5G Standards:
3GPP Release 15, 16, and beyond

Sasha Sirotkin – Vice Chairman of 3GPP RAN3

Agenda

- 3GPP - home of cellular standards
- 5G vision - 5G NR
- Release 15 - the advent of 5G
- Release 16 - towards the full 5G vision
- IMT-2020 submission
- Release 17 - outlook

3GPP - home of cellular standards
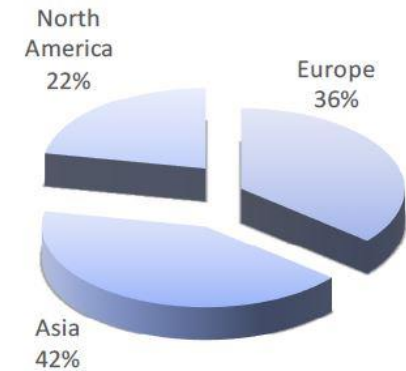
3GPP – a truly global project

- 3GPP Member companies participate via one or more of the Organizational Partners (OPs). Each OP is a recognized SDO from their country or region
    - ARIB (Japan)
    - ATIS (USA)
    - CCSA (China)
    - ETSI (Europe)
    - TTA (Korea)
    - TTC (Japan)
    - TSDSI (India)

- Africa, Latin America, Russian Federation and Australasia have no SDO present, so companies choose one-of-the-above

- ~400 Companies from 39 Countries
- 50.000 delegate days per year
- 40.000 documents per year
- 1.200 specs per Release
- New Release every ~18 months

North America 22%

Europe 36%

Asia 42%

3GPP structure

Project Co-ordination Group (PCG)		
TSG RAN **Radio Access Network**	**TSG SA** **Service & Systems Aspects**	**TSG CT** **Core Network & Terminals**
RAN WG1 **Radio Layer 1 spec**	**SA WG1** **Services**	**CT WG1** **MM/CC/SM (lu)**
RAN WG2 **Radio Layer 2 spec** **Radio Layer 3 RR spec**	**SA WG2** **Architecture**	**CT WG3** **Interworking with external networks**
RAN WG3 **lub spec, lur spec, lu spec** **UTRAN O&M requirements**	**SA WG3** **Security**	**CT WG4** **MAP/GTP/BCH/SS**
RAN WG4 **Radio Performance** **Protocol aspects**	**SA WG4** **Codec**	**CT WG6** **Smart Card Application Aspects**
RAN WG5 **Mobile Terminal** **Conformance Testing**	**SA WG5** **Telecom Management**	
RAN WG6 **Legacy RAN radio and protocol**	**SA WG6** **Mission-critical applications**	

5G vision → 5G NR

What is 5G NR ?

- Operation from **low to very high** bands: 0.4 – 100Ghz

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

- Set of **different numerologies** for optimal operation in different frequency ranges

- **Massive MIMO** for optimal performance
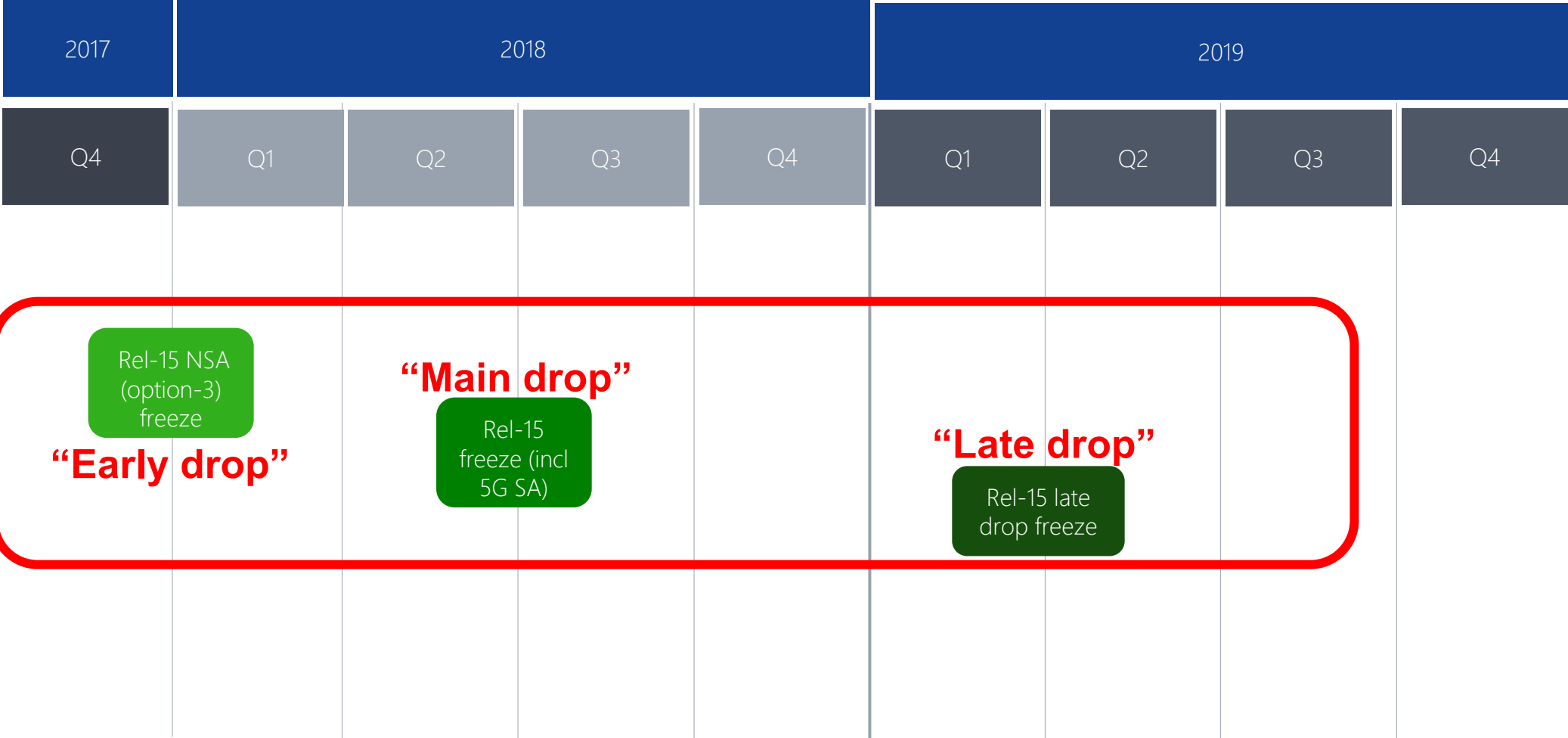
What is 5G NR ?

