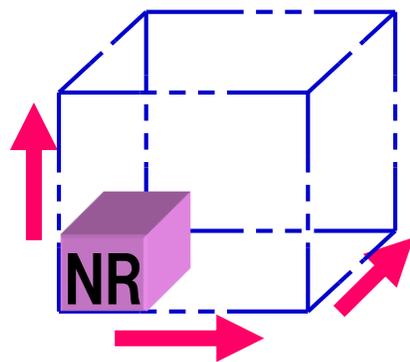
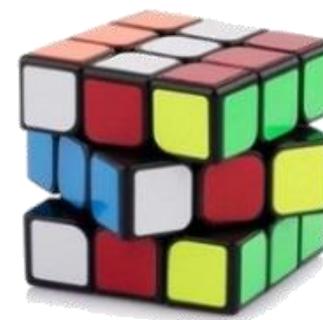


Views on Release 17

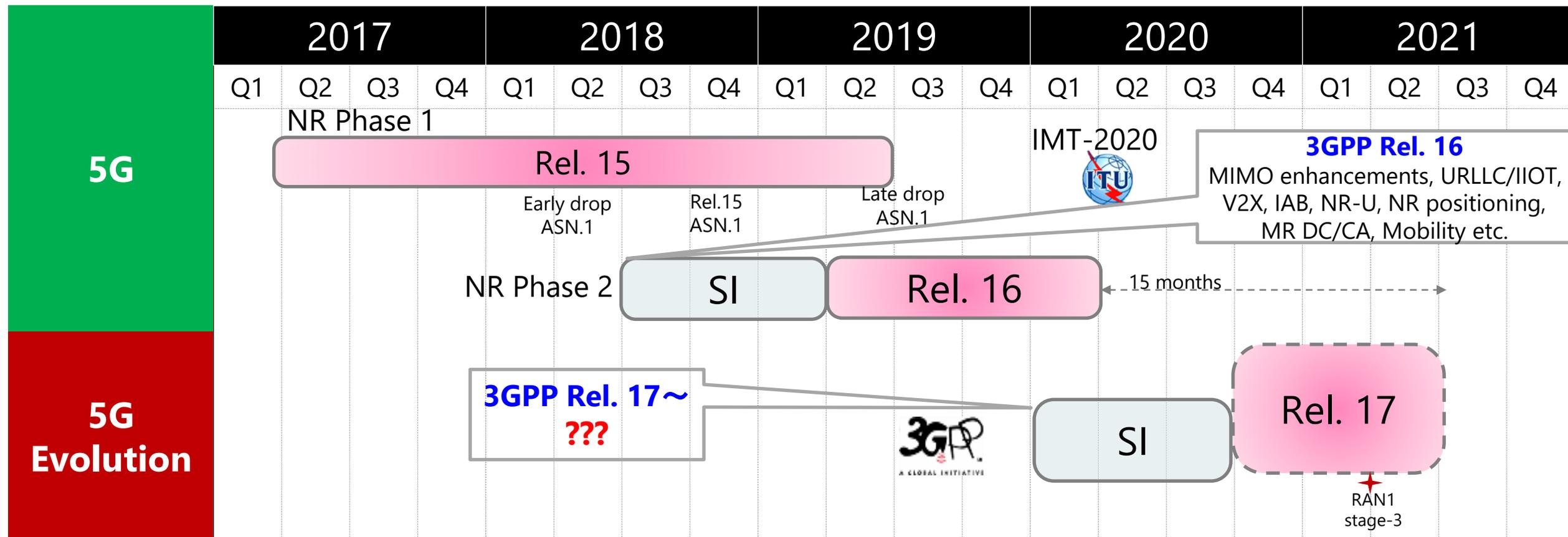


NTT DOCOMO, INC.



3GPP Release 17 Timeline

- 5G is now in commercial development phase, and researchers should focus on future wireless technologies
 - Rel.17 RAN 1 stage 3 completion is March 2021



■ Release 16 topics Review

Further enhancements from Release 15 Support more use cases

- Enhancements on MIMO
- Enhancements on mobility
- Enhancements on DC/CA
- *Etc.*

- Enhancement URLLC/Industrial IOT
- V2X
- IAB (Integrated Access Backhaul)
- NR-based access to unlicensed spectrum
- Positioning
- *Etc.*

