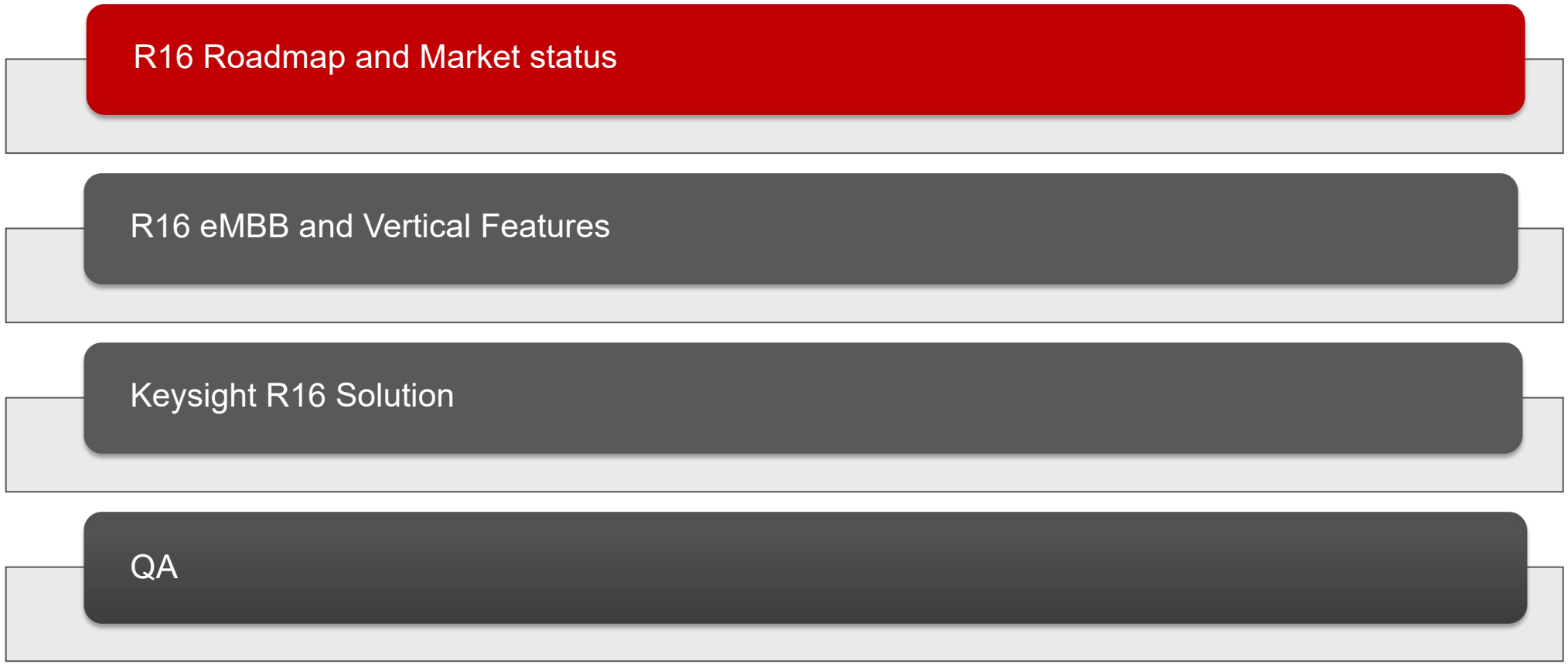
5G Network Emulation Solutions 3GPP Release 16