- Native **forward compatibility** mechanisms

- **Advanced channel coding**
  - LDPC for data channel, Polar coding for control channel

- 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**

- Designed for **Virtualization**

Release 15 – the advent of 5G

Release 15 timeline

2017	2018				2019			
Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4

Rel-15 NSA (option-3) freeze

"Early drop"

"Main drop"

Rel-15 freeze (incl 5G SA)

"Late drop"

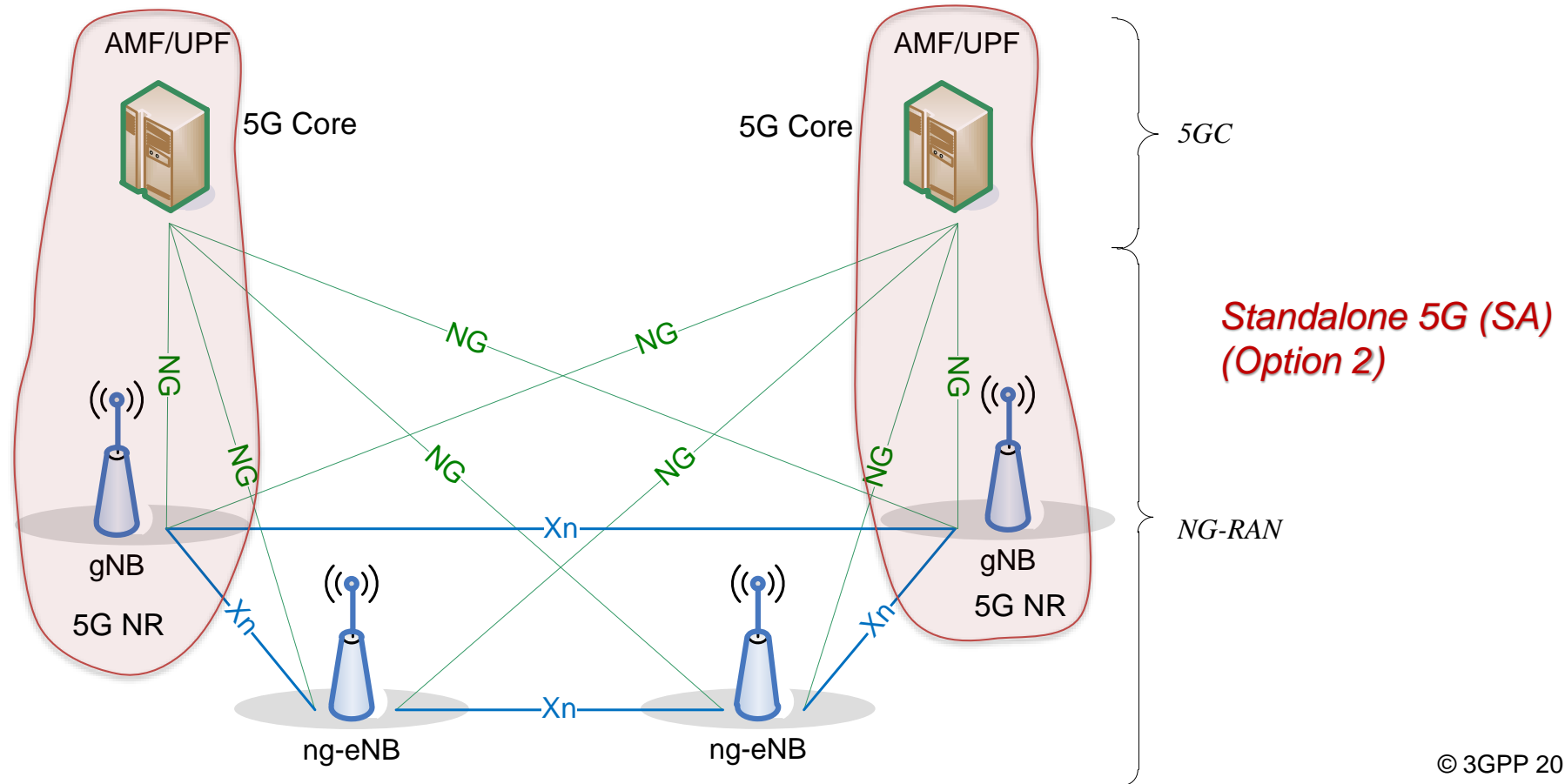Rel-15 late drop freeze

'Early drop' in Rel-15

- "Early drop" introduced for Rel-15 to accelerate initial availability of specifications for the very first deployments

