Enabling the information society

IOT Update

Barney Duffy FBCS CITP

BCS Bedford Branch

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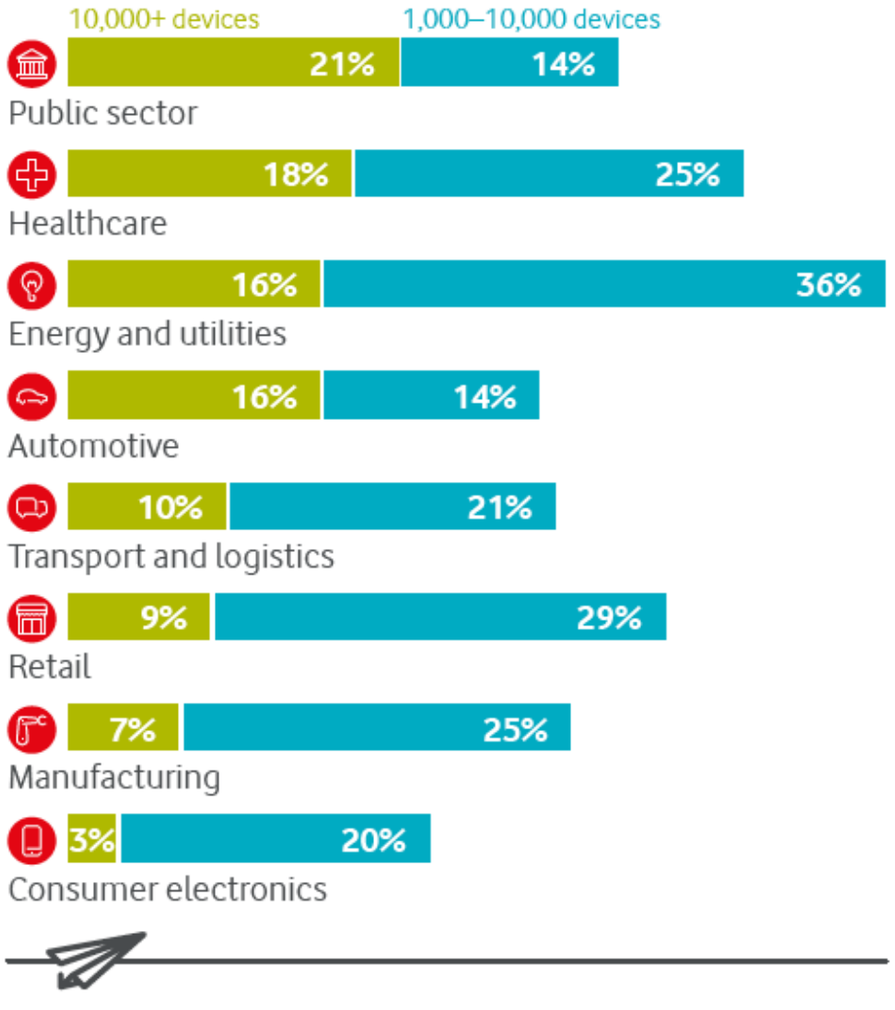
IOT Stats

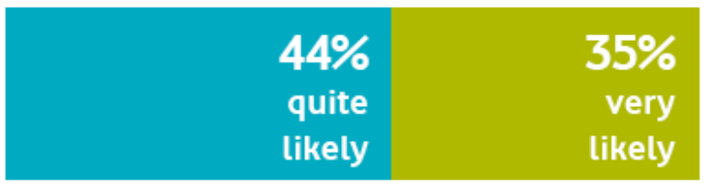
Number of connected devices



Opinions on the future of IoT

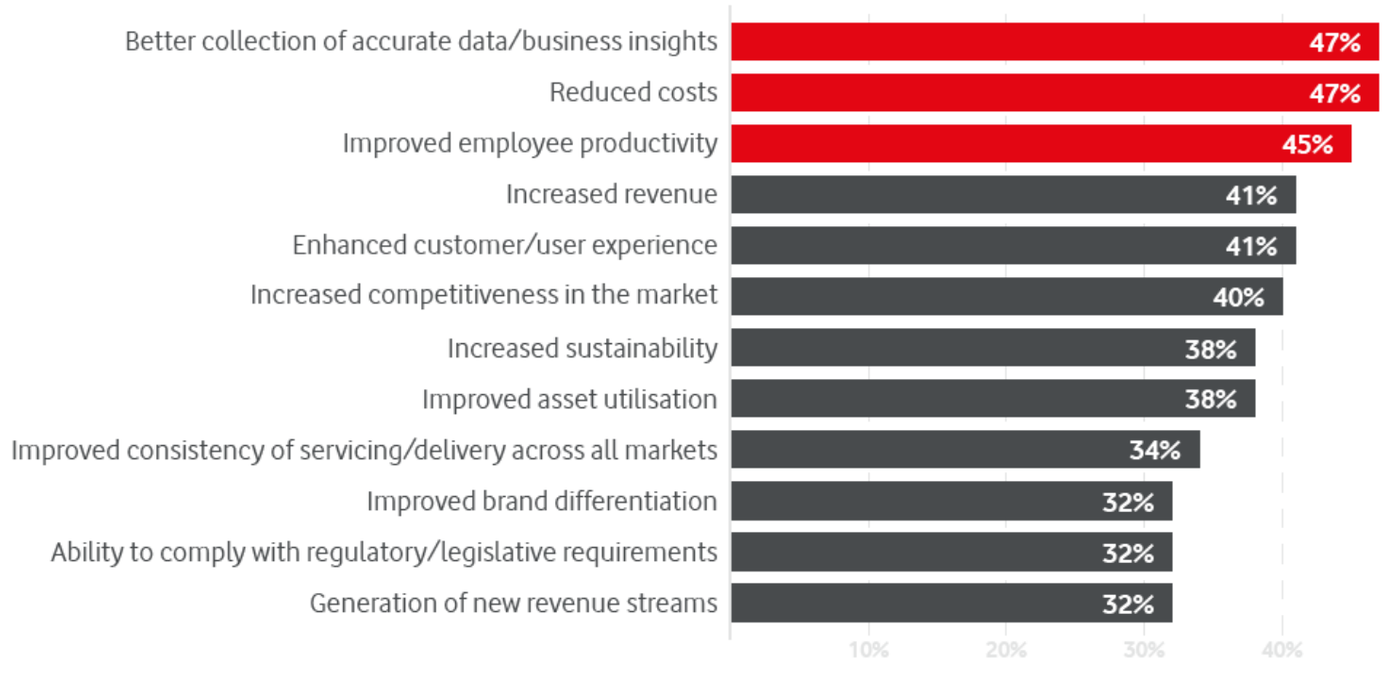
We're optimistic about the possible business outcomes of connecting almost everything

