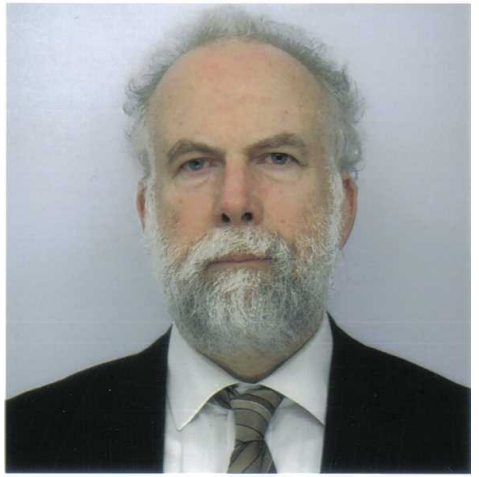

Use of ICTs for Smart and Sustainable Development

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Climate Associates

Climate Associates Limited (CAL)

- Provide consultancy services
  - to improve energy efficiency and reduce carbon dioxide emissions arising from the use of information communication and related technologies

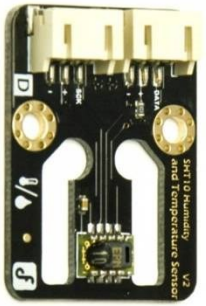
- Customers include: ITU, environmental protection agencies, telecommunications operators, regulators, network providers, systems providers

  - Most of the material in this presentation was selected from over 900 pages in 23 reports produced by ITU-T Focus Group on Smart Sustainable Cities
    - http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

Contents

Sensors

Devices



- Aim of this presentation
- The sensor layer
- Example of Smart water management
- ICTs for Climate Change Adaptation
- Integrated management and open data
- Conclusion

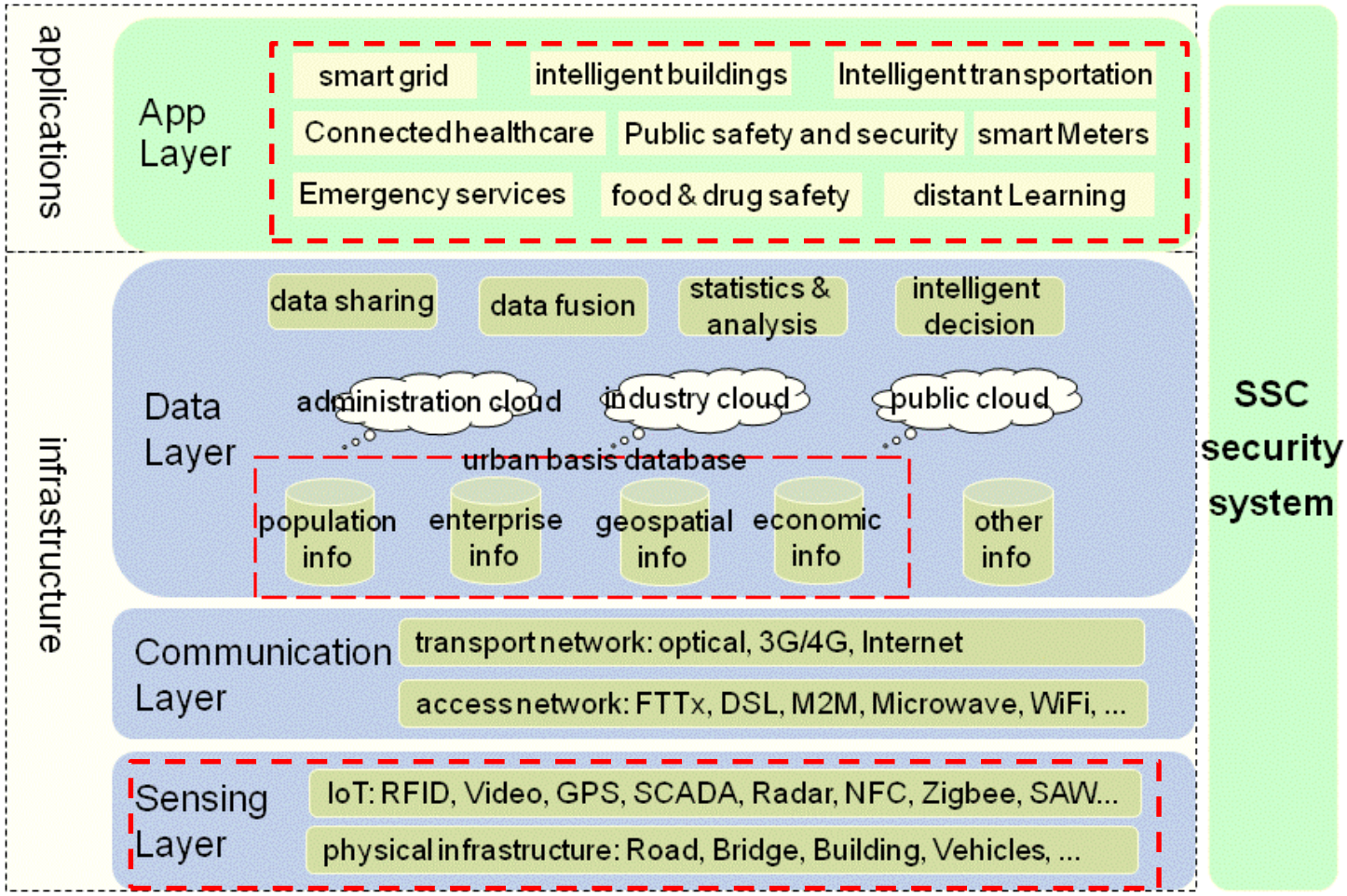
Climate Associates

Aim of this Presentation

- to provide a technical overview of
  - The use of ICTs for Smart and Sustainable Development and Protection of the Environment
- with focus on
  - What technologies are needed?
  - How will they be used?

