Connected Micromobility

A case study demonstrating cellular IoT business value to the transport industry

How cellular IoT can help the micromobility industry

City-dwellers are moving more freely thanks to connected cellular IoT

Cities are becoming increasingly noisy and congested, making it difficult for residents to get where they need to go quickly and impacting their quality of life. There are new ways of addressing these problems with innovative solutions such as electric 'e-scooters' that rely on cellular IoT, powered by advanced connectivity management platforms like Ericsson IoT Accelerator.

E-scooters, however, come with their own challenges. Some users abandon them – or park them carelessly – cluttering streets and pedestrian walkways. This is a problem for city dwellers and micromobility companies. And because scooters are so quiet, they can pose safety issues for unexpecting pedestrians.

Enabling e-scooters with cellular IoT can address these challenges. With location-aware units, micromobility companies can set up safety zones by enforcing low speeds and recovering abandoned scooters before they become a problem. But these are far from the only benefits to micromobility companies. Specifically, cellular IoT provides:

- Longer life span of e-scooters
- Accurately implemented dynamic pricing
- More cost-efficient service logistics

These three benefits create an annual value for an e-scooter operator of $460,000 USD in a single city, according to a model created by Ericsson and micromobility company Voi.

This report is based on a joint study by Ericsson, Voi, Arkessa and Arthur D Little. It examines and quantifies the potential value of cellular IoT for the micromobility industry.

Contents

Electric 'e-scooters' provide fast and affordable individual transportation over short distances, are smaller than cars, produce no emissions and almost no noise.

Internet of things: An exploding micromobility market

Conquering smart cities with a digital transformation

Improving efficiency, sustainability and safety with data gathered with cellular IoT connectivity

The number of cellular IoT connections is growing by double-digits, with the number of global cellular IoT connections expected to more than triple from 1.7 billion in 2020 to 5.9 billion in 2026.[1] Broadband IoT (covers wide-area use cases that require high throughput) and Critical IoT (covers time-critical communications that must meet specific latency targets) are also expected to show strong growth at a 25% compound annual growth rate (CAGR).[2]

This growth in IoT and the prospect of IoT digital transformation offers huge opportunities for improving efficiency, sustainability and safety for society and different industries, including transport and logistics. One of the most promising subsectors within this industry is micromobility.

Given the explosive growth of the micromobility market, and to help potential participants within the e-scooter ecosystem better understand the opportunity, Ericsson conducted a business case study with European micromobility operator Voi, to quantify IoT connectivity management value for connected e-scooters.

This growth in IoT and the prospect of IoT digital transformation offers huge opportunities for improving efficiency, sustainability and safety for different industries and society, including transport and logistics.

The micromobility market and ecosystem

Micromobility powered by IoT: a new cornerstone for sustainable transportation

Urban planners and leaders can see e-scooters leading efficiency, sustainability and safety based on cellular IoT connectivity and real-time data.

Micromobility is a new mode of transport that can be defined as "lightweight vehicles that may be rented or borrowed as part of a self-service for short-term use within a city."[3] Vehicles within the definition refer to electric vehicles which typically operate at speeds below 25 km/h, including e-scooters.[4] Urban planners and leaders are particularly interested in micromobility because it can serve as a cornerstone for new, sustainable city transportation.

The micromobility market is expected to experience double-digit growth during this decade. Specifically, it is estimated to grow at a CAGR of 16% during the period 2019–2027 (from $3 billion USD to $12 billion).[5] This market growth is driven by a number of factors:

- Emerging business models such as the sharing economy, have shaped new customer behaviors that set the stage for the micromobility industry.
- Increased access to smartphones, more advanced mobile apps, and seamless online payment methods have enabled product-as-a-service where products and services are offered based on geopositioning.
- Ever-present high-speed wireless connectivity, and the growing supply of high-tech sensors, provide the required technological foundation for building more advanced and competitive e-scooters.
- An increasingly competitive micromobility landscape is lowering costs for consumers, making it an affordable and attractive transportation option.
- New players are rapidly entering the market, which is resulting in market fragmentation.

Out of the total micromobility revenue for 2019, North America and Europe had the largest shares at 41% and 21%, respectively.[6] In fact, in 2019, people took 136 million trips on shared bikes and scooters in the U.S., a 60% increase over 2018.[7] Shared micromobility service providers are a driving force within an ecosystem of partnerships that together enable the deployment of micromobility fleets in cities.

