Drive Sweden Digital Platform, Drive Sweden 5

DRIVE SWEDEN

With support from

VINNOVA Sweden's Innovation Agency

Swedish Energy Agency

FORMAS

Strategic innovation programmes

Executive summary

Molnplattformen ***Drive Sweden Innovation Cloud*** har används som bas för flera delprojekt i Drive Sweden, bland annat flera pilotförsök med uppkopplade självkörande fordon och nya mobilitetstjänster. Plattformen, tjänsterna och pilotförsöken har rönt nationellt och internationellt intresse. Delar av funktionaliteten har kunnat kommersialiseras av projektets aktörer, och här används konceptet ***Connected Traffic Tower*** för att paketera, marknadsföra och exportera lösningar som specifikt stödjer uppkopplad automatiserad mobilitet.

Under projektperiod har den gemensamma molnplattformen försetts med ny utökad funktionalitet för Innovation Cloud och Traffic Tower med stöd för digital tvilling, AI, simulering samt nya mjukvaruverktyg för att hitta nya insikter i data. Sedan 2022 har vi sett ett betydligt större intresse av att nyttja funktioner för att stödja projekt med leveransrobotar och mikromobilitet. Ovanpå detta kommer molnplattformen att stödja och drifta de delprojekt och tjänster som väljer att driftas i den gemensamma molnplattformen. Den specifika satsningen på gods- och logistik samt mikromobilitet syftar till att få i gång mer projekt inom området och identifiera och testa funktionalitet relaterat till detta.

Projektet har varit en fortsättning på det arbete som genomförts under 2016-2021 och omfattar arbete uppdelat på följande nya arbetspaket/leverabler:

- **WP 1 – Digital plattform**

Den digitala plattformen som omfattar Innovation Cloud och Traffic Tower utvecklas vidare för att stödja innovativa demonstrationsprojekt inom Drive Sweden. Prioriterade områden för uveckling och innovation omfattar mer utvecklad digital tvilling, AI-stöd samt förbättrad onboarding av partners och data. Innovation Cloud control system så som Traffic Tower utvecklas med utökat stöd för Connectivity Management (SIM card management) samt Remote Operation Support för att kunna ge uppkopplat stöd till förarlösa fordon och mobilitetstjänster av olika slag, inklusive mikromobilitet och leveransrobotar.

Tekniskt stöd vid implementation och drift ges till projekt inom Drive Sweden som använder Innovation Cloud och Traffic Tower.

- **WP 2 – Säker datadelning**

Studie, utveckling och testing av funktionalitet för ökad digital säkerhet i samband med datadelning. Omfattar end-to-end analys av säkerhetshot och lämpliga motåtgärder. Labtester kommer att genomföras, och strategier för att höja datasäkerheten kommer tas fram.

- **WP 3 – Transport och Logistik**

Fortsatt utveckling av ny funktionalitet för uppkopplad automatisering av transport och logistik. Support till piloter och demonstrationer inom området. Samverkan med bl a projekten E-Comstrat samt SMARTHEM kring e-handel och uppkopplade leveransboxar i syfte att skapa

ytterligare innovation och automatisering inom området. Ny funktionalitet som stödjer detta kommer testas med hjälp av Innovation Cloud och Traffic Tower.

- **WP 4 - Mikromobilitet**

Utveckling och test av ny funktionalitet för uppkopplad automatisering av mikromobilitet. Support till piloter och demonstrationer inom området. Samverkan med bland annat VOI, Vianova och RISE för att definiera prioriterat behov av innovation, samverkan och demonstrationer. Ny funktionalitet som stödjer mikromobilitet kommer testas och demonstreras i Innovation Cloud/Traffic Tower samt i partnerapplikationer.

1 WP 1 Innovation cloud

WP 1 – Digital plattform

Den digitala plattformen som omfattar Innovation Cloud och Traffic Tower har utvecklas vidare för att stödja innovativa demonstrationsprojekt inom Drive Sweden. Prioriterade områden för uveckling och innovation omfattar mer utvecklad digital tvilling, AI-stöd samt förbättrad onboarding av partners och data. Traffic Tower utvecklas med uttökat stöd för Connectivity Management samt Remote Operation Support för att kunna ge uppkopplat stöd till förarlösa fordon och mobilitetstjänster av olika slag, inklusive mikromobilitet och leveransrobotar.

Tekniskt stöd vid implementation och drift ges till projekt inom Drive Sweden som använder Innovation Cloud och Traffic Tower.

Background:

WP 1 – Digital Platform

This work package adds to the existing Innovation Cloud data brokering services as developed earlier years at Drive Sweden's Digital Infrastructure thematic area and adds novel innovative solutions including a minimal viable product (MVP) of an edge functionality. I.e., while the central deployment may keep data models on how to share data, the ambition is to study the possibility and demonstrate how to share data payload at the edge.

This requires not only continuing with the Drive Sweden Innovation Cloud concept, but also combine what has been developed at other projects such as the Nordic Way Interchange European Data Task force projects and the project is open to also connect and learn from other parties too in a so-called systems of many systems.

These sub systems / control systems are hosted on the same backend infrastructure, aka digital infrastructure.

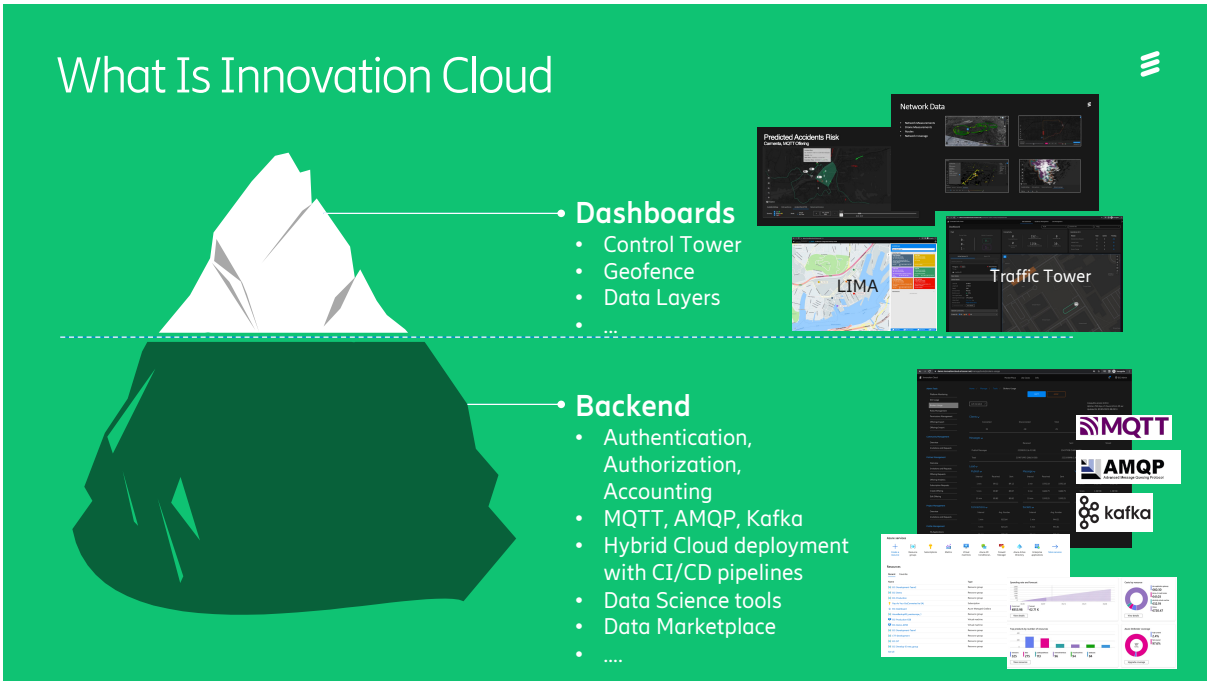


Figure. This page illustrates how different control systems (sub systems) such as Traffic Tower is hosted on the same digital infrastructure (Innovation Cloud).

