5G NR standards in 3GPP

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Outline

- 3GPP – facts and figures
- What is 5G
  - Timeline and key technology components
- Where is 5G
  - Expansion to new spectrum bands
- Where will 5G take us
- Challenges
- Summary

3GPP facts and figures

3GPP mission

- 3GPP will expand the LTE platform to improve its efficiency to meet the mobile broadband demand

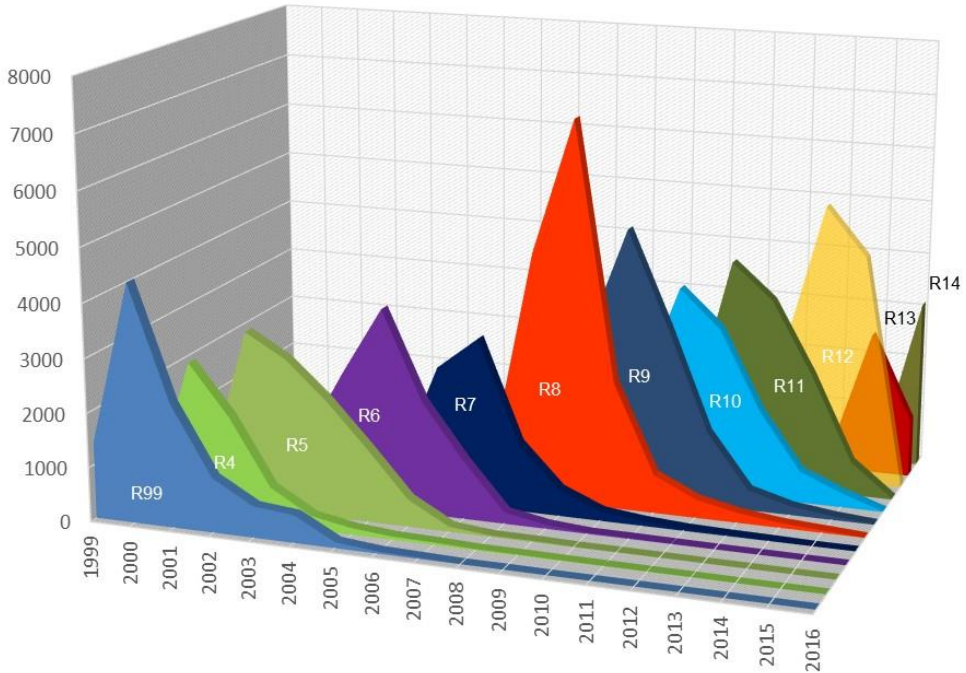
- 3GPP has an aggressive timeline for the standardization of

5G NR

with the goal to address the expanded connectivity needs of the future

3GPP facts & figures

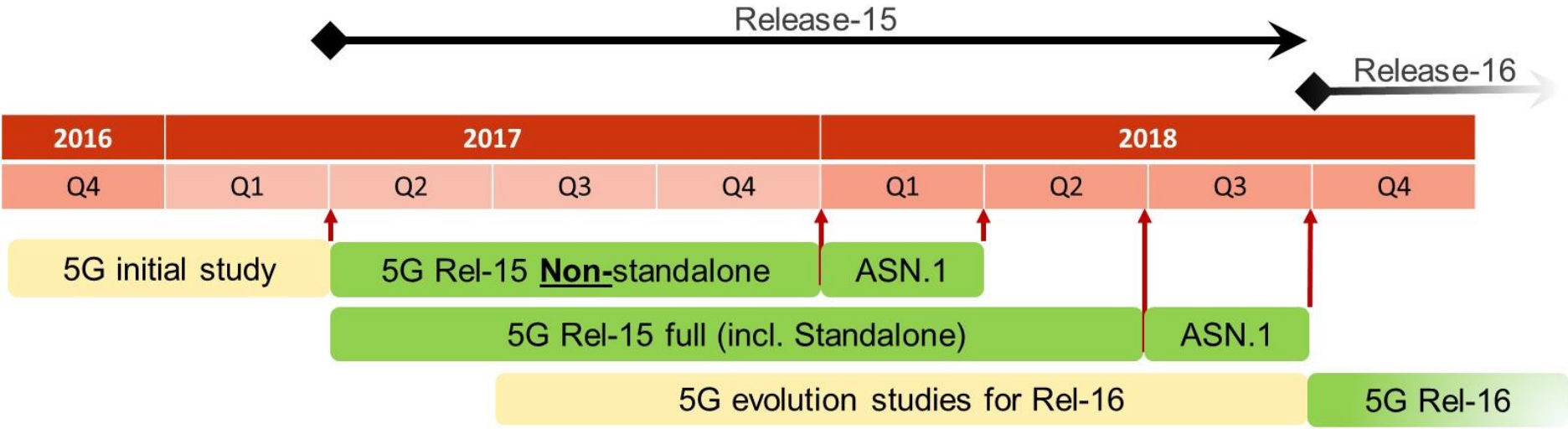
- 514 Companies from 45 Countries
- 50,000 delegate days per year
- 40,000 meeting documents per year
- 1,200 specifications per Release
- 10,000 change requests (CRs) per year
- New Release every ~18 months



