



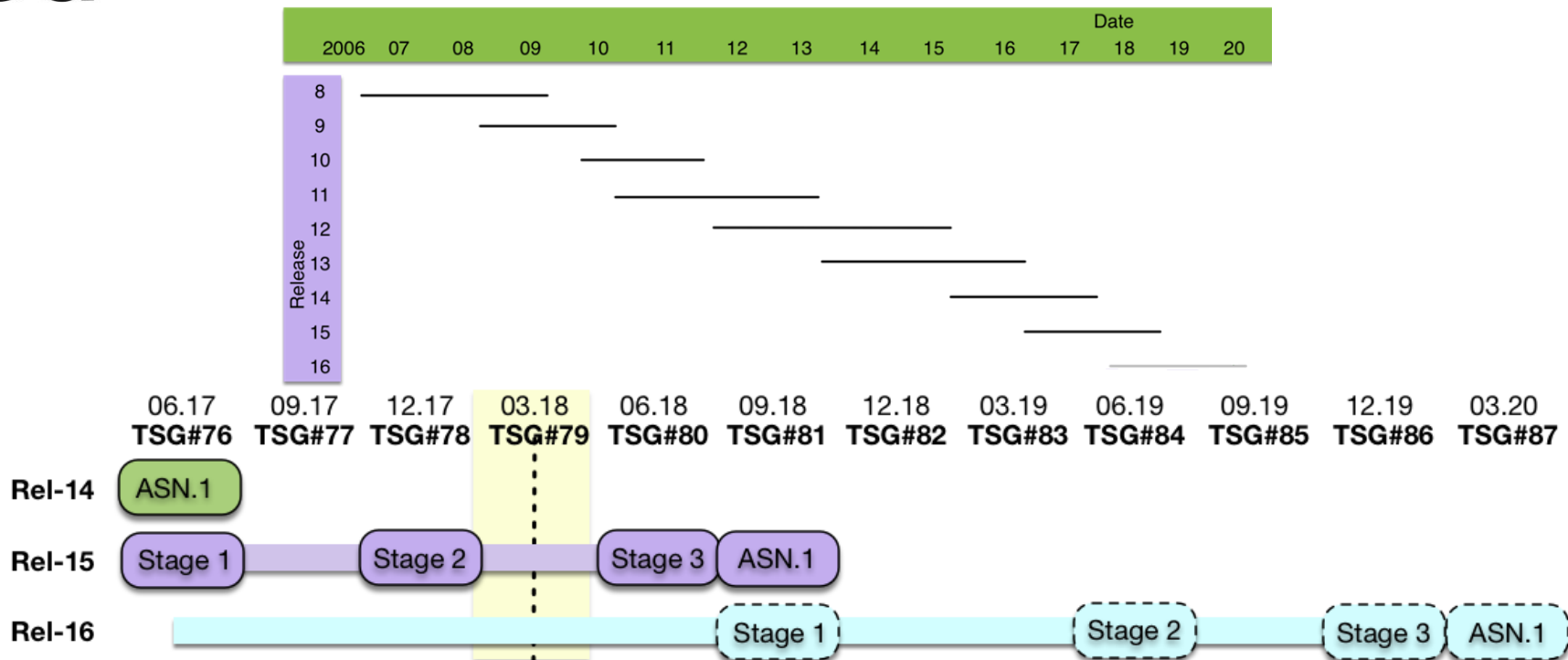
NR: 3GPP's answer to 5G radio requirements

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*using with permissions slides from
Balazs Bertenyi, Chairman of 3GPP RAN & Erik Guttman, Chairman of 3GPP SA*



3GPP Status Overview




5G Phase 1: Rel-15, 5G Phase 2: Rel-16, IMT-2020 Submission: 12.19



What is 5G NR ?

-  Operation from **low to very high** bands: 0.4 – 100Ghz
 - Including standalone operation in unlicensed bands

-  **Ultra wide** bandwidth
 - Up to 100MHz in <6GHz
 - Up to 400MHz in >6GHz



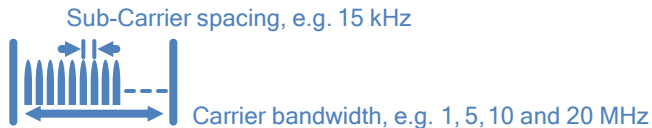
What is 5G NR ?

