



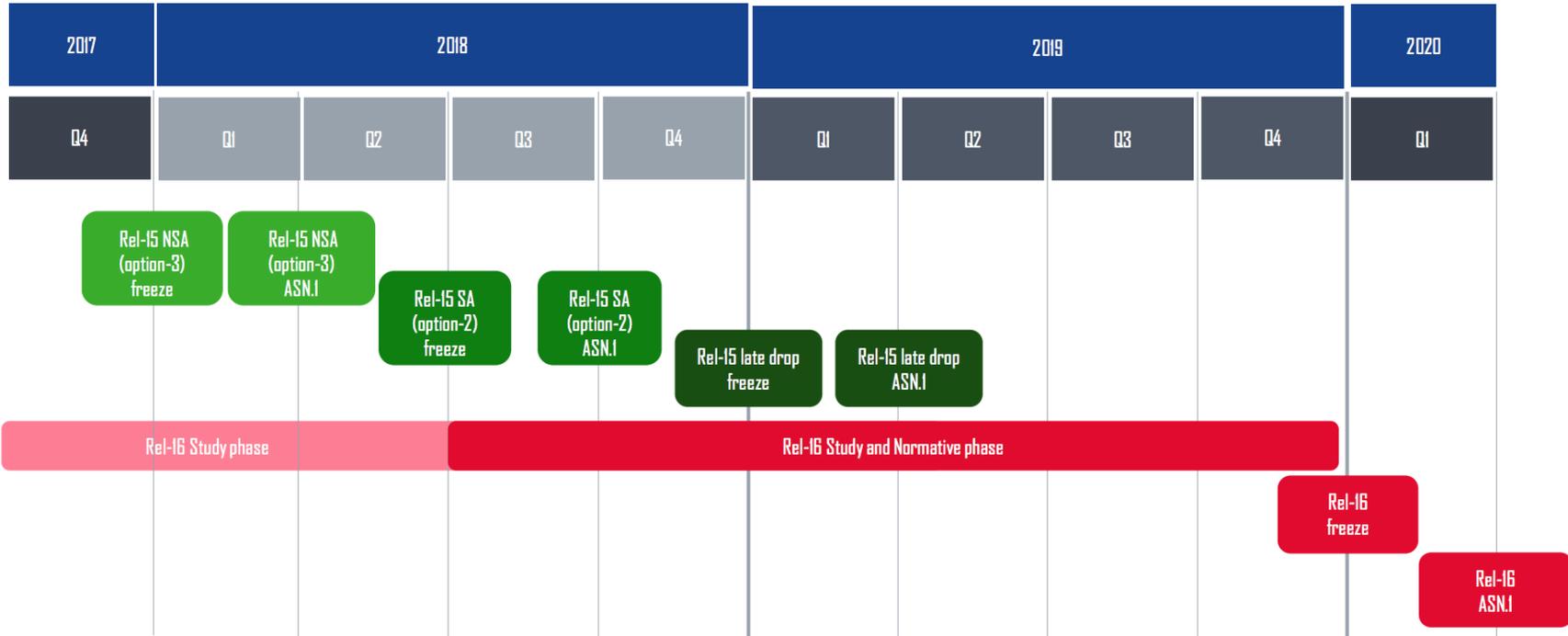
# 5G Roadmap

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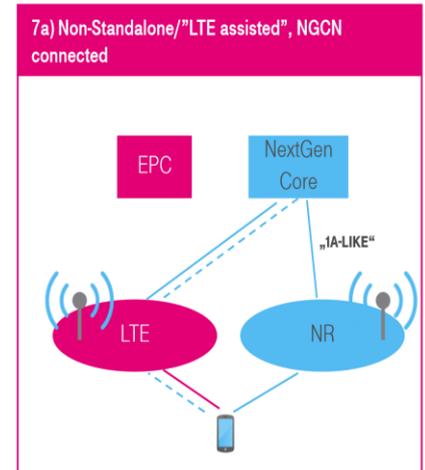
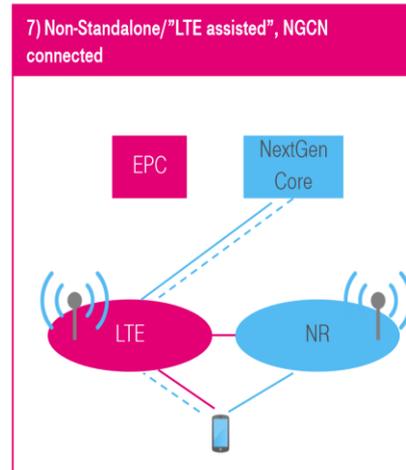
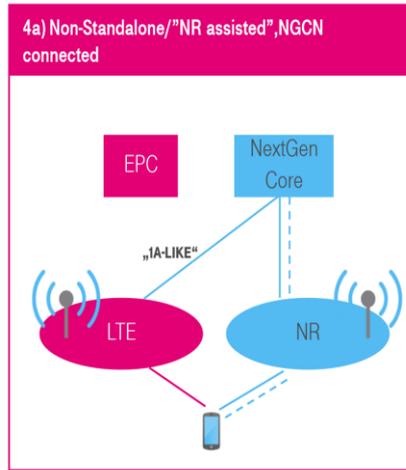
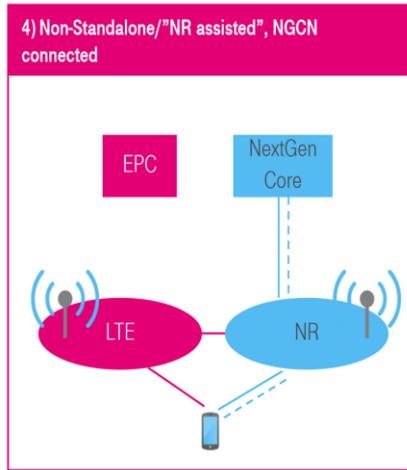
# 3GPP Timeline