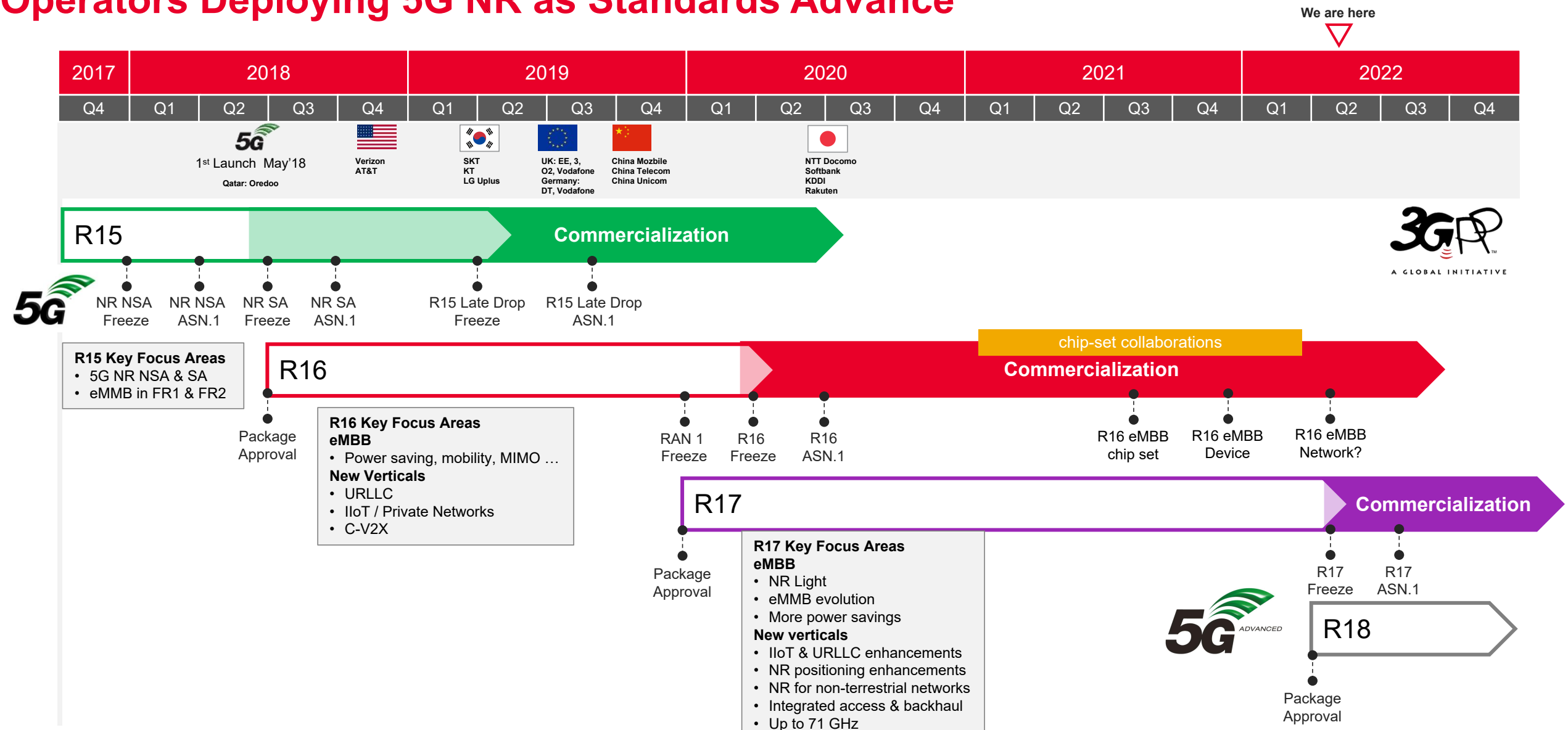
Zhiyi Lu
4-20-2022

Agenda

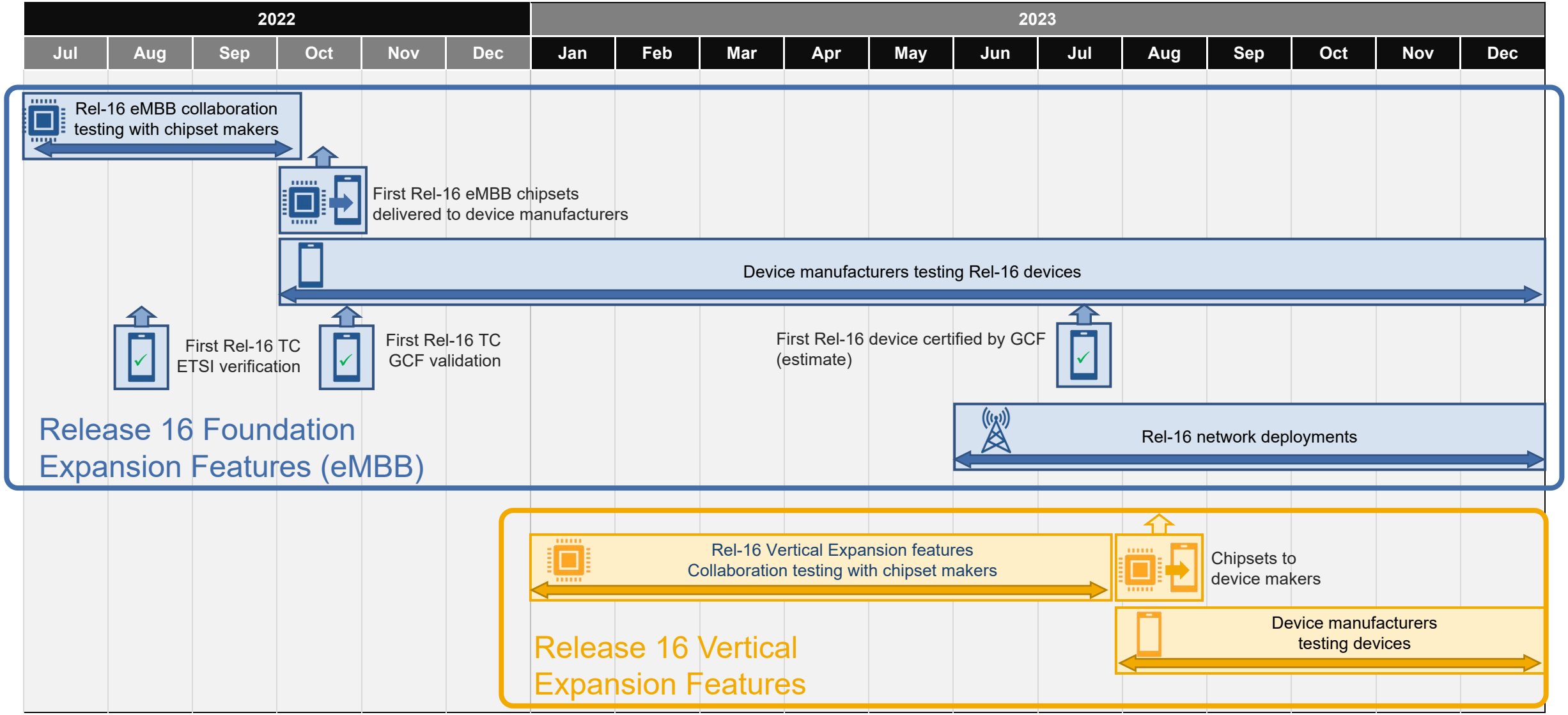
- R16 AND Test Solution



Operators Deploying 5G NR as Standards Advance

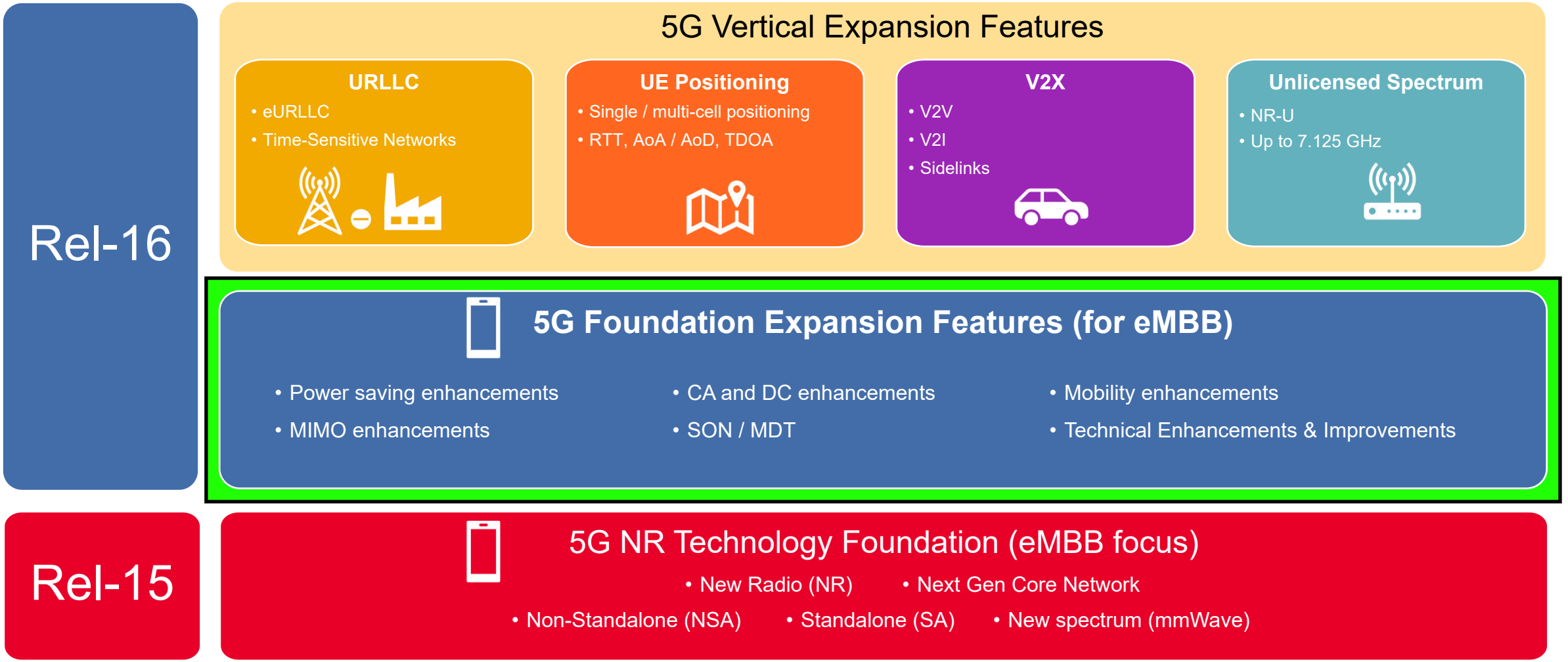


5G Rel-16 Market Requirements Timeline



5G Rel-16 Foundation and Vertical Expansion Features

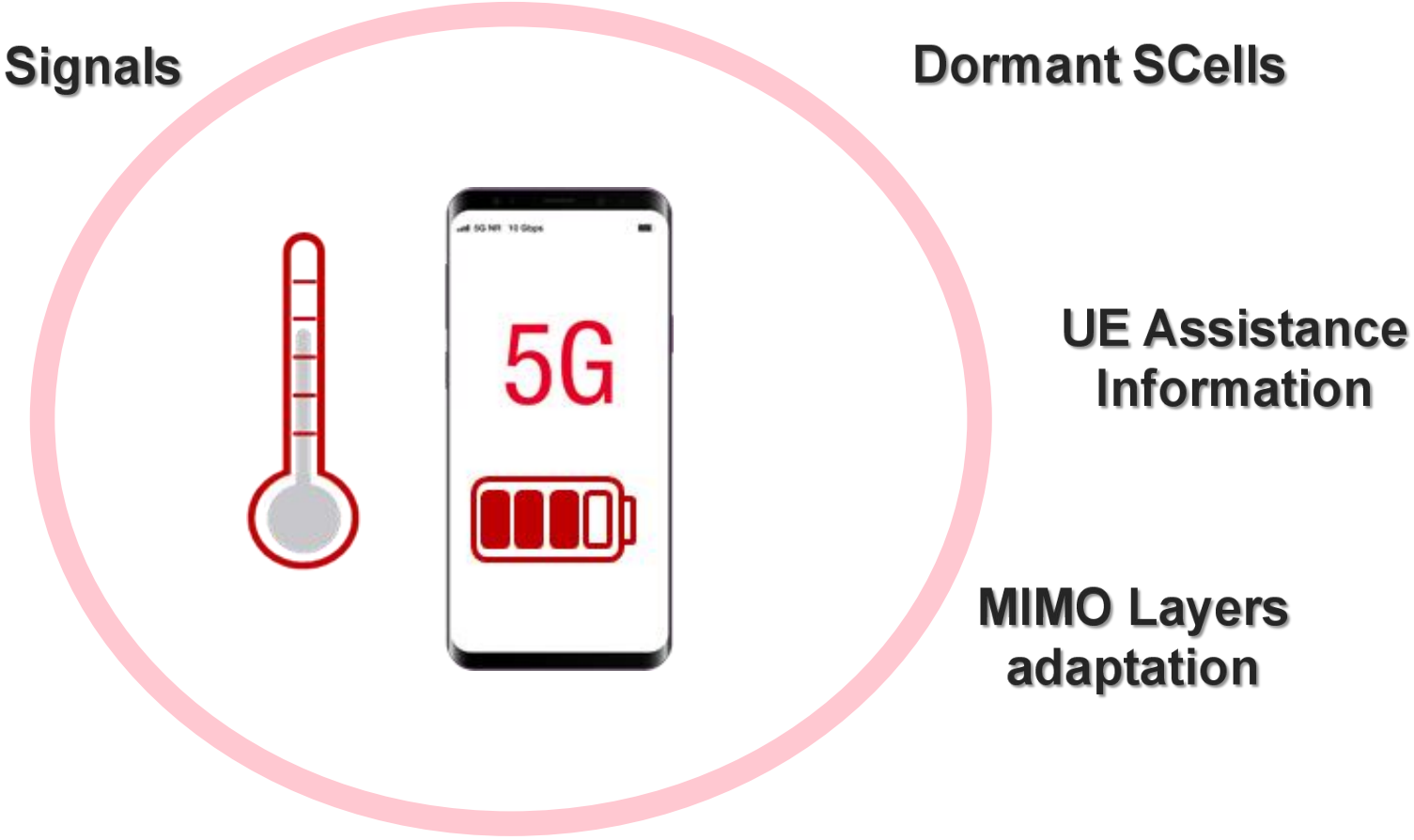
- Feature Groupings



5G Rel-16 Foundation Expansion Features