This emerging ecosystem includes providers of batteries, hardware and connectivity, as well as service and maintenance. Additionally, the ecosystem includes local partnerships with both private and public sectors, including city councils. This ecosystem collaborates to foster sustainable urban transportation for the future.[8]

Voi – An emerging urban micromobility company

Launched in September 2018, Voi is a European urban mobility company that provides e-scooter sharing in partnership with cities and local communities. The company is currently present in more than 70 cities in 11 countries, providing service to more than 6 million users with 70 million rides. As of 2019, the company had a revenue of 317 million SEK and operated with more than 500+ employees.[9]

Voi is focused on improving e-scooters and is at the forefront of hardware and technology. Its mission is to contribute to sustainable cities by deploying IoT connected e-scooters which leverage 4G LTE connectivity.

Arkessa – Providing global cellular IoT connectivity
Arkessa not only provides world-class and global cellular IoT connectivity, but makes it easy to create, deploy and manage your IoT devices securely, efficiently, and at scale, regardless of your needs or business model. With offices in the UK, Europe and the US, they offer competitive rates, and best-in-class technical support, all in a single platform to simplify ordering, managing and connecting smart devices.

Arkessa's connectivity management offerings are powered by Ericsson IoT Accelerator. As global communication service provider partner to Ericsson, Arkessa is able to offer powerful automation features on the Ericsson IoT Accelerator platform, including market-leading IoT security and global coverage.

> We believe in cities free from congestion, noise, and pollution. We believe in cities where citizens can freely move around on their terms. To accomplish this, we have taken the most advanced technology and made it accessible to everyone.
> – Voi

Voi's e-scooter evolution

With IoT the future is scalable and secure

How Voi developed their e-scooters in five steps adding technology powered by cellular IoT connectivity

Voi's e-scooters have gone through five major upgrades since the launch of the original version. The life span, design and hardware have improved over time. For example, 4G LTE connectivity was integrated in the Voiager 3X scooter, and today, the Voiager 4 promises a life span of five years with a 35% increase in motor performance, powered by IoT.

The e-scooters have an eSIM-card (eUICC ready) that leverages 4G LTE connectivity from local CSPs, managed by Arkessa's Connectivity Management platform – Global Enterprise Connect powered by Ericsson IoT Accelerator. Arkessa provides Voi with commercial and technical flexibility for any application or business model.

The service offered by Arkessa is:

- **Scalable:** Arkessa offers global roaming, has access to about 600 networks and provides coverage in 200 countries, which enables high flexibility and support.
- **Secure:** Arkessa provides a secure network infrastructure, private APN static IP addresses and secure VPN connections to private and public clouds. All are provided via security-as-a-service.
- **Futureproof:** Arkessa offers 2G, 3G, 4G and will soon provide 5G connectivity. In addition, the company has NB-IoT, LTE-M, eSIM and eUICC.

For Voi, cellular IoT is a key enabler for fleet management and asset tracking to further optimize operations. It's a key part of Voi's strategy to scale globally.

For Voi, cellular IoT is a key enabler for fleet management and asset tracking to further optimize operations.

Leveraging IoT for micromobility

New solutions like micromobility can address urban quality-of-life issues within cities – but they have their own set of challenges.

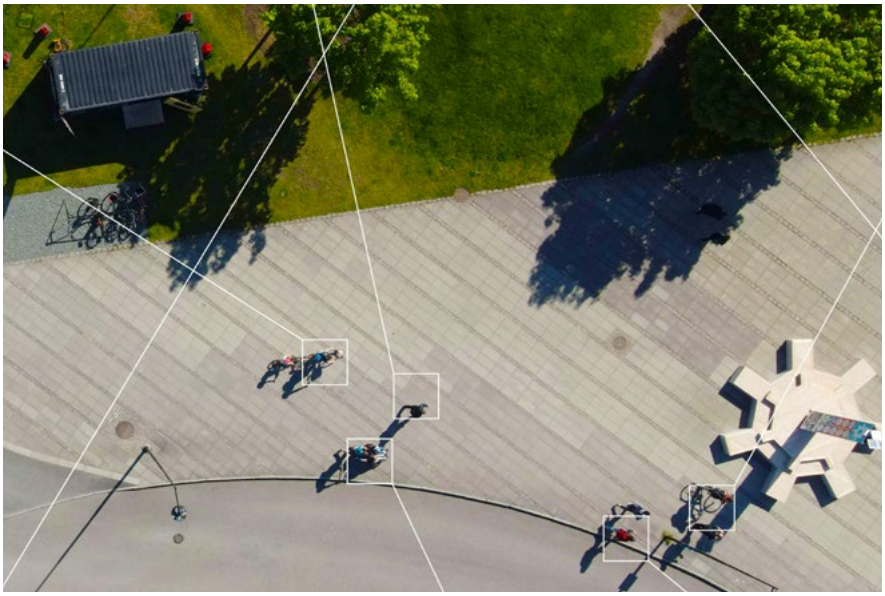
Today's cities deal with a number of serious challenges that are negatively affecting the health of urban dwellers, including environmental pollution, high noise levels, and poor use of city space. While new solutions, like micromobility, aim to solve these urban issues, they also have their own set of challenges such as safety and cluttering.

