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# Challenges and Solutions for 5G Testing

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# Agenda

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- Wireless Evolution
- Introduction to 5G
- Technology Developments
- Importance of Testing 5G
- 5G Testing Challenges
- 5G Technology Testing Solutions
- 5G Device Testing Solutions
- Conclusion

# Evolution of Wireless Technologies

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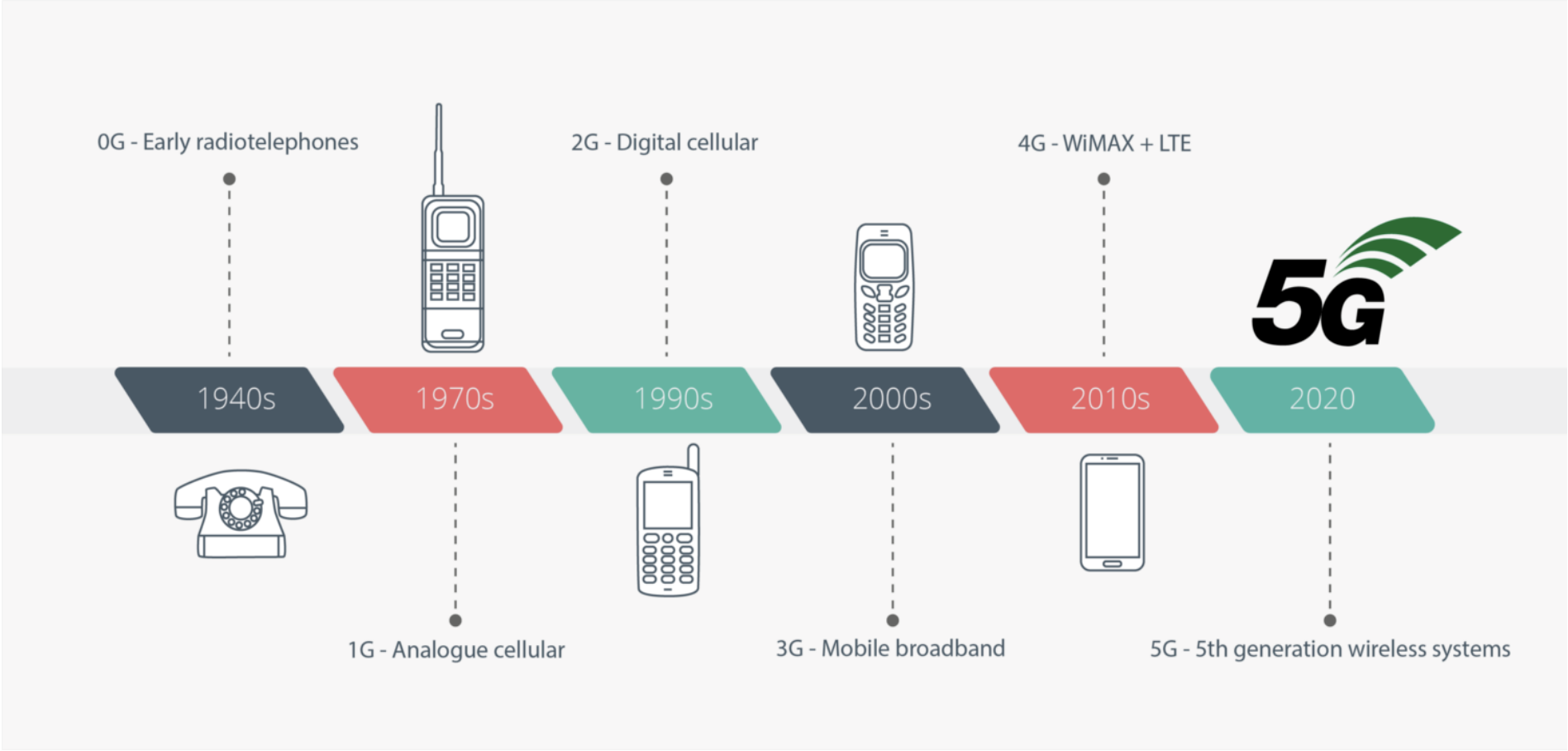

# Introduction to 5G

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- 5G will build on the foundation created by 4G LTE. It's going to allow people send texts, make calls, and browse the web as always— and it will ***dramatically increase the speed*** at which data is transferred across the network.


