

SILK ROAD TO 5G-2020+

Approved Release 16 projects and the start of Release 17 projects
March 2019 (RAN#83)





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“ HEPTA 7291 STRIVES TO ENHANCE THE QUALITY OF LIFE, SENSE OF WELL-BEING, SOCIAL INTERACTION AND CONNECTIVITY TO THE CONSUMER. WE BELIEVE IN PROVIDING INTELLIGENCE FOR HEALTHIER AND SAFER LIVING ENVIRONMENTS WITH THE INTEGRATION OF TECHNOLOGIES BASED ON THE DEVELOPMENT OF 5G-2020 AND BEYOND. ”

Creating the world's leading source of infinite intelligent information combining communications technology, computing, big data, machine learning, and health and wellness.

HEPTA 7291 is a member of ETSI, which is a world-leading standards developing organization for Information and Communication Technologies (ICT).





INTRODUCTION

- Release 16 will be "5G phase 2" and should be completed in December 2019
- Release 16 is about cellular expansion
- Release 16 is an integral part of the 5G vision
- We are now at the start of the formation, where researches on Release 16 study items (SIs) and work items (WIs) can begin for innovation. December 2019 is expected to see the completion of a full set of 5G standards meeting all requirements of the International Telecommunication Union (ITU).
- **Dr. Carolyn Taylor, a Master Researcher, said, "Release 16 is like a 2 prongs tuning fork, the main reason for using the tuning fork U-shape is that it produces a very pure tone, where Release 15 is the 1st prong and Release 16 is the 2nd prong, for infinite intelligence information to enable a new era where everything is interconnected".**

NEW RELEASE 16 PROJECTS

Verticals

- NR V2X (Vehicle to Everything)
- Enhancement to NR URLLC (Ultra Reliable Low Latency Communications)
- NR support Industrial IoT (Internet of Things)
- NR Non-terrestrial networks (Spaceborne/satellites vehicles and Airborne vehicles)

