Empowered by Innovation NEC

The Challenges of M2M Communications for the Cellular Radio Access Network

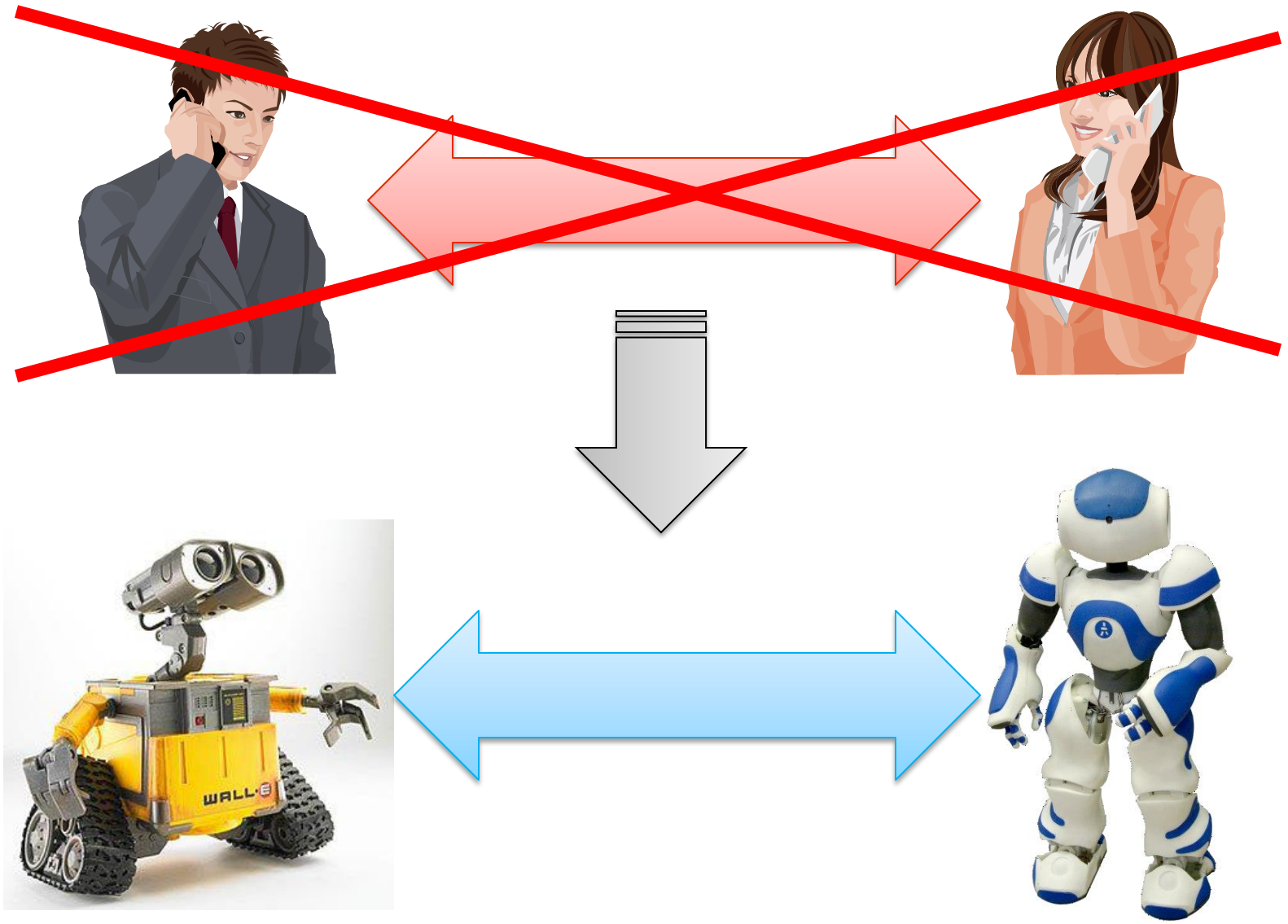
EuroView 2011

A. Maeder[1], P. Rost[1], D. Staehle[2]
[1]NEC Laboratories Europe