- 5G will make it easier for people to download and upload Ultra HD and 3D contents. It will also make room for the thousands of internet- connected (IoT) devices using low power or long battery life entering our everyday world by providing fast and highly efficient network infrastructure.

# Where we need 5G?

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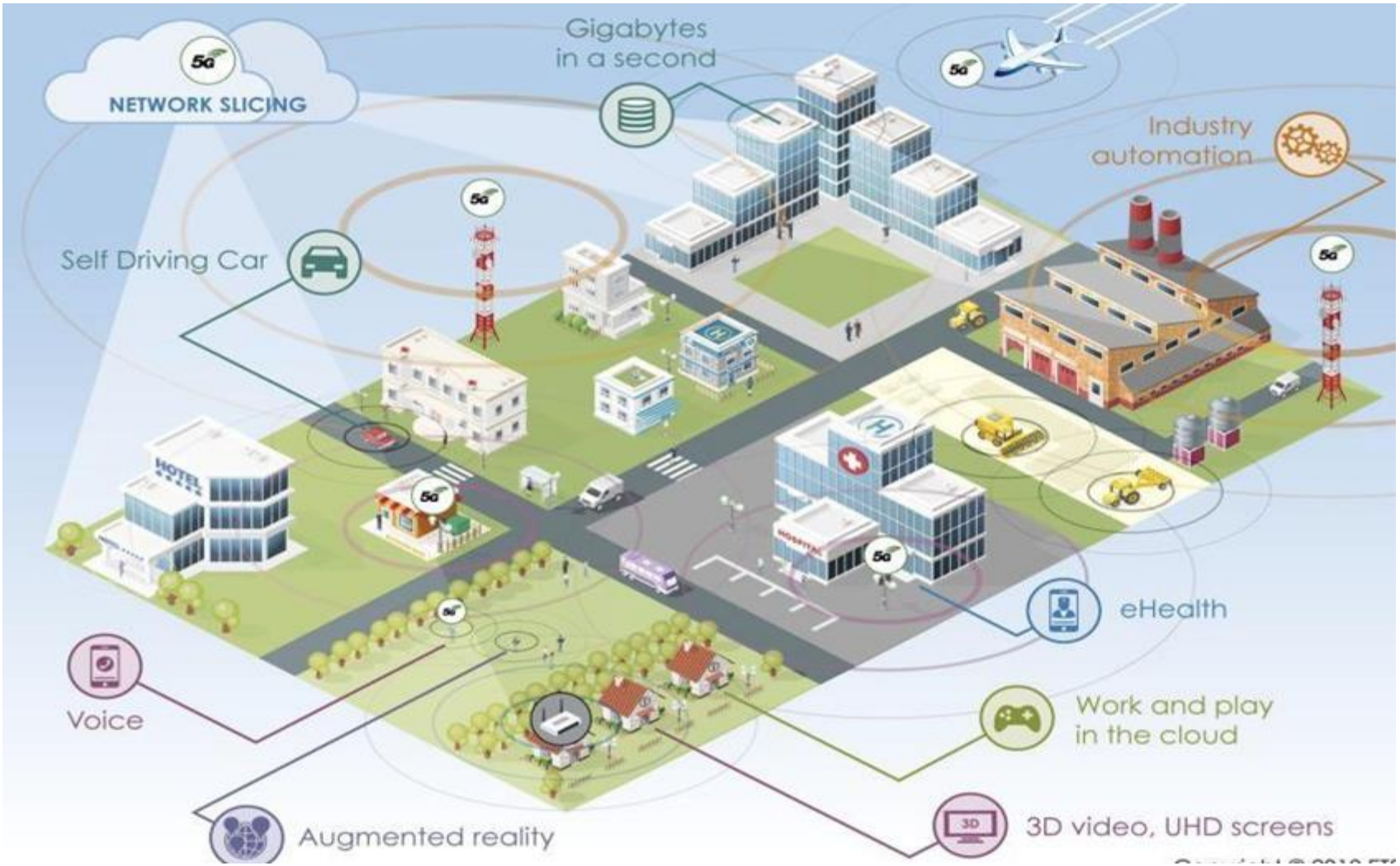