Key activities and functionality:

Digital Twin & AI Automation

When physical assets are connected e.g., with mobile communication such as 4G or 5G their digital twin representation may be connected into a digital twin world version of the real world. This "IoT Viewport" enables a plurality of digitalization opportunities including AI powered automation.

In the digital world it is also possible to add synthetic data addons to the physical reality commonly known as simulation. In that way the said "digital twin" represents many elements including but not limited to:

Decision Support Systems

More specifically - in the project we will use these digital representations as a baseline to enable partners connected through the data broker to become proactive instead of being reactive. An example of this would be to empower connected devices to share a digital twin representation of the world to take necessary proactive decisions. An embodiment of that include e.g., in WP4 a delivery robot sharing its intent of a certain planned route with the "digital twin", where other connected sensors may complement the world view sharing e.g., hinders on the said path, so that the delivery robot may update its planned route before it even started the journey. This is a novel solution powered by a reliable mobile connection in comparison to other similar solutions such as described at SvD 9th of February with a delivery robot in Miami which today need a person cleaning the path before the robot could drive

The information between the assets is shared either through APIs or through data streaming protocols

such as MQTT, AMQP or Kafka. Simulation of vehicles and sensors enables us to work faster and more effectively without being constrained by permits needed in the real world, nor limited by lack of resources, like physical sensor or autonomous vehicles. The related AI models can therefore be trained on a plurality of scenarios proactively and constantly updated as new events occur.

The digital twin is also be used as a visualization tool, to present data in a real-world context – as data layers on top of the real world, either in for example AR or VR, which will further be developed in WP3.

Method:

Partner onboarding framework
In order to simplify the above use cases, and to empower other projects using the Innovation Cloud the project is also to creating a novel partner onboarding framework. Documentation, training and support to facilitate easy self-service onboarding of more Drive Sweden partners for data sharing functionalities in a secure and reliable way.

Traffic Tower & Remote Operation Support
Using the Innovation Cloud Backend demonstrating operation view tailored to personas within operation flow, traffic management, fleet management and vehicle management using enablers such as positioning, connectivity and data.

Developed Interfaces, APIs, GUI
Continued development of Interface towards Test Sites, Vehicles Fleets and partners. Open access point to enable easy onboarding of new partners.
Continued development of Graphical User Interface.

Test Site Integration
Further integration to meet specific needs from Test Sites, partners, and projects within Drive Sweden.
Operation of Innovation Cloud Backend Enablers
Continued operation of cloud environment and connected services supporting partners, projects and test sites share data with evolved cybersecurity systems powered by WP2 as well as improved tools to allow enterprise partners themself manage end-to-end connectivity through APIs. Including federated network architecture and software hosting or software connections.

Results:

Main delivery and are continued development and operation of Drive Sweden Innovation Cloud supporting pilots and partners within Drive Sweden where they themself shall know how to leverage the system through self-service onboarding of both partners as well as data sharing and consuming.

APIs in a common marketplace is not enough. Those APIs needs to harmonize over time as more and more actors join the ecosystem and share their input using the same digital infrastructure so that e.g.,

how to communicate with micro mobility services becomes a de facto standard (and later a proper standard).

Having a common marketplace for data, but also for software applications such as Qlik and Notebook Jupyter or other control systems further simplifies for all parties to use this Innovation Cloud as a meeting place to exchange valuable information.

Drive Sweden 5 have worked as an example of how to do this effectively in the use case of micro mobility on the journey to make a city made for living.

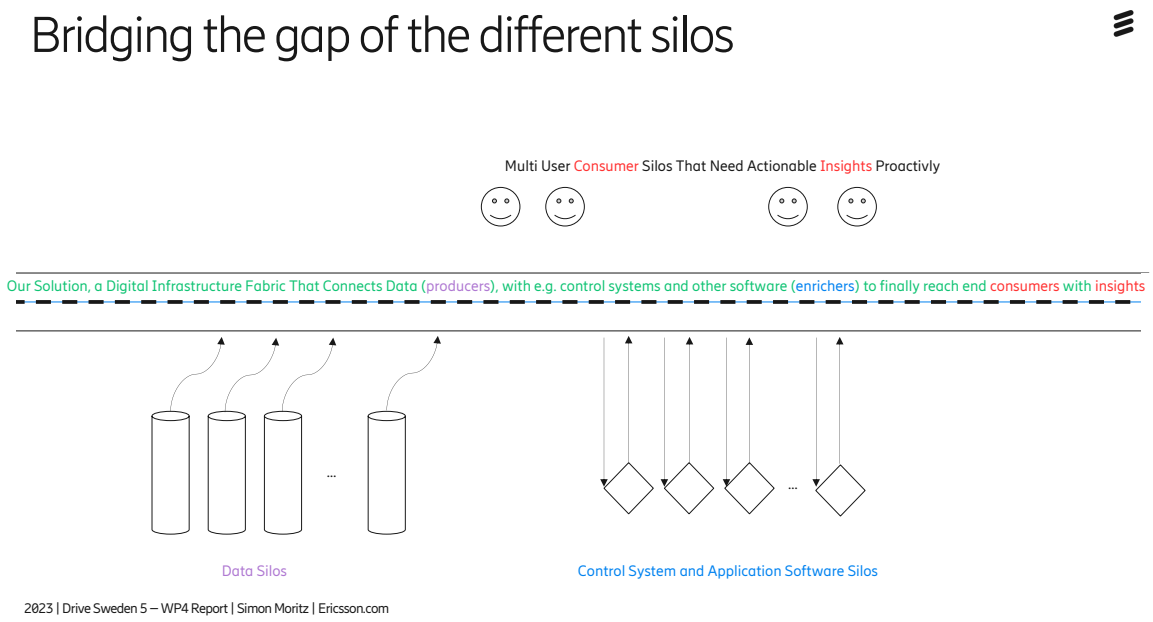


Figure. Illustration how different data can be connected to the digital infrastructure and further enriched to insights using one or more control systems (sub systems) to discover new insights.

Drive Sweden / Ericsson Innovation Cloud was used as a solution to bridge these gaps during the Drive Sweden 5 project.

Different partners contributed with different assets to the Innovation Cloud digital infrastructure system of systems in the use cases of logistics (WP3) and micro mobility (WP4).

Example of contributions from partners:

- Vision / The Why: RISE & VOI
- Policies and rules: Vianova / RISE
- Data: VOI, Smarthem
- Connected Hardware: VOI / Smarthem
- Connected Software: Ericsson IoT Accelerator, Qlik/Stretch
- Users: All partners

Though metadata of how such actors can share information between each other can be shared on a global level. The actual raw data is only needed to be presented in a local ecosystem, a local habitat. Innovation Cloud federated network architecture can realize meta data on a global level.

The architecture with its docker containerization is easy to be deployed on a local edge node too. However, the realization of such an architecture using Innovation Cloud did not fit the budget of the project, so that is left to further project calls.