■ Release 17 topics should be driven by

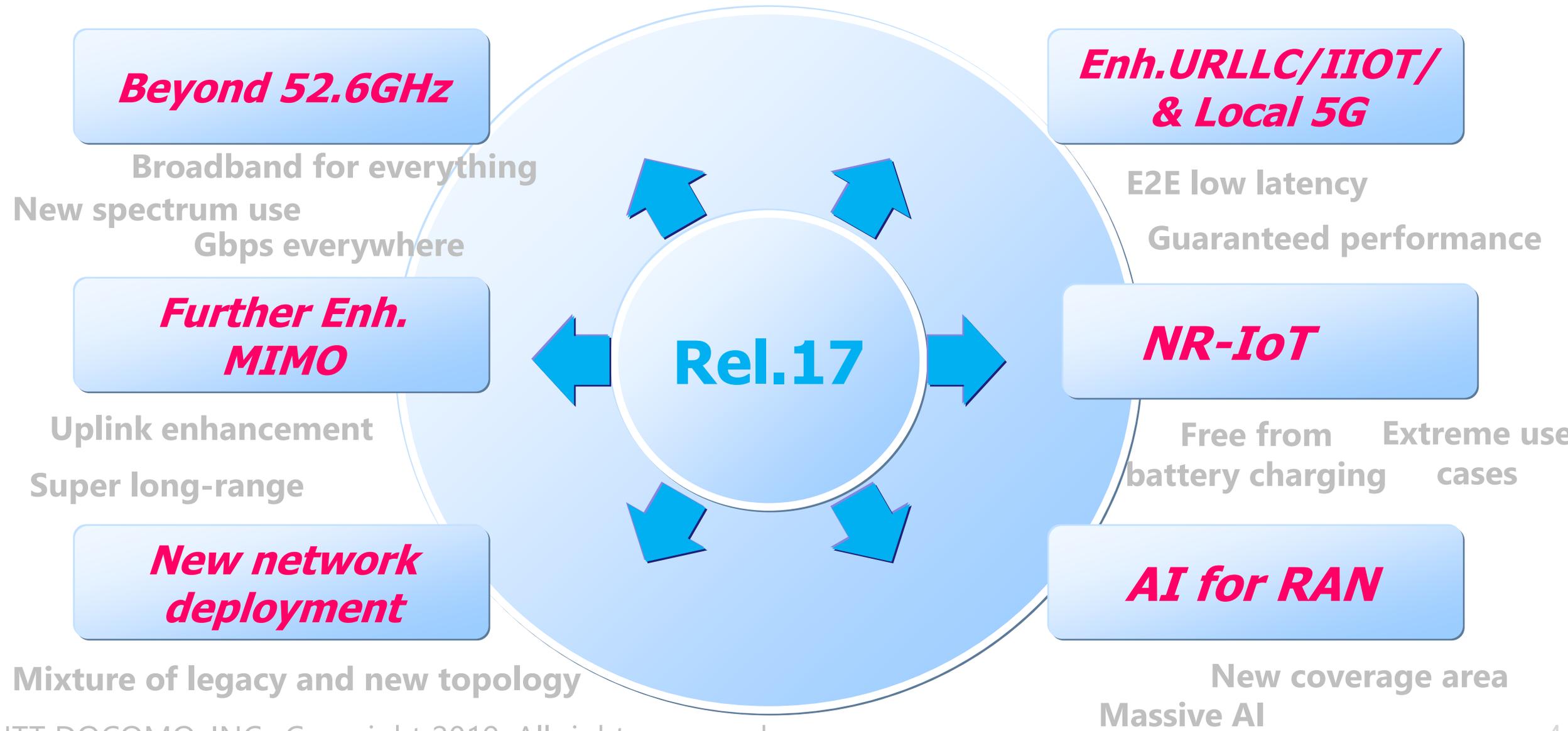
**Spectrum
Extension**

New Use Cases

**New NW
Deployment**

**Better
Performance**

DOCOMO's interest for Release 17



NR Beyond 52.6 GHz (New Rel. 17 SI/WI)