# 5G-Technology Developments

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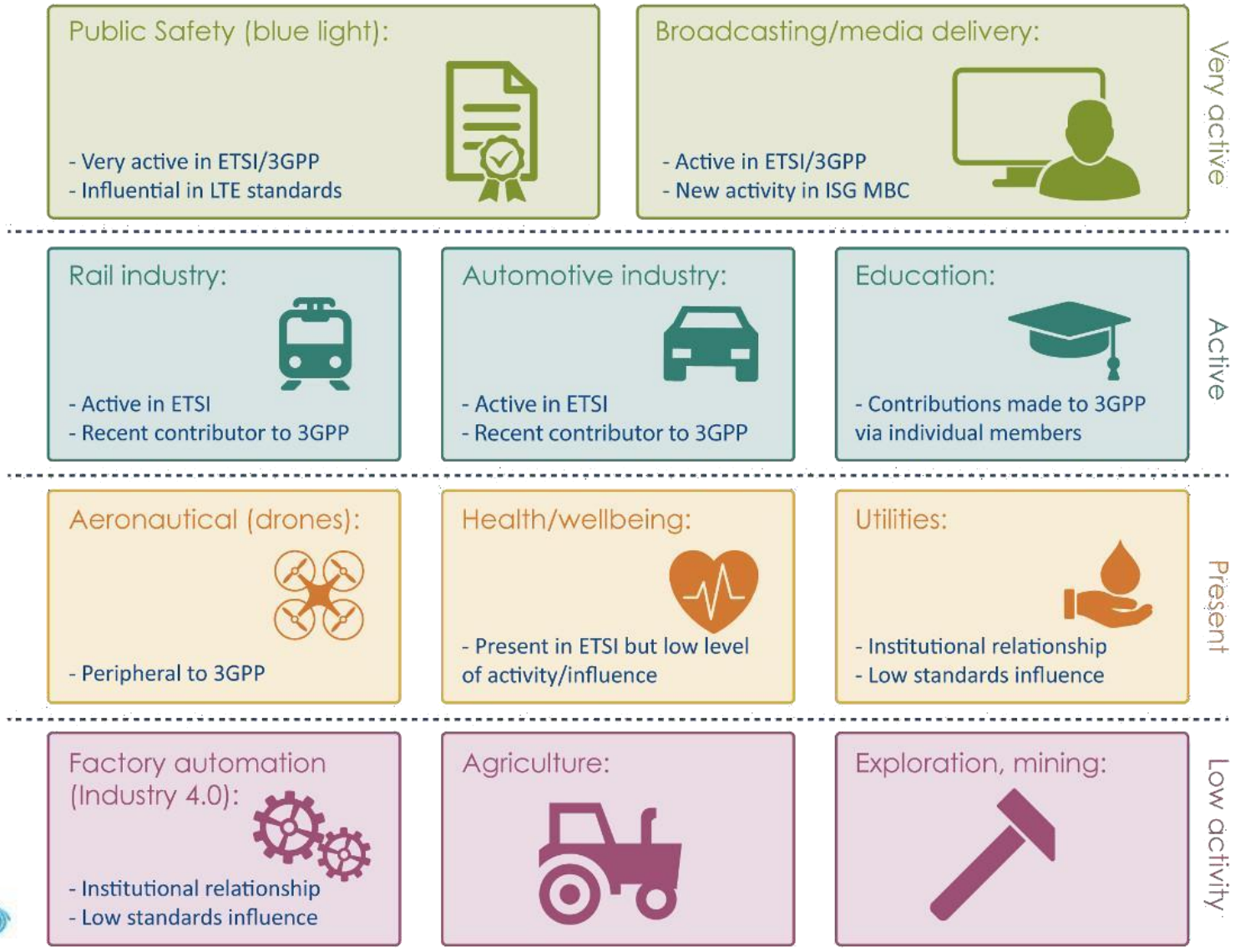
- In response to the 3GPP **Release 15** September 2017 and **Release 16** in July 2018 which defines **the 5G NR** standards, telecommunications operators are targeting early **2019 for a rollout** of commercial 5G services with many announcing an accelerated timetable for practical trials.

