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3GPP TSG RAN Rel-18 workshop  
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Agenda Item: 4.2

# On 5G & IOT

A UE-centric perspective

Qualcomm

5G

# UE perspectives on 5G IOT

- Most important aspects from a silicon manufacturer perspective for "IOT"
  - (1) "fitness" of product to requirements
  - (2) scale (aka targeting as large a market as possible with the same design elements)
- Because of these aspects, it is important that 3GPP defines platforms that
  - (a) initially address a meaningful market segment
  - (b) gradually enhance them to increase their addressable market
  - (c) avoid fragmentation

# eMBB, LPWA, RedCap

## NR eMBB

- Defined in Rel-15
- Healthy evolution path focused on smartphone performance
- Typically leveraged to address adjacent segments
  - Eg Automotive, Fixed-Wireless Access, Connected Laptops & others

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## LPWA

- LPWA defined as ~1MHz, ~1Mbps
- Defined in Rel-13 (two variants)
- Initially fairly limited scope
  - Eg NB-IOT used to be FDD only
- 5 releases of evolution with enhancements in various directions: better performance & power consumption & increase of the addressable market size
  - Eg addition of TDD, support of NTN
- This vertical is taking longer than eMBB to ramp up
  - “New”, slower replacement rates, very cost sensitive
- 3GPP designing a new hardware platform for this segment runs the risk of fragmenting the market