In five years, over 50% of business processes will include IoT sensing/controls



IoT will be critical for the future success of any organisation in our sector

Benefits of IOT



IOT Considerations

- IOT technology has been available for over 25 year
- IOT technology includes
    - Machine to Machine (Mobile network 2G, 3G, and 4G heading towards NB-IOT, and 5G)
    - Radio (Licensed Spectrum (400MHz), Satellite, ZigBee, etc)
    - Point to Point or Mesh (Hub) Network Connectivity.
- Technology deployed depend upon requirements
    - Lifecycle of deployment (1, 5, 10, 20 years)
    - Amount of data and connectivity
    - Power Requirements (How much power do you need)
    - Local Processing (CPU) requirements.
    - Energy sources available
        - Local source
        - Battery
        - Solar
        - Energy harvesting

MIOT (M2M) is a complex Technology to deploy

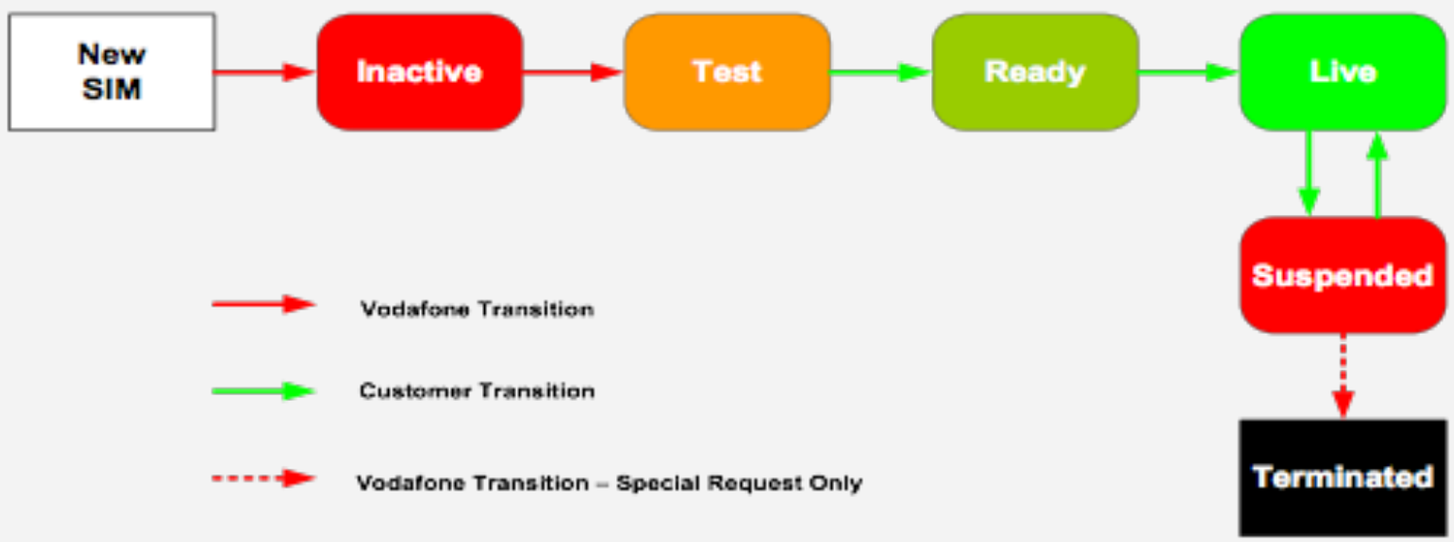
- All mobile networks are not the same
- Different carriers have different services service solution is based on your requirements
- Where the mobile networks are used connectivity to the device is often different dependant upon technology used.
    - Technology used can be 2G, 3G, 4G heading towards NB-IOT, and 5G)
    - Connections can roam across multiple networks (Dependant upon contract and carrier)
    - Can be global connectivity
    - Dependant upon SIM that is used within device (Sim stores network connectivity)
    - Lifecycle of deployment (1, 5, 10, 20 years)
    - Amount of data and connectivity (This affects the cost of the service)
    - CPU Processing Capability
    - Power Requirements (How much power do you need)
    - Energy sources available
        - Local source
        - Battery
        - Solar
        - Energy harvesting

MIOT Considerations

- IP services (IP addressing) (Allocation methodology Fixed/DHCP)
- Number of devices you need to connect to!!
- Connectivity (Public (Internet) or Private APN)
- Short Message Service (SMS)
- Voice??? (Point to Point only)
- Additional services
    - Radius
    - Applications
    - SMS Management
- Backhaul
    - Public (Internet) APN
    - Private APN
    - IPVPN
    - Encryption