- The primary technologies will be **Millimeter wave bands** (26, 28, 38, and 60 GHz) offer performance as high as 20 Gbit/s and “Low-band 5G" and "Mid-band 5G" use frequencies from 600 MHz to 6 GHz, especially 3.5-4.2 GHz.

# Who will need 5G?



# Importance of Testing 5G

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- 5G-related features such as **Beamforming** at **mm-Wave** and **spectrum sharing** increase test quality reasonably using reliable and stable test equipment to avoid the issues in the field.
- 5G brings **higher bandwidth**, **lower latency**, and **ultra-reliable** communication to the end users, so that Network is optimized to process a very high volume of data messages with minimal delay .
- To achieve in the fast-moving 5G market, it's important that you can simulate all the **5G network characters** flexibly, make **true measurements** and make informed decisions during the early development stage.

# 5G Technology and Spectrum Requirements

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## ❖ Technology:

- Optimize existing spectrum **below 6GHz, new waveforms** to overcome issues with LTE (OFDMA) but keep the benefits of this technology
- Understand how to use **higher frequency (26-86 GHz)** bands for mobile communications, through modeling, propagation measurements, and field trials
- Build a HetNet architecture that can bring together both the below 6GHz bands and the above 6GHz bands into a single "**seamless**" network that
- is based around the user services and
- quality of experience.

## ❖Spectrum:

- At the latest ITU-R meeting World Radio communications Conference (**WRC15**) is was confirmed to continue with existing spectrum **below 6GHz** for global use of bands mostly in use today.
- There was agreement on global harmonization for the **spectrum at 694- 790 MHz, 1427-1518 MHz, and 3.6-3.8 GHz.**
- This makes these bands now global mobile communications bands suitable for **licensing/deployment** in all countries, rather than being just
- local/regional bands.

# Understanding 3GPP 5G Schedule

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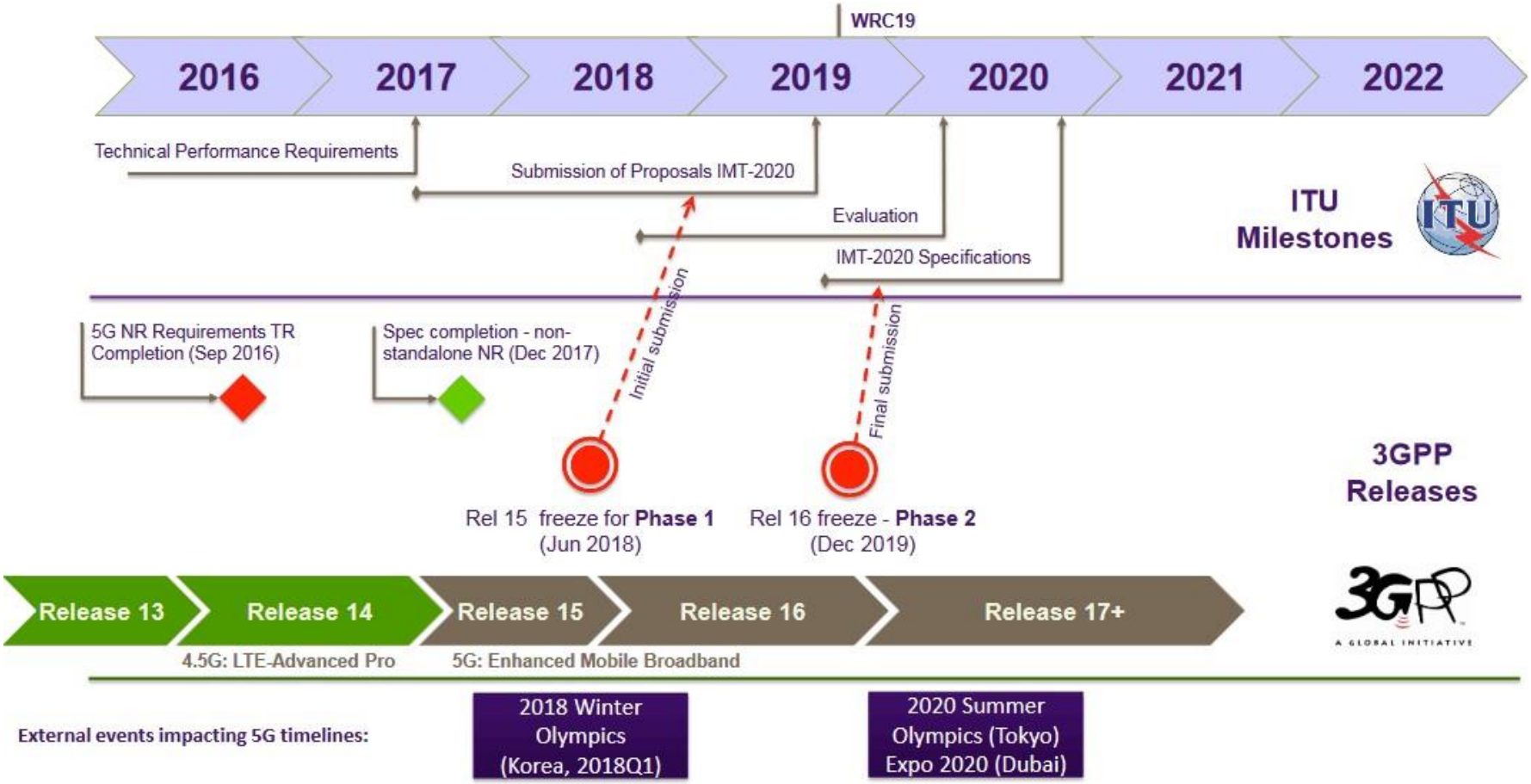

