5G

Session 5: The economic impact of 5G – Ensure regulation and keep pace of innovation

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ITU Overview

Committed to connecting the world

193 Member States
673 Sector Members
168 Associates
108 Academia

ITU-T

Telecommunication standardization - network and service aspects

ITU-D

Promote and assist the extension of ICTs to all the world's inhabitants - narrowing the digital divide

ITU-R

Global radio spectrum management and radiocommunication standardization

Mobile Networks Evolution

5G (IMT2020)

4G* (IMT-Advanced)
- Digital System, IP-based
- Service Convergence: Telecom & Datacom
- Very High Data rate (Broadband); multimeda format, Video
- Seamless Roaming
- Global Radio Access / Global Solution

3G (IMT-2000)
- Digital System
- Service Concepts and Models: Multimedia Apps.
- High Data rate (Broadband)
- Seamless Roaming
- Global Radio Access / Global Solution

2G
- Digital System
- More Services: Digital Voice; Text-based Apps.
- Low data speed (Narrowband)
- Advanced Mobility (Roaming)
- Towards Global Compatibility

1G
- Analog System
- Very basic Services (mostly voice)
- Basic Mobility
- Systems Incompatibility

2016
4 Years
2012
5 Years
2007
7 Years
2000
10 Years
1990

For over 30 years, ITU has been developing the standards and spectrum arrangements to support International Mobile Telecommunications (IMT)

First Generation (1G)

1G analogue systems provided two key improvements over the first radiotelephone services:

- the invention of the microprocessor; and
- digitization of the control link between the mobile phone and the cell site.

1970s

Frequencies for mobile services allocated in the Radio Regulations

Second Generation (2G)

2G systems digitized not only the control link but also the voice signal - better quality and higher capacity at lower cost.

Regional/global operation was hampered by:
- multiple incompatible standards;
- different frequency bands and channels in different parts of the world.

1980s-1990s

ITU-R develops the international mobile telecommunication system (IMT) to address these issues – first global IMT frequencies identified at WRC-92

IMT-2000 – Third Generation (3G)

ITU's IMT-2000 global standard for 3G unanimously approved at the ITU Radiocommunication Assembly 2000 – digital voice and data.

Global standard and harmonized frequencies:
- global roaming;
- massive economies of scale;
- innovative applications and services.

2000s

WRC-2000 and WRC-07 identify additional frequency bands for IMT in the Radio Regulations

IMT-Advanced – Fourth Generation (4G)

IMT-Advanced specifications approved at the ITU Radiocommunication Assembly 2012 - packet-based, multi-media, high data rates.

Mobile broadband becomes the main method of accessing the Internet

2010s

WRC-15 harmonizes and identifies additional frequency bands for IMT in the Radio Regulations

1G → 2G : Analog to Digital
2G → 3G : Narrowband to Broadband
3G → 4G : Broadband evolution (Multimedia)
4G → 5G : High Broadband to connect **People** and **machines**

		Real World (avg)		Theoretical (max)	
		Download	Upload	Download	Upload
2.5G	GPRS	32-48Kbps	15Kbps	114Kbps	20Kbps
2.75G	EDGE	175Kbps	30Kbps	384Kbps	60Kbps
3G	UMTS	226Kbps	30Kbps	384Kbps	64Kbps
	W-CDMA	800Kbps	60Kbps	2Mbps	153Kbps
	EV-DO Rev. A	1Mbps	500Kbps	3.1Mbps	1.8Mbps
	HSPA 3.6	650Kbps	260Kbps	3.6Mbps	348Kbps
	HSPA 7.2	1.4Mbps	700Kbps	7.2Mbps	2Mbps
Pre-4G	WiMAX	3-6Mbps	1Mbps	100Mbps+	56Mbps
	LTE	5-12Mbps	2-5Mbps	100Mbps+	50Mbps
	HSPA+	-	-	56Mbps	22Mbps
	HSPA 14	2Mbps	700Kbps	14Mbps	5.7Mbps
4G	WiMAX 2 (802.16m)	-	-	100Mbps mobile / 1Gbps fixed	60Mbps
	LTE Advanced	-	-	100Mbps mobile / 1Gbps fixed	-

