# Next generation cellular

## Challenges for M2M scenarios

Yue Li

# What is 5G?

Avalanche of
**Traffic Volume**

**Further expansion of mobile broadband**

**Additional traffic due to communicating machines**

**"1000x in ten years"**

Massive growth in
**Connected Devices**
***"Communicating machines"***

**"50 billion devices in 2020"**

Large diversity of
**Use cases & Requirements**

**Device-to-Device Communications**

Car-to-Car Comm.

**New requirements and characteristics due to communicating machines**

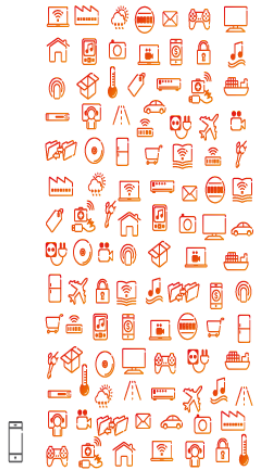
**Figures above come from the publications of Metis Project.*

# Technical Objectives for 5G

**1000x data volume**

1000x
higher mobile data volumes

**50/500 B devices**



10-100x
higher number of connected devices

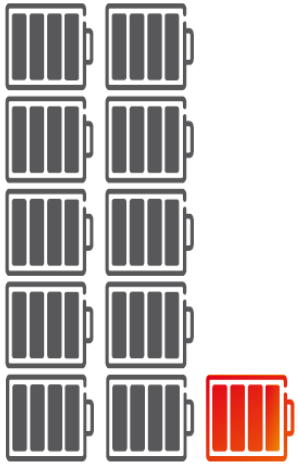
**Up to 10Gbps**

10-100x
typical end-user data rates

**Few ms E2E**

5x
