Multi-service infrastructure for smart sustainable cities in new-development areas

David Faulkner, Ziqin Sang, N.S. Deepu
Flavio Cucchietti, R. M. Agarwal,
ITU-T Focus Group on Smart Sustainable Cities (FG SSC)

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- What utilities do we need?
- Utility Corridors and Trenching
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Objective

- This document focuses on answering the question, "How should ICT infrastructure be planned for a new city given that it has to be both 'smart' and 'sustainable'?"
  - The approach taken assumes that no infrastructure exists and the city or urban development area is to be built from new

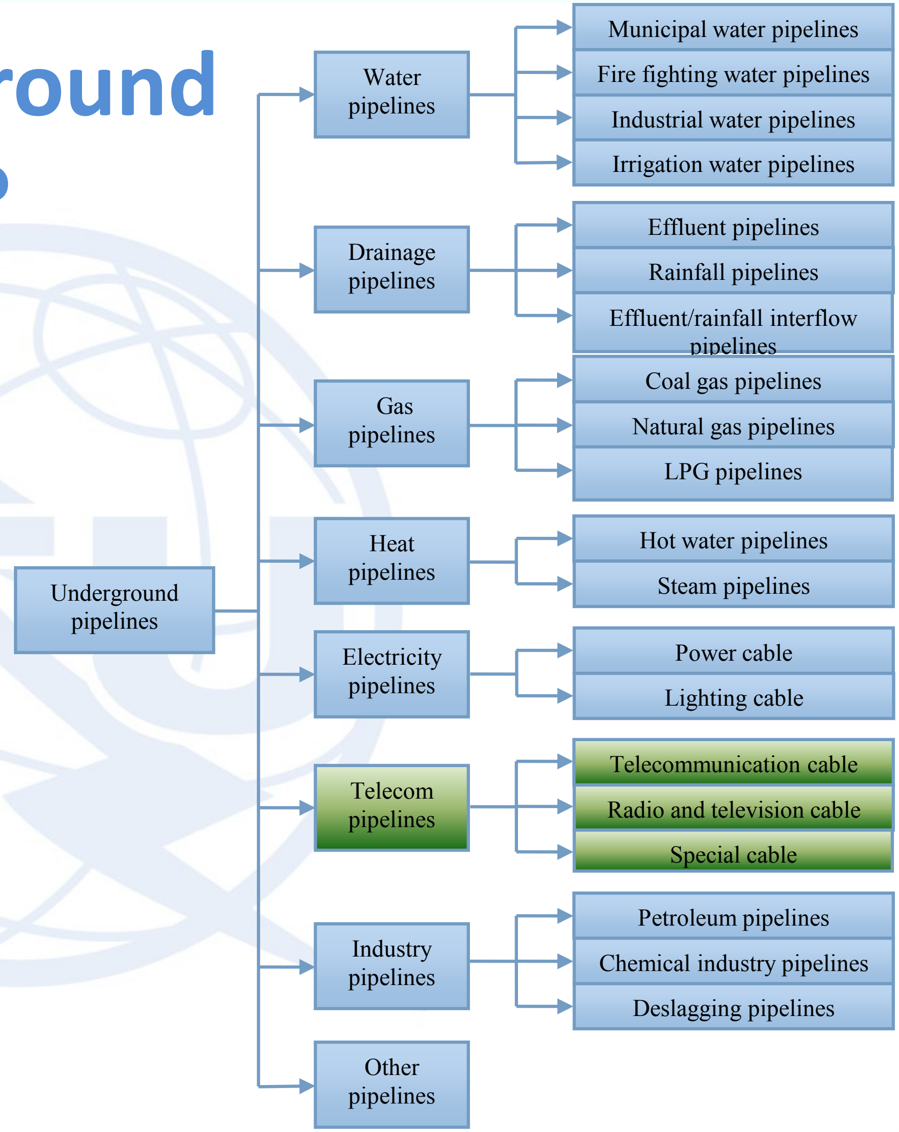
A key problem to be solved

Can new infrastructure be to be shared to save costs, be smarter and more sustainable?

