



KEY TO SOLVING THE URBAN CHALLENGE

Transportation is one of the toughest challenges that cities and regions across the globe are facing. Already today, 50 percent of the world's population lives in urban areas. By 2050 this number is expected to increase to 70 percent. The Nordic region is no exception to this megatrend. The share of Nordic inhabitants residing in urban areas increased from 25 percent in 2005 to almost 35 percent in 2015.

Urbanization creates significant economic, social and environmental challenges, in both the long term and for the everyday lives of businesses and people. For example, the average commuting time in Stockholm increased by over 20 percent between 1995 and 2013. As a consequence, the urban and regional public transport systems of tomorrow must become smarter.

Regions and cities in the Nordics have set ambitious goals for public transport. The goal is to make public transport more efficient, while increasing its share of the transportation sector as a whole. For example, the city of Copenhagen has set a target of having 75 percent of all trips in 2025 by public transport, bike or by foot. The public transport sector in Sweden has set the common goal of doubling the number of public-transport trips between 2006 and 2020. Also, in 2015 the Swedish government earmarked

WHAT IS SMART PUBLIC TRANSPORT?

Connected solutions for shared passenger transport services such as buses, trains and ferries. Includes applications for connected vehicles and related infrastructure, such as passenger information, ticketing & payment systems, cloud & analytics services as well as traffic management & control.

€200 million for the development of new and smart public transport. In order to reach these targets, the systems need to become easier to access and increasingly passenger-centric, as well as more efficient and with lowered environmental impact.

At the same time, leading public-transport operators in the Nordics, such as Nobina and MTR, are exploring new opportunities created by digital technology to increase their efficiency and differentiate the passenger experience. Investments made in fleet management, predictive and preventive maintenance as well as on-board services can help decrease operational costs and make public transport journeys more convenient and attractive for passengers.

BENEFITS OF SMARTER PUBLIC TRANSPORT



Life quality

Travelers will experience higher safety and punctuality, clearer and more relevant information, increased comfort, simpler and more universal ways to pay

The environmental impact of traveling will decrease, and access to other services in society will increase

→ Passengers



Increased efficiency

Public transport operators can increase their profitability through higher operational efficiency and new revenue streams

Information flows will improve leading to more efficient communication and environmental reporting

→ Operators



Improved society

Cities will be able to increase the share of public transport as well as improving the environment and traffic safety

Improved public transport will help cities increase their competitiveness and attract more competence

→ Society



FÄLTCOM – CONNECTING THE TRAFFIC LIGHTS OF NEW YORK

In order to create a better and more secure traffic flow in New York, the Swedish company Fältcom has been tasked to connect 475 traffic lights, in a first step towards connecting all 13,000 of them. Fältcom, who is a wholly owned subsidiary to Tella Company, has emerged in recent years as a leading player and innovator in IoT, in particular when it comes to connected public transportation. This is the third project Fältcom has conducted in cooperation with the New York City Department of Transportation – including connecting some 16,000 bus stops.

Digitalization also drives the increasing importance of Information and Communication Technology (ICT) providers and tech-startups to enable smarter public transport. These players are developing new solutions by using digital infrastructure and platforms. Their innovations are used to create new services for authorities, operators, vehicle manufacturers and passengers.

Smart public transport is essential to meet the challenges of urbanization

Early moves are now being made to integrate public transport into other services such as connected infrastructure (e.g. traffic lights, traffic monitoring and parking). The inner-city buses in Stockholm communicate with traffic lights to be granted priority if they are running late and information boards provide travelers with information about delays and alternate routes. Similarly, car pools such as Volvo's Sunfleet and BMW's DriveNow are creating new alternatives to both individual car ownership and public transport. Through the release of the Whim app in late 2016, the start-up company MaaS Global now offers citizens in Helsinki multimodal means of transportation including car pools, bikes and taxis. Swedish operator Västtrafik is working on similar solutions in the south-western parts of Sweden, as a step towards the smart city.

