3GPP Release 16: Study Items and Road Map

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For those following the development of 5G, it might be easy to say 5G development is over. For those following the marketing of various telecom companies, it might be easy to say 5G is already here. In reality, that is partially true. Yes, 3GPP Release 15 is complete. And yes, this release contains pieces of the standard that can be considered "5G." But 5G development is not finished. Release 16, sometimes referred to as "Phase 2" of 5G on ITU timelines, will contain standardization for a lot of use cases and scenarios not addressed in Release 15.

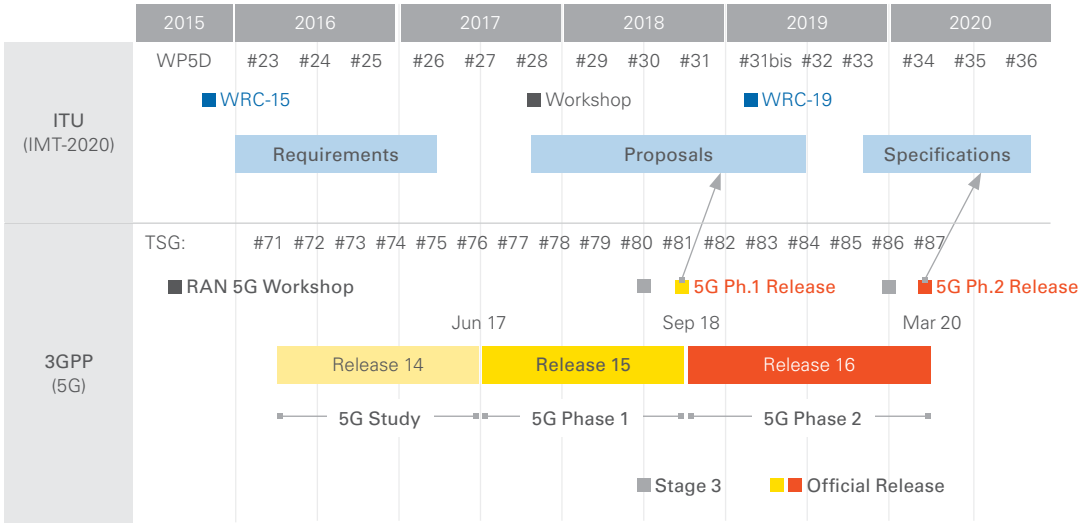

Figure 1. 5G Timelines From ITU and 3GPP. Source: Netmanias

Release 16 is designed to be an 18-month project that wraps up at the end of 2019. The three key performance indicators for 5G are faster peak rates (the enhanced mobile broadband, eMBB), more connections per cell (massive machine-type communication, mMTC), and lower latency (ultra-reliable low-latency communications, URLLC). Most of Release 15 focused on the eMBB use case. Release 16 focuses more on URLLC to expand the features that 5G enables and to increase the efficiency of the existing feature set.

Release 16 Trends: Feature Expansion

A few areas of study for Release 16 involve feature expansion. These include increasing support for vertical industries, unlicensed spectrum (NR-U), Integrated Access Backhaul (IAB), and frequencies above 52.6 GHz.

Frequencies Above 52.6 GHz: Work is starting slowly for the frequencies above 52.6 GHz because industry is not demanding this service at the moment. The main goal is to explore how New Radio (NR) needs to be applicable in higher bands and with potentially up to 2 GHz bandwidth (more than double the 800 MHz from Release 15). Over the course of the next nine to 12 months, a radio access network (RAN) plenary will identify target band ranges, use cases, and deployment scenarios.

URLLC Applications: The ability to meet URLLC and Industrial IoT (IIoT) application challenges is the new Release 16 feature that is generating the most buzz. Release 15 incorporates basic URLLC features, but they are not developed enough to fully expand 5G beyond the typical cellular use case. To achieve this, Release 16 focuses on increasing reliability, lowering latency, and improving timing. Most of these goals will be achieved through improvements to the protocol and physical layer. Data duplication enhancements are needed to improve reliability, especially L1 reliability enhancements. Enhancements for Time Sensitive Networking, including wireless Ethernet, accurate reference timing, and Ethernet header compression, are also a specific focus.

5G for Non-Terrestrial Communications: The main use case for this application is in the satellite industry. The goal is to use commercial 5G networks to communicate with satellites as shown in Figure 2. Features for study include physical layer control procedures, uplink timing advances, retransmission schemes, and architecture and handover schemes to make 5G usable for satellite communications. Things like the Doppler effect make this an intriguing study item that is different from a traditional mobile cellular communications application.

Figure 2. Using 5G NR gNB to Communicate With Satellites

V2X Use Cases for LTE and NR: V2X is arguably the killer app that sets 5G apart from 4G. Release 16 focuses on the continuance of LTE's cellular V2X and tries to tackle advanced use cases. These include vehicle platooning, enhanced vehicle to infrastructure features, extended sensors, advanced driving (to enable semiautomated or full-automated driving), and remote driving. There are no restrictions on the frequency band at this point, and Release 16 authors are planning to address both low and high bands. Low band is a higher priority for this study item.

