



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



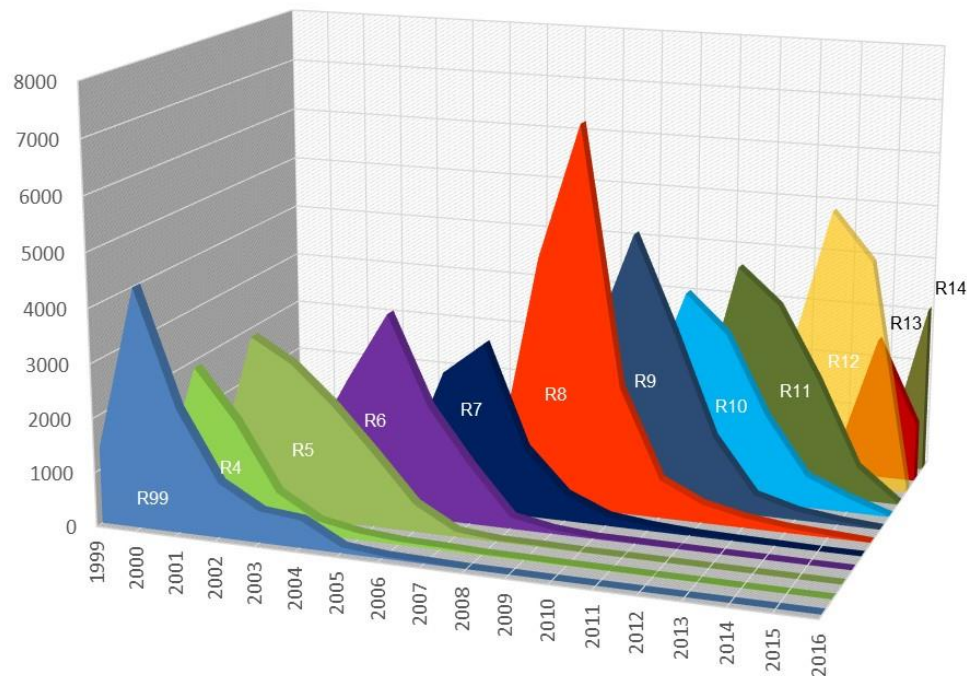
 3GPP will expand the LTE platform to improve its efficiency to meet the mobile broadband demand



 3GPP has an aggressive timeline for the standardization of **5G NR** with the goal to address the expanded connectivity needs of the future



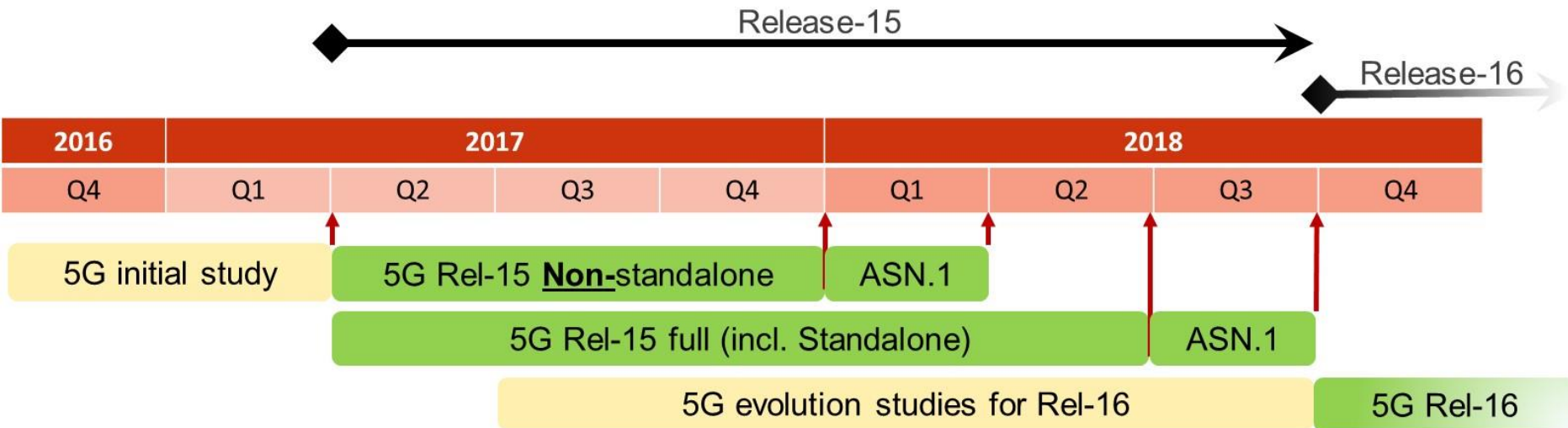
- 514 Companies from 45 Countries
- 50,000 delegate days per year
- 40,000 meeting documents per year
- 1,200 specifications per Release
- 10,000 change requests (CRs) per year
- New Release every ~18 months