Source: 3GPP

# 3GPP On Fast Track to 5G Completion

June 2018 RAN plenary concludes 5G-NR R15 with the exception of NR-NR DC options 4 and 7 to be completed in December 2018



Figures from RP-161266, Deutsche Telekom, T-Mobile

# Standards Status

R15 New Radio now completed (for the most part)

Late drop forthcoming on NR-NR Dual Connectivity (Dec. 2018)

Some aspects of RAN4 delayed

R16 Work Item is now beginning

Work item time allocations finalized in RAN Plenary #80

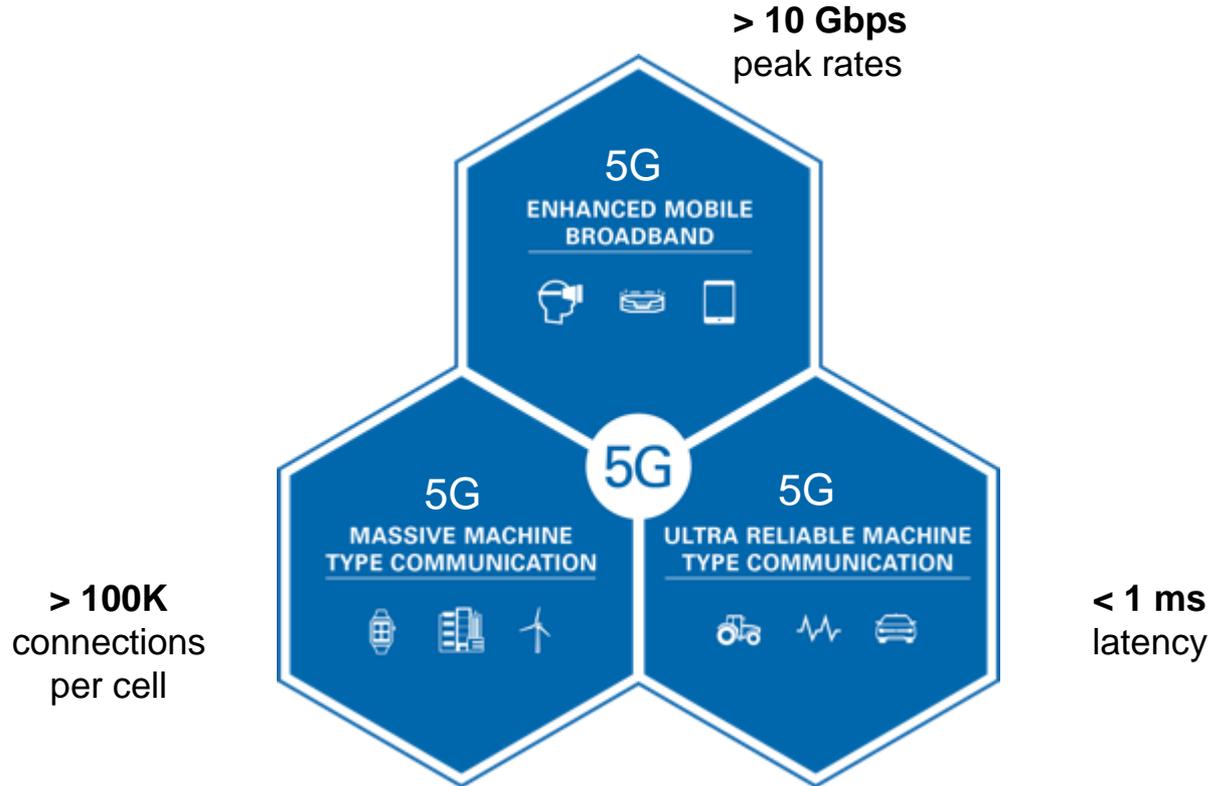
Should be a 18 month Work Item

>52.6 GHz NR to be studied in RAN Plenary for R16.