- 📶 Set of **different numerologies** for optimal operation in different frequency ranges
- 📶 Native **forward compatibility** mechanisms
- 📶 **New channel coding**
 - LDPC for data channel, Polar coding for control channel



Scalable 5G NR OFDM numerology

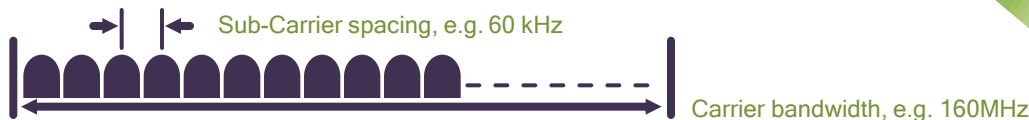
Outdoor macro coverage
e.g., FDD 700 MHz



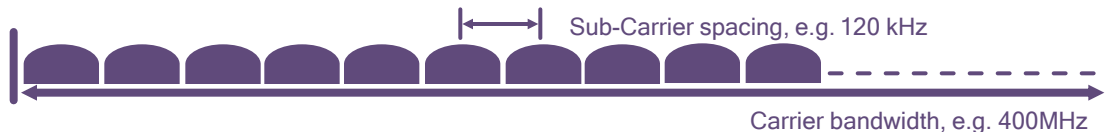
Outdoor macro and small cell
e.g., TDD 3-5 GHz



Indoor wideband
e.g., unlicensed 6 GHz



mmWave
e.g., TDD 28 GHz



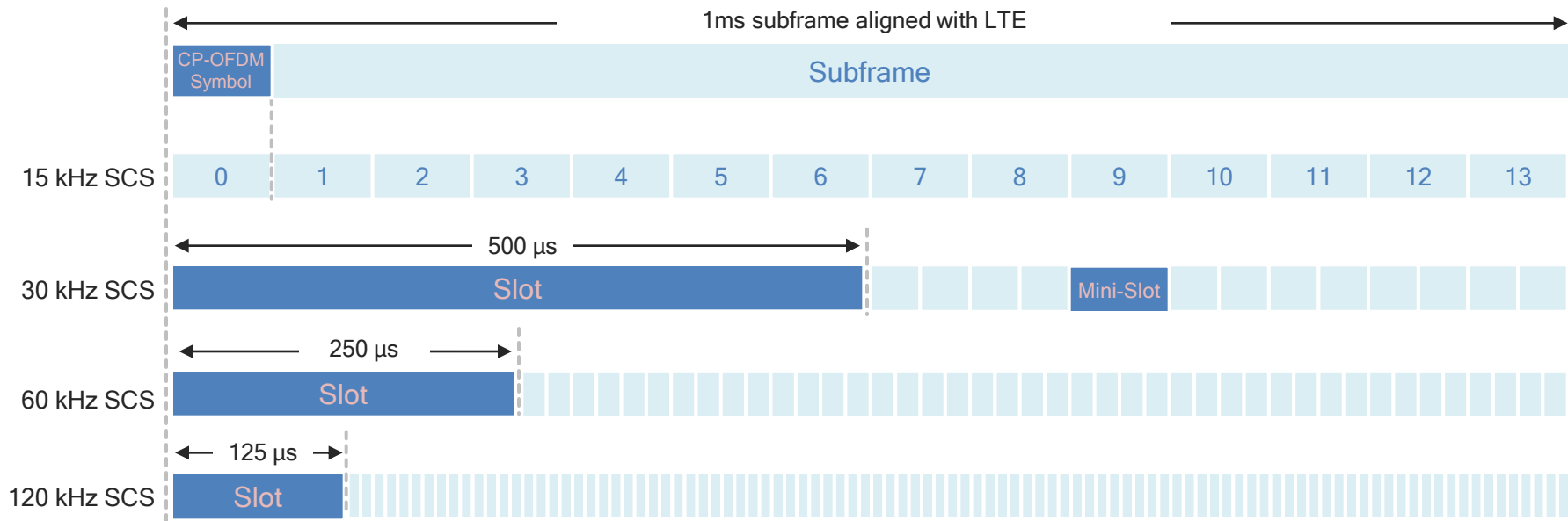
2ⁿ scaling of Sub-Carrier Spacing (SCS)

