

# How to design a smart and sustainable city? LuxTurrim5G solution

Authors: Hannele Ahvenniemi, Joni Turunen,  
Pekka Torvinen, Markku Heino, Ville Kotovirta,  
Pekka Wainio & Juha Salmelin

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## LuxTurrim5G - Building the Digital Backbone for a Smart City

**LuxTurrim5G ecosystem creates the digital backbone for a smart city. Our network of smart poles combines fast 5G connectivity, relevant data from a variety of sensors and a secure platform to build new data-driven services. This will help cities to tackle the grand challenges regarding urbanization and climate change, boost sustainable development and enable their digital transformation to smart or even hyperconnected cities.**

### CHALLENGES THE CITIES ARE FACING - URBANISATION AND CLIMATE CHANGE

Cities consume 78% of the world’s energy, and IEA expects the energy demand in cities to rise by 57% from 2006 to 2030. According to the UN, 56% of the world’s population lives in urban areas, and the proportion is increasing at the pace of 80 million new citizens each year. Cities are responsible for up to 80% of global carbon emissions. Due to the rapid urbanisation, cities face major challenges regarding inequality and poverty, health, resource scarcity, environmental issues and housing, among others. From a citizen point of view, living in a city is not a static but highly dynamic combination of habitation, working, travelling, socializing, communication, and entertainment activities. Cities are expected to deal with personal challenges such as long commuting times, environmental pollution, poor transport structures, and congestion.

### SMART CITIES RESPONDING TO THE CHALLENGES

The aim of smart cities is often seen in improving social, environmental and economic sustainability by utilising modern technologies – providing a low-carbon and environmentally friendly surroundings with maximised citizen well-being and thriving business activities (Figure 1). A smart city is a complex ecosystem of people, policies, services, public and private organisations, technologies etc., all participating in the endeavour of developing an urban environment towards desired outcomes. The networks of stakeholders within cities (e.g. governments, the private sector, academia and citizens) play a crucial role in building the global future since each city is contributing to the adoption of innovative technologies in its way to fit the global agenda of sustainable living environment.

Smartness of cities is typically highly dependent

on the development of smart services. Smart city services are based on the end-user (citizen) needs. Cities can offer services both for the citizens and their service providers. At the same time, private companies and other stakeholders can provide services to citizens.

Typical smart city services are related to city maintenance, public safety, health care, citizen engagement, transportation and mobility, energy, and many others making life in the city easier and more sustainable.

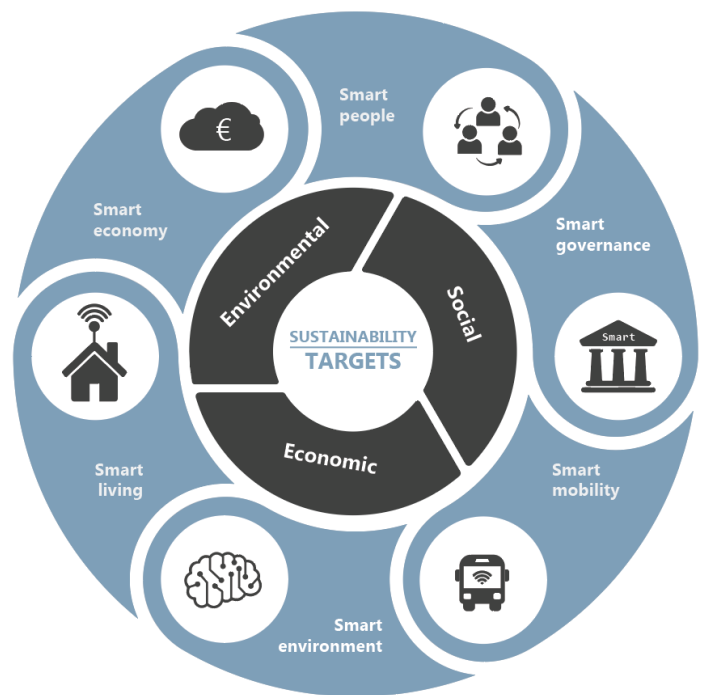


Figure 1. Typical smart city ecosystem elements and the three dimensions of sustainability.

**Smart mobility** is an umbrella concept for the collective use of many modes of transportation, e.g. public transport, car-sharing, autonomous vehicles and city bikes as a service or on-demand, the need of which is strongly driven by megatrends such as urbanization, digitalization and climate change (Figure 2). All in all, the future of transportation and mobility is more shared, electric, driverless and sustainable.





The core enabling technology for smart mobility services is improved network connectivity in the form of 5G with its low-latency and high-bandwidth connections, as well as sharing of data among the stakeholders involved. In logistics, where efficiency, situational awareness and utilisation rates matter, system-level thinking utilising smartness is the key.



