NOKIA Vision & Priorities for Next Generation Radio Technology

3GPP RAN workshop on 5G

17.-18. September 2015

Phoenix, AZ, USA

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Growth and enabler of societal innovation

What is needed to make 5G a true global success?

Flagship of Digital Agenda	Cross region collaborative research and pre-consensus	Market driven competition and consolidation	Legislation on Net Neutrality
Drive global standardization	More globally harmonized spectrum (for LTE and 5G)	Data Protection for information centric networks	Fair rules for standard essential patents

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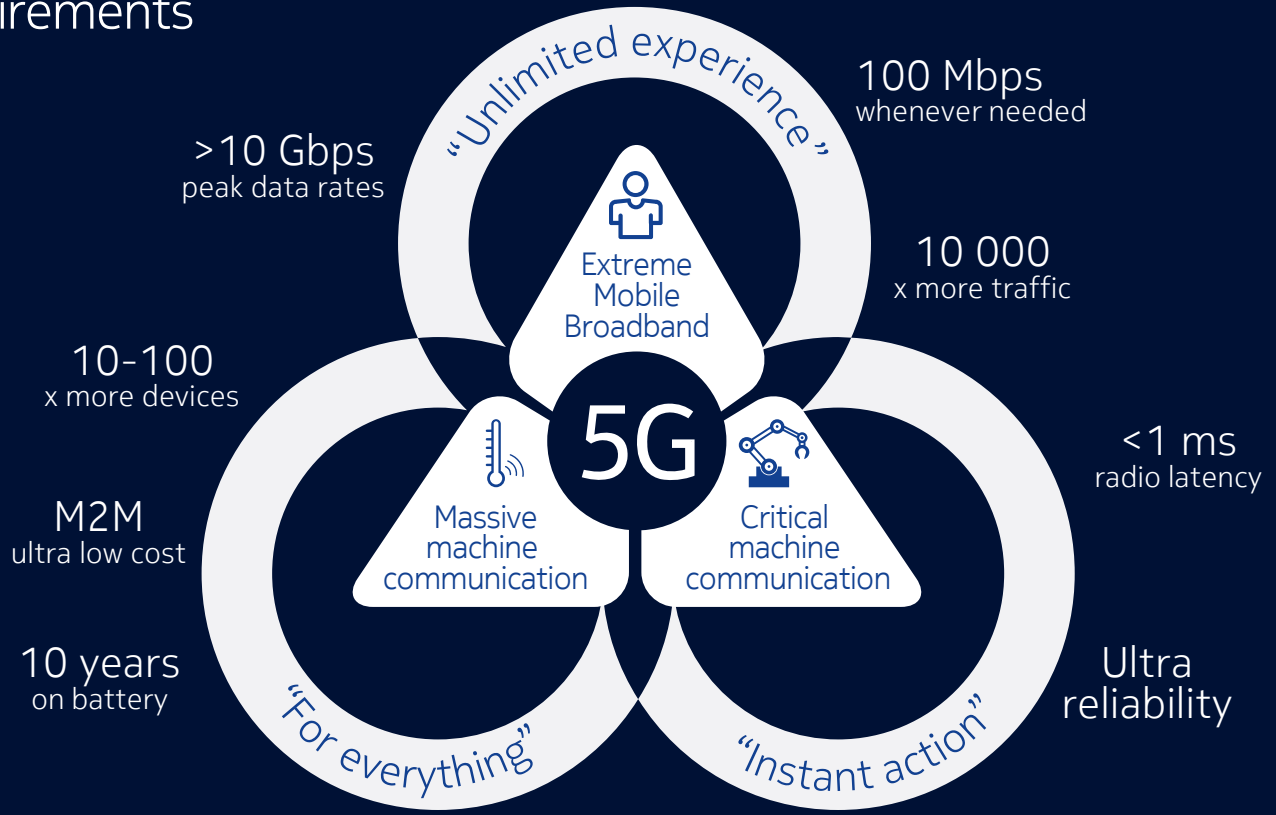
Heterogeneous use cases – diverse requirements