Sim Details

Description	M2M Standard Industrial	M2M Robust Plastic	M2M Plastic
Format Size	• Industrial solderable M2M Form-factor (MFF) • 6x5mm SON-8 package as per ETSI standard TS 102 671	• Plug-In UICC (2FF) • Micro SIM (3FF)	• Plug-In UICC (2FF) • Micro SIM (3FF)
Operating Conditions	• Extreme Environmental Conditions - Temperature - Shock - Humidity - Corrosion • Extreme Electrical Conditions - Longer usage life-span - Intensive Use	• Standard Environmental Conditions • Extreme Electrical Conditions - Longer usage life-span - Intensive Use	• Standard Environmental Conditions • Standard Electrical Conditions
Temperature Range	• -40°C to +105°C[1]	• -35°C to +85°C	• -25°C to +85°C
Erase & Write Cycles	• High stress memory (HSM) supports >2M E/W cycles per file • Outside of HSM 500K E/W cycles	• High stress memory (HSM) supports >2M E/W cycles per file • Outside of HSM 500K E/W cycles	• 500k E/W cycles
Data Retention	• Minimum 10 years between -40°C to +85°C	• Minimum 10 years between -40°C to +85°C	• 10 years between -25°C to +25°C
Designed Lifetime	• 10 years+ at -40°C to 85°C	• 10 years+ electrical only	• 2 years+



NB-IOT

- NB-IoT is a new cellular radio access technology specified by 3GPP in Release 13
- To achieve global coverage and wide adoption of NB-IoT services, MNOs must ensure that devices and end-to-end services will connect to the NB IoT systems that have been deployed.