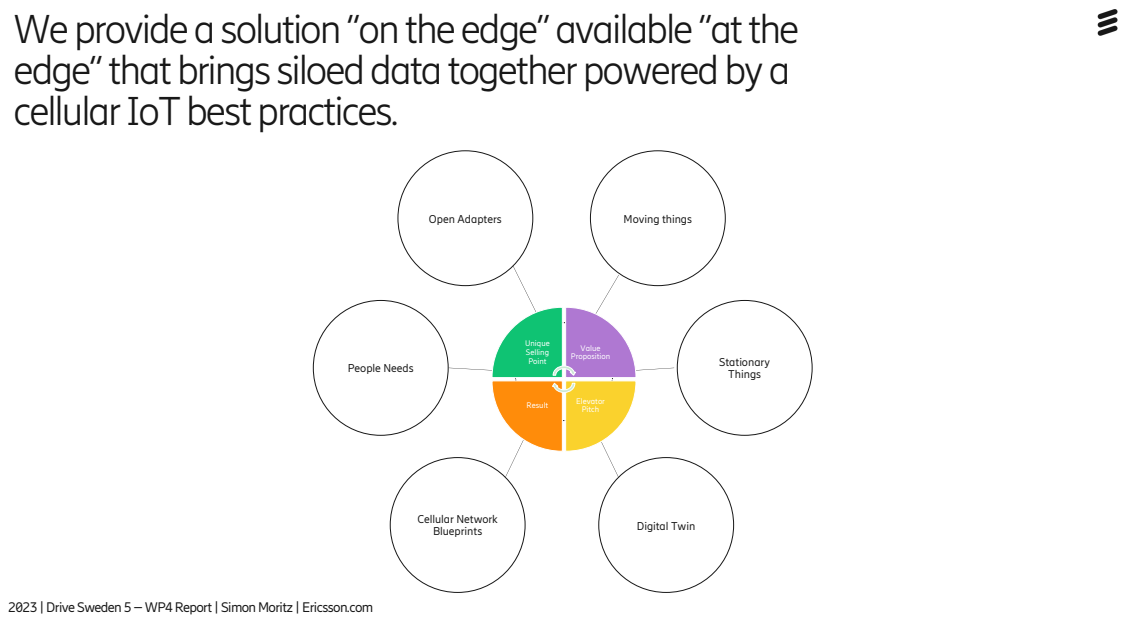


Figure. The figure above illustrates how a local ecosystem habitat of Innovation Cloud can leverage the global agreed metadata exchange to effectively share data at the edge.

Conclusion:

Innovation Cloud managed was once again to successfully connect the strength from a plurality of different actors in an API led connectivity solution. Using the digital twin it was possible to present a path how logistics could become smarter, and how a city made for living can be realised.

Today different puzzle pieces exist commercially, but there is a lack for a digital infrastructure transactional platform that enables new business models to be realized. Innovation Cloud in Drive Sweden 5 acted as an MVP (minimum viable product) presenting of such a system of system.

The federated network architecture of Innovation Cloud was discussed and worked upon during the project, while the realization is left for future project calls to realize.

2 WP2 Security

Background:

The scope of WP 2 security was to make end-to-end cybersecurity analysis for distributed enterprise edge application data sharing use case, with shared model of reality where actors (cars, etc) contribute with measurements and images, available as a Service from the mobile edge cloud.

In such scenarios, a Common Operating Picture (SOP) for security across actors in value-chain is beneficial, including Security Operations Centers (SOCs).

WP2 has dependencies to the other WPs, in particular to WP3 Transport & Logistics and WP4 Micromobility.

Method:

Security analysis of the Ericsson Innovation Cloud sensor data sharing platform was conducted, including threat analysis.

Modelling of business actors and their respective security responsibilities, and information flow between them to enable Common Operating Picture for the security

The security analysis included:

- Threat analysis (threat modelling)
    - Unauthorized access
    - Personal data (PII) exfiltration
    - DoS and DDoS, overload attacks
- Review of overall solution design in light of the threat model
    - Prevention of access to internal interfaces
    - Prevention of unauthorized access
    - Prevention of PII data exfiltration
    - DoS/DDoS protective measures
    - MQTT Security
- Security posture management
- Security log monitoring
- CA and keystores

In addition, experience from operational environment was collected including practical experience from real-world incidents.

Results:

The security analysis resulted in recommendation for cybersecurity strategies for resilience and threat mitigation related to data sharing as well as solution security improvements

Cybersecurity readiness was improved for the involved project partners. Learnings were done in participating teams, including increase knowledge of threats related to data sharing and means for protection, detection, and response against such threats.

Conclusion:

Data sharing is a multi-actor problem and involves a system of interconnected systems. Valuable insights were created, and improvement suggestions were made. The WP 2 created a good baseline for potential future commercialization. In commercialization stage there needs to be a continued analysis of the end-to-end system and further exercising of the security processes for protection, detection, and response across the actors in the use cases.

3 WP 3 Smart Logistics

Background:

The goal of WP3 has been to drive and support Drive Sweden projects within Transport and Logistics, aiming to develop and test functionality within data sharing and connected automation. During 2021, this work was initiated by Ericsson, Scania and Lindholmen/CLOSER, including cooperation with the project HITS as well as DigiGoods. During 2022 focus has been on new concepts (e-commerce, connected boxes, transport automation), secure datasharing (WP2), and utilizing Innovation Cloud for projects within Transport and Logistics.

Method:

This workpackage has focussed on establishing and driving project cooperation within Transport and Logistics, where Drive Sweden Innovation Cloud has been used and developed.

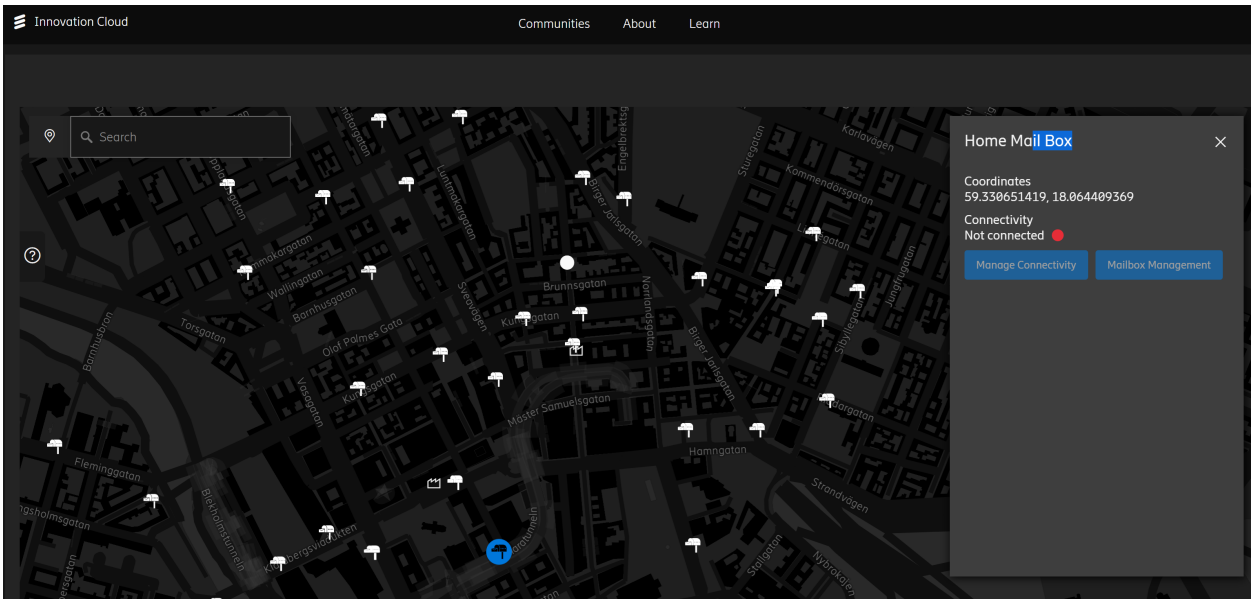
Main activities during the project:

- *Project cooperation within Transport and Logistics*
  Development of further cooperation with selected goods/logistics projects to be used to define wanted functionality. Key projects and actors mentioned below. Innovation Cloud and Traffic Tower has been used to support data sharing and new functionality together with these projects.
- *Develop and implement functionality*
  New functionality in Innovation Cloud and Traffic Tower to specifically support automation of goods and logistics. Connectivity Management, Fleet Management, Asset Tracking, Connected delivery robots, Connected mailboxes.
- *Test and demonstration*
  Testing of functionality and use cases in cooperation with partner projects mentioned below. Demonstrations at Drive Sweden events and externally, also within the partner projects.

