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

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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 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?

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
• 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

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

Railway

* Footway

* Boundary

* Carriageway

* Cable TV
* Gas
* Water
* Telecom

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.

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

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.

Utility Tunnel Examples


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

Ring structure Protects against a single point of failure

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...
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