NB-IOT

IOT Platform

Device Management Cloud

2G/3G/4G/Wi-Fi/Fixed

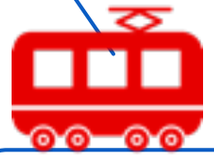
Unlicensed LPWA Networks in ISM Bands

3GPP License NB-IOT

Battery Operated

Smart Meter

Smart Building

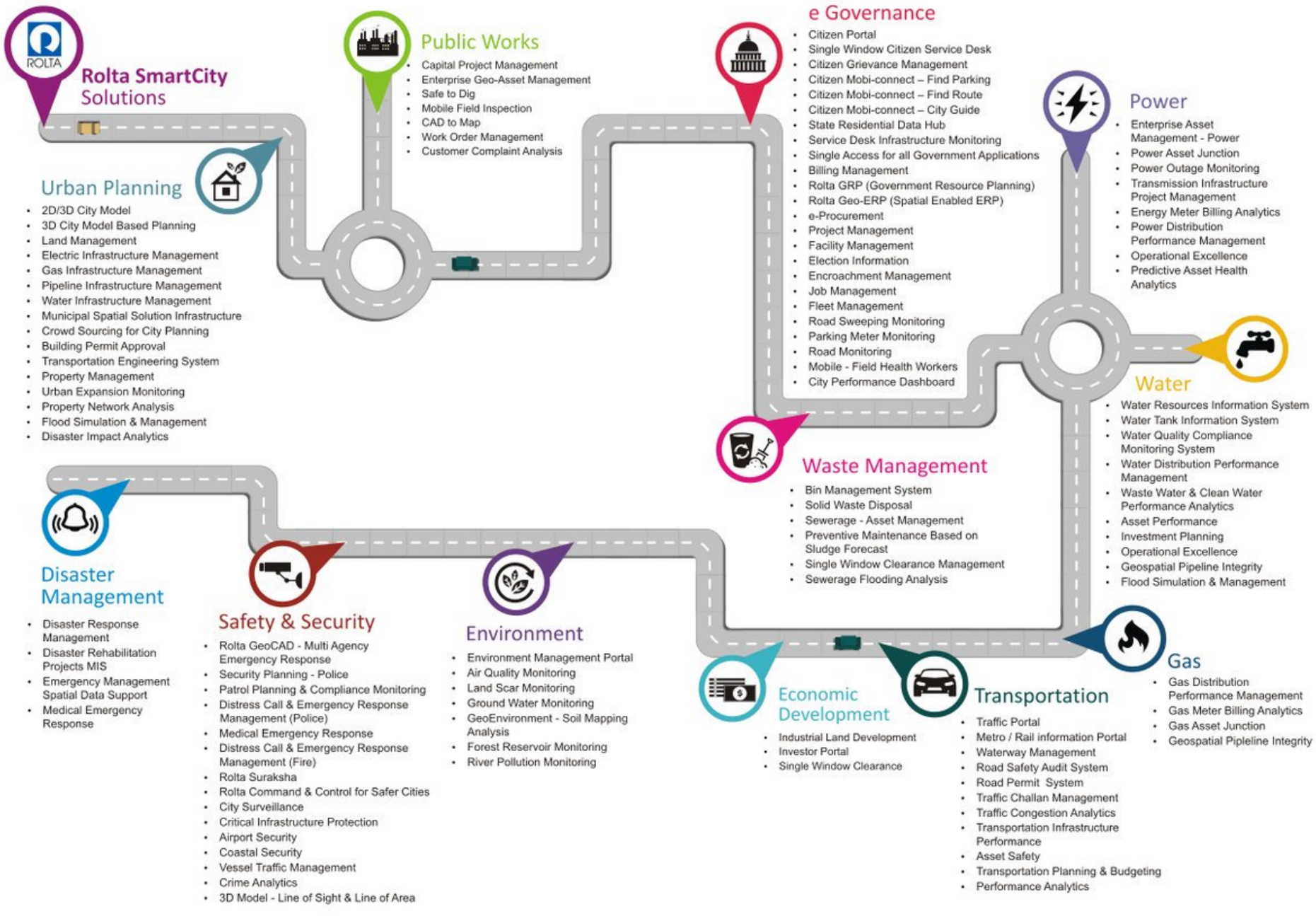


Fleet Management

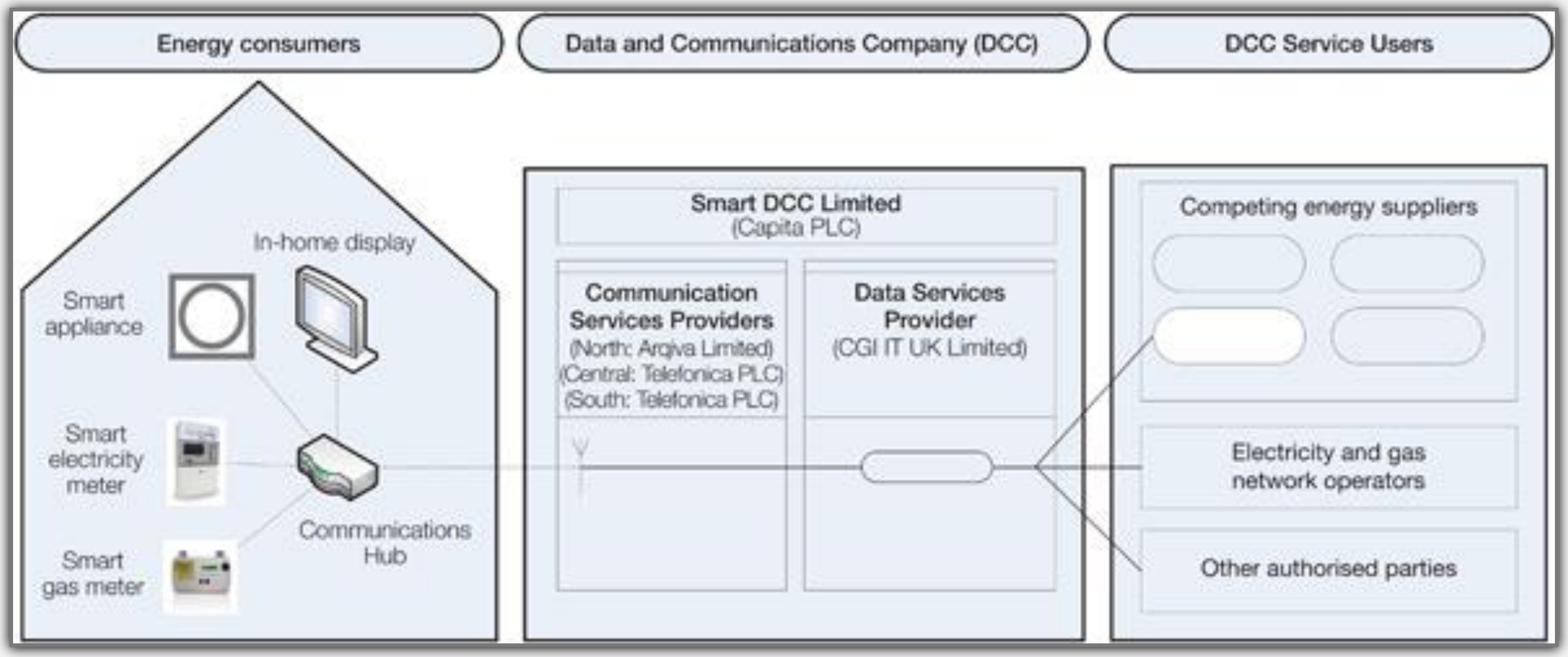
Smart waste management

Smart Parking

Smart Cities and Networks



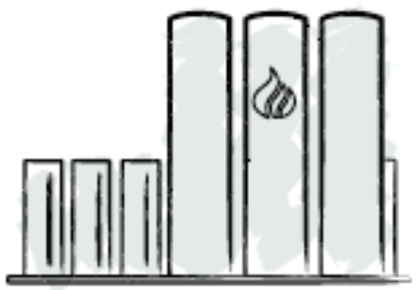
Typical Smart Metering Solution



Smart Metering In the UK

Who?	What?	Where?	When?	Why?	How?
Gas, Electric, Water Utilities, Network Operators, Smart lighting Grid	Smart metering options for UK homes & small businesses	4 zones for energy; Scotland, North, Central & South	Ongoing to 2020+	Reduce UK CO2 footprint and consumer energy consumption	Better Management Reduce Costs Profile Customers New Services Remote updates