Source: ITU-T FG-SSC Multi-service infrastructure for smart sustainable cities in new-development areas
Nilesh Puery: Presentation "Gujarat International Finance Tec-City" made at ITU Training Event "Leveraging ICTs for Smart Sustainable Cities for Asia-Pacific Region", Delhi, March 24-26, 2015.

What are the Underground Utility Requirements?

- Telecommunications systems is our focus
- but ICT's can add intelligence to all other services
  - Sensors to warn of faults
  - Control systems to shut down and activate services
  - Special cables are needed
    - A sensor layer network is needed
- Don't miss anything
  - It could be expensive to add it later!
  - e.g. pipes for solid waste disposal?

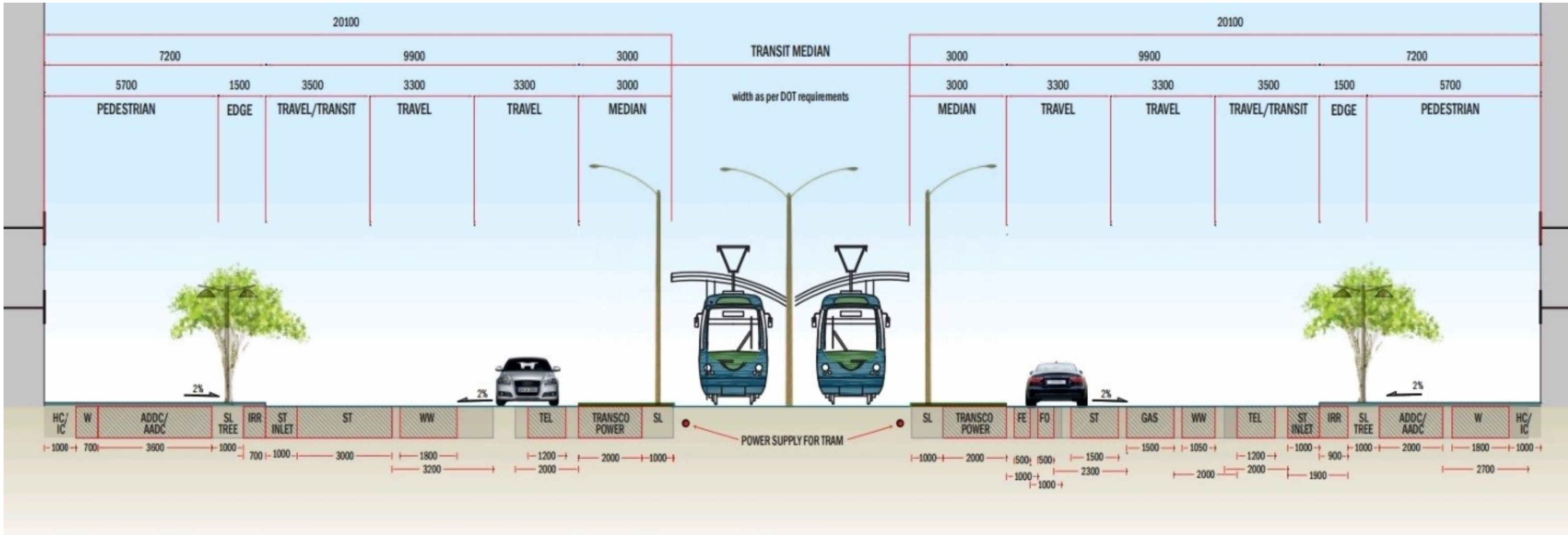


Sources: ITU-T FG-SSC deliverable "Multi-service infrastructure for smart sustainable cities in new-development areas" and
Standard of Ministry of Construction of China CJJ 61-2003, Technical specifications for detecting and surveying underground pipelines and cables in city (2003), in Chinese.