# 5G Testing Technology Challenges

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

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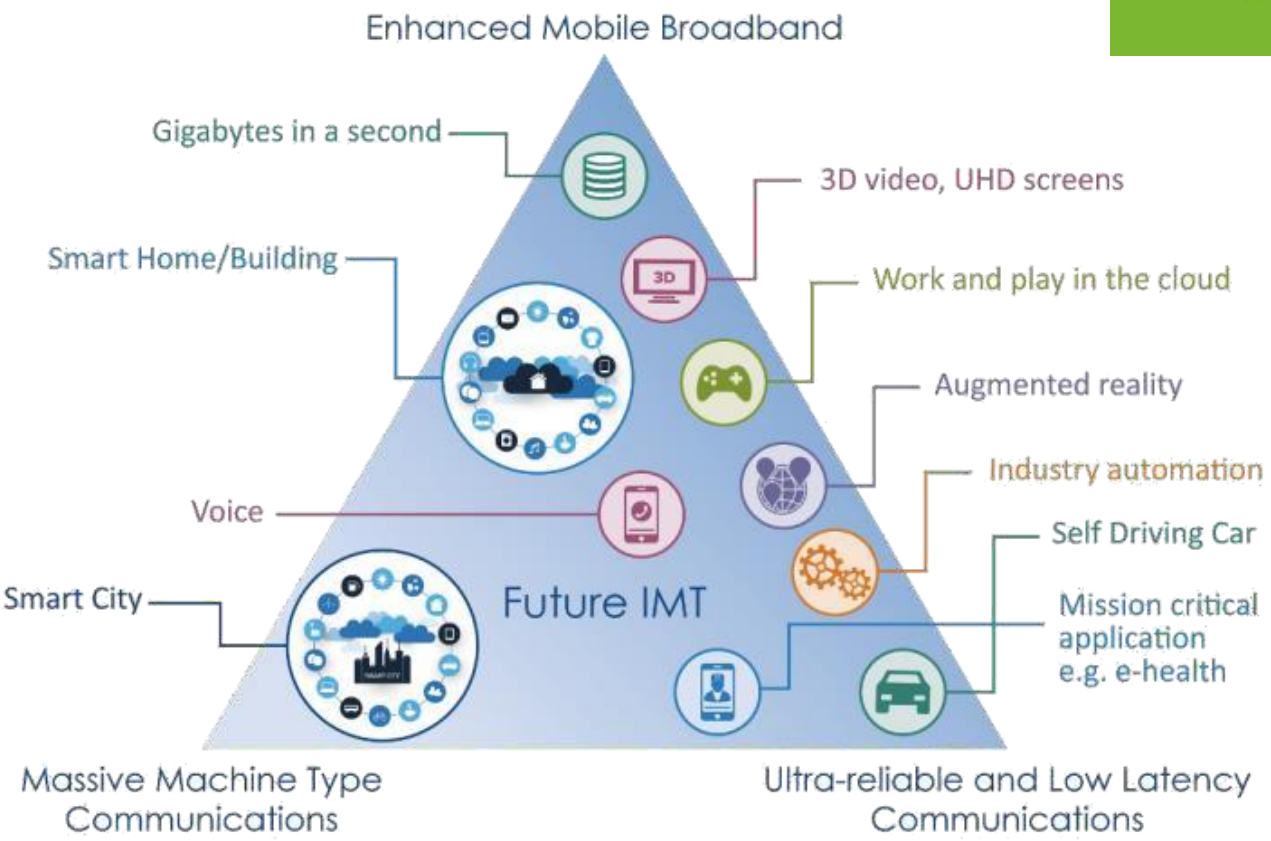
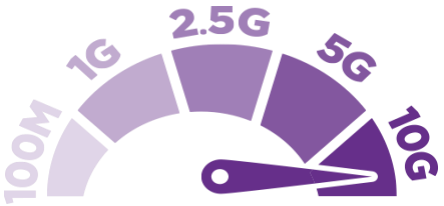