lower latency

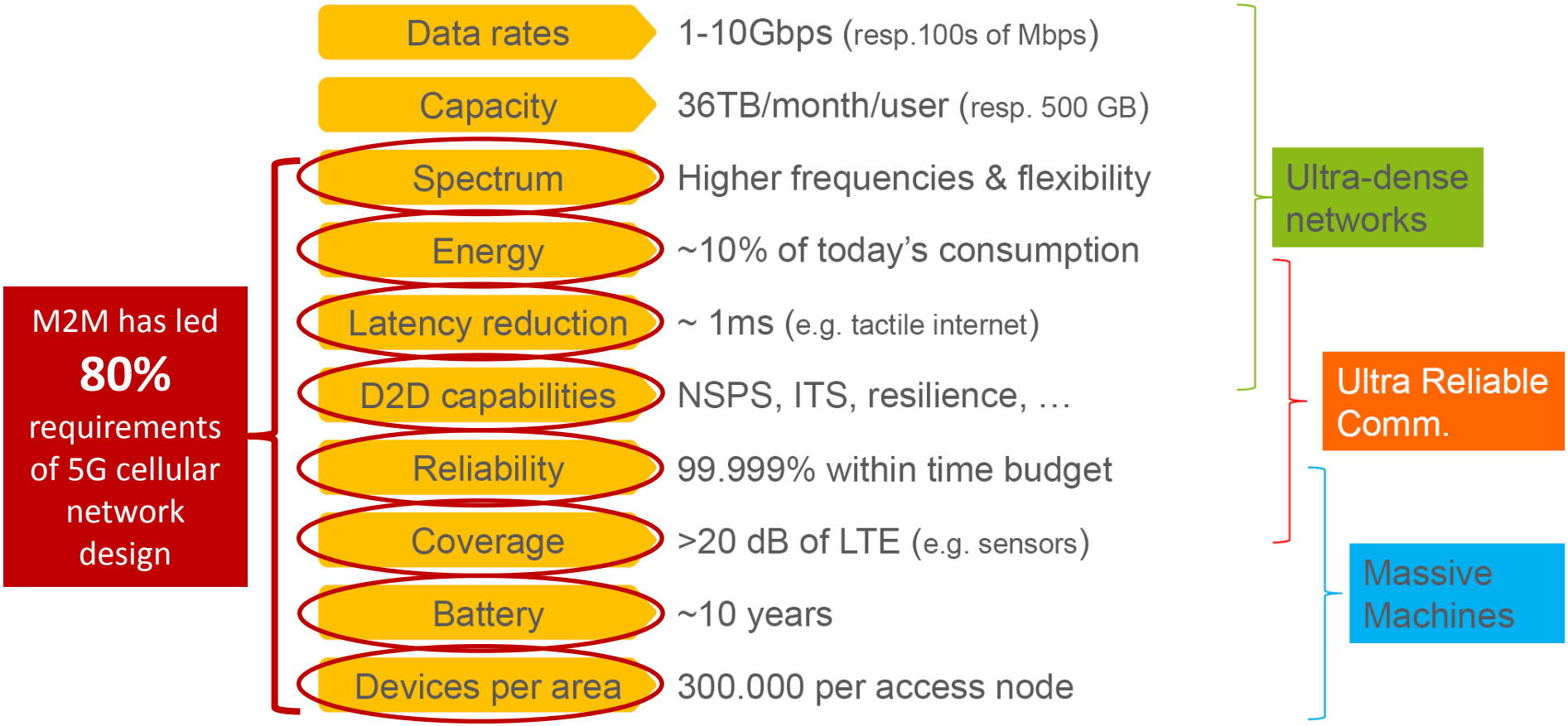
**10 years**



10x
longer battery life for low-power devices

**Figures above come from the publications of Metis Project.*

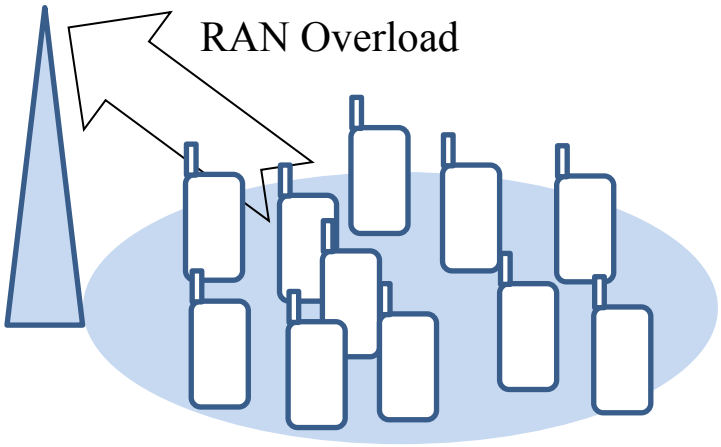
# M2M leads the requirements of 5G



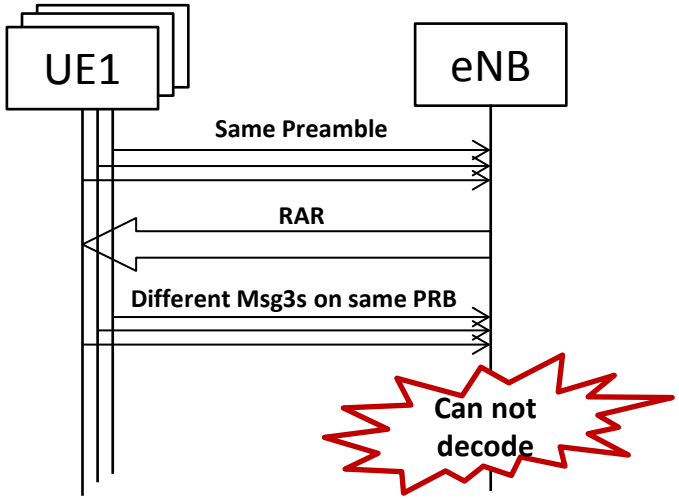

**Part of figures above come from the publications of Metis Project.*

# Challenges for M2M

## 1. Large number of M2M devices




Synchronized Report




- Proposed solutions:

1. *Spread the preamble transmissions of UEs*
2. *Introduce more PRACH resources.*
3. *Paging or group paging based solutions.*
4. *ACB based (including scale factor scheme and bitmap scheme)*

- Finally, 3GPP accepted the ACB based solution (bitmap).

- **Enough??**

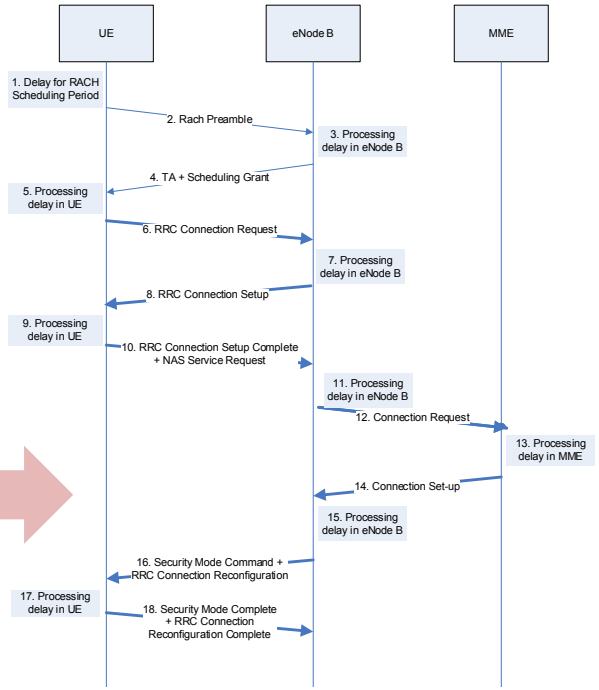
# 2. Small packet transmission

How many signaling have to be transmitted in order to sent a single small M2M packet?