Figure 2. Smart city has various forms of transportation that need to communicate in real-time with various stakeholders.

**Smart health** solutions are forecasted to both improve personal living quality and reduce costs. Typically, technical support for personal health is based on information on person's health conditions from historical data and diagnostics connected with real-time data from wearable sensors, ambient environmental conditions such as weather, air quality, noise, pollution, processed with the intelligent situation awareness system. Utilising all this data improves quality of life, decreases the probability of sudden critical health events and the reaction time in health events and accidents, therefore reducing the costs of public health care. To achieve this, three components are needed: First, the citizen being aware, motivated and equipped to be part of the individual service provider supporting their health. Second, the real-time ambient, hyperlocal and rich sensor data, and third, the back-end system processing the relevance of the data streams, anomalies and insights in combining environmental data to the personal information. As an example, providing air quality measurement data for the citizen - the real-time hyperlocal data of pollutants on street level - has an impact on citizens' awareness and behaviour (Figure 3).

**Smart safety** can be comprehended as physical and psychological. The ideal situation is when smart cities consist of structures and solutions which enhance both. For example, 'feel of safety' is one of human's basic needs, which is psychological. Physical safety, in turn, can be understood as a result of actions that detect, prevent or reduce the impact of accidents, crimes and even citizen's abrupt health failures. Video surveillance has been part of the authorities' toolbox in cities for decades. Today, situational awareness, dating back to the 80s, has reincarnated and is the core element for smart safety solutions. Added with AI the authorities and safety operators today have a state-of-the-art toolbox in hands to enhance safety. With the powerful tools it is important to take necessary actions to safeguard the privacy of the citizens.



Figure 3. Local air quality is often part of smart health solutions.

Energy consumption forms a remarkable share of building life cycle GHG emissions, and **smart energy** solutions are seen as a key in solving the



energy challenges. Smart cities have introduced the concept of regional smart energy networks with decentralised renewable energy production, optimisation and storage systems to generate neighbourhood level efficiencies.

In buildings, smart energy solutions consist of smart monitoring providing real-time feedback and automation systems adjusting heating and electricity. Ideally, building energy systems are connected to a smart grid, enabling optimisation at a large scale, smart storage systems and demand response of individual energy users (or prosumers).

## LUXTURRIM5G SOLUTION

LuxTurrim5G solution consists of two main parts (Figure 4):

- 1) smart pole-based infrastructure with integrated 5G network and IoT devices forming a common connectivity layer and
- 2) locally managed data platform and marketplace for collecting, enriching and sharing data for local users and the local smart city service developers' community.

5G mmWave small cell network can provide the necessary high bandwidth uplink capacity and

low latency communication needed by many of the future smart city services like autonomous driving and real time situational awareness.

**LuxTurrim5G smart pole product family** is based on a modular design. Combining different modules can create multiple variations of pole designs to fit in all types of urban areas, street environments and service needs (Figure 5).



Figure 5. Real-life smart pole prototype in Kera, Espoo, Finland with lighting, weather, traffic monitoring, camera, public announcement, surveillance and LIDAR modules.

