



Motivation for New WI: High-Performance eMTC (HeMTC)

Agenda item: 10.1.1

Source: Intel Corporation

Document for: Discussion

Introduction

In Release 12: Category 0 UE and Power Saving Mode (PSM)

- Cat. 0 UE reduces the UE complexity and the peak data rate compared to Cat. 1 UE.
- PSM extends the battery life for devices with relaxed MT reachability requirements.

In Release 13: eMTC, eDRX and NB-IoT UE

- eDRX extends the battery life for devices with stricter MT reachability requirements.
- eMTC
 - Cat. M1 UE reduces device complexity vs. Cat. 0 UE (e.g. simplifying features, 1.4 MHz BW operation).
 - Cat. M1 reduces the peak data rate vs. Cat. 0 (e.g. around 300 kbps when operating in HD-FDD and 800 kbps when operating in FD-FDD)
 - Enhanced coverage (+15 dB over LTE).
- NB-IOT
 - NB-IOT UE reduces device complexity vs. Cat. M1 UE (e.g. simplifying features, 180 kHz BW operation).
 - NB-IOT reduces the peak data rate vs. Cat. M1 (e.g. around 200kbps)
 - Support for extreme coverage (+20dB)

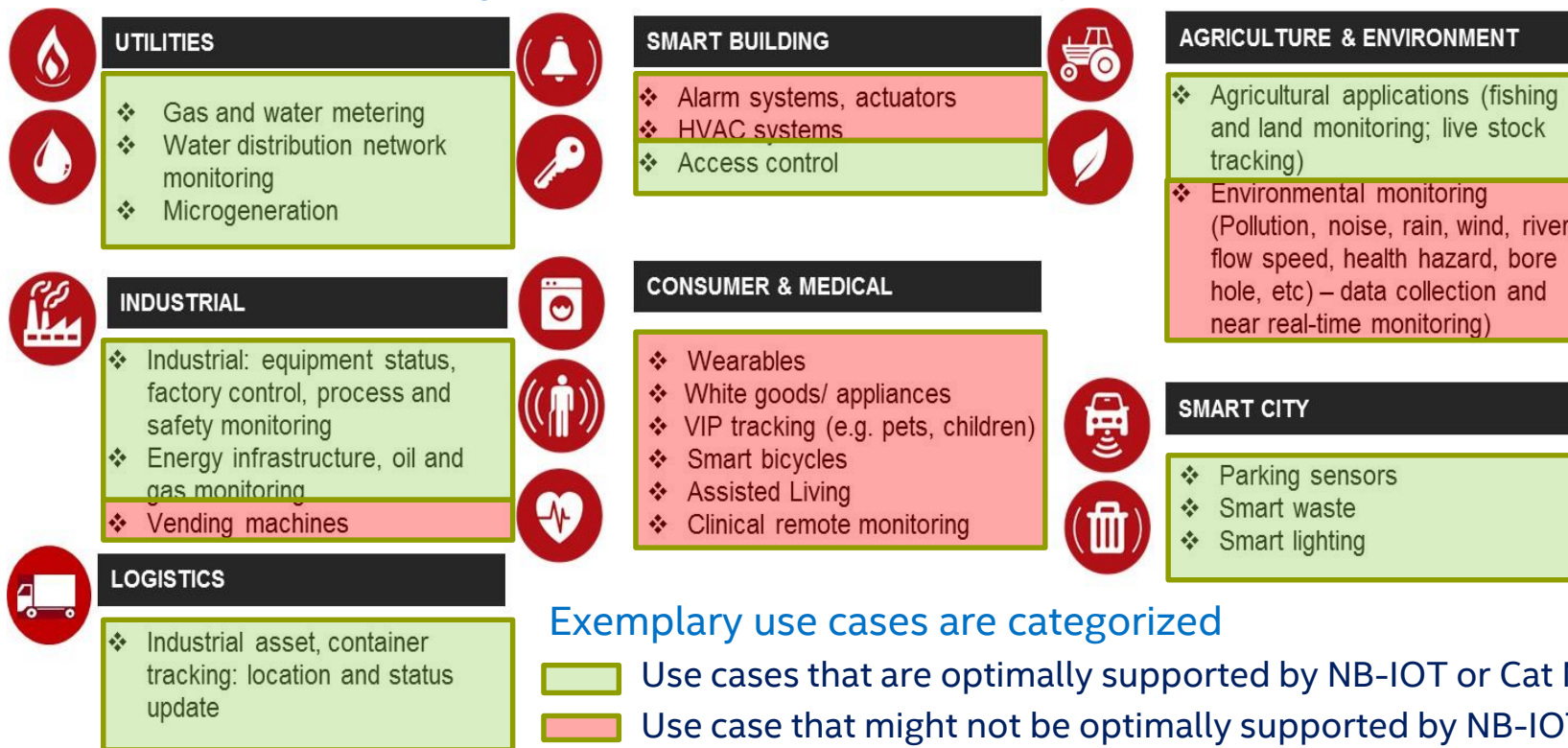
In Release 14: High-performance eMTC UE

- Support of VoLTE with no coverage loss compared to Cat. 1 LTE UE and
- Higher data rates (e.g., in the order of several Mbps)

while getting the benefits introduced by Rel-13 BL MTC UEs (e.g., UE complexity reduction, support coverage enhancements) amongst others.