Likely to be standardized in R17.

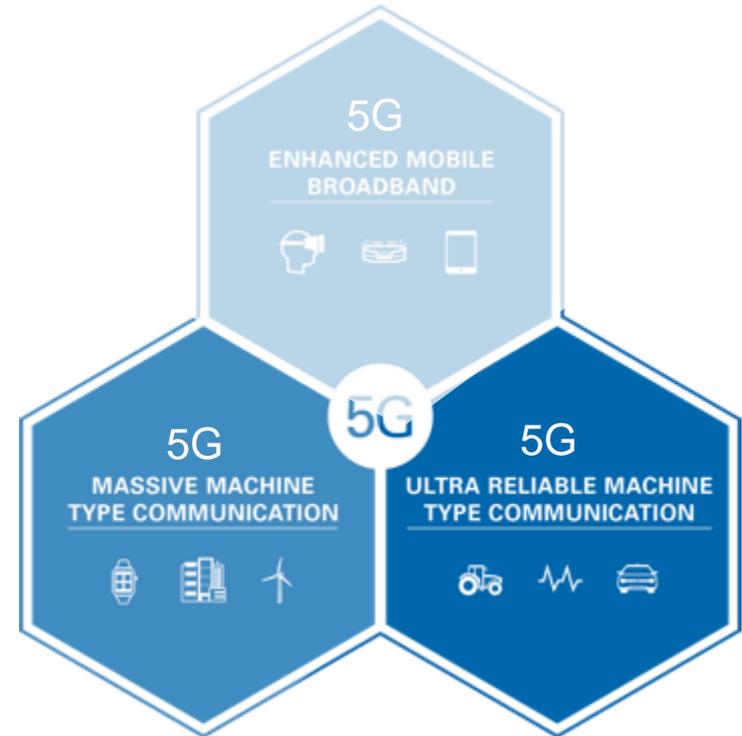
# 5G New Radio : Phase 2

# 5G KPIs



# R16 Trends – Feature Expansion

- Increasing support of vertical industries
- Unlicensed Access (NR-U)
- Integrated Access Backhaul (IAB)
- Frequencies above 52.6 GHz

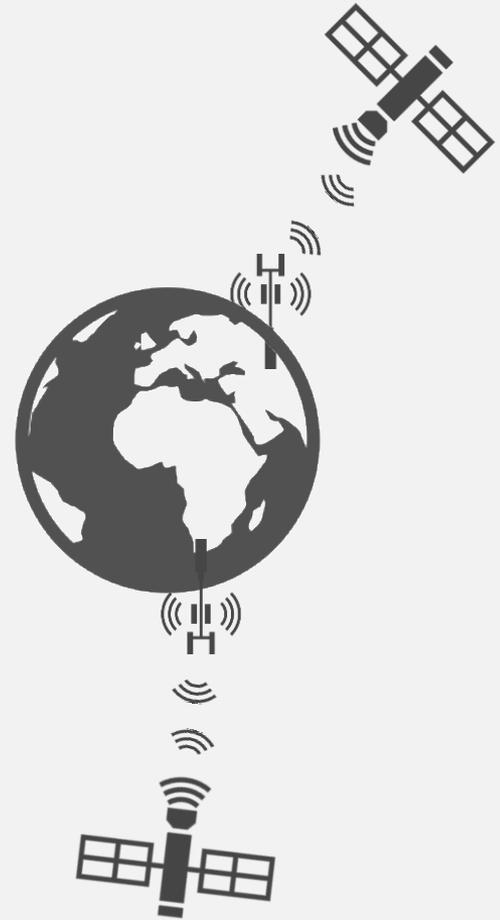


# IIoT and other URLLC applications

- R16 will be protocol and physical layer
  - Data duplication enhancements,
  - Enhancements needed for time sensitive networking,
    - Wireless ethernet
    - Accurate reference timing
    - Ethernet header compression
- URLLC enhancements
- L1 reliability enhancements
- Functions like grant free transmission
- Reliability, low latency, and timing

# 5G for non terrestrial

- Main use case comes from satellite industry
- Features for study include:
  - PHY layer control procedures,
  - Uplink timing advance
  - Retransmission schemes
  - Architecture and handover schemes to make 5G usable for satellite communication



# V2X Use Cases for LTE and NR

New evaluation methodology to be defined for the new V2X use cases

- **Vehicles Platooning**
- **Enhanced vehicle to infrastructure features**
- **Extended Sensors**
- **Advanced Driving**  
(enables semi-automated or full-automated driving)
- **Remote Driving**

No restrictions on the frequency band at this point.