Results:

Main delivery and outcome are development, testing and demonstration of functionality supporting use cases of connected automation within Transport and Logistics, supporting selected pilot projects in this area.

The cooperation with CLOSER has continued in several projects. Close cooperation has been developed with project SMARTHEM, led by LTH. This project is focused on connected home delivery concepts. (www.plog.lth.se/smarthem/). In this project, Innovation Cloud has been used to develop and test concepts of data sharing for smart logistics, and also to manage the connectivity for connected mailboxes.



Other pilots and demonstrations have been developed together with Poppytec (Factory logistics) and Combitech (Mining Logistics). Cooperation has also been established with the Train Brain, regarding functionality for predictive movements.

The partner demonstration projects have been demonstrated at Drive Sweden events, and at Hannover Messe and Mobile World Congress in Barcelona.

Conclusion:

Secure connectivity and data sharing is key to enabling smart logistics. But there any many hurdles and challenges. Many partners are very restrictive when it comes to share data. Also, IoT connectivity can be cumbersome to establish. There is also a difficult landscape of data sharing platforms. Still, any actor who wants to remain competitive within transport and logistics, need to digitalize, connect and automate their services.

4 WP 4 Micro Mobility

Background:

Development and testing of functionaliteis for connected and automated micromobility. Supporting pilots and demonstrations within the area. Collaboration between VOI, Vianova, RISE, Qlik and Stretch to define the prioritise need for innovation, collaboration and demostrations. New functionality to support micromobility will be tested and demonstrated using Innovation Cloud and Traffic Tower together with the partner applications and underlying systems of systems.

Method:

The core idea behind this workstream (and the whole of Drive Sweden) is that automated vehicles and new mobility services will benefit heavily from behind ***connected and managed on a system level***, rather than having "autonomous" vehicles and services independently trying to operate mainly based on local sensors and local intelligence.

1. The goal of WP4 is to support Drive Sweden projects within the micro mobility area, aiming to develop and test functionality within data sharing and connected automation. Input to this work package is expected from the micro mobility pre study, led by RISE ("Rundabordsmöten 4 med Nätverk Mikromobilitet"). The scope and definition of micro mobility includes not only e-scooters, but also other types of short-distance mobility with small and often shared vehicles, including also last mile delivery.
    - *Project cooperation within micro mobility*
      Develop cooperation with selected micro mobility projects aiming to define wanted functionalities improving the business as described in the micro mobility report and through the business value calculator.

    - *Develop functionality*
      Define and develop new functionality in Innovation Cloud and Traffic Tower to specifically support micro mobility. Identified functionality and use cases to consider include but are not limited to: *Connectivity Management*, *Analytics, Tracking*, *Optimized re-allocation*, *Crowd insights, Weather, Parking, Charging, Location Accuracy.*

Results:

With input from RISE micro mobility “Nätverk Mikromobilitet” that we received from Kent Eric Lång et al, we have scoped our work package 4 to address the problem finding a solution how various actors in the mobility solution for a city can come together and share information using an API led connectivity approach. A summary of that challenge is the city of Gävle.

Connected micro mobility is one use case that we worked on together with Drive Sweden, one of the Swedish Governments Strategic Innovation Program (SIP) funded by Vinnova.

4.1.1 VOI’s vision for cities made for living

Most cities around the world are facing challenges of transportation that public transport and cars not alone can solve. Using a system approach and introducing complementary transport modes, can help creating the vision of a city made for living Read the whole VOI vision statement

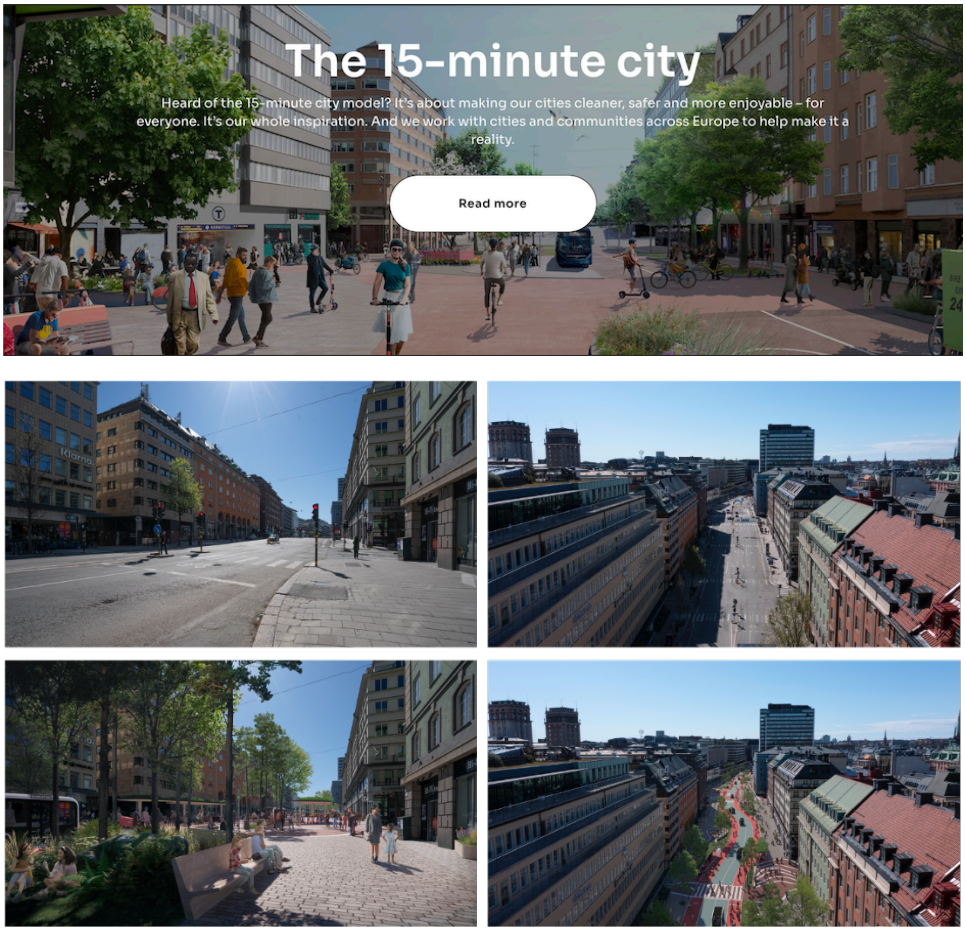


Figure. Illustration how VOI sees a city made for living, where micro mobility fulfils the people travel needs without taking up too much space of the city centres (in contrast to car transport)

