Will 5G Power the IoT?

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Smart City Applications
Smart Cities IoT/M2M Applications
Industrial IoT/M2M Applications

- **Features**:
  - Low Power Long Range up to 6 years of battery operation
  - True Multi-hop Capabilities
  - A Single Network with up to 500 Nodes
  - License Exempt 2.4 GHz Band
  - Mode to Range up to 300m Range

- **Applications**:
  - Industrial IoT
  - M2M

- **Applications**:
  - **Structures & Geotechnics**
    - Tunnels
    - Bridges
    - Railroad
    - Buildings
    - Airports
    - Highways
    - Foundations
    - Slope monitoring
    - Land slides
    - Landslip early warning structures
    - Soil mechanics
  - **Digital Oilfields**
    - Field supervision
    - Oil production monitoring
    - Gas production monitoring
    - Terminal & tank monitoring
  - **Environment**
    - Water Quality
    - Air Pollution
    - Fluorescence, Soil moisture
    - Chlorides, pigments
    - Irrigation
  - **Industry**
    - Frac pressure and temperature
    - Structures
    - Heat exchangers
    - Electrical
    - Chemical

- **Other Features**:
  - Wireless Monitoring
  - Smart Auto Organised Sensor Networks
  - 8 Directional Communication Give Remote Configuration Capabilities
  - Robust Equipment Ready for Harsh Environments

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Today’s Smart City Rollouts

Smart Parking

Smart Bins

Traffic Flow

Critical Infrastr.

Travel Time

Historic Sites

Proven Technologies With Solid Deployment
Track-Record Today!
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Data Access Technologies
# Standardized M2M Protocol Stacks

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Problems of ZigBee-like Solutions

Interference in ISM
- 868 MHz
- 2.4 GHz
- 5 GHz
- 433 MHz

No Global Infrastructure

Lack of Interoperability

Higher Total Cost

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Advantages of Low-Power WiFi

Ubiquitous Infrastructure

Number of Wi-Fi Public Hotspots in the World (in million), 2009-2015


Vibrant Standard

300 members

Interference Management

NAV Medium Reservation

Sound Security

WPA2/PSK/TLS/SSL

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Advantages of LPWA M2M Networks

Large Coverage

Low Cost

Available Today

Operator Model

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Current Eco-System

**Sigfox** (market leader in Q1 2014):
- **technical**: sub-GHz, UNB, very long range, one-way
- **business approach**: operator, yearly license fee; Intel Ventures €10 million VC

**On-Ramp**:
- **technical**: 2.4GHz ISM band; “Random Phase Multiple Access”; 170dB link budget
- **business approach**: equipment provider mainly; Managed Service SLA possible

**Cycleo (now Semtech)**:
- **technical**: sub-GHz, CDMA-based, long range
- **business approach**: equipment provider

**Neul**:
- **technical**: initially TVWS only; now shift into other bands too (notably licensed!)
- **business approach**: originally only equipment; now SLA possible
Advantages of Cellular M2M

Ubiquitous Coverage

Mobility & Roaming

Interference Control

Service Platforms
Towards a 5G Architecture
**M2M Prime Business Criteria**

Availability = coverage, roaming, mobility, critical mass in rollout, etc.
Reliability = resilience to interference, throughput guarantees, low outages, etc.
(Total Cost of Ownership = CAPEX, OPEX.)
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Concluding Remarks
Virtualization & Cloudification

Citizens, City service providers, application developers ...

CSaaS
City application software as a Service

CPaaS City Platform as a Service

ClaaS
City Infrastructure as a Service

© http://clout-project.eu; partly also developed in ICT-VITRO

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Closing the Data Cycle

Big Data Analytics:
- Raw Data
- Information
- Knowledge

Data Collection → Data Processing → Data Actuation

Machine-to-Machine:
- Sensor Streams

Human-to-Machine:
- Crowdsourcing

Information-to-Machine:
- Internet

Improving Efficiency
Offering New Services
Powering Applications

Data Feedback
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