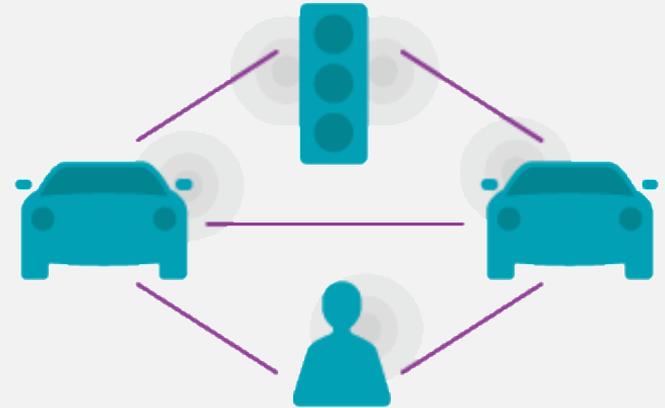


Figure from Qualcomm website

# Access to Unlicensed Spectrum

Create a single global solution for NR-based access to unlicensed spectrum

For unlicensed bands both below and above 6GHz

## Coexistence methods

- Within NR-based
- Between NR-based unlicensed and LTE-based LAA
- With other incumbent RATs
- In accordance with regulatory requirements in e.g., 5GHz , 37GHz, 60GHz bands

# Integrated Access & Backhaul

Study support for wireless backhaul and relay links

- Enable flexible and very dense deployment of NR cells
- Avoid densifying the transport network proportionately

Both in band and out of band relaying in indoor and outdoor scenarios

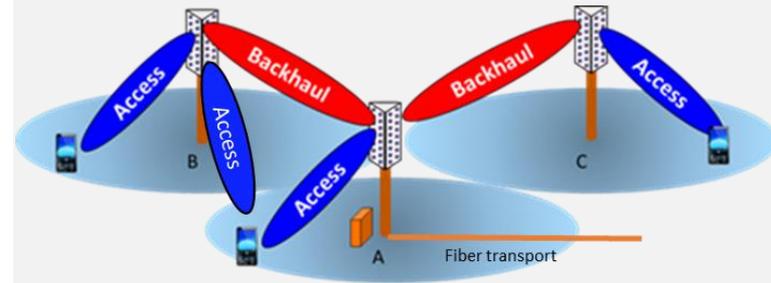
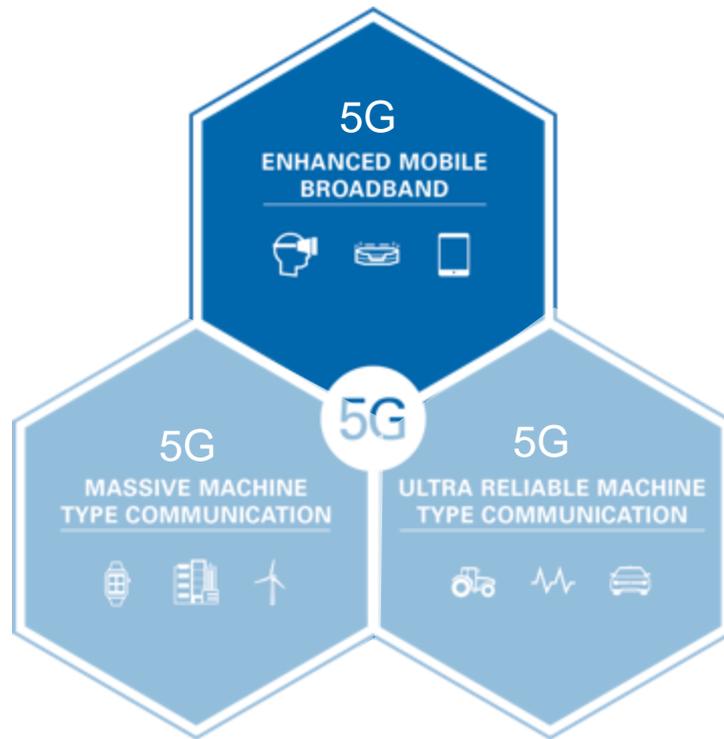


Figure from RP-170831

# R16 Trends – Efficiency Improvements

- SDN & Big Data
- MIMO enhancements (especially > 6 GHz)
- Location and positioning enhancements
- Power consumption improvements
- Dual connectivity enhancements
- Device capabilities exchange
- NOMA



Questions?

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