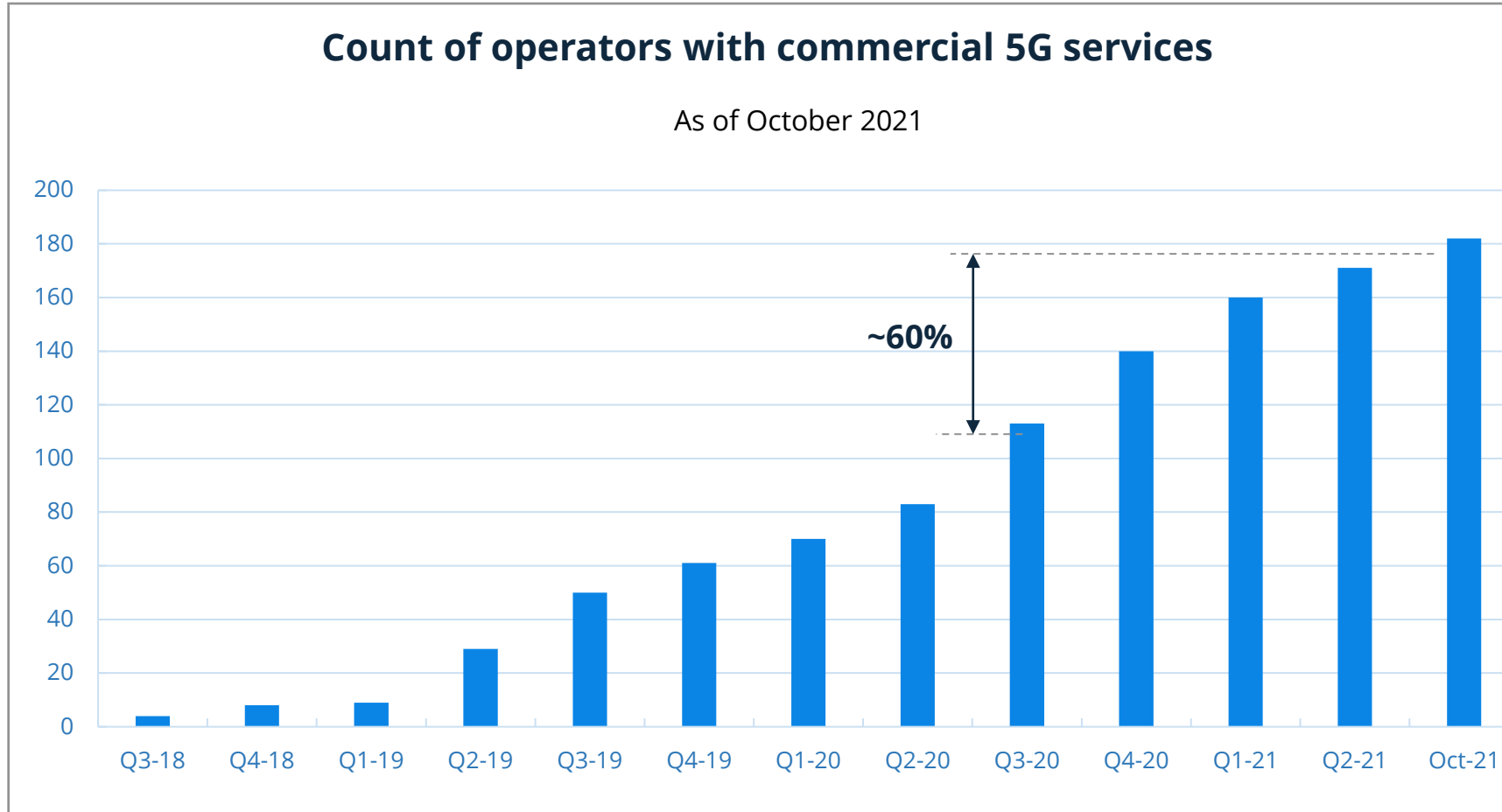
5G Coverage & Connections



By the end of 2021, 5G subscriptions are expected to reach 660 million. Looking into the future, north America is in the leading position of adopting and establishing 5G mobile networks with more than 90% (410 million) of connections using 5G standards closely followed by West Europe (83%) and developed Asia (72%). The global average for adoption of 5G mobile networks will be around 49%, that is 4.4 billion individuals, by 2027.