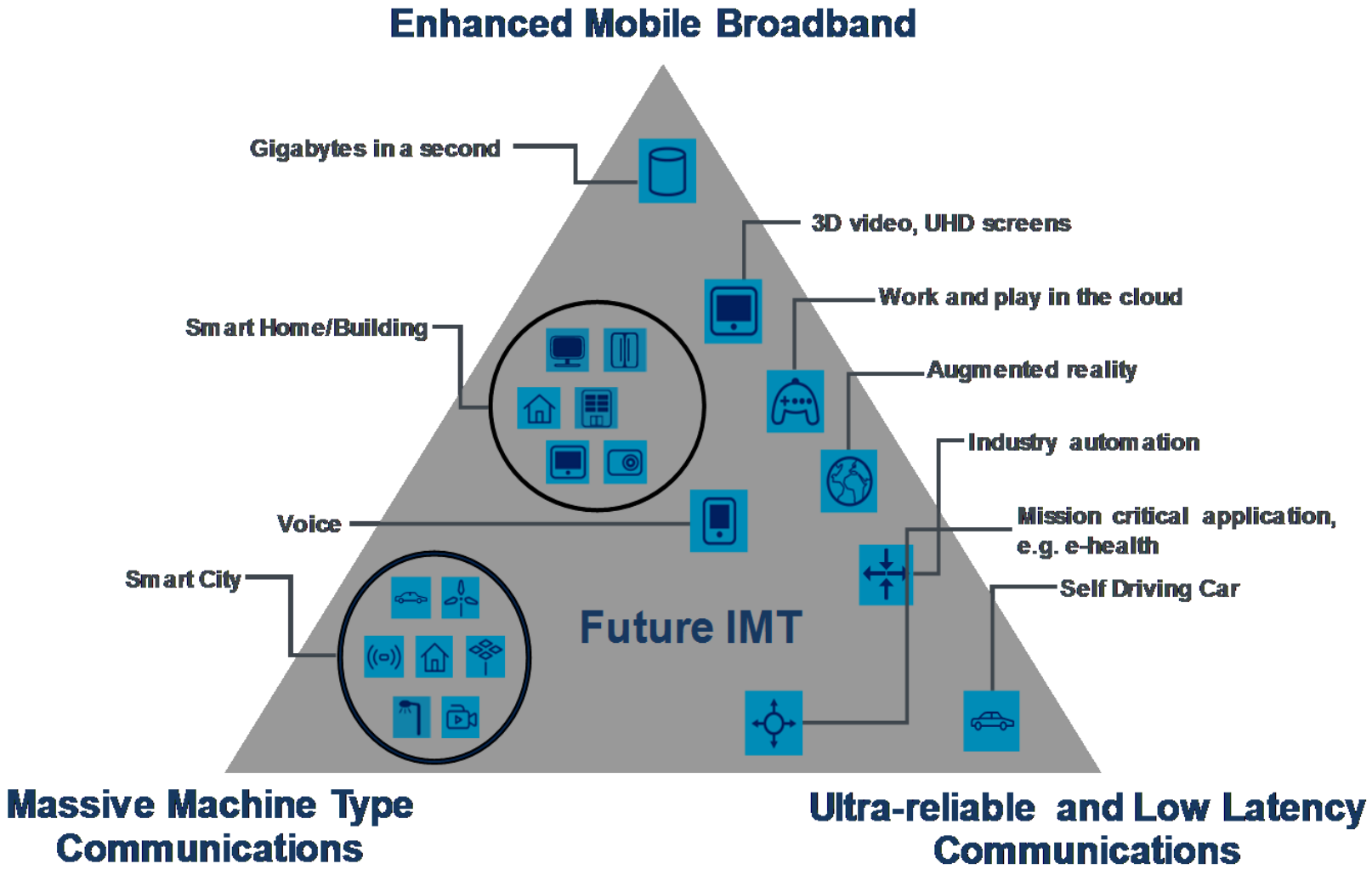
2G→3G Transition

3G→4G Transition

4G→5G Revolution

Figure taken from: http://sudhakarreddymr.wordpress.com/2011/06/01/difference-between-1g-2g-2-5g-3g-pre-4g-and-4g/