■ Background

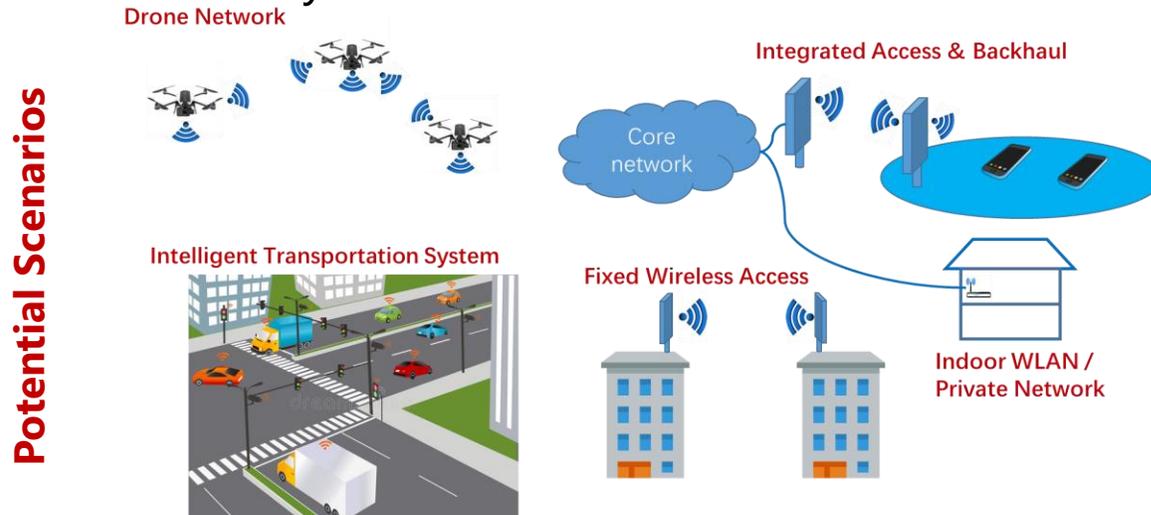
- NR on Beyond 52.6 GHz band is studying in RAN Plenary SI with the following scope
 - » Global spectrum availability and regulation.
 - » Protentional use cases and deployment scenarios.
 - » NR design requirements and considerations.

■ Motivation

- There are plenty spectrums which can be used for mobile systems.
- Several use cases and deployment scenarios has been identified during the RAN Plenary studies.

Potential candidates for future 5G band between 52~114 GHz in Japan.

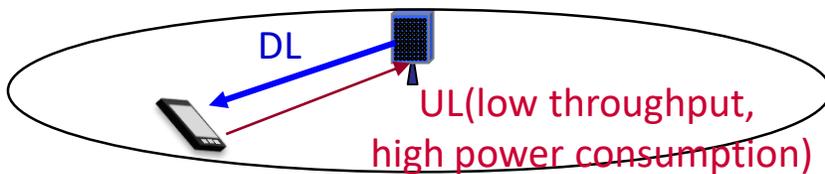
Frequency range (GHz)	Bandwidth (GHz)	Relative BW (%)
10.7	11.7	1
14.4	15.25	0.85
27	29.5	2.5
31.5	33.4	1.9
39.5	41	1.5
45.3	47	1.7
47.2	50.2	3
51.2	52.6	1.4
66	71	5
71	76	5
81	86	5
92	102	10
102	105	3
136	148.5	12.5
151.5	164	12.5
167	182	15
185	200	15
209	226	17
231.5	248	16.5
above 252	infinity	



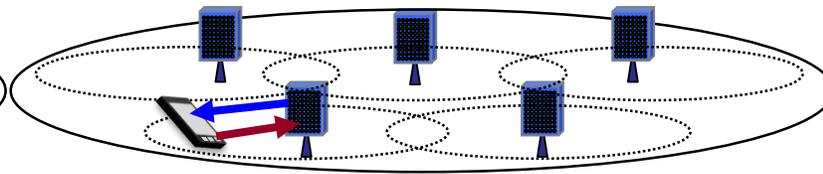
- **Suggest a RAN1-lead SI after the RAN Plenary SI, with the following scope**
 - Study the practical channel & RF model to evaluate the performance of B52GHz systems.
 - » The system design highly relies on the channel & RF model, which should be carefully studied to represent the practical environments and components.
 - Study the following aspects, taking into account phase noise model, non-linearity model of PA and fixed-point processing model
 - » Carrier bandwidth with potential new numerologies
 - » Waveform
 - » Physical channel design
 - » Physical procedures: e.g. efficient and faster beam management

Further Enhancements for MIMO

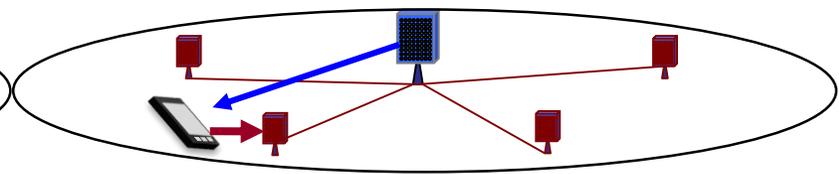
- Rel-16 eMIMO focuses more on the DL MIMO enhancements, generally.
- Rel-17 FeMIMO is expected to focus more on improving **“Uplink”** performance
 - Uplink is critical on mmW coverage
 - UL high throughput is attractive for new use cases (e.g., live video streaming, life-log, etc.)
- Enhancements for **“Uplink”** and Downlink performance
 - UL MIMO enhancements
 - » Transmitter: Support of higher rank; UL multi-panel; MU-MIMO enh.; UL RS enhancement, e.g., SRS, DMRS
 - » Receiver: Dense deployment of UL Rx points within a cell to minimize UL pathloss and UL Tx power
 - Efficient SRS based beam sweeping etc.
 - DL MIMO enhancements
 - » Multi-panel, beam management