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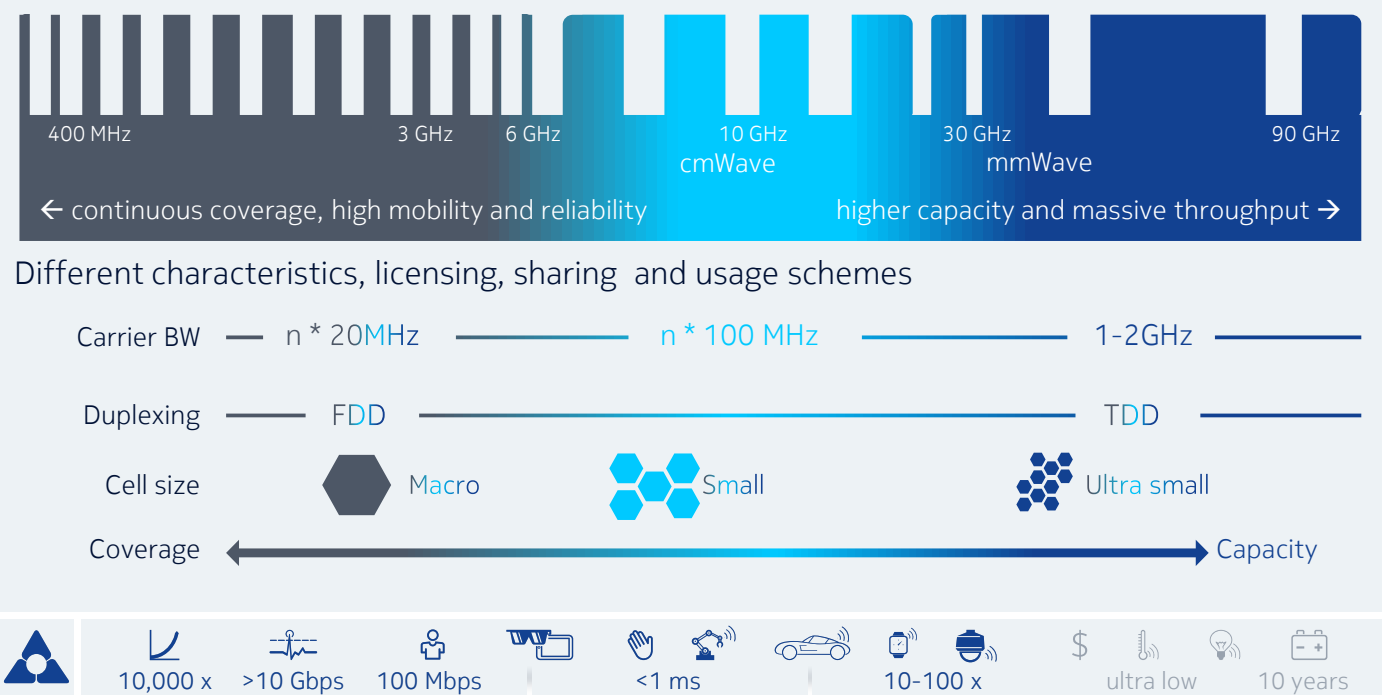
Unlocking new spectrum assets | Foundation for 5G

Leveraging all bands, ranging from ~400MHz - 100GHz



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Configurability | One versatile and self-configurable radio for everything

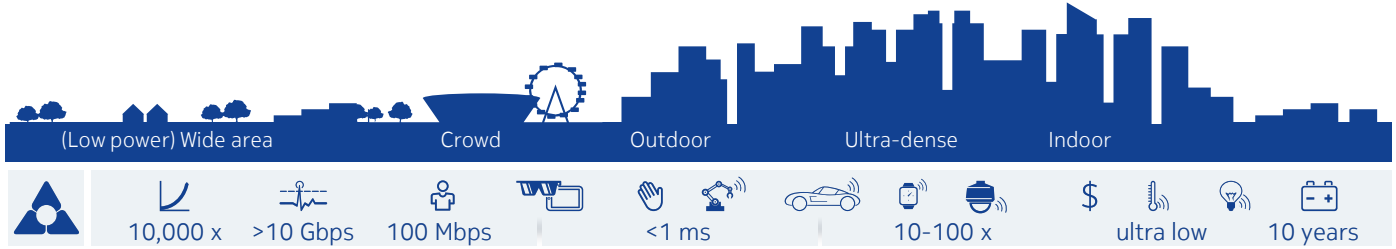
Flexible radio parameter setting for tailored QoE