[2]University of Wuerzburg

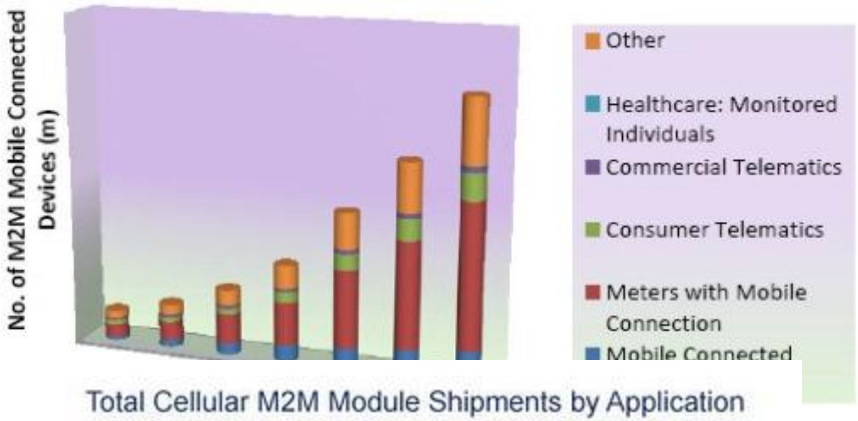
FLAVIA

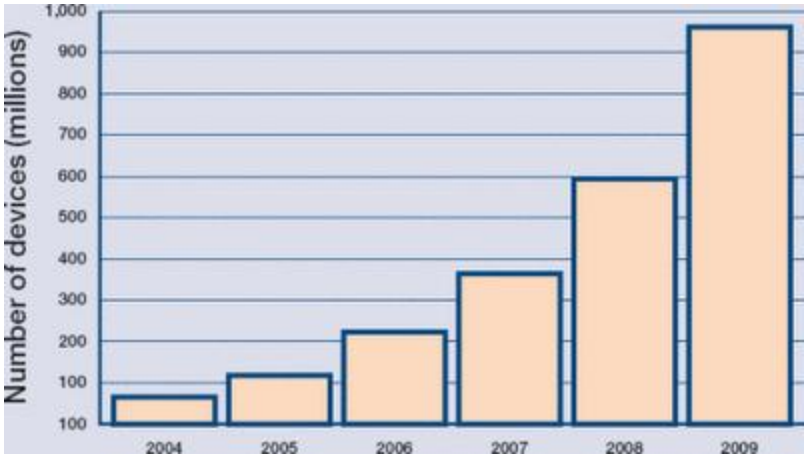
euronf NETWORK OF EXCELLENCE ITG

What is M2M?

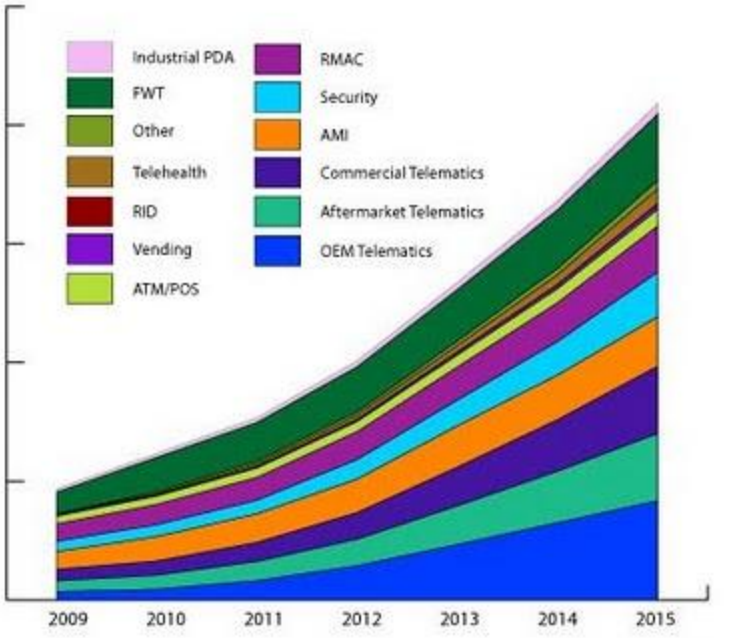


Why M2M?