Layered Architecture

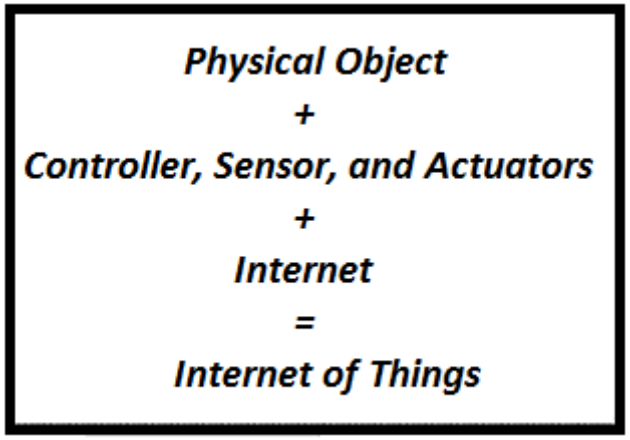
Note the presence of a Sensing Layer



This diagram introduces the concept of layers within the networks serving a Smart City or Community. Note: red lines indicate new features

Sources: FG-SSC "Technical Report on Smart Sustainable Cities Infrastructure" Page 12 and document FG-SSC-0112, proposed by Fiber Home Technologies Group and Telecom Italia

Sensing layer and Internet of Things (IoT)



An equation for the Internet of Things

- IoT predictions show that we will have 16 billion connected devices by the year 2020, which will average out to six devices per person on earth and to many more per person in digital societies.
- Existing sensors may not have direct internet access. IoT devices areable to connect to the internet directly
- Smart phones and machine to machine (M2M) (or thing to thing - ToT) communications devices will be the main springboards for IoT development.

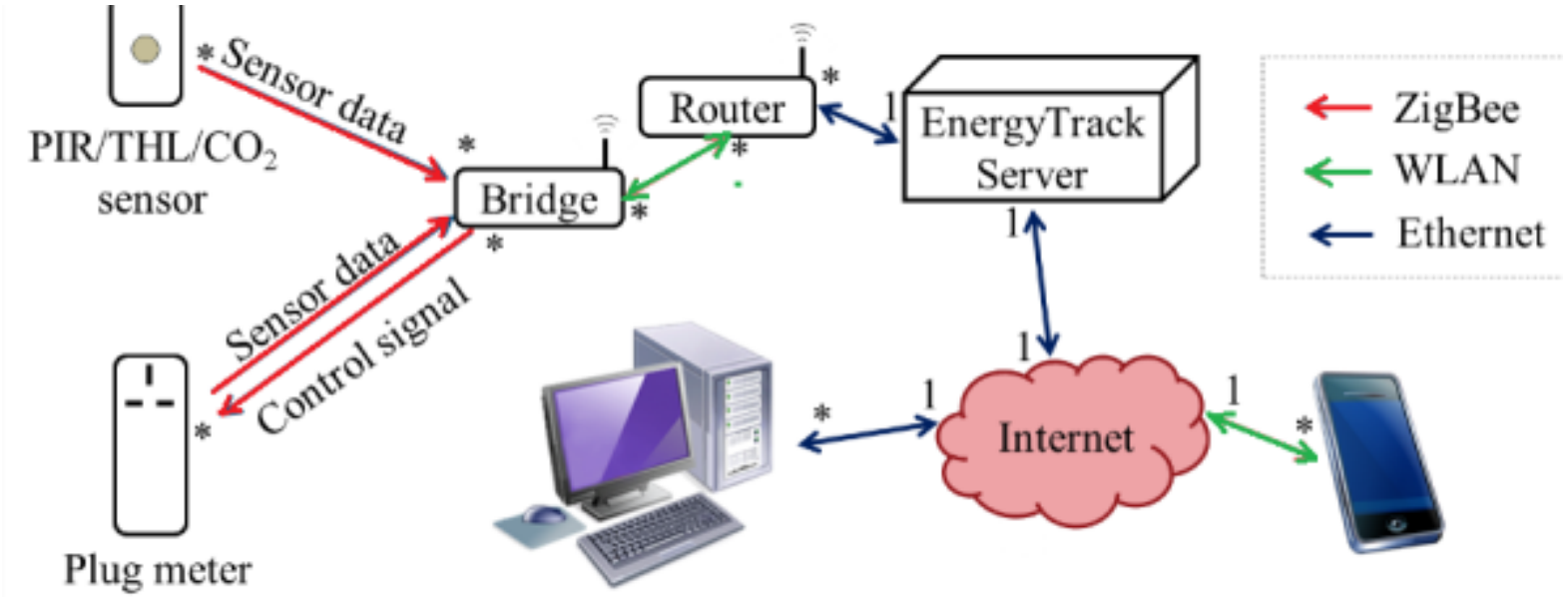
Source: FG-SSC "Technical Report on Smart Sustainable Cities Infrastructure" Page 57 and "Designing the Internet of Things". By Adrian MCEwen, Hakim Cassimaly

Sensing Layer

- The sensing layer collects data to capture and respond to environmental stimulations
  - Data are collected by sensors such as:
    - Thermometers, stress gauges, cameras, etc.
    - Location information is needed along with the measured parameter
  - Data are transported via cables in conduits, common ducts, poles, etc.
    - Similar infrastructure is also used for services such as telecommunications, cable TV and electricity supply
    - Existing infrastructure should be used as much as possible to save costs of building a dedicated sensor network
    - Only at the edge will the device need a dedicated communication link to the internet or sensor network

Source: FG-SSC "Technical Report on Smart Sustainable Cities Infrastructure" Page 12