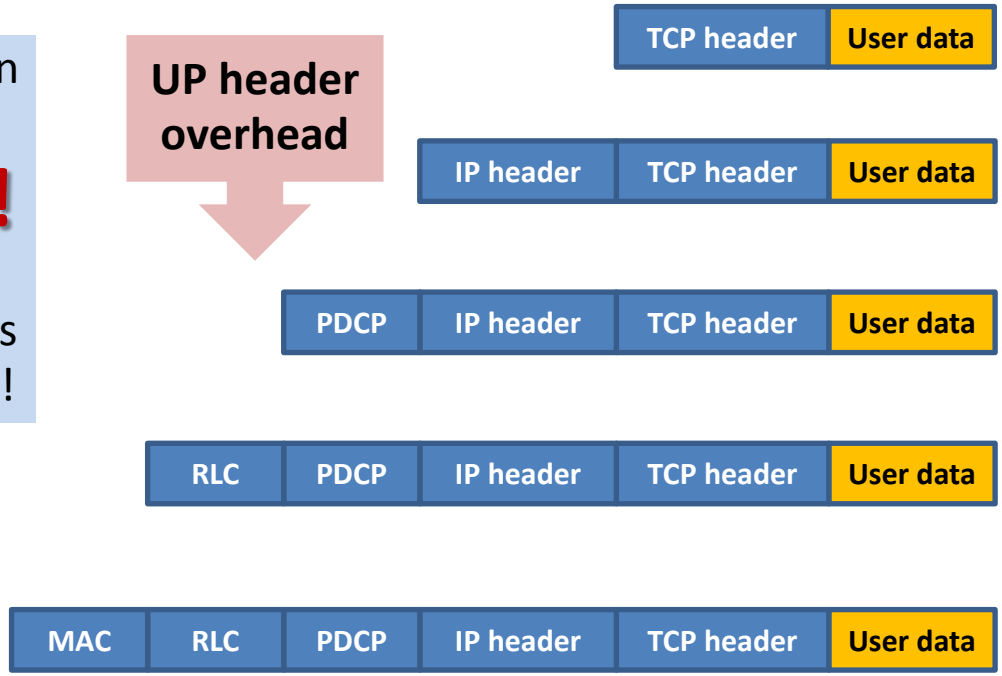
**Signaling >> User's data** **Inefficient!**

Because the current cellular networks such as UMTS/LTE/LTE-A are designed for H2H traffic!

**Signaling overhead**




**UP header overhead**



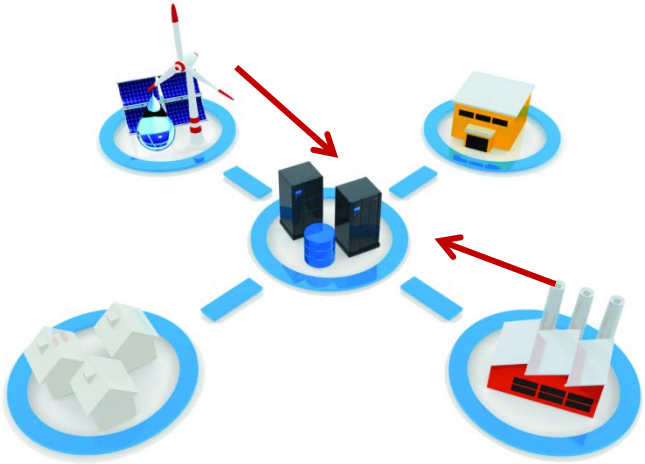

How many UP header have to be transmitted in order to sent a single small M2M packet?

**UP Header >> User's data** **Inefficient!**

Even the header compression cannot work if there is only one packet to be transmitted!

## 3. Low latency requirement

**Emergency report in Smart grid**



**Emergency warning broadcast in ITS**

The latency requirements varies among different applications, starting from 30ms to 5ms, even 1ms.