The 3GPP-5G commercial network launches keep the momentum

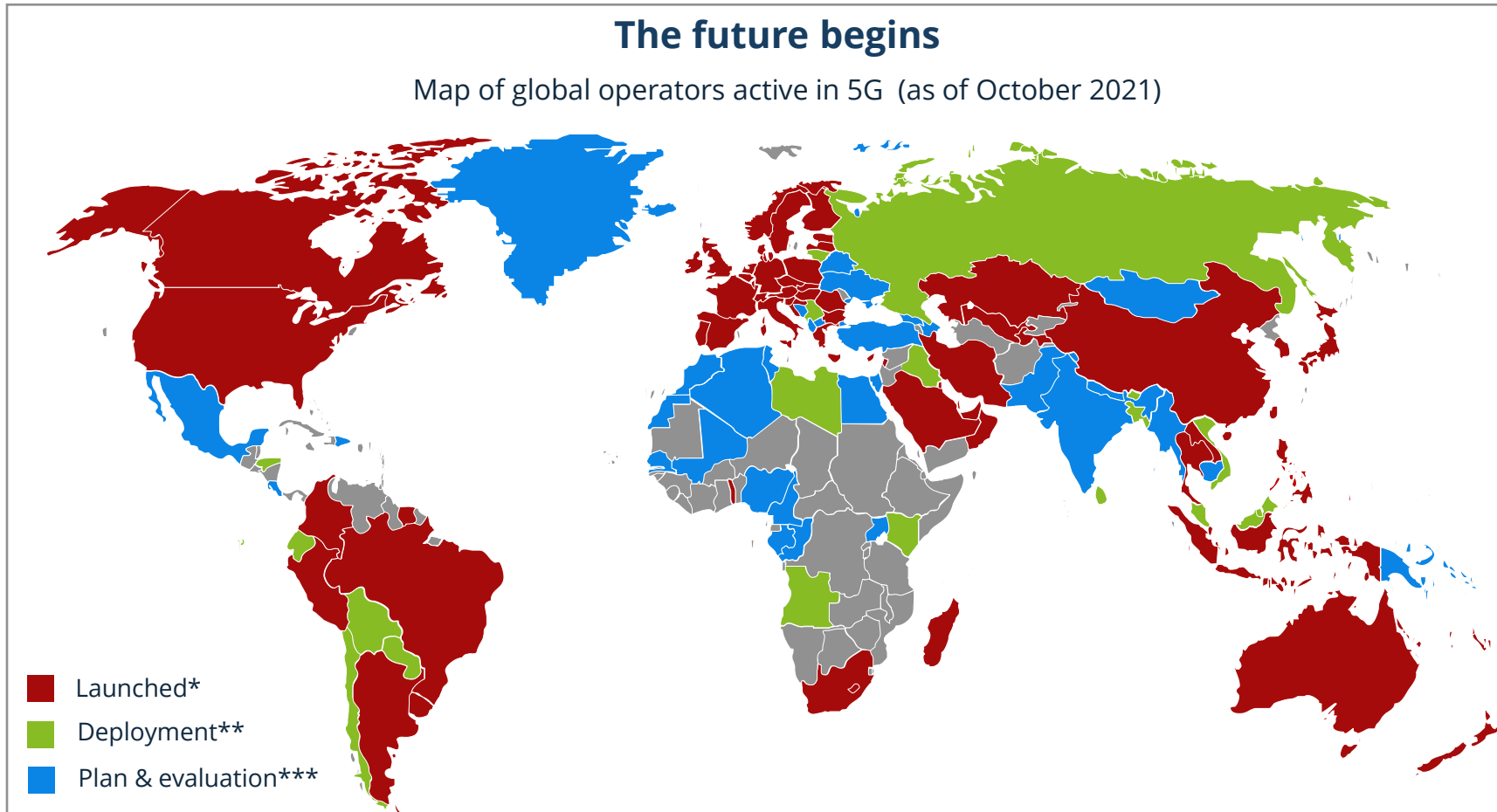
5G commercialization speed



By end of October 2021, the number of operators worldwide who have launched 5G services commercially has reached **182**, i.e., end consumers in **73** countries around the world can now use 3GPP-compliant 5G services. Additionally, two commercial 5G Open RAN network deployments have been announced in Japan during 2020, one greenfield (Rakuten) deployment and one brownfield (DoCoMo). Whereas only DoCoMo's compliance with O-RAN Alliance LLS' open interface specification is confirmed.

3GPP-5G network expansion: 140 countries have already started the journey

5G expansion map around the globe



5G has launched globally. According to the plans of various telecommunication operators, most countries will get access to 5G in the coming years. By end of October 2021, **469** operators in **140** countries had announced that they had at least started investing in mobile or fixed wireless access 5G networks. These investments have been in the form of tests, trials, pilots, planned and actual deployments. Out of these operators, 182 have already made it commercially available.

Notes: *Commercial services are generally available to customers over a live 5G network, either launched or soft launched ** deploying or deployed in network but still precommercial.*** Planning, evaluating, testing and trialing

Source(s): [5G market snapshot November 2021](#)

[illegible]

The infographic displays three key metrics related to global mobile networks:

- Live 5G Networks:** Represented by a large number '19' above a horizontal line.