Sensor Network

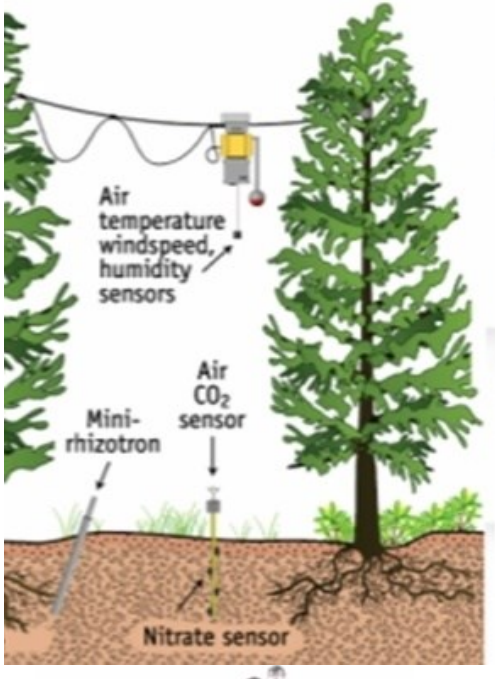


- Sensors don't need high bandwidth but they do need low latency (delay) and very low energy consumption for long battery lives
  - Standards such as Bluetooth and WLAN are not suited for low power applications, because of power-hungry RF-ICs and protocols.
- ZigBee is a new global standard for wireless connectivity, focusing on standardizing and enabling interoperability of products
  - ZigBee (IEEE 802.15.4) got its name from the way bees 'zig' and 'zag' while tracking between flowers and relaying information to other bees about where to find resources.

Sources: FG-SSC "Technical Report on Smart Sustainable Cities Infrastructure" Page 51

Sensor Network Examples

- environmental data collection
  - collect sensor readings from hundreds of points over a period of time in order to detect trends and interdependencies
- security monitoring
  - security networks do not need to collect data continuously
  - sensors only have to transmit a data report when there is a security violation
- sensor node tracking
  - tracking of a tagged object, such as vehicle with an RFID tag through a region of space monitored by a sensor network

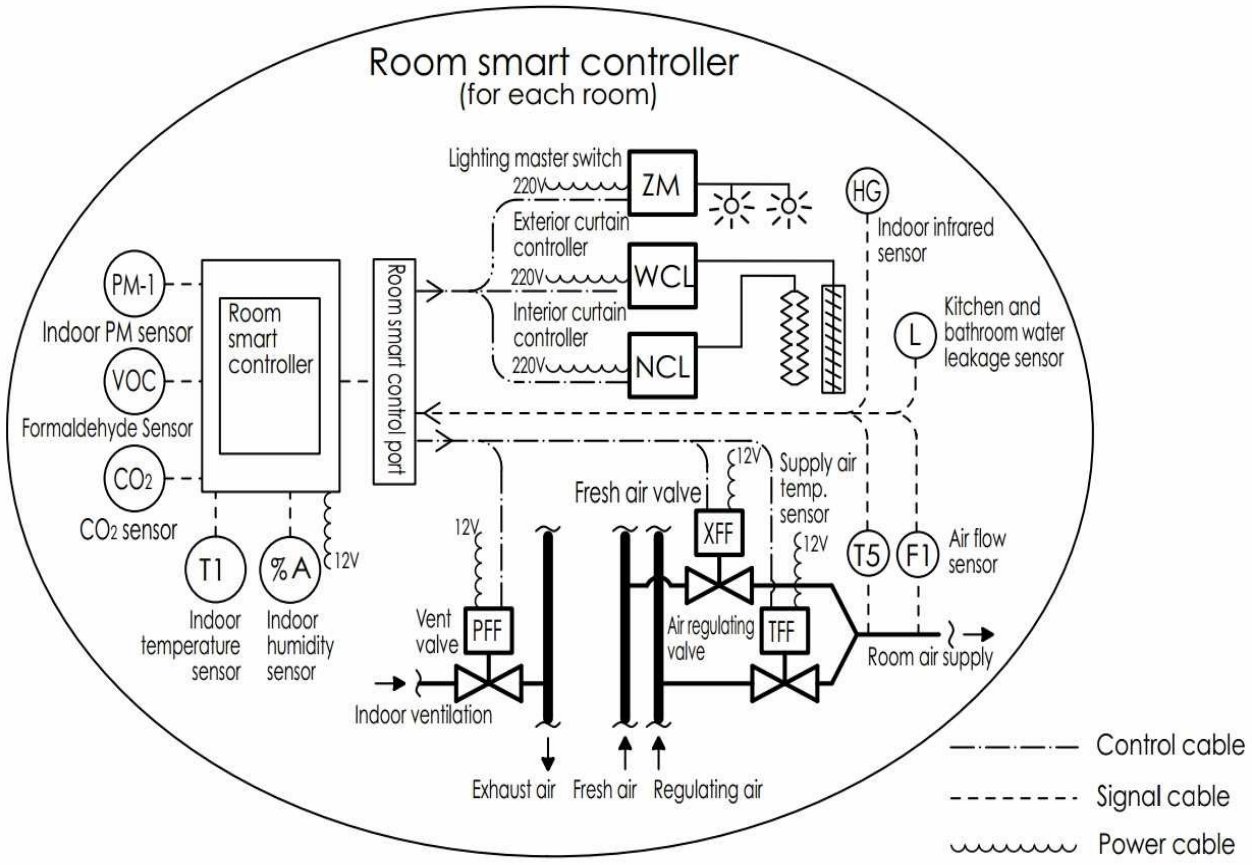


video camera sensor

On screen RFID

Sources: FG-SSC "Technical Report on Smart Sustainable Cities Infrastructure" Pages 45-46

Smart Sustainable Buildings - Example: ICT for Prefabricated 30 Storey Hotel



The room controllers, together with energy and outdoor sensor inputs, are connected to a master computer, which also controls the centralised heating and cooling equipment.