Legacy deployment



Dense (DL+UL) deployment
(high deployment cost)



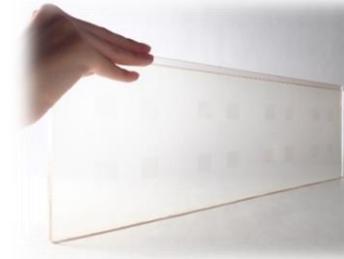
UL dense deployment
(easier than regular TRP (DL+UL) deployment)

New Network Deployment

New NW Deployment

■ Mixture of legacy and new-type deployments, e.g., IAB, cooperated device with following desired features

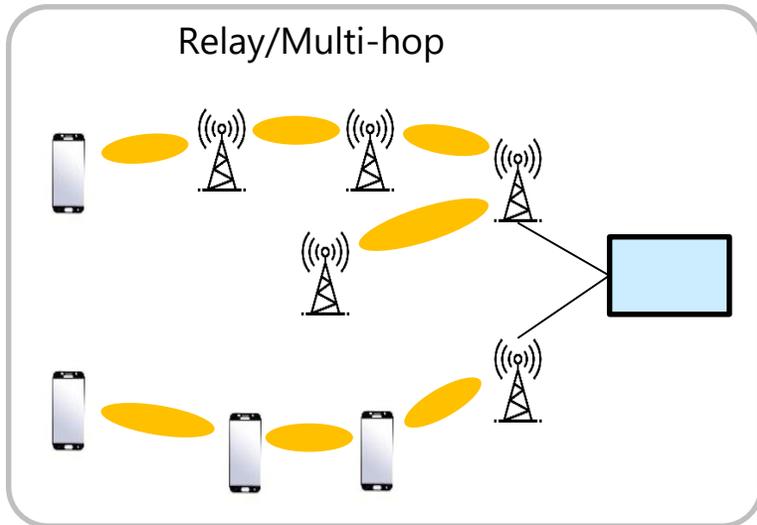
- Small size and light weight
- Cost and energy efficient
- Plug-and-Play and wireless



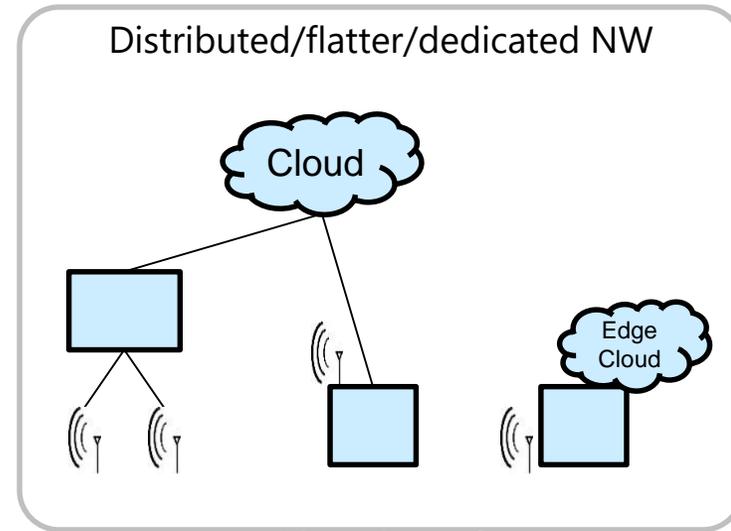
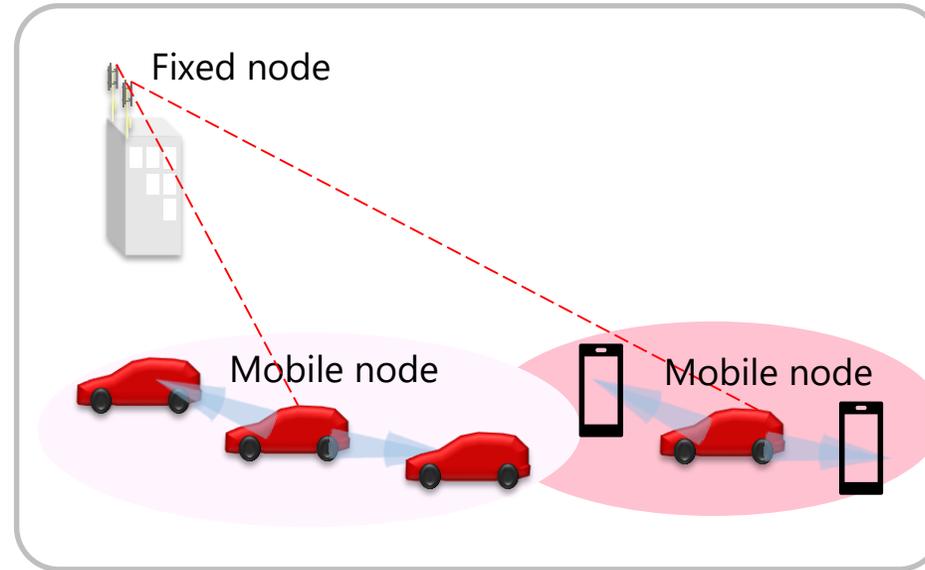
On-glass antenna