Surface and above ground utilities

- Roadways
- Footpaths
- Tramways
- Street lighting
- Wireless networks
- Corridors for trees (e.g., to provide cooling and absorb polluting gases (NOx and CO_2)
- Arrangement of solid waste collection facilities/bins

Typical Utility Corridor



- Inter-agency coordination is needed to
  - Reduce road maintenance costs
  - Provide smoother roads with fewer closures for maintenance
  - Be cost-effective to suit local conditions
  - Eliminate disputes among stakeholders
  - Expedite project delivery

Sources: ITU-T FG-SSC deliverable “Multi-service infrastructure for smart sustainable cities in new-development areas” and
Abu Dhabi Urban Planning Council, “Abu Dhabi Utility Corridors Design Manual” Version 1
http://www.upc.gov.ae/template/upc/pdf/UCDM_Version-1-En.pdf

Advantages of Trenching

- Initial costs may be lower because of the avoidance of the cost of the utility duct and subsequent installation of the cables into such duct
- Planning time needed among stakeholders is minimized
- Maintenance workers can focus their expertise on one utility
- No central authority is needed to manage the stakeholders.

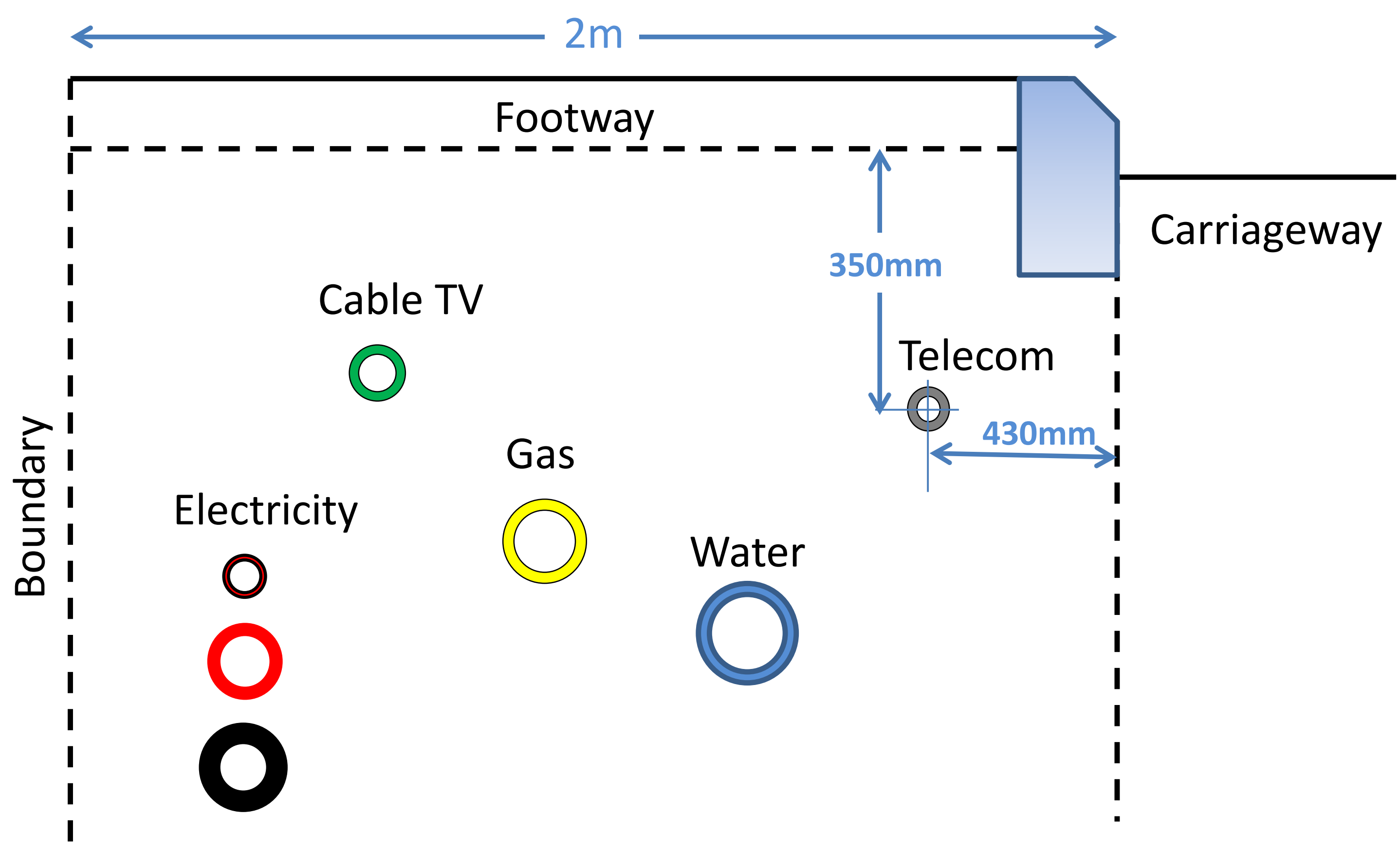
Source: ITU-T FG-SSC deliverable “Multi-service infrastructure for smart sustainable cities in new-development areas”