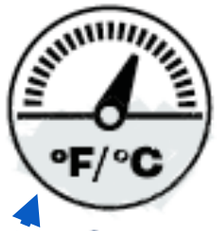
Flexnet Radio 400MHz



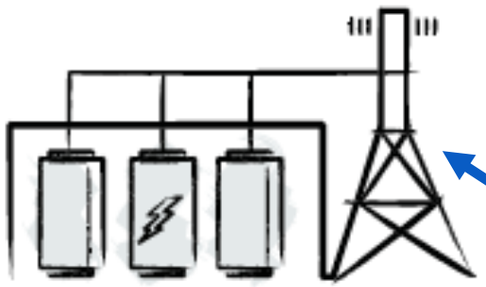
gas utility

water

electric



gas

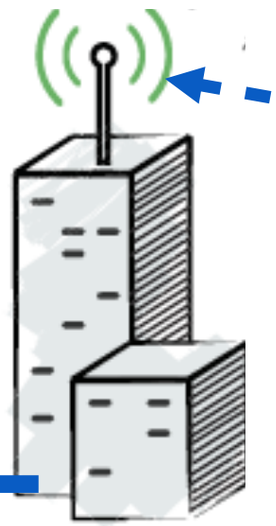


Power Utilities

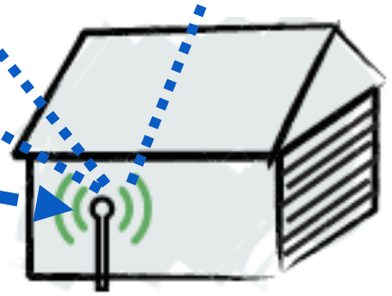
Water Utility

DCC

Data Service Provider



Communication Service Supplier



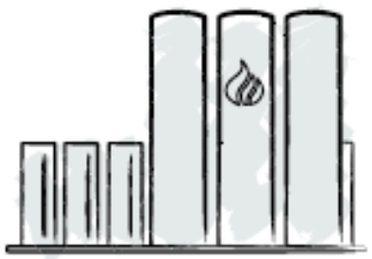
end users

Benefits of Radio for Meter Reading

✓ **Based on the FlexNet system;** Excellent coverage and latency
✓ **Simple design** and reduced network costs
✓ **Uses a dedicated radio spectrum** (400 MHz) guarantees performance (QoS) and minimises interference
✓ **Uses a single communication hub**
✓ **Works well for water meters**

✓ **Designed around high availability!!!!**
✓ **Based on a star design** which minimises noise
✓ **Dedicated radio channels** guarantee transmission of critical data, alarms, and distribution information
✓ **Higher transmission power** allows coverage over greater distances
✓ **Lower frequencies and higher output** power deployed allow for greater building penetration
✓ **No need for costly repeaters**
✓ **Secure closed network** & network connection to DCC

MIOT

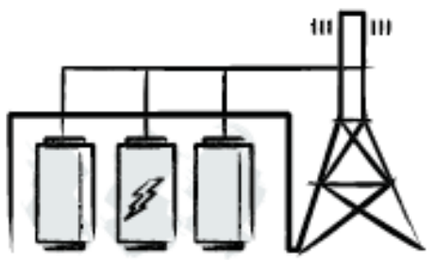


gas utility

water

electric

gas



Power Utilities

Water Utility

DC
C

Data Service Provider

Mobile telco

end users

Communication Service Supplier

MIOT as a Smart Meter Solution

✓ **Mature 2G, 3G and 4G networks** ready to support UK smart metering & has the capability of roaming on other mobile networks. Plus NB-IOT on the horizon.

✓ **Mesh connectivity** to cover difficult to reach areas.

✓ **Layered security architecture** providing trust for critical national infrastructure

Limitations

✗ **Increased support costs**

✗ **Current 2G, 3G & 4G networks to be replaced** with NB-IOT, 5G and 6G in 20 years time?

✗ **No service guarantees**

✗ **Complex design** & additional overheads

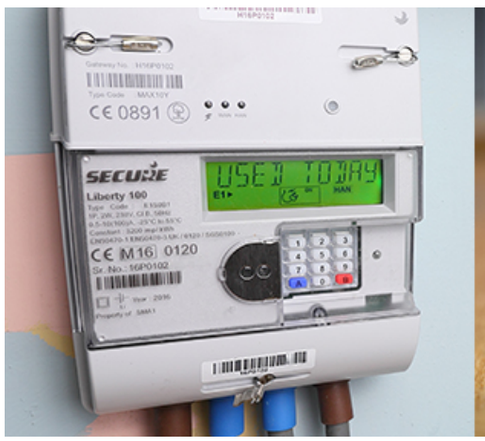
Different Types of Smart Meters

- SMETS 1
  - Smart Metering Equipment Technical Specifications. Point to Point only

- SMETS 2
  - The major difference between version 1 & 2 variants is in the way that they communicate with the utility companies.

    Version 1 is direct and Version 2 is via DCC.

  - Most SMETS 2 meters are more intelligent than SMETS 1 Meters.



