BrightSites

by signify

Signify Powers Tampere's Smart City Vision

Signify BrightSites installation in Tampere, Finland, demonstrates how private mesh networks lead to better smart city solutions, with enhanced citizen experiences, improved sustainability, safety and new business opportunities.

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Executive summary

As part of its 'smart city' transformation, the city of Tampere, Finland, has installed an end-to-end (E2E) solution that includes a wireless mesh network, delivered through Signify's BrightSites solution, which hosts a 5G network by Edzcom and Wapice AI video surveillance.

Utilizing smart technology allows the city to make improvements to the safety and security of its citizens, and to city planning and maintenance, while also contributing to its sustainability goals. The benefits of the E2E solution and Signify's BrightSites infrastructure were brought to the fore during the 2022 Ice Hockey World Championship in Tampere, where real-time traffic and footfall data could be analyzed and acted upon.

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TAMPERE

1. Introduction

Today, over four billion people – 55% of the world's population – live in cities, with this figure set to reach six billion by 2045. With this rapid urbanization, the concept of 'smart cities' is gaining currency: these are cities in which 'traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and businesses'. The strain that an increasing population exerts on the environment is also propelling the uptake of smart technologies in densely populated urban spaces. The ambitions of the C40 group of smart cities, a global network of cities taking urgent action to confront the climate crisis, is evidence of this movement in action.

Tampere, in Finland, is a smart city pioneer. Over the last 10+ years, Tampere has put considerable effort into creating smart city ecosystems, including open platforms and open data, that drive sustainability through technology. With this ground-breaking work, the city is setting an example on the national and international stage.

Tampere's evolution into a smart city was undertaken through the Smart Tampere strategic development program, from 2017 to 2021. The program consisted of three key elements:

- An Ecosystem program to promote business growth in the city. The aim was to create the best possible foundation for companies to network and create new solutions for the city and its residents.
- A Digitalization program to digitize city services by 2025. Tampere aims to make everyday life easier and offer services that can be used regardless of place and time.
- A Sustainability program, which was aimed at reducing CO_2 and other emissions from urban planning, housing, mobility, energy and consumption. Tampere has committed to becoming carbon neutral by 2030. The city's climate actions have been compiled into the Carbon Neutral Tampere 2030 Roadmap, which includes 236 actions under six themes: urban planning, mobility, construction, energy, consumption and nature.

The program is evidence of Tampere inserting itself into a wider, global context in which cities use smart technology to hit their sustainability targets. For example, Oslo and Zurich are focusing on building management systems to optimize heating, electricity and cooling; Berlin is looking to AI, blockchain, IoT and quantum computing to improve its data gathering; and Vancouver is using video feeds at busy intersections to regulate traffic. As metropolitan areas are under intense pressure to reduce their CO_2 emissions to help achieve national and international climate targets, many are turning to smart systems that boost the efficiency of city services and allow for a data-based approach to city management.

2. Delivering data with a wireless mesh network

Data is at the heart of how Tampere aims to achieve its Smart City goals. Building on the work of the Smart Tampere program, a new project for 2022-2025 has been set up as the next step in the strategy, called "Data Driven City for Citizens".

Using, transferring and sharing large amounts of data requires high-quality infrastructure solutions. The networks must be fast, secure and able to adapt to different needs. The 'gold standard' in such data transport is the use of fiber, given its reliability, low latency, and almost unlimited bandwidth. For this reason, Tampere has already installed fiber throughout the city.

However, although fiber might be available at key locations, it is often unavailable at the exact spot where it is needed.

To extend the reach of the fiber connectivity, a flexible "wireless mesh network" is the perfect solution, opening up new opportunities for cities to achieve their strategic objectives.

This is the direction Tampere has taken, having deployed an end-to-end solution that comes in three parts: the Signify BrightSites transport network that turns any lighting fixture into a potential power and data outlet; a 5G private network by Edzcom that is plugged into the BrightSites network and creates a connection to any mobile device across the city center; and Wapice software which sends the video feed from cameras connected to the BrightSites infrastructure to edge locations for further AI analytics, so that meaningful data can be extracted and utilized for the optimization of city services.

The project has already proven that wireless mesh technology, used together with existing street light infrastructure, makes the deployment of the network fast and agile.