The scale of the quality-of-life issues within cities is serious. Recent studies show that 40% of the EU population is exposed to dangerous traffic-related noise, which increases stress levels, exacerbates depression, and reduces the ability to learn.[10] Between 15 to 30% of urban areas are occupied by car parking, reducing the amount of public and commercial space.[11]

E-scooters can address these issues. Each scooter can provide rides to more than 20 people per day, requiring minimal public space and making almost no noise at all.[12]

In order to capture the data from e-scooters, six different sensors have been identified, and are included in the scope of this use case:

- **Condition sensor:** Allows the provider to remotely diagnose battery levels, damage, and the overall condition of units.
- **Sound communication sensor:** Used to warn pedestrians that an e-scooter is approaching.
- **Near field communication (NFC) sensor:** Used for online payments and enabling contactless unlocking of Voiager 4 units.
- **Motion sensor:** Measures the scooter's specific force, angular rate and orientation. This enables the scooter to send signals in case it has, for example, been vandalized or thrown to the ground. This sensor also allows tracking of driver behavior and speed.
- **Geographical location sensor:** Makes it possible for customers and micromobility providers to map out the exact location of each scooter in their fleet.
- **Air quality & noise sensors:** These sensors measure noise and air quality as the scooter travels along the streets. This allows micromobility providers to gather environmental data in order to provide insights to third parties. This data can, for example, be provided to city councils through the existing city data dashboard that Voi is offering.



Cellular IoT benefits to e-scooters

Optimizing fleet costs, revenue and asset tracking

Connected e-scooters generate positive impact for micromobility players, city councils and end users.

Micromobility players
For micromobility players, connectivity via IoT optimizes fleet costs by extending the life spans of units. The life span of e-scooters has grown to more than five years as a result of upgraded hardware and IoT connectivity (previously they lasted between 12 to 38 months), making them a more cost-effective and durable solution.[13]

IoT-enabled asset tracking is a key driver to optimize micromobility, because it improves the ability to service and maintain the fleet by enabling onboard and remote diagnostics and real-time developer access. This increases the ability to provide necessary service to the e-scooter before it breaks.

Thanks to the e-scooter's cellular technology, powered by the IoT Accelerator, the intelligent onboard system conducts automatic diagnostic checks. These checks can predict the need for maintenance or repairs, identify unique error conditions, remove the scooter from service, and alert the operational team when necessary.[14]

An equally valuable benefit of IoT-enabled asset tracking is that no scooters get "lost," which would require them to be replaced before end of life.

To improve location accuracy, IoT-enabled asset tracking compensates for lost or degraded GNSS satellite signals in three ways. In an industry first, the IoT uses dual-band GNSS (L1 and L5 bands). Comparing and averaging the two signals minimizes positioning errors, since each signal can be affected differently by urban features such as tall buildings, trees, or atmospheric disruptions. It also accesses corrections from EGNOS, provided by the European Space Agency. When GNSS-only positioning is difficult or impossible, IoT combines information from various sensors (gyro sensor, accelerometer, e-scooter speed) to calculate the scooter's current position. The V4 also includes a dedicated slot for extra sensor devices, expanding IoT's future capabilities.[14]

The end result is optimized service costs powered by improved logistics, including pick-up, service, and charging. Service logistics can be managed in a more cost-efficient way by ensuring service teams focus their time and energy on only those scooters requiring immediate attention.

IoT-enabled tracking also optimizes revenue streams through both dynamic and differentiated pricing. Predictions can be made based on real-time data, from current scooter availability in a certain area of the city to aggregated data like historical peaks in usage, geographical ride patterns, and other customer behaviors.

Micromobility companies operate with a limited amount of scooters – and these are distributed within a restricted area (often a city center). That means data gathered with IoT technology enables operators to predict demand and user patterns, based on day of the week and time of day.