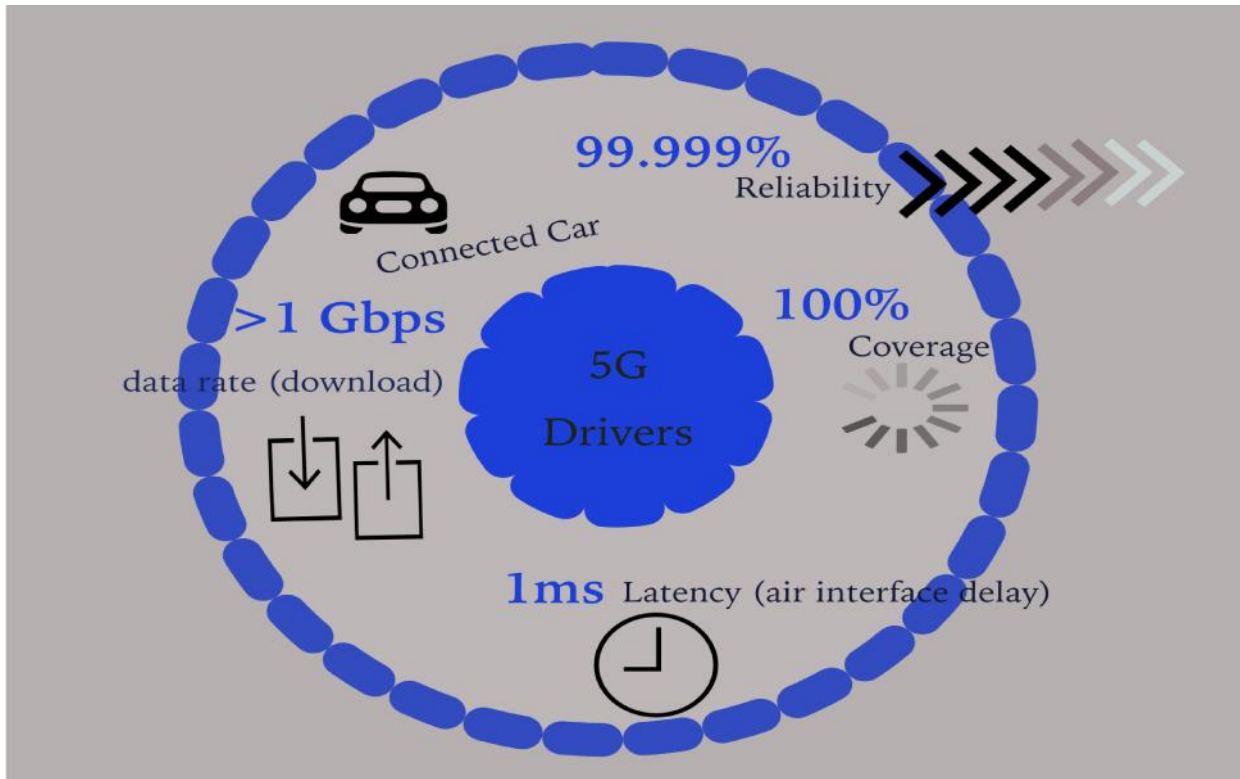
Networks & Services

- NR DC and CA enhancements
- NR mobility enhancements
- NR Positioning
- NR MIMO
- NR 2-Step RACH
- NR CLI mitigation
- NR Remote Interference Management
- NR Big Data/SON/MDT
- NR Integrated access and backhaul
- NR-U (Unlicensed Spectrum)
- NR design beyond 52.6 GHz
- LTE-based 5G Terrestrial Broadcast
- LTE MIMO further enhancements
- LTE mobility further enhancements

UEs, Machines & Things

- NR 2-Step RACH
- NR MIMO
- NR DC and CA enhancements
- NR UE Power Savings
- NR mobility enhancements
- NR UE radio capability optimizations
- NR Positioning
- NR-U (Unlicensed Spectrum)
- LTE eMTC further enhancements
- LTE NB-IoT further enhancements
- LTE mobility further enhancements
- LTE high speed further enhancements
- LTE MIMO further enhancements