- This was a critical move to re-unite the ecosystem after several initial proprietary standards development initiatives (Korea, US)
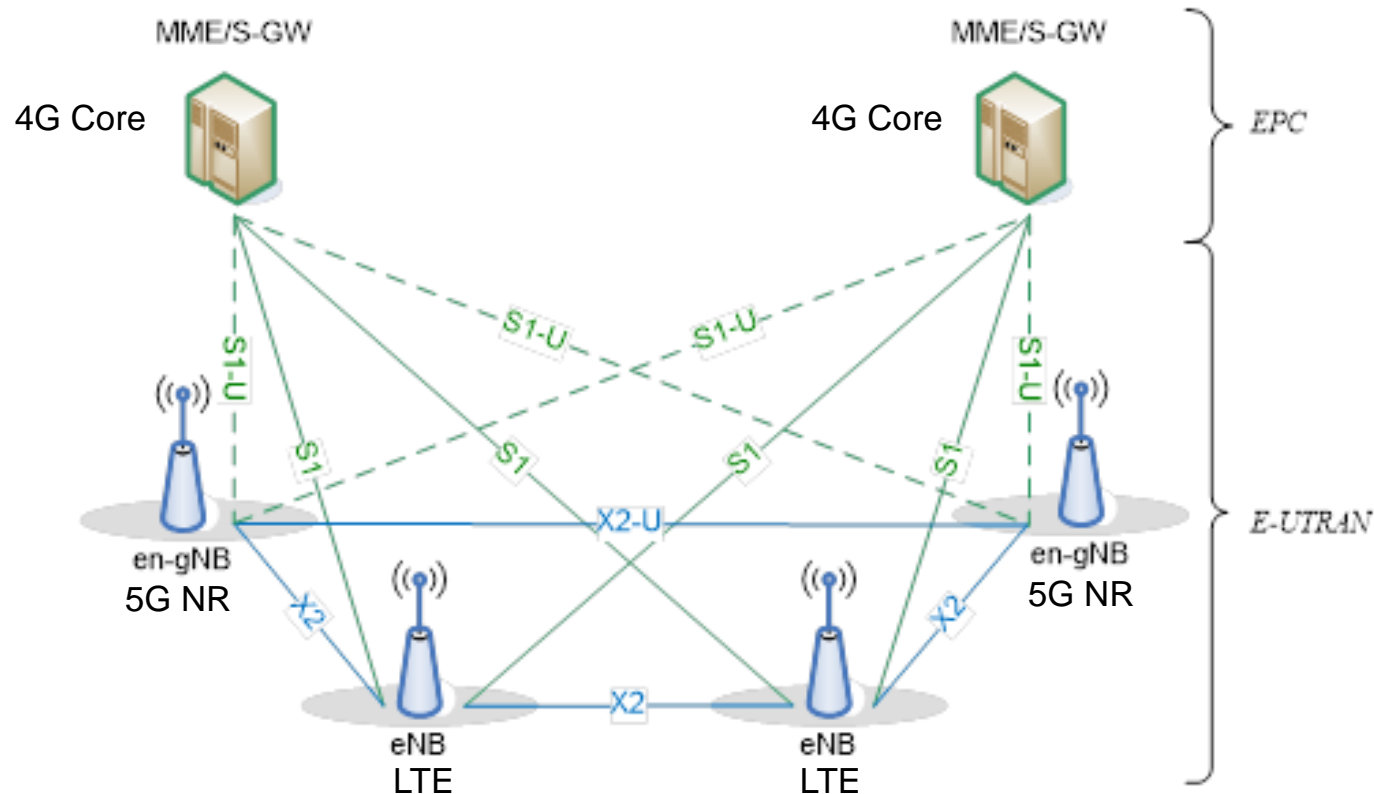
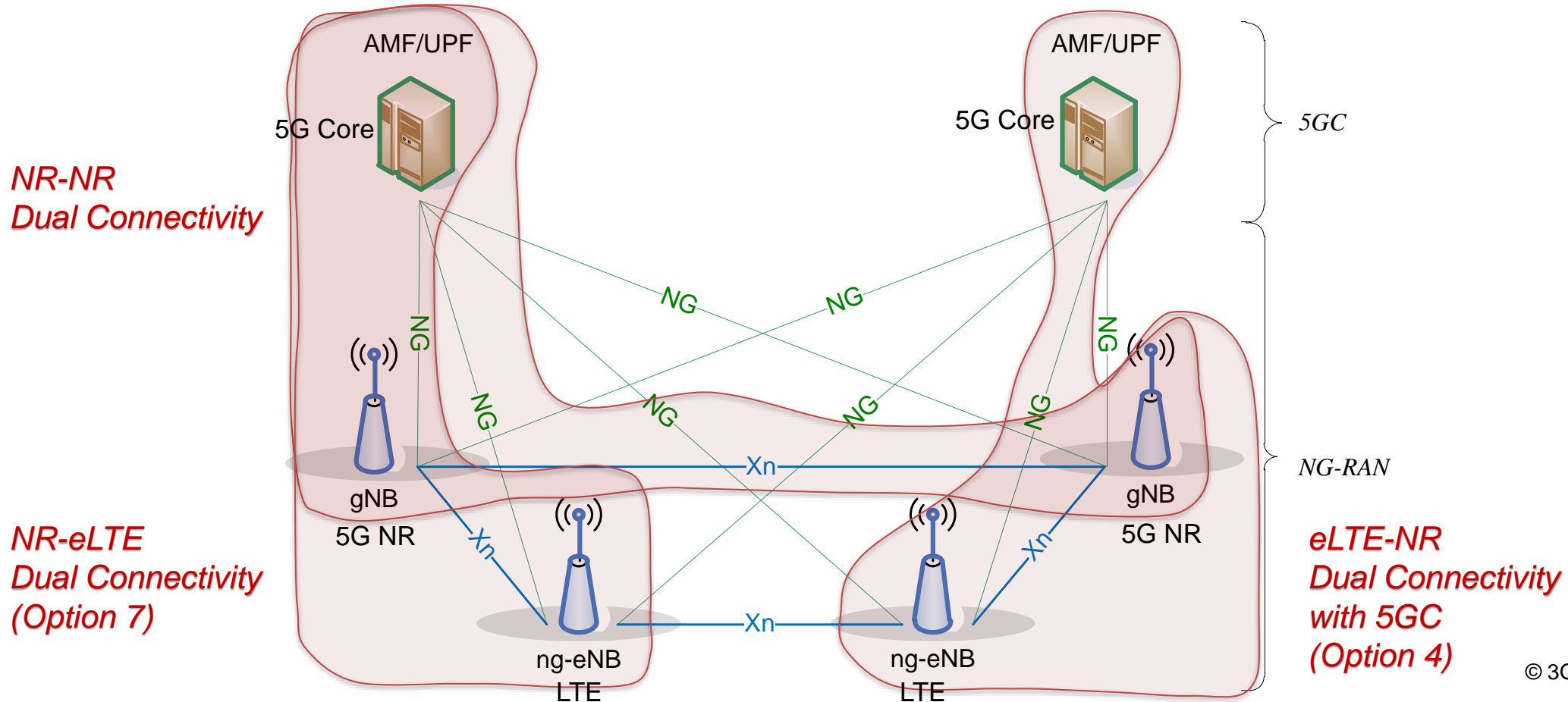*Non-Standalone 5G (NSA)*
(Option 3 family)