PUBLIC POLICIES AND IoT DRIVES SMARTIZATION IN THE NORDICS

In the Nordics, implementation of smart services in public transport fleets has been ongoing since the early 2000s. A majority of the vehicles across the region are already equipped with one or more connected solutions. The smart public transport market was worth around €500 million in 2016 and is expected to reach almost €1 billion by 2021, with an annual growth of around 14 percent.

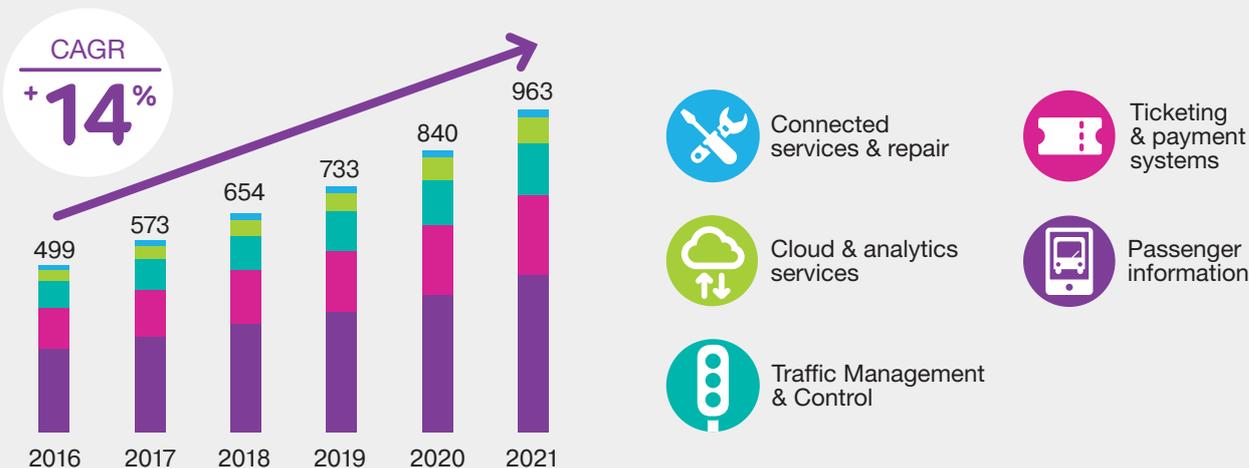
Passenger information is the largest segment at around €200 million. This includes smart screens and trip planners such as the RuterReise app in Oslo, allowing passengers to plan their trips using both bus and local trains, operated by different parties. The second largest segment is ticketing systems at around €100 million. Driven by an increasing need for real time analysis of traffic data, cloud and analytics services is the fastest growing segment at around 19 percent, expected to reach a size of almost €80 million in 2021.

Traffic management and control systems is the third largest segment at close to €80 million. Investments in this segment have enabled operators to increase punctuality, for example through driver information and connected traffic lights giving priority to buses. Despite a high potential, connected service and repair is the smallest and slowest growing segment at €15 million and 10% respectively.

An important driver of this development is changing customer behavior and expectations. Customers expect connectivity in public transport to improve at the same rate as in their homes and offices. When purchasing tickets, customers expect flexible and smooth transactions as in other services such as Uber. Commuters expect to be able to work from the train or bus traveling to and back from work. As the time spent traveling continues to increase, being able to utilize this time for, e.g. working or shopping, becomes more important.

The rapid expansion of IoT in the Nordics has also driven the development of smarter public transportation. An increasing share of vehicles and infrastructure have become connected. Roadside sensors and positioning technologies have increased the amount of traffic information that is gathered. Improvements in software services such as cloud and analytics tools have enabled better analysis of data. Combined with increasing connectivity, such as 4G and the widespread prevalence of smartphones, this has enabled a fast development of new transportation services. Advancements in passenger counting has helped both operators and authorities to more efficient route planning, and enabled volume based contracts. Driver information application, helps operators to lower fuel costs and gives the

SMART PUBLIC TRANSPORT MARKET SIZE IN THE NORDICS (€m)



Source: Markets and Markets, Arthur D. Little analysis

passengers a smoother ride. Fleet management systems has allowed operators to handle their fleets more efficiently.

