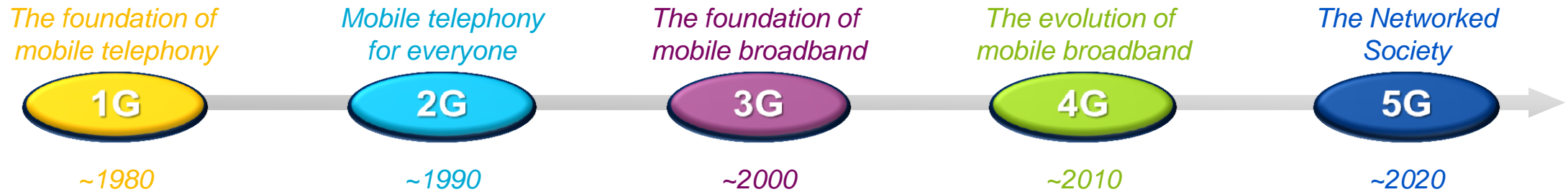


# M2M COMMUNICATIONS IN FUTURE CELLULAR NETWORKS

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**Ericsson Research**

VDE/ITG Fachtagung Mobilkommunikation  
Osnabrück, 21. - 22. Mai 2014

# WIRELESS ACCESS GENERATIONS

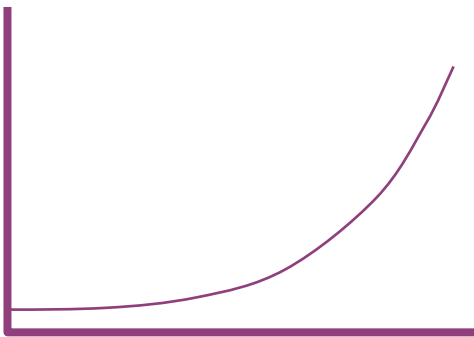


*Non-limiting access to information and sharing of data  
anywhere and anytime for anyone and anything*

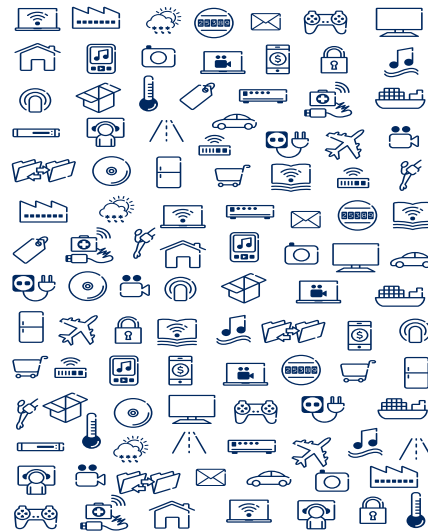
# KEY CHALLENGES



Massive growth in  
**Traffic Volume**



Massive growth in  
**Connected Devices**



Wide range of  
**Requirements & Characteristics**

- Data rates
- Latency
- Reliability
- Energy performance
- Cost
- .....