11

'Main drop' in Rel-15

- "Main drop" in Rel-15 introduces standalone 5G
- No dependency on LTE deployments
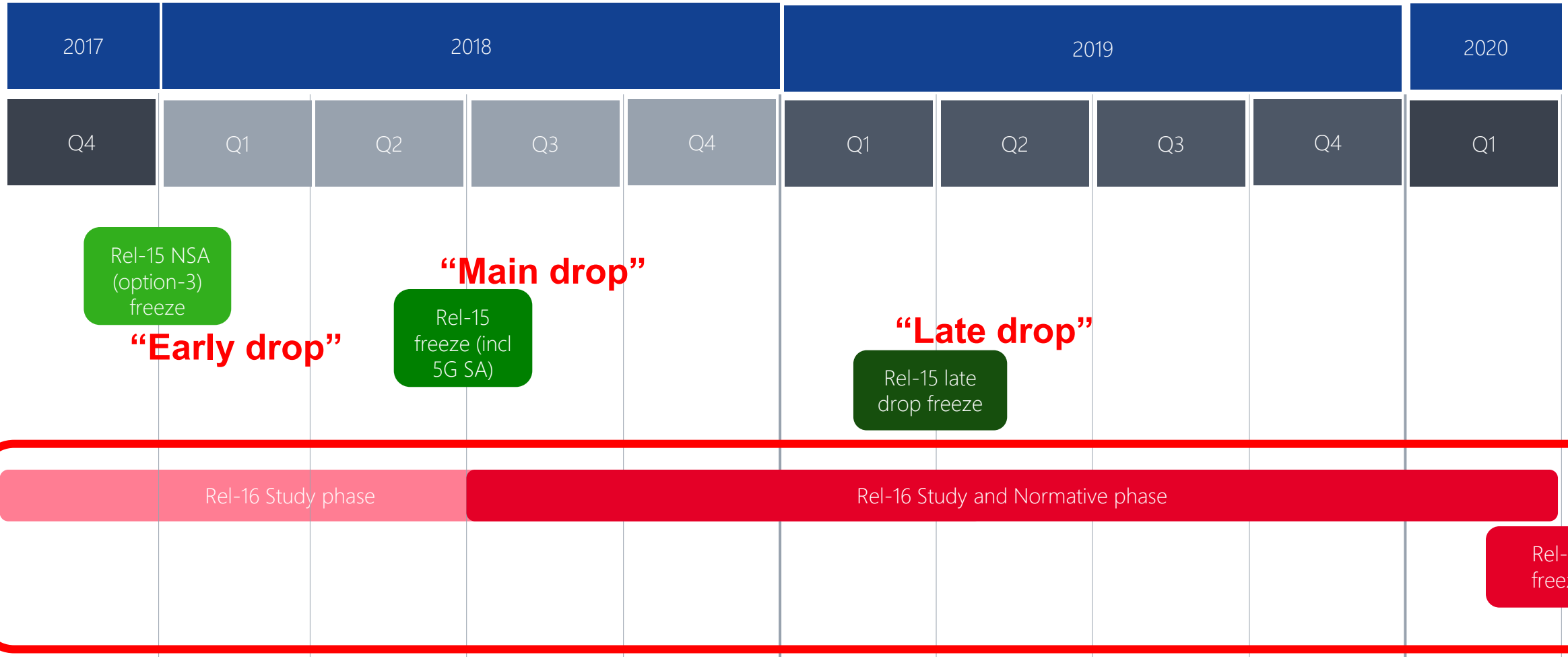- Main initial proponent: China