Lighting infrastructure is globally recognized as the backbone of smart city applications. It provides an existing physical infrastructure for network technologies and can host sensors needed to deliver smart city solutions. Utilizing the wireless mesh network integrated into the luminaires allows for flexible smart city sensor connectivity.

In Tampere, Signify and its partners were able to build and deploy the network within months. The technology is now showing its usefulness for the citizens of the city across a wide range of use cases. For example, the system was tested for people monitoring during the World Ice Hockey tournament in April-May 2022, and has extended to Tampere's high street and the area around the city's tram line. Other new use cases have been implemented in Tampere that show the different ways in which the city benefits from strong connectivity.

3. Benefits of the end-to-end solution

Enhancing safety & security

Studies show that maximizing security technologies can lead to a 30-40% reduction in crime, as well as an 8-10% reduction in fatalities, road traffic and use of emergency services.

In Tampere's case, smart security developments align with the city's strategy to utilize environment data to benefit the city's residents. The returns are promising, not only in terms of technological innovation, but also in relation to socio-economic welfare. Smart Urban Security and Event Resilience (SURE) aims to increase preparedness across all sectors for threats against public spaces and other urban security threats in Tampere. This local innovation has brought a social return on investment (SROI) of 2:1 to Tampere, with contributions mainly to public savings and citizens' sense of safety.

City mobile service over 5G private network

The city's own wireless connections can now, and in the future, be made using a private network. This way, Tampere knows that the data is secure because all network devices are connected to the city's own internal network. Edzcom's private network will be designed together with the city to ensure that there is sufficient capacity. In addition, future applications that require short latency, such as autonomous vehicles or AR / VR applications, are easy to connect.

Private networks:
The perfect fit for smart city development

Predictability
of performance and low latency

Privacy & security
Since the infrastructure is not shared with other public users

Bandwidth savings
with local processing and reduced data transfer costs

Autonomy
Independence from the public networks, and higher reliability if under limited outside connectivity

How we empower city evolvement:
Main benefits of connectivity

Better sensors
For health & environments

Better cameras
For surveillance & monitoring

Manage traffic
For increased safety

Create revenue opportunities
For business- and consumer-focused services

Boost critical communications
Accelerate emergency response

Reinvent people's experience
Autonomous buses, AR/VR Tourism

Mobile Connectivity with 5G public network

The demand for 5G mobile connectivity is driving the need for higher capacity urban networks.

The economic benefits of 5G for cities with strong connectivity are huge, as the technology is expected to add USD 330 billion to global GDP by 2030. With Signify's BrightSites solution, the entire lighting grid of a city can host the seamless deployment of 5G.

Public Wi-Fi

Tourist and student populations in the city rank public Wi-Fi among their top five priorities when judging a city's appeal. Improved Wi-Fi connectivity can boost tourism by at least 1%, resulting in a 0.31% increase in GDP. Offering services through public Wi-Fi can also reduce labour costs by 20 to 30% and 65% of restaurants cite Wi-Fi as a sales-booster. Expanding the public Wi-Fi network with Signify's broadband luminaire solution is highly cost effective and easy to deploy on a large scale.

Tele-health

Digital technologies are advancing the use of remote tele-health services, enabling the digital delivery of essential medical services that previously required a physical visit to a hospital or doctor's surgery. However, many of these services, such as remote healthcare monitoring systems or video-enabled paramedic support, require strong public bandwidth – which can be provided through Signify's BrightSites network.

Flexible Smart City sensors

A cost-effective sensor in smart city outdoor applications is a camera: a basic camera can detect several things with a single sensor that would typically require the installation of several sensors. In Signify's BrightSites network, connectivity in the luminaires allows for the flexible positioning of the cameras, and the 60GHz mesh provides sufficient capacity for transferring the camera signals securely to the city fiber network through a smart pole gateway.

Data driven traffic planning

Managing city mobility and traffic congestion is an effective way of reducing a city's carbon footprint, as mobility contributes up to 30% of urban carbon emissions. Limiting the number of cars on the road and encouraging the use of public or green transport are fundamental to success. As a result, the right technology must be in place to monitor the carbon emissions of traffic and so understand if these climate goals are being met.

City traffic planning engineers face the challenge of not having enough available data to carry out their role efficiently. While existing systems do already provide some data through open interfaces, these measurement points can be expanded with camera sensors and AI-based machine vision.