***Affordable and sustainable***



# WHAT DOES 5G BRING?

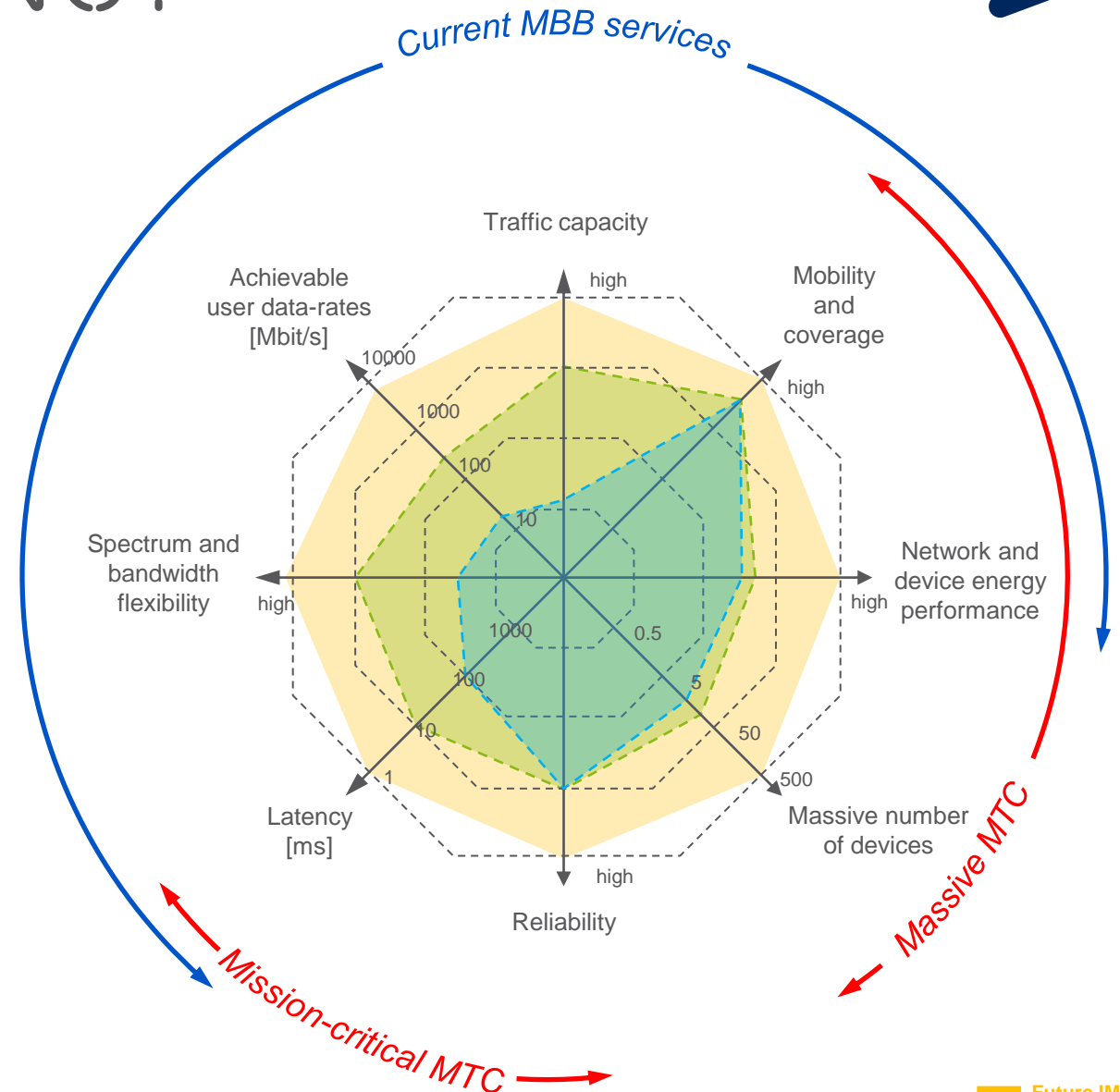


## › Enhancing current Mobile Broadband Services

- Massive capacity, very high end-user data rates, low latency, improved energy performance, ...

## › Enabling new use cases – “Machine-Type Communication”

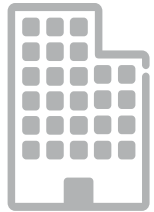
- Massive MTC, Mission-critical MTC, ...



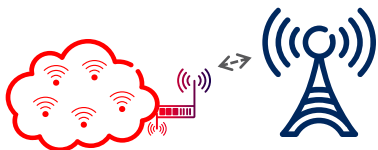
# MACHINE TYPE COMMUNICATION



## Massive MTC



Sensors, actuators



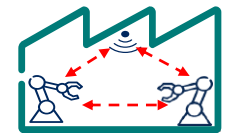
Capillary networks

- › Ultra-long range
- › Low protocol overhead
- › Scalable Access
- › Capillary Networks & short-range radio

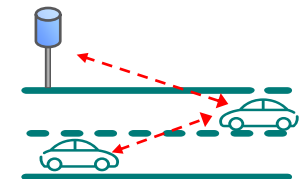
Low cost  
Low energy  
Small data volumes  
Massive numbers

Ultra reliable  
Very low latency  
Very high availability

## Critical MTC



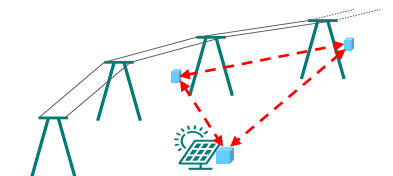
Industrial application



Traffic safety/control



"Tactile Internet"



Smart grid

- › ms-level latency
- › Robust transmission
- › Fast channel assignment
- › Multi-level diversity
- › ...