What is 5G

Release 15 – the advent of 5G NR

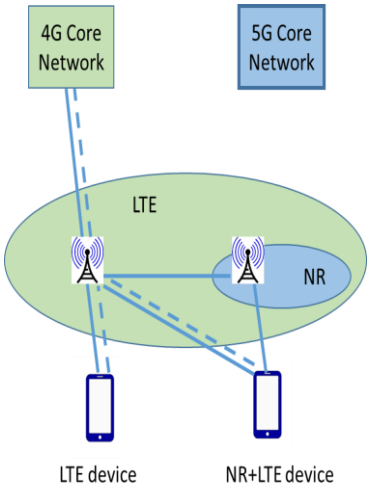
- Overall timeline as agreed in March/2017
- How can this aggressive timeline be met ?



Stepwise approach

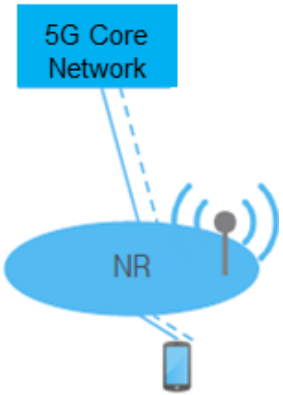
Non-standalone NR

- Uses LTE core and LTE radio anchor with NR in DC configuration
- Mobile BroadBand capacity boost



Standalone NR

- Uses 5G core and NR anchor
- 5G overlay
- Expansion of the wireless ecosystem



What is 5G NR ?

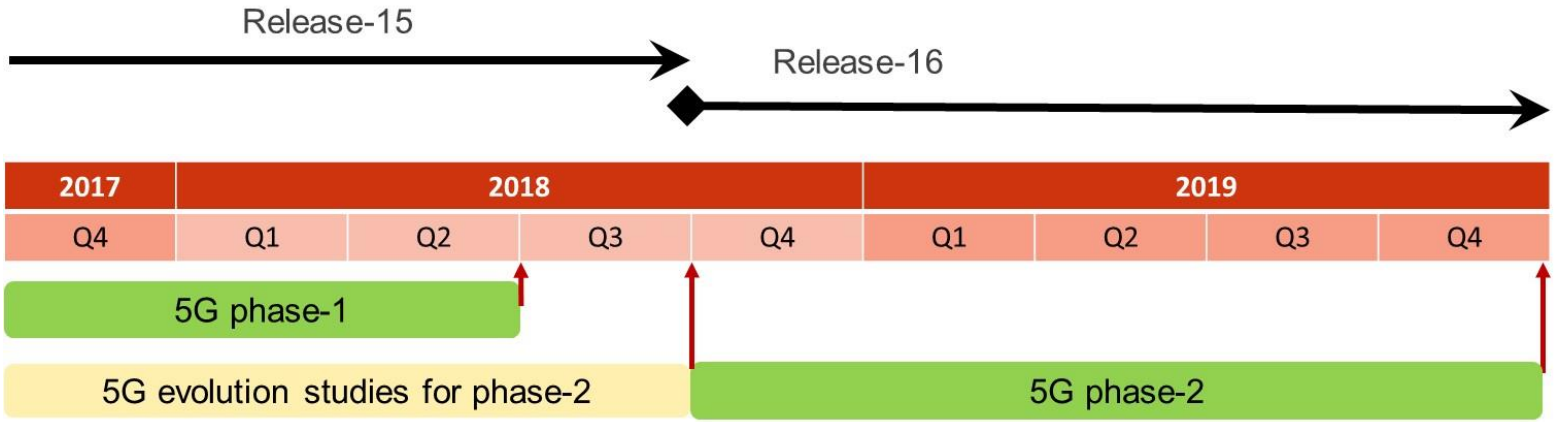
- Operation from **low to very high** bands: 0.4 – 100Ghz
  - Including standalone operation in unlicensed bands
- Set of **different numerologies** for optimal operation in different frequency ranges
- Native **forward compatibility** mechanisms
- **Ultra wide** bandwidth
  - Up to 100MHz in <6GHz
  - Up to 400MHz in >6GHz
- **New channel coding**
  - LDPC for data channel, Polar coding for control channel
- Native support for **Ultra Reliable Low Latency**
- **Flexible and modular** RAN architecture: split fronthaul, split C-U plane
- Native end-to-end support for **Network Slicing**