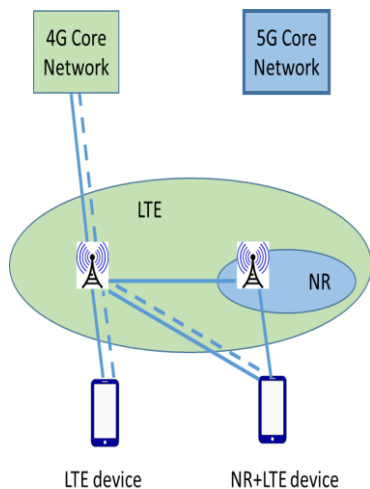
What is 5G

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



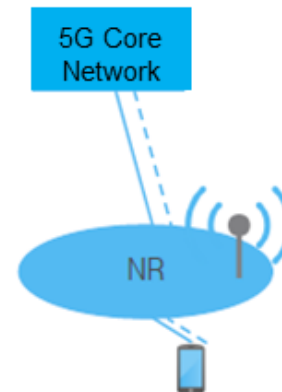
Non-standalone NR

- 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**

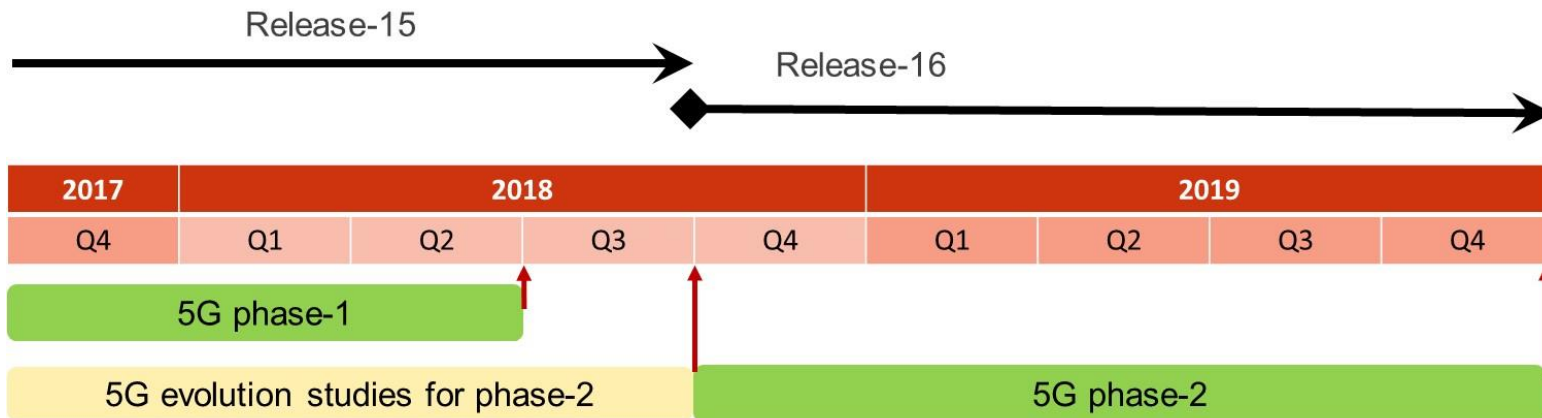
Latest news...