Efficiently address 5G diverse spectrum, deployments and services

Scaling reduces FFT processing complexity for wider bandwidths with reusable hardware



Scalable 5G NR slot duration for diverse latency/QoS



14 OFDM symbols per slot with mini-slot (2, 4, or 7 symbols) for shorter transmissions

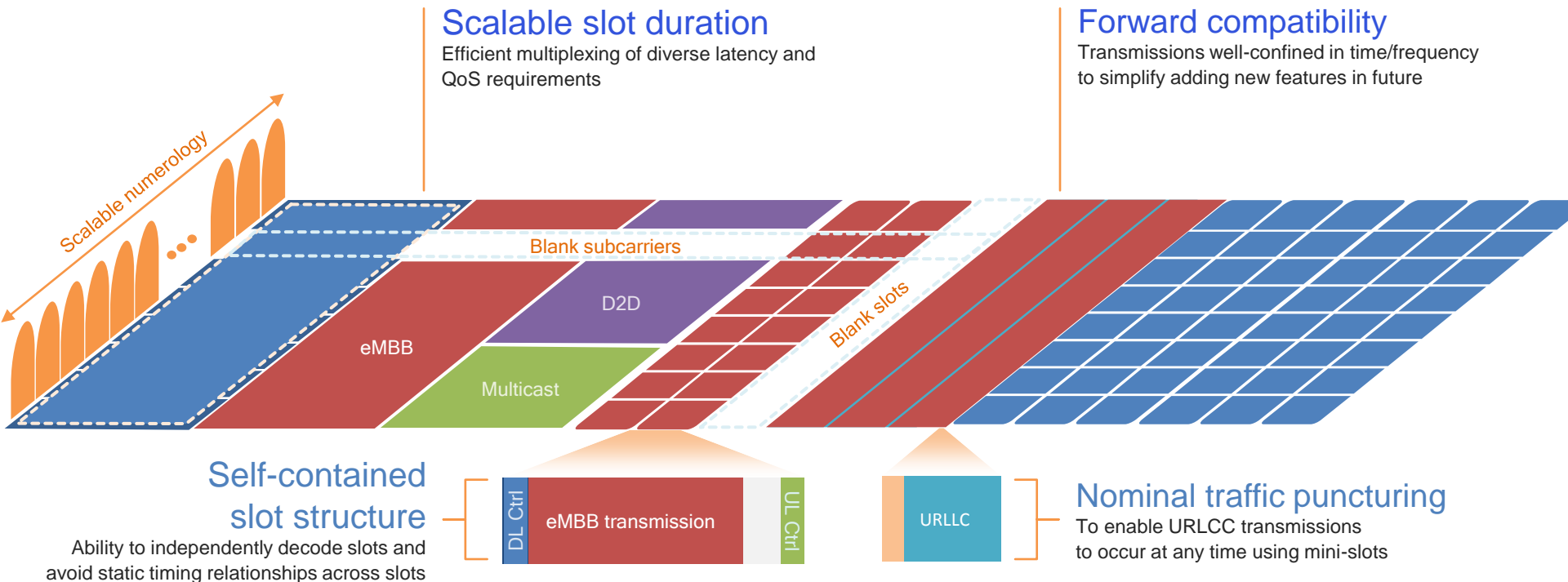
Supports slot aggregation for data-heavy transmissions

Efficient multiplexing of long and short transmissions, symbols across numerologies align at boundaries






Flexible slot-base 5G NR framework

Efficiently multiplex envisioned and future 5G services on the same frequency





What is 5G NR ?