Latest news…

- 3GPP RAN plenary In late September re-enforced the timeline commitment
- Focus for the “early drop” (December/2017)
  - Focus on LTE-anchored LTE-NR dual connectivity
  - Several functions moved beyond December/2017, e.g.: FDD half duplexing, power control for NR-NR DC, transmit diversity, etc…
- Focus for the full Rel-15 (June/2018): standalone NR with new 5G Core
  - Focus on NR control plane functionality (RRC, etc…)
- Explicit signaling to be developed for “problematic” LTE-NR band combinations
- NR UE categories: no explicit signaling, “just” a marketing concept
- Uplink sharing between LTE and NR
  - UL sharing from the NW perspective to be supported in early drop
  - UL sharing from the UE perspective to be supported in June/2018 release
- ITU submission (IMT2020) – important from the perspective of WRC-19 spectrum debates

Where is 5G – the spectrum expansion

Expansion to high bands



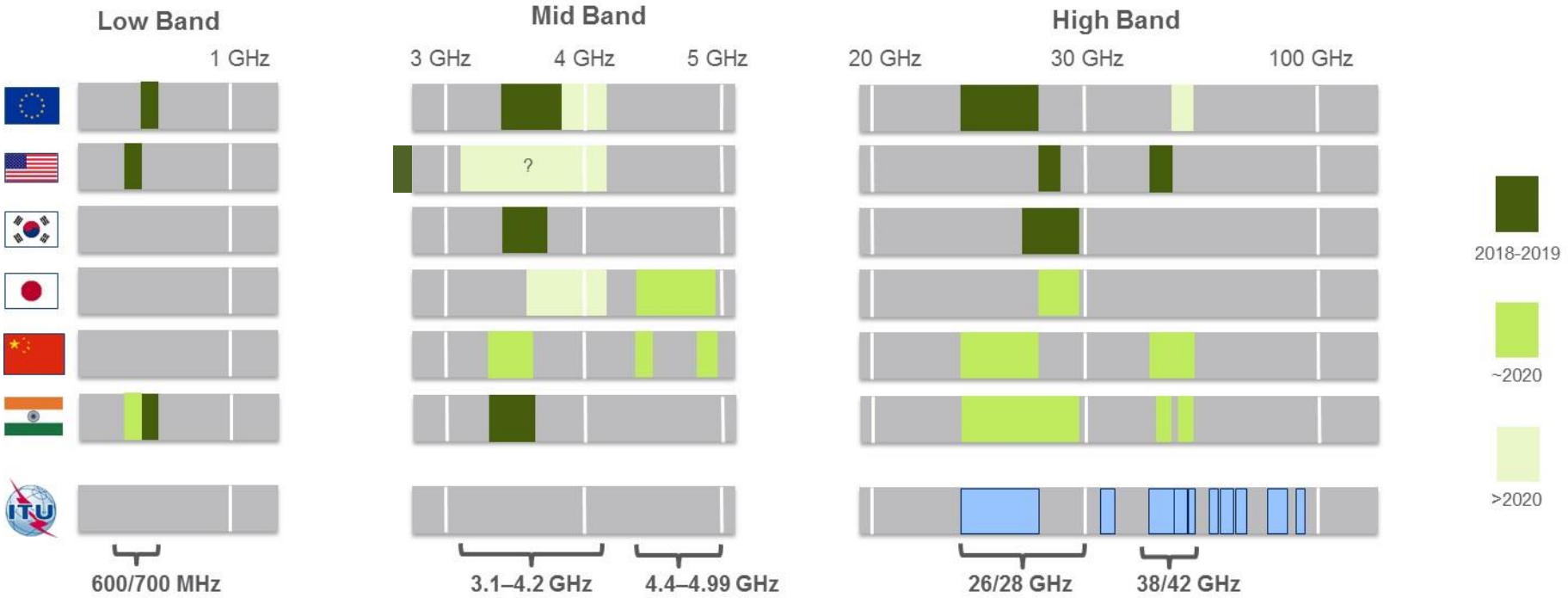
5G phase-1

0.4GHz – ~50 GHz

5G phase-2 onwards

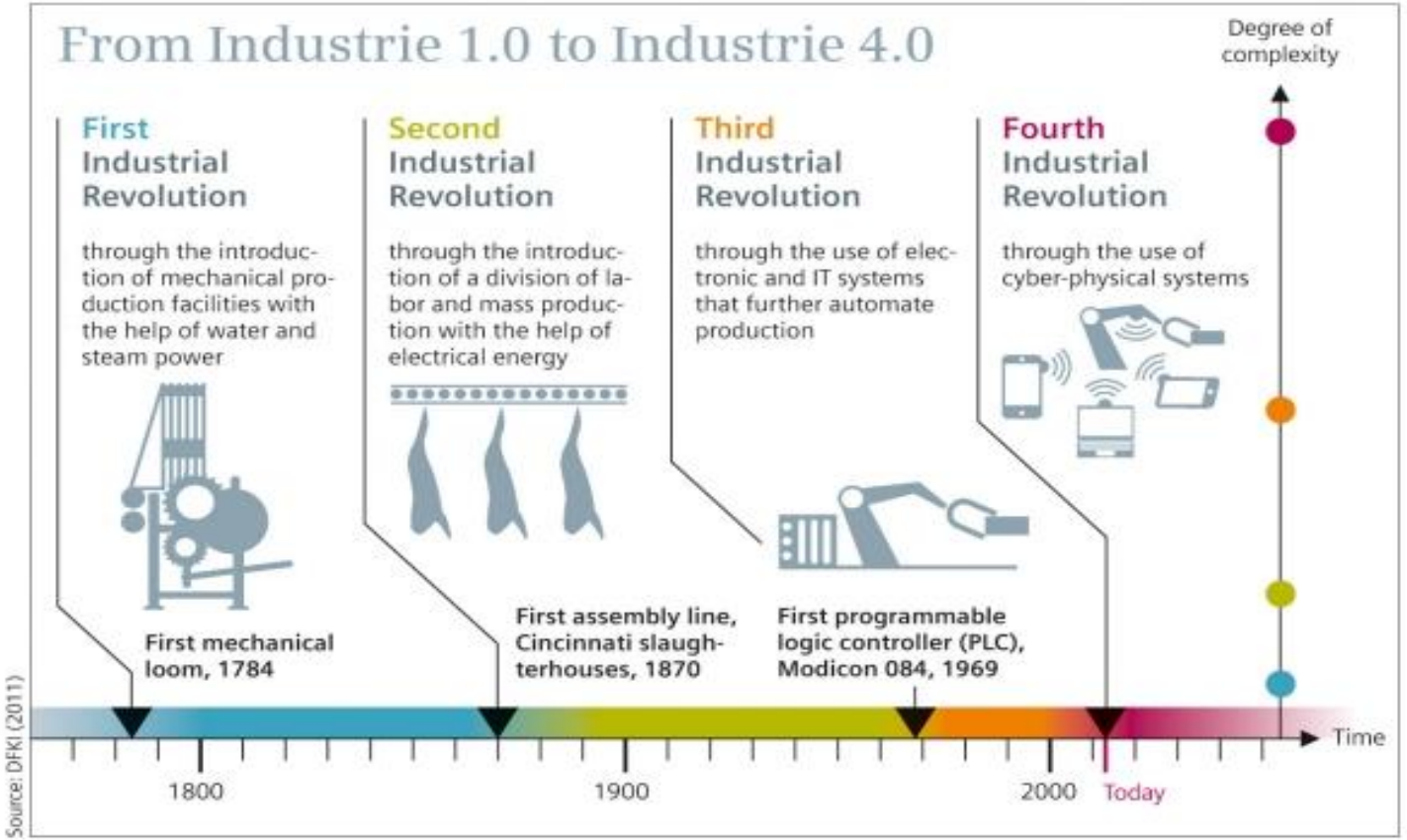
Potentially ~50 GHz – 100 GHz (TBD)