Source: http://en.broad.com/uploads/pdf/tsjd.pdf
See also https://www.youtube.com/watch?v=GVUsIlwWWM8

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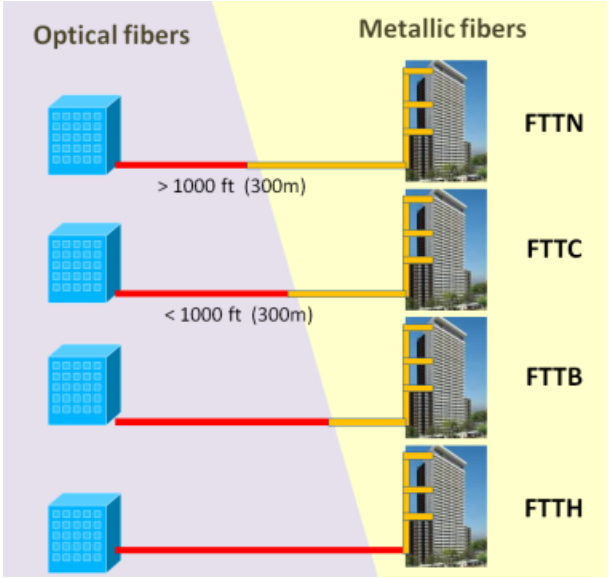
Communication Layer

- Fibre to the X (FTTX) is a generalization for several configurations of fibre deployment, ranging from
  - FTTN (fibre to the neighbourhood)
  - FTTC (fibre to the cabinet)
  - FTTdp (fibre to the distribution point)
  - FTTB (fibre to the building)
  - FTTH (fibre to the home)
  - FTTD (fibre to the desktop)
- The nearer the fibre is to the end user the faster the end to end transmission can be



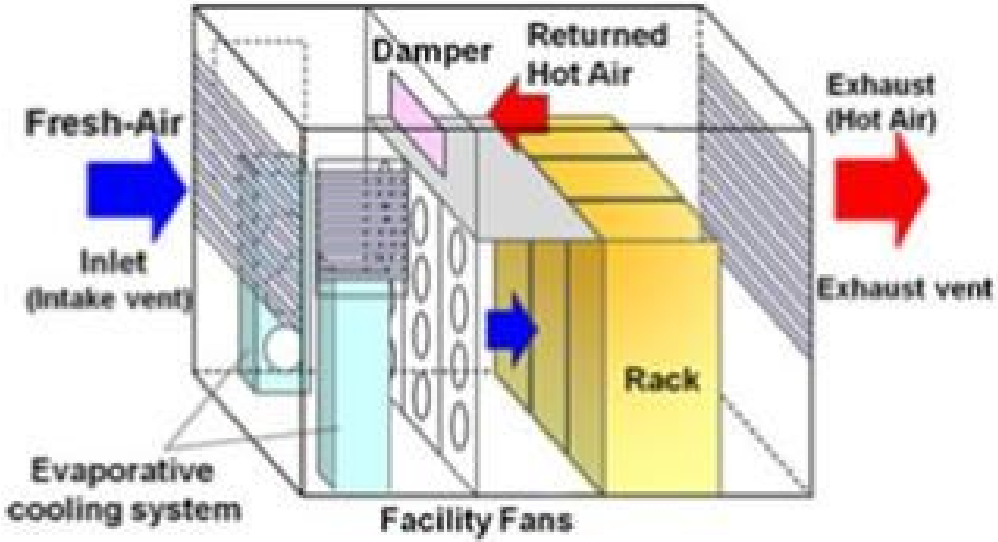
Note: metallic pairs may be needed at the edge of the network to power data sensors

Sources: FG-SSC "Technical Report on Smart Sustainable Cities Infrastructure" Page 32 and 33

Data Centre Energy Efficiency

- ITU-T Recommendation L-1300 “Best practices for green data centres”
  - Recommends features to improve the energy efficiency of a data centre or telecommunications building
  - It may be used as a basis for a checklist for an energy efficiency audit of an ICT building
- The use of external ambient air (e.g. at night or when appropriate) reduces the amount of electricity used by the air conditioning

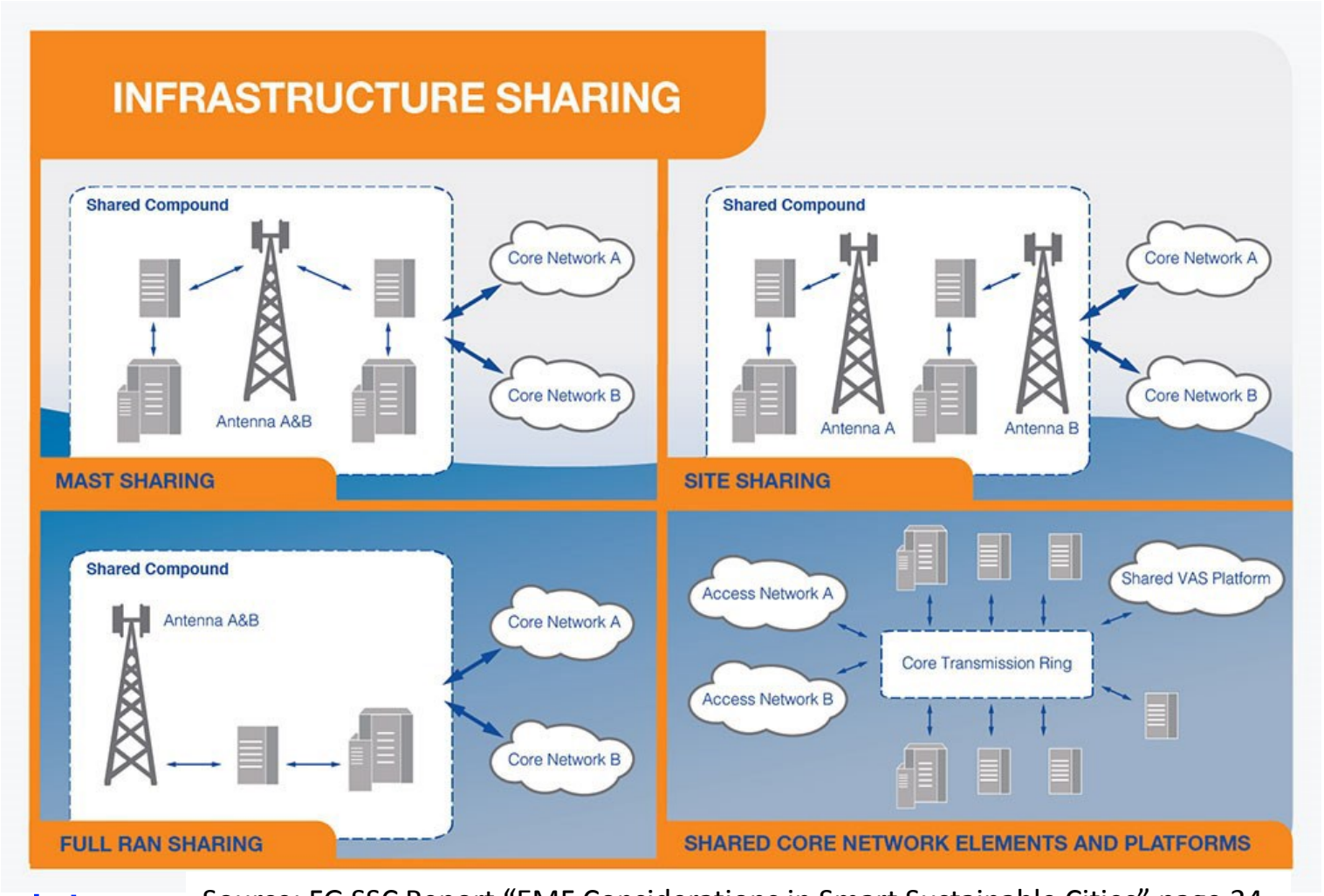
Example: Prototype container-type data centre and schematic of the container’s contents (Fujitsu)