City IoT solutions and related user interfaces can bring this information together in a single application. This enables traffic planning engineers to reduce the carbon footprint of city mobility, improve traffic safety, and carry out data-driven traffic planning. The traffic data digital twin can be further utilized in end-user applications to visualize city traffic development for citizens and encourage the take-up of green transport options around the city.

As a bonus, traffic data can also support data-driven urban area maintenance planning or dynamic lighting control with the help of data analytics and AI.

Optimizing event crowd flow with data-driven urban area planning

With the help of data analytics and AI, data-driven traffic planning can help to analyze the people flow on event sites, such as the Nokia arena or Ratina stadium in Tampere's case.

In addition to traditional traffic planning, the analysis optimizes the timing of public transport and traffic lights, allowing people to move to and from events more efficiently. This can be done dynamically in real time, based on data and AI algorithms. Improved people flow ultimately leads to an improved visitor experience and a lower mobility carbon footprint.

Urban area maintenance

Camera and machine vision can provide information on how much city parks and outdoor sports areas are used.

With this data, urban area planning and maintenance can be improved, so that maintenance is directed to where it's most needed and investments in urban areas are made with confidence. This results in a better citizen experience with more attractive and safer urban environments, as well as a more efficient use of taxpayers' money and reduced carbon emissions.

In addition, camera machine vision applications can produce useful information on road conditions by inspecting the road surface and vehicle speed and behavior. Using this information, city planners can focus maintenance efforts to where they're needed most.

4.Wireless network in a city environment

In dense urban areas, Mobile Network Operators (MNOs) often encounter network congestion problems in heavy traffic locations. This is likely to occur during peak times and in areas of high footfall, such as metro stations during rush hour or pedestrianized zones. To alleviate congestion, MNOs often need to introduce small cells to supply additional mobile capacity targeted at the area of high demand.

MNOs operating in urban environments must also contend with tall buildings and other localized factors that block the signal from a macro cell, in which case they need to provide coverage infill.

As a result, the optimum choice in urban areas with high traffic density is to install small cells on street lighting, which facilitates the line of sight to mobile devices at street level, free from building obstruction.

5. Building the network in Tampere

Signify's network solution, complemented by Edzcom's 5G technology, is designed for scalability and ease of deployment. With the latest generation of broadband luminaires, the light fixture infrastructure is upgraded to be able to form a wireless network, which can transport data from a fiber location to where the data is needed. The integration with the fixture leverages the readily available power in the luminaire, which is at the proper height and location for creating line-of-sight links that cannot be interrupted by cars and other infrastructure.

By simply exchanging an existing luminaire with a broadband-enabled one – a 10-minute job – it is possible to greatly expand network capacity to meet the city's increasing demand.