Disadvantages of Trenching

- Maintenance costs are higher
  - damage risk to other utilities
- Location records are poorly kept
- Lack of coordination results in crossed paths/chaotic routing
- Road surfaces can be seriously damaged by frequent trenching
- Without common utility tunnels or ducts, new types of networks require new trenches which are costly to build

Source: ITU-T FG-SSC deliverable "Multi-service infrastructure for smart sustainable cities in new-development areas"

Trench Sharing
Example from United Kingdom 1/2



Source http://www.njug.org.uk/wp-content/uploads/V1-Positioning-Colour-Coding-Issue-8.pdf

Trench Sharing
Example from United Kingdom 2/2

- Reduces disruption to both vehicular and pedestrian traffic
- Offers cost savings in construction and reinstatement
- Maximizes available space in the highway

- It is essential that early consultation takes place with representatives from relevant authorities and all other interested parties ..etc.

Source: http://www.njug.org.uk/wp-content/uploads/V1-Positioning-Colour-Coding-Issue-8.pdf

Utility Tunnel

- A utility tunnel is considered an optimal solution to avoid underground crowding of utilities in narrow right-of-ways
- Shared infrastructure can save significant costs, especially when provision is made for maintenance, upgrade and growth over the lifecycle
- Requires cooperation among stakeholders

Sources: ITU-T FG-SSC deliverable “Multi-service infrastructure for smart sustainable cities in new-development areas” and Abu Dhabi Urban Planning Council, “Abu Dhabi Utility Corridors Design Manual” Version 1
http://www.upc.gov.ae/template/upc/pdf/UCDM_Version-1-En.pdf

Advantages of Utility Tunnels

- Easier accessibility to utilities for maintenance and upgrading
- Environmental impacts are minimized: such as traffic disruption
- Location information is made more accessible
- Utility ducts greatly reduce surface area occupied
- An adequate airflow in ducts allows better heat transmission from electricity cables than in direct trenched/buried situations

Source: ITU-T FG-SSC deliverable "Multi-service infrastructure for smart sustainable cities in new-development areas"

Disadvantages of Utility Tunnels

- High initial construction cost as compared to traditional open excavation methods
- The issue of compatibility between the utilities housed in the tunnel. A defect in one system may adversely affect the other systems.
- The concerns of people entering the tunnels to maintain one service when they are not experienced in dealing with other types of services (and associated risks) of other utilities

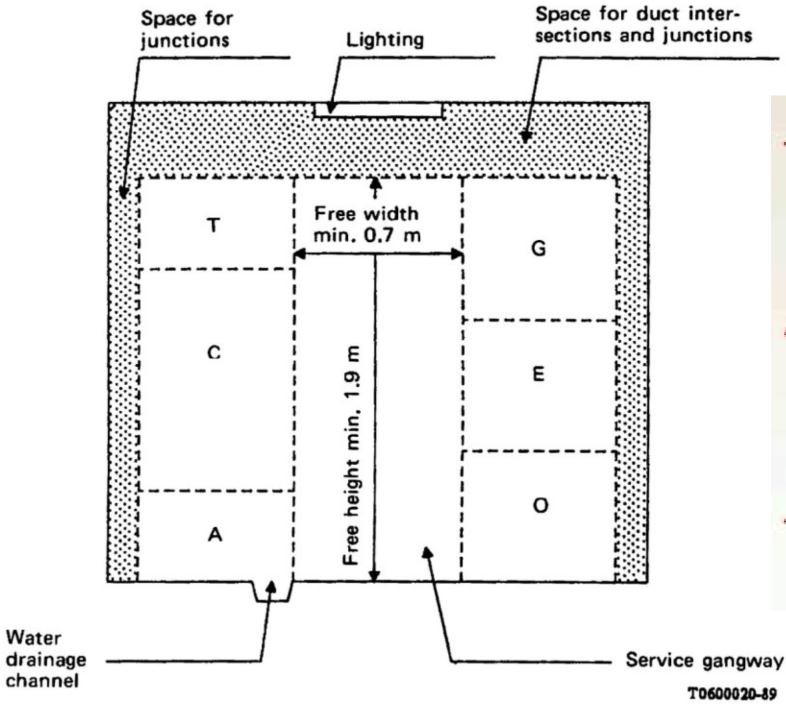
Source: ITU-T FG-SSC deliverable "Multi-service infrastructure for smart sustainable cities in new-development areas"