- Countries with Live 5G:** Represented by a large number '49' above a horizontal line.
- Unique Live 5G Operators:** Represented by a large number '76' above a horizontal line.

Below these statistics, there are three rows of logos for various mobile network operators from different countries, including AT&T, Airtel, AIS, BSNL, Bell,中国移动, 中国联通, 中国电信, 中興電信, Docomo, Easycell, Glomac, HKT, LG U+, Magenta, Monaco Telecom, Ooredoo, Optus, Rain, Rogers, SoftBank, SK Telecom, Smartfone, Sunrise, STC, Swisscom, Sprint, T-Mobile, Taiwan Mobile, TELE2, Telcel, Telekom Sverige, Telia, TELUS, Veon, Zain, TIM, Mobicel, true move, 台灣之星, and US Cellular.

5G BSS | OSS

- ALEPO, amdocs, ANTELOPE, cerillion, digi, ERMEDIA, LOTUSLAB, MATRISKY, MDS, Netradar, NOKIA, OPENET, Optiva, Tescnet, VMware Cloud, amdocs, blueplanet, cerillion, ERICSSON, Enghouse Networks, HANSEN SYSTEMS, Netradar, NOKIA, synchronise

5G Assurance

- ACCEDIAN, allot, blueplanet, EMPIRIX, EXFO, ERICSSON, infovista, mycomosi, NOKIA, NETSCOUT, RADIOMIZING, SANDVINE, SevOne, SUBEX, Osprent, TECO, VIIVI

SD-WAN

- i28, adaptin, arylaka, Bandaana, bigleaf, CATO, citrix, alibaba CSCO, Meraki, viptela, paloalto, CLOUDGENIX, cradlepoint, ECESSEA, FATPipe, flexiWAN, FORTINET, infovista, JUNIPER, multiplatform, riverbed, silverpeak, VERSA, velocloud, dimension data, DDC INFORMATION, KAILASHIN, HCL, IBM, NOKIA, Cognizant, Deloitte, wipro

5G System Integrators

- accenture, amdocs, AtoS, BearingPoint, Capgemini, Cognizant, Deloitte, dimension data, DDC INFORMATION, KAILASHIN, HCL, IBM, NOKIA, Cognizant, Deloitte, wipro