Use Case Examples

MTC/IoT use cases for higher data rates and lower latency than Rel-13 eMTC and NB-IoT

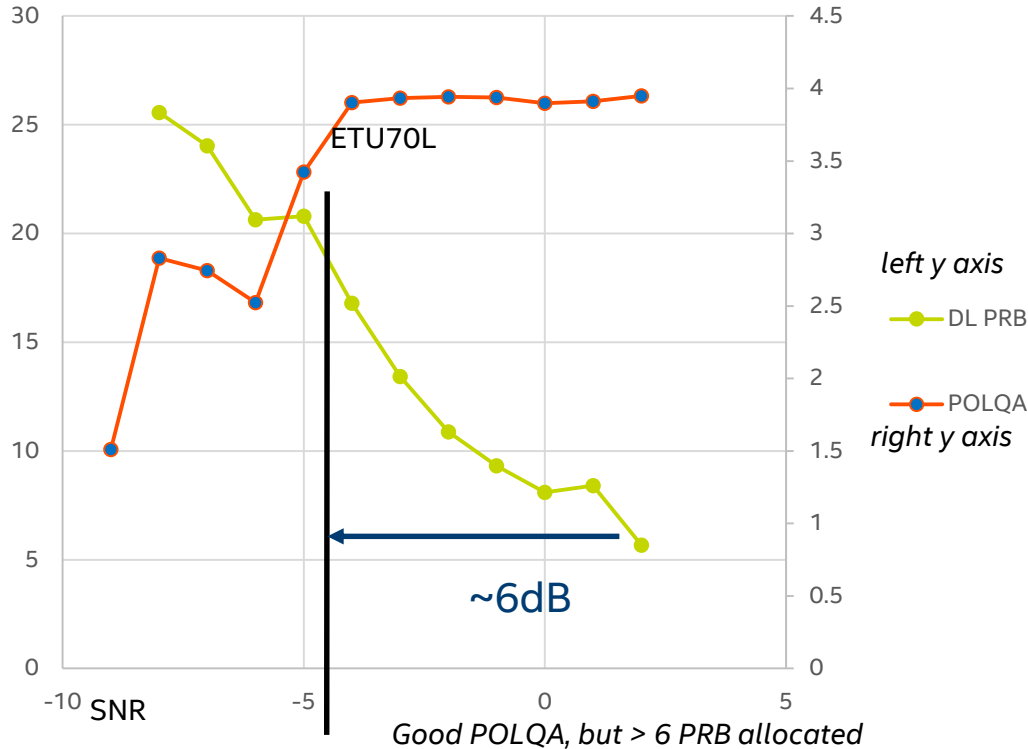


Exemplary use cases are categorized

- Use cases that are optimally supported by NB-IOT or Cat M1
- Use case that might not be optimally supported by NB-IOT or Cat M1 due to the required support of voice or the data rate, e.g.:
 - Wearables supporting voice or video connecting directly to the network without using the smart phone as concentrator.
 - Health care requiring call feedback opportunities for emergency
 - Tracking with voice to guide lost children or trouble shooting
 - Surveillance to trigger voice or video for monitoring purposes

(*)Source for use cases: Analysis Mason, 2015

Measurement Results Cat 1 (DL)



Scenario:

- DL 2 RX; BW: 20 MHz
- Each SNR point consists of 50 Harvard sentences (~ 50*10 sec.)
- Averaging of POLQA and PRB allocation over 500sec. is done for each SNR point.
- AMR-WB 12.65 kbps TBS 712 bits
 - IPv4 (20 byte) + RoHC + C-DRX-40
- Target Coverage: $\text{SNR}_{\text{Target}} = -4 \text{ dB}$ (R1-143769)

➔ For Cat 1, an allocation with up to a maximum of 6 PRB is only possible for $\text{SNR} \geq 2 \text{ dB}$.

Cat M1 needs to enhance coverage by 11 dB to support AMR12.65 like with legacy LTE categories:

- 6 dB due to the lower number of PRBs in Cat. M1
- 5 dB due to the single antenna and the loss of frequency diversity in Cat M1

Therefore Cat M1 does not support VoLTE with the same coverage as for Cat 1

Objectives

A new feature for a UE targeting higher data rate MTC/IoT applications as a (backward compatible) evolution of Rel-13 eMTC aiming to re-use the specified Rel-13 design

- Enhance support for delay sensitive services (such as VoLTE)
- Enhance peak data rates on the order of several Mbps
 - For example, AMR-WB requires a TBS of 2000 bits for voice packets with uncompressed IP headers (DRX-40)
- Enhancements to bandwidth-reduced (BR) operation to enable scalable bandwidth support in RRC connected mode depending on data rate requirements
 - (1) The new solution targets UEs in connected mode (i.e. UEs in idle mode behaves as Rel-13 BL (Cat-M1) UEs)
 - (2) In general, the UE still operates in BR manner with respect to the system BW supported by the eNB
 - (3) The UE only receives a given number of PRBs (within a maximum reduced bandwidth) depending on the required data rate at any given time.