Data-driven differentiated and dynamic pricing increases the ability to remain competitive and maximizes revenues.[15] For example, IoT enables micromobility players to track and service e-scooters. It can also help to decrease cluttering and vandalism, and to introduce preferred parking zones. Moreover, IoT enables the implementation of restricted driving areas and safety measures such as low speed zones, audible alarms, and indicators. All of these are designed to increase the visibility of e-scooters to pedestrians and to vulnerable road users, including the visually impaired.[16]

IoT-enabled tracking optimizes revenue streams through both dynamic and differentiated pricing.

More freedom, less expense with the "15 minute city"

Benefits for city councils
Cellular IoT connectivity enables micromobility companies to track mobility patterns. When shared with city leaders, the data can be used to optimize the use of public spaces, such as car parking spots and, in the future, contribute to overall urban mobility planning such as public transportation investments.

To ensure that city leaders have access to this data, Voi is developing an integration into city data dashboards to provide them with a deeper understanding of mobility patterns. Providing this detailed data will also allow Voi to highlight the value that connected scooters bring to city residents.[17]

Benefits for the end user
City residents and visitors gain increased accessibility in cities with connected scooters, providing more freedom for less expense. In this way, micromobility companies can enable the "15-minute city,"[18] an urban planning concept that aims to enable anyone who lives in a city to meet almost all their needs by traveling no more than 15 minutes from their home. Cellular provides superior connectivity to the Bluetooth-enabled solution in place previously.

This, in combination with the smartphone app, only allowed for localization of e-scooters nearby. Additionally, it limited the ability of e-scooter companies to gather information from the scooter's destination. This made it impossible to locate the e-scooter if someone moved it without connecting to Bluetooth.

Cellular IoT connectivity has improved location accuracy which makes it easier for users to locate and connect to an e-scooter, regardless of whether the e-scooter is in use. It also allows e-scooter providers to relay important safety instructions to users, helping to reduce the number of accidents. Additionally, an increased use of e-scooters may reduce the prevalence of other forms of transportation, which could help lower the dangerous levels of traffic noise that affect 40% of the EU population today.[19]

IoT-connected e-scooter fleets and U.N. sustainable development goals
In 2015, the United Nations established 17 Sustainable Development Goals as a call-to-action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere. IoT-enabled e-scooters help people to access micromobility in real-time, which can cut the number of car rides taken by up to 50%, according to the International Transport Forum.[20] This reduction lowers C02 emissions. Additionally, connectivity enables e-scooters to generate alerts when in need of service, which extends their life span and creates more efficient use of resources.[21]

Ultimately, IoT-enabled e-scooter fleets will strengthen the Global Partnership for Sustainable Development, as different public and private actors come together to work towards a more sustainable world.

The proof is on the streets

Asset tracking for micromobility

A case study demonstrating cellular IoT business value to the transport industry

A baseline urban city model
In order to quantify the value from this use case, Ericsson used an urban European city as a baseline, building a KPI model to calculate business value. Cities like Stockholm, Oslo and Milano each have approximately 1 million inhabitants. Moreover, this number represents a third of the population in Berlin and half the population in Paris.

The Voi fleet for the baseline city provides approximately 3,500 e-scooters. In this model, based on real-world data from Voi, the annual value created for an e-scooter operator in our baseline city is estimated to be $460,000 USD.[21] The largest value comes from the IoT-enabled increased life span. This value accrues from the following benefits:

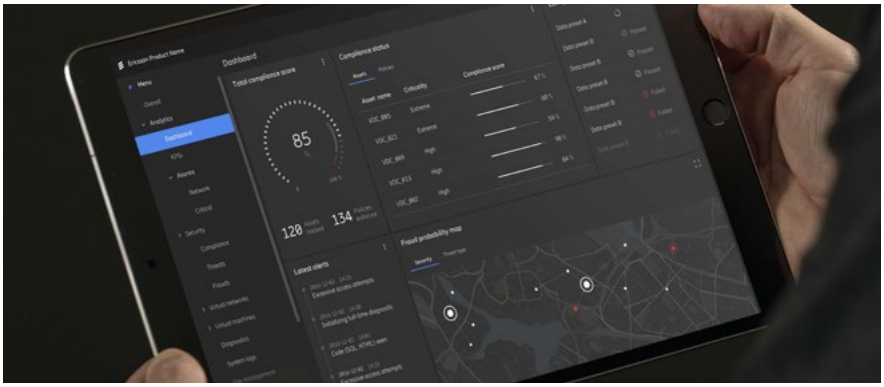
Longer life span of e-scooters (69% of value): [21]
The key enabler of an increased life span for Voiager 4 is IoT, combined with hardware updates. IoT improves the ability to provide service and maintenance, through onboard and remote diagnostics. A cellular connection increases the possibility of providing vital service to the e-scooter before it breaks. Additionally, tracking enables Voi to find displaced scooters instead of having to replace them. And an increased life span means that micromobility players need to replace e-scooters less often.