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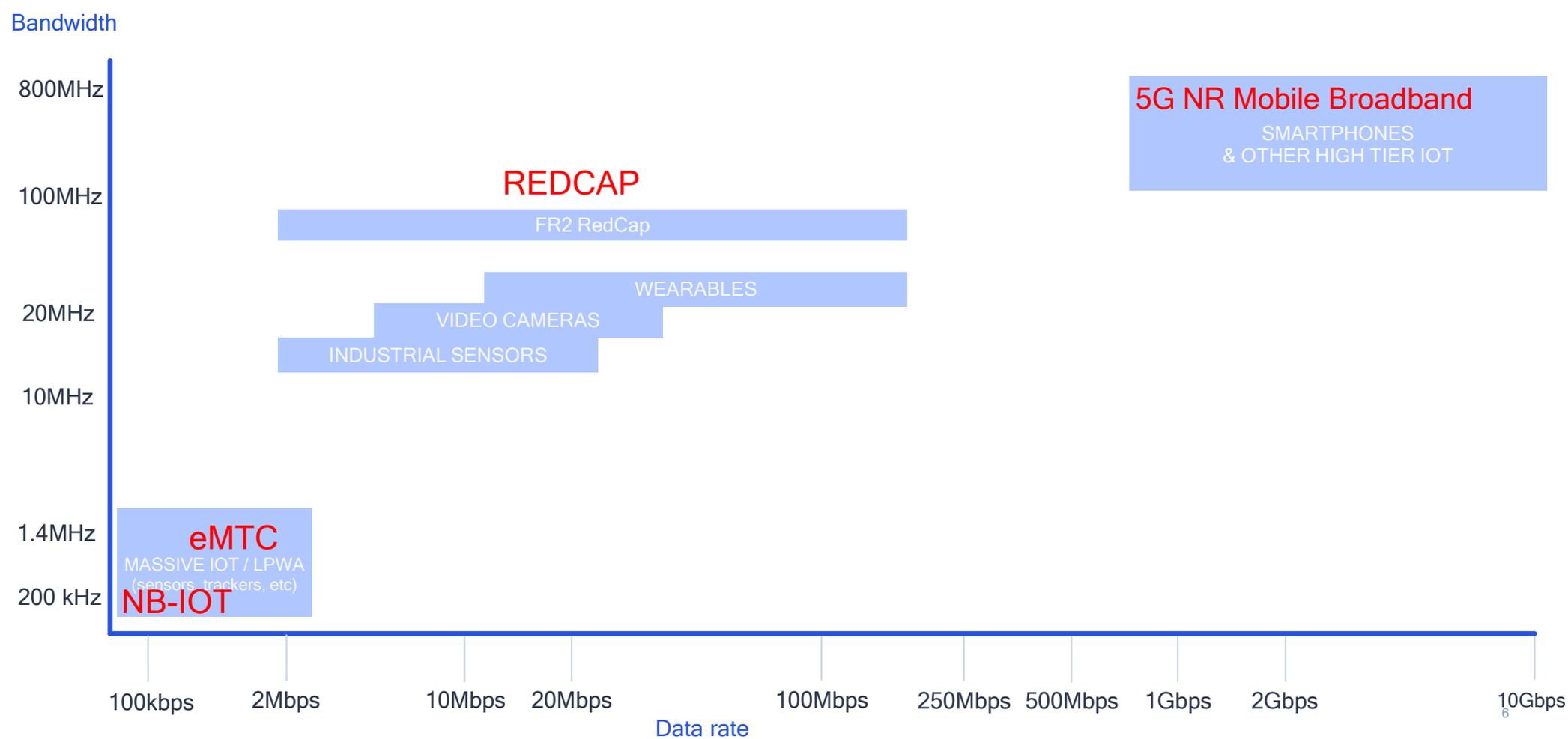
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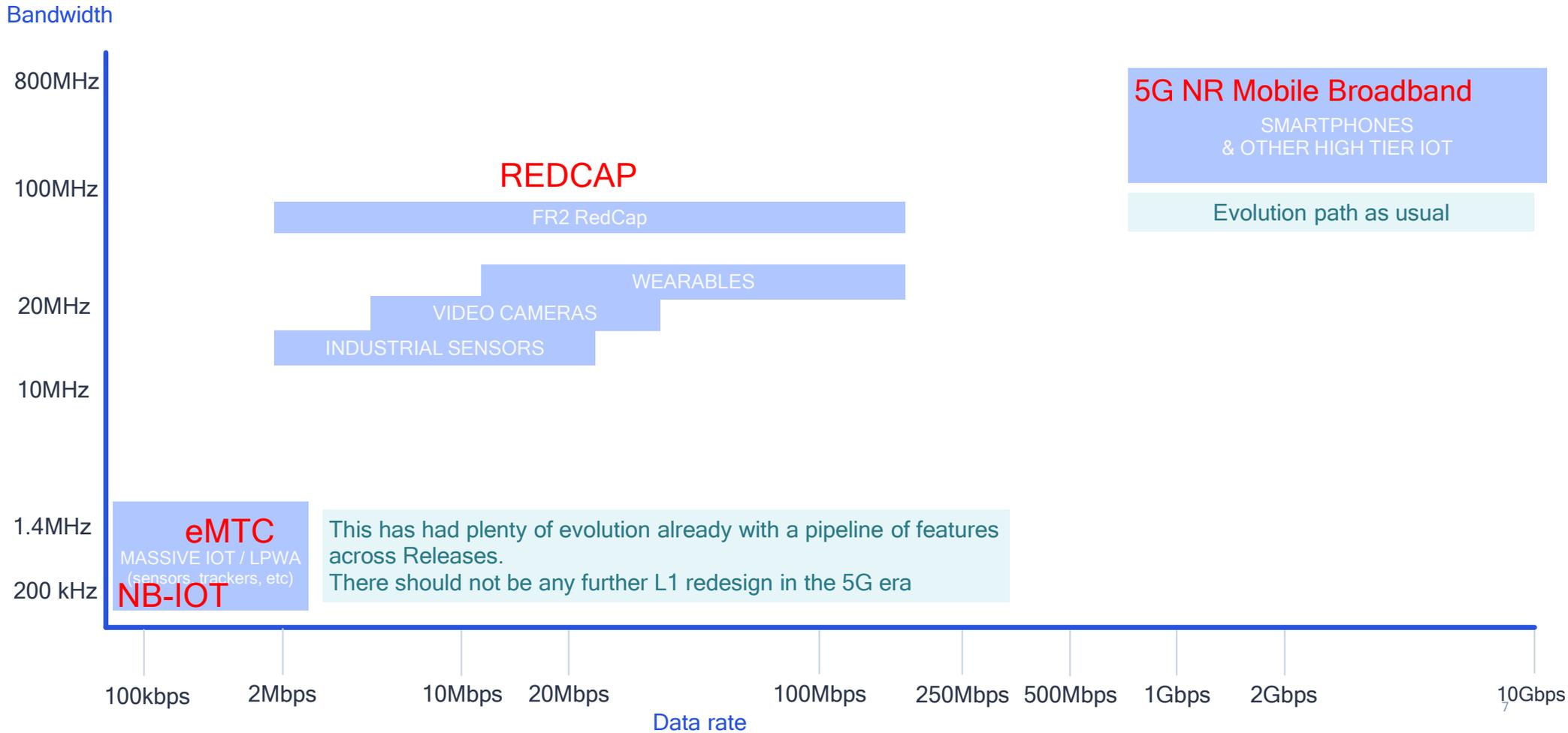
## RedCap

- Being defined in Rel-17
- Initial definition relatively limited
  - Address “mid-tier” IOT & wearables
  - FR1: 20MHz (40MHz TBD), FR2: 100MHz
- After Rel-17, 3GPP should treat RedCap in the same way as LPWA in Rel-13, i.e. **a new “platform”**
- The RedCap platform should be enhanced with additional features and also evolved towards lower tiers in such a way to gradually expand its addressable market, while leveraging the initial Rel-17 design
- **Examples** may be support of positioning, support of sidelink, beam management, different bandwidth, including smaller bandwidth below 20MHz