'Late drop' in Rel-15

- "Late drop" introduced for Rel-15 that follows Rel-15 completion by 6 months
  - The late Rel-15 ASN.1 drop is to be strictly backwards compatible
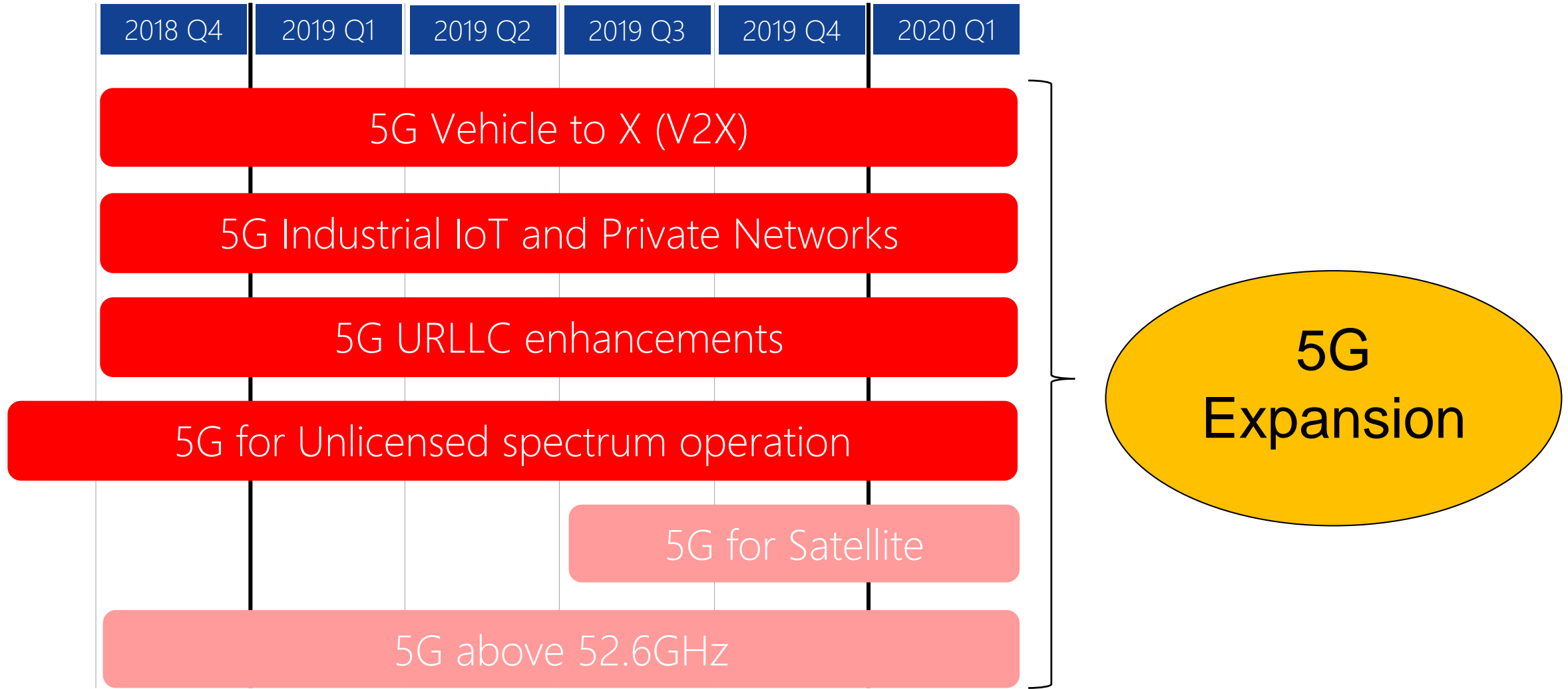- The late drop is to exclusively contain outstanding NR architecture options

NR-NR Dual Connectivity

NR-eLTE Dual Connectivity (Option 7)

eLTE-NR Dual Connectivity with 5GC (Option 4)

AMF/UPF

5G Core

AMF/UPF

5G Core

5GC

NG-RAN

NG

gNB
5G NR

gNB
5G NR

ng-eNB
LTE

ng-eNB
LTE

Xn

13

Release 16 -
towards the full 5G vision

Timeline

2017	2018				2019				2020
Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1

Rel-15 NSA (option-3) freeze

"Early drop"

"Main drop"

Rel-15 freeze (incl 5G SA)

"Late drop"

Rel-15 late drop freeze

Rel-16 Study phase

Rel-16 Study and Normative phase

Rel-16 freeze

Release 16 – 5G Expansion

2018 Q4	2019 Q1	2019 Q2	2019 Q3	2019 Q4	2020 Q1

5G Vehicle to X (V2X)