SDOs | Market Partners & Alliances

- AKARIJIO EDGE STACK, 5GT DRONES, AKARIJIO EDGE STACK, 5G-encore, 5G NR, 5G, ebsr, ctia, ESQA, ETRI, GCF, GSA, IEEE, INETC, EDGE, ngm, tnf forum, TELECOM INFRA PROJECT, WIRELESS

5G Security

- A10, allot, alibaba CISCO, BROADCOM, Check Point, CLOUDFLARE, digitcert, FORTINET, JUNIPER, KEYSIGHT TECHNOLOGIES, NetNumber, NOKIA, paloalto, Osprent, TREND MICRO

SASE

- Akamai, BROADCOM, CATO, alibaba CISCO, CLOUDFLARE, Forcepoint, FORTINET, McAfee, netskope, paloalto, perimeter 81, proofpoint, VERSA, vmware, zscaler

5G Phones

- Apple (iPhone 12)
- Huawei
- LG
- Motorola
- OnePlus
- OPPO
- Samsung

5G Management & Orchestration

- ADVA
- amdocs
- blueplanet
- cisco
- cloudify
- ericsson
- flumeo
- infinera
- juniper
- netcracker
- nmf
- oanap
- openrio
- whitestack

5G Wearable

- nreal

5G Laptops

- dell
- hp
- lenovo

5G Testing

- anritsu
- active
- exfo
- infocivista
- keypoint
- metronome
- osprent
- viavi
- zindus

5G Silicon / Chip / Device Manufacturers

- amd
- arm
- aspeed
- brocade
- eridan
- graphcore
- intel
- latte
- macom
- marvell
- mediatek
- nvidia
- nxp
- precomm
- qualcomm
- samsung
- skyworks
- tegra
- ti
- uclink

5G Tower / DAS / Small Cells

- airtel
- at&t
- cellnex
- china tower
- corning
- oceanic
- ib access
- exide
- helios
- towers
- mobilitie
- sba
- tesco
- uniti
- us cellular
- verticalbridge
- zihwave

5G Edge

- micro
- edgeline
- gigamon
- icant
- qwest

Cloud Service Providers

- alibaba cloud
- aws
- equinix
- google cloud
- ibm cloud
- microsoft azure
- tencent cloud

Data Center

- datacenter
- data
- ec

The image displays a collection of logos for mobile network providers, organized into four columns based on their technology: 5G eSIM, 5G vRNC, 5G Core, and 5G vIMS. Each column contains a list of logos, with some providers appearing in multiple categories.

- 5G eSIM:** Includes logos for Airtel, Airspan, Altiostar, Altair, Asiacom, Blinq, Comba, DASH, Eutelsat, Ericsson, Huawei, Metaswitch, Nokia, Open Lens Core, Qualcomm, Quercus, Redline, Samsung, Sercom, and ZTE.
- 5G vRNC:** Includes logos for AT&T, DASH, Huawei, Ericsson, Metaswitch, Nokia, and Samsung.
- 5G Core:** Includes logos for AT&T, DASH, Huawei, Ericsson, Metaswitch, Nokia, and Samsung.
- 5G vIMS:** Includes logos for AT&T, DASH, Huawei, Ericsson, Metaswitch, Nokia, and Samsung.

A collage of logos for various companies, including Cerillion, A10, Allot, Cisco, Broadcom, Check Point, Cloudflare, DigiCert, Fortinet, Juniper, Keysight, NetNumber, Nokia, Palo Alto, and OpSpirant.