5G Usage scenarios



International regulation

- **Globally harmonized standards/spectrum** enable global roaming and provide massive economies of scale – resulting in lower cost services and equipment usable everywhere

- The detailed technical specifications for ITU's IMT standards are developed in close **collaboration** with the leading national, regional and international radio standards development organizations and partnerships

- The **involvement** of ITU Member States, equipment providers, network operators, industry fora and academia in this process enables these harmonized standards to be implemented on a worldwide basis

International regulation

- All 3G and 4G mobile broadband systems are based on the ITU's IMT standards.
- ITU established the detailed specifications for **IMT-2000** and the first 3G deployments commenced around the year 2000.
- In 2012 ITU defined 4G wireless cellular technology – **IMT-Advanced** – this is being progressively deployed worldwide.
- The scope of **IMT-2020** is much broader than previous generations of mobile broadband communication systems and specifications will be ready by 2020.
- IMT is the global platform on which to build the next generations of mobile broadband connectivity

IMT and Mobile Labels

- **IMT:** Devised within ITU through the work of *ITU Study Groups* (worldwide participation, amongst all stakeholders: Regional Organizations, Regulators, operators, manufactures, universities and R&D Centers,, etc.)
Unique set of Definitions and Specifications (through ITU-R publications)
IMT encompasses all its versions: IMT2000, IMT-Advanced, IMT 2020

- **xG:** Devised by operators and mobile community.

There is no unique set of definitions and specifications.