mmW reflector



to improve coverage & capacity



to cope with variety of use cases

➔ **Technical study considering such new-type deployment will be needed**

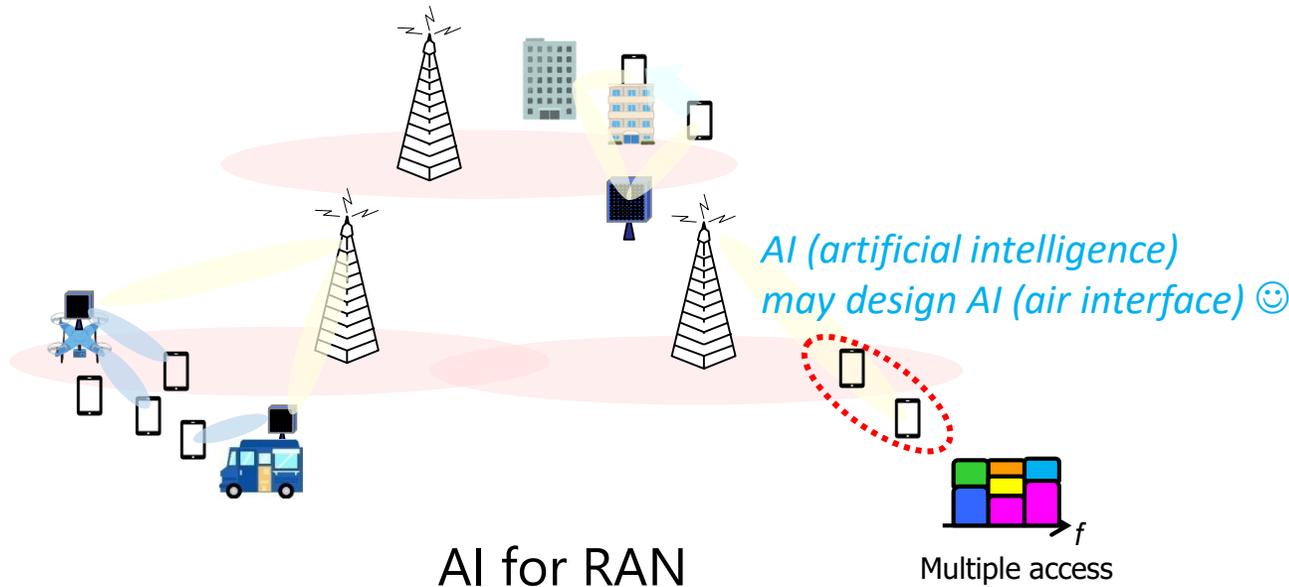
AI for RAN

Evolutions Triggered by AI Technologies

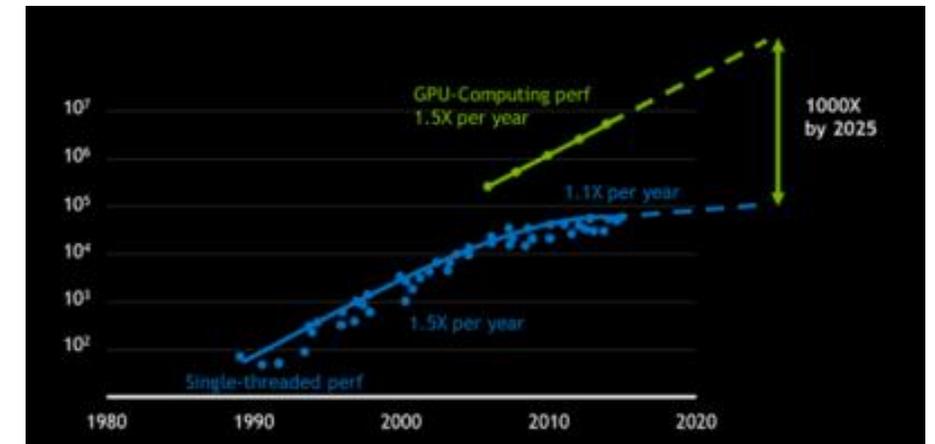
■ Evolutions triggered by AI will happen in 5G era and beyond

- AI for RAN - Super intelligent RAN
- Massive AI devices
 - » D2D and UE cooperation will be more important
 - » Potential high requirements for them, with abilities beyond human beings

Cell design, parameter optimization, estimation and controls, etc.