Source: FG-SSC “Technical Report on Smart Sustainable Cities Infrastructure” Pages 24 and 25
See also ITU-T Recommendation L-1300 “Best practices for green data centres”

Infrastructure Sharing - wireless

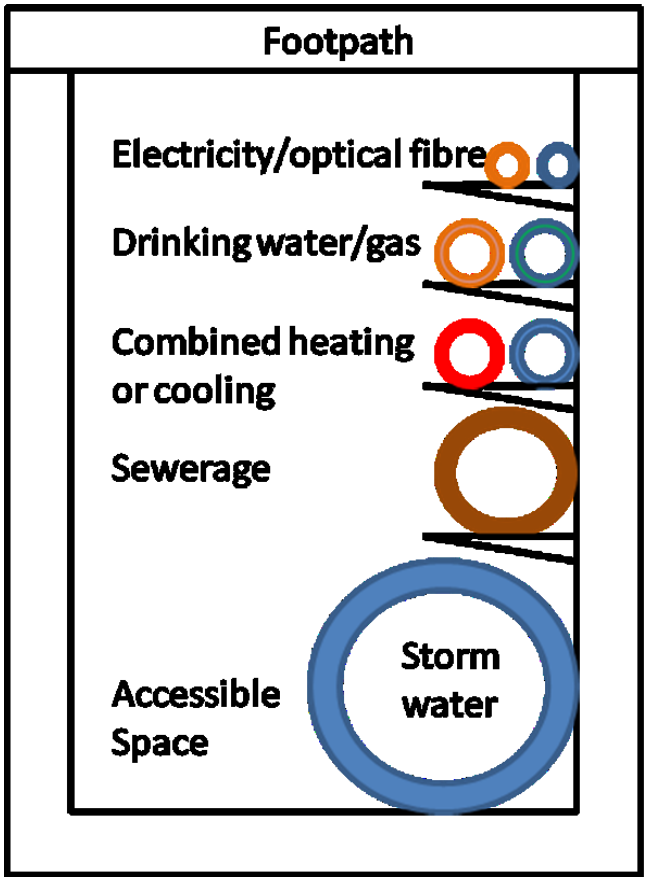
- May be between mobile operators and/or emergency services
  - Shares costs by leveraging existing technology to obtain a sensor layer network
  - demands more agreement between operators



Source: FG SSC Report "EMF Considerations in Smart Sustainable Cities" page 34

Infrastructure sharing- wired

- Traditional networks have evolved with separate ducts for each service
- For new-build districts, can synergies be exploited to save cost?
  - Example of a trenched infrastructure
  - Optical fibre infrastructure for ICT services could be laid in easily-accessible ducts by sharing conduits for electricity, gas, water and sewerage.
  - Footpaths or cycle tracks could be laid on movable covers along the entire route length to ensure easy access
- Flexibility is needed for growth and upgrade
  - Can this be provided with a shared underground infrastructure/