# MASSIVE MTC

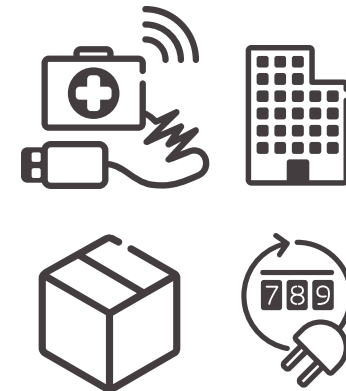
## INTERNET OF THINGS



- › Building automation (temperature, light, doors, heating, ...)
- › Ambient Assisted Living
  - personal monitor (blood pressure, pulse, ...)
- › Sensors and smart meters in the smart grid
  - distributed weather sensors)
  
- › Goods / fleet tracking in logistics
- › Agriculture / aquaculture sensors ( irrigation, fertilization, ...)
  
- › MTC scalability and performance
  - supporting 10-100 times more devices
  - 10 times better battery lifetime
  - 99.9% coverage

### Meters and Sensors

- › Sensor, actuators, meters, connected devices and things
- › Small, simple, low-cost
- › Low energy consumption



# MASSIVE MTC



## Requirements – *Huge number of different use cases, quite some variance in requirements*

- › Low device cost
- › Low device energy consumption
- › Ultra-coverage  
(challenging locations)
- › Low protocol overhead
  - Signaling load in the network
  - Device battery life time
- › Highly scalable

## LTE Rel-12 & Rel-13

- › Low-cost UE categories
- › Extended sleep
- › Coverage extensions
- › Signaling reduction
- › Integration of Capillary Networks

## Technology components for 5G

- › “zero-overhead” transmissions
  - Connectivity states and signaling (RAN+CN)
  - Channel access, MAC
- › Extreme device sleep opportunities

# MISSION-CRITICAL MTC

*INDUSTRIAL INTERNET, TACTILE INTERNET*



## › Distributed embedded control

- Smart grid distribution automation
- Industrial manufacturing & control
- Autonomous driving



## › Remote control of machines

- Remote sensual education and therapy
- Micro manufacturing
- Manufacturing in hazardous environments



## Requirements

*huge number of different use cases, quite some variance in requirements*

- Guaranteed ms-level end-to-end delays (~1-10 ms)
- High reliability of successful transmission (e.g. ~99.999%)
- High availability of connectivity
- Support for local communication solutions

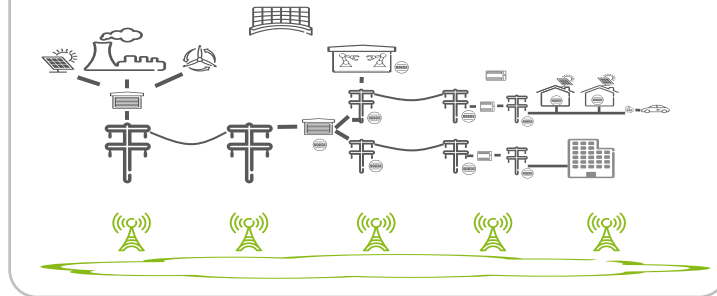


# MISSION-CRITICAL MTC

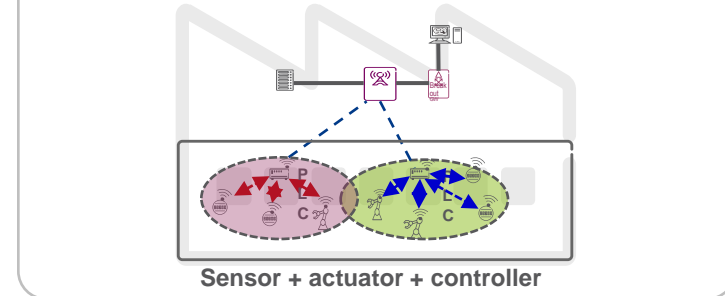
*INDUSTRIAL INTERNET, INDUSTRY 4.0, TACTILE INTERNET*