Massive AI devices



Rise of GPU computing
(Source: Presentation by NVIDIA)

Enhancements for eURLLC/IIOT and Dedicated/Local 5G

Rel.15

Basic URLLC functionalities to achieve IMT2020 requirements

UL configured grant, CBG-based re-transmission, Low-SE MCS/CQI-tables, PDCP duplication, etc

Rel.16

URLLC enhancements targeting specific use-cases and industrial IOT

Enhancements to PDCCH, UCI, PUSCH, UL-CG, DL-SPS, support of out-of-order, intra-/inter-UE mux, etc

Rel.17

Further enhancements for following:

More use-cases

Public safety

Space/marine

Drone/aircraft

Sensors

Better performances

Guaranteed rate

Guaranteed jitter

99.999999%?

0.5ms latency?

Higher efficiency

More UEs/cell

Less overhead

Higher SE

Less nodes/m²

Better co-existence

Inter-cell co-ex

Inter-UE co-ex

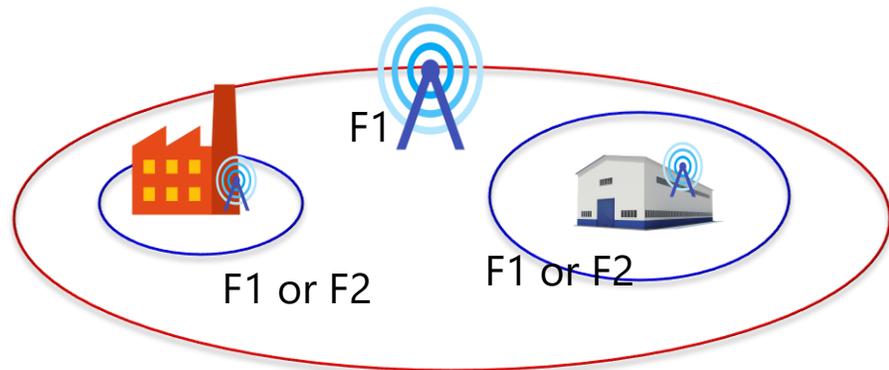
Intra-UE co-ex

Inter-area co-ex

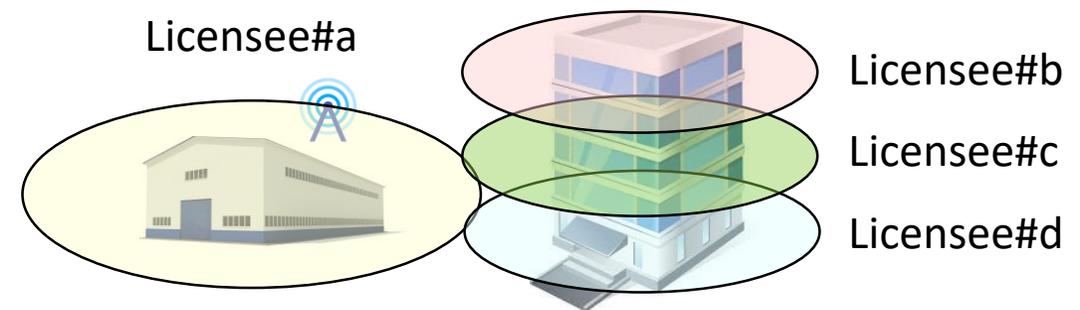
■ Two cases should be targeted for the enhancements:

- Case 1: Operator's spectrum for dedicated/Local 5G network
 - » Operator services dedicated/Local 5G network using own spectra
 - » Benefits: Better performance by planning/coordination
 - » Challenges: Interworking b/w wide-area/local-area 5G, etc
- Case 2: Shared-licensed/unlicensed spectrum for dedicated/Local 5G network
 - » 2-1: Shared license for operators/service providers
 - » 2-2: Unlicensed band for everyone (even for other RATs)
 - » Challenges: Coexistence among dedicated/Local 5G networks, etc

Order of DOCOMO's interest:
(1) Licensed
(2) Shared licensed
(3) Unlicensed spectrum



Local 5G service provided by an operator using own frequency (F1 or F2)