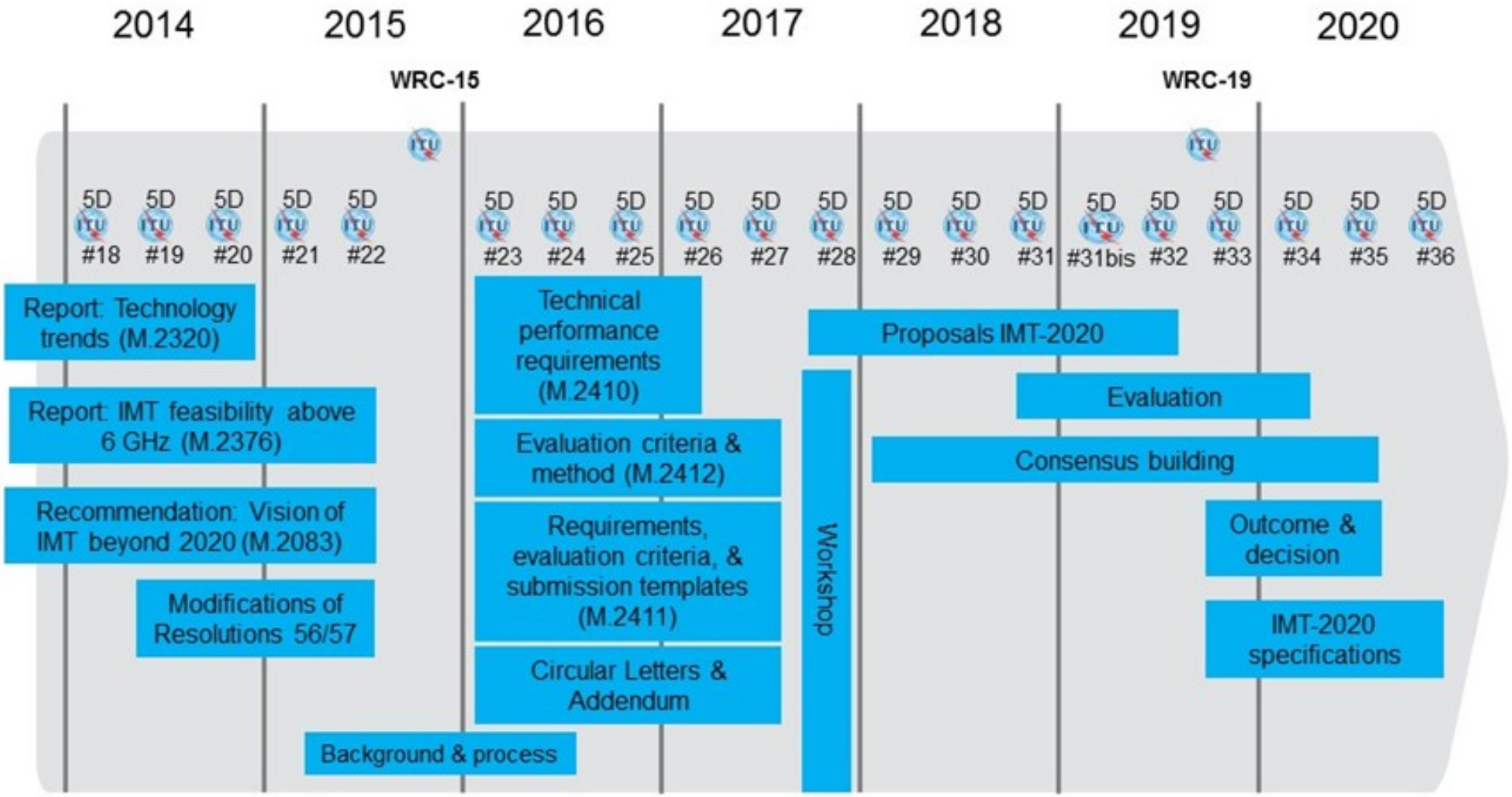
- **IMT-2000 and 3G:** there was consensus about matching both these concepts and associated specifications.
- **IMT-Advanced and 4G:** no consensus has been yet reached:

- Some Regulators demand that a 4G brand must comply with IMT-Advanced specifications.
- Other Regulators recognize 4G as those technologies providing an enhanced performance in comparison to IMT-2000 Specifications.

IMT-2020 and 5G: searching the consensus

IMT-2020 standardization process

Standards



IMT-2020

- ITU-R Study Group 5 Process
- IMT-2020 Vision, overall requirements, radio interface specifications
- ITU membership, other standard making bodies
- Industry driven

- ITU WRC Process
- Mobile spectrum allocations and IMT identifications
- ITU membership, ITU-R Study Groups, Regional Groups, International organisations
- Member States driven