Another key driving force is public policy to increase the share of public transport. Authorities have realized the importance of digitalization as a means to increase the attractiveness of public transport. An increasing share of contracts are volume-based, which incentivizes operators to invest in digitalization as this improves customer satisfaction and contributes to growth. More and more contracts now also include specific clauses regarding

customer satisfaction and safety, such as Wi-Fi and surveillance cameras onboard. In Norway, a new national standardization of the requirements for buses from Standard Norge, with particular focus on decreased environmental impact and cost efficiency, is expected to come into force in 2018. Following successful examples from the Swedish market, the Danish Public Transport Authorities formalized new goals, predominantly focused on increased connectivity, availability and eco driving, in 2009. Also, the city of Helsinki has set a goal, to provide a mobility-as-a-service concept by 2025, that makes it quite unnecessary to own a car.

INTERVIEW

PETER VIINAPUU, CEO, MTR NORDIC

MTR is one of largest railway operators in the world, transporting millions of passengers every day and employing almost 5,000 people in the Nordic alone. Since 2009, the company is responsible for operating the Stockholm metro and, since the end of 2016, also the commuter trains. MTR also operates a rapid train between Stockholm and Gothenburg, MTR Express. For MTR, digital solutions helps to improve operations and improve customer experience through the whole journey.

“There is a high correlation between operational efficiency and customer experience. For example, digitalization has helped us drive trains more efficiently, reducing energy expenditure and giving passengers a smoother ride with very high punctuality.”

MTR has developed an app that supports its drivers, letting them know exactly how many seconds they have per stop, enabling them to focus on more important tasks, such as making sure the platform is clear. Train attendants can see which seats have been booked and paid for, so passengers in these seats don't need to scramble for their tickets. Real-time passenger counting enables information about congestion, allowing passengers to choose less-crowded sections. MTR is working on connecting its trains to relay technical status in real-time, enabling prediction of

time to failure and providing information to service depots on what needs to be repaired, before the train even arrives.

“We cannot escape the physical aspects of public transport. Even in future digital societies, passengers will still need to move between different locations.”

Digitalization enables an understanding of how and why people move. This is critical for making public transport integral to city planning. Railway requires large investments over long time horizons, and the role of stations is changing. Where once the station was viewed as a distraction, sometimes removed from the city centers, nowadays proximity to a station increases the market value of property. Analysis of public-transport data is a key success factor in understanding how to build cities and transport system that cater for the mobility needs of the future. Leveraging its international experience, MTR is taking an active role in this development through dialogues with decision-makers and public-private partnerships.

“We want to take a central position in the ecosystem, being able to improve the whole customer experience and help build a more sustainable society. Digitalization, enabling us to know more, is an essential part in this.”



Despite these developments and the Nordic region being at the forefront of digitalization, with a digitally skilled population, an innovative business community and advanced infrastructure for both fixed and mobile connectivity, the targets for public transport risk not being met. For example, Sweden is expected to only come halfway towards its goal of doubling the share of public transport between 2006 and 2020. At the same time, other regions and cities such as Hong Kong, London, Dubai, New York City and Vienna are investing heavily in digitalization. Players in the Nordic public transport market need to act in order to tackle the

challenges of urbanization and secure global long term competitiveness, compared to other regions.

“Players in the Nordics need to act now in order to avoid the risk of falling behind!”

– Mikael Långström, CEO Fältcom

INTERVIEW

JONAS KEMPE, CHIEF MARKETING OFFICER B2B, NOBINA

Nobina is one of the largest public transport operators in the Nordic region, with over 1 million passengers daily. To Nobina, the smartization of public transport is an opportunity to improve the customer experience while increasing the efficiency of their operations. Already today, applications for eco-driving are helping the company to significant savings in fuel costs.