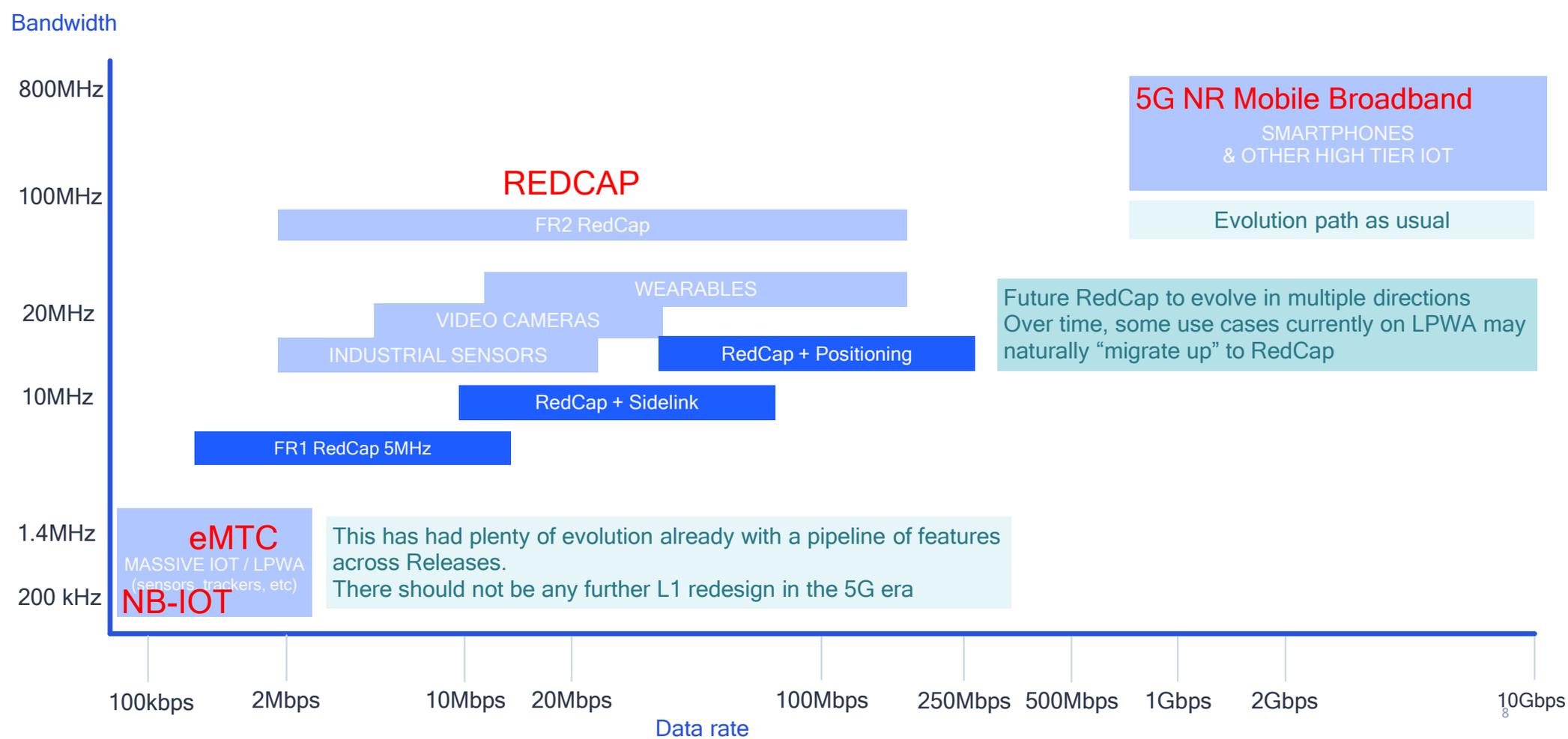
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# Conclusions & Proposals

## (1) Stop any major evolution of LPWA in 3GPP during the 5G timeframe

- From an ITU/IMT-2020 perspective, “5G mMTC” has already been addressed by eMTC/NB-IoT
- No further redesign of “5G mMTC”
- Any additional features for NB-IoT/eMTC would have to be very low impact, if any

## (2) Focus evolution on RedCap for Rel-18+

- Gradually expand the RedCap addressable market
- Over time, RedCap’s downward trajectory may partially overlap with the upper end of LPWA
- More details in the following slide

