Extending the benefits of LTE to unlicensed spectrum

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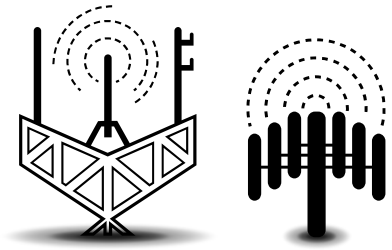
- Motivation
- Spectrum
- Features & Performance
- Standardization

Motivation

Make best use of all spectrum types for cellular

Licensed Spectrum

Cleared spectrum for 3G/4G



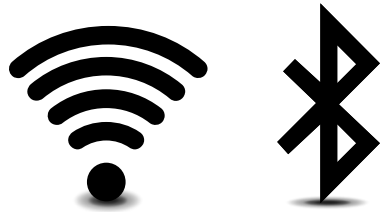
Exclusive use

Cellular industry's top priority

Ensures quality of service (QoS), mobility and control

Unlicensed Spectrum

Multiple technologies (Wi-Fi, BT & others)



Shared use

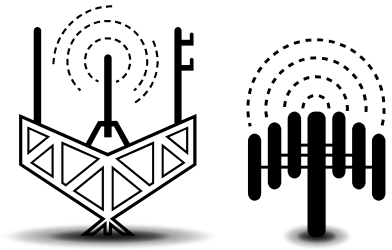
Unpredictable QoS

Good for local area access & opportunistic use for mobile broadband

Make best use of all spectrum types for cellular

Licensed Spectrum

Cleared spectrum for 3G/4G



Exclusive use

Cellular industry's top priority

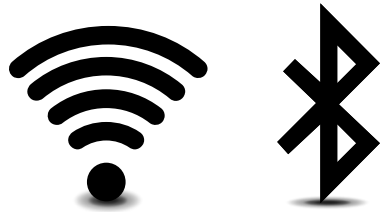
Ensures quality of service (QoS), mobility and control

Proposal:

Enable LTE in unlicensed spectrum in a licensed-assisted manner

Unlicensed Spectrum

Multiple technologies (Wi-Fi, BT & others)