EXECUTIVE SUMMARY



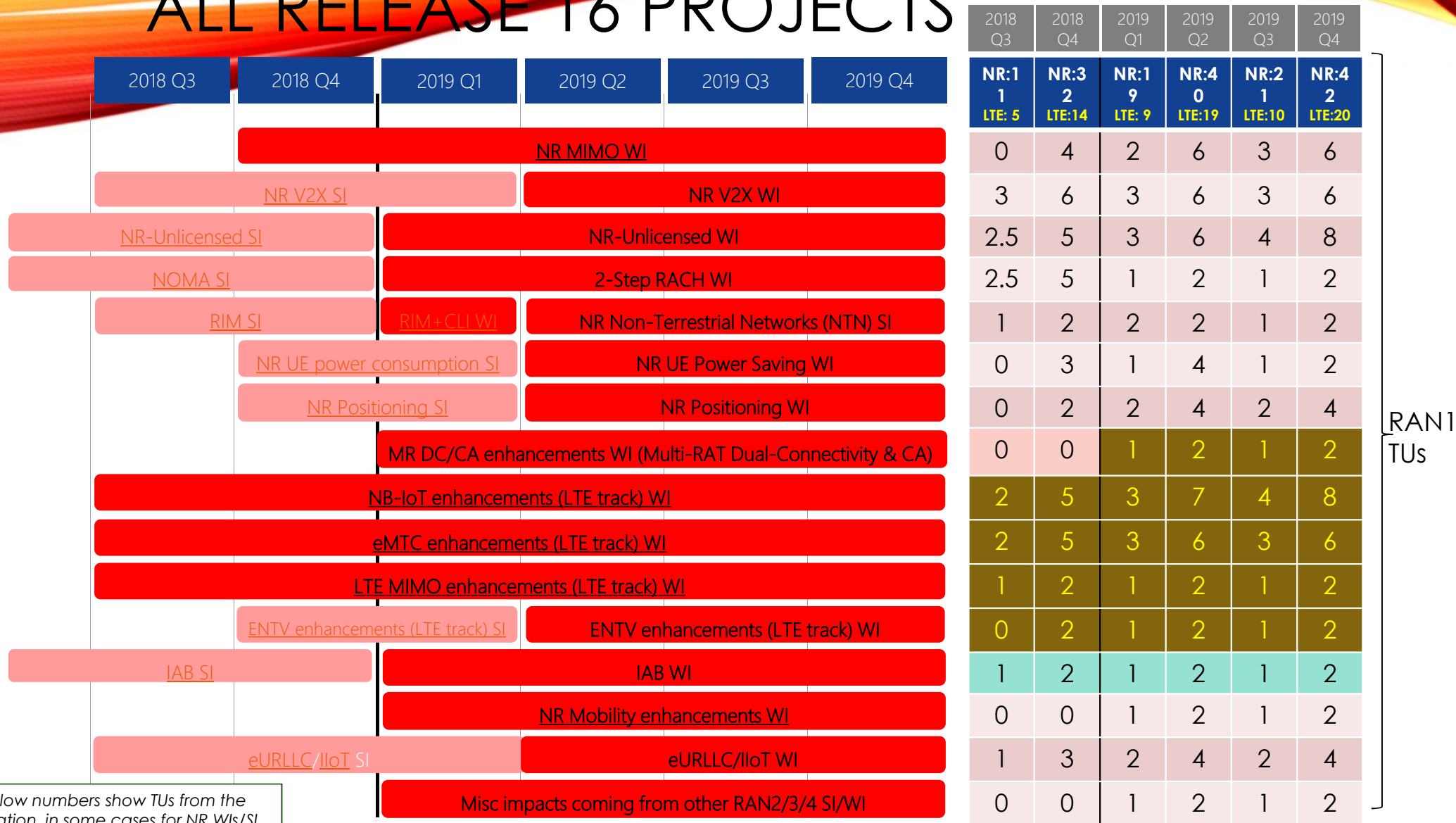
- The Release 15 of the 3GPP 5G NR specifications for non-standalone (NSA) operation was complete in December 2017.
- In June 2018, 3GPP has approved the completion of the 5G NR specifications for standalone (SA) operation in Release 15.
- With the completion of both SA and NSA specifications, we started the Release 16 projects, which is the technologies for the digitisation and integration of vertical industries with the completion date of December 2019.
- For 5G to satisfy the demands of some vertical industries, additional features require further attention in Release 17.



HOW WE GOT HERE

- The 3GPP Release 15 of the 5G NR specifications for non-standalone (NSA) operation was successfully completed in December 2017.
- At the 3GPP meeting in La Jolla, the Release 15 of the 5G NR specifications was approved for the completion of the standalone (SA) operation in June 2018.
- The completion of SA specifications which complements the NSA specifications, not only gives 5G NR the ability of independent deployment, but also brings a brand new end-to-end network architecture, making 5G a facilitator and an accelerator during the infinite intelligent information and communications technology improvement process of enterprise customers and vertical industries.
- This means, the industry can now take the final sprint towards 5G commercialization, although the first will be limited deployments of 5G.
- Now, Release 16 is being developed to largely be used to build the 5G cases for infinite intelligence information to enable a new era where everything is interconnected.
- The large-scale 5G deployments can only be expected from the year 2020 onwards with Release 16.
- Next, there will be a call for Release 17 proposals at RAN#84 (June-2019). At RAN#84 the proposals will be organized into Work Areas.
- At RAN#85 (September-2019), there will be a review of email discussion progress on Work Areas.
- Lastly, approval of SIs (WIs) for RAN1/2/3 will be done at RAN#86 (December-2019).