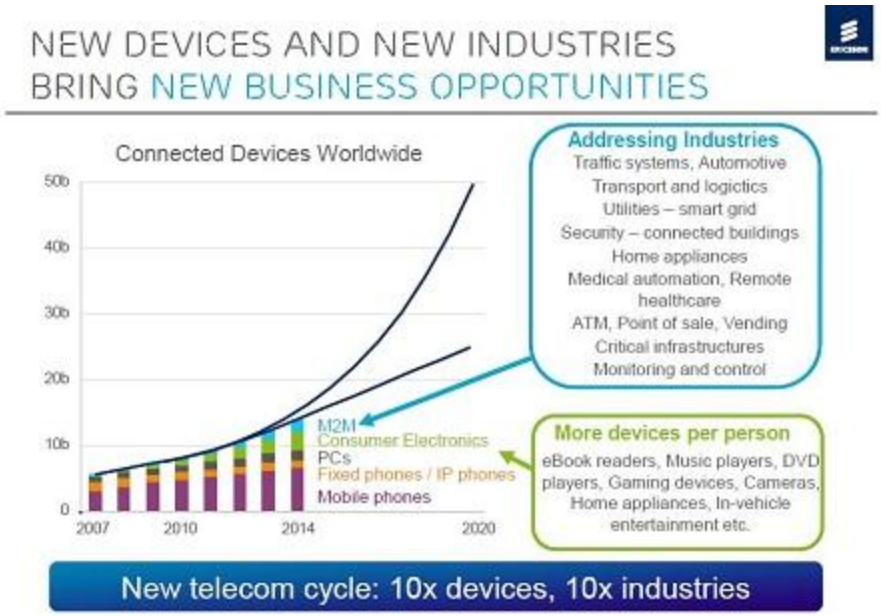




Total Cellular M2M Module Shipments by Application
World Market, OEM-Basis Forecast: 2009 to 2015



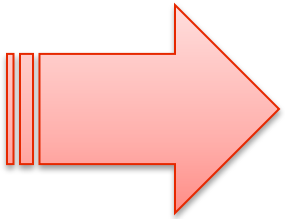
Source: ABI Research



What is the issue?

- Cellular mobile networks are designed for human communication
  - Interactive communication between humans (voice, video)
  - Data communication involving humans (web browsing, file downloads, etc).
  - Communication is connection-centric

- Cellular mobile networks are optimized for traffic characteristics of human-based communication applications
  - Communication with a certain length (sessions) and data volume
  - Communication with a certain interaction frequency and patterns (talk-listen, download-reading, etc.)



But: M2M communication is different

Why is M2M communication different?

- A vast number of use cases exist

Automotive & e- Toll

- Car Communication & Infotainment
- Vehicle Telematics
- e-Call
- Electronic Toll Collect
- Stolen Vehicle Recovery

Health Care

- Tele-Monitoring & Tele-Care
- Ambient Assisted Living
- Disease Management

Metering

- Electricity Meters
- Gas Meters
- Water Meters
- Multi Utility Controller

Tracking & Tracing

- Fleet Management
- Pay-as-you-Drive
- Dispatcher Systems
- Asset Tracking
- Geo Fencing

Payment

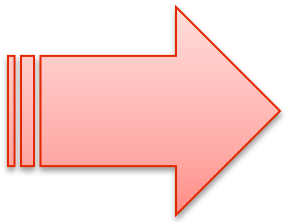
- Point-of-Sales Terminals
- Venting Machines
- ATMs
- Cash Registers

Remote Maintenance & Control

- Remote Service & Alarming
- Predictive Maintenance
- Remote Configuration & Control