The global landscape

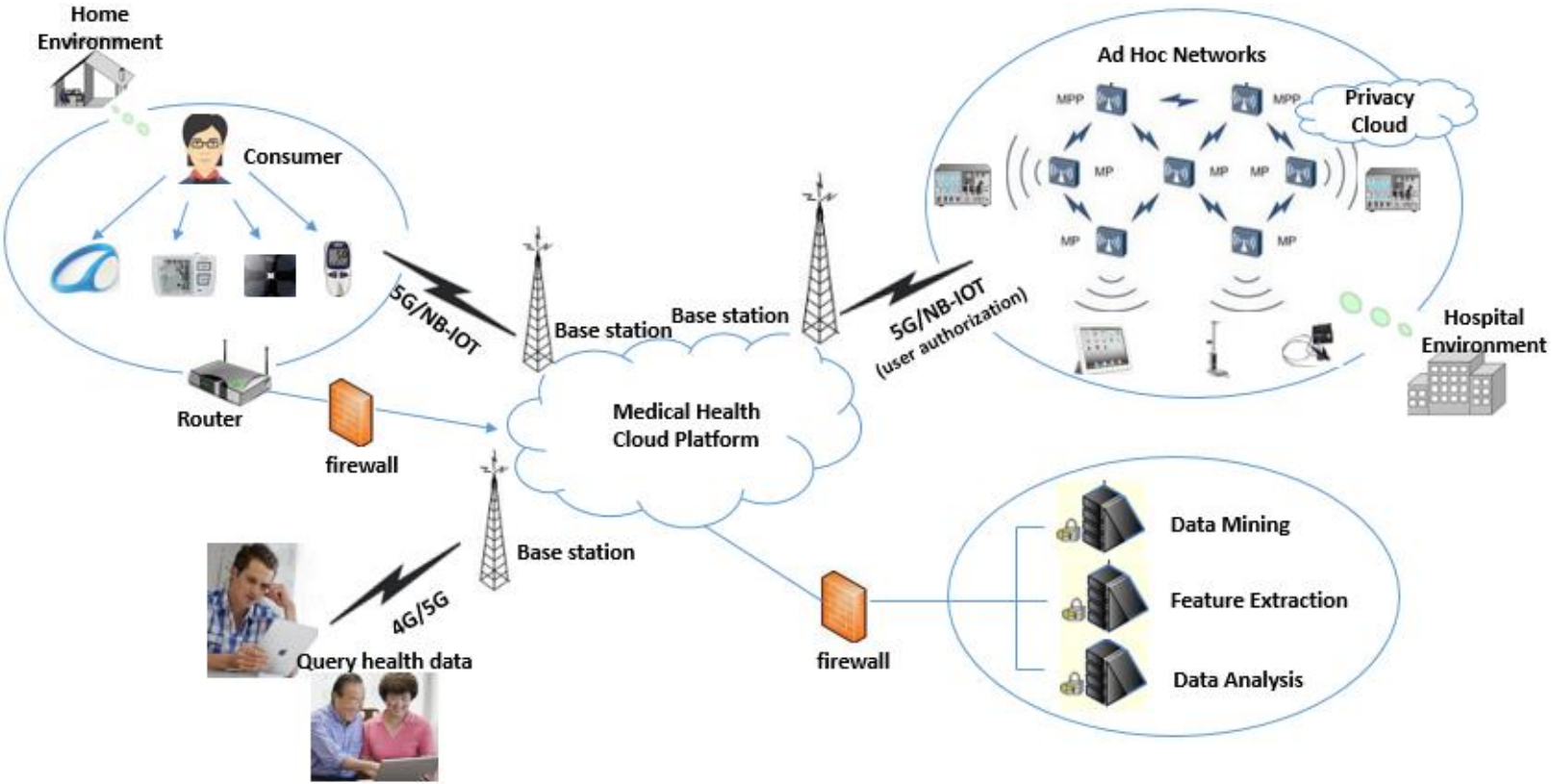


Where will 5G take us?