“The traditional analog timetable is gradually playing out its role. Today, passengers get more exact information directly on their smart phones.”

Through a series of pilots, Nobina has developed local solutions to improve customer experience. Experiences from these pilots have now been collected and summed up in a portfolio of new services that Nobina can offer to all authorities in Sweden. These services include for example onboard wi-fi, guidance in case of disturbances and a smoother onboard payment system.

“The smartization of public transport will probably occur in several phases. Already today, connectivity has made more of today's systems available and simpler to integrate with travel planners. In later phases, different systems in public transportation will be more integrated with each other and external systems.”

On the horizon, Nobina sees integration of the multitude of different systems, enabling new and innovative services. For example, operators and authorities will begin partnering with providers of other forms of transportation to offer passengers access to car pools, bikes and taxis integrating with platforms for traditional public transportation. Applications such as trip planners can be integrated into passengers' schedules, informing hosts if a person is late to a meeting. Predictive maintenance is another application with large potential to further improve operational efficiency.

To drive the development, there is a need to find a business model that supports innovation for increasing the share of public transport. Nobina believes there are benefits in this regard in moving towards volume based contracts. In ten years' time they have increased the share of volume based contracts from virtually zero to a third of their revenues. Experience has shown that volume based contracts have a positive impact on customer experience. To be in the driver's seat of this development requires a delegated mandate, but as long as the commercial model supports it, Nobina is ready to start driving.

FROM CONNECTED VEHICLES TO INTELLIGENT TRANSPORT SYSTEMS

Most smart public transportation services are still operated in “silos”, meaning that integration of smart services is very limited or non-existing. This needs to change in order to unlock the full potential of digital technology and drive public transport from individually connected vehicles to Intelligent Transport Systems (ITS). Characterized by integration of multiple modes of transportation along with physical and digital infrastructure, ITS will redefine public transport as well as enable it to become more *passenger centric*, *autonomous* and *integrated*.

As for *passenger centricity*, a platform economy approach will enable passengers to travel on the same ticket or subscription, whether they travel by bus, bike or taxi. Newer and more integrated ticketing systems will enable a pay-as-you-go system, as opposed to the subscription-type model of many public transport systems today. The city of Vienna is a leading example with its

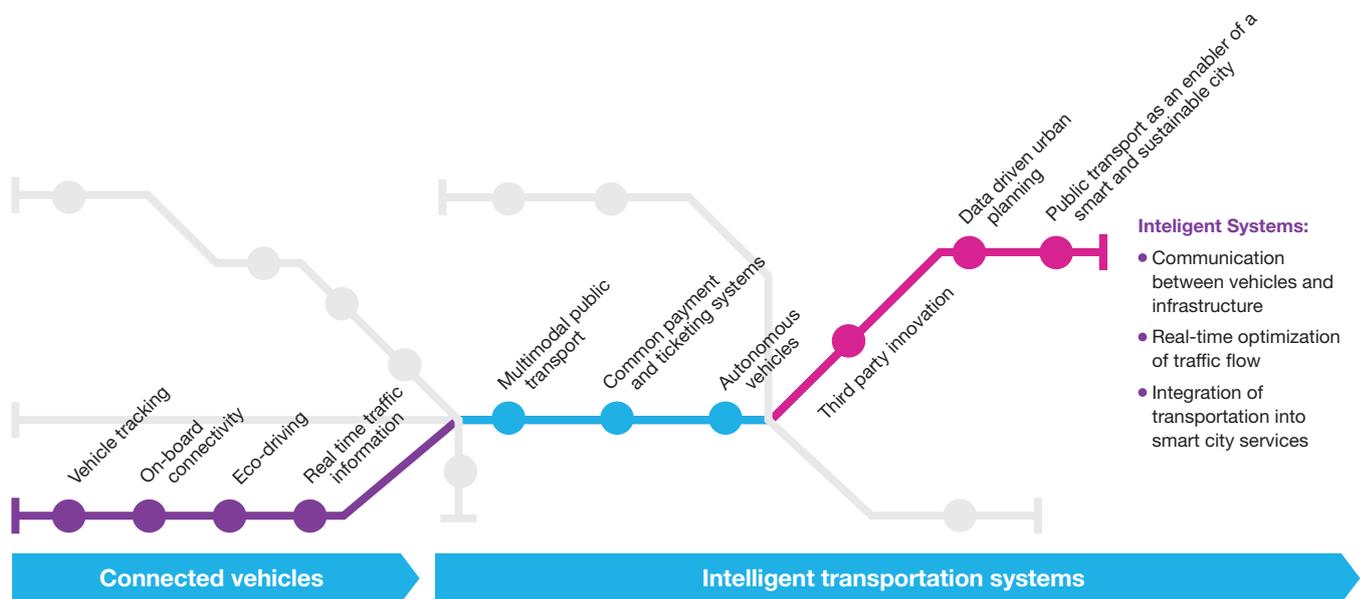
SMILE projekt, offering a fully multimodal solution and one-click reservations and payments.