Technical performance for IMT-2020

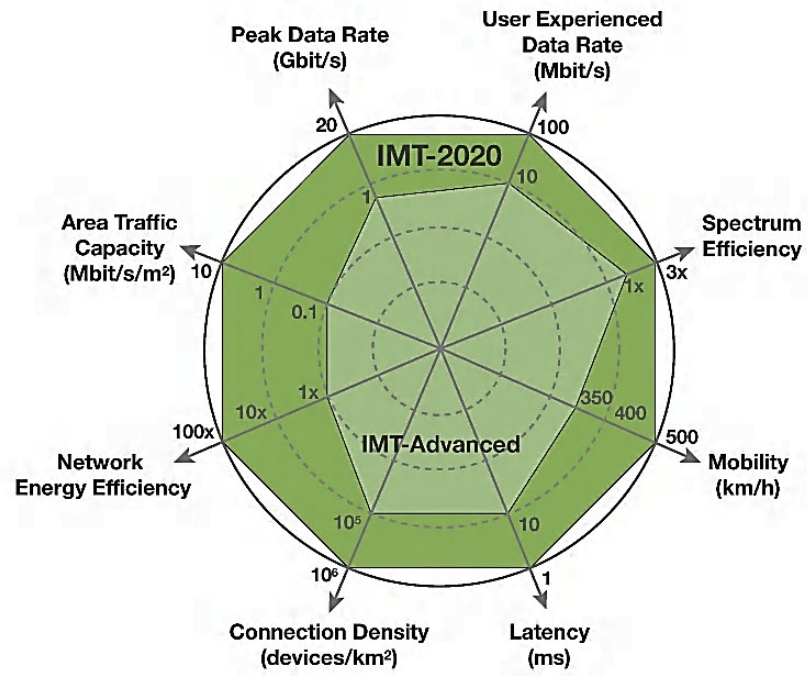
Standards

Target values for user experienced data rate in the Dense Urban eMBB:	Minimum user plane latency:	Minimum connection density in mMTC usage scenario:
• Peak rate is 1G • Downlink user experienced data rate is 100 Mbit/s • Uplink rate: 50Mbit/s	• 4 ms for eMBB • 1 ms for URLLC	• 1 000 000 devices per km^2

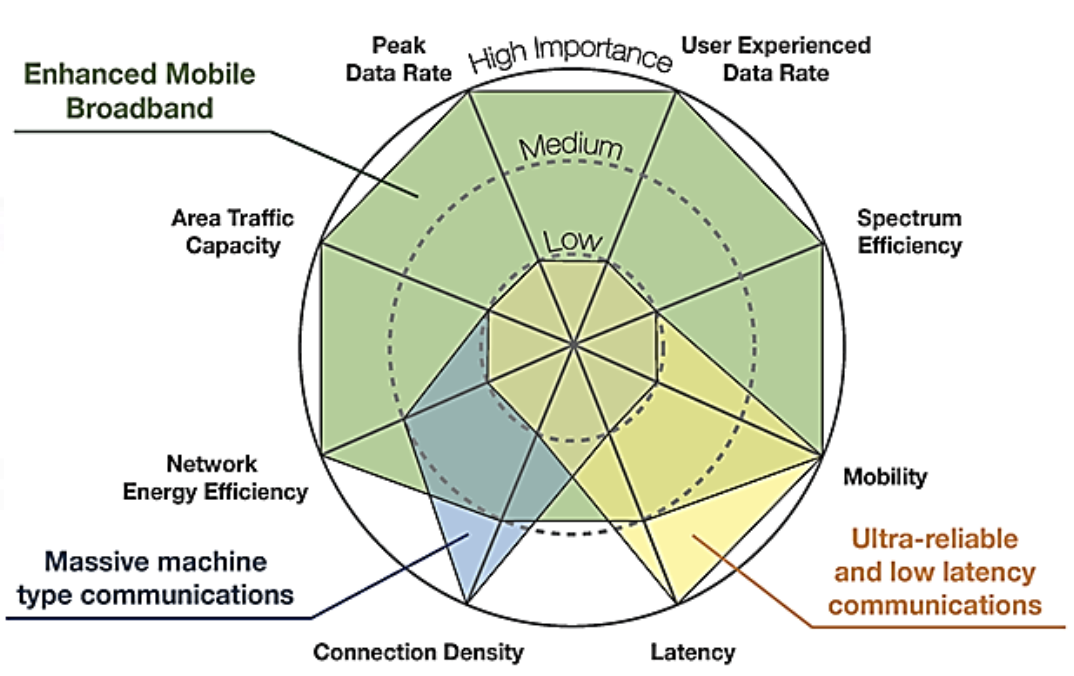
eMBB	Enhanced mobile broadband
URLLC	Ultra-reliable and low-latency communications
mMTC	Massive machine type communications

Source: Draft Report ITU-R M.[IMT-2020.TECH PERF REQ] - Document 5/40 https://www.itu.int/md/R15-SG05-C-0040/en

5G Capability Perspectives from the ITU-R IMT-2020 Vision Recommendation



Enhancement of key capabilities from IMT-Advanced to IMT-2020



The importance of key capabilities in different usage scenarios

The values in the figures above are targets for research and investigation for IMT-2020 and may be revised in the light of future studies. Further information is available in the IMT-2020 Vision Recommendation (Recommendation ITU-R M.2083)