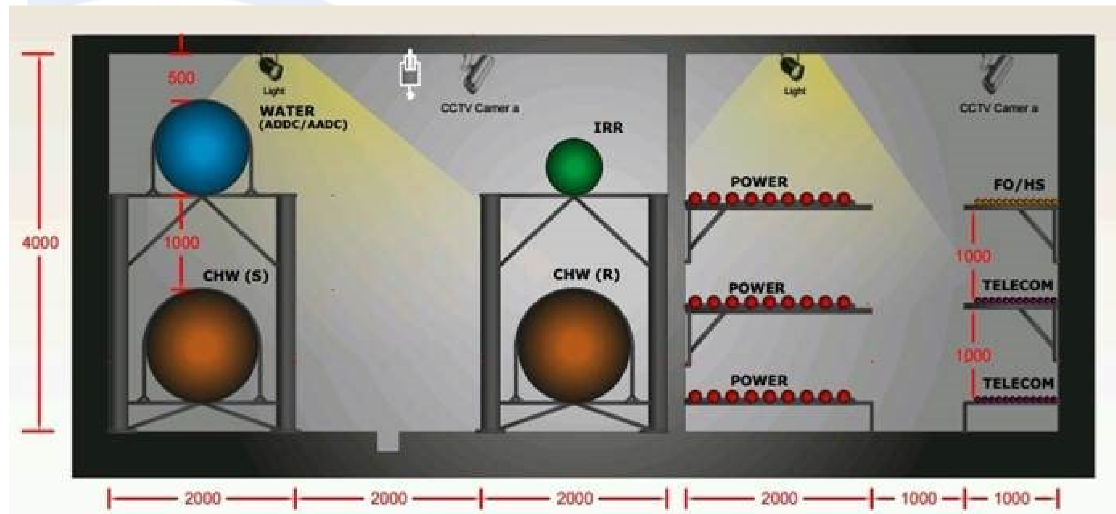
Utility Tunnel Specifications

- Wet utilities should be in a separate compartment from dry
- An adequate head-height and width is needed to allow for removal and replacement of equipment
- Lighting should be designed to a minimum level of 150 LUX
- Fire detection and alarm systems are needed
- Firewalls may be required to isolate sections of the tunnel during a fire
- Tunnels should include an emergency escape
- Wet utilities tunnels should include floor drains draining into a sump
- Tunnels should include a closed-circuit TV system
- Tunnels should be equipped with a gantry for lifting heavy equipment, such as valves.

Sources: ITU-T FG-SSC deliverable “Multi-service infrastructure for smart sustainable cities in new-development areas” and
Abu Dhabi Urban Planning Council, “Abu Dhabi Utility Corridors Design Manual” Version 1
http://www.upc.gov.ae/template/upc/pdf/UCDM_Version-1-En.pdf
ITU-T Recommendation L.11 “Joint use of tunnels by pipelines and telecommunication cables, and the standardization of underground duct plan”, 1988.
http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=1415

Utility Tunnel Examples





T Telecommunication duct area (exposed cables)
E Power duct area
G Gas duct area
O Water duct area
C District heating duct area
A Waste water duct area