Key Characteristics Summary (1/2)

Advantages over Cat.1

- BW on demand for scalable data rate up to a maximum bandwidth within the maximum supported LTE system bandwidth
- Reduced complexity

Cat. 1	Estimation ⁽¹⁾	Cat. M1
100%	~55%	45%

- Reduced power consumption

	Cat. 1	Estimation ⁽¹⁾	Cat. M1
Idle ⁽²⁾	100%	~65%	60%
VoLTE (high SNR, normal coverage) ^(3,4)	100%	~55%	55%
VoLTE (low SNR, low coverage) ^(3,5)	100%	~65%	NA

- Cost reduction

Advantages over Cat.M1

- Higher data rates (several Mbps)
- Improve the support of delay sensitive services (e.g. VoLTE)

Maximal reuse of Cat M1 design

- Cross-subframe scheduling
- No simultaneous reception of multiple TBs
- Limited support of transmission schemes and modes
- No dynamic scheduling for SI message transmissions
- Random access and paging support via “M-PDCCH” CSS instead of legacy PDCCH spanning entire LTE system BW
- HD-FDD with optimizations beyond Cat M1
- UE Requirements based on 1 RX

(1) Based on a maximum bandwidth of 5MHz, FD-FDD.

(2) 1.28s eDRX

(3) DRX 40ms, (M-)PDCCH, on duration 4ms, inactivity timer 4ms, max. HARQ Tx 4, Band 4, speech activity 40/40/20

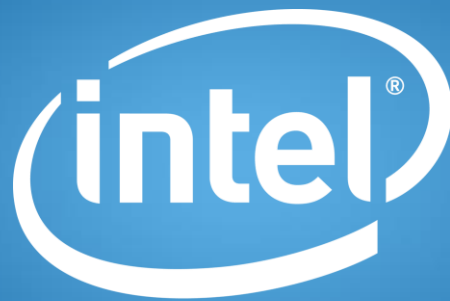
(4) 0dBm, 6PRB P_{SCH}

(5) PDSCH: 18 PRB for 1-rx, 9 PRB for 2-rx (Cat 1), PUSCH: 6 PRB, 23 dBm

Key Characteristics Summary (2/2)

Characteristics	Cat. 1	Rel-12 Cat. 0	Rel-14 HeMTC	Rel-13 Cat. M1
Peak data rates	DL/UL 10/5 Mbps	DL/UL 1/1 Mbps	DL/UL: no less than 3/2 Mbps	800kbps FD / ~300Kbps HD
Rx chains, layers	2, 1	1, 1	1, 1	1, 1
BW	1.4, 3, 5, 10, 15, 20 MHz	1.4, 3, 5, 10, 15, 20 MHz	e.g. 1.4, 3, 5 MHz	1.4 MHz
Deployments	Standalone LTE channel, HD-FDD optional	Standalone LTE channel, HD-FDD optional	Standalone, LTE in-band, HD-FDD preferred	Standalone, LTE in-band, HD-FDD preferred
Max. modulation	DL 64-QAM, UL 16-QAM	DL 64-QAM, UL 16-QAM	e.g. DL 16QAM, UL QPSK	DL/UL 16-QAM
Max. UE Tx power	23 dBm	23 dBm	23 dBm	20/23 dBm
PSM, eDRX, mobility	connected mode mobility	connected mode mobility, PSM	eDRX, connected mode mobility	PSM, eDRX, connected mode mobility
Coverage, MCL	DL: 145.4 dB (20 kbps, FDD) UL: 140.7 dB (20 kbps, FDD)	DL: 145.4 dB (20 kbps, FDD) UL: 140.7 dB (20 kbps, FDD)	similar to Cat-M1 Mode A at least	target 155.7 dB (15 dB improvement) at least in certain conditions
LTE design	LTE	LTE	Cat M1 with enhancements to enable scalable bandwidth	repetition, M-PDCCH, X-SF scheduling
DL Scheduling	PDCCH, EPDCCH	PDCCH, EPDCCH	M-PDCCH with enhancements	M-PDCCH
Support of VoLTE	Yes	Yes (possible limitations because of reduced TBS)	Yes	Limited support especially for HD-FDD
Complexity scaling [36.888]	100%	~55% [36.888] ⁽¹⁾	~55% ⁽¹⁾	~45% ⁽¹⁾

⁽¹⁾Comparison assumes FD-FDD



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