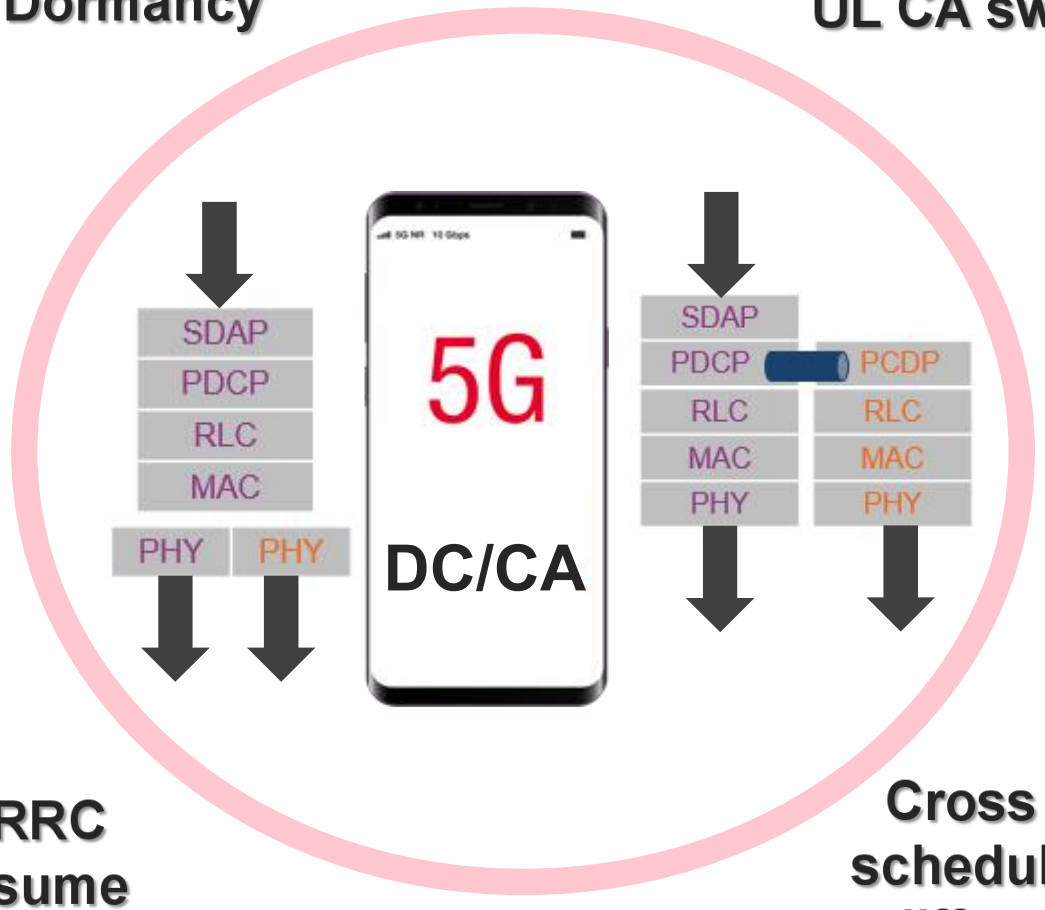
R16 UE Power Saving

- Enhancing power efficiency



R16 DC/CA Enhancements

- Increasing robustness, reducing latency

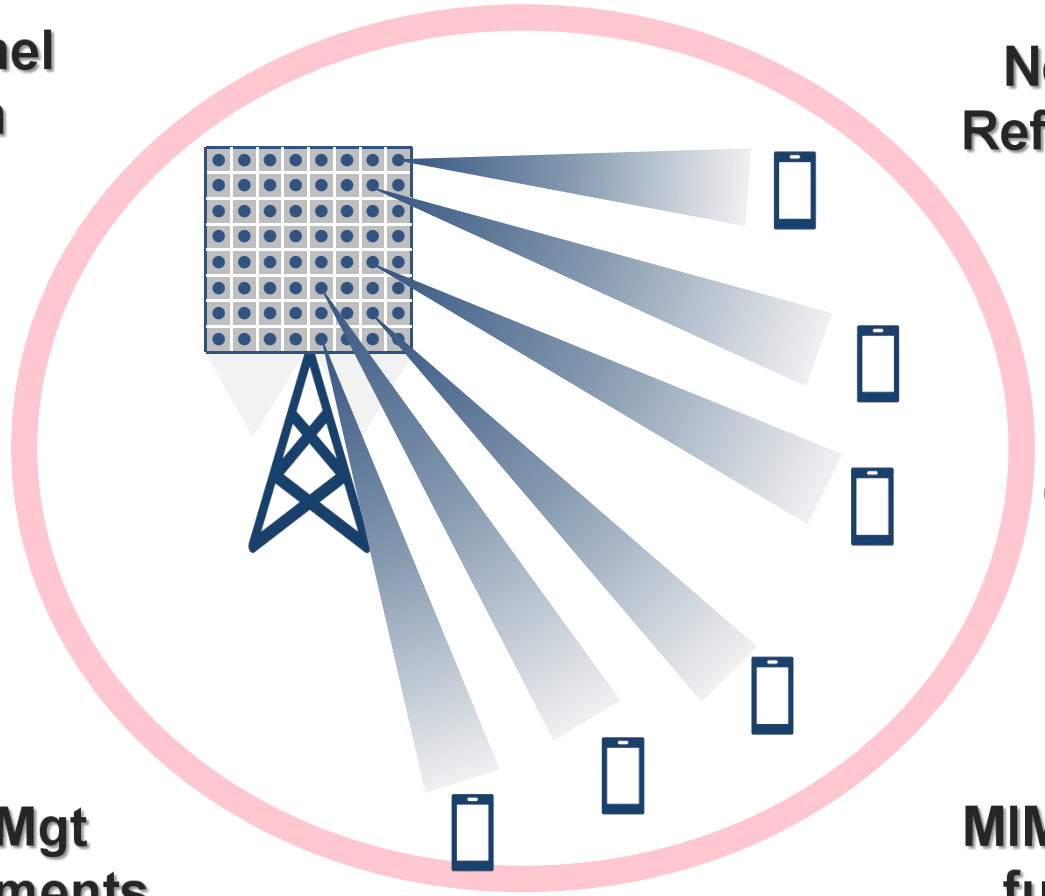


R16 MIMO Enhancements

- Multiple MIMO improvements

Multi TRP / panel transmission

New low PAPR Reference signals



Beam Failure recovery for Scell

Type II CSI enhancements