# eMBB Test Solutions

- Enhanced mobile broadband (**eMBB**) focuses on supporting the ever-increasing end user data rate and system capacity.
- To fulfill this demand, eMBB introduces two major technology enhancements:
- *Shift of frequency spectrum to **cmWave** and **mmWave** range to achieve much higher bandwidth allocations*
- *Advanced antenna array that includes tens or even hundreds of TX/RX antenna elements to enable **massive MIMO** and **beamforming***
- High frequencies and high bandwidth as well as compact over-the-air test solutions for mobile devices and base stations in R&D and production will be required to test eMBB




Fiber Like Speed

Low Latency

Low Cost

# mMTC Test Solutions

- Massive machine type communications (**mMTC**) targets the cost-efficient and robust connection of billions of devices without overloading the network. Critical success factors include
  - Coverage
  - Cost efficiency
  - Low power consumption
  - Long-time availability
- Testing is essential in order to ensure proper functionality as well as lifetime quality, security, performance and use cases a success.

Energy Saving

Extended Coverage

Availability

# URLLC Test Solutions

- Ultra-reliable, low latency communications (**URLLC**) covers an entirely new use case family by supporting new requirements from vertical industries such as **autonomous driving** for the **automotive** industry, remote surgery for **eHealth** and **cloud robotics** for Industry 4.0. All applications demand
  - ***Improved latency***
  - ***Improved reliability***
  - ***Higher availability***
  - ***Higher security***

Automotive Safety

New Trust Models

Cloud Robotics

- Its is important to test the development of tailor-made communications interfaces for vertical industries, laying the foundation for **connected mobility** and **automotive safety** applications.

# High Level Testing Challenges to Chipset, Mobile and Network Operators

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- NFV/SDN
- Edge Computing
- IP MPLS
- Low Energy
- mmWave with Massive MIMO
- Beam Steering and Beam Tracking
- New Waveform
- Extreme Broadband-Multi Gbps
- Ultra Low Latency<1ms
- Low cost, Low power and wide area
- Multi-RAT
- Dual Connectivity