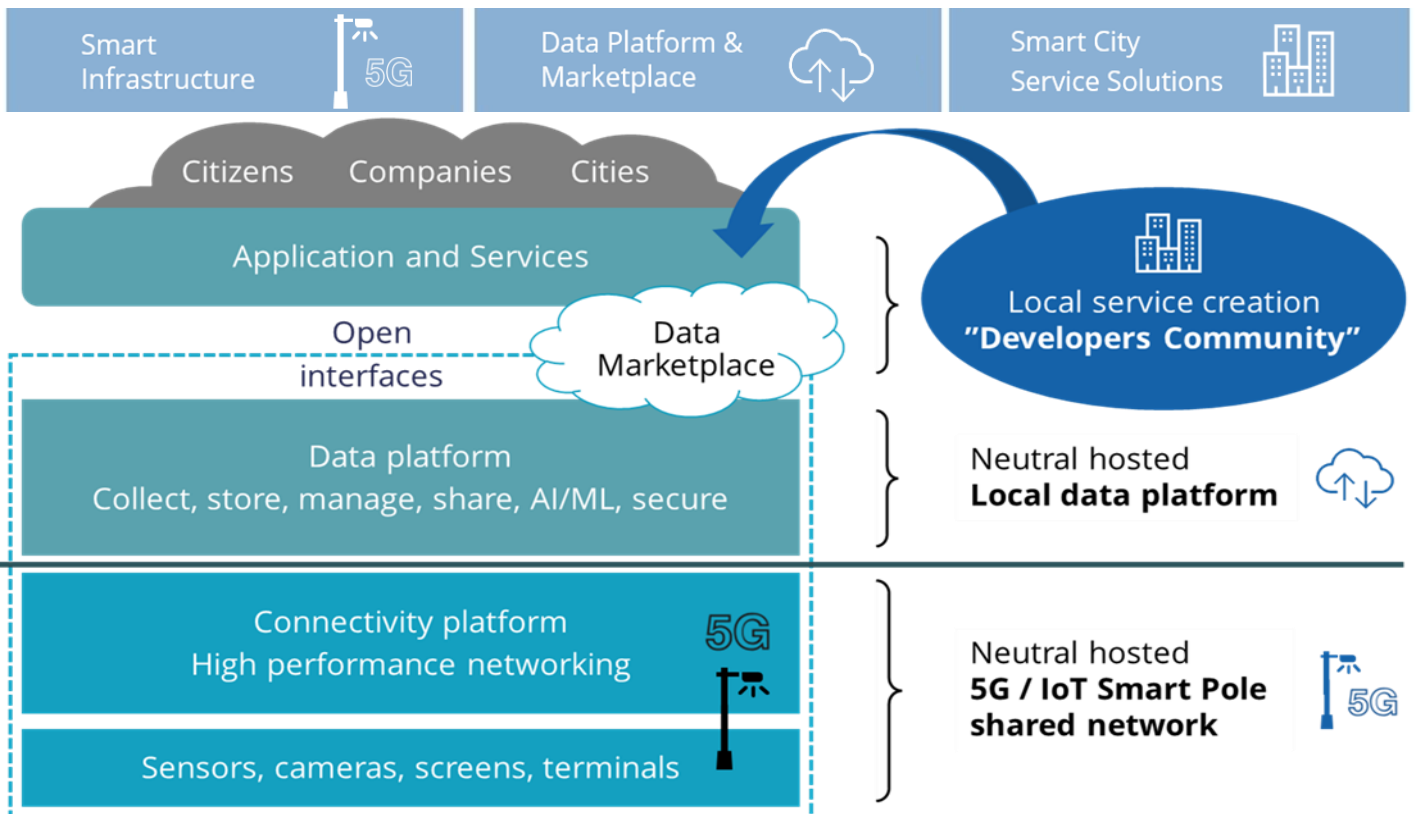


Figure 4. Neutral Host concept – operation of smart infrastructure, data platform and marketplace and various smart city services.





Figure 6. LuxTurrim5G solution adapts to various sizes and areas of a city.

### INFRASTRUCTURE REQUIREMENTS FOR SMART POLES

- Spacing: mainly determined by the need for lighting - a typical streetlight infrastructure spacing in the city is 30 - 50 m
- Power: constant AC power in the region of 1-2 kW increasing if e.g. EV charging is integrated
- Fibre: the smart poles equipped with 5G base station require up to 4 pairs of optical fibre connections. If fibre is not available, mmWave point to point radios can be used or 5G routers in those smart poles without 5G base stations.

The modularity enables flexibility in providing and upgrading the required services for the site. Plug and play feature of cabling between the modules enables easy swapping of module in the structure. This eases the replacement of the modules for maintenance and futureproofing. The LuxTurrim5G connectivity solution is based on a shared 5G network which can vary from small geographical hotspots (e.g. market square, street corridor) and campus network (port, factory or university campus) to a bigger city sector or district and finally up to a city-wide regional network (Figure 6).

**A neutral and local entity - Neutral Host** - builds and operates the smart pole infrastructure and local services. The operation includes