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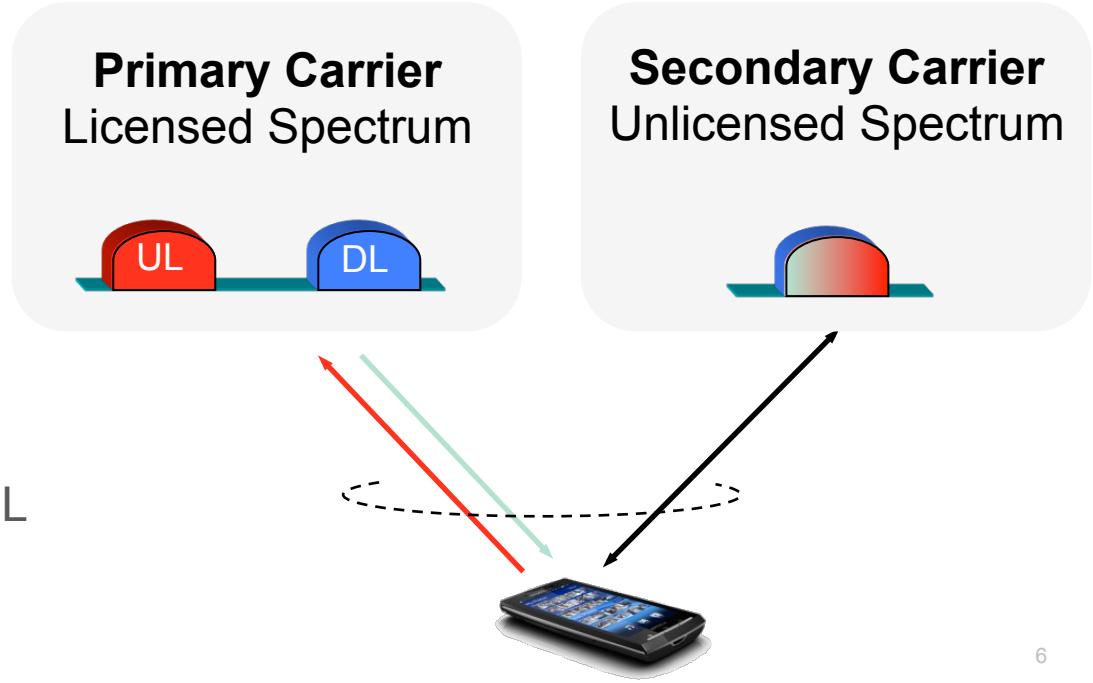
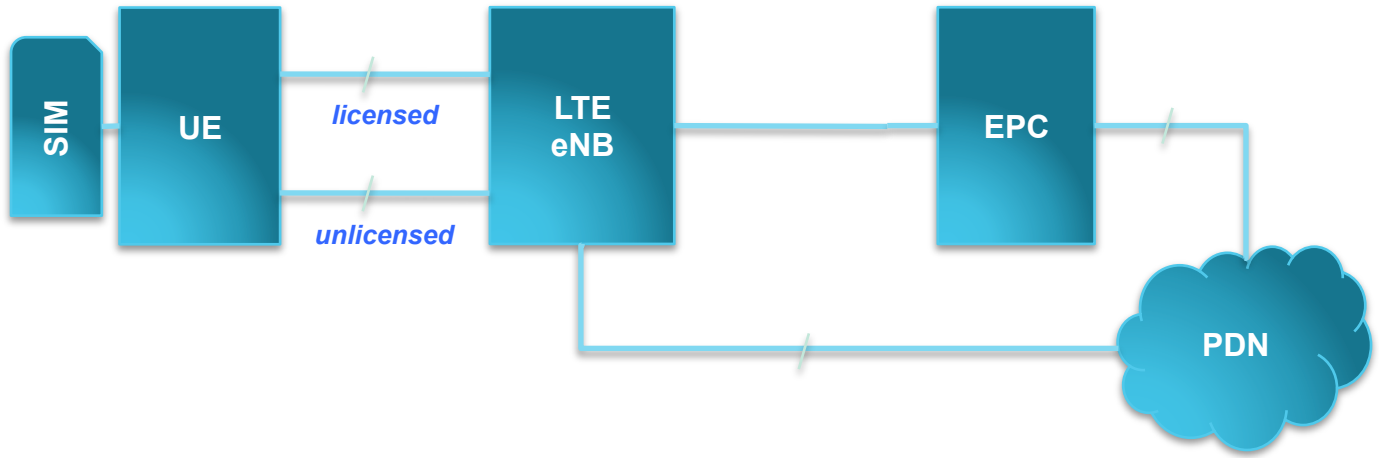
LTE in Unlicensed Spectrum

- LTE transmitted according to unlicensed spectrum regulation in unlicensed spectrum
  - Accompanied by a licensed carrier
  - Carrier Aggregation / Supplemental Downlink
  - Dual Connectivity in the future
- **Primary Carrier** always uses licensed spectrum
  - FDD or TDD
  - Control signalling, mobility, user data
- **Secondary Carrier(s)** use unlicensed spectrum
  - Best-effort user data in either DL-only or both DL and UL



Unified LTE network for operators

- Builds on LTE scale and ecosystem
- The same RAN can provide LTE data access in licensed & unlicensed
- No impacts foreseen to the core network nodes
- Management of one network



Spectrum

On the use of unlicensed spectrum for cellular operators

- We believe licensed spectrum remains the **preferred way** to enhance capacity
  - Identification of more licensed spectrum for cellular communication needs to remain a top priority for the industry at WRC, ITU & other regional regulatory bodies