5G Industrial IoT and Private Networks

5G URLLC enhancements

5G for Unlicensed spectrum operation

5G for Satellite

5G above 52.6GHz

5G Expansion

5G V2X

Evolution to 5G,
while maintaining backward compatibility
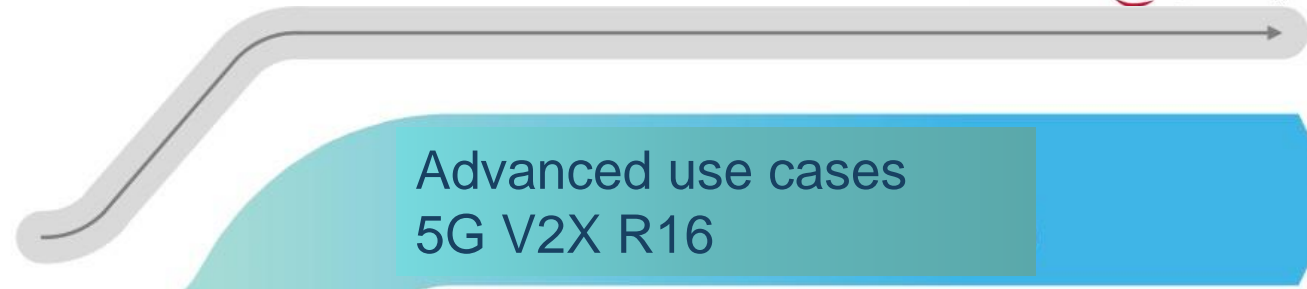
Advanced use cases
5G V2X R16

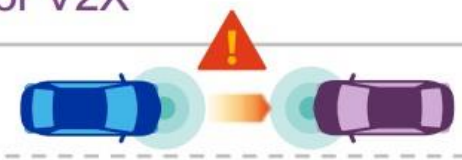**Enhanced safety**
C-V2X R14/15

Higher throughput

Higher reliability

Wideband ranging
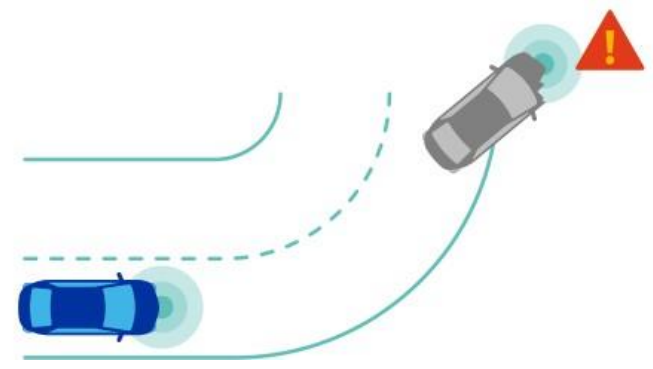and positioning

Lower latency

Basic safety
802.11p or C-V2X R14
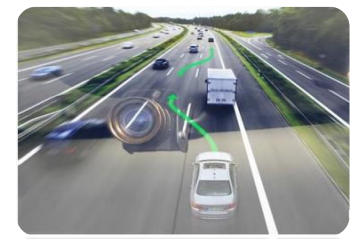
Enhanced range and reliability

Established foundation
for V2X

Basic Safety services
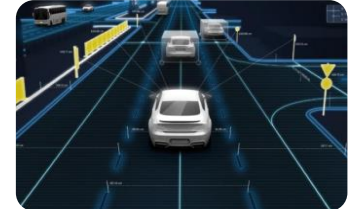incl. warnings and signal
phase information

Vehicle
Platooning

Cooperative Manoeuver,
Sensor sharing

Remote Driving

Advanced Driving
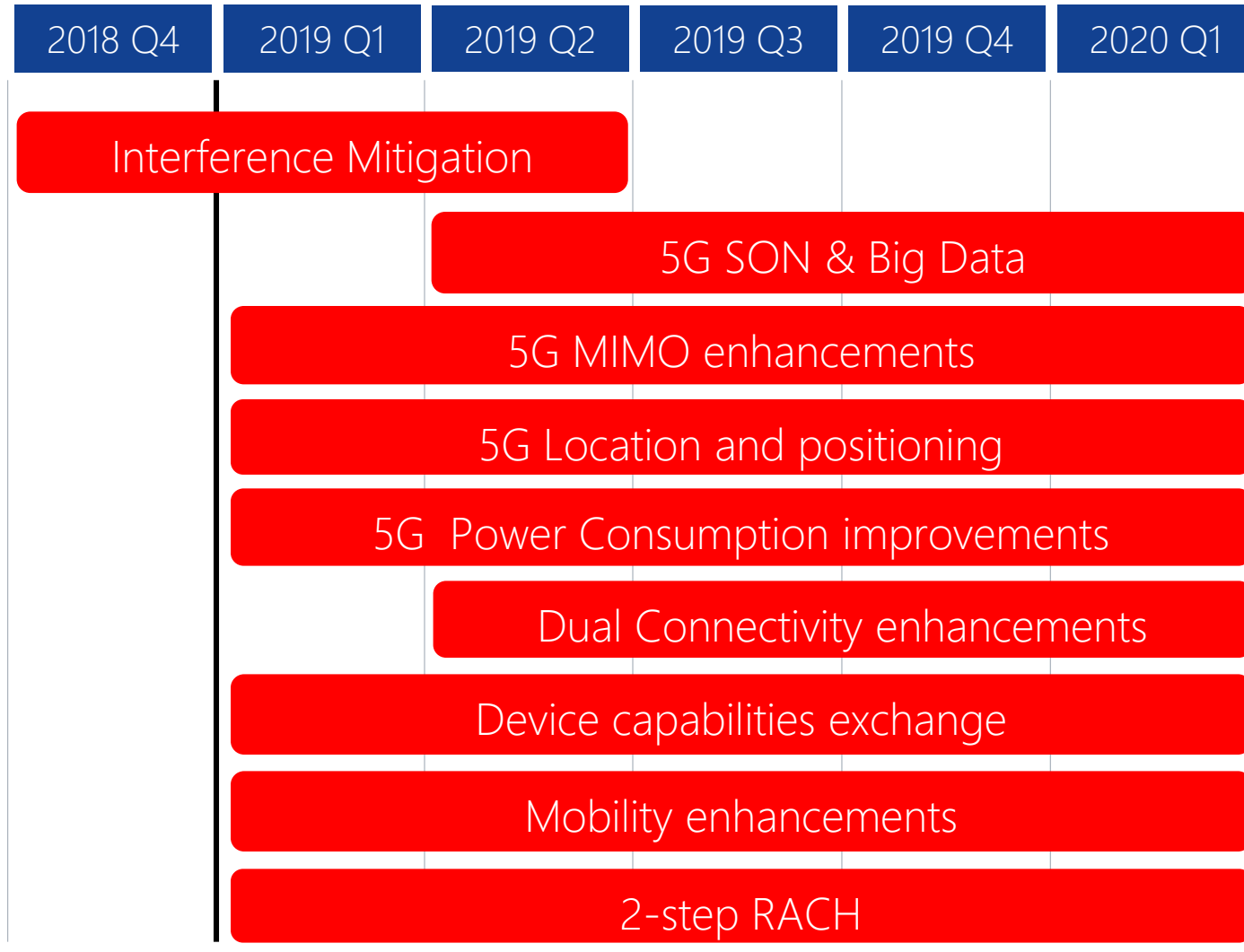
Industrial IoT and URLLC