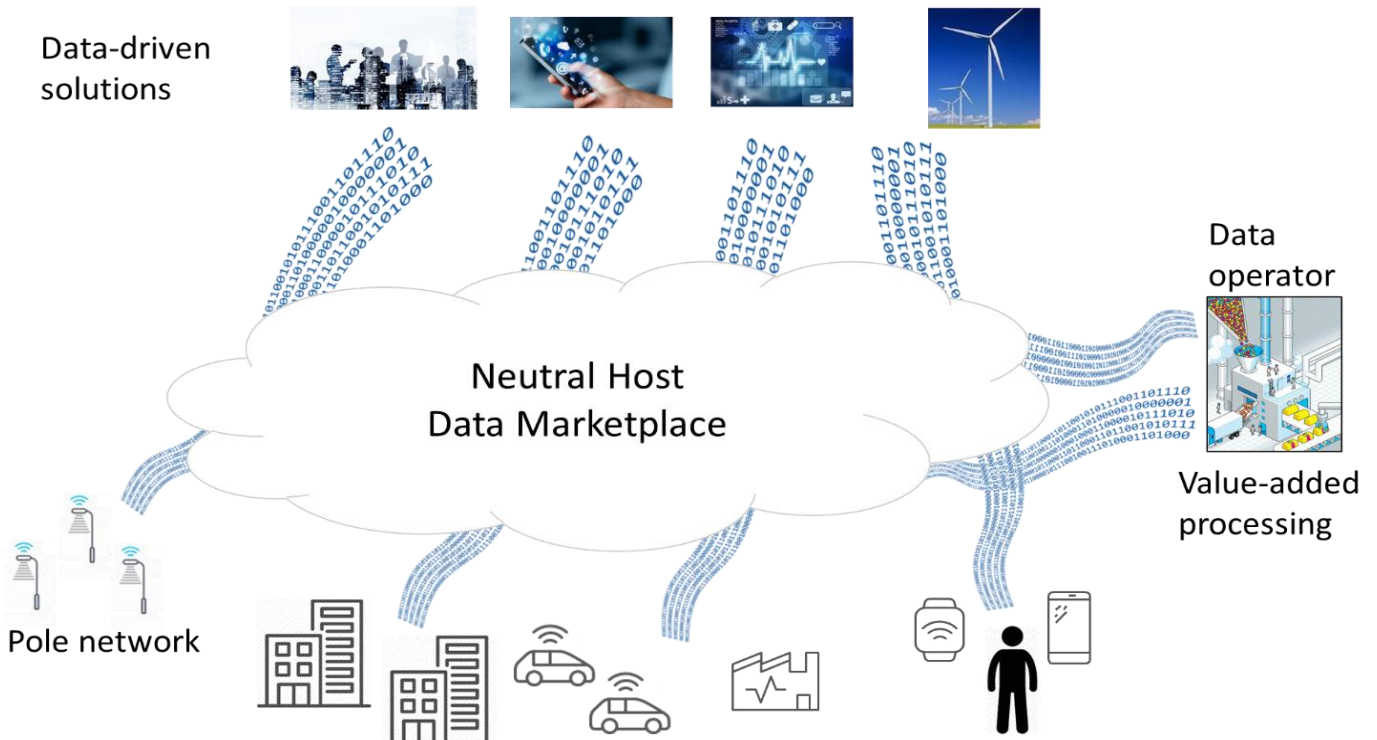


Figure 7. Data marketplace unites the various data streams, data sellers and buyers, and data driven solutions.



ownership and sharing of smart pole and IoT network, data platform and marketplace. It may include local radio frequency and a neutral host mobile network infrastructure. Neutral Host collects data from the sensors of the network and shares the data through a data marketplace with neutral rules and based on the local data regulations. Service providers can use the data from the marketplace to provide various smart city services. Neutral Host's revenue comes mainly from the data sold through the marketplace and from leasing the radio network to mobile operators and the like.

The data marketplace enables data transactions between data sellers and buyers (Figure 7). This creates **smart city data economy** with new incentives for citizens, authorities, and companies to share data for data-driven solutions. New businesses, like data operators, emerge to create value-added data products needed by services and solutions.

### HOW TO APPLY SMART CITY SOLUTIONS

The connectivity and data platforms enable new value adding services and products that would not be commercially attractive without the digital backbone. Standardized data flow and marketplace allow low effort service development and creation of secure solutions between the city and the citizens.

#### TO ENABLE THE CREATION OF NEW 5G AND DATA DRIVEN SMART CITY SERVICES, CITIES NEED TO

- Understand the current and future service needs for the target location
- Plan and support the building of the smart infrastructure
- Establish a local entity to build, host and operate the smart infrastructure - including local 5G frequencies - and data marketplace which facilitates the developer community and access to the smart infrastructure

One company can run all the tasks above or they can be shared between companies based on the

needs in each city. LuxTurrim5G solution has been built as a flexible and modular solution to serve the diverse levels of infrastructure, local ecosystem and smart city requirements the customers have.

### CONCLUSIONS

LuxTurrim5G ecosystem provides the digital backbone for building smart and sustainable cities.

The key elements, modular 5G/IoT smart poles, exist as a pre-commercial product family serving the various needs of cities. Several digital services related e.g. to public safety, last-mile logistics, autonomous transport and healthy living have been piloted and prepared for commercialization. Together with a secured local data platform this all provides a holistic solution for cities, helping them to turn smart and sustainable and to be ready for new unforeseen digital service needs. A unique LuxTurrim5G physical smart city pilot environment around Nokia Campus in Espoo, Finland with its digital twin continues to serve as a living lab for new smart city development actions.

Join us building the future now!

Read more:

Whitepaper: [LuxTurrim5G - Building the Digital Backbone for a Smart City](#)

Whitepaper: Creating data markets in future smart cities (upcoming)

Contact:

Markku Heino, Spinverse  
[markku.Heino@spinverse.com](mailto:markku.Heino@spinverse.com)

Juha Salmelin, Nokia,  
[juha.Salmelin@nokia.com](mailto:juha.Salmelin@nokia.com)

[www.luxturrim5g.com](http://www.luxturrim5g.com)