98
Live 5G Networks

49
Countries with Live 5G

76
Unique Live 5G Operators

[illegible]

5G Tower | DAS | SmallCells

AMERICAN TOWER
AT&T
cellnex
CHINA TOWER
CORNING OPTICAL CABLE
CROWN CASTLE
Iaccess
exelnet
helios towers
JABIL
mobilitie
SBA
TESSCO
Uniti
US Cellular
verticalbridge
zinwave

5G Edge

Micro
affirmed
edge
Icont
QW

Cloud Service Providers

Alibaba Cloud AWS Equinix
Google Cloud IBM Cloud
Microsoft Azure Tencent Cloud

Platforms | Exchange | MEC

soft MEC

alef

AKELLIO

altrun

JAGGON

CLEARBLADE

4D Systems

edgeworks

Google Cloud

IBM

Red Hat

khaloorm

ran

MobileedgeX

M mutable

NVIDIA

packet

veeva

volterra

WIND

Radisys

Soguno

Silicom

Veeva

Centers | Colocation service Providers

BT CDNetworks 中国电信 CERNET Cyttera

FOUNDRY DATABANK DIGITAL REALTY interxion IRON MOUNTAIN

QUINIX FLEXENTIAL NTT COMMUNICATIONS TELEHOUSE tierpoint

5G Virtual Infra Manager (VIM)

CANONICAL CISCO ERICSSON HUAWEI MIRANTIS NOKIA
openstack. IBM Red Hat vmware WIND

5G Open Source Projects & Labs



The image displays a grid of logos for various 5G open source projects and labs. The logos are arranged in two rows. The first row includes Linux, ONAP, OpenDaylight, OpenNFV, 5GPP, and ETSI. The second row includes Open Air Interface, O-RAN, and Open RAN Alliance. Each logo is enclosed in a dashed border.

5G Assurance

- ACCEDIAN
- allot
- blueplanet
- EMPIRIX
- EXFO
- ERICSSON
- infovista
- mycomosi
- NOKIA
- NETSCOUT
- RADCOM
- SANDVINE
- SevOne
- SUBEX
- Spirent
- TECOO
- VIAYI

SASE

- Alkami
- BROADCOM
- CATO
- CISCO
- CLOUDFAR
- Forcepoint
- FORNET
- McAfee
- netskope
- paltoir
- perimeter 81
- proofpoint
- VERSA
- vmware
- zscaler

SD-WAN



128 adaptive anyika Barroosa bigleaf CATO citrix cisco Meraki viptela paloalto cloudgenix cradlepoint ECSSA F5 flexiwan FORADNET infovista JUNIPER MULTASTEP muxym magentaethernet riverbed silverpeak VERSA velocloud