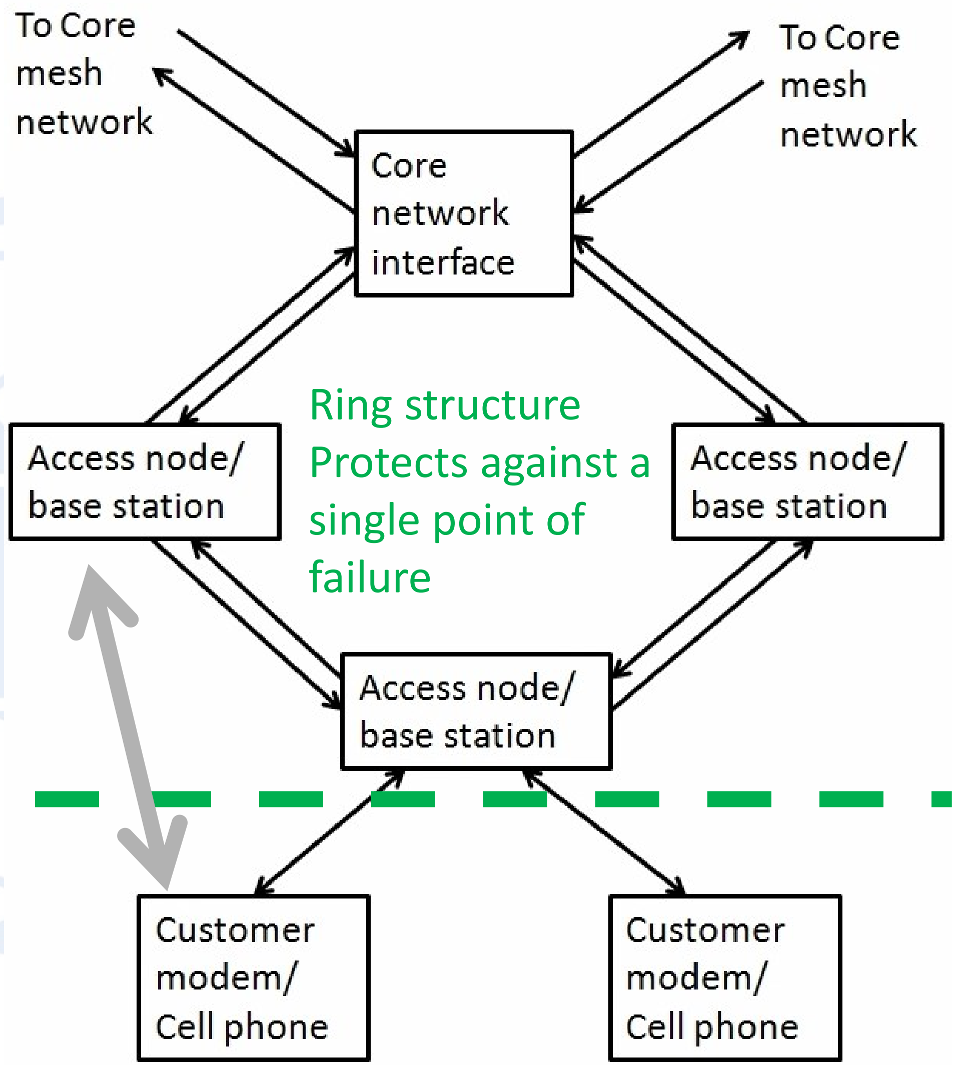
ITU-T Recommendation L.11 "Joint use of tunnels by pipelines and telecommunication cables, and the standardization of underground duct plan", 1988. http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=1415

Abu Dhabi Urban Planning Council, "Abu Dhabi Utility Corridors Design Manual" Version 1 http://www.upc.gov.ae/template/upc/pdf/UCDM_Version-1-En.pdf

Network Resilience

Duplicate the transmission path and devices

e.g. ‘ring’ automatically ‘folds back’ if there is a break in traffic at a node or link



- **Resilience may be increased with dual access**
- **Add an additional access path to a different access node**
- **Wireless and fixed**