- 📶 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



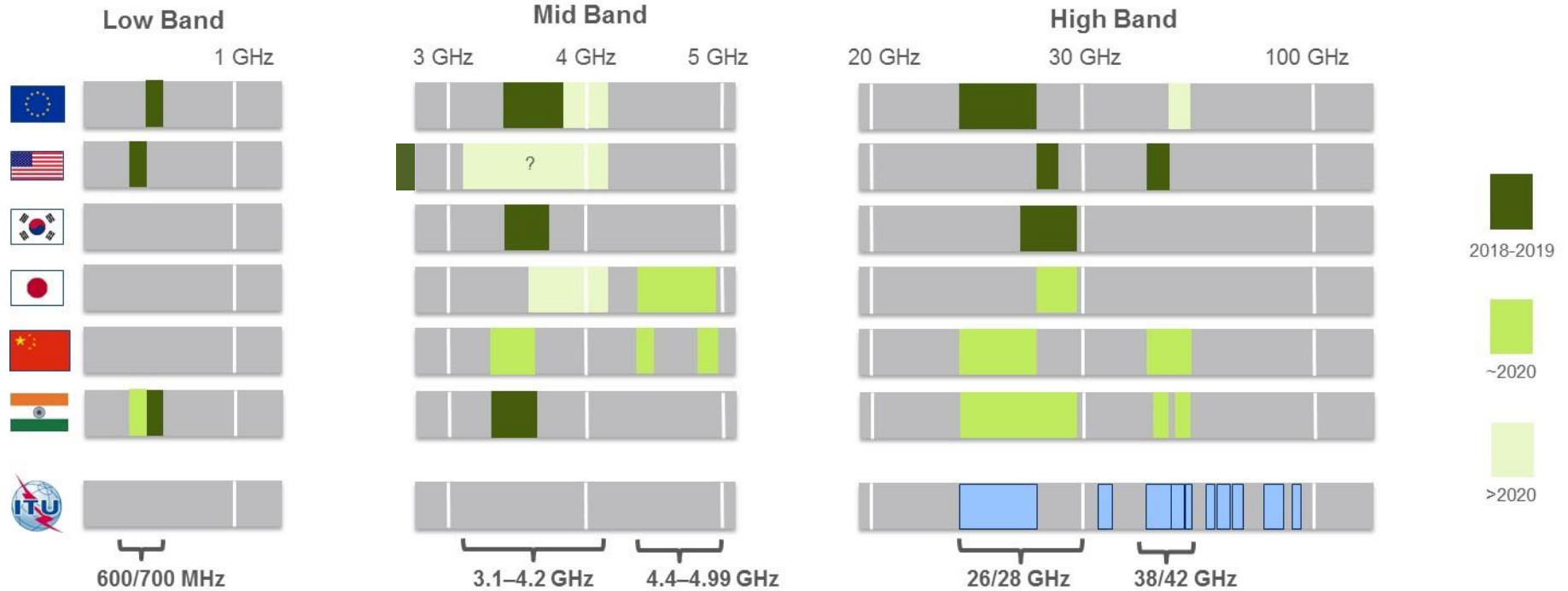
5G phase-1

0.4GHz – ~50 GHz

5G phase-2 onwards

Potentially ~50 GHz –
100 GHz (TBD)