# Rel-18 proposed RedCap evolution areas

- **Support for lower bandwidth, down to 5 MHz in FR1 (not lower than 5MHz)**
  - This automatically will translate into lower peak data rate, which then means lower memory footprint & lower cost
  - Use of the scaling factor can then naturally enable multiple tiers of products
  - Support of smaller bandwidth, down to 5MHz, can be achieved with relatively limited system/network impacts (see slide in Annex A)
    - Support of 30kHz SCS would have to be further considered
    - Additional cost reduction schemes need to be also considered, e.g., timeline relaxation
- **Narrowband positioning**
  - Ensure evolved RedCap UEs can benefit from 5G positioning performance enhancement
- **Sidelink with (e)RedCap**
  - We consider this is useful for some IOT use cases where sidelink can provide some form of coverage enhancement and power saving
    - Note that support of sidelink may benefit from support of two carriers for simultaneous Uu and PC5 operations
- **Enhanced broadcast/multicast for (e)RedCap**
  - On-demand transmission, RX antenna/BWP switching and PDCCH enhancements for simultaneous scheduling of unicast and multicast
- **Co-existence with legacy UE**
  - BWP and RACH enhancements, inter-UE priority handling, DSS support, beam management
- **Coverage improvements for Uu interface**
  - Lower priority than other items above depending on available time
- **Mobility enhancement**
  - Optimization for stationary deployment, especially important for FR2 use cases (see Annex B), e.g., measurement reduction, BFR procedure
- **Power saving techniques**
  - Study benefits of low-power wake-up radio beyond what is offered by Rel-16 WUS and Rel-17 PEI
- **Upper-layer enhancements**
  - Enhancements to support further reductions in UE capability/complexity (e.g. access, cell re-/selection, user-plane simplifications, etc)
  - Small data transfer (SDT) in RRC Idle and further enhancement to SDT over PUR

*Note: All enhancements above (other than the first bullet) can be applicable for both 20MHz and 5MHz UE types in FR1*



# Thank you!

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## Annex A: RedCap UE BW Evolution & System Impact Assessment for FR1

Spec impacts	20MHz (Rel-17 RedCap)	Candidate bandwidths for Rel-18	
		10MHz (52PRB 15KHz SCS)	5MHz (25PRB 15KHz SCS)
Peak data rate - DL	160+ Mbps (2 layers, 64QAM)	40 Mbps (1 layer, 64QAM)	20 Mbps (1 layer, 64QAM)
Peak data rate - UL	80+ Mbps (1 layer, 64 QAM)	20 Mbps (1 layer, 16QAM)	10 Mbps (1 layer, 16QAM)
PSS/SSS (12 PRB)	Reuse	Reuse	Limited reuse (15KHz SCS)
PBCH (20 PRB)	Reuse	Reuse	Limited reuse (15KHz SCS)
CORESET #0 (24/48/96 PRB)	Reuse	Limited reuse (24/48 PRB with 15KHz SCS or 24 PRB with 30KHz SCS)	Limited reuse (24 PRB with 15KHz SCS)
PRACH (long: 6 PRB, short: 12 PRB)	Reuse	Reuse	Reuse
PDSCH	Reuse	Reuse	Reuse
PDCCH*	Reuse	Reuse	Reuse
PUSCH	Reuse	Reuse	Reuse
PUCCH	Reuse	Reuse	Reuse
SRS ( $\geq 4$ PRB)	Reuse	Reuse	Reuse
CSI-RS/TRS ( $\geq 24$ PRB)	Reuse	Reuse	Reuse
PSBCH/S-PSS/S-PSS (sidelink, 11 PRB)	Reuse	Reuse	Reuse

\* Compact DCI may be introduced in Rel-17 and future releases

## Annex B: RedCap Use Cases & FR2 applicability

### Generic Requirements

Device complexity	Lower the device cost and complexity as compared to high-end eMBB and URLLC devices of Rel-15/Rel-16 (especially for industrial sensors)
Device size	Enable a device design with compact form factor
Deployment scenarios	System should support all FR1/FR2 bands for FDD and TDD

### Use case specific requirements

	Industrial Wireless Sensors	Video Surveillance Cameras	Wearables
References	22.832, 22.104, 22.804	22.804	
Latency	< 100 ms, safety related: 5-10 ms	< 500 ms	
Reliability	99.99%	99% - 99.9%	
Data Rate (Mbps)	< 2 (UL heavy)	UL dominated Economic: 2-4, High End: 7.5-25	Ref DL/UL = 5-50/2-5 Peak DL/UL = up to 150/50
Battery	Few years	May use power supply → no power issue	Multiple days (up to 1-2 weeks)
Mobility	Stationary		Mobile

FR2 candidate

Possible FR2 candidate  
(e.g., medical devices)