Source: Intel

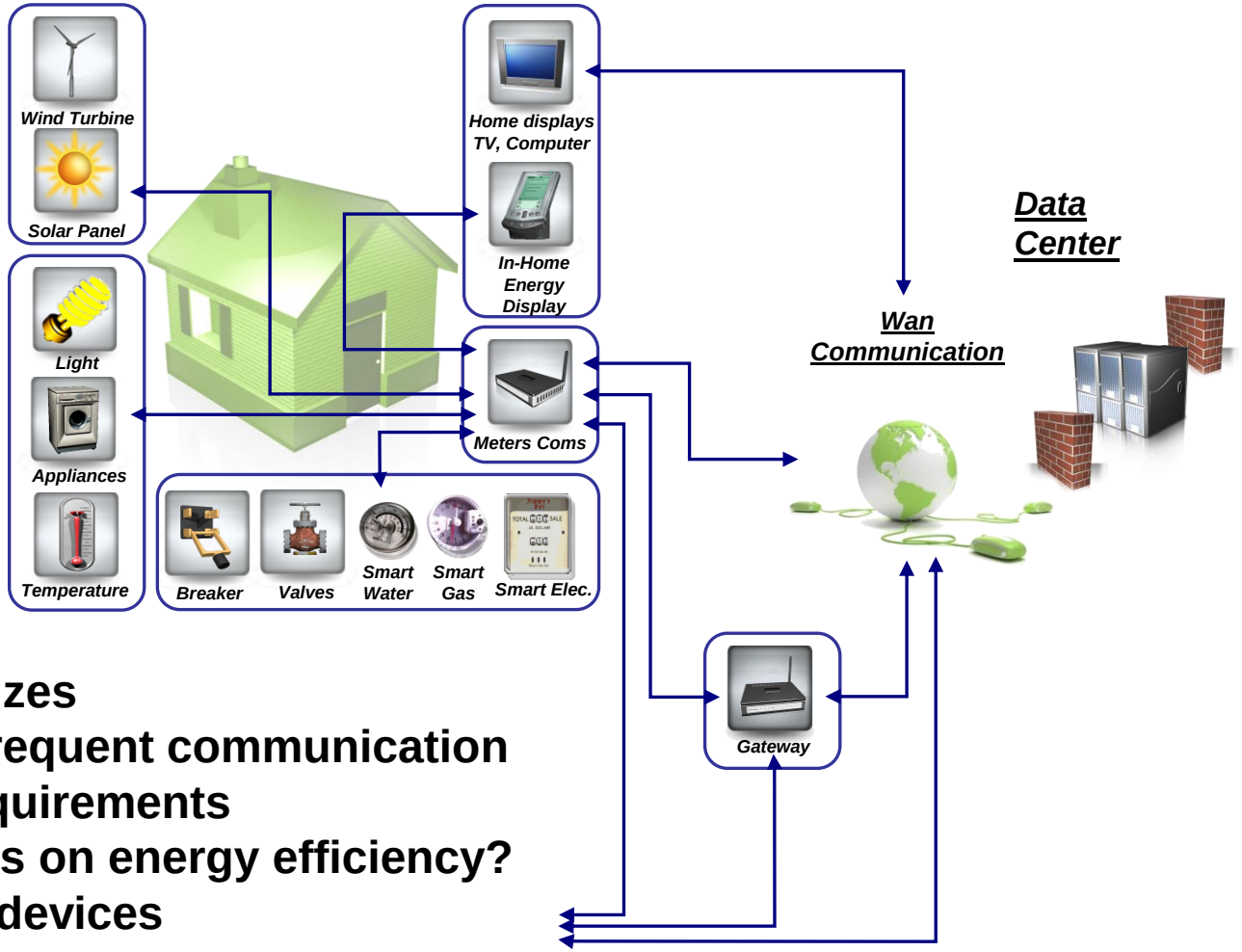
- With very different traffic characteristics and QoS requirements
  - Traffic patterns: time-controlled, (near) deterministic, random
  - Message sizes: very small (smart meters) to high volume (tele-care)
  - Latency: very low (car-to-x) to very relaxed (metering)