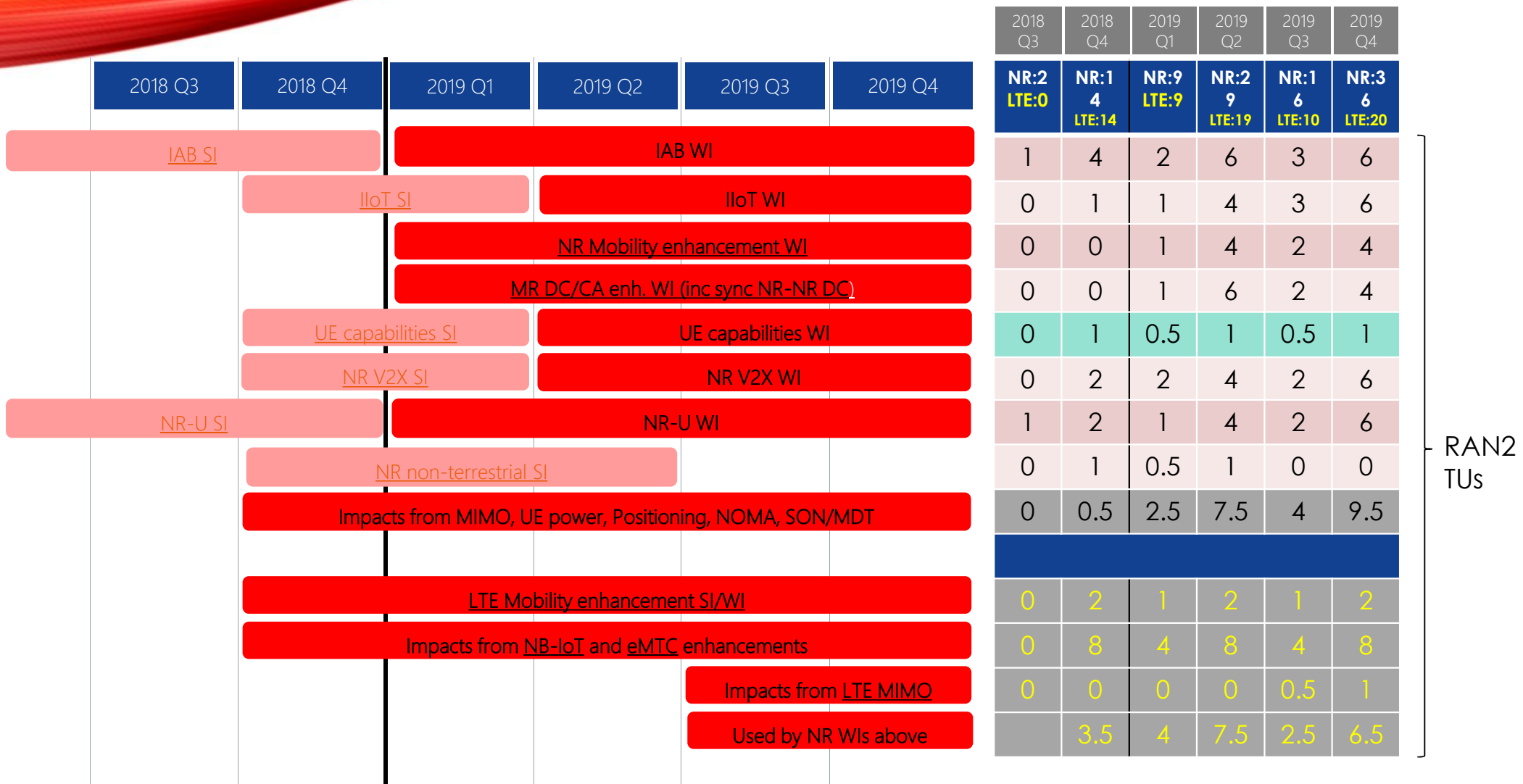
ALL RELEASE 16 PROJECTS



Note: Yellow numbers show TUs from the LTE allocation, in some cases for NR WIs/SI