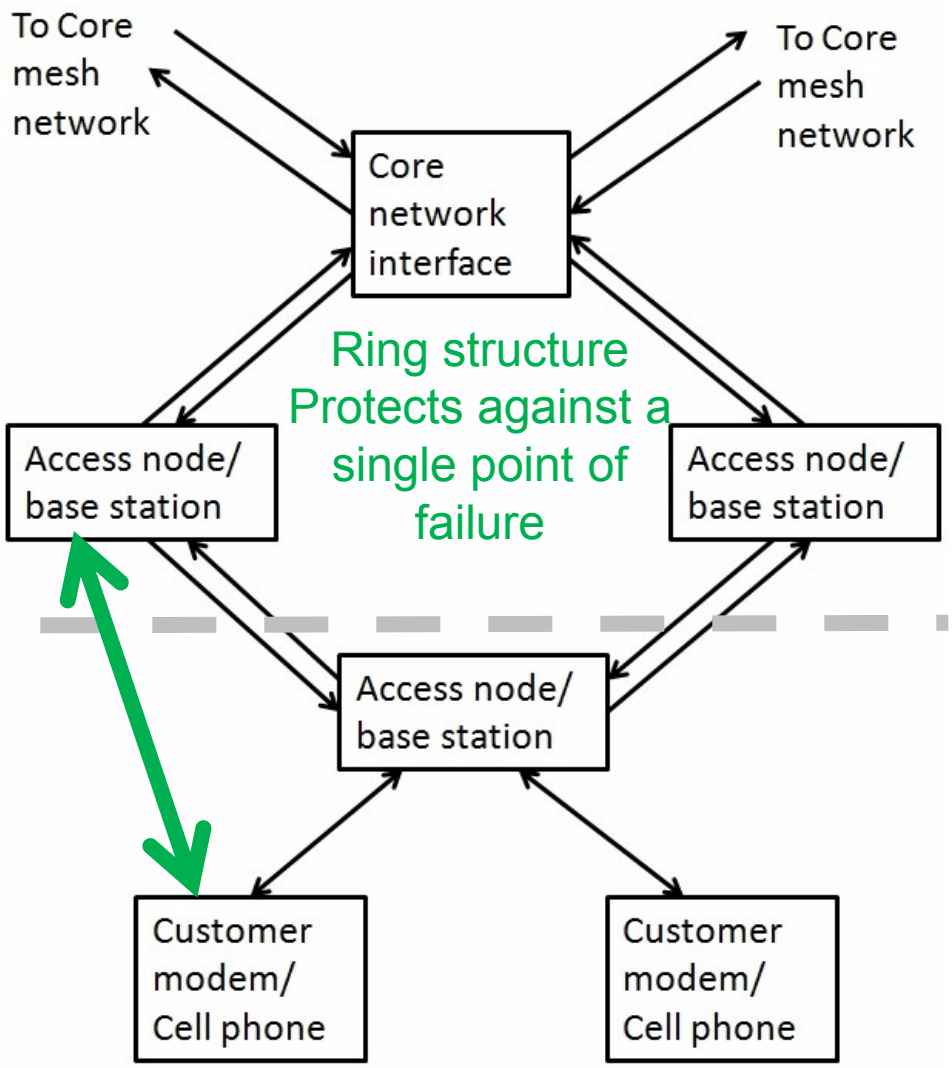


Ensuring Service Continuity

Ring networks may be 'folded' automatically at any node in event of a link or device failure

Additional paths may be added to customer end to give added protection

e.g. fibre and/or wireless

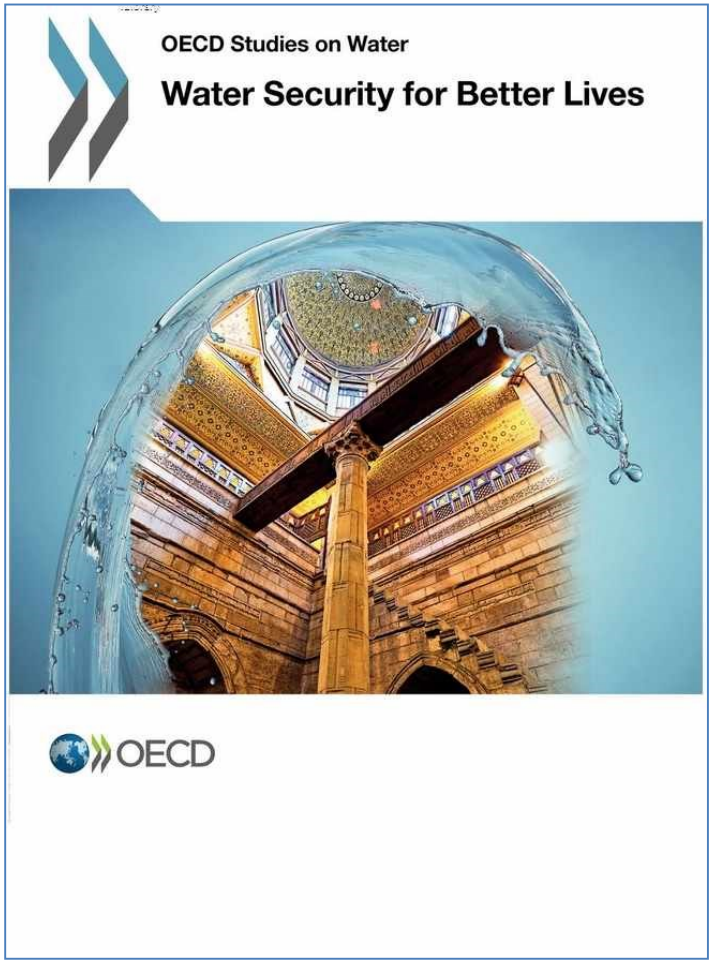


Source: ITU-T "Resilient pathways: the adaptation of the ICT sector to climate change, page 27
http://www.itu.int/en/ITU-T/climatechange/Documents/Publications/Resilient_Pathways-E.PDF

Next:
Smart Water Management

Smart Water Management

- The OECD report 'Water Security for Better Lives'*
  - identifies three key water risks:
    - shortage (including droughts)
    - inadequate quality
    - exceeding the capacity of the surface and groundwater drainage systems
  - raises awareness of the importance of tackling water-related challenges from an integrated, holistic perspective, to achieve acceptable levels of risk for all stakeholders



Source: FG-SSC "Smart Water Management in Cities", Page 3
*http://dx.doi.org/10.1787/9789264202405-en

ITU-T Focus Group on Smart Water Management

- For more information read
  - reports being written by the Focus Group on Smart Water Management (FG-SWM)
    - This was established by the ITU-T TSAG meeting in Geneva, 4-7 June 2013
  - See
    - http://www.itu.int/en/ITU-T/focusgroups/swm/Pages/default.aspx

Source: FG-SSC “Smart Water Management in Cities”, Page 1

Next:
ICTs for Climate Change Adaptation

Example: Off-Grid Base Station and a Green Energy Solution

"Launched in Aug 2011, the Indus Towers Green Sites Project flagged off with 6 major Indian cities being declared Green….where **no diesel** would be consumed for cell site operations".