- Focus on both commercial and industry use
    - AR/VR, Factory automation, Transport Industry (incl Automotive), Electrical Power Distribution
- Time Sensitive Networking (TSN)
    - Accurate reference timing, wireless Ethernet, etc...
- Reliability and latency enhancements
- Intra-UE prioritization and multiplexing

5G NR in unlicensed bands

- 3GPP work on unlicensed operation will be focused on NR
  - No new functions on LTE-LAA
- NR-U specifications kept separate, not part of the ITU submission
- Focus is on bands below 7GHz
- Addresses both LAA and **Standalone** operation
- Co-existence with LTE-LAA and other incumbent technologies

Release 16 – 5G Efficiency

2018 Q4	2019 Q1	2019 Q2	2019 Q3	2019 Q4	2020 Q1

Interference Mitigation

5G SON & Big Data

5G MIMO enhancements

5G Location and positioning

5G Power Consumption improvements

Dual Connectivity enhancements

Device capabilities exchange

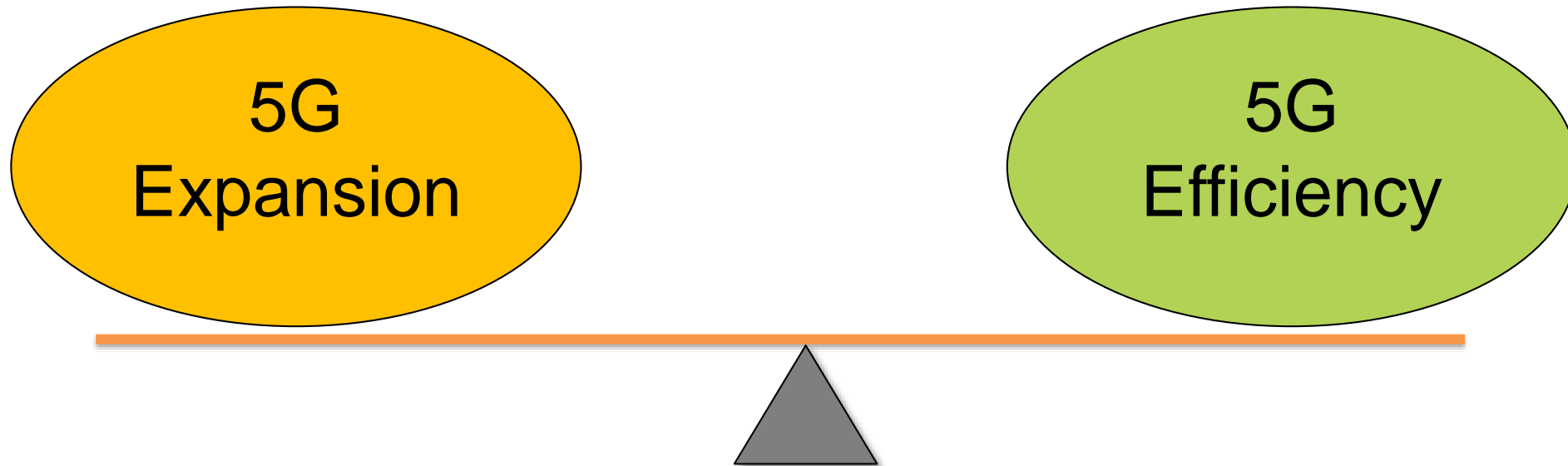Mobility enhancements

2-step RACH

5G Efficiency

Positioning in 5G

- Going beyond basic regulatory requirements (E911)
- Based on identified accuracy, latency, capacity and coverage requirements
  - Both indoor and outdoor
  - Both low (FR1) and high (FR2) frequency bands
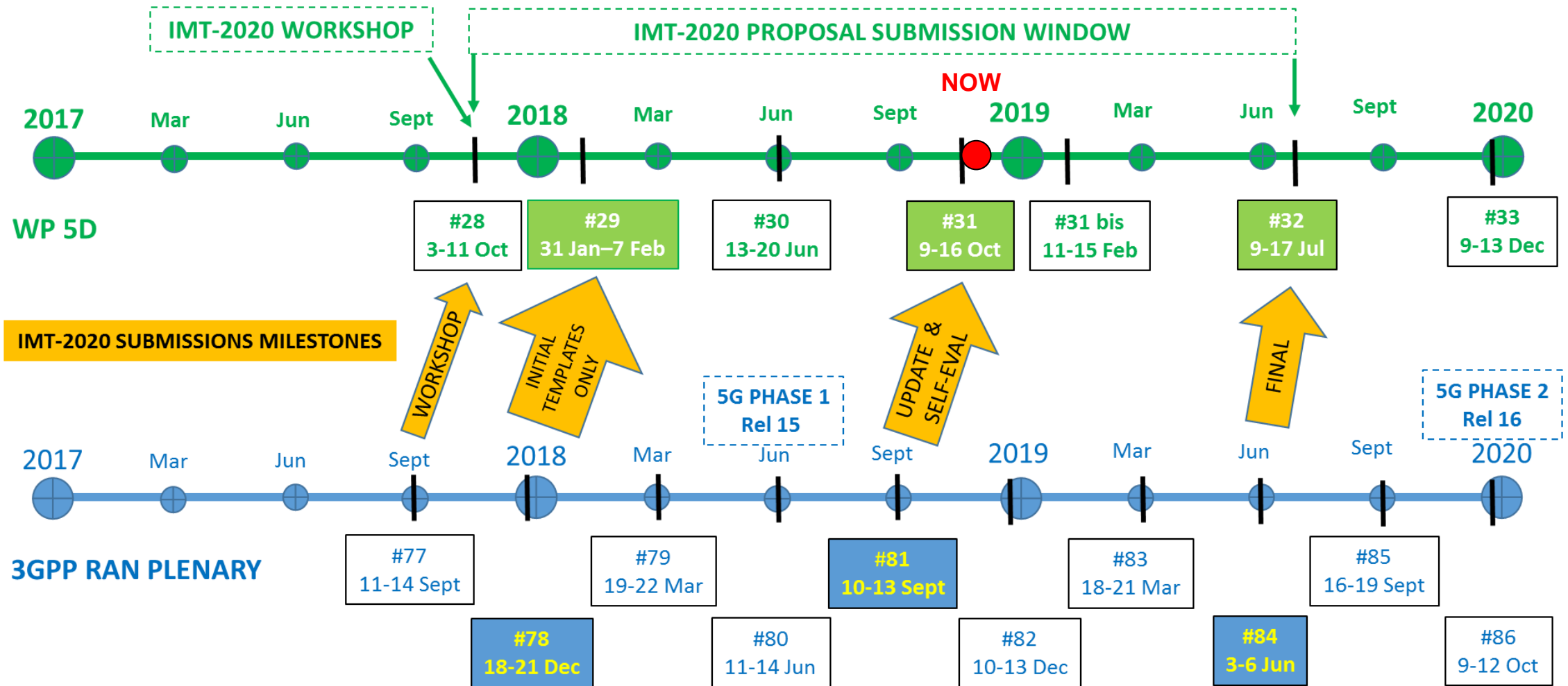- Positioning based on measurement on reference signals

Balance

IMT-2020 submission

IMT-2020 - timeplan

Submission Milestone Name	3GPP Meeting	ITU-R Meeting	General Submission Content	Submission Templates (Release Basis)	Self- Evaluation (Release Basis)
Workshop	RAN # 77 Sept 2017	WP 5D #28 Oct 2017	Overview	-	-
Initial Templates Only	RAN # 78 Dec 2017	WP 5D # 29 Feb 2018	Description Templates	Description Templates 5.2.3 (R15)	-