Very large number of devices

Example: Smart Grid/Smart Metering

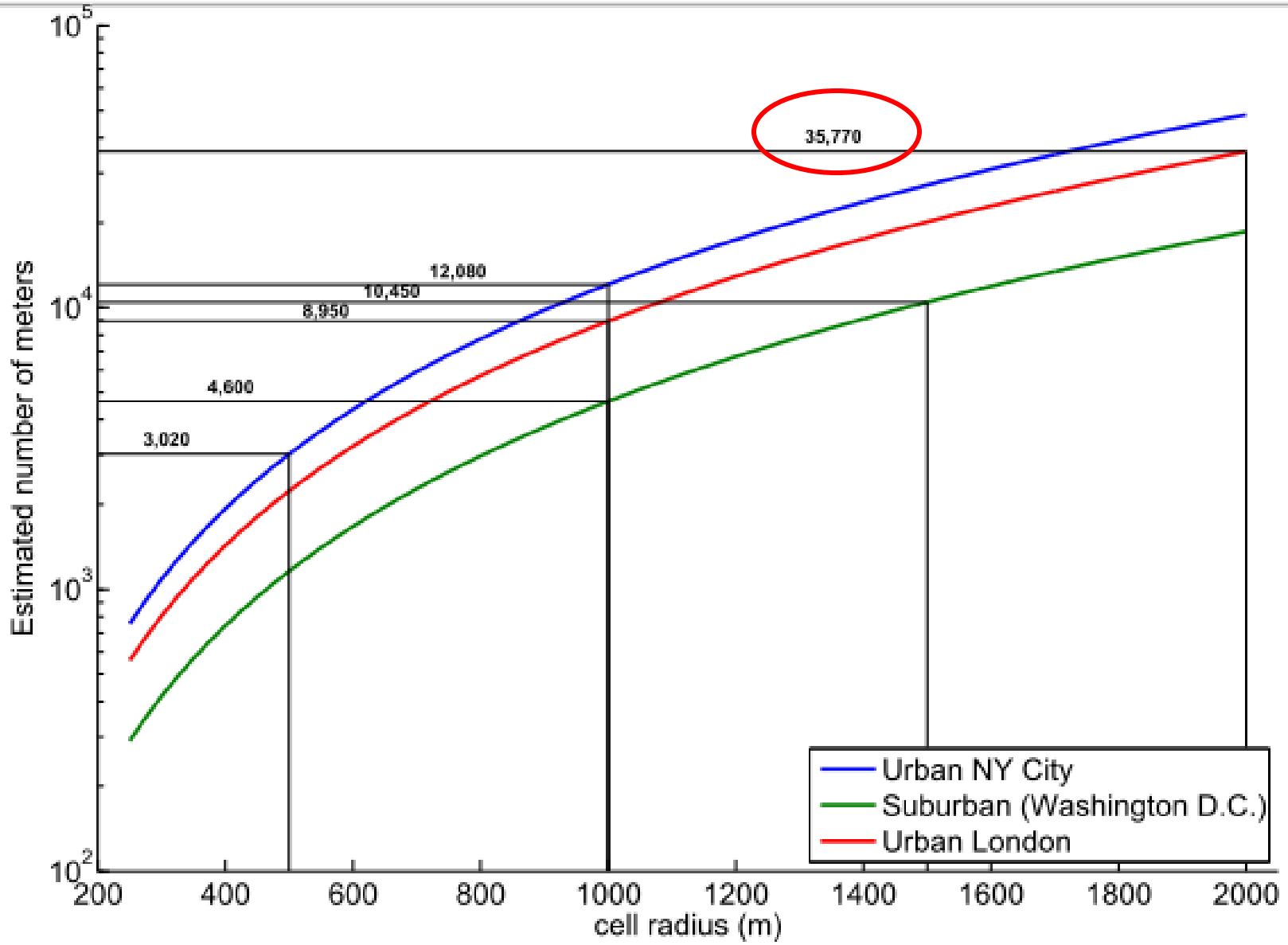
- Control and reading of metering/infrastructure



Small message sizes
Low to medium frequent communication
Relaxed delay requirements
High requirements on energy efficiency?
Large number of devices
"Alarm" scenarios

Image source: ETSI

Example Scenario: Smart Meters in Urban London



M2M communication requirements and features

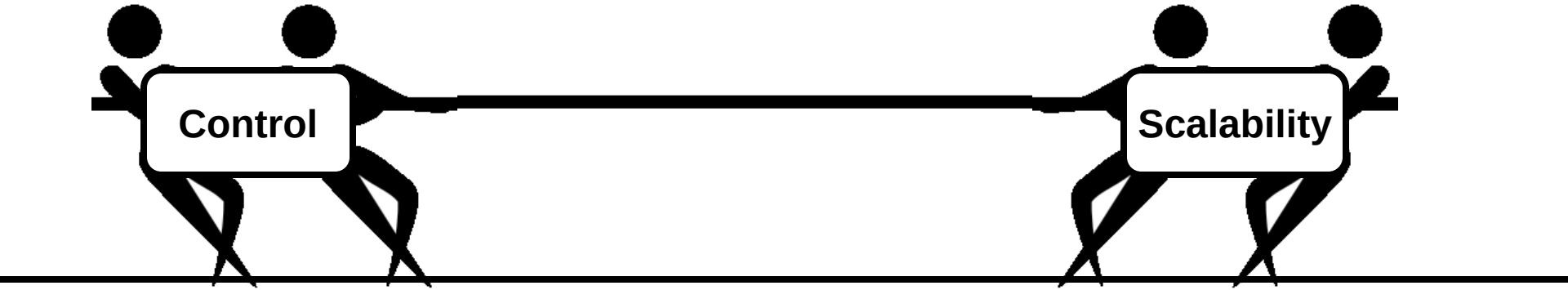
- **Extremely low power consumption**
- High reliability
- Access priority
- **Large number of devices**
- Group control
- Security
- **Small burst transmission**
- Time-controlled operation
- Low or no mobility
- Very high mobility
- One way data traffic
- Mobile only originated traffic
- **Long range access**
- Infrequent traffic
- **Extremely low latency**
- Time-tolerant operation