The public transport system will also become increasingly *autonomous*. Soon, we expect self-driving vehicles to become a reality in everyday public transport. Already today, subway trains in Copenhagen are fully autonomous, and in the spring of 2017, the Nordic operator Nobina performed a successful pilot with self-driving buses in Kista, Stockholm. Such self-driving vehicles can help operators save up to 70 percent of labor costs, and possibly enable operators to drive more frequent trips.

Alongside the development of smarter passenger services and operations, smart-city infrastructure investments are made throughout the region. Telia has announced plans to launch 5G in Helsinki and Stockholm already in 2018. Integration of e.g. traffic monitoring and public-transport platforms into smart cities enables interaction between different services in society. When public transport systems understand how and when people move, it can adapt in real-time, for example re-routing traffic using heat maps of where people are located.

With ITS, the share of public transport will increase and unlock not only economic and social but also important environmental benefits. Substituting single-vehicle use with buses, bikes or trains will lead to lower CO₂ emissions, less congestion

“We could be seeing self-driving vehicles on some bus routes in the Nordics as soon as 2021”
 – Mikael Långström, CEO Fältcom



Authorities will then need to formulate strategies that considers the importance of open data and platforms to ensure that third-party service providers and start-ups can innovate and add value. Meanwhile, services that are less suitable to being open, such as security and surveillance, should be aggregated by a single player that controls and brings together services from multiple contributors.

For operators, the key challenge is to ensure that they can create sustainable business models in the new ecosystem. One of the most important aspects of this is to collaborate with authorities on setting the rules for the ecosystem. Operators that want to take a leading role in developing more attractive public transport need to be rewarded for innovation and growth in share of total transportation. When contracts allow, digitalization is an opportunity for operators to find new business

models. For example, opening up platforms such as infotainment to third party service providers can open up new revenue streams.

To drive the development of a new digital ecosystem, forming long standing relationships with the right ICT-players is critical for actors in public transportation. Different types of ecosystem have different needs. For an aggregation type ecosystems it is essential that platforms and data are secure without limiting the ability to integrate with other services. For marketplace ecosystems, the challenge is rather to have open and flexible platforms for open data, that can be accessed by anyone. ICT-players can support with integration of new technologies such as 5G as well as facilitate collaboration to promote innovation and standardization of technologies.