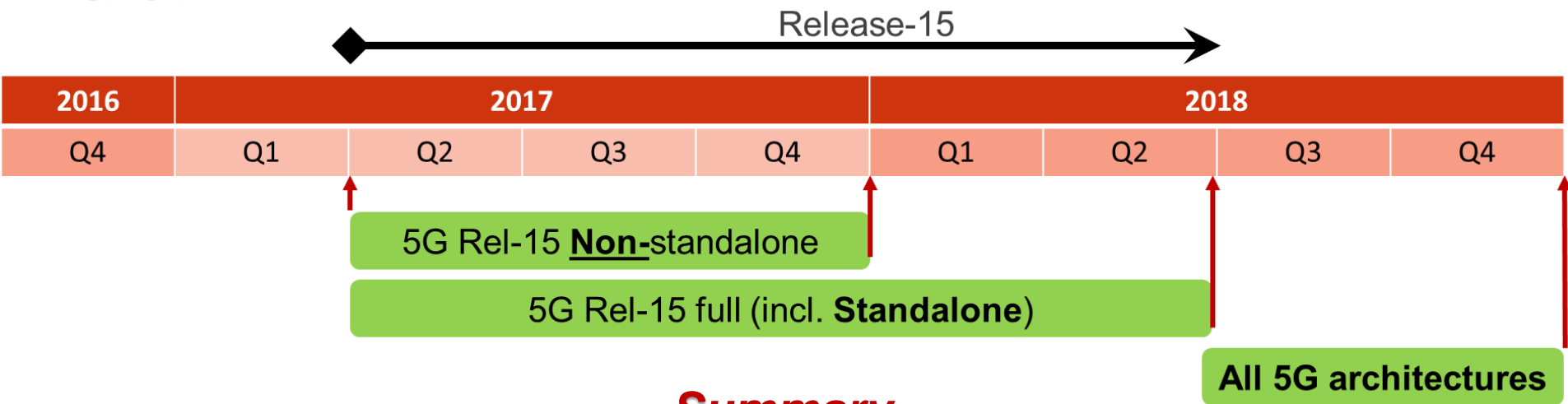
-  Native support for **Low Latency and Ultra Reliability**
-  **Flexible and modular** RAN architecture: split fronthaul, split control- and user-plane
-  Native end-to-end support for **Network Slicing**



Delivering the 5G vision through multiple phases



5G phase-1 in Rel-15



Summary

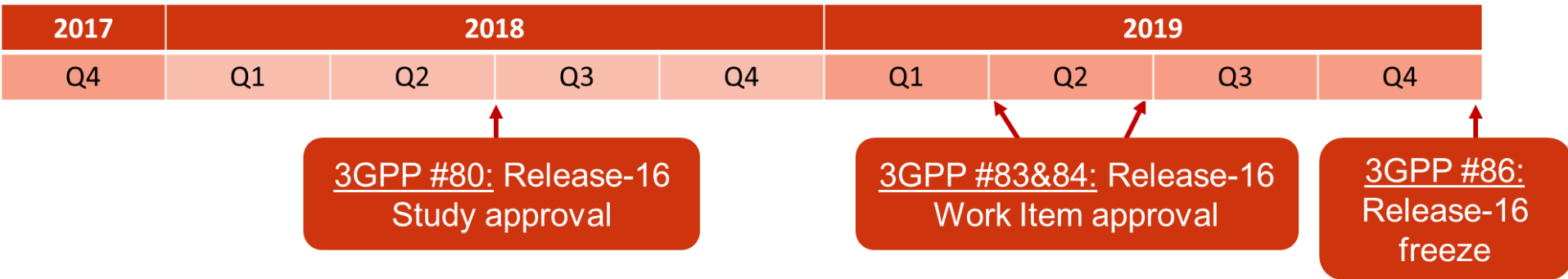
- Licensed bands between 600MHz – 43 GHz
- LTE-Anchored 5G (NSA), and Standalone (SA) 5G
- Basic URLLC support
- Massive MIMO
- Flexible RAN architecture
- Fulfills IMT2020 criteria



5G phase-2 in Rel-16

Release-15

Release-16



... towards the full 5G vision:

- V2X support – autonomous driving
- Enhanced MIMO
- Support for Unlicensed bands
- Factory automation
- Support of higher bands (>52.6 GHz)
- ...



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