One versatile radio

Diverse use cases

Diverse deployments

OFDM-based waveform	Same for uplink & downlink
Scalable carrier bandwidth	5MHz → 100-200MHz → 2GHz
Sub frame lengths	Scalable, base sub frame length of 0.1…0.2 ms



For all use cases

For all bands

For all deployment scenarios

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Slim Radio | Low cost & power for massive machine type communication

Rel-13/14 LTE-M & NB-M2M for small, infrequent & low cost data transfer

Power saving

Longer sleeping cycles*

Less signaling for wakeup

Power Save Mode

Simplified modems

Narrowband transmission

Reduced transmit power

Limited downlink transmission modes

UE processing relaxations

...

At least 4 x coverage

compared to LTE

New coding

Repetition and power spectral density boosts

+15~20 dB coverage

>10 years

Battery life with two AA batteries

Very low device cost

Standard availability

3GPP Rel-13

10,000 x	>10 Gbps	100 Mbps	<1 ms	10-100 x	ultra low	10 years

*) Extended Discontinuous Reception (DRX)

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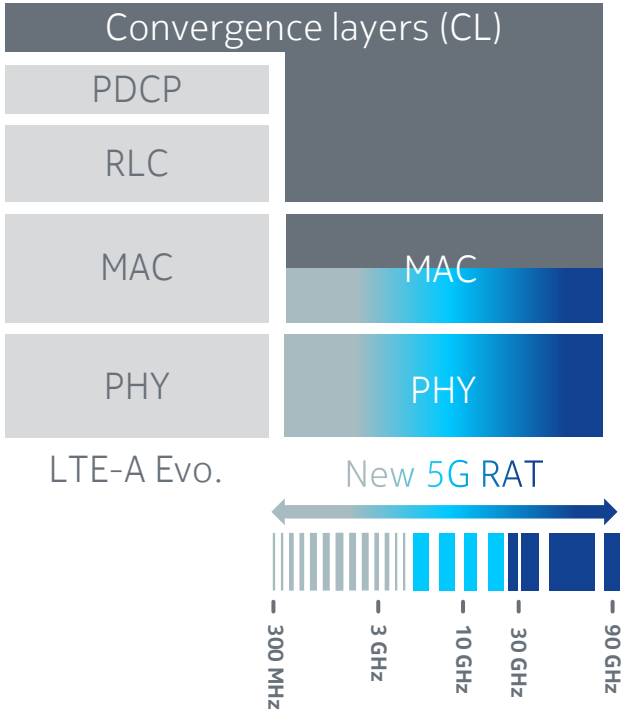
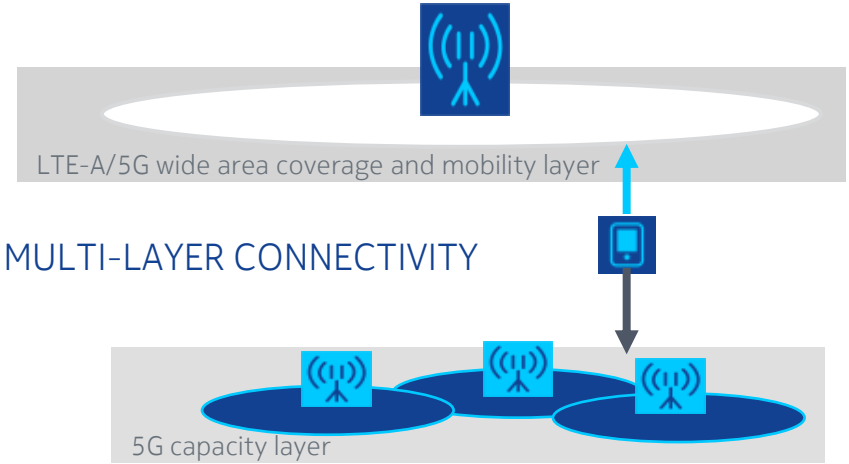
Different radio deployments managed as one 5G system