The Chartered Institute for IT

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Condition Monitoring

BCS Bedford Branch

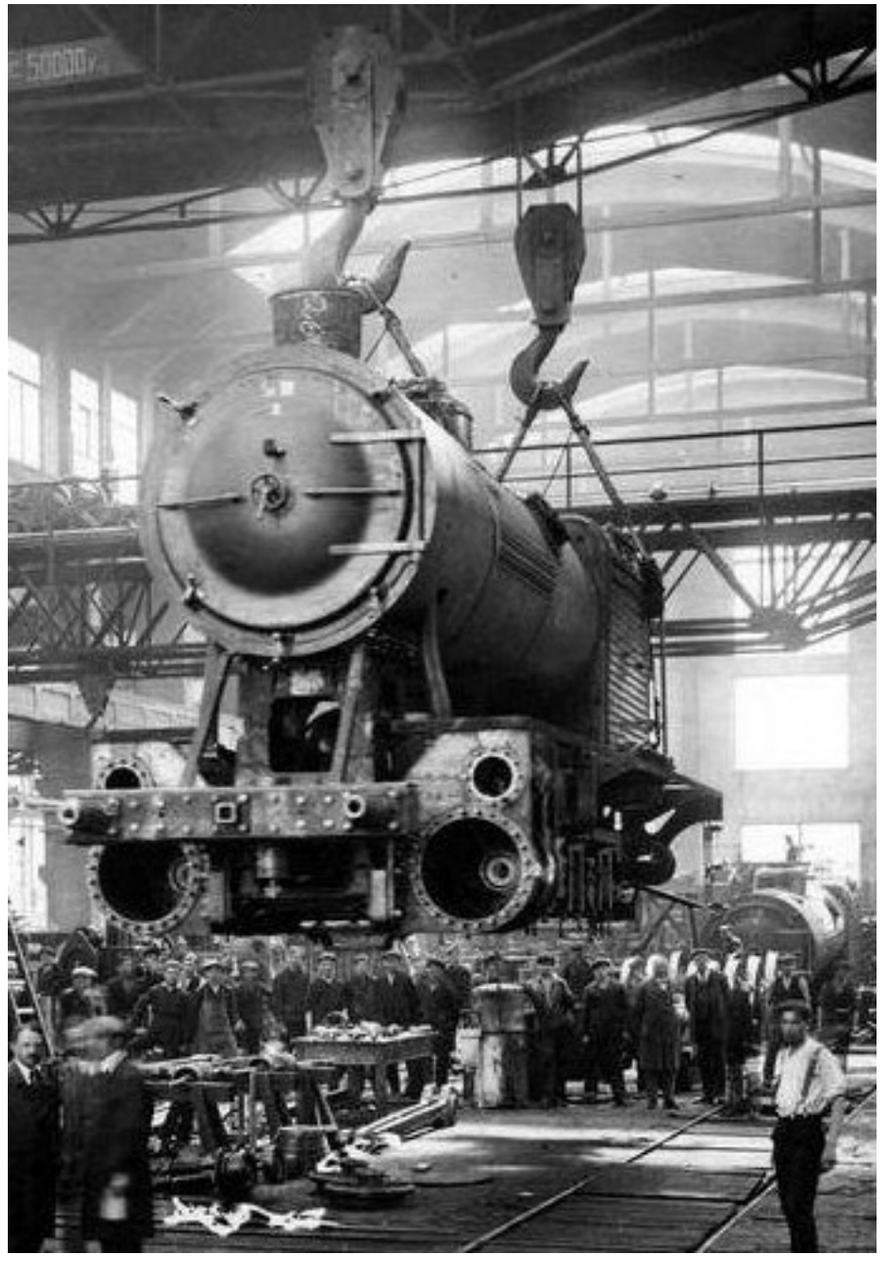
Date: 26th June 2018

Condition Monitoring
A history from the 1930s

Condition Monitoring History

1930s

- Predominantly simple machinery
- Simple instrumentation
- Periodic inspection
- Preventative maintenance
- Simple tools
- Simple repairs



Condition Monitoring History

1950s

- More complex intricate machinery
- Condition monitoring a higher priority
- Reduced downtime important
- Beginnings of predictive maintenance
- Repairs more planned and involved
- First availability of computers

Condition Monitoring History

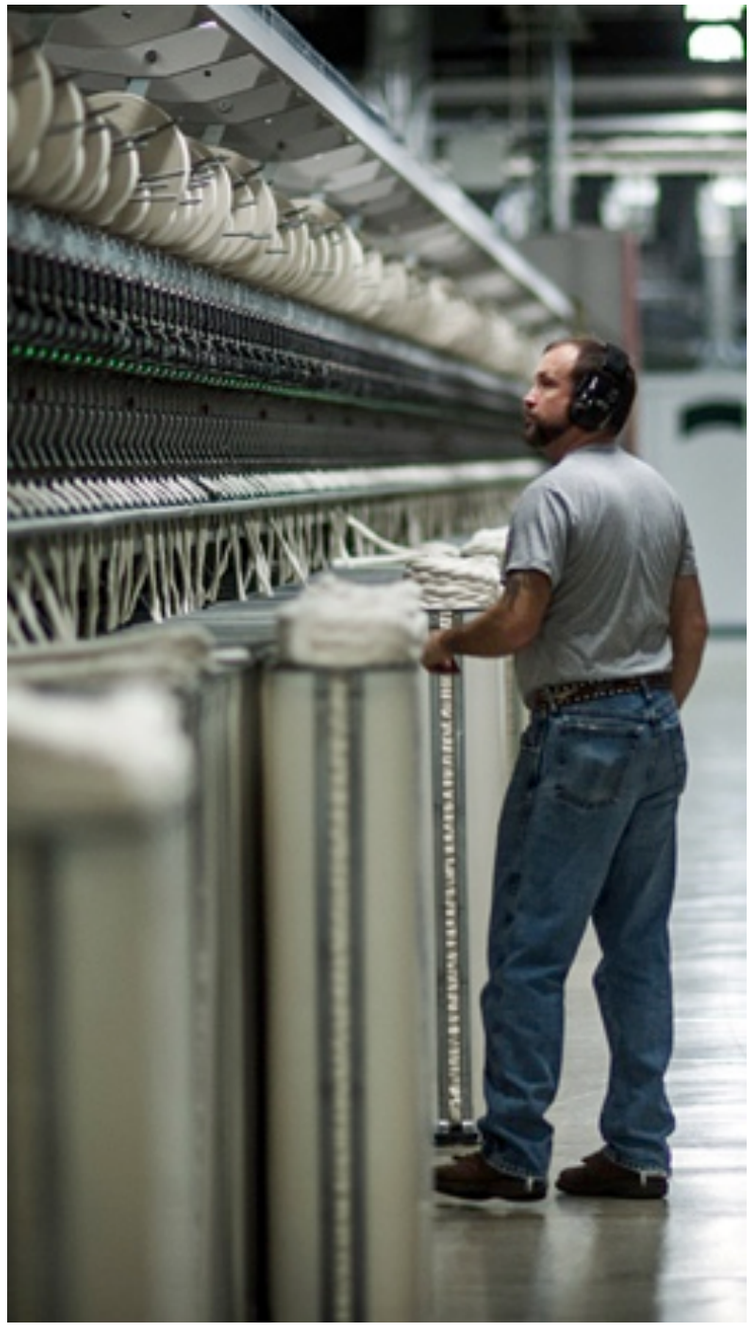
1980s

- Introduction of microprocessors cost of computing falls
- Condition monitoring more extensive
- Monitoring applied to more areas
- Repair times extend
- Reliability becomes the key issue
- Better predictive maintenance