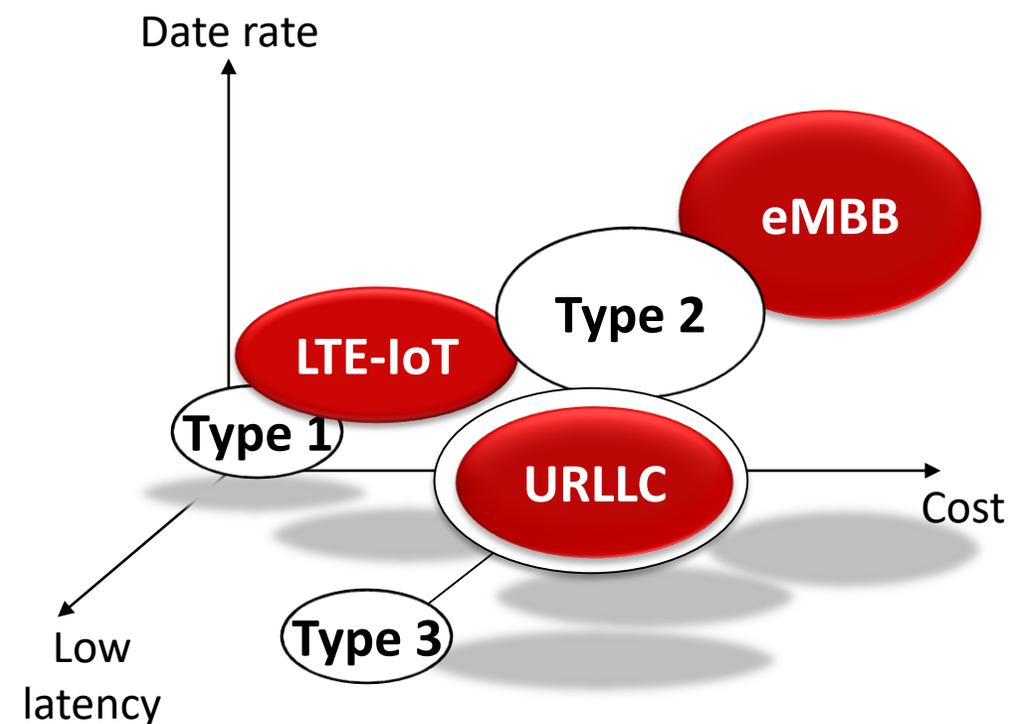


Local 5G service provided by service providers/operators using dedicated spectrum or same spectrum (F3)

NR IoT

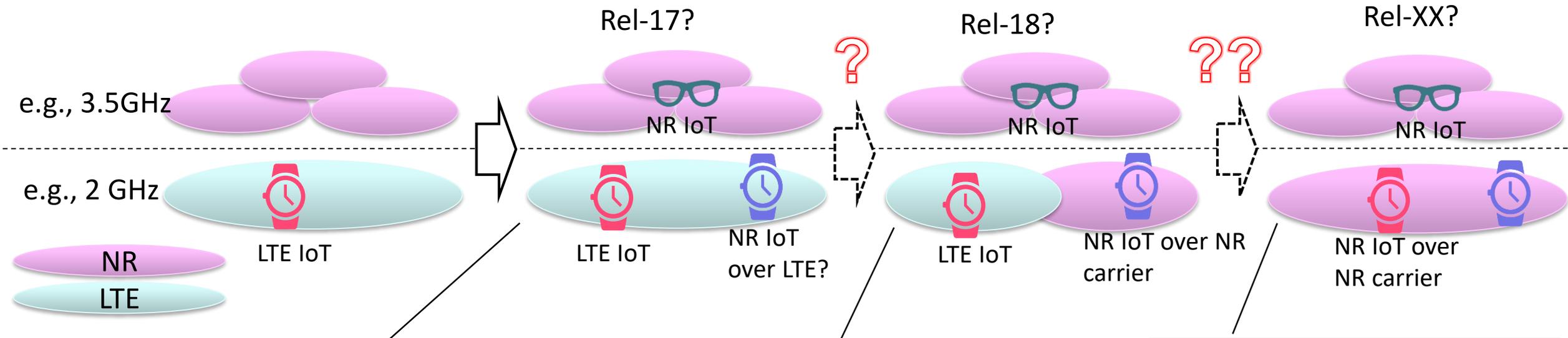
- Clear definition for NR-IoT
- Coexistence of LTE/LTE-M/NB-IoT/NR devices

Type	Solutions
Type 1: Almost cost-zero and ultra energy efficient terminal <i>e.g. printable device</i>	<ul style="list-style-type: none"> • Solution 1: supported by enhanced LTE NB-IoT/eMTC • Solution 2: supported by LTE additional specified categories • Solution 3: supported by NR
Type 2: Middle throughput range <i>e.g. device targets the data rate of 10Mbps~100Mbps</i>	<ul style="list-style-type: none"> • Supported by NR <ul style="list-style-type: none"> • 3GPP should avoid the overlapping between LTE enh. and NR
Type 3: Lower latency and high reliability <i>e.g. Wireless Sensor, remote control drone, and intelligent devices</i>	<ul style="list-style-type: none"> • Solution 1: supported by LTE HRRLLC enh.? • Solution 2: supported by NR URLLC further enh



What is 5G IoT? Enhanced LTE-IoT and/or new NR IoT?