Native HetNet design integrating LTE and 5G radios as one 5G radio access



Better mobility robustness and lower signaling overhead



High capacity layer with very high data rates

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5G multi-service architecture

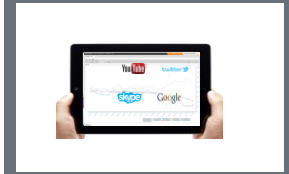
5G Radio Interf. (RI) Multi-connectivity
5G – LTE Tight integration
Multi-Dual Connectivity require anchor point

Common Core Network

Diverse deployment scenarios depending on available xhaul

Any xhaul

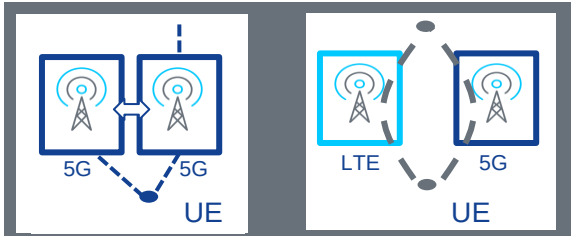
QoE for Traditional, verticals and dynamic application-aware QoE for OTT



Enhanced QoS-QoE

Flexible scalability of functions:
C/U Plane, Cell/UE related
Load-adaptive scaling

Elasticity



Multi connectivity

Flexible, programmable multi-service architecture

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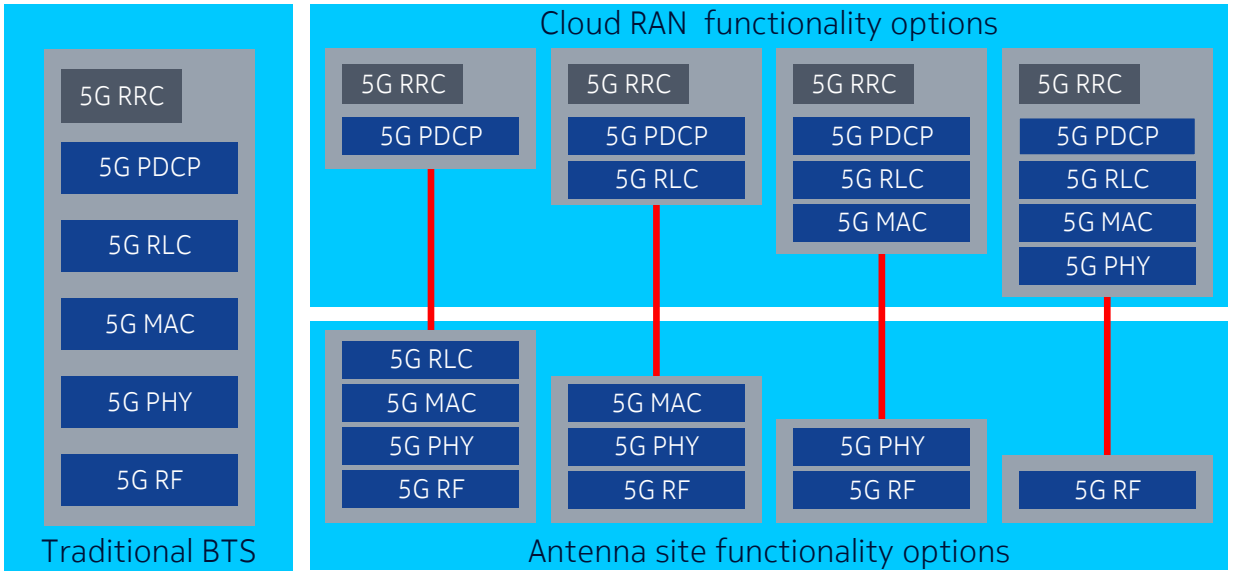
5G Cloud RAN