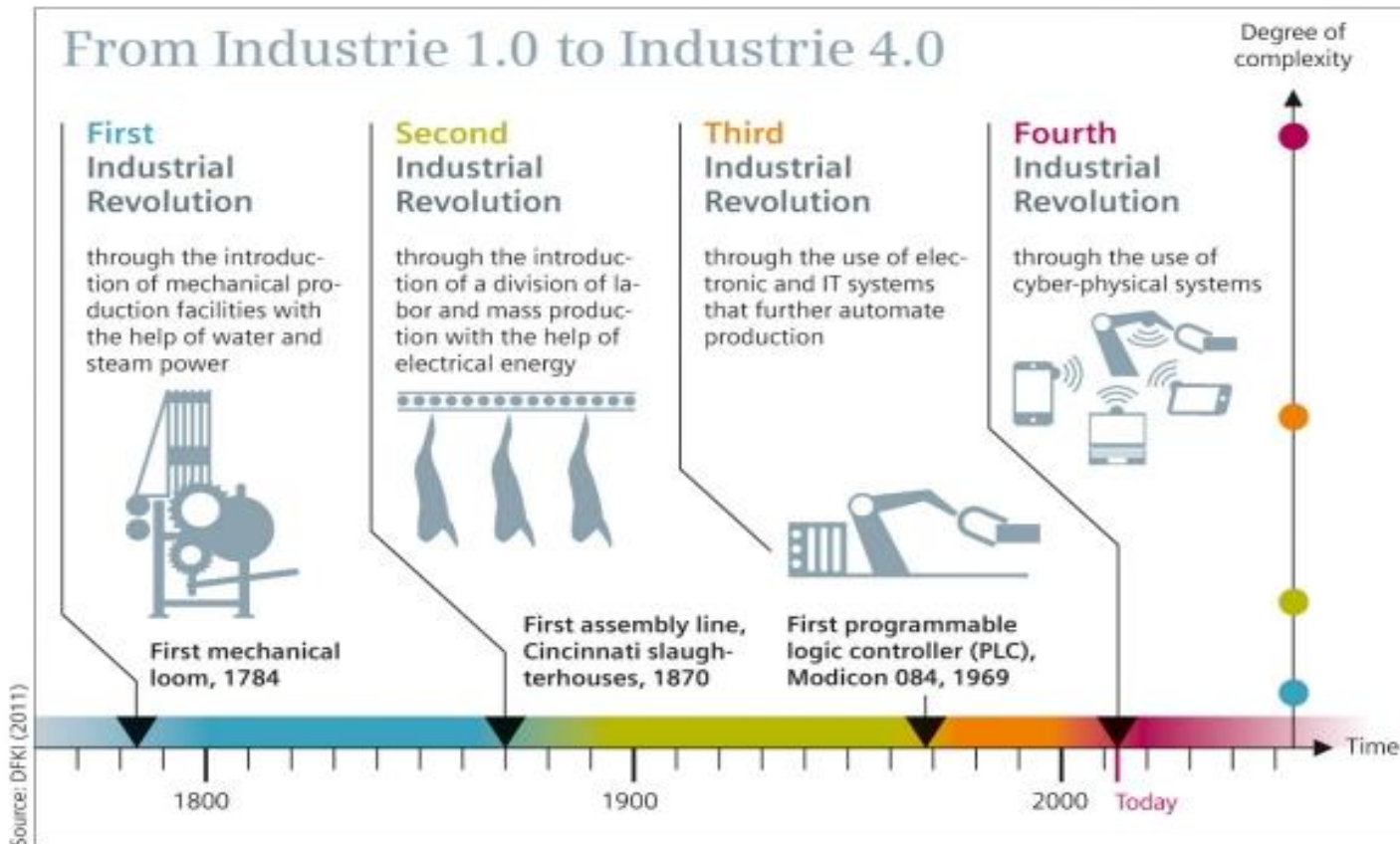
The global landscape

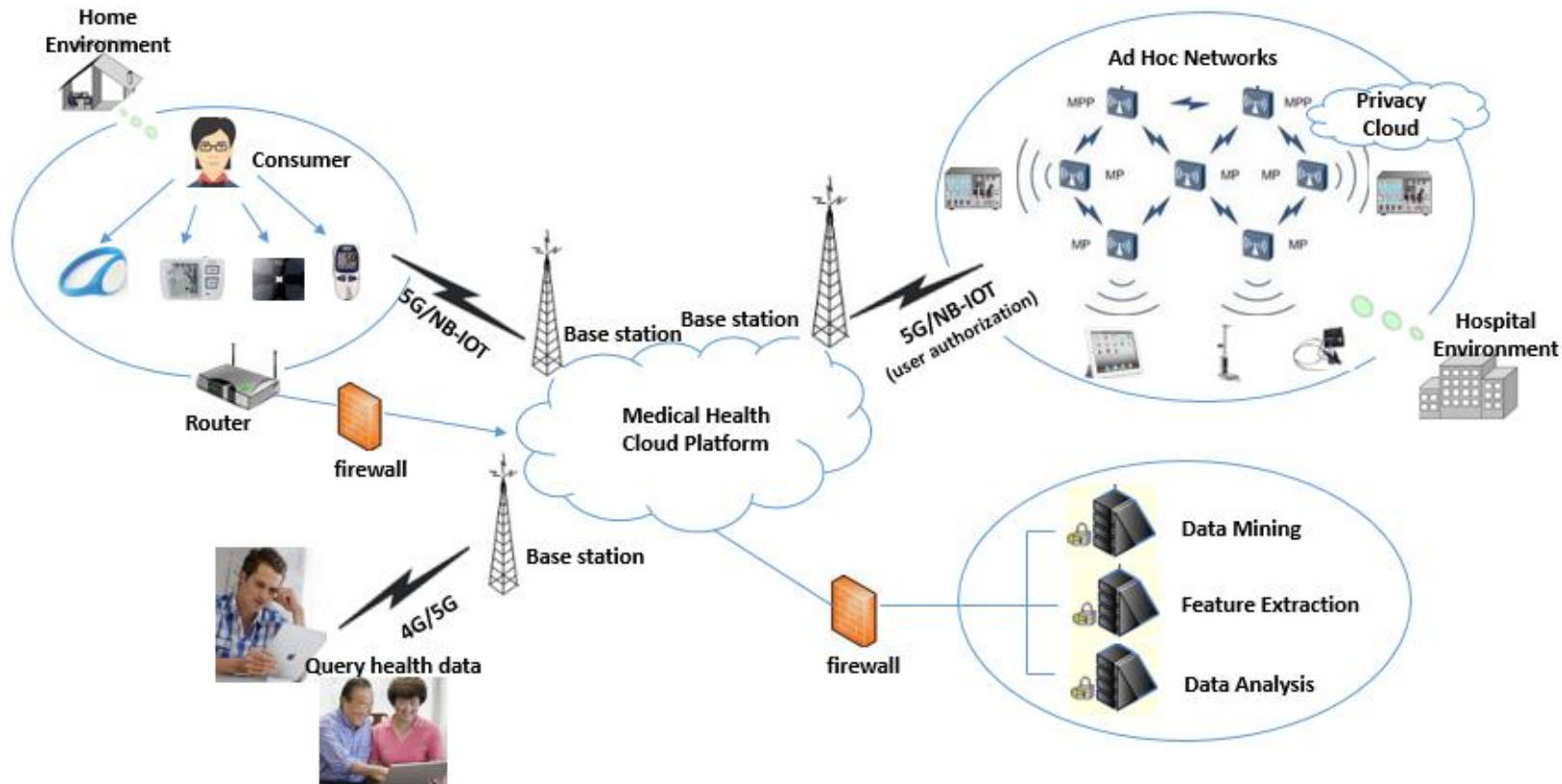