Co-existence with human communication:
QoS/QoE must be guaranteed

Challenge for cellular RAN: putting it all together

Security
(Billing)
QoS
Management
Monitoring
Scheduled access

Large device numbers
Low latency
Low power consumption
Small burst transmission
Low cost
Low overhead

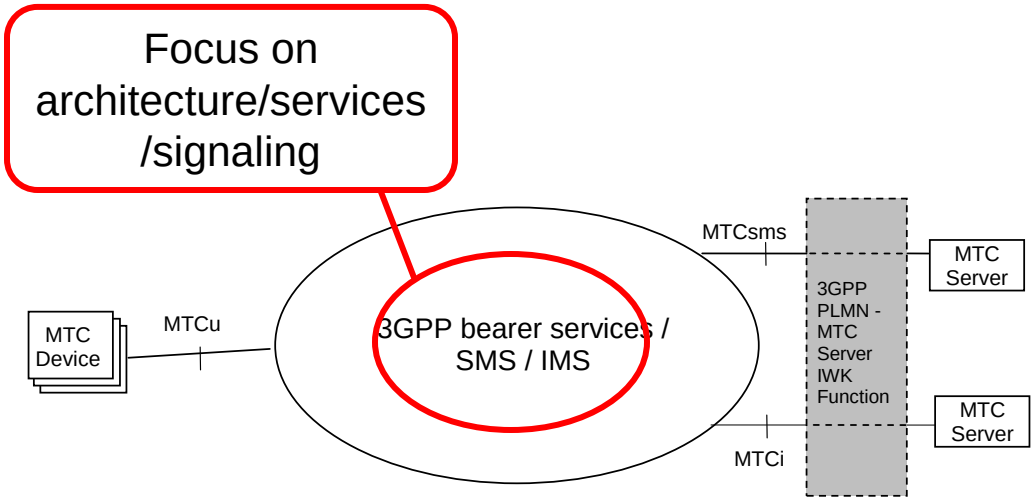


Diverse and partially contradicting requirements

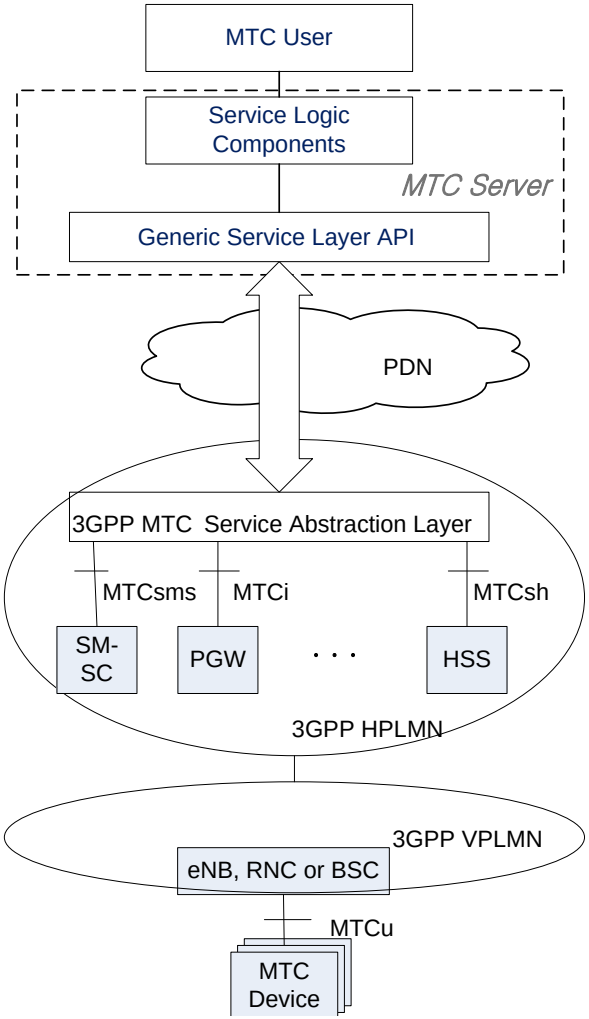
Is it sufficient to modify existing technologies?