- Unlicensed spectrum is a **complement** to licensed spectrum
  - The introduction of LTE into unlicensed does not reduce or dilute the need for licensed spectrum
  - The benefits of licensed spectrum **cannot be matched** by unlicensed spectrum

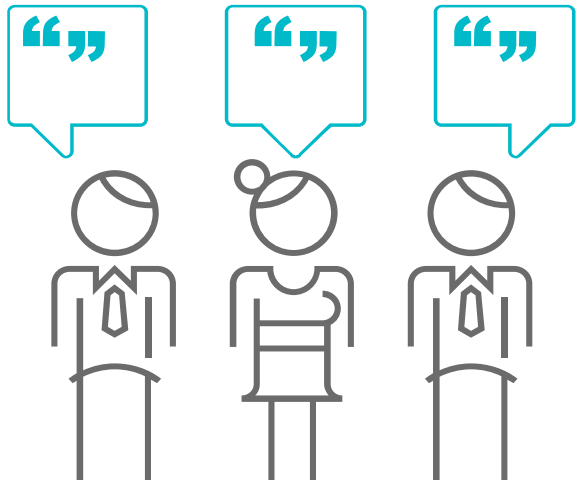
Which unlicensed bands?

- 3GPP should study how to enhance LTE for unlicensed in a generic manner
  - Enhancing features not being dependent on a specific spectrum band
- Prioritizing some band of broad interest is however important