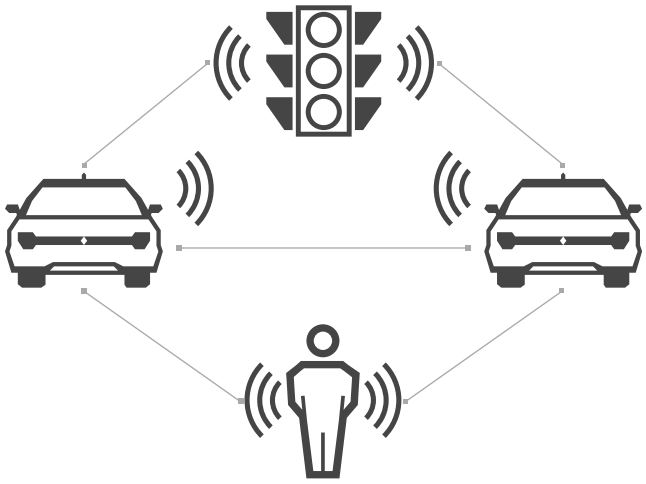

Figure 3. In 5G NR, vehicles will need to communicate with each other and infrastructure. Source: Qualcomm

Access to Unlicensed Spectrum: There are LTE versions of license assisted access (LAA) to unlicensed spectrum. 5G aims to help people access unlicensed spectrum in a stand-alone manner without assistance from a licensed carrier. This study item also addresses dual connectivity between licensed and unlicensed carriers. The goal is to create a single global solution for NR-based access to unlicensed spectrum for bands both below and above 6 GHz. Coexistence methods need to be established within NR, between NR-based and unlicensed and LTE-based LAA, with other incumbent Radio Access Technologies (RATs), and in accordance with regulatory requirements in unlicensed bands such as 5 GHz, 37 GHz, and 60 GHz.

Integrated Access and Backhaul (IAB): The concept of IAB is illustrated in Figure 4. The study item examines support for wireless backhaul and relay links. This is considered critical enabling technology for mmWave. Base stations need to be deployed very densely for mmWave, but linking fiber to all the new installations is not viable from a cost or an installation perspective. IAB also adds flexibility to NR cells and avoids densifying the transport network proportionately. Both in-band and out-of-band relaying options for indoor and outdoor scenarios are being considered.

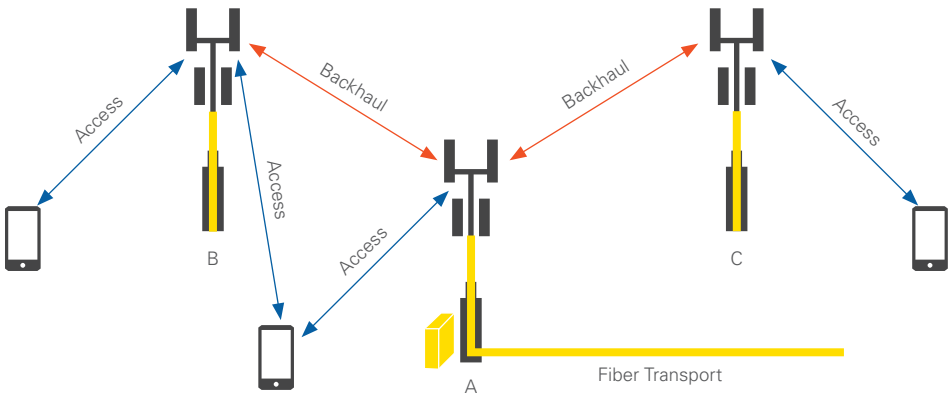

Figure 4. Illustration of IAB. Source: RP-170831

Release 16 Trends: Efficiency Improvements

As stated above, Release 16 does not purely address new applications. The approved study items below aim to make NR more efficient for the eMBB use case:

Interference Mitigation: This item addresses interference from remote base stations for semi-static uplink/downlink configurations, cross-link interference, and network coordination mechanisms for uplink/downlink configurations. There is a nine-month timeline for this study item.

Software-Defined Network (SDN) and Big Data: Adding machine learning and artificial intelligence (AI) techniques to 5G may make 5G more efficient. This study item encapsulates a collection of RAN-centric data for self-optimizing networks (SONs), RAT optimization, load sharing, and mobility optimization.

Multiple Input, Multiple Output (MIMO) Enhancements: Release 15 is not comprehensive enough to meet all the different MIMO use cases. This study item investigates Multiuser MIMO, multi Pseudo-Random Postfix (PRP), and enhancements for multibeam scenarios, which mmWave MIMO systems need.

Location and Positioning Enhancements: These improvements are truly new features for a wireless standard. No one expects them to be complete by the end of Release 16. This study item defines a more accurate set of positioning techniques for both indoor and outdoor, with a particular focus on higher frequency bands.

Power Consumption Improvements: Release 15 began exploring this, but Release 16 examines the Radio Resource Control (RRC) connected state specifically to make devices less power hungry. Adding Radio Resource Management (RRM) measurements in devices is one idea this study item outlines.

Dual Connectivity Enhancements: Two examples of the types of technology that this study item addresses are carrier aggregation and dual connectivity with fast line sharing service (LSS).

Device Capabilities Exchange: To add efficiency to the network, mechanisms that detect a device's capabilities are being considered. For example, 5G networks need to know whether a specific device has mmWave capabilities.

Nonorthogonal Multiple Access (NOMA): NOMA, a study item for quite some time, is still being evaluated for its usefulness. By December 2018, a decision will be made to either continue studying it or move it to implementation.

Work on Release 16 has already begun. These study items, which were identified at the end of work on Release 15 as priorities for Release 16, will evolve as the standardization process continues. With the 2020 deadline rapidly approaching, 2019 is sure to be an exciting year for 5G technological innovations and developments.