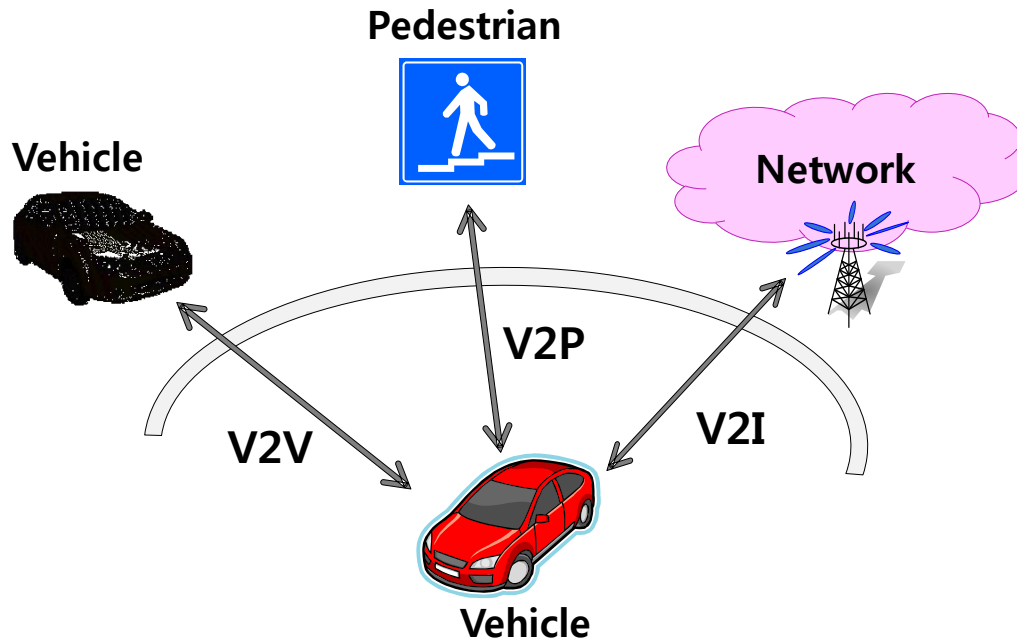
Where will 5G take us?