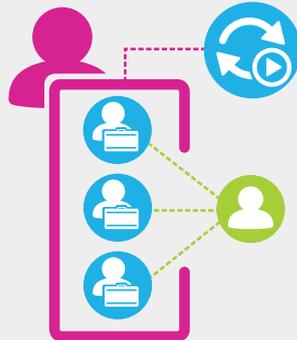
ECOSYSTEM TYPES



Aggregator

- An Ecosystem driver brings together services from multiple Service contributors
- The aggregator owns the customer relationship
- Network is selective

Example: The SMILE project in Vienna is aggregating services from a number of actors into a single integrated mobility platform



Marketplace

- A Marketplace facilitator runs a marketplace where Service contributors offer services
- The customer relationship is owned by the individual Service contributors
- Network is open and actors joint/leave frequently

Example: In Milton Keynes the open data approach enables anyone to access large amounts of data from multiple kinds of networks including social media.



End-consumer

Leading roles



Marketplace facilitator

Operates a marketplace where Service contributors can offer services



Ecosystem driver

Brings together services from multiple contributors with own offerings to the end customer

Contributing roles



Service contributor

Offers own services in a marketplace or an aggregator ecosystem



Platform enabler

Provides technical solutions (horizontal and vertical) that enable the ecosystem

ALL ABOARD – TIME TO ACT

The preconditions to build a more passenger-centric, autonomous and integrated public transport system are all available in the Nordics. The region is at the forefront of digitalization and has a strong public sector with ambitious targets regarding public transport to meet the regional and urban economic, social and environmental challenges of tomorrow. However, these ambitious targets risk not being met; Sweden is expected to only reach the halfway point towards its goal of doubling the share of public transport between 2006 and 2020. At the same time, other regions such as London, Vienna, Hong Kong and Dubai are investing heavily in intelligent transport systems.

There is a need for new digital ecosystems in the Nordics that are open for and rewards innovation. Data and platforms need to be increasingly open to allow third party service providers and start-ups to innovate and add value. The players in the Nordic public-transportation market needs to rethink their position in the new digital ecosystem. Authorities need to ensure that innovation and growth is rewarded and by finding models that ensure open data and platforms. For operators, finding ways

to create sustainable business models through openness will be key. ICT companies will play a central role in creating open digital platforms where new services can be added easily, bridging the gap between the players of today and tomorrow. For authorities and operators, choosing the right ICT partner will ensure that they can make the transition to new market conditions.

As a more open ecosystem emerges, public transport becomes more accessible to disruption and innovations that increases efficiency and benefits passengers. No-one knows exactly how public transport will change, but change will come. Not only will the current public transport system become more connected and integrated – the entire concept of public transport will change. The scope of public transport is expanding with “new” modes of transportation, such as car pools, taxis and bikes. These are already integrated into the public-transportation systems in cities like Helsinki and Vienna. In the light of shared economy trends, one might see a potential Uberization of public transportation.

“A digitized system for public transportation is at the core of our future society. Unlocking the full potential, requires Nordic players to rethink their positions in a new ecosystem, built on open platforms, leveraging scalable and reliable technology together.”

– Johan Öberg, Head of Marketing and Partner management, Telia IoT

ABOUT TELIA IoT

Telia Company, a New Generation Telco that serves millions of customers every day in one of the world's most connected regions. With a strong connectivity base, we're the hub in the digital ecosystem, empowering people, companies and societies to stay in touch with everything that matters 24/7 – on their terms.

Telia IoT delivers reliable, secure and scalable solutions that lets you turn IoT into business.

We connect and integrate everything from vehicles to business processes and believe that IoT has the power to transform the way companies do business as well as how people live their lives.

Within Telia we are part of Division X – the innovation and growth engine that is transforming Telia Company into a New Generation Telco. Read more at www.teliacompany.com/en/about-the-company/internet-of-things

ABOUT ARTHUR D. LITTLE

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have strong practical industry experience combined with excellent knowledge of key trends and market dynamics. Arthur D. Little is present in the most important business centers around the world. We are proud to serve most of the Fortune 1000 companies, in addition to other leading firms and public sector organizations. For further information please visit www.adlittle.com

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