Condition Monitoring History

2000s

- Explosive growth of cheap computing
- Cloud computing makes its mark
- Explosion of sensors in type and volume
- Realisation of infrastructure legacy
- Incorporation of asset management
- Risk based maintenance
- Cooperation between CM systems



Condition Monitoring Applications

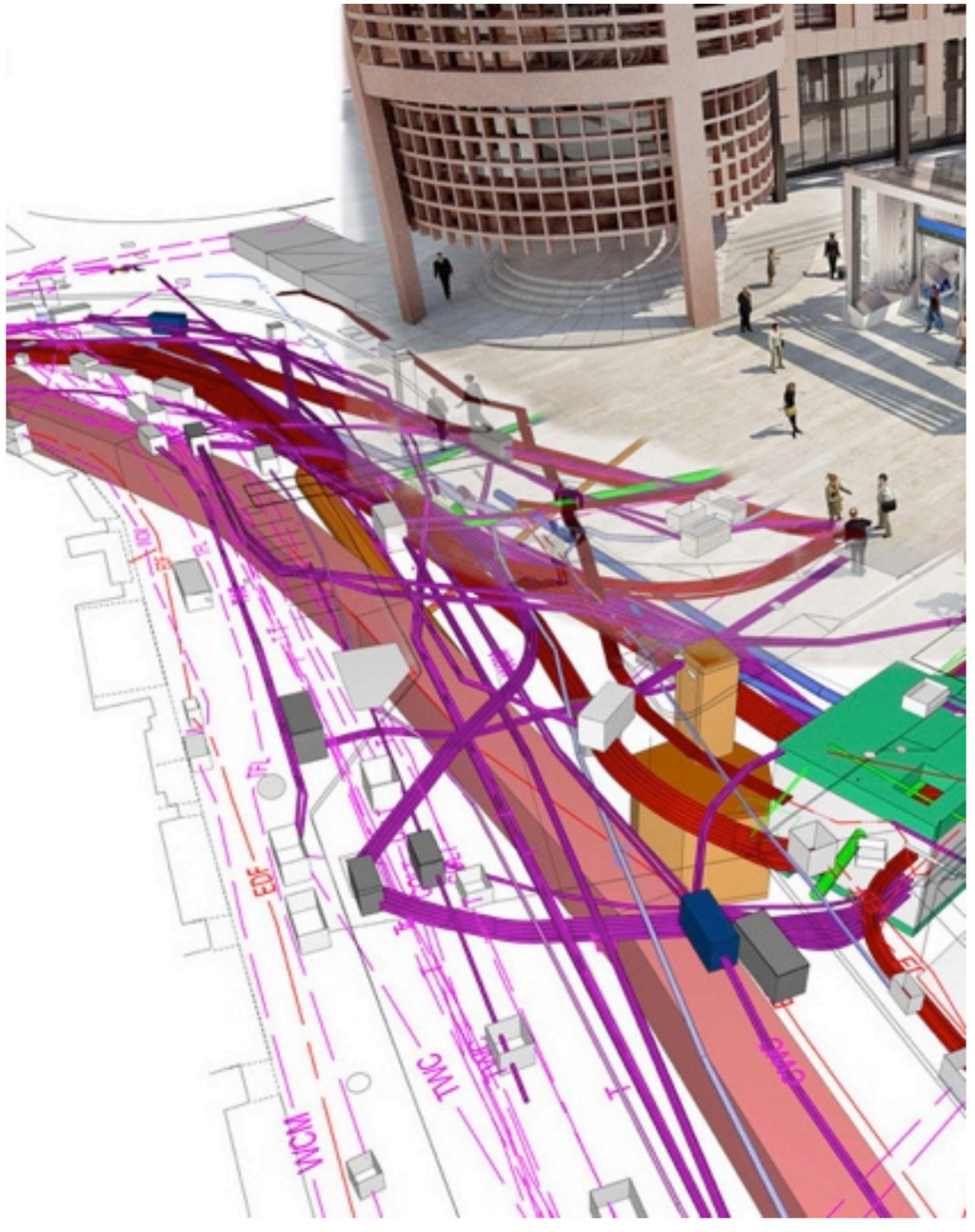
Construction

Condition Monitoring Applications Construction

- Building Information Modelling
- Sensor Arrays
  - Embedded - new build
  - Added - legacy Infrastructure
  - Wireless/radio
- Virtual Reality
- Vibration modelling
- Stress and strain measurement

Condition Monitoring Construction Building Information Modelling

- Virtual prototype
- Layout optimisation
- Energy efficiency
- Facilities management
- Cost/supply chain management
- Shared information
- Vital for legacy



Condition Monitoring
Virtual Reality

Construction

- Design exploration
- Enhanced communication of the design to third parties
- Can be immersive
- Continued value into legacy
- Mixed virtual and real environments
- Drone laser scanning to capture legacy buildings

Condition Monitoring

Sensors

Condition Monitoring Sensor Arrays

Sensors

- Large number of types
- Self powered
- Radio/wireless/Cellular networks
- Continuous monitoring
- Vibration, ingress, temperature, wind, stress, strain
- Real time and post processing

- A fusion of sensors to afford measured variables and parameters that:-

  - Improves reliability / robustness
  - Extends coverage
  - Increases resolution
  - Yields higher performance from simple sensors
  - Yields a wide spread of optimal performance using multiple sensor technologies.