**However,**

The typical latency of current LTE system is **80ms at least !**

# Challenges for M2M

4. Low cost and low power requirements

**M2M monitoring applications**


**e.g. Earthquake monitoring**

**Low cost = Industry development**
**Low power = Low maintaining consumption**

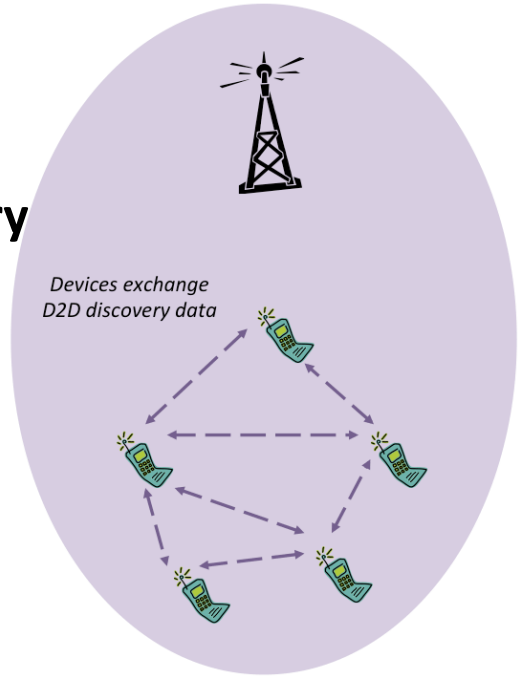
**Reduce the complexity and power consumption of wireless module:**