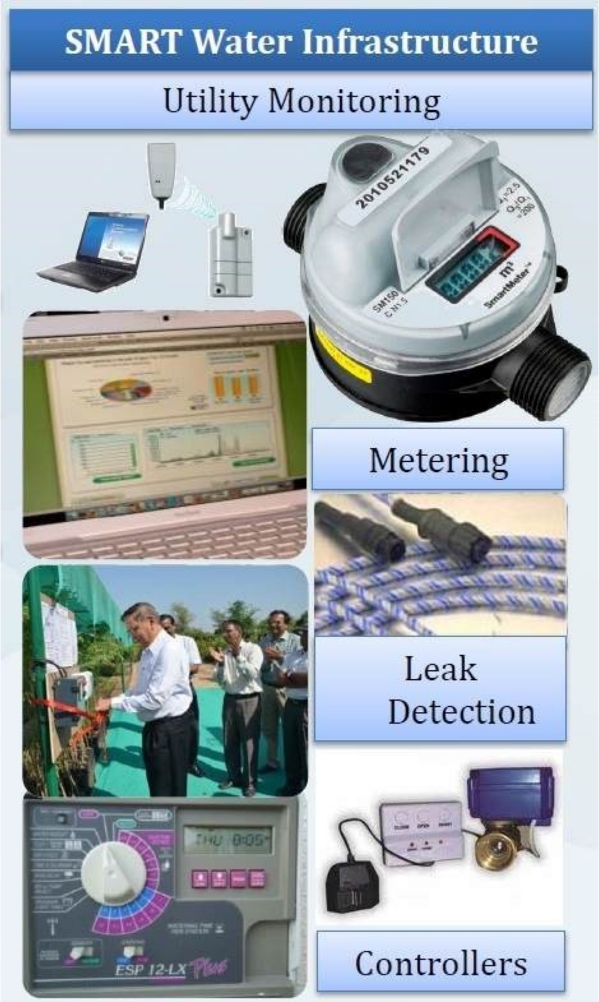
Source: ITU-T FG-SSC deliverable “Multi-service infrastructure for smart sustainable cities in new-development areas”

Powering the sensor layer network

- Batteries for remote radio sensors have a limited life and may be expensive to locate and replace
  - Greater than 10 year life is needed
- Wired networks can avoid this problem
  - ADSL (telecommunications cable)
  - Power over Ethernet (4 twisted pairs)
  - HomePlug Powerline Alliance (electricity cable)
  - USB (computer cable)
- Be sure to allow space for the wires!

Opportunities for ICT to support other utilities

- Sensors can facilitate better monitoring and control and give advance warning of failure or blockages
- Possible examples include:
  - Flood detection sensors in utility ducts
  - Fire detection sensors in utility ducts
  - Temperature sensors in electric cables
  - Gas leakage detectors
  - Traffic flow monitoring
  - Street lamp control
  - Street lighting control
  - Water utility…



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Opportunities for sharing the Application Platform

- A wide range of service applications are envisaged
- Each requires termination onto a server, data storage, a smart processor and connection to personal devices, sensors and controllers
- Most existing cities have a multiplicity of platforms to support these services because expertise for managing the services resides in silos
- When building a new SSC planners have the option to select a service platform which can handle the bulk of the software functions required by application developers on a single platform
- Example…

- FIWARE was funded by the European Union in a $100M R&D Programme
- Provides an open, public and royalty-free managed service architecture for smart cities
- Offers a set of open APIs that allow developers to avoid getting tied to any specific vendor, therefore protecting application developers' investments
- http://www.fiware.org/contact-us/

Sources *http://cordis.europa.eu/fp7/ict/
**http://www.fi-ppp.eu/projects/fi-ware/
***http://www.fiware.org/about/

Conclusions

- A SSC is a concept which can be applied to a range of construction projects with focus on cities
  - May be applied in both new-build and in new development areas
- Resource sharing at all stages and level of construction can offer significant advantages
  - such as cost reduction when maintenance is taken into account
  - A wide range of stakeholders need to cooperate to get the best result
- New construction techniques are needed to obtain a rapid and comprehensive result
- ICT needs to be central to all stages of the planning and operation of a SSC