RAN1
TUs

ALL RELEASE 16 PROJECTS



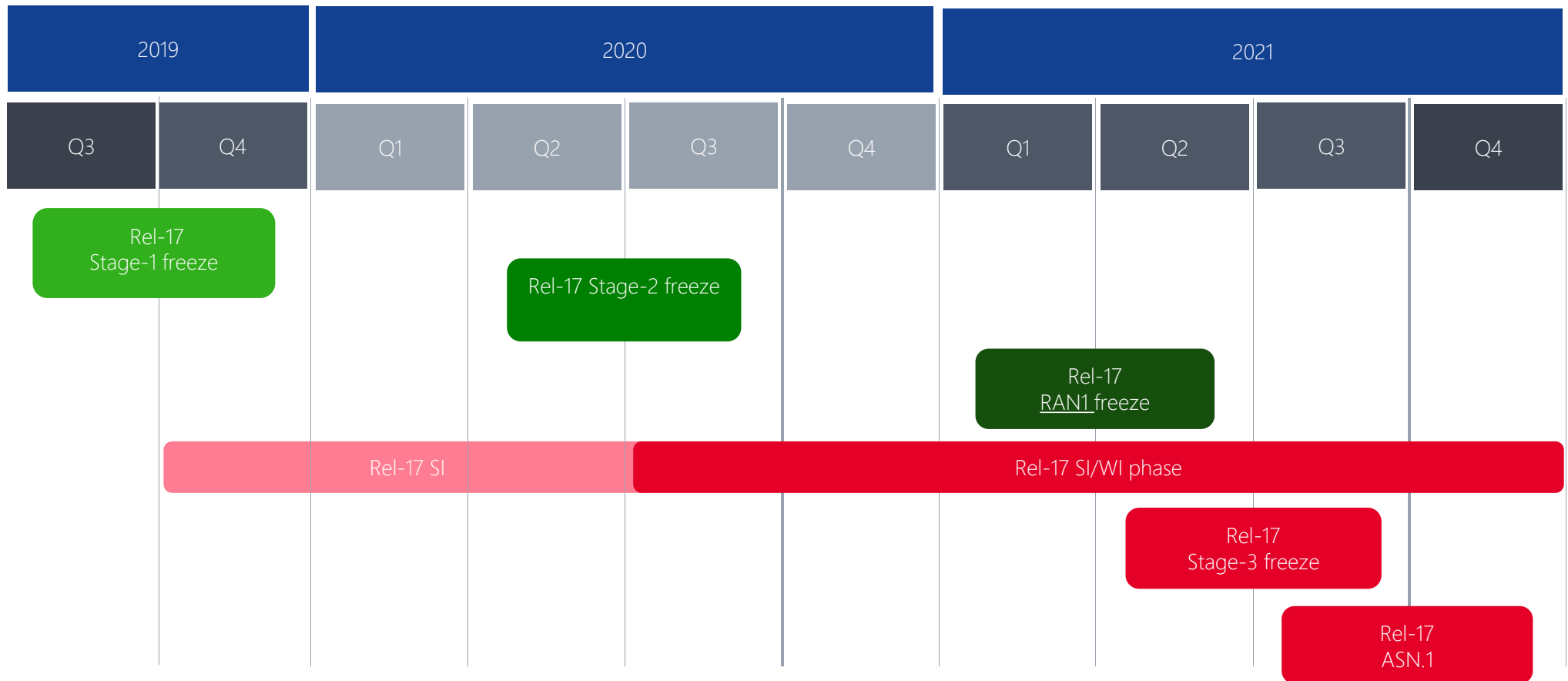
ALL RELEASE 16 PROJECTS



RAN3 TUs

Note: TUs for NR corrections and late drop are not shown

EVOLUTION FROM REL-16 TO REL-17



POTENTIAL RELEASE 17 PROJECTS

- NR
 - NR AI
 - NR Drone
 - NR-IoT
 - NR Broadcast
 - NR Multi-SIM
 - NR based mMTC
 - NR smart grid
 - Coverage enhancement for NR
 - UE distribution enhancement for IDLE/INACTIVE
 - Public safety over NR
 - Outer packet coding in NR
 - Support of multiple connectivity in NR
 - Enhancement to 52.6GHz
 - Enhancements to NTN
 - Enhancements to NR SL
 - Enhancement to NR based V2X
 - Enhancement to backhaul (IAB)
 - Enhancements to 2-Step RACH
 - NR improved positioning accuracy
 - Further enhancements to URLLC
 - Further enhancements to IIOT
 - Further enhancements for MIMO
 - Leftovers from Rel-16
- LTE
 - IOT relay for LTE
 - eMBB related enhancements
 - Vertical enhancements
 - Multi-RAT related enhancements, e.g.
 - Leftovers from Rel-16

POTENTIAL RELEASE 17 SCHEDULE

	TSG SA-CT*	TSG RAN	Comments
Stage 1 freeze	September-2019 for 80% December-2019 completion	NA	Stage 1 freeze already decided at TSG#82
Project package approval	NA	December-2019	
Stage 2 freeze	September-2020	NA	This date will be reviewed in TSG-SA based on agreement of Rel-17 contents and time schedule agreed jointly by SA/RAN. Note: 9 month overlap of SA2/RAN2/RAN3 phase allows for coordination
RAN1 freeze	NA	March-2021 or June-2021	Early freeze of RAN1 to help RAN2 work finalize on time
Stage 3 freeze	June-2021 or September-2021	June-2021 or September-2021	June-2021 corresponds to a 15-month Release September-2021 corresponds to an 18-month Release