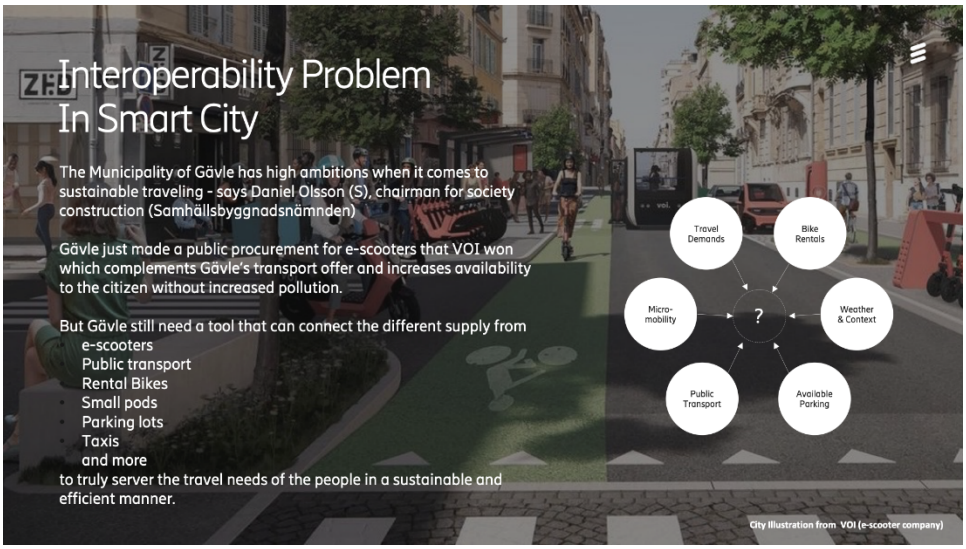


Figure. Illustration of the challenge in a city, where micro mobility can come in and fill a need but needs to be connected to a bigger ecosystem to address the complete need for the city.

4.1.2 The micro mobility vision deployed in Innovation Cloud

This vision resulted in that the project created a best practice blueprint on how to address these challenges.

Figure. Micro mobility Use Case at Ericsson MWC 2023 entrance.

Demonstrating how micro mobility can create a city made for living

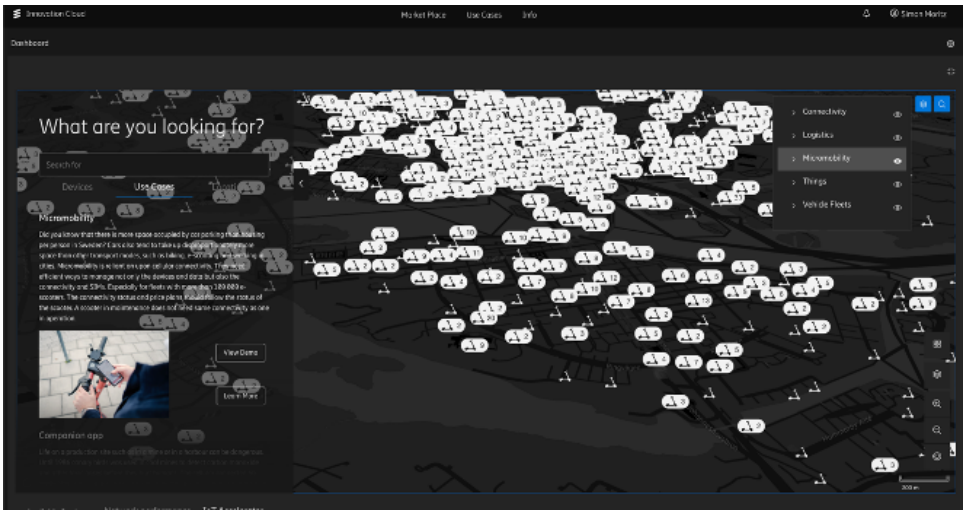


Figure. The figure above demonstrates real time VOI scooter positioning on the Innovation Cloud map.

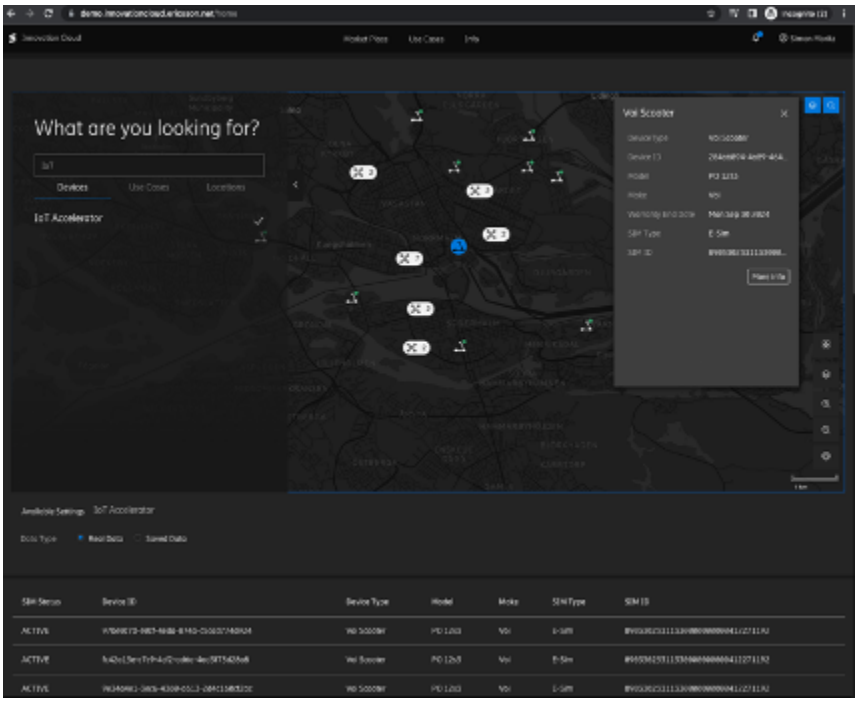


Figure. The figure above demonstrates how an asset, like a scooter can see not only more details of the data and the device, but also how to manage the connectivity (SIM card) status.

Where each e-scooter can be come smarter and more sustainable both in terms of business, effectiveness as well as environmentally friendly the more connected it is.

To have a reliable connectivity an enterprise like VOI need to not only manage their devices but also have full control over the connectivity end to end.

This is something that they can get through an effective usage of Connectivity / SIM management.

An example of this is the work that we done with the Swedish e-Scooter company VOI powered by Ericsson's CSP customer Arkessa powered by Deutsche Telekom (DT) Magenta. You can review the full report here while some key take aways are listed below.

The challenges in many cities are growing population, while the public transport system is stiff and not easily adapted to the travel needs of the citizens.
Micromobility solutions opens new opportunities to facilitate the transport need of the people, while also introducing new challenges.

Cellular connected e-Scooters helps reduce the negative effects while opening for a plurality of new business opportunities such as:
- 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 micro mobility company Voi.

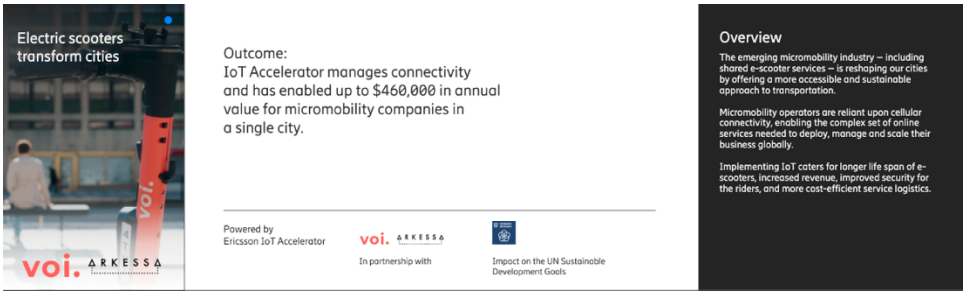


Figure. High level overview how micro mobility is improved by more effective SIM management

Figure. High level challenge for a micro mobility provider such as VOI

Figure. High level solution addressing the micro mobility challenge using SIM management.

Figure. High level benefit for a micro mobility provider using cellular network and SIM management.

However more e-scooters in a city also means new problems like e-scooters parked on pedestrian pathways, on bridges, or other narrow path making it difficult for others to get around in the city as well as making it look less nice.