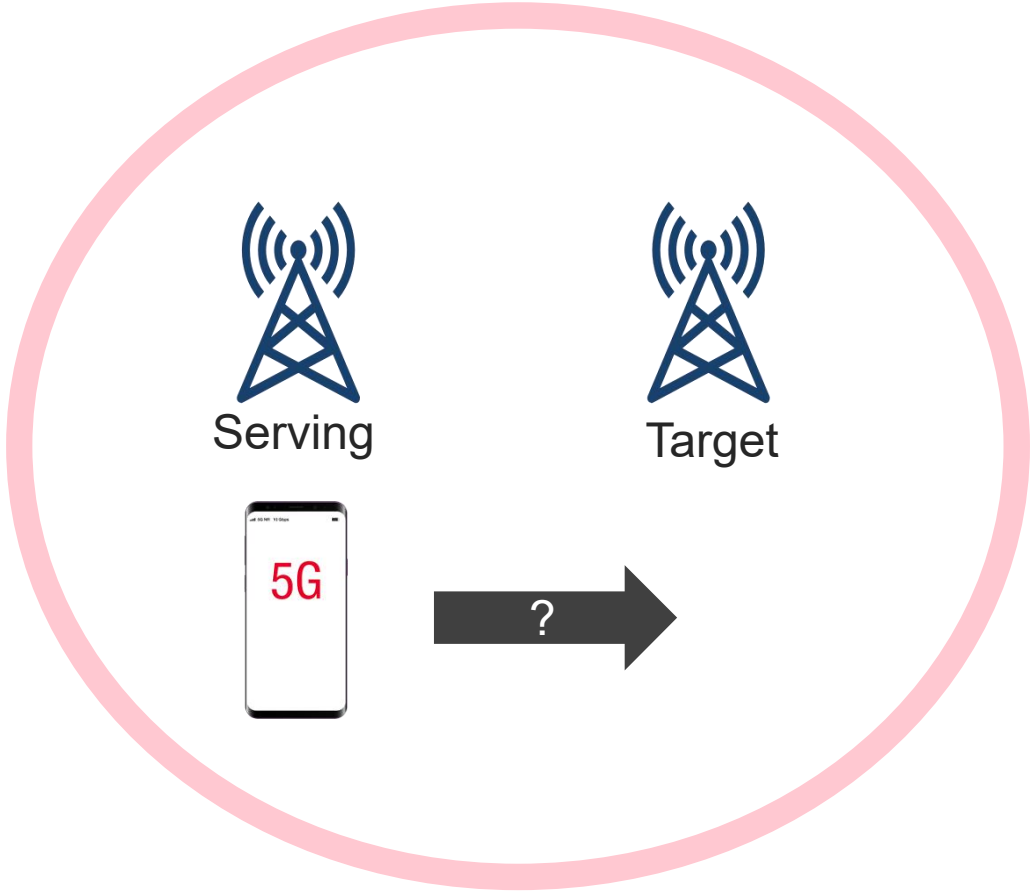
Beam Mgt Enhancements

MIMO enhanced full Tx power

R16 Mobility Enhancements

- Increasing robustness, reducing latency

DAPs



Early Measurement Reporting

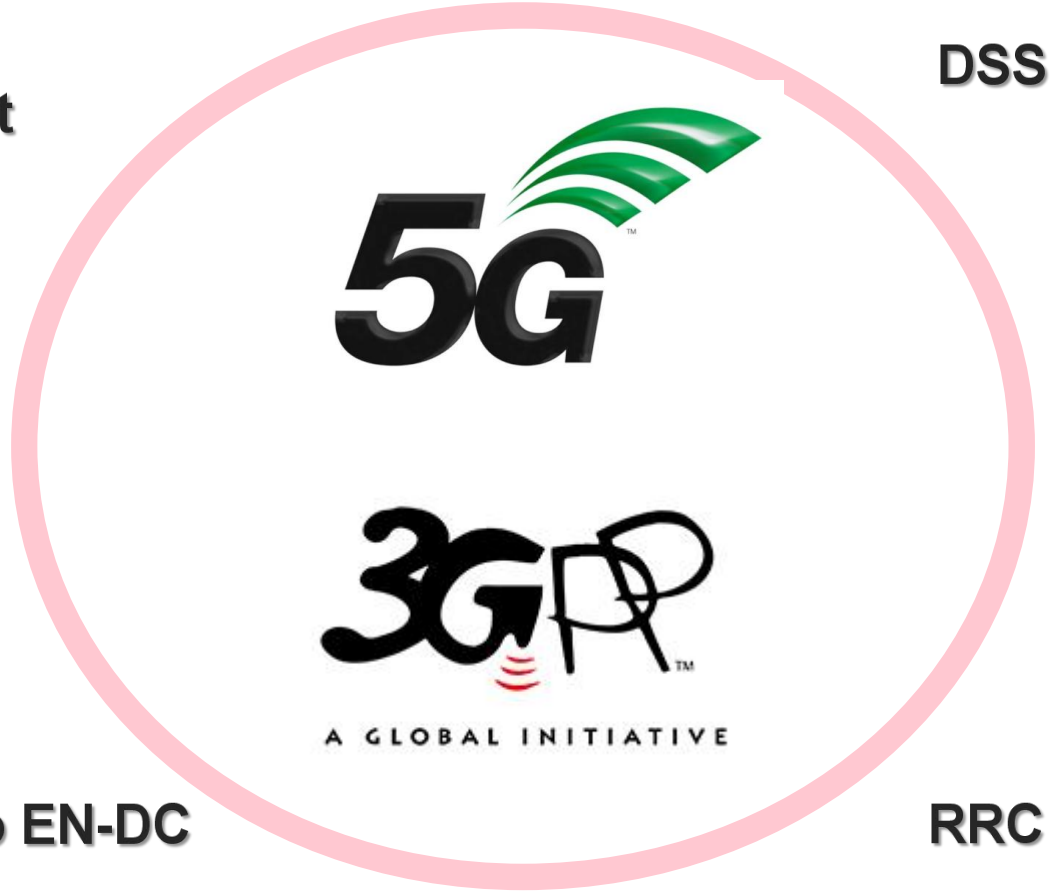
Conditional Handovers

R16 TEI

- Technical enhancement or improvement

Inter freq measurement without MG

DSS Enhancements



Alternate cell re-selection priorities (EN-DC)