  - Especially for assessment of the coexistence scenarios
- Unlicensed spectrum @ 5GHz is the top candidate

Features & Performance

LTE can efficiently work in unlicensed spectrum

- Tools at protocol/architecture level for Wi-Fi/LTE coexistence
- Techniques to meet specific regulation & enhance coexistence
  - We expect RAN WGs to study these aspects in detail, eg Listen-Before-Talk
- The following slides share some data accordingly



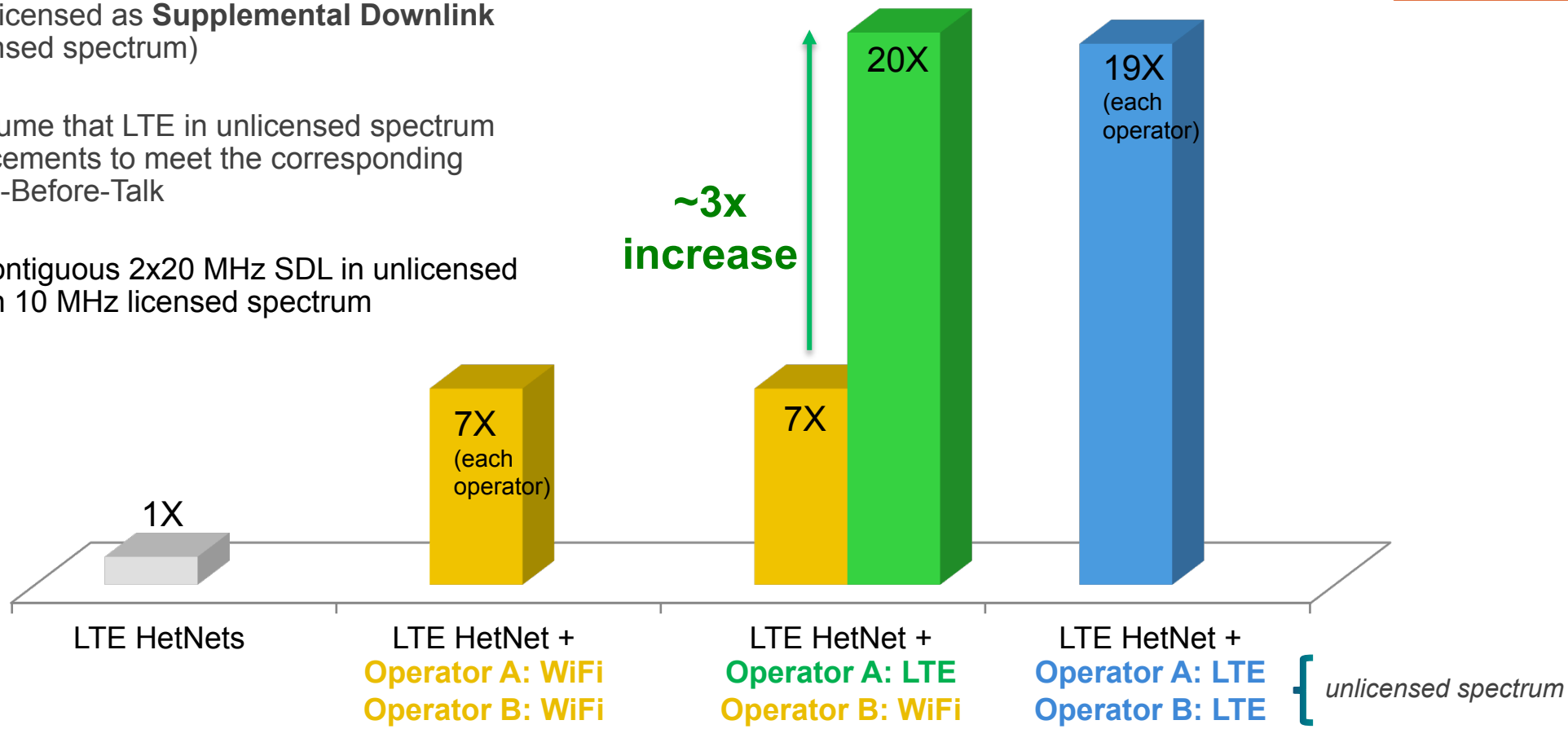
Performance evaluation – DL Median User Tput Gain

