

Powering the IoT growth by 4G and 5G technologies

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The Internet of Things (IoT) is here



Cellular technologies enable a wide range of IoT services Bringing significant value for LPWA' use cases over non-3GPP solutions



1. Low-power, wide-area; 2. Including cellular and LPWA M2M connections, Machina Research, May, 2017

Ubiquitous connectivity

To reach challenging locations by achieving device link budget of 164 dB³

Ultra energy efficiency

To realize10+ year device battery life² and 100x network energy efficiency³

Massive scale

To efficiently support dense connections of 1+ million devices/km

Evolving LTE IOT

for the massive Internet of Things

Extreme simplicity

To allow scaling to the lowest-end use cases with e.g., single Rx antenna

Addressing the growing needs of low-power, wide-area IoT use cases

1. Maximum Coupling Loss, assuming data rate of 160bps; 2. Assuming 200B UL + 20B DL per day at 164 MCL with 5Wh battery; 3. Compared to IMT-Advanced

LTE provides a scalable IoT connectivity platform



Reducing complexity: start supporting narrowband operation

To enable low-cost modules optimized for small, infrequent data transmissions

	LTE Cat-1 (Rel-8)	eMTC Cat-M1 (Rel-13)	NB-IoT Cat-NB1 (Rel-13)
Peak data rate	Up to 10 Mbps	Up to 1 Mbps ²	<100 kbps
Bandwidth	Up to 20 MHz	1.4 MHz	200 kHz
Rx antenna	Dual Rx ¹	Single Rx	Single Rx
Duplex mode	Full duplex FDD/TDD	Full or Half duplex FDD/TDD	Half duplex FDD
Mobility	Full mobility	Limited-to-full mobility	Cell reselection only
Voice	VoLTE	VoLTE	No voice support
Transmit power	23 dBm	23, 20 dBm ³	23, 20 dBm ³

Reduces baseband/RF complexity and decreases memory

1. Single Rx added in Rel-14; 2. Full duplex mode, ~300 kbps in half-duplex mode; 3. Integrated PA possible

Strong global momentum for LTE IoT – June 2017 status Over 20 mobile operators committed to deploy Cat-M1 and/or Cat-NB1 networks



Sources: GSA NB-IoT Report Feb. 2017; AT&T, NTT DoCoMo, KDDI, KPN, Orange, TELUS, Telstra, Telefonica, Verizon, Feb. 2017, Sprint May 2017, Bell June 2017; SKT, Softbank, SFR from GSA 4G Market & Technology Update, Jan. 2017

We are driving broad ecosystem adoption of LTE IoT Addressing a wide range of applications and enabling global deployments

Commercial LTE IoT devices

- Multiple design wins across leading module OEMs & operators
- Announced support for Verizon ThingSpace Platform, Jan. 2017
- Demonstrated LTE IoT VoLTE call with Ericsson & AT&T, Feb. 2017
- Announced 1st multi-mode trial with Mobike & China Mobile, May 2017





- Global multi-mode solution—single SKU
- Cat-M1 modules commercially available today
- Over-the-air software upgrade to Cat-NB1 support
- Pre-certified for major global mobile operators

MDM9206 is a product of Qualcomm Technologies, Inc.

A rich roadmap of enhancements in 3GPP Rel-14 & 15

eMTC

Enhancing VoLTE¹ For wearables to more efficiently handle voice in half-duplex mode

eMTC and NB-IoT Single-cell multicast¹ Efficient OTA firmware update for large number of devices

Device positioning¹ Providing location services for e.g., asset tracking and eCall

Higher data rate¹ Supporting wider bandwidth, e.g.,

5 MHz, and more³

NB-IoT

Additional cyclic prefixes to support

cell radius of at least 100km



Better mobility

Full support for inter-frequency measurements¹ and higher velocity in extended coverage²



Lower latency More HARQ processes¹, faster system

More HARQ processes', faster system acquisition², early data transmission²

Energy reduction

Wake-up radio for low-power channel monitoring⁴ and lower transmit power classes⁵

Higher density support²

Improved load control with level-based access class barring

TDD support²

For deployment in higher TDD bands, also further optimizing for small cells

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-Release 14 and 15 enhancements

1. Rel-14 feature; 2. Rel-15 feature; 3. FeMTC adds support for 5 MHz, larger TBS, more HARQ processes, eNB-IoT increases TBS and HARQ process; 4. Also relaxed monitoring for cell reselection, semi-persistent scheduling, quicker RRC release in Rel-15; 5. eNB-IoT adds 14 dBm in Rel-14, lower transmit power proposed for eFeMTC in Rel-15;

5G - a unifying connectivity fabric Enabling always-available¹, secure cloud access



LTE IoT starts to connect the massive IoT today Complemented with early 5G NR eMBB deployments starting in 2019



5G NR Rel-15 focuses on enhanced mobile broadband, also suitable for high-performance IoT, while LTE IoT address the massive IoT

LTE IoT leverages existing LTE infrastructure & coexist with other services such as Gigabit LTE – the anchor to the 5G experience

1. Ultra-reliable, low-latency communications; 2. 3GPP also defining new 5G core network that will support continued eMTC and NB-IoT evolution

Accelerating 5G NR, the global standard for 5G





Leading the LTE loT evolution to connect the massive loT

- LTE IoT starts to connect the massive IoT today
- Continued LTE IoT evolution is broadening use cases
- We are driving broad ecosystem adoption of LTE IoT

Learn more at: http://www.qualcomm.com/LTE-IoT

Thank you

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