# 5G Interoperability Testing

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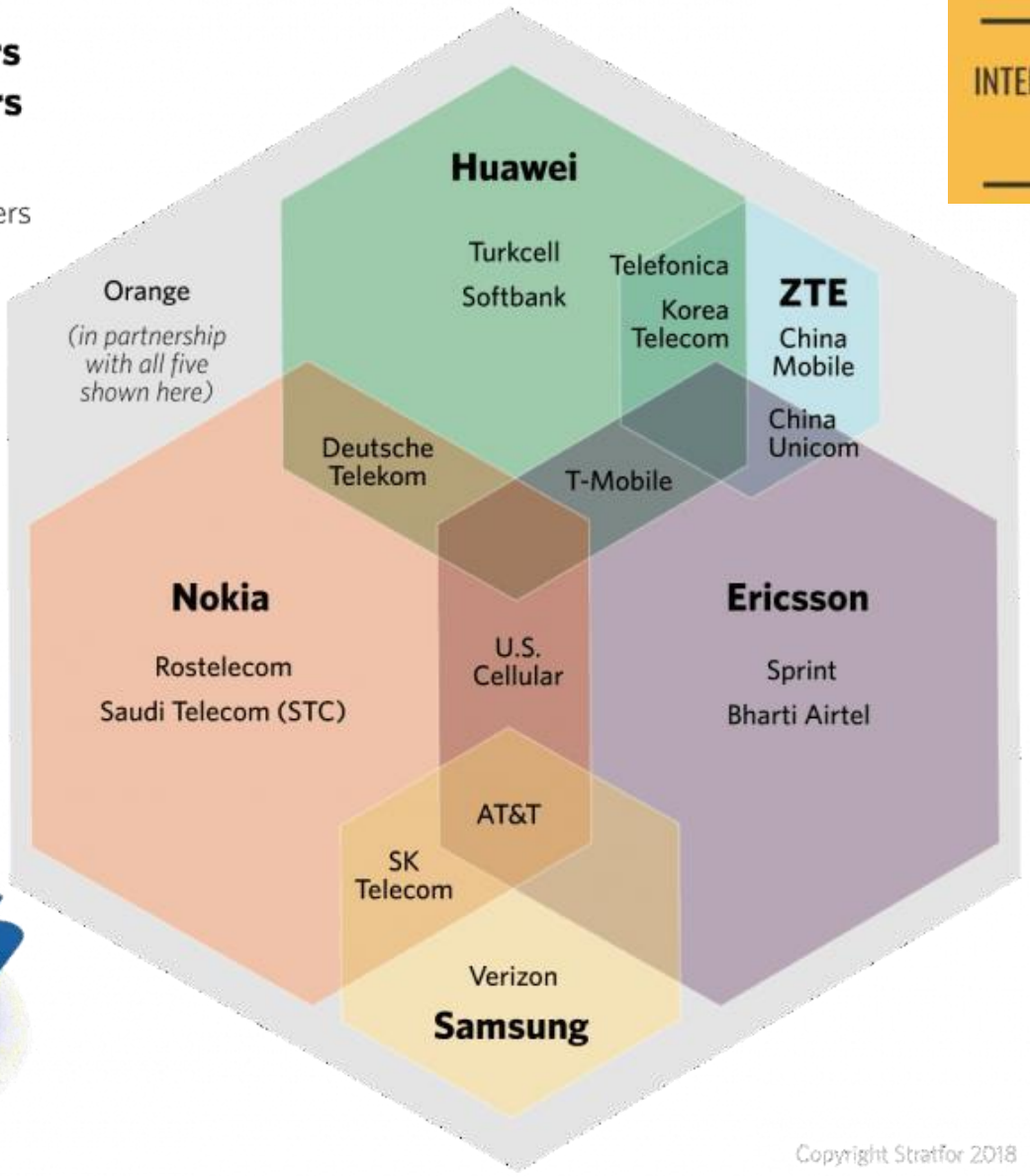
INTEROPERABILITY TESTING

## Telecom Operators and Manufacturers

All of the five largest equipment manufacturers for telecom networks have been partnering with carriers for 5G networks. Here are a selected few of the partnerships.




# 5G Device Testing Solutions

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### FUNCTIONAL TESTING
Proven package of services for the delivery of flawless system functionality

### OPERATOR ACCEPTANCE TESTING
Making sure devices meet network specific requirements

### PERFORMANCE TESTING
Seamless integration of performance testing services at any stage of SDLC

### CONFORMANCE TESTING
Conformance testing prescribed by regularatory bodies such as GCF and PTCRB

### SECURITY TESTING
Protecting your business and devices from cyber attacks

### COMPATIBILITY TESTING
Complete application compatibility with mobile OS software testing services

### FIELD TESTING
Test individual elements and field scenarios in trial and live networks

### USABILITY TESTING
Helping you see the world through your customers' eyes

### APPLICATION TESTING
Enhance the quality of the applications supported by mobile devices

### USER ACCEPTANCE TESTING
High quality software testing to a large user base

# Conclusions

- Higher quality tests through better design
- Easier to review by non-testing experts
- Better, faster test development
- Seamless integration of RF, Protocol, Applications with testing equipment and tools
- Cost Effective

Thank you for your time

Team Tessolve

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