- How to transport in a city made for living (15 min city) more transportation equipment's like scooters will enter, and if not managed they will clog the city
- E-scooters (100 of thousands in EU) need to be managed and to manage the physical devices requires connectivity. And to be connected they need a SIM card.
- But how would a company like manage not only the scooters but also the even more SIM stock that they get…? Shall they call a CSP and wait for 24h to get the SIM cards activated for each device? Or can they do something themselves in their own device and data management IoT portal?
- Yes, they can manage not only data and devices, but also connectivity through simple APIs.
- In the micro mobility demo on Innovation Cloud we can see an examples of how a e-scooters company in Stockholm in the same window can manage the connectivity too. I.e. when selecting one or more SIMs they can change the SIM status as simple as flicking a switch…

In addition to manage SIMs the fact that the scooters are connected opens a plurality of other positive side effects. Scooters can for instance be carriers of new novel data from their onboard sensors.

Example of sensors that can capture new data:

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 behaviour and speed.
Geographical location sensor: Makes it possible for customers and micro mobility 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 micro mobility 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.

This opens for city authorities to communicate their policies and rules for said cities using platforms such as Vianova

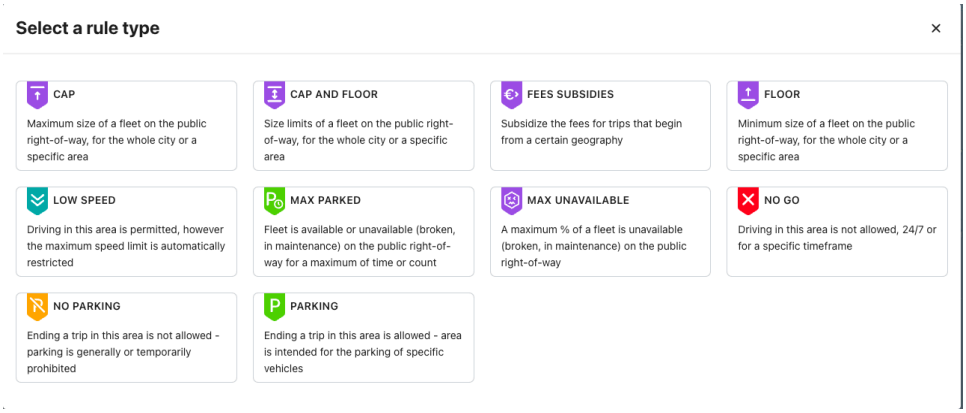


Figure. The figure above is a screenshot of what policies and rules a city may provide to micro mobility service providers including speed, preferred parking zones etc where all information is shared over APIs or data streams in a pre-agreed format such as MDS (https://www.openmobilityfoundation.org/about-mds/)

Brining in different dimensions to the policy makers helps them create a responsive society that adapts to the peoples need instead of forcing the people to adapt to the limited infrastructure.
I.e. instead of you catching the bus, the bus will (eventually) catch you.

Example on how to view a combined view of several actors and create geofence to follow said policy could be viewed at the Innovation Cloud Map

When viewing e.g., the data layer of e-scooters (real time information from VOI) we could also see an example on how to use the Connectivity Management APIs powered by Ericsson IoT Accelerator as described on Ericsson IoT Accelerator Developer Portal

Figure. The screenshot above shows VOI micro mobility data together with traffic incident risk data displayed on Innovation Cloud map.

Using the Ericsson IoT Accelerator portal or the APIs from the developer portal companies such as VOI can then manage the SIM cards on an individual bases

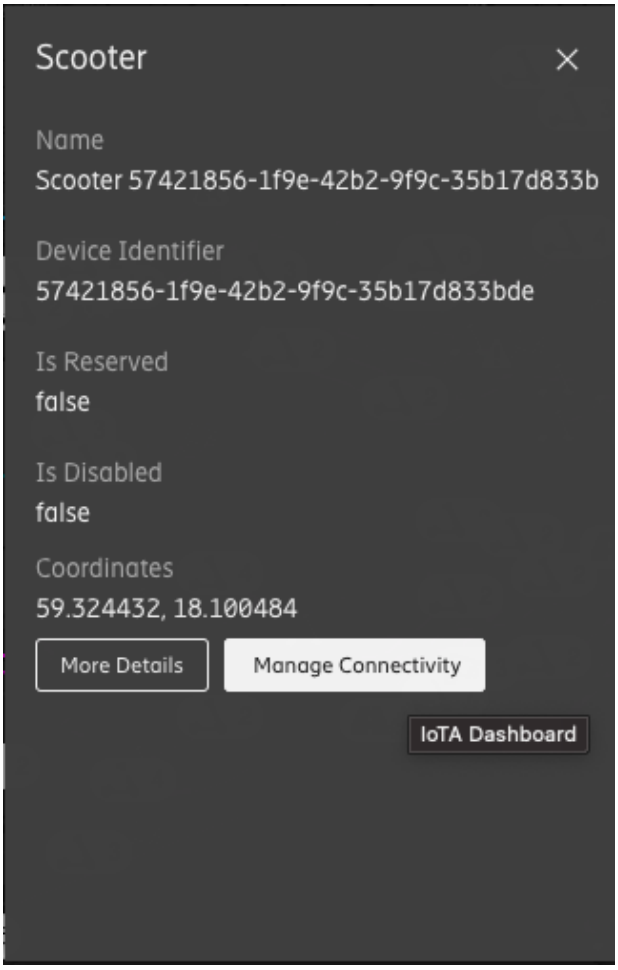


Figure. Demonstrates how a IoT company like VOI may manage their SIM cards using APIs from e.g., Ericsson IoT Accelerator.

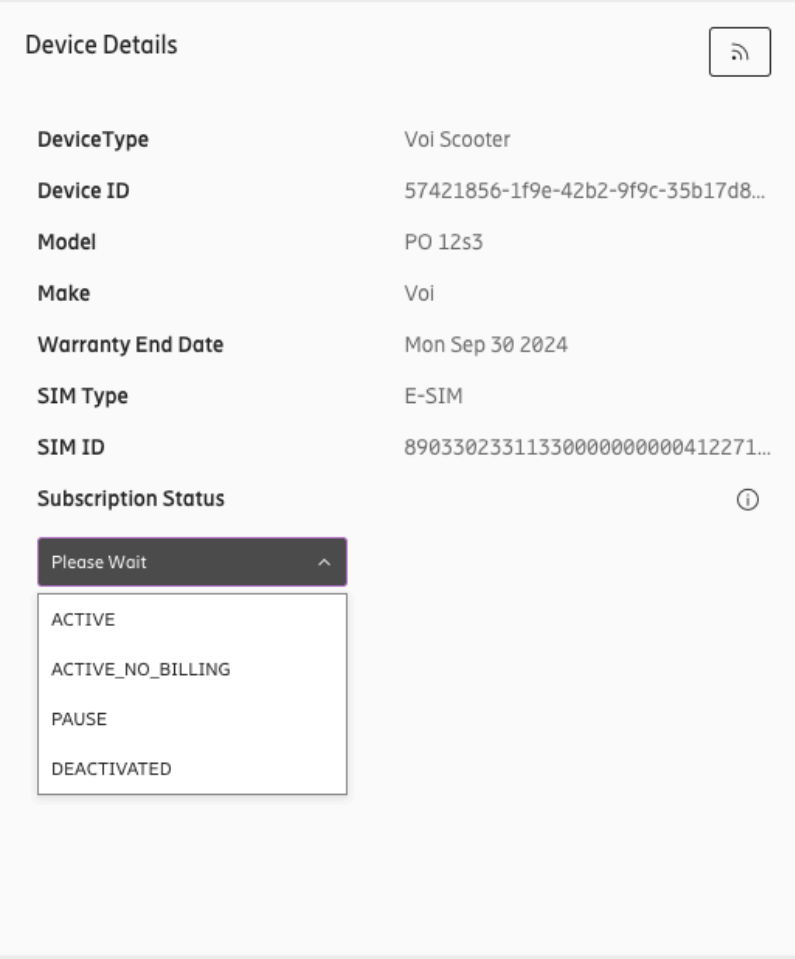


Figure. SIM cards managed individually through a graphical user interface using said APIs from Ericsson.