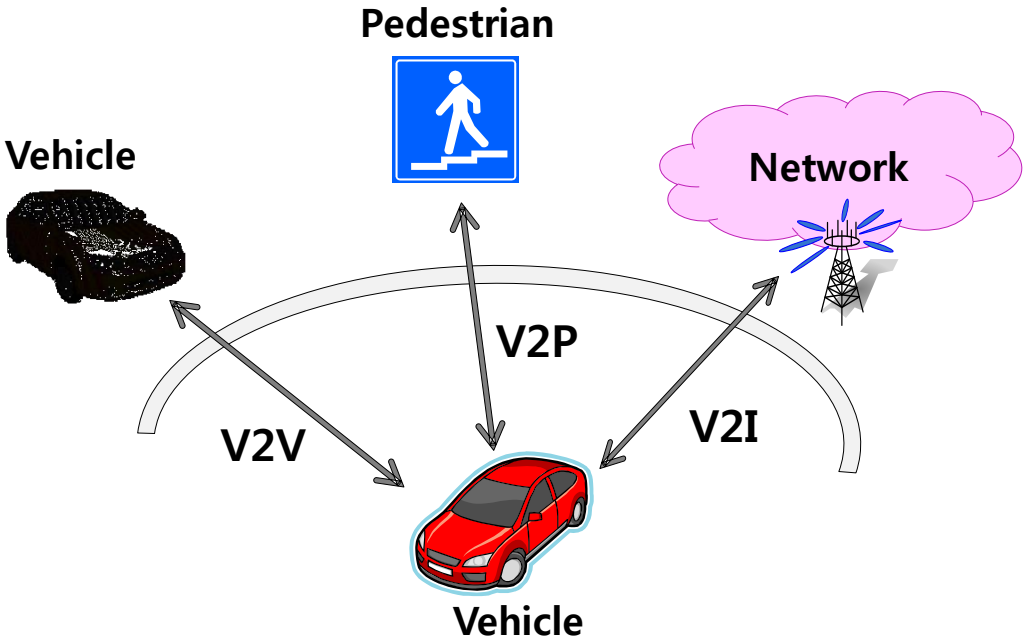
The 4th industrial revolution



eHealth



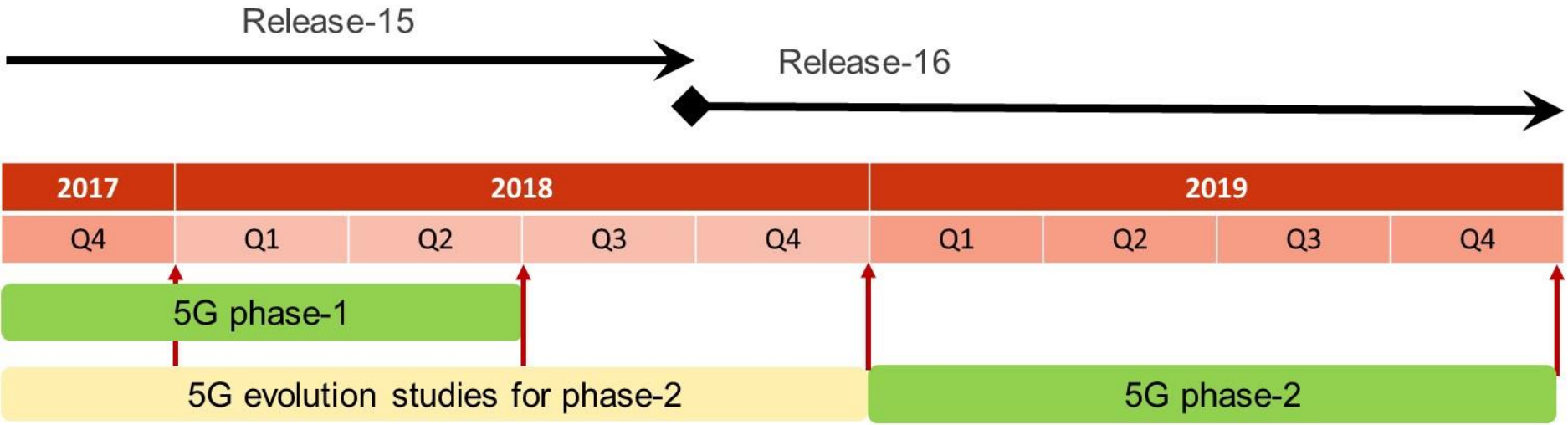
Autonomous driving



Virtual and Augmented Reality

Outlook beyond Release 15

- Some technology studies already ongoing
  - Operation in unlicensed bands, Non-orthogonal Access, Non-terrestrial access, etc…
- Next wave of technology study approvals expected in June/2018
  - eV2X, MIMO enhancements, Positioning, High-speed UE support, >52.6GHz support,…



Key challenges

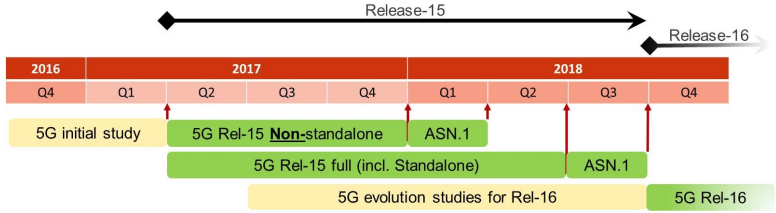
Key challenges

- Number of spectrum bands and band combinations growing exponentially
  - Global fragmentation more substantial than ever
- Interoperation and co-existence of LTE and NR
  - Challenges in RF design