Uniform Scenario

LTE deployed in Unlicensed as **Supplemental Downlink** (Primary Cell in licensed spectrum)

The simulations assume that LTE in unlicensed spectrum incorporates enhancements to meet the corresponding regulation, eg Listen-Before-Talk

Each device uses contiguous 2x20 MHz SDL in unlicensed spectrum, along with 10 MHz licensed spectrum



3GPP model, Scenario 1, two operators (A & B) each deploys 16 Picos per operator per macro cell. 3GPP Bursty traffic model with 1MB file.
Baseline is 10MHz FDD LTE HetNets with FeICIC/IC.
Unlicensed band in 5GHz with 24x20MHz.
DL 2x2 MIMO for LTE, LTE and WiFi with rank 1 & 2. WiFi assumes 802.11ac (no MU-MIMO). Simulations assume LTE+WiFi layer 2 aggregation (proposed for Rel-13)
LTE in unlicensed assumes no synchronization among operators. Channel selection for the unlicensed part is randomized across eNBs

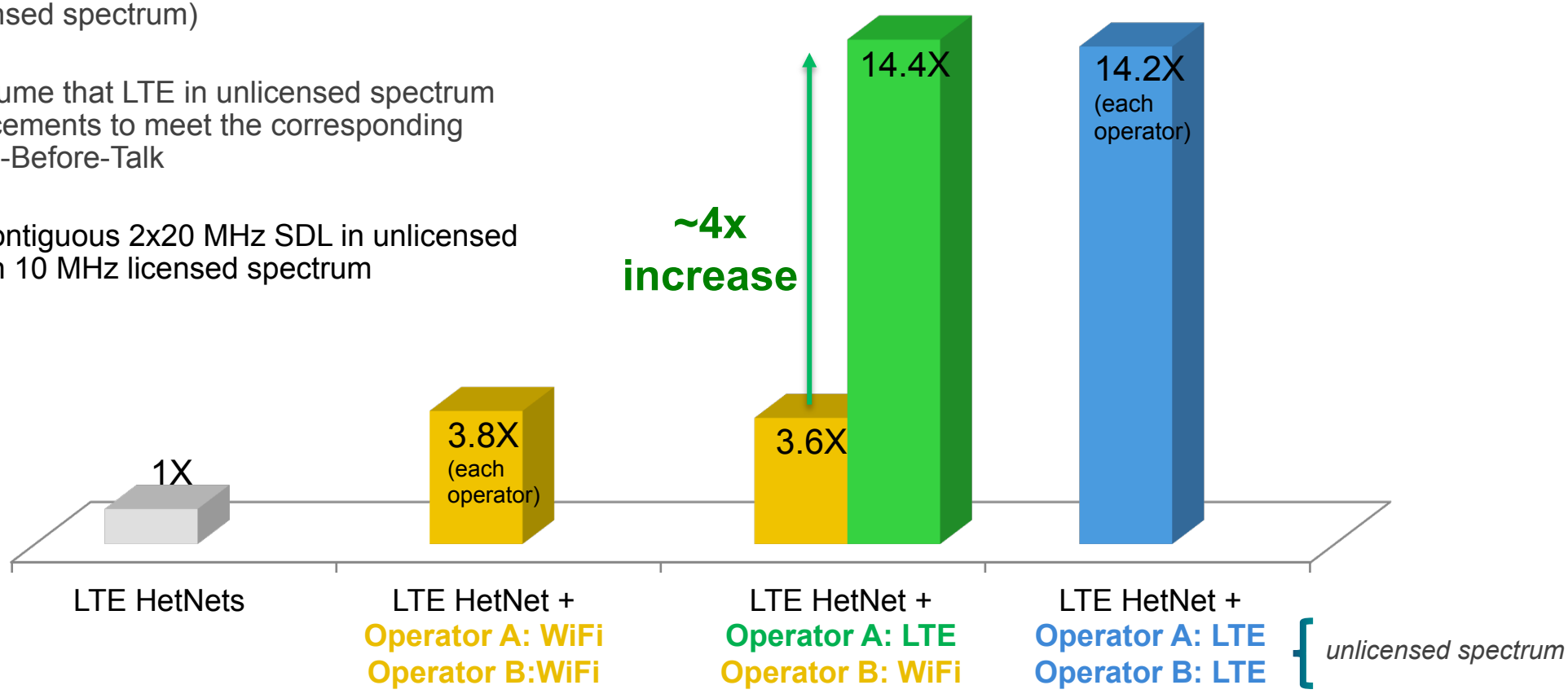
Performance evaluation – DL Median User Tput Gain (cont.)

Cluster Scenario

LTE deployed in Unlicensed as **Supplemental Downlink** (Primary Cell in licensed spectrum)

The simulations assume that LTE in unlicensed spectrum incorporates enhancements to meet the corresponding regulation, eg Listen-Before-Talk

Each device uses contiguous 2x20 MHz SDL in unlicensed spectrum, along with 10 MHz licensed spectrum



3GPP model, Scenario 3, two operators (A & B) each deploys 8 clustered Picos per macro cell. 3GPP Bursty traffic model with 1MB file.
Baseline is 10MHz FDD LTE HetNets with FeICIC/IC.
Unlicensed band in 5GHz with 24x20MHz.
DL 2x2 MIMO for LTE, LTE and WiFi with rank 1 & 2. WiFi assumes 802.11ac (no MU-MIMO). Simulations assume LTE+WiFi layer 2 aggregation (proposed for Rel-13)
LTE in unlicensed assumes no synchronization among operators. Channel selection for the unlicensed part is randomized across eNBs