Wide-area (distributed) control



Local-area (distributed) control



## 5G solutions

- › Short TTI, wide bandwidth
- › Direct D2D links (with network coordination)
- › Faster channel access (controlled contention based, pre-scheduled...)
- › Multi-connectivity for robustness (reliability and availability)

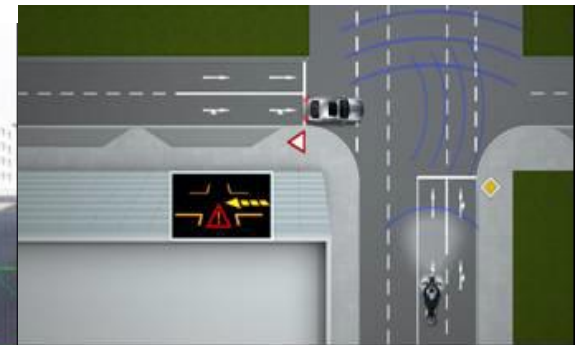
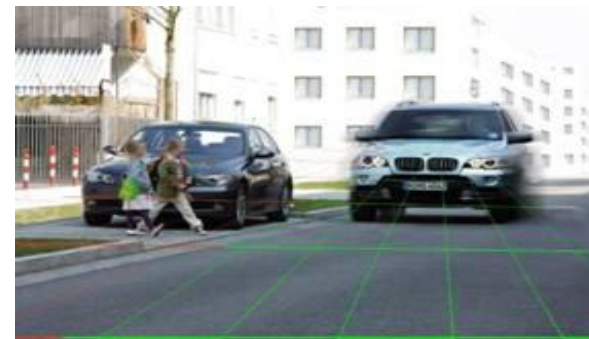
# INTELLIGENT TRANSPORT SYSTEMS

## 5G / METIS (2012-2015)



### › Test Case: “Traffic Safety and Efficiency”

- road platooning (vehicle-2-vehicle)
- traffic safety, including pedestrians & cyclists (vehicle-2-vehicle, vehicle-2-infrastructure, vehicle-2-device)
- integration of wide-area connectivity with D2D and DSRC
- Requirements
  - › guaranteed e2e delay of 5ms
  - › transmission reliability of 99.999%
  - › relative velocities up to 500 km/h
  - › 100% availability



# EXISTING STANDARDS



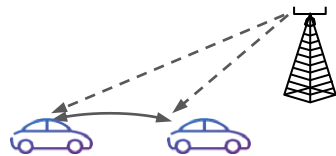
## › Ad hoc based communications

- **Short range communications using 802.11p D2D**
  - › Scalability and reliability issues for high number of users
  - › Does not natively support V2D
  - › Minimum penetration rate required

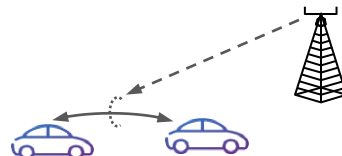
## › Cellular-based communications (3G/4G LTE)

- LTE Unicast
- Enhanced LTE broadcast
- LTE D2D

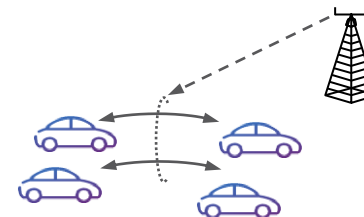
## › Hybrid approaches (cellular + D2D)



- NW schedules D2D traffic (~TTI level)



- NW allocates uni/bidirectional resource pool per D2D pair
- Devices schedule traffic



- NW allocates common D2D resource pool
- Devices schedule traffic

# SUMMARY



- › Machine-to-machine communication is a major element in enabling the Networked Society
- › Cellular communication will play a strong role
  - Capabilities, availability, global market
- › Optimization of cellular communication is possible for M2M
  - Several activities ongoing in 3GPP
- › 5G addresses novel and demanding use cases (e.g. in METIS)



**ERICSSON**