Source: http://www.industowers.com/green-sites.php

Climate Change Risks

- A society's 'sectors' are interconnected
  - a failure in one sector because of an extreme event could have a 'domino effect' on other sectors and cause economic loss

- Climatic changes such as variation in rainfall, temperature or sea level are having an impact on
  - agricultural production and the food supply chain
  - water supply
  - disease proliferation

Source: FG-SSC "Technical Report on ICTs for Climate Change Adaptation in Cities", page 10

Example: Climate Change Adaptation Plans

- It is a United Nations Framework Convention on Climate Change (UNFCCC) requirement for countries to have a National Climate Change Adaptation Plan
- In developing its climate change strategy, the Durban Municipality in South Africa identified a set of ten interrelated climate change response themes:
  - water, sea level rise
  - biodiversity
  - food security
  - health
  - energy
  - waste and pollution
  - transport
  - economic development
  - knowledge generation and understanding
- The response includes the development of an implementation framework, and a monitoring and evaluation system

Source: FG-SSC "Technical Report on ICTs for Climate Change Adaptation in Cities", page 15

Example: Use of ICTs for Disaster Early Warning

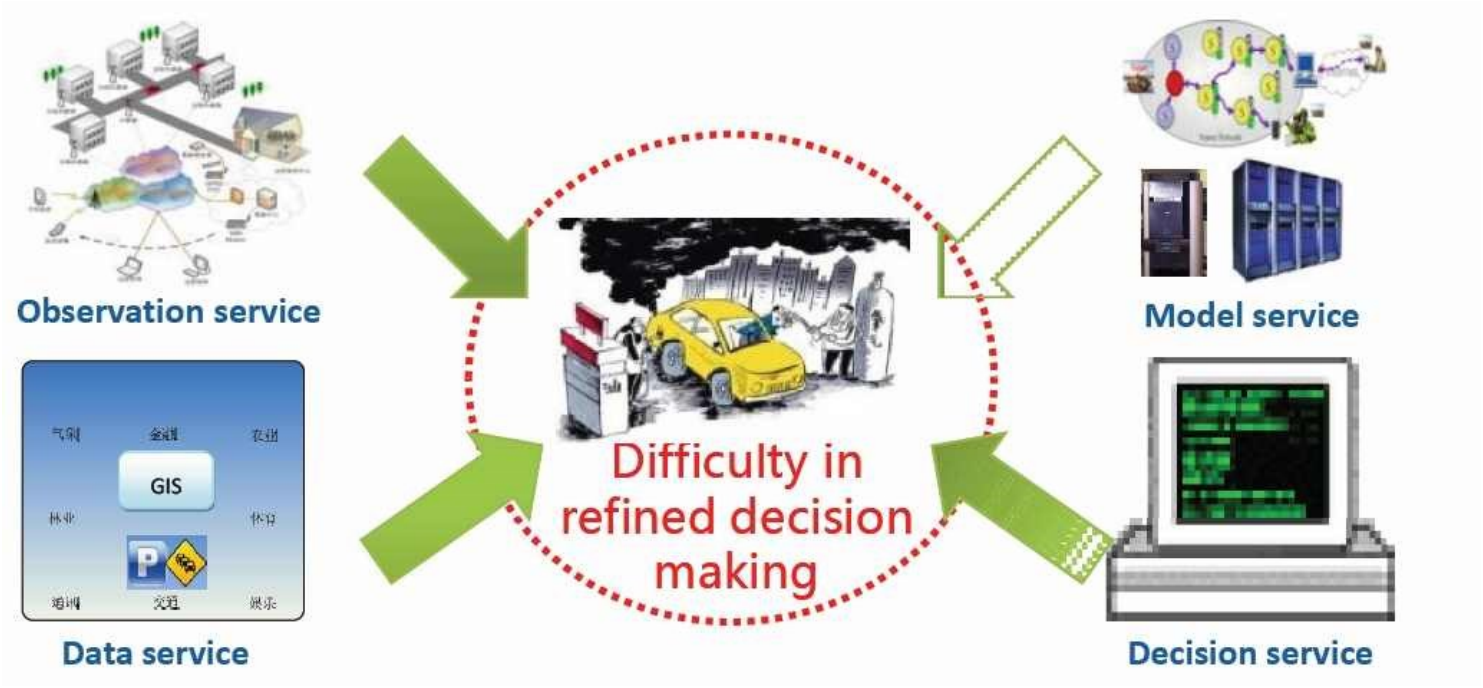
- Disaster Early Warning Network (DEWN), Sri Lanka
  - A public/private partnership delivered it
  - Multiple technologies were adopted
    - cellphones and alarm devices
    - cell broadcast (CB) and short message service (SMS) were specially developed for this initiative
  - The Disaster Management Centre (DMC)
    - receives early warning information from recognised technical agencies
      - floods, landslides, earthquakes and tsunamis
    - verifies the emergency situation and then issues alerts. Emergency personnel first followed by public alerts
  - It generates mass, personneldirected or locationbased alerts
    - DEWN2 is being developed for smart-phones

Source: FG-SSC "Technical Report on ICTs for Climate Change Adaptation in Cities", page 21

Next:
Integrated Management and Open Data

Current Management Situation

- Diverse requirements and information sources
- A passive information service (i.e. requiring human interactions)