1. *Bandwidth reduction*
2. *Tx power reduction*
3. *……*

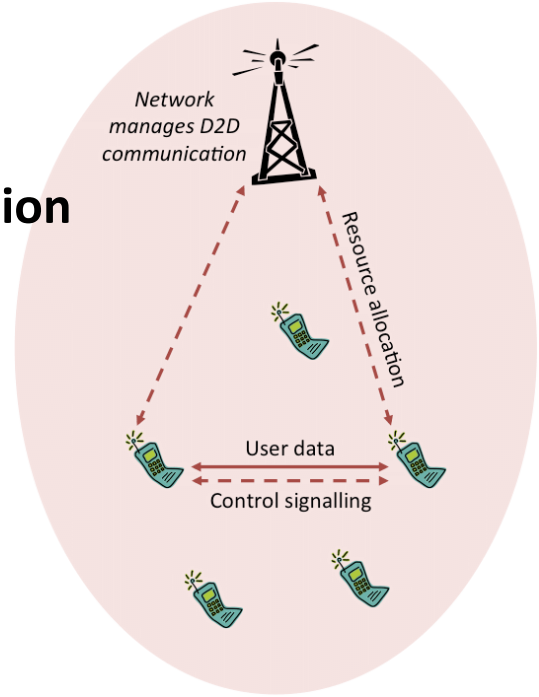
# 5. Network controlled D2D

**e.g. Car-to-Car communication**

**D2D discovery**



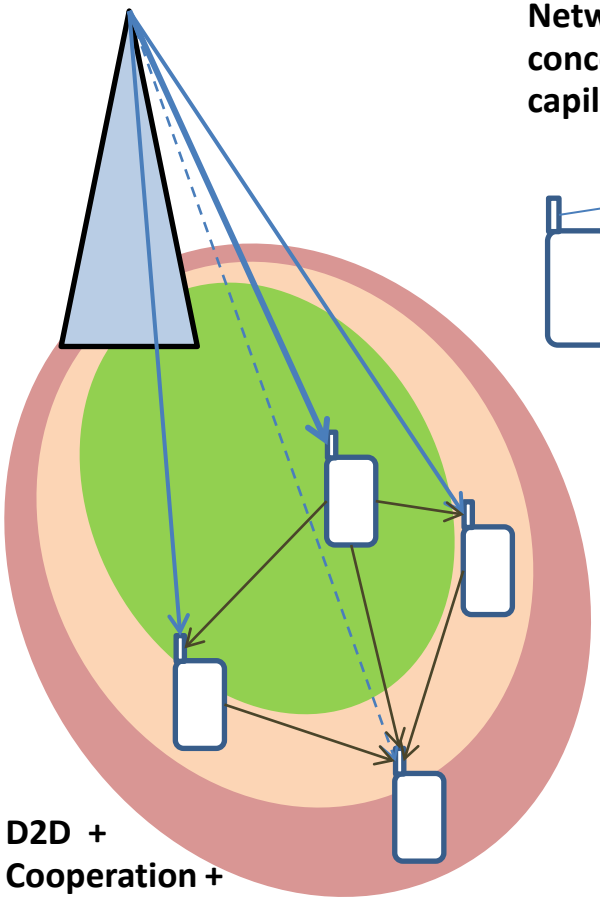

**D2D transmission**



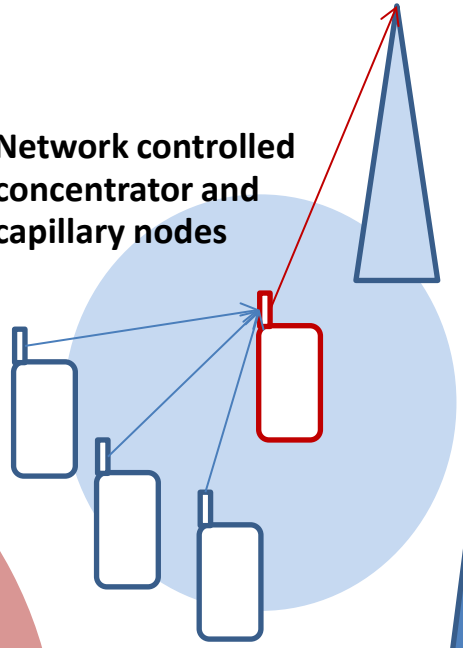

LTE based D2D had been introduced to 3GPP specification in R12.

**It's only a start now!**

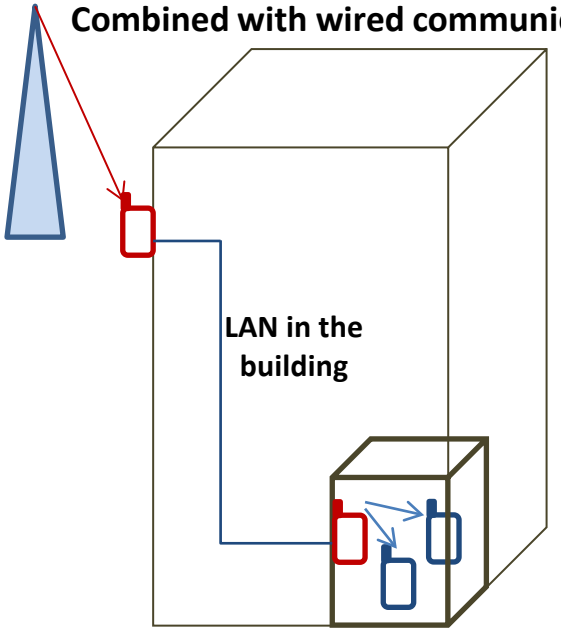
# Way forward



D2D +
Cooperation +
network coding + Fountain code

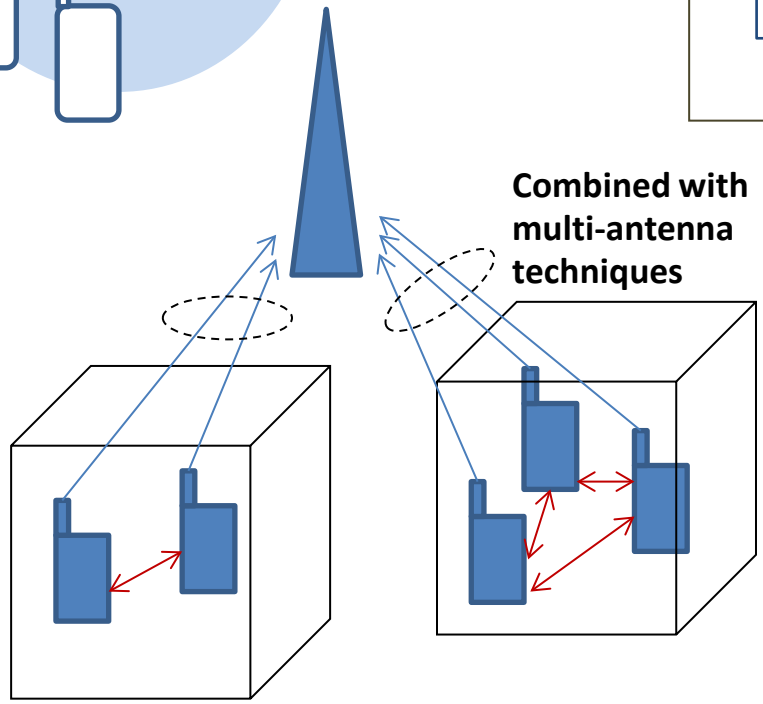


Network controlled
concentrator and
capillary nodes



Combined with wired communication

LAN in the
building



Combined with
multi-antenna
techniques

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