ASN.1 freeze	NA	September-2021 or December 2021	
RAN4 performance completion	NA	March-2022 or June-2022	Allow additional 3 months for RAN4 performance work completion

INFINITE INTELLIGENCE

MORE THAN 400 INTELLIGENT MINDS FROM AROUND THE WORLD WAS GATHERED IN SHENZHEN CHINA DURING JUNE 18-21 2019 TO CONCEIVE AND DISCUSS ABOUT THE IDEAL FUTURE AND HOW TO GET THERE SOLVING REAL CHALLENGES BASED ON THE DEVELOPMENT OF 5G-2020 AND BEYOND NEW TECHNOLOGIES.

THESE DELEGATES FROM THE WORLD'S MAJOR TELECOM OPERATORS, NETWORK VENDORS, UE AND CHIPSET VENDORS, INTERNET COMPANIES, SMALL COMPANIES, START-UP COMPANIES, AND OTHER VERTICAL COMPANIES.

COMPETITIVE ACTIVITY

OPERATORS & VERTICALS

- **NR**
 - RAN-centric Big Data collection and utilization (SON)
 - NRV2X
 - NR URLLC enhancements
 - NR MIMO enhancements
 - NR Positioning
 - NR Mobility enhancements
 - NR UE power consumption
 - NR beyond 52.6 GHz
 - NR Non-terrestrial Networks
 - NR Remote Interference Management (RIM)
 - Non-public networks (NPN) for NR
 - Study on local NR positioning in NG RAN
- **LTE**
 - LTE MIMO
 - LTE URLLC enhancements
 - LTE MTC enhancements
 - NB-IoT enhancements
 - LTE for high speed enhancements

UE & CHIPSET VENDORS

- **NR**
 - NR MIMO
 - NR UE Power Consumption
 - NR URLLC
 - NR V2X
 - NR Positioning
 - NR Mobility enhancements
 - NR beyond 52.6 GHz
 - NR DC and CA enhancements
 - NR Cross Link Interference (CLI)
 - NR Remote Interference Management (RIM)
 - NR Industrial IoT
 - Optimisations on UE radio capability signalling – NR/E-UTRA Aspects
 - NR unlicensed
- **LTE**
 - LTE MIMO
 - LTE based 5G Terrestrial Broadcast
 - LTE URLLC enhancements
 - LTE MTC enhancements
 - NB-IoT enhancements

