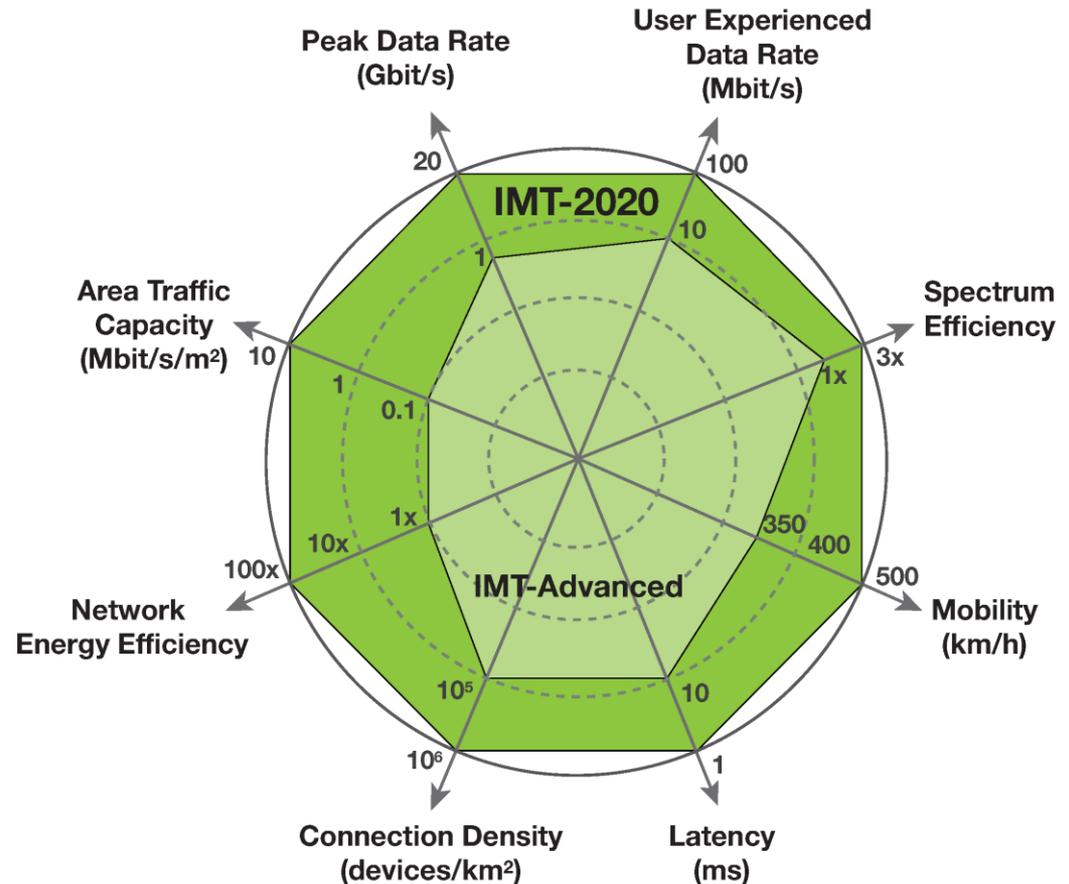


View on RAT and IMT-2020

Panasonic

Requirements of IMT-2020

- According to current draft M.[IMT.VISION] document, right figure key capabilities are agreed.
- Following use cases are recognized.
 - *enhanced Mobile Broadband*
 - *ultra-reliable and low latency communication*
 - *massive machine-type communication.*