National regulations & policies

- Ensure international regulation is reflected in national regulations
- Ensure existing globally harmonized spectrum bands for IMT are allocated nationally
- Encourage infrastructure sharing and network sharing
- Facilitate access to passive infrastructure (utility poles, traffic lights, ducts, and other state owned assets)
- Facilitate licensing process (e.g. small-cells)
- Incentivize deployment of high speed backhaul networks (e.g. fiber networks, microwave links, satellites)

National regulations & policies

- In the bands below 1 GHz, coverage obligations ensure that the corresponding spectrum is used to reduce the digital divide
- Technologically neutral licenses encourage gradual migration to newer, more efficient technologies (4G and eventually 5G)
- When setting the reserve price, care should be taken so that the auction does not lead to the ‘winners curse’
- Mechanisms should be adopted to ensure fairness and transparency, and promote competition
- The proposed rules and procedures should be submitted to public scrutiny/public consultations before being adopted

Impact of 5G for the industry

"(…) The industrials are, I think, the prime beneficiaries of 5G."

"We talked to the GEs and the Honeywells of the world. They are all intrigued by how 5G can help them transform their business and it comes typically in one of three categories or all three of them: **reducing operating costs and increasing efficiencies**; transforming their end user or customer experience, so taking market share; or creating new revenues."

Niklas Heuveldop, Ericsson SVP and head of Market Area North America

Impact of 5G for the citizens (beyond increasing broadband speed)

"5G-powered smart city solutions applied to the management of vehicle traffic and electrical grids alone could produce an estimate of $160 billion in benefits and savings for local communities and their residents. These 5G attributes will enable cities to **reduce commute times**, **improve public safety** and generate significant **smart-grid efficiencies**."

Tejas Rao, managing director and Mobile Offering Network lead for Accenture's North America practice

ITU Report 2018:
Setting the Scene for 5G: Opportunities & Challenges*

This report reviews expectations of 5G and examines the infrastructure and investment requirements on the private and public sectors as they prepare for 5G. It is designed to support emerging use cases and services, and to help all sectors meet the expected performance (Gbps), low latency and high reliability requirements of these services, ensuring that end users reap in full the economic benefit that 5G is expected to offer.

- **Section 2 examines 5G**, its evolution and what it can deliver over and above existing wireless technologies, including economic and wider societal benefits.
- **Section 3 explains 5G spectrum requirements** and the technologies to support 5G networks and how operators are expected to evolve to 5G networks.
- **Section 4 describes the key challenges** of rolling out 5G networks from an infrastructure and spectrum policy perspective.
- **Section 5 provides examples** of how policy-makers are starting to work through the issues associated with deploying 5G networks.
- **Section 6 explores the investment requirements** of developing 5G networks and potential approaches to incentivizing investment in them.
- **Section 7 recommends actions for policy-makers** in NRAs and governments, helping them simplify and reduce costs as they move towards implementation.

* Open Free download at: https://www.itu.int/en/ITU-D/Documents/ITU_5G_REPORT-2018.pdf

Key issues for consideration

Investment case	Policy makers may consider undertaking their own independent economic assessment of 5G to evaluate the commercial viability of deploying 5G networks.
4G network strategy	Until such time that the case for 5G networks can be made, policy makers may consider enhancing the availability of and boosting the quality of 4G networks.

Harmonize spectrum	NRAs may consider allocating/assigning globally harmonized spectrum bands for 5G.
Spectrum roadmap	NRAs may consider a spectrum roadmap with a predictable renewal process.
Spectrum sharing	NRAs may consider allowing spectrum sharing to maximize efficient use of available spectrum particularly to benefit rural areas.
Spectrum pricing	NRAs may consider selecting spectrum award procedures that favour investment.
700Mhz spectrum	Policy makers may consider supporting the use of affordable wireless coverage (e.g. through the 700 MHz band) to reduce the risks of the digital divide.