The SIM cards can also be managed in bulk.

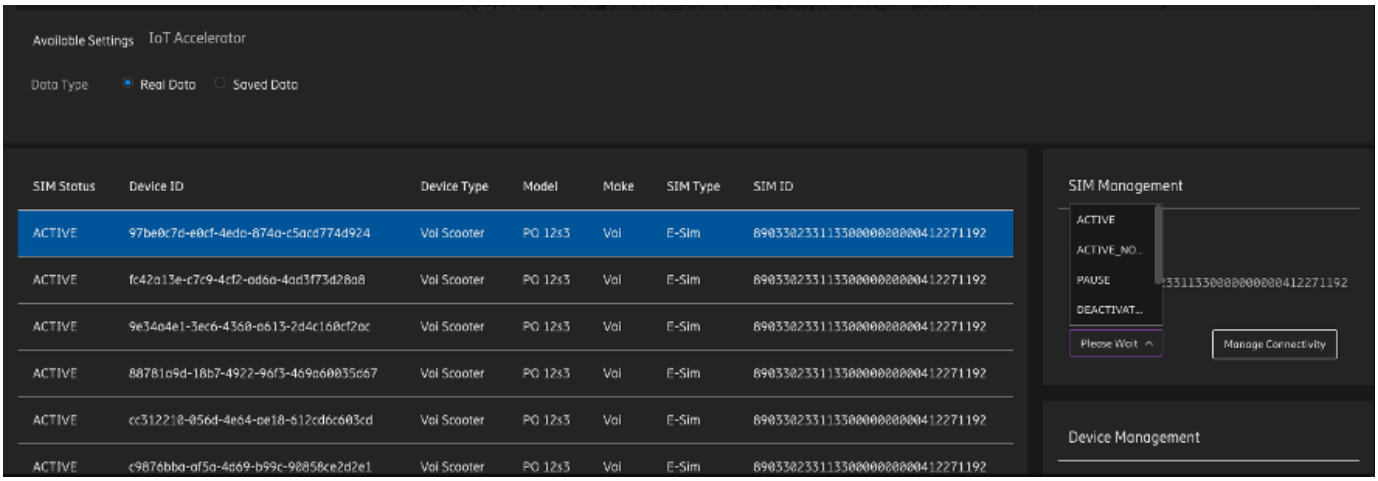


Figure. Screenshot example of how to manage SIM cards in bulk on a graphical user interface using Ericsson APIs.

Figure above demonstrates when Daan and Ana presented the micromobility use case and how to manage connectivity at the annual road show Mobile World Congress in Barcelona.

The result from working with VOI with this technology was that VOI discovered that they had 70 000 too many active SIM cards. They could easier see that they had around 200k active SIM cards, while only 130k active scooters.

And thought the ability to manage these SIM cards had been with them since start, they never fully understood how to manage the SIM cards effectively.

Through the project we could guide them through the available tools disable / paus the SIMs cards that had not been in use the last 6 months with a flick of a button / API.

Handling SIM cards is however only an enabler to get into the exciting data. And it is with access to right and relevant data one can take correct proactive actions.

Data in the digital infrastructure MVP, Innovation Cloud is possible to connect through the self-serving onboard API and data stream service.

And for that each actor must be register to the portal following the Drive Sweden Innovation hierarchy

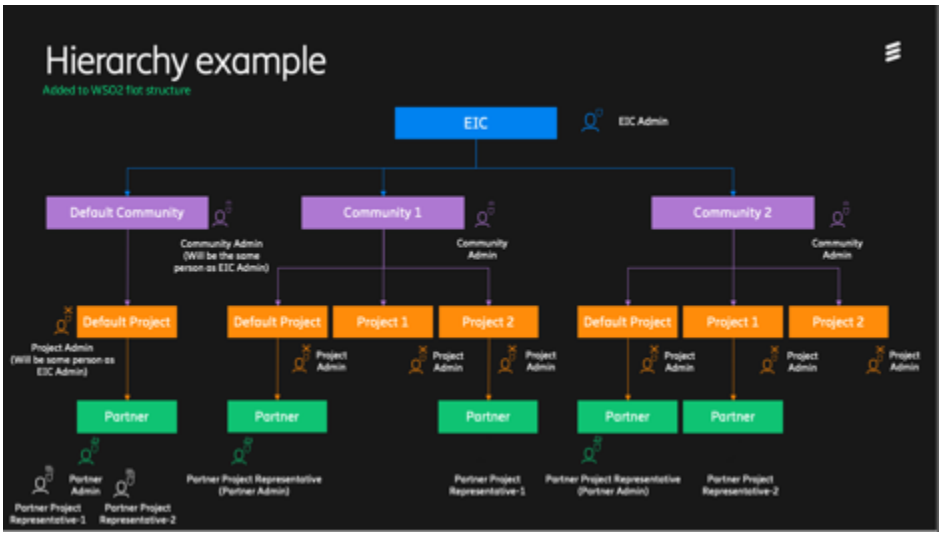


Figure. Example of how WP4 partners is leveraging Innovation Cloud hiearchy structure

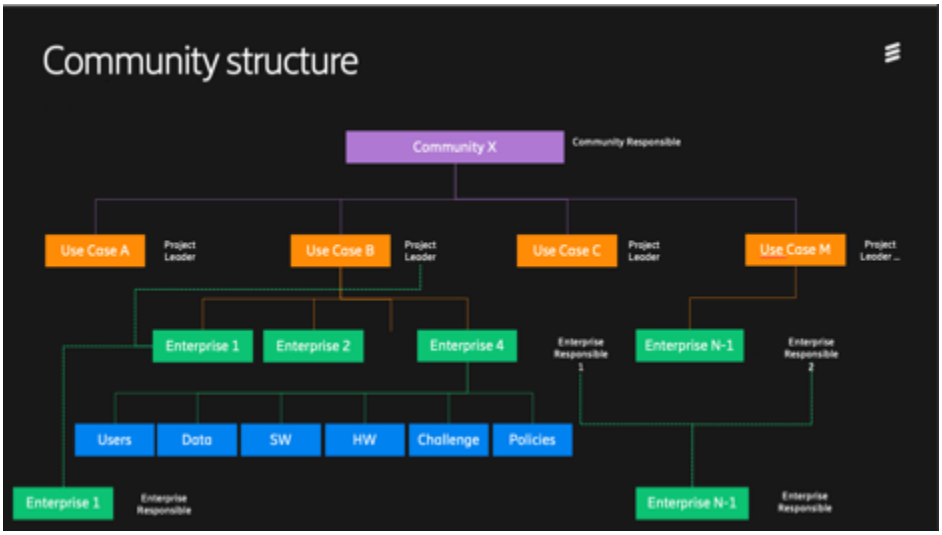


Figure. Example of how WP4 partners share “things” such as Challenge from VOI and RISE, policies from Vianova and RISE, Connected Hardware from VOI, Data from VOI, Software from Qlik/Stretch and connected software support from Ericsson IoT Accelerator.