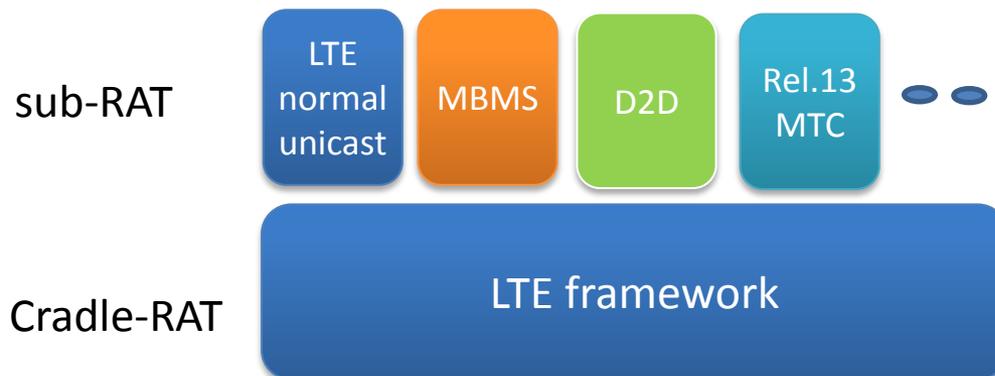


New RATs

- Single new RAT covers all requirements is difficult.
 - Smooth migration from LTE/LTE-advanced.
 - One RAT covers large difference on the requirements makes very complex RAT.
 - Different requirements are coming from different use cases (*enhanced Mobile Broadband, ultra-reliable and low latency communication , massive machine-type communication*)
- Thanks to Carrier Aggregation/Dual Connectivity like design, multiple RATs can be aggregated can be basic assumption.
 - Lower cost UE may not support aggregation but large system coverage would be designed with lower frequencies.