NETWORK VENDORS

- **NR**
 - NR URLLC
 - NR V2X
 - NR MIMO
 - NR UE Power Saving
 - NR Remote Interference Management (RIM)
 - NR Positioning Support
 - NR Big Data/SON/MDT
 - NR Mobility enhancement
 - NR Industrial Internet of Things (IIoT)
 - NR DC and CA enhancements
 - NR Non-terrestrial Networks
 - NR 2-Step RACH
 - NR in Unlicensed
 - NR Integrated Access & Backhaul
 - NR Cross Link Interference (CLI)
 - Study on enhancement for disaggregated gNB architecture
 - NG interface usage for WWC (Wireless Wireline Convergence)
- **LTE**
 - LTE NB-IoT further enhancements
 - LTE eMTC further enhancements



MARKET TRENDS

- The digitalization transformation will not just connect people but things too. This includes vehicles being connected to roads, patients and their medical devices to their doctors, consumers being connected to the Internet of Things (IoT), and smart cities offering new connected services to residents and workers.
- But first, open access to street furniture is necessary in order to speed up 5G deployments.
- Local authorities need to be flexible with the street furniture in order to help the 5G rollout deployments.
- Mobile operators need to be able to have equal access to lampposts and other street furniture for deployment of much more small cells.



MARKET TRENDS

- The main vertical industries are automotive, manufacturing, media & entertainment, energy, health & wellness, and smart cities. Requirements for the different use cases varies and depends on capabilities requirements.
- Vertical industrial use cases, such as motion control or mobile robotics, may have very stringent requirements in terms of reliability and latency, whereas others, such as wireless sensor networks, require more mMTC-based services.
- Use cases and applications exist that require very high data rates as offered by eMBB, such as augmented reality (AR) or virtual reality (VR).
- AR requires quite high data rates for transmitting (high-definition) video streams from and to an AR device.



MARKET TRENDS

- Industrial use cases may have the highest requirements in terms of availability and ultra-low latency and are often characterized by somewhat small payload sizes.
- The cycle time is the transmission interval in periodic communication, which is often used in industrial automation. The latency is usually smaller than the cycle time.
- Motion control is a challenging and demanding use case. A motion control system is responsible for controlling moving and/or rotating parts of machines in a well-defined manner. Such a use case has very rigid requirements in terms of ultra-low latency, reliability, and determinism.
- Process automation lies somewhere between the two, and focuses on monitoring and controlling chemical, biological or other processes in a plant, typically extended, involving both a wide range of different sensors (e.g. for measuring temperatures, pressures, flows, to name a few) and actuators (e.g. valves or heaters).



MARKET TRENDS

- In regards to the connected driving use case, Deutsche Telekom and partners conducted tests for connected driving technology on the A9 Digital Test Track in Germany.
- The project was funded and set up by the Bavarian Ministry for Economic Affairs in 2016, with the objective of gaining insights into the value of Multi-access Edge Computing (MEC) for connected driving.
- Deutsche Telekom, along with its partners, tested a number of different use cases on the A9 autobahn:
 - Including emergency warning, end of traffic jam alerts, variable speed limit assistant and High-Definition (HD) maps.
- Deutsche Telekom deployed two locally separated MEC installations along the A9 Digital Test Track, sharing resources with the existing mobile network.
- The project results validated the performance of edge computing over their mobile network as a potential enabler for automotive cases that require low latency and ultra-high reliability.



MARKET TRENDS

- The main domains of a 5G system are access, transport, management, cloud, and applications (including network functions).
- Cloud and applications are traditional IT areas that have progressively become an integral part of the wireless telecommunication systems.
- The access domain provides wireless connectivity between the devices and the access nodes (e.g. a base station (BS)). The transport domain enables connectivity between remote sites and equipment/devices
- The transport network are interconnected via backbone nodes that carry information from the access nodes to the data centers, where most of the data is stored and the network is managed.
- 5G systems comprise of control and data planes. Most of the control plan intelligence (mobility management, session management, to name a few) resides in the data center, while most of the data plane intelligence resides in the access network (scheduling, QoS, multi-user).