Many functional split possibilities – different fronthaul requirements



5G should be deployable regardless of the fronthaul technology, latency or capacity

Optimal functional split may depend on the available fronthaul

5G radio specification should consider functional split and not limit deployments

Fronthaul interface

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3GPP and ITU-R process geared for 'Full 5G' meeting the needs of 2030

Immediate commercial needs a subset of 'Full 5G'

Phase 1

"Initial 5G Features"

Catering for the immediate commercial requirements

Specification completed in 2018

Meeting the needs of 2020+

Phase 2

"Additional 5G Features"

Catering for all the identified long-term commercial requirements and meeting all the ITU-R IMT-2020 requirements

Specification completed in 2019

Ready for the needs of 2030+

See also RWS-150036

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5G Radio Standards – Phase 1

Minimum requirements identified

Frequency bands

3…30-40 GHz, TDD

Up to ~200 MHz carrier BW

Deployments

Urban Macro (UMa)

Urban Micro (UMi)

Indoor Hotspot (InH)

Energy efficiency

Key design principle

No overhead channels

Peak >10 Gbps

~50 Mbps cell edge

1 ms radio latency

New frame structure
with scalable ~0.2ms TTI

New L1 and lower part of L2

Phase 1 to be integrated with LTE, no 5G stand-alone operation

Phase 1 a stepping-stone on the path to 'Full 5G' of Phase 2

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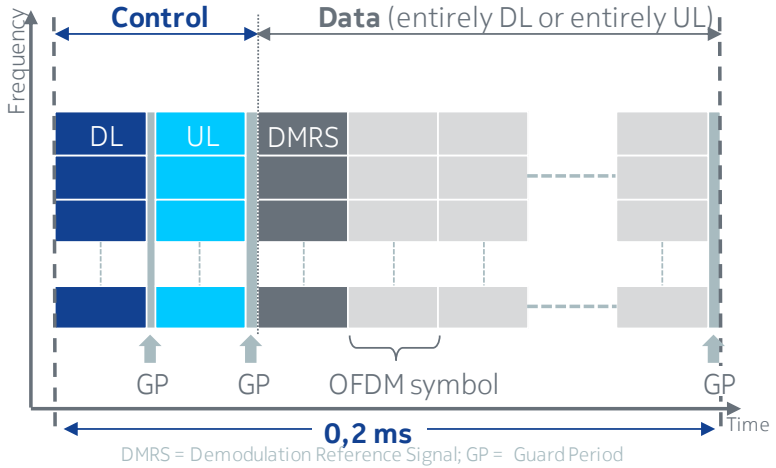
Phase 1 frame structure and numerology for 3...30-40 GHz

Other frame structures and numerologies to be derivatives of the Phase 1 solution



Max Carrier BW [MHz]	100-200 MHz
Clock Rate [Msps/s]	153.6
Subcarrier spacing [kHz]	75
Symbol length [us]	13.3
Symbols / sub-frame	14
Data (I)FFT block size	2048-4096
Sub-frame length [us]	200
Cyclic Prefic [us]	0.75
Guard period [us]	0.95
CP+GP Overhead	6.7 %

0.2 ms sub-frame with cascaded UL/DL control signals

1 ms userplane latency

DL and UL have same PHY (control, data, RS)

Flexible UL/DL

Control channel located before data

Energy-effective pipeline processing

Control plane localized in time & frequency

Cross link interference free control channels

Frequency range 3...30-40 GHz

Urban Macro/Micro and Indoor Hotspot

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Path to “5G and 5G e2e optimized architecture” in 3GPP – Phase 1

Phase 1: 5G radio & EPC

5G radio optimized for MBB (user plane only)