Activities in Standards: 3GPP

- Two work items: network improvements for MTC (NIMTC, Rel. 10) and system improvements for MTC (SIMTC, Rel. 11)
- Current focus on architecture (MTC server), control plane, services, features
- Study on RAN improvements on hold
  - TR 37.868, section on RAN overload control



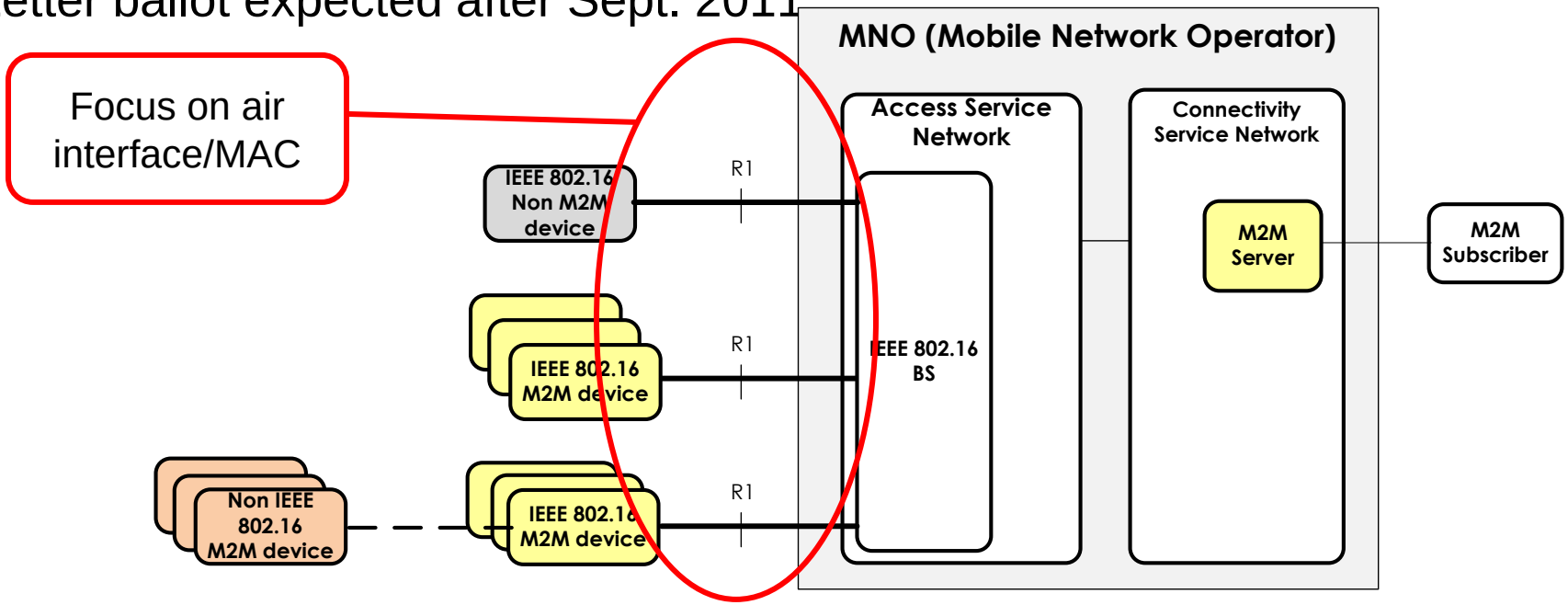
3GPP MTC architecture



3GPP MTC service abstraction

Activities in Standards: IEEE 802.16p

- IEEE 802.16p: started in Sept. 2009
- Extension of 802.16e (WiMAX) and 802.16m (WiMAX 2.0)
- MAC and minimal OFDMA PHY enhancements
- Current status: enhancements for network entry, group control, multicast, mobility
- Letter ballot expected after Sept. 2011



802.16p M2M service reference system architecture

Conclusion and Outlook

- M2M is an enabler of the **Internet of Things**
- M2M is **challenging** for today's and future cellular networks
  - Different traffic characteristics
  - Wide range of QoS requirements
  - Energy efficiency
  - Cost
  - Large number of devices

- **Efforts in Standards**: "Fix" existing systems by adding as much as necessary, as less as possible

- **Research needs to think new communication paradigms for M2M in cellular networks!**
  - Novel or different key network performance metrics
  - Flexible MAC, novel architectures, virtualization, energy efficiency, hierarchical networks, …
  - Talk to **industries and users** of M2M communications

Empowered by Innovation