GEOPOLITICAL RACE TO 5G

- The race to 5G have started and countries like China, Japan, South Korea, and United States are doing everything they can to win.
- It is estimated that South Korea is currently leading the world in 5G readiness, with China closely behind and the United States trailing both.
- The list of countries readiness for 5G are as such:
 - South Korea
 - China
 - United States
 - Japan
 - United Kingdom
 - Germany
 - France
 - Canada
 - Singapore
 - Russia
- Whoever wins the 5G race will be in a good position to possibly dominate politically, economically, and militarily.



COST BENEFITS ANALYSIS

- 5G RAN leads to opportunities for current UE and Network vendors and the opportunities for new vertical market entrants.
- 5G is going to power billions of connections and be the network infrastructure for Internet of Everything POSSIBLE.
- It will be the go-to technology that reinvent the business world and impact every aspect of everyday people digital world.
- This is the reason why there is a global RACE on to reap the benefits of 5G first.
- Who's winning? So far, its South Korea and China.
- What does it mean? South Korea and China are being agile and productive in terms of small cells because 5G requires at least 5X as many cell sites.



COST BENEFITS ANALYSIS

- Below is a summary of 5G RAN investments and estimates, including build spending in China, South Korea, Europe, and the United States.
- China has been a major contributor to the 5G standards, aiming to commercialize 5G services in 2019.
 - Huawei filed the most patents in 2018.
 - ❑ Huawei filed a total of 5,405 patents in 2018, which is an all-time record by any company.
 - ❑ The record number of patents filed by Huawei says that, its one of the biggest inventors in 5G technology in the world.
 - China is set to become the biggest market for 5G by 2025.
 - ❑ The nation is expected to have 570 million 5G users by 2025, or over 40% of global consumption.
 - It was estimated that the nation's 5G capital expense is expected to hit 1.5 trillion yuan (\$224 billion) between 2019 and 2025.
 - ❑ It will be more than that since operators will invest a further \$58 billion over the next few years.



COST BENEFITS ANALYSIS

- South Korea have a 5G mobile strategy with plans to launch in 2019 and to make it happen it will invest 1.6 trillion won (€1.1 billion) in technology.
 - South Korea is projecting to generate 331 trillion won (€230 billion) between 2019 and 2026 from the sale of 5G devices and equipment to the domestic and overseas markets.
- Europe have a 5G mobile strategy with plans to launch in 2020 and As part of EC's larger Horizon 2020 project, the 5G PPP is investing more than €4.2 billion (of which up to €700 million is from public investment, the rest from private funding):
 - The third and final phase of the EC project is €4.2 billion
 - In 2018, three new projects receive more than €50 million of EC funding



COST BENEFITS ANALYSIS

- United States have a 5G mobile strategy with plans to launch in 2019
 - 5G deployment will follow a phased approach in the U.S.
 - The nation is expected to have 190 million 5G users by 2025, or over 40% of global consumption.
 - There are four national mobile operators, AT&T, Sprint, T-Mobile, and Verizon
 - Operators will spend \$billions on 5G
- The following is forecasts made for the 2025 time frame for emerging connected vehicles services in the United States:
 - Connected vehicles will generate around US \$150 billion in annual revenue
 - The number of connected vehicles will grow to around 100 million globally



COST BENEFITS ANALYSIS

- Transportation will be central to the rapid growth of 5G. As 5G and Artificial Intelligence (AI) are considered to be the enablers to traveling safer, by communicating vehicle locations in real time and lessening the chances of accidents or collisions. Plus, enable the use of self-driving vehicles, including autonomous trucks, making the roads safer.
- From the year 2020 onwards, digitalization revenues from 5G for Information Communications and Technology (ICT) players are estimated to exceed \$4.2 trillion, of which approximately \$234 billion is accounted for by the corresponding vertical manufacturing. The verticals are projected to constitute an incredibly large and fast-growing market.

THANK YOU

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