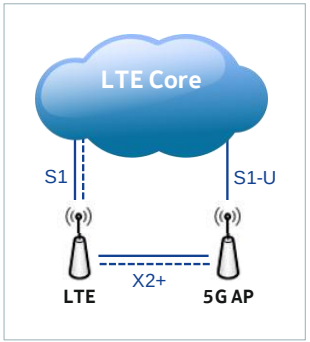
5G radio anchored to LTE radio

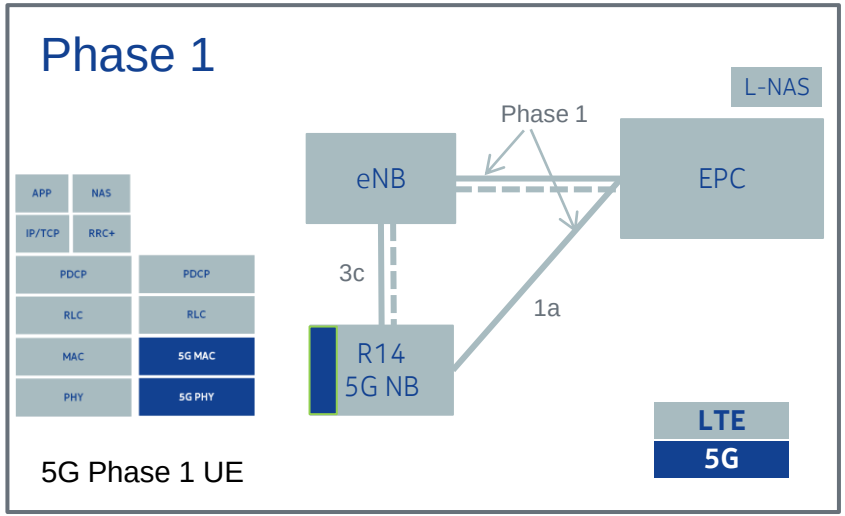
5G & LTE dual connectivity

Dynamic QoS framework inherited for 5G

Minimum feature set to ensure forward compatibility to rel-15

Phase 1





Anchoring 5G radio to LTE radio makes the new RAT transparent to the core

No direct CP connectivity from 5G radio to core, new core is not required for phase 1

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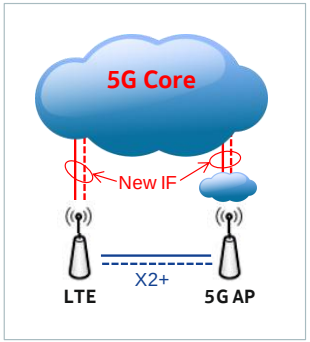
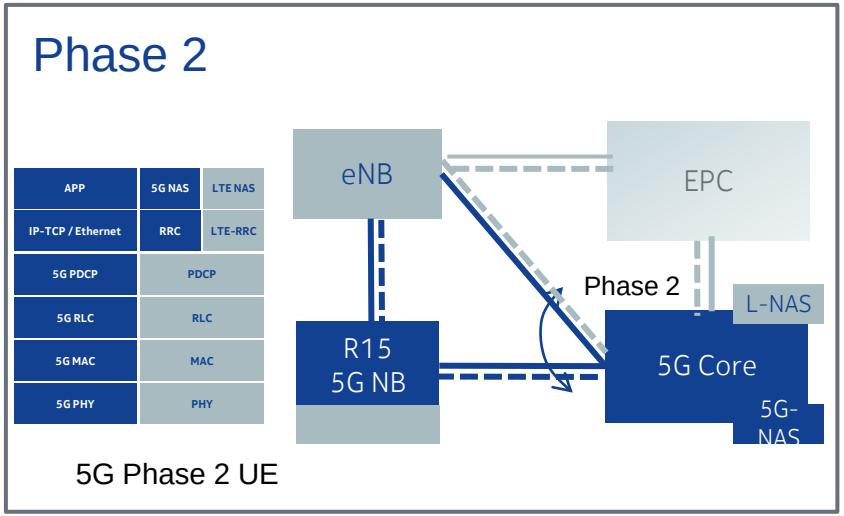
Path to “5G and 5G e2e optimized architecture” in 3GPP – Phase 2