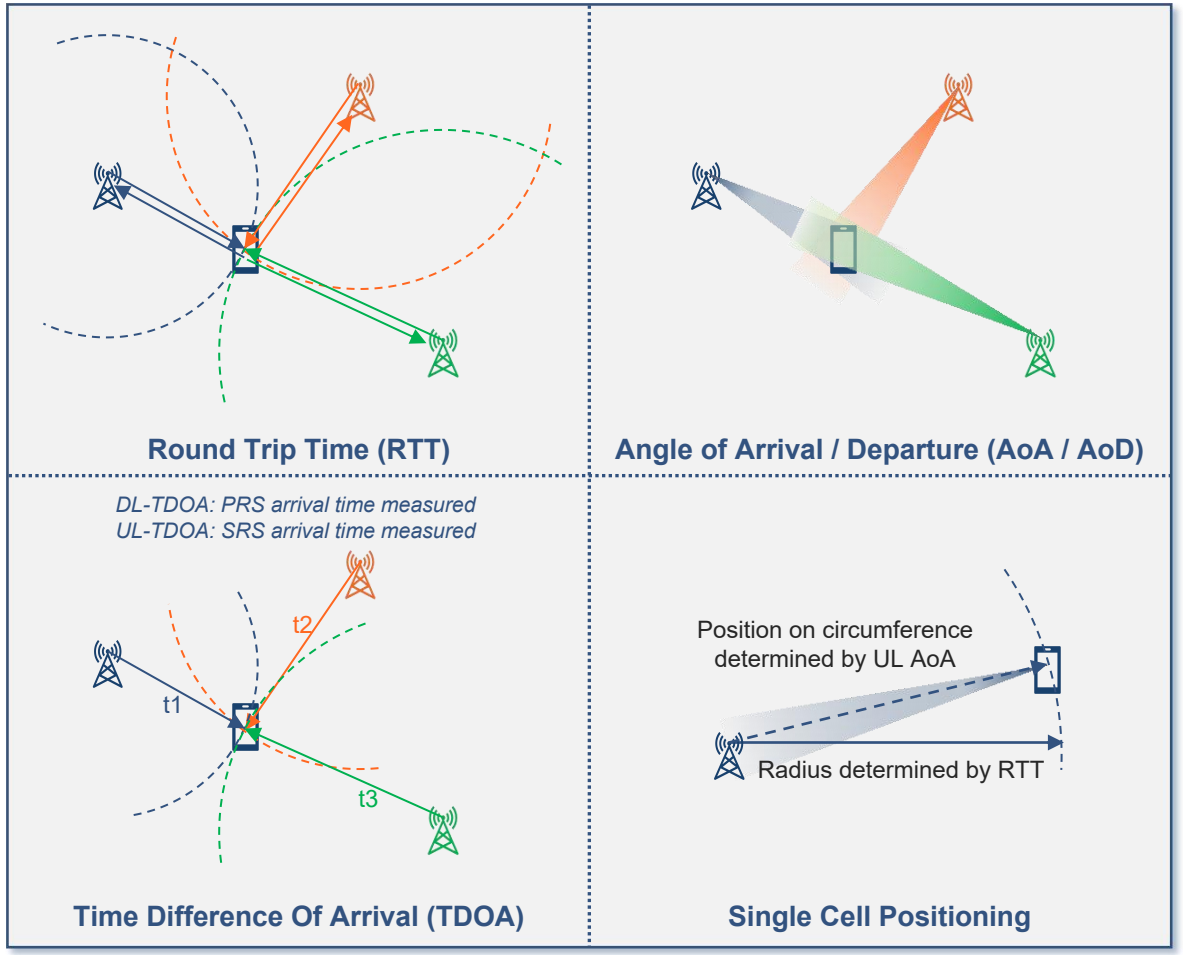
Dual CDRx: FR1+FR2 CA

iRAT NR to EN-DC

RRC segmentation

5G Rel-16 UE Positioning

- Delivers 3m indoor and 10m outdoor accuracy requirements 80% of time
- New Positioning Reference Signal (PRS) allows detection of more neighbouring transmission points
- Network-based positioning methods
  - Multi-cell positioning
    - Round Trip Time (RTT)
    - Angle of Arrival / Departure (AoA / AoD)
    - Time Difference of Arrival (TDOA)
  - Single cell positioning
    - AoA + RTT
- Location Positioning Protocol (LPP) or Secure User Plane (SUPL) protocols



5G Rel-16 Vertical Expansion Features

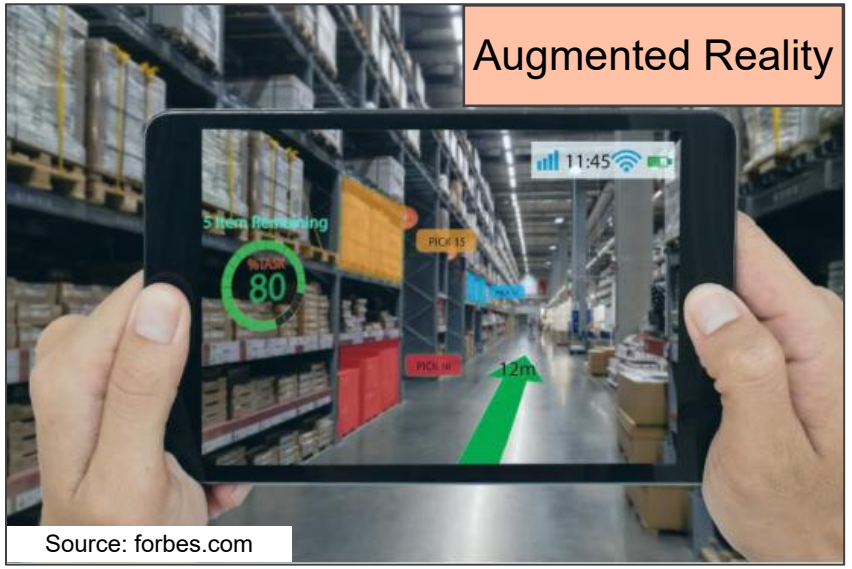
New Devices and New Applications

- Enabled by “REAL TIME”R16 technology

Tactile internet

- Human / machine interaction in real time via the internet
- Remote surgery

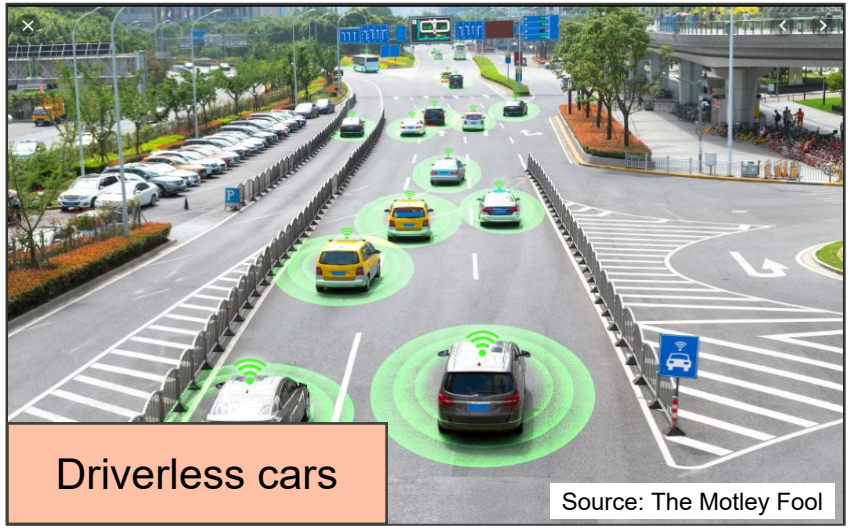
Augmented Reality



Source: forbes.com

- Superimpose intelligent computer generated images on real world views
- Made more powerful by new devices