The 4th industrial revolution





Autonomous driving

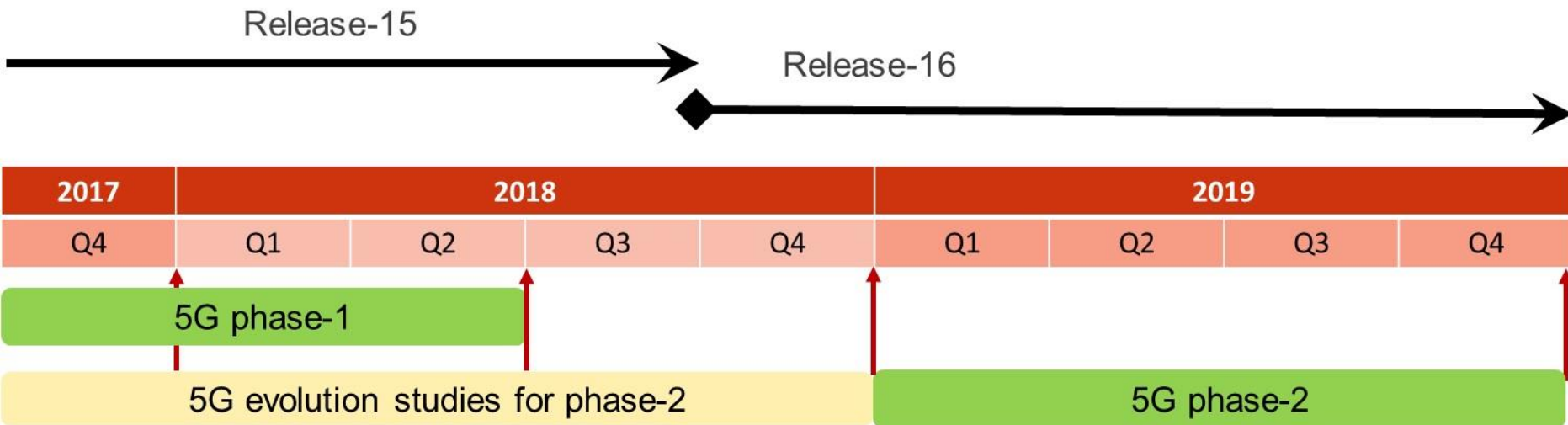


Virtual and Augmented Reality



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

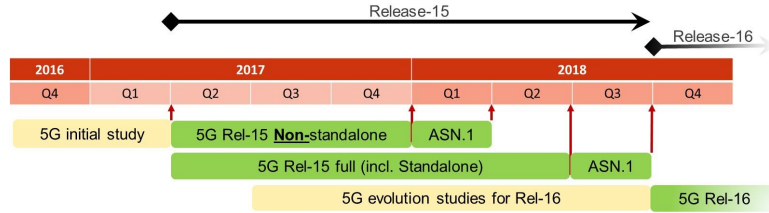
- 📶 Balancing demands from wireless carriers and vertical industry players
 - Realizing the full 5G vision goes way beyond current carrier footprint

- 📶 Managing accelerated innovation vs deployment realities



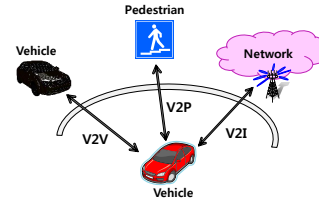
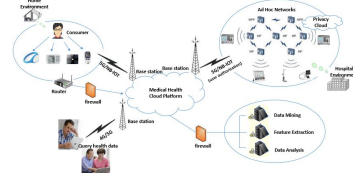
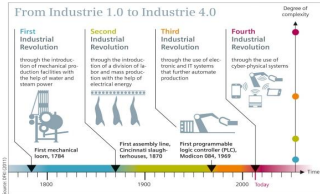
Summary

Accelerated timeline – full commitment from the industry

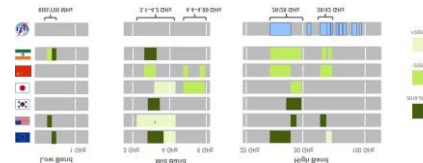


The realization of the full 5G vision will take several Releases over the next decade

- 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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