Phase 2: 5G radio access & 5G core

Evolve the 5G radio to support stand alone operation and optimize architecture to enable new services

Phase 2





Phase 2 evolves the new RAT and introduces optimized architecture fulfilling the needs of the next decade – and beyond

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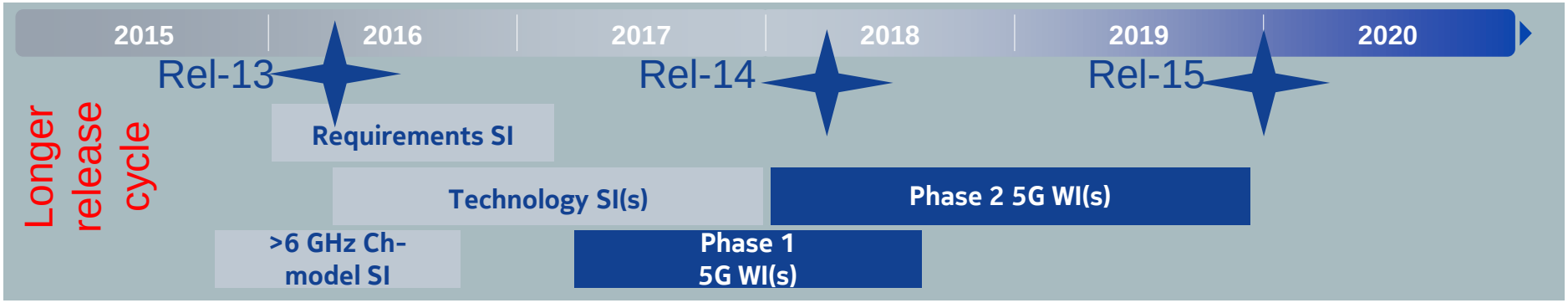
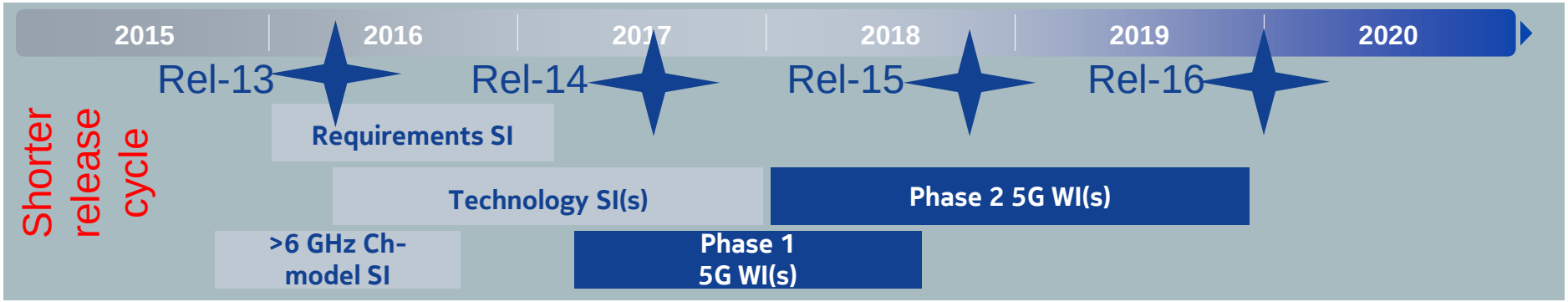
3GPP release schedule and 5G work phasing in RAN

Short or long release cycle – 5G timing should not heavily depend on it





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Conclusion

Flexible and configurable radio system

Flexible and programmable multi-service architecture

Ensure smooth progress of LTE standards in parallel

Consider fronthaul and Cloud-RAN functional split

Phasing ensures meeting markets needs in time

Let’s make 5G a true global success together

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www.networks.nokia.com/innovation/5G