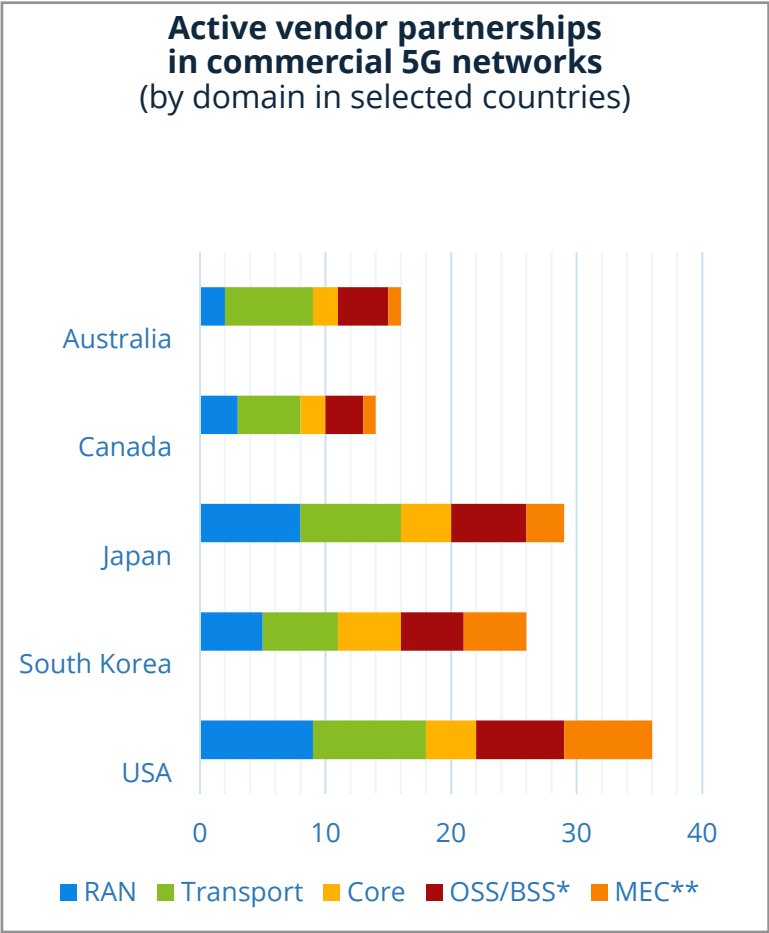
5G System Integrators

accenture | amdocs | Atos | BearingPoint | Capgemini | Cognizant | Deloitte.

dimension data | DXC Technology | ERM | HCL | IBM | NOKIA | TATA | Tech Mahindra | wipro

3GPP defines a common standard, providing operators with numerous choices of 5G vendors

5G mobile network vendor ecosystem



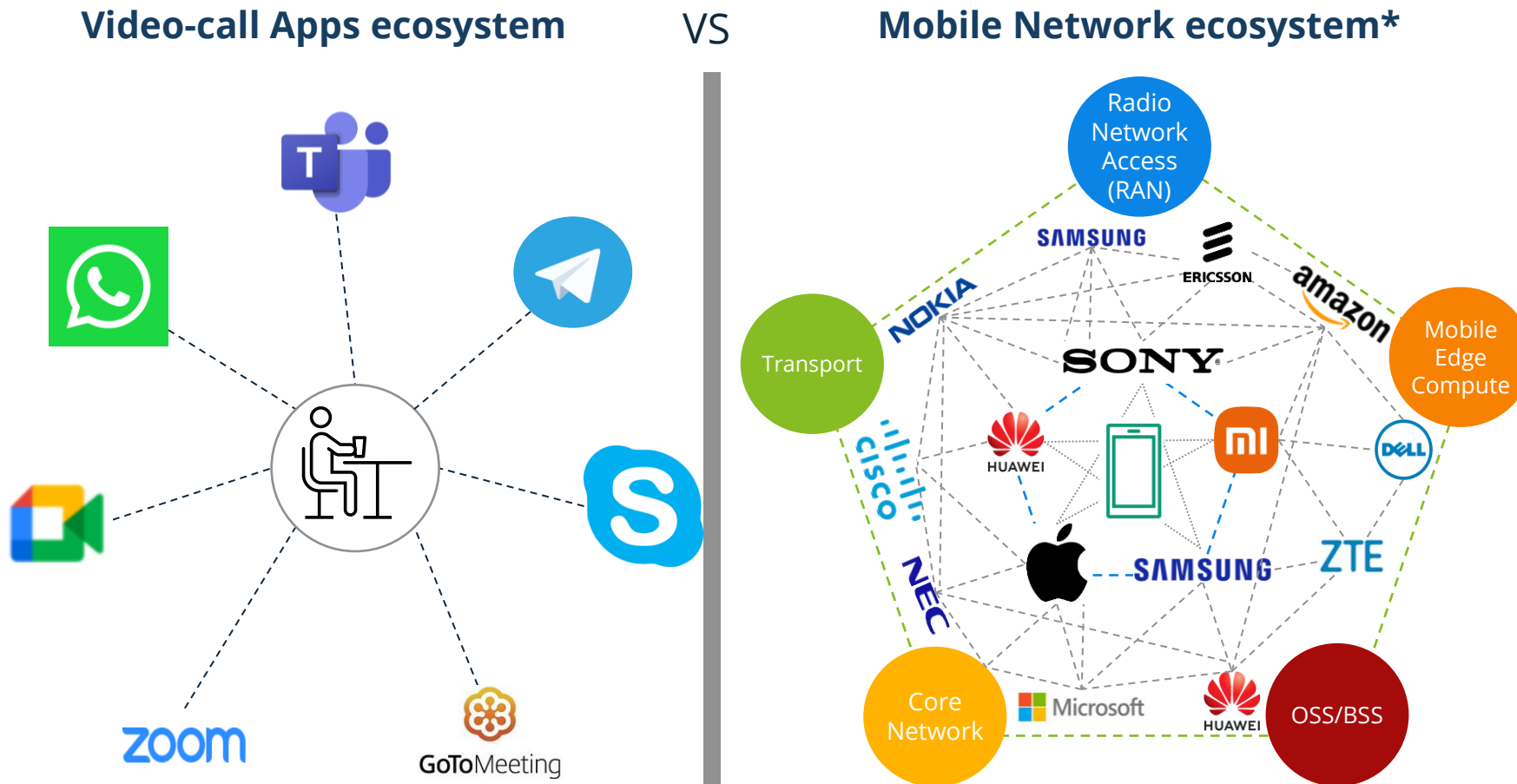
Examples of current 5G network solution suppliers