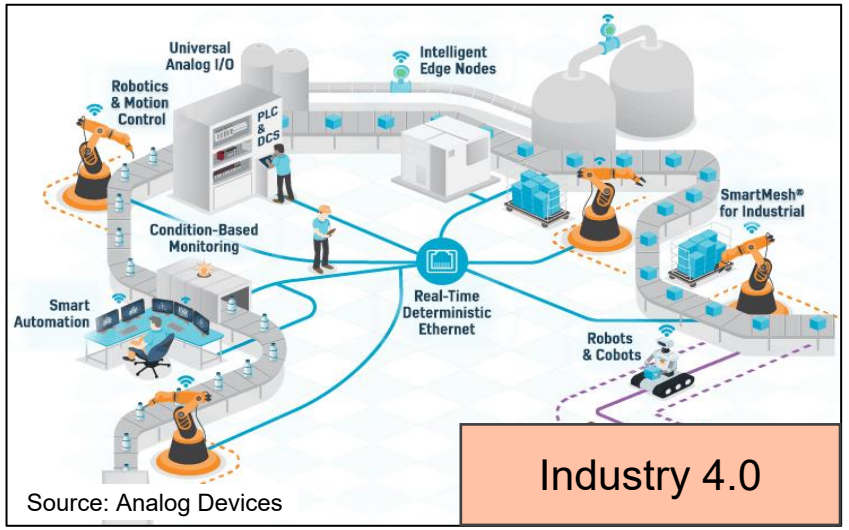
Driverless cars



Source: The Motley Fool

- Cars that can drive themselves
- Cars that can manage themselves

Industry 4.0



Source: Analog Devices

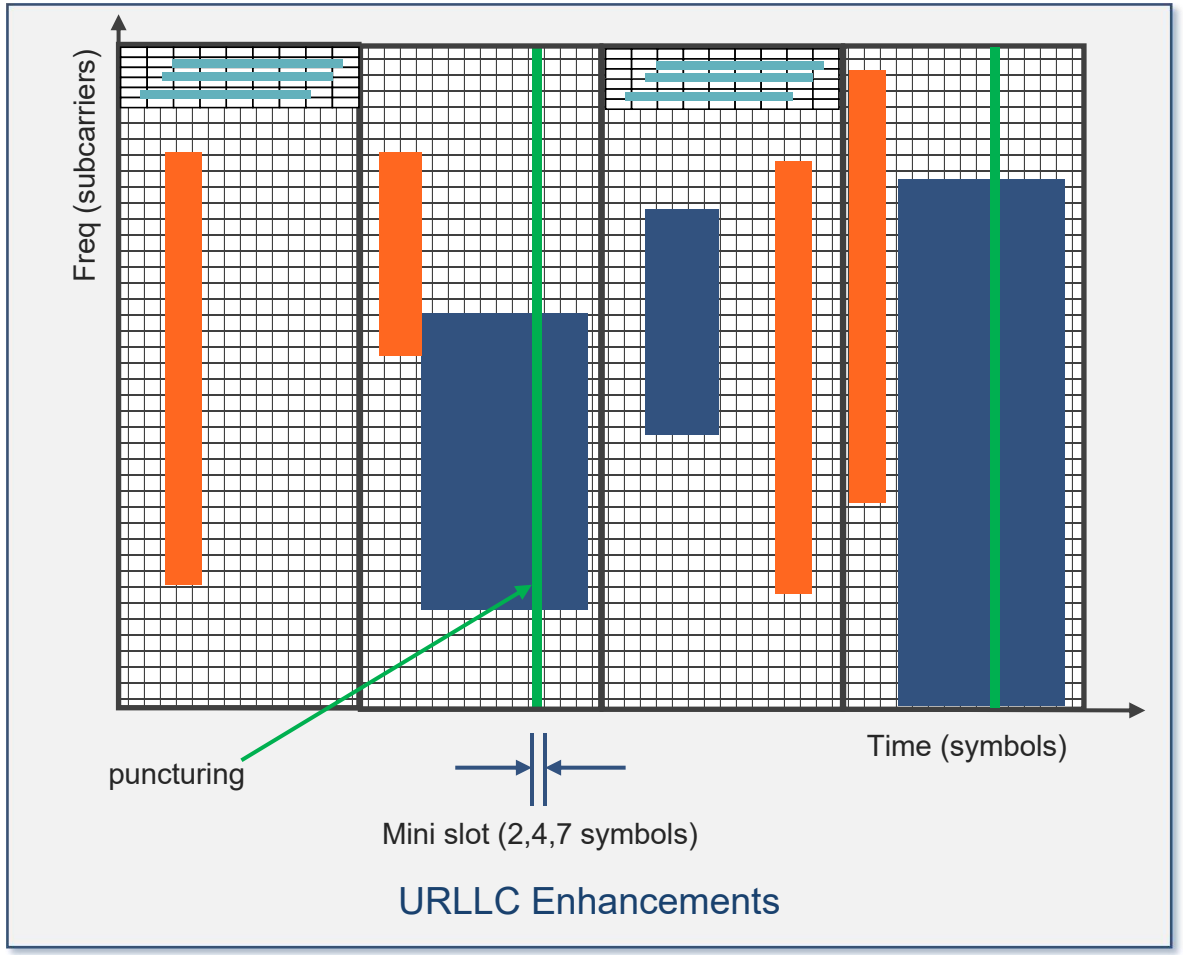
- Cyber physical systems
- Integrating computing, networking and physical processes
- Security is vital