- (LTE and NR) IoT standardization should take into account market needs, requirements, migration/evolution path to avoid unnecessary market fragmentation
- If NR IoT is to be standardized, potential aspects that we can study are:
 - Multiple access schemes including grant-free/contention-based transmission, etc
 - Waveform designs including single-carrier, OFDM, new waveform, etc

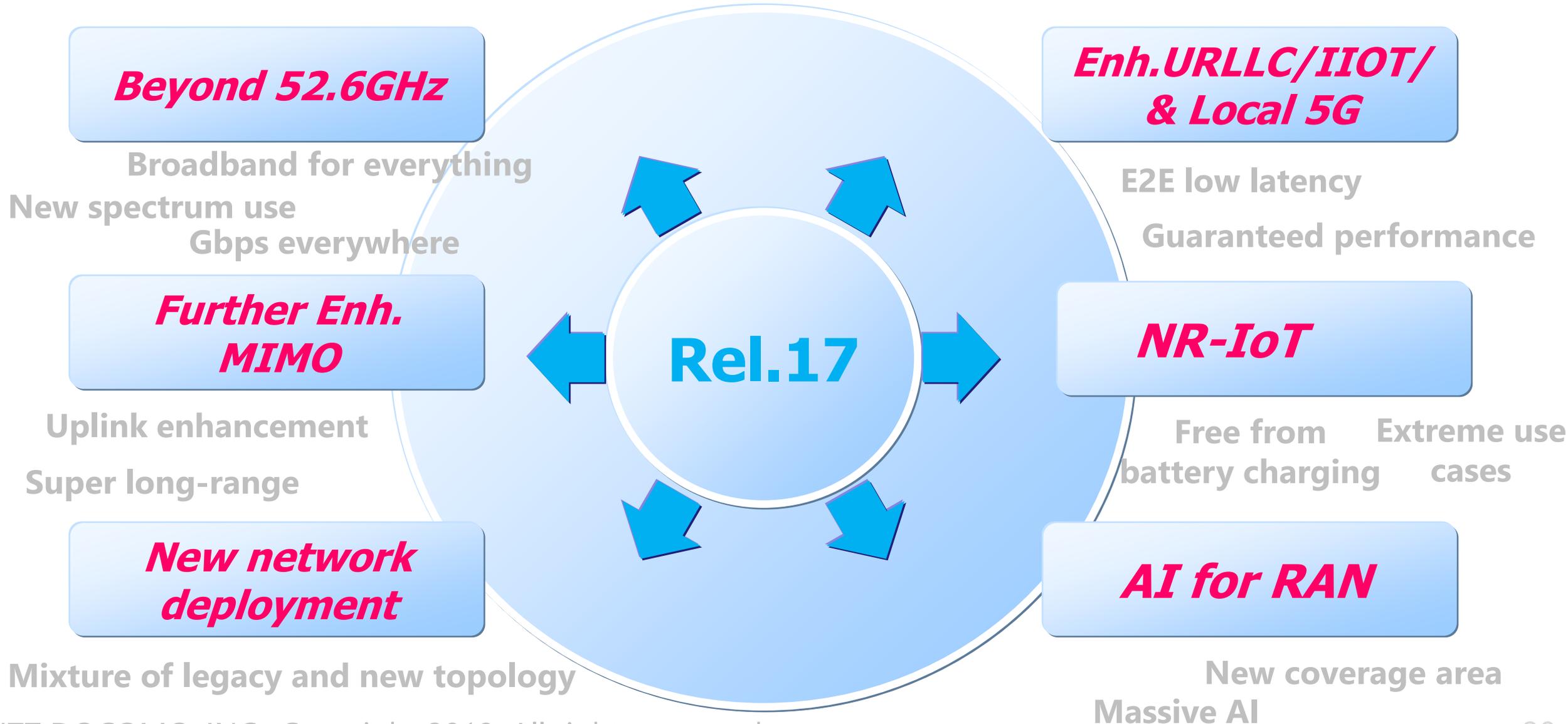


- Target usage case of NR-IoT may be different from LTE-IoT
 - ✓ Define new UE category for NR IoT
 - ✓ Relying on Rel-15 coexistence mechanism

- This evolution may happen if NR and LTE are operated in the same band
- Consider efficient way of coexistence

- LTE IoT is fully replaced by NR-IoT?
- NR IoT is for any of IoT use cases?

DOCOMO's interest for Release 17



Thank you!