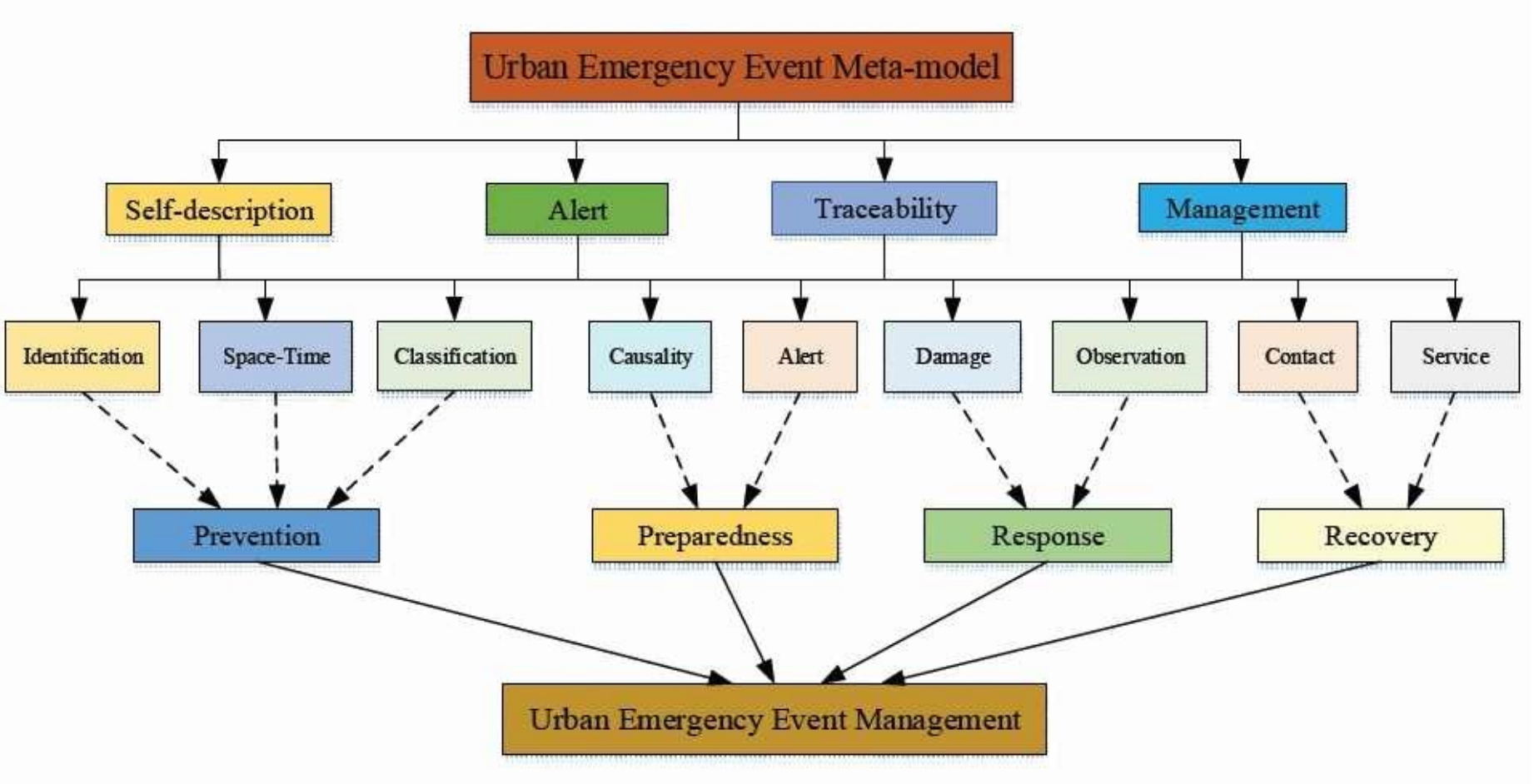


- There is a need for unified service interfaces to enable active (automated) decision making and alerts
  - A standard set of interfaces, metadata (data about data) and processing steps are needed which can be applied to all ICT environments

Source: FG-SSC 'Technical report on Integrated Management for Smart Sustainable Cities", page 8

Example of Event Meta-model

- A flow diagram showing an automated event-management system is shown below



Source: FG-SSC 'Technical report on Integrated Management for Smart Sustainable Cities", page 21

Motivation for Open Data

- Governments may choose to publish open data to maximize public reuse
  - To strengthen transparency
  - To promote efficiency and effectiveness in administration
  - To create economic opportunity
  - To improve quality of life

Source: FG-SSC report "Technical Report on Anonymization Infrastructure and Open Data in Smart Sustainable Cities", Page 6

The Technology for Open Data

- Example: Social Networks
  - Allow people to create a personal profile and link to others on the network
  - People are no longer anonymous and can access databases via service providers such as Facebook, Twitter, LinkedIn etc.
  - Government agencies are now using social networks to promote and access open data
  - New types of 'Social Network' will apply to 'Internet of Things'

Source: FG-SSC report "Technical Report on Anonymization Infrastructure and Open Data in Smart Sustainable Cities", Page 24

Gathering Data for Key Performance Indicators

KPIs and monitoring

Habitation and use

Buildings Con-struction

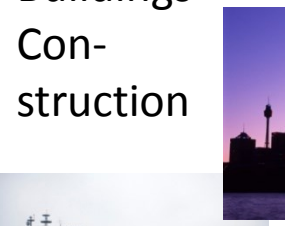
Road Con-struction

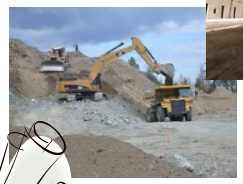
Metro rail

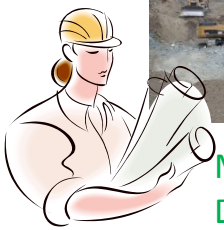
Under-ground Infra-structure

Laying foundations

Planning







Applications, Control, Monitoring and Communications systems

Control, Monitoring and Communications systems

Mapping, Design and Monit-oring systems

Control systems

Monitoring systems

Mapping and Design tools

Project Management tools

2015 2016 2017 2018 2019 2020

Climate Associates

Sensors to gather data for KPIs need to be planned from the outset

Conclusion

- For smart sustainable development a sensor network is needed in addition to traditional telecommunication networks
- Planning from the outset and infrastructure sharing are key to saving cost
  - Both physical and electronic
  - Existing communication networks should be exploited
    - both fixed and wireless
  - Sensors need adding at the ‘edge’ to gather data needed to monitor and manage essential services
    - Electricity, water, transport, etc.
    - In some cases a smart-phone may be used as both a sensor and an output device
    - In other cases a dedicated wired or wireless link will be needed to connect the sensors

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