More cost-efficient service logistics (26% of value):
Cellular IoT connectivity provides micromobility providers with more cost-efficient service logistics, when compared to Bluetooth connectivity. IoT delivers cellular-enabled remote diagnostics, a longer life span and accurate geographical localization for e-scooters. As a result, service logistics such as pick-up, service and charging can be managed in a more cost-effective way. With less time and resources wasted finding and prioritizing e-scooters that don't need service, these features enable service teams to optimize their routes in accordance with the exact need for service, thereby reducing costs.

Accurately implemented dynamic pricing due to IoT (5% of value): [21]
IoT allows micromobility providers to understand the driving behavior of customers, via accurate and detailed data. Given that micromobility companies are operating with a specific capacity of units (often restricted near city centers) and with variable demand (both in terms of time of the day as well as for different areas), IoT provides a data-driven approach that meets these challenges. In addition, introducing data-driven dynamic pricing allows providers to remain competitive and maximize revenues.

According to International Transport Forum[21], there are also sustainability benefits:

- Replacing car rides with e-scooters can potentially reduce CO_2 emissions up to 61%.[21]
- Increasing the life span of e-scooters can potentially reduce CO_2 emissions up to 33%.[21]
- Reducing congestion in cities can potentially reduce CO_2 emissions up to 6%.[21]



Final word

The whole micromobility industry relies upon a stable, secure and scalable IoT infrastructure, without the technology of e-scooters would not be possible.

E-scooters with cellular IoT connectivity provide substantial benefits to e-scooter fleet operators, as well as to city planners. E-scooters are unquestionably a convenient, inexpensive and sustainable way to transport people quickly to their destinations while reducing congestion, traffic noise and CO^2 emissions. And with the additional data provided by IoT, the benefits will continue to grow.

Citations

1. https://www.ericsson.com/en/mobility-report/reports/june-2020/iot-connections-outlook
2. https://www.ericsson.com/4adc87/assets/local/mobility-report/documents/2020/november-2020-ericsson-mobility-report.pdf
3. https://www.lexico.com/definition/micromobility
4. https://www.itdp.org/wp-content/uploads/2019/12/ITDP_The-Electric-Assist_-Leveraging-E-bikes-and-E-scooters-for-More-Livable-Cities.pdf
5. https://www.verifiedmarketresearch.com/product/Micromobility-market/
6. BIS data set via https://www.statista.com/statistics/1201028/micromobility-market-revenue-worldwide-by-region/
7. https://nacto.org/shared-micromobility-2019/
8. https://www.VOIscooters.com/wp-content/uploads/2019/09/VOI-Technology-Sustainability-Statement-.pdf
9. https://www.allabolag.se/5591602999/VOI-technology-ab
10. http://www.euro.who.int/en/health-topics/environment-and-health/noise/data-and-statistics
11. https://www.VOIscooters.com/wp-content/uploads/2019/09/VOI-Technology-Sustainability-Statement-.pdf
12. https://www.VOIscooters.com/wp-content/uploads/2019/09/VOI-Technology-Sustainability-Statement-.pdf
13. https://www.drivesweden.net/en/VOI-scooters-and-iot
14. https://www.VOIscooters.com/blog/VOI-unveils-the-VOIager-4/
15. https://blog.capacent.com/fi/how-to-profit-from-dynamic-pricing-in-any-business
16. https://www.VOIscooters.com/wp-content/uploads/2019/09/VOI-Technology-Sustainability-Statement-.pdf
17. https://www.voiscooters.com/for-cities/
18. https://www.c40knowledgehub.org/s/article/How-to-build-back-better-with-a-15-minute-city?language=en_US#:~:text=In%20a%20%2715%2Dminute%20city,decentralising%20city%20life%20and%20services.
19. https://www.euro.who.int/en/health-topics/environment-and-health/noise/data-and-statistics
20. https://www.itf-oecd.org/sites/default/files/docs/safe-micromobility_1.pdf
21. Arthur D. Little

At Ericsson, we connect businesses

Let's talk about how you can connect yours.

Get in touch at IoT@ericsson.com

Or read more on www.ericsson.com/enterprise

Ericsson
SE-164 80 Stockholm, Sweden
Telephone +46 10 719 0000
www.ericsson.com