Standardization

How to move forward in 3GPP

RAN #65

RAN1/RAN2/RAN4
Study Item
on system coex & technical solution

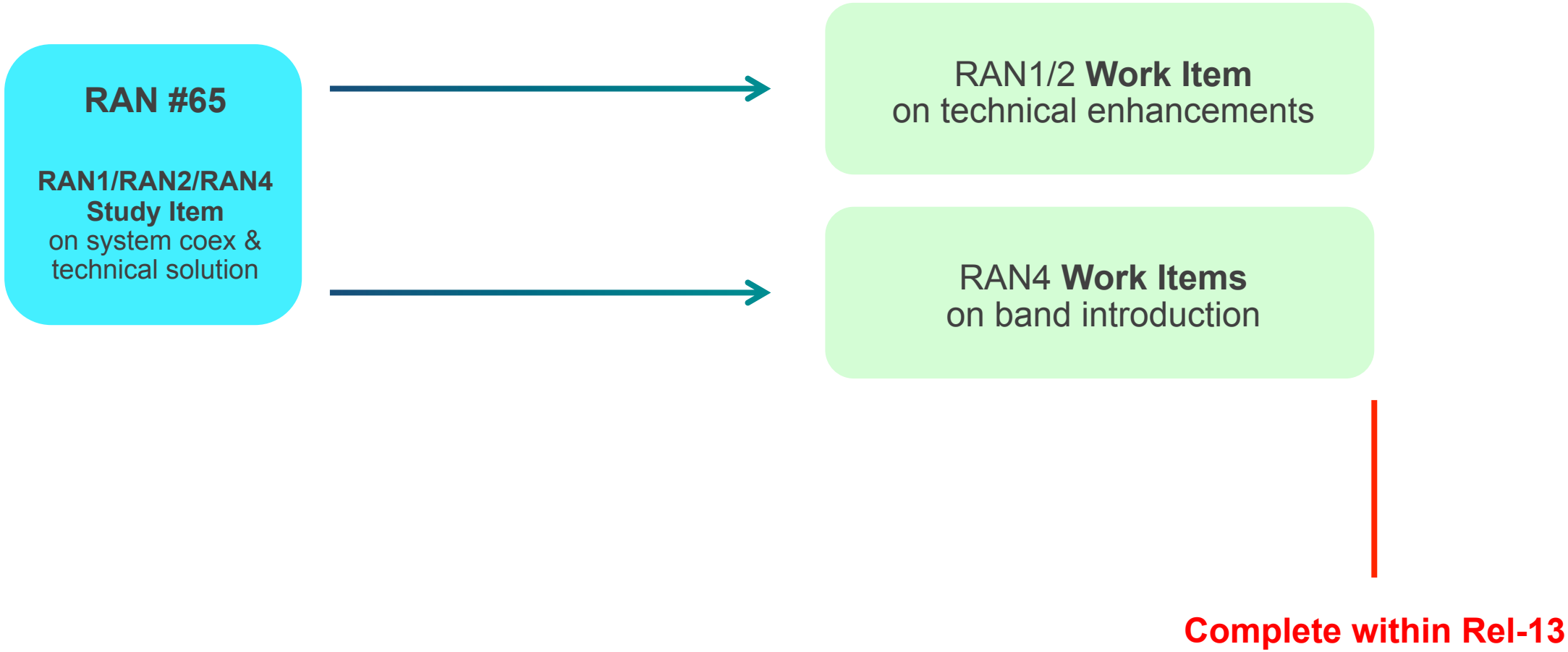
Create an evaluation methodology incl. use cases & scenarios of interest

***System coex sims** between LTE & WiFi (co-channel & adjacent), and different LTE operators*

Study how to enhance LTE to coexist effectively

*Document candidate **enhancing features** & **feasible deployment scenarios***

How to move forward in 3GPP



Conclusions

- Introducing LTE in unlicensed spectrum in a Licensed Assisted manner will bring benefit to the 3GPP industry

- 3GPP can effectively deliver a clear message on LTE in unlicensed spectrum & at the same time reconfirm that the benefits of licensed spectrum **cannot be matched** by unlicensed spectrum

- LTE can coexist with WiFi and other technologies in unlicensed spectrum with a variety of tools and standardized enhancements

- 3GPP standardization can start in RAN #65 from a RAN1-led Study Item

Thank you

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