Condition Monitoring Applications

Transportation

Condition Monitoring Applications Transportation

- Large number of assets over large geographic areas
- Multiple agencies caring for each network
- Vehicle and network monitoring
- Inter-network data sharing and cooperation

Condition Monitoring Rail Networks

Transportation

- Safer network for passengers
- Safer network for maintainers
- Move to minimal planned maintenance
- Monitoring aged network degradation
- Enhanced understanding of systems behaviour
- Network Rail monitors over 40,000 assets across the network

Condition Monitoring Road Network

Transportation

- Accompanied by large investment in the network over the coming years
- Traffic modeling
- Road state
- Asset condition
- Condition based scheduling of repair crews
- Data sharing with other transport networks

Condition Monitoring Applications

Machinery and Robotics

- Data trends reveal changes in machine condition
- Measuring –
  - Lubricant temperatures, pressures
  - Strains and stresses
  - Sound
  - Vibration
  - Proximities
  - Velocities
  - Accelerations
- Modeling and diagnostics

Condition Monitoring Machinery & Robotics Robotics

- Much commonality with machinery condition monitoring
- Dynamics modeling to discover torques and forces
- Monitoring robot degradation through periodic observation of repeated behaviours
- Real time processing of dynamics and joint behaviours – friction, backlash, motors energy losses, signal to noise ratios, spectral analysis
- Sharing of information with control systems, GUI dashboards etc.

Condition Monitoring

Technology

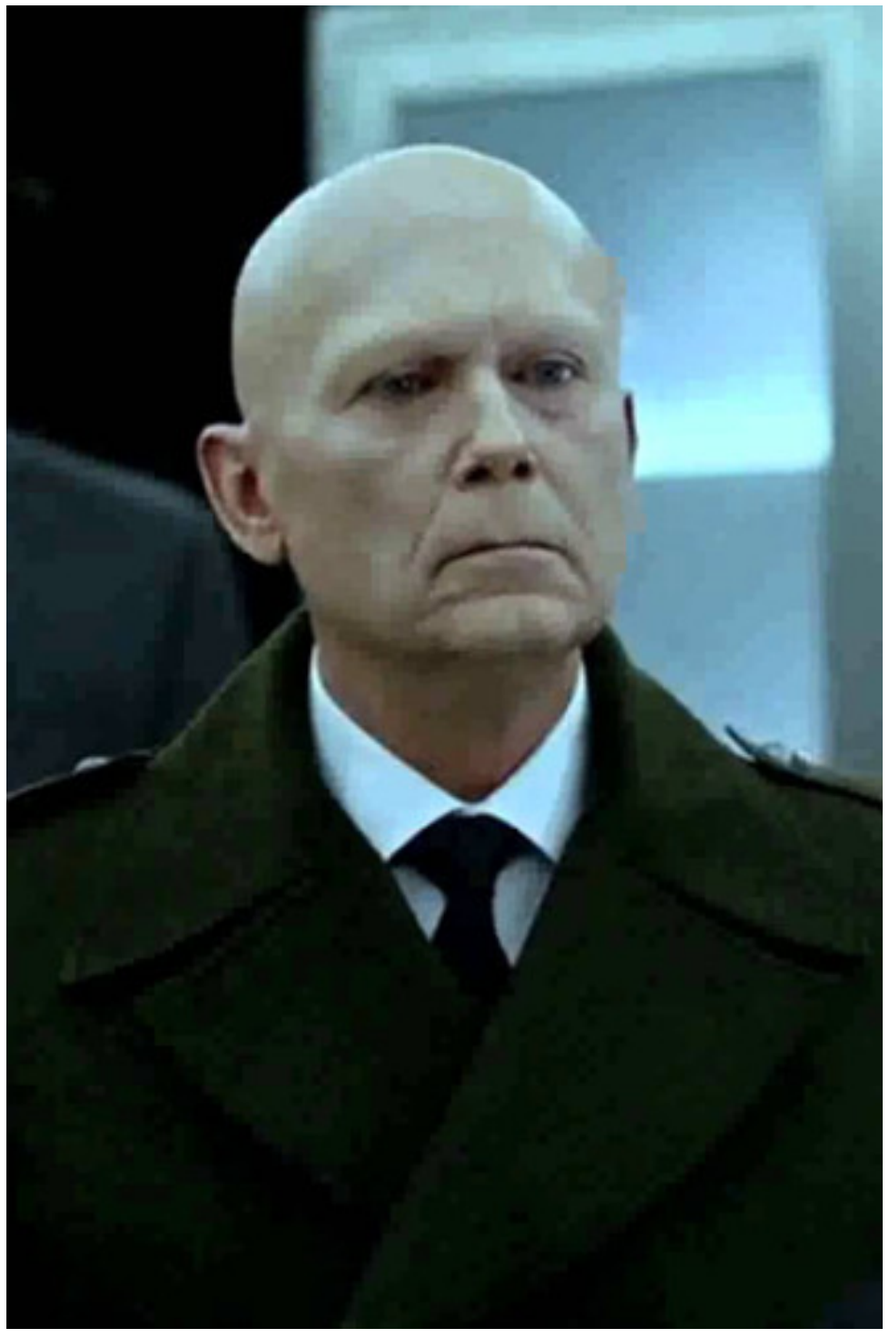
Condition Monitoring Technology Some Examples

- Distributed asset databases
- Internet of Things
- Cloud computing
- Data acquisition
- Radio/wireless
- Nodal graph processing:
  Apache Storm, Apache Flink etc.
- Modeling techniques:
  black and white box

Condition Monitoring

Security Issues

- Hostile reconnaissance
- Cloud computing
- Internet of Things requires IPV6
- Building Information Modeling contains potent information
- Data sharing between organisations



Condition Monitoring

Conclusion and Questions