Key issues for consideration (continued)

Fiber investment incentives	Where market failure has occurred, policy-makers may consider stimulating fiber investment and passive assets through PPPs, investment funds and offering grant funds, etc.
Fiber tax	Policy-makers may consider removing any tax burdens associated with deploying fiber networks to reduce the associated costs.
Copper migration to fiber	Policy-makers may consider policies and financial incentives to encourage the migration from copper to fiber and to stimulate the deployment of fiber services.

Wireless backhaul	Operators may consider a portfolio of wireless technologies for 5G backhaul in addition to fiber including point to multi point (PMP) microwave and millimeter wave (mmWave) and satellite where possible.

Key issues for consideration

Access/sharing of passive infrastructure	Policy makers may consider allowing access to government-owned infrastructure such as utility poles, traffic lights and lampposts to give wireless operators the appropriate rights to deploy electronic small cell apparatus to street furniture. NRAs may consider continuing to elaborate existing duct access regimes to encompass 5G networks allowing affordable fiber deployments
Access costs	Policy-makers/NRAs may consider ensuring reasonable fees are charged to operators to deploy small-cell radio equipment onto street furniture.
Asset database	Policy-makers may consider holding a central database identifying key contacts, showing assets such as utility ducts, fiber networks, CCTV posts, lampposts, etc. to help operators cost and plan their infrastructure deployment more accurately.
Wayleave (rights of way) agreements	Policy-makers may consider agreeing upon standardized wayleave agreements to reduce the cost and time to deploy fiber and wireless networks.
5G test beds	Policy makers may consider encouraging 5G pilots and test beds to test 5G technologies and use cases and to stimulate market engagement.

5G: Main Recomendations

Expectations of 5G are high, with many assuming it will deliver a transformative promised land – an improved end-user experience, new applications, new business models and new services riding swiftly on the back of gigabit speeds, improved network performance and reliability. 5G networks and services, standing as they do on the shoulders of successful 2G, 3G and 4G mobile networks, are forecast by independent economic studies to deliver very significant economic gains.

Caution: high levels of investment needed

Despite the potential benefits, there is concern that 5G is premature and notes of caution are being sounded. Operators are sceptical about the commercial case given the high-levels of investment needed to deploy 5G networks.1 The report estimates the cost to deploy a small cell-ready 5G network – assuming fibre backhaul is commercially feasible – can range from USD 6.8 million for a small city to USD 55.5 million for a large, dense city.

Danger of increasing digital divide

A viable case for investment in 5G can be made for densely populated urban areas – always the most commercially attractive regions for operators. More challenging will be a commercial argument for investing in 5G networks outside such areas, especially in the early years of 5G deployment. As a result, ***rural and suburban areas are less likely to enjoy 5G investment, and this will potentially widen the digital divide***.

5G: Main Recomendations

Balanced view is needed

As long as the investment case for 5G remains uncertain, industry and policy-makers should remain cautious and should consider enhancing the availability and quality of existing 4G networks in the run up to 5G. The need for 5G is not immediate. Policy-makers and operators should only consider deploying 5G networks where there is demand or a robust commercial case in favour of doing so.

Policy-makers' actions will make a difference

Where demand exists alongside high 5G deployment costs, policy-makers can use a range of legal and regulatory actions to facilitate 5G network deployment. These include:

- Supporting the use of affordable wireless coverage (e.g. through sub-1 GHz bands) to reduce the digital divide;
- Commercial incentives such as grants, or PPPs to stimulate investment in 5G networks.

Keep an eye in the future
and another in the present
thus
develop 5G while
prioritizing the reduction of
the digital divide
by
fostering affordable and
universal access to ICTs and
telecommunication services

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193
MEMBER STATES

+700
INDUSTRY & INTERNATIONAL ORGANIZATIONS

+100
ACADEMIA MEMBERS

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International Telecommunication Union

Thank you