KEYSIGHT

keysight

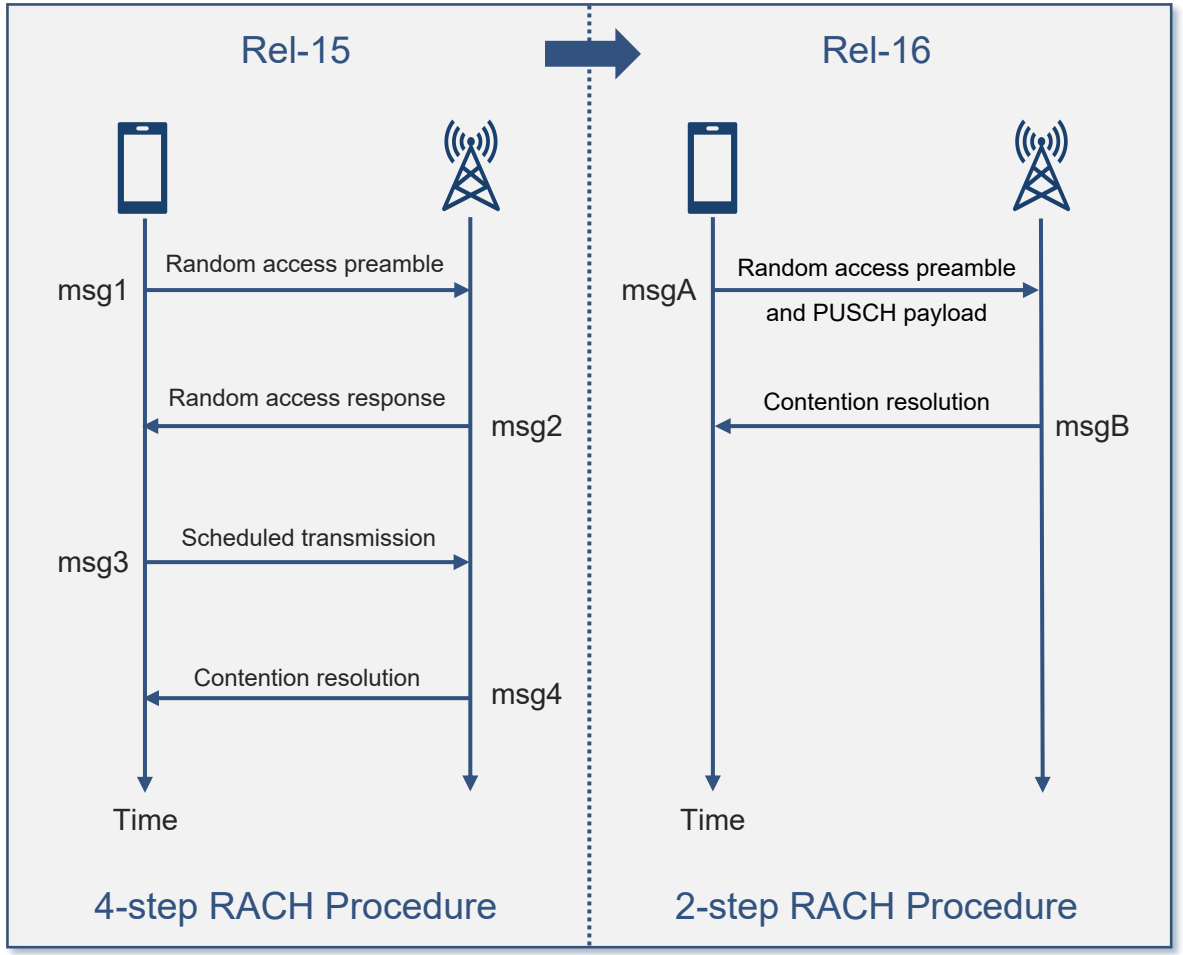
5G Rel-16 URLLC Enhancements

- Rel-16 eURLLC builds on the Rel-15 URLLC foundation
- Low Latency
  - Multiple BWPs mixed numerology
  - DL pre-emptive scheduling (puncture an eMBB allocation)
  - CBG-based HARQ
  - UL configured grant scheduling
  - UL pre-emptive scheduling
- Ultra Reliability
  - Blind repetitions
  - New CQI table optimised around 10^{-5}
  - PDCP layer packet duplication increased from 2 to 4



5G Rel-16 2-step RACH Procedure

- Improves efficiency of the existing Rel-15 RACH Procedure
- Reduces number of steps from 4 to 2
- Reduces signaling overhead and latency
- Improves capacity and power efficiency
- Supports small grant-free uplink



Keysight 5G Rel-16 Solution

UXM 5G Test Application

S8711A UXM 5G Test App — Multi-Domain

Overview

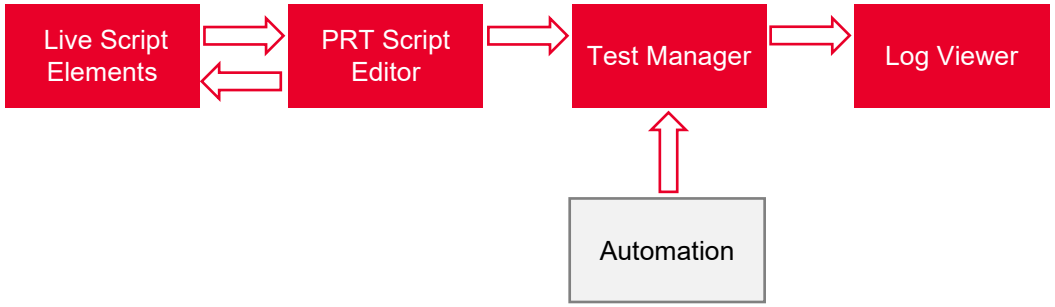
- The most comprehensive R&D solution in the market
  - A suite of tools for RF and Functional testing
  - Rich parameterization enabling a wide range of test scenarios
  - Supports early development test phases, from prototyping to systems integration and verification
  - Scalable from development to full-rack RF acceptance
- Flexible, easy-to-use interface
  - A single, all-inclusive user interface for both RF and Functional testing
  - Test devices interactively across all network scenarios
  - Easily automate your own test scenarios via SCPI commands

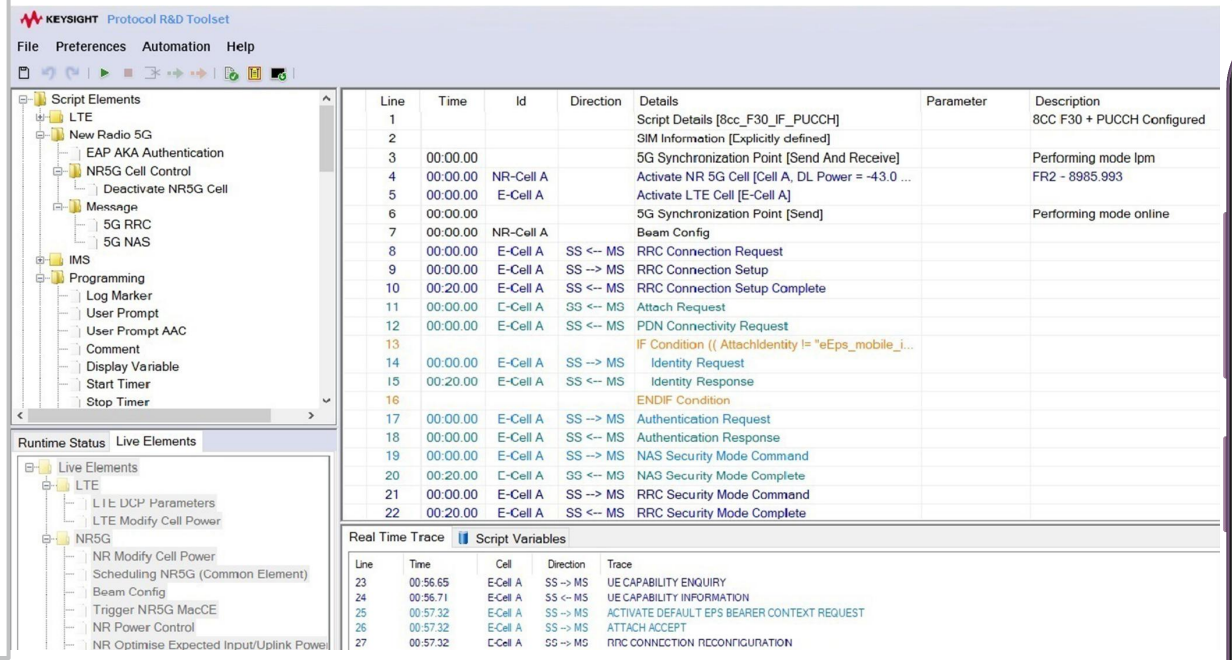
E7515B UXM 5G wireless test platform

S8701A Protocol R&D Toolset

Overview

- Comprehensive solution for wireless chipsets and devices
  - Supports early development and test phases
  - From prototyping to systems integration and verification
- Toolset designed for protocol and application testing by
  - Protocol stack developers
  - Systems integration
  - Verification teams
- Flexible, easy-to-use interface enables
  - Building tests with no programming knowledge required
  - Test development acceleration during feature integration and regression phases





E7515B UXM 5G wireless test platform

UXM 5G – Proven 5G Release 16 Leadership

Qualcomm

businesswire A BERKSHIRE HATHAWAY COMPANY HOME SERVICES NEWS EDUCATION ABOUT US Search

Keysight's 5G Test Platforms Used to Establish the Industry's First 5G New Radio Data Connection Based on 3GPP Release 16

Qualcomm Technologies, Inc. validates 5G new radio Rel-16 chipset using Keysight's 5G Protocol R&D Toolset