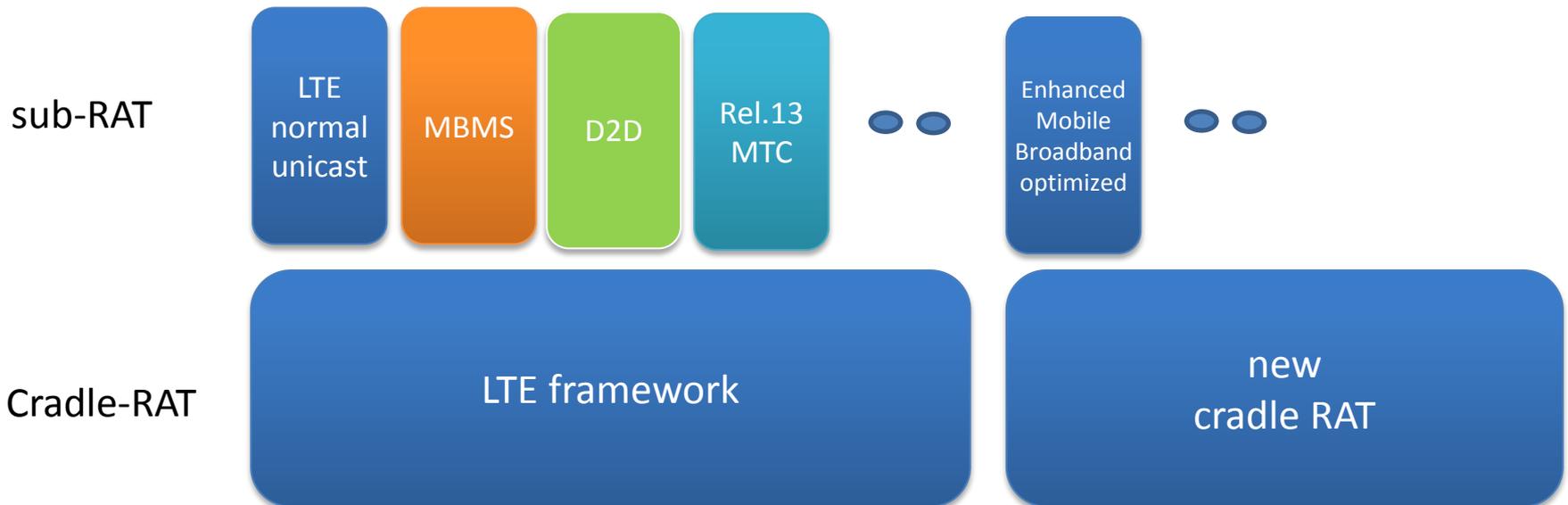
Relation of RATs

- In order to support multiple RATs flexibly, good container like structure is required. Or it could be said as "sub-RAT" on "cradle-RAT".
- The certain time/frequency resource are allocated to sub-RAT. Within sub-RAT, design/parameters are tuned to its usage scenario.
- LTE-framework is one of cradle-RAT. "1ms/PRB/CC" is one unit.
 - Sub-RAT example is MBMS, D2D and Rel.13 LC MTC.
 - In future, shorter latency or high UE speed may be covered by new sub-RAT.



Relation of RATs

- New cradle-RAT would be required from following reasons.
 - New numerology/parameters optimized for "above 6GHz".
 - To overcome the restriction coming from LTE-framework.
 - CRS presence and so on.



Relation of RATs

- Basically sub-RAT is self-contained.
 - But synchronization signal and part of broadcast information may be provided by cradle-RAT.
 - Sub-RAT can have flexible uplink , downlink and side link (D2D) usage
 - Reference signal is boundary area between sub-RAT and cradle-RAT.
 - DMRS is under sub-RAT.
- Time/frequency partition of Sub-RAT boundaries may be relatively slow change.
 - But similar to MBSFN subframe usage when no MBMS transmission, overlapped usage is also possible.
- Different numerology of sub-RAT may be used.
- Sub-RAT can be further added when release increases.

Relation of RATs

- For the concept discussion, cradle-RAT and sub-RAT are categorized but no need of clear definition. To take such high level thinking would be sufficient.
- Protocol framework is also basically common within cradle-RAT.
 - But specific optimization for each sub-RAT could be applied.
 - Network based mobility and connection oriented for high volume traffic including virtual cell without cell edge.
 - UE based mobility and connection-less oriented for low volume traffic/massive number of UEs.
- RAN-CN architecture is common within cradle-RAT.
 - Especially relation to Dedicated Core Networks (DECOR)
 - How common among different cradle-RATs is FFS.

The first sub-RAT on New cradle RAT

- "Enhanced Mobile Broadband optimized sub-RAT" on "new cradle RAT" is optimized for "above 6GHz operation" but not limited to above 6GHz usage.
- WRC-15 would raise the issue of above 6GHz frequency allocation. Until WRC-19, the actual frequency may not be determined.
 - To cover both below 6GHz and 6-100 GHz would be required.
 - Some reference frequencies for the system design would be defined.
- This sub-RAT should work well for small cell deployment.
- This sub-RAT satisfies "peak-rate 20Gbps", "100 Mbps user data rate", "3 times spectrum efficiency", "High area traffic capacity" and "1ms latency".

The first sub-RAT on New cradle RAT

- This sub-RAT can rely on beam-forming aggressively in order to compensate large path loss in above 6GHz.
 - Common channel coverage and narrow beam relation needs to be covered.
- In order to support very short latency, sub-ms order subframe is required. On the other hand, to extend the coverage is required.
 - Flexible TTI length would be required.
- Massive MIMO is fully utilized to increase the capacity.
 - CoMP framework of TM10 could be foundation of the design.
- Unlicensed band like deployment or shared usage must be supported.
 - LAA like design should be taken into account.

How to achieve remaining requirements

- Mobility 500 km/h
 - Additional RS could be considered for very high speed in LTE framework.
- Connection Density 10^6 devices/km²
 - Further enhancement of MTC/CIoT
- Network energy efficiency 100x
 - All sub-RAT/cradle-RAT should take this into account.
 - Try to minimize "always on" signal as much as possible during the design of cradle-RAT/sub-RAT.
 - Larger DRX periodicity.
 - Dynamic on/off

IMT-2020 proposal

- IMT-2020 proposal is (at least) aggregation of LTE-framework and new cradle RAT.

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