  - Challenges in evolution path
- Balancing demands from wireless carriers and vertical industry players
  - Realizing the full 5G vision goes way beyond current carrier footprint
- Managing accelerated innovation vs deployment realities

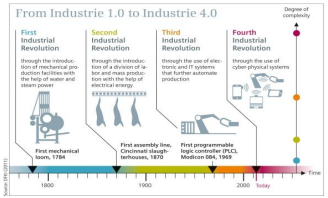
Summary

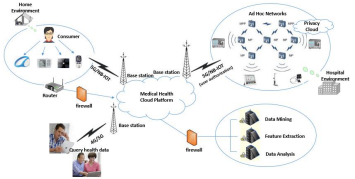
Summary

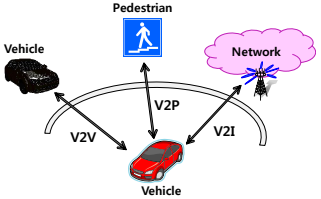
- Accelerated timeline – full commitment from the industry



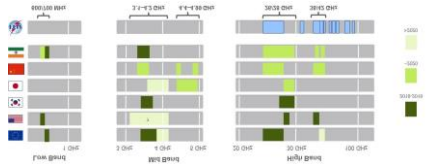
- The realization of the full 5G vision will take several Releases over the next decade
  - Success of the full vision needs wide-scale buy-in from vertical industries







- Spectrum will continue to be an (even more) critical resource



Thank you!

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