RAN	Transport	Core	OSS/BSS	Edge
Airspan	Adtran	Affirmed	Amdocs	Amazon
Altistar	Airspan/Mimosa	Casa	Cerillion	Dell
Casa Systems	Aviat Networks	Cisco	Cisco	Google
Commscope	Ceragon	Ericsson	Comarch	Huawei
Croning	Ciena	HPE	CSG	Intel
Ericsson	Cisco	Huawei	Ericsson	Microsoft
Fujitsu	Commscope	Mavenir	HPE	QTC
Huawei	DragonWave-X	Microsoft/(Metaswitch)	Huawei	Radisys
Nokia	Ericsson	NEC	NEC/Netcracker	Red Hat (IBM)
Mavenir	Huawei	Nokia	Nokia	
NEC	Juniper	Oracle	Openet	
Parallel Wireless	Nokia	Samsung	Optiva	
Samsung	Siklu	ZTE	Sigma Systems	
ZTE	ZTE		ZTE	

The transition from one mobile generation to the next has, historically, been a time when mobile operators evaluate their current suppliers and explore new ones. Vendors see this transition period as an opportunity, allowing them to enter new markets and build new relationships with mobile operators. With 5G, unlike previous generations, there is unified agreement on what 5G technology should be. 5G ecosystem provides operators with many vendor choices, as illustrated in the table.

3GPP defines a common standard, providing a seamless connection between the users and providers

3GPP as a mean to interoperability



Unlike countless other technologies which surround us, mobile networks are interoperable. Taking the example of different video call apps, one could see that they are in most of cases incompatible, it is impossible to send or receive calls from for instance Skype to Zoom directly. Considering mobile calls, we take it for granted that all kinds of cell phones are seamlessly compatible, regardless of their type. In addition, 3GPP standard has made it possible for all numerous providers and suppliers throughout the supply chain to be able to sync.

Sources

3GPP

Accenture

BBVA Research

Cable U

Choose Energy

Delloro

DigitalTrends

Economist

EIA

Emarketer

Ericsson

Eurostat

Expatisan

Facebook

Global Findex Database

Grandview Research

GSA

GSMA

Instagram

ITU

Jefferies & Companies

Migrationdataportal

MPAA

Newzoo & United Nations

PayPal

PriceWaterhouseCoopers

Rantcell

Round Solutions

Spritmonitor

Statista

Time

USA today

Uswitch

World Bank

Worldometer

WHO

Whole sale solar

Tecknexus

Omdia

Fortune business

GFU

UNDP

RCRwireless

comvia

Global petrol prices

5G security

Unsplash

Recommendations

Dossiers

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[Telecommunication services](#)

[Smart Cities](#)

Digital Market Outlook

[E-Commerce](#)

[Digital Media](#)

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Company Database

[Alibaba Group Holding Ltd.](#)

.... (many more)

Top lists

[Top 2,500 Companies: Global](#)



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