Update & Self-Eval	RAN # 81 Sept 2018	WP 5D # 31 Oct 2018	Description Templates Compliance Templates Self-Evaluation	Description Templates 5.2.3 (R15) Compliance Templates 5.2.4 (R15)	Self-Evaluation (R15)
Final	RAN # 84 June 2019	WP 5D # 32 July 2019	Description Templates Compliance Templates Self-Evaluation	Description Templates 5.2.3 (R15+R16) Compliance Templates 5.2.4 (R15+R16)	Self-Evaluation (R15+R16)

From RP-172098

IMT-2020 - format

- **Submission 1**
  - SRIT
    - Component RIT: NR (*)
    - Component RIT: EUTRA/LTE
      - incl. standalone LTE, NB-IoT, eMTC, and LTE-NR DC
    - full 38 and 36 series, and subset of 37 series
- **Submission 2** (In addition to the above)
  - NR RIT (*)
- **Naming**
  - Name : 5G
  - Footnote: Developed by 3GPP as 5G, Release 15 and beyond

(*) The plan is to leverage the NR RIT (in submission 2) as the NR component RIT in submission 1; NR details TBD

Release 17 - outlook

TSG SA focus areas

- Stage 1 (SA1) to be 80% complete by Sep 2019
- Some potential areas:
  - Verticals: Critical Medical, Factories of the Future, Unmanned Areal Systems, Asset tracking
  - Enhancements: relays, multicast-broadcast, edge, proximity services
  - Multi-USIM devices
  - Immersive teleconferencing and telepresence

TSG RAN focus areas

- RAN Release-17 scope has not been agreed yet

- Potential areas:
  - NR evolution
    - NR-lite
    - Beyond 52.6 GHz
    - Enhancements for: IoT, MIMO, NR-U, sidelink, coverage, DC and CA
  - New features
    - Non-terrestrial networks (NTN)
    - Integrated Access and Backhaul (IAB)

Thank you!

Sasha Sirotkin
Vice Chairman of 3GPP RAN3
Sasha.Sirotkin@intel.com
+972 50 7288473