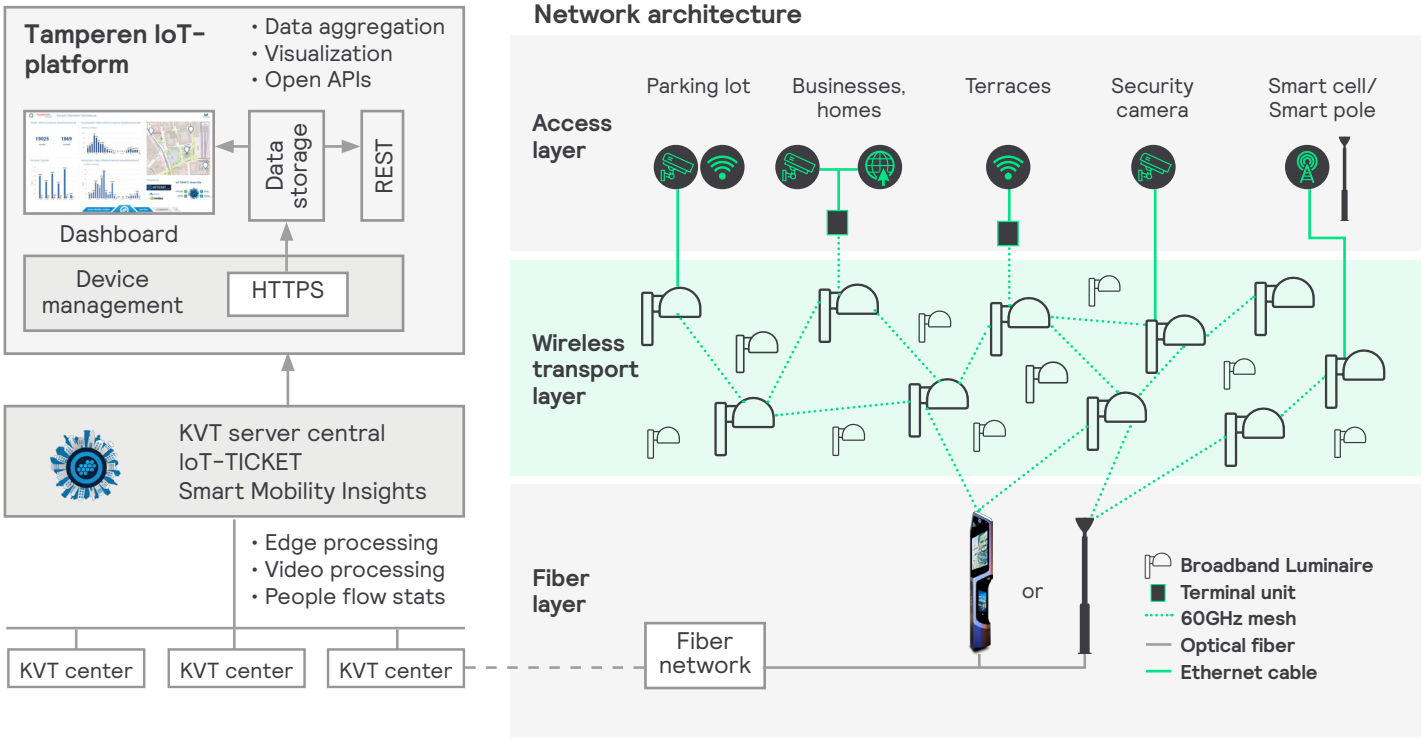
As lighting infrastructure is so uniform, coupled with the ease of upgrading a regular luminaire with mmWave-enabled Broadband Luminaires, the network can grow to virtually unlimited capacity on demand. Integrating the technology into Signify luminaires ensures that the city landscape can remain unchanged, while providing uninterrupted connectivity across the city.

6. Case study of people flow surveillance

In the BrightSites network around the Nokia Arena, the Wapice system helped in analyzing which routes people take to and from the site, and what effect changes to traffic planning can have on this.

As cameras provide a cost-effective option for monitoring urban areas, camera sensors were chosen for measuring the people flow. There were already some existing cameras around the area, but there were other locations without cameras or an available fiber connection. For these locations, the measurement point coverage could expand by connecting cameras to the wireless network through the luminaire PoE connector. A total of three cameras were connected to the people flow application. The cameras' video streams were routed through the smart pole to the city KVT network and to the edge processing unit. The principle connectivity diagram is presented below.

Principle connectivity diagram



Principle picture of the data flow / processing

Edge Level

Camera connectivity

Machine learning

Processing

Cloud Level

Data storage

Application tools

Device & asset management

Application Level

Dashboards

Alarms & events

Data API's

Diagram presenting the implemented application structure
IoT-TICKET® Smart Mobility Insights

Overview

Real-time situational picture of the event area.

Measurement view

Single measurement point view visualizing the data from selected area.

Area view

Area view with measurement point data from selected area.

Edge processing

Fully cutomizable low code/no code machine vision platform performs detection and route tracking on the edge in real-time. GDPR compliant: only anonymized statistical data is sent to the IoT platform.

Experiences of the network

During the Ice Hockey World Championship matches – a busy period – the network operation was stable. The camera streams from the three cameras connected to the wireless mesh network could be used in a similar fashion to the existing cameras connected directly to the city's fiber network. From an edge processing or configuration point of view, there was no noticeable difference in performance. Taking all this into account, it seems that the mesh network provides a viable option in enabling flexible Smart City monitoring.

7. Conclusion

The success of the project in Tampere has demonstrated the robust nature of the network, with its quick installation and provision of strong connection stability and bandwidth during periods of heavy data use, and the usefulness of the luminaire-based mesh network in a real-time urban setting. As this paper has laid out, there are many other use cases for Signify BrightSites and Edzcom Private Networks to enable Tampere's (and other cities') smart city vision, bringing enhanced safety, efficiency, sustainability and economic activity for residents, city planners and metropolitan authorities.

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