February 17, 2021 11:00 AM Eastern Standard Time

SANTA ROSA, Calif.--(BUSINESS WIRE)--Keysight Technologies, Inc. (NYSE: KEYS), a leading technology company that helps enterprises, service providers and governments accelerate innovation to connect and secure the world, announced that company's 5G test solutions were used to establish the industry's first 5G new radio (NR) data connection based on 3GPP Release 16 specifications (Rel-16).

businesswire A BERKSHIRE HATHAWAY COMPANY HOME SERVICES NEWS EDUCATION ABOUT US Search

Keysight and Qualcomm First to Achieve 10 Gbps Data Connection Using 5G New Radio Dual Connectivity

Industry milestone reached by aggregating 5G mmWave and sub-6GHz spectrum

July 06, 2021 02:00 PM Eastern Daylight Time

SANTA ROSA, Calif.--(BUSINESS WIRE)--Keysight Technologies, Inc. (NYSE: KEYS), a leading technology company that delivers advanced design and validation solutions to help accelerate innovation to connect and secure the world, announced a demonstration at Mobile World Congress 2021 (MWC 21) of a ten gigabit per second (Gbps) data connection using 5G new radio dual connectivity (NR-DC), an industry-first milestone achieved in close collaboration with Qualcomm Technologies, Inc.

"This accomplishment clearly reflects that the industry has entered the second phase of 5G NR deployment, which will enable advanced wireless communications built on the latest 3GPP Release 16 specification."

Tweet this

The demonstration included Keysight's network emulation platform and Snapdragon® X65 5G Modem-RF System with Qualcomm® QTM545 mmWave Antenna Module to aggregate 5G mmWave and sub-6GHz spectrum. The achievement builds on a long-term collaboration between the two companies to drive 5G commercialization across the device ecosystem. NR-DC allows 5G NR devices to concurrently connect and aggregate multiple NR cells, leading to significantly increased data transfer speeds.

"We're pleased to collaborate with Qualcomm Technologies to reach another industry-first milestone that lays the foundation for consumers and enterprises to achieve wired-broadband grade speeds in this next phase of 5G," said Cao Peng, vice president and general manager for Keysight's wireless test group. "This accomplishment clearly reflects that the industry has entered the second phase of 5G NR deployment, which will enable advanced wireless communications built on the latest 3GPP Release 16 specification."

MEDIATEK

businesswire A BERKSHIRE HATHAWAY COMPANY HOME SERVICES NEWS EDUCATION ABOUT US Search

Keysight Solutions Deployed by MediaTek to Validate First 5G Modem with mmWave Spectrum Capabilities

Integrated 5G test solutions speed market introduction of new designs

March 25, 2021 11:00 AM Eastern Daylight Time

SANTA ROSA, Calif.--(BUSINESS WIRE)--Keysight Technologies, Inc. (NYSE: KEYS), a leading technology company that delivers advanced design and validation solutions to help accelerate innovation to connect and secure the world, announced that MediaTek has used Keysight's integrated 5G test solutions to validate the company's new M80 5G modem, which combines mmWave and sub-6 GHz 5G technologies into a single chip to support ultra-fast data speeds.

.@Keysight Solutions Deployed by @MediaTek to Validate First 5G Modem with #mmWave Spectrum Capabilities. Integrated #5G test solutions speed market introduction of new designs

Tweet this

Many 5G new radio (NR) deployments in urban environments will leverage greater bandwidth at higher frequencies to effectively address broadband connectivity and connection density requirements. MediaTek used Keysight's 5G network emulation solutions to validate signaling, non-signaling and radio frequency (RF) performance, as well as verify compliance to 3GPP standards, and requirements set by global mobile operators.

"We are pleased to help MediaTek accelerate global 5G new radio deployments

MEDIATEK Products Technology Investors About Press Blog

Keysight and MediaTek affirm M80 modem 3GPP Release 16 validation

May 6, 2021 - 3:00 PM - 5G

MediaTek used Keysight Technologies' integrated 5G test solutions to validate its latest M80 5G modem to 3GPP release 16 (Rel-16) specifications. Using Keysight's 5G platform, the MediaTek M80 verified features such as frequency range 1 and frequency range 2 carrier aggregation, (FR1+FR2 NR-CA), 5G Standalone dual connectivity (FR1+FR2 NR-DC) and others, based on 3GPP release 16 (Rel-16) specifications.

3GPP Rel-16 enables 5G connectivity enhancements including increased coverage, capacity, mobility and reliability, as well as lower latency and potentially improved power efficiency. Shortly after the global standards organization 3GPP finalized the Rel-16 specifications, the two companies have worked together to achieve physical layer interoperability development testing (IODT), a crucial step all products much achieve towards commercialization.

Learn More »

3GPP Release 16 is the latest global cellular technology standard. Through this collaboration and other recent achievements, MediaTek has again successfully demonstrated the capability of its M80 modem that combines 5G sub-6GHz and mmWave connectivity into a single chip.

Other recent MediaTek M80 achievements:

- MediaTek and Ericsson drive 5G Standalone Dual Connectivity Commercialization
- MediaTek M80 enables over 7Gbps performance with 5G Standalone Dual Connectivity

The MediaTek M80 5G modem technology capabilities showcase industry-leadership:

- Extreme performance through sub-6GHz (FR1) + mmWave (FR2) Dual Connectivity and Carrier Aggregation
- Sustainable connections and fast speeds with FR1 FDD+TDD CA

SAMSUNG

businesswire A BERKSHIRE HATHAWAY COMPANY HOME SERVICES NEWS EDUCATION ABOUT US Search

Keysight Enables Samsung to Establish 5G Data Call Based on 3GPP Release 16 Specifications

Selects Keysight's 5G test platforms to validate modem according to latest 5G NR standard

June 14, 2021 11:00 AM Eastern Daylight Time

SANTA ROSA, Calif.--(BUSINESS WIRE)--Keysight Technologies, Inc. (NYSE: KEYS), a leading technology company that delivers advanced design and validation solutions to help accelerate innovation to connect and secure the world, announced that Samsung Electronics' System LSI Business, a global leader in semiconductor components and 5G technology, has selected the company's 5G test platforms to establish a 5G data call based on 3GPP release 16 (Rel-16) specifications.

.@Keysight Enables Samsung to Establish #5G Data Call Based on 3GPP Release 16 Specifications. Selects Keysight's 5G test platforms to validate modem according to latest #5GNR standard #semiconductor

Tweet this

Samsung selected Keysight's 5G network emulation solutions to successfully demonstrate a data link based on 3GPP Rel-16 specifications for the 5G new radio (NR) standard. Finalized in 2020, Rel-16 brings numerous enhancements to 5G NR deployments, leading to improved spectrum use, lower network latencies and higher connection reliability. Such improvements are critical to machine-to-machine (M2M) communications in industrial automation, autonomous vehicles and greater operational efficiencies for service providers.

"We're pleased to support Samsung's strategic 5G technology goals with integrated software-based chipset and device test solutions for validating new designs according the latest 3GPP specifications across the protocol stack," said Cao Peng, vice president and general manager for Keysight's wireless test group. "Keysight is committed to delivering test platforms that accelerate commercial introduction of 5G devices and networks to 5G leaders such as Samsung."

Samsung used Keysight's 5G Protocol R&D Toolset and Test Application software to validate the modem maker's Exynos Modem chipset, which many global device makers use to bring 5G products to market. The toolset enables Samsung to perform 3GPP Rel-16 physical player interoperability development testing (IODT), verify power saving IODT performance and validate new radio to new radio dual connectivity (NRDC) functionality, in both sub-7GHz (FR1) and mmWave (FR2) spectrum.

KEYSIGHT