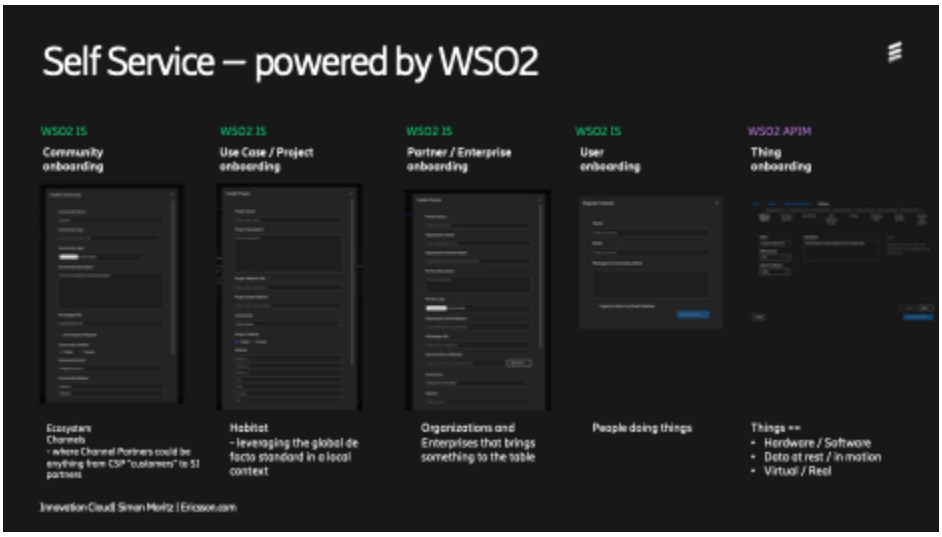


Figure. To simplify partner onboarding to support WP4 the self-service support

Where the onboarding system is leveraging our partner WSO2, API Management and identity server functionality.

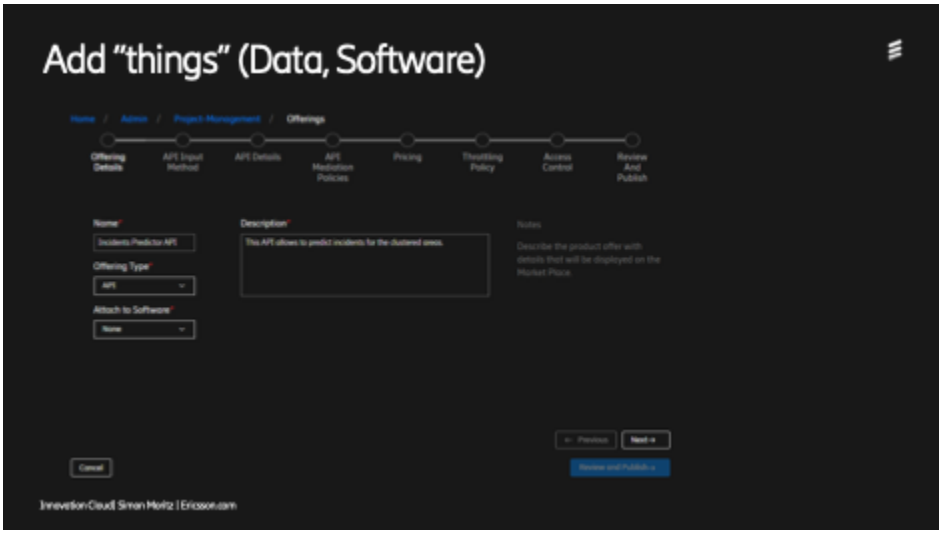


Figure. Screenshot of how e.g., RSET APIs is leveraging Innovation Cloud infrastructure.

When data has been added to the portal it becomes part of the data marketplace.

Where the asset can be either coming from APIs, or in data streams through e.g., MQTT, AMQP or Kafka.

Also, software can be onboarded.

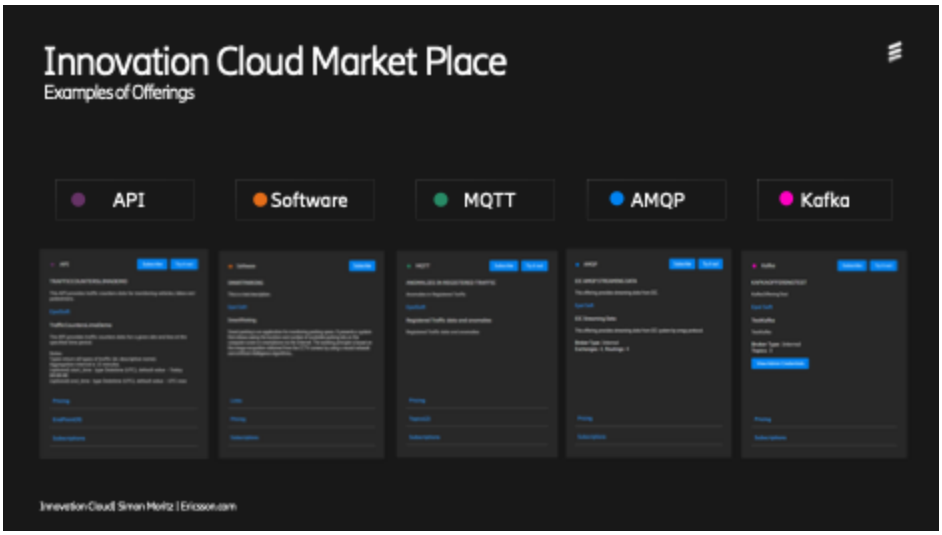


Figure. Demonstrates which types of assets / things that Innovation Cloud have support for.

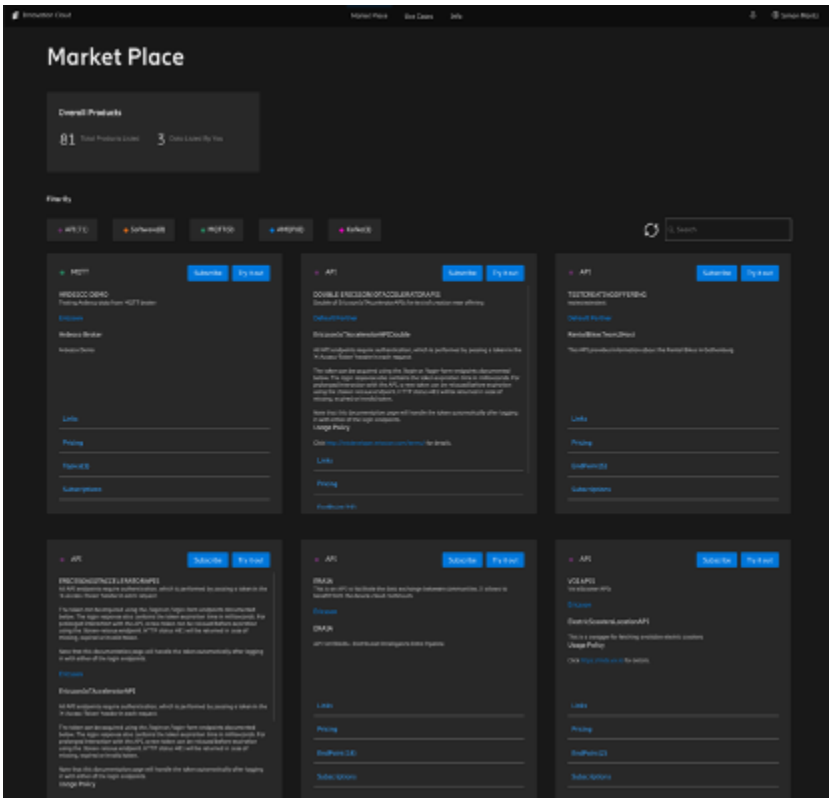


Figure. Screenshot of the Innovation Cloud marketplace where the assets are discovered like in an e-commerce platform. This demonstrates how each partner in the ecosystem can get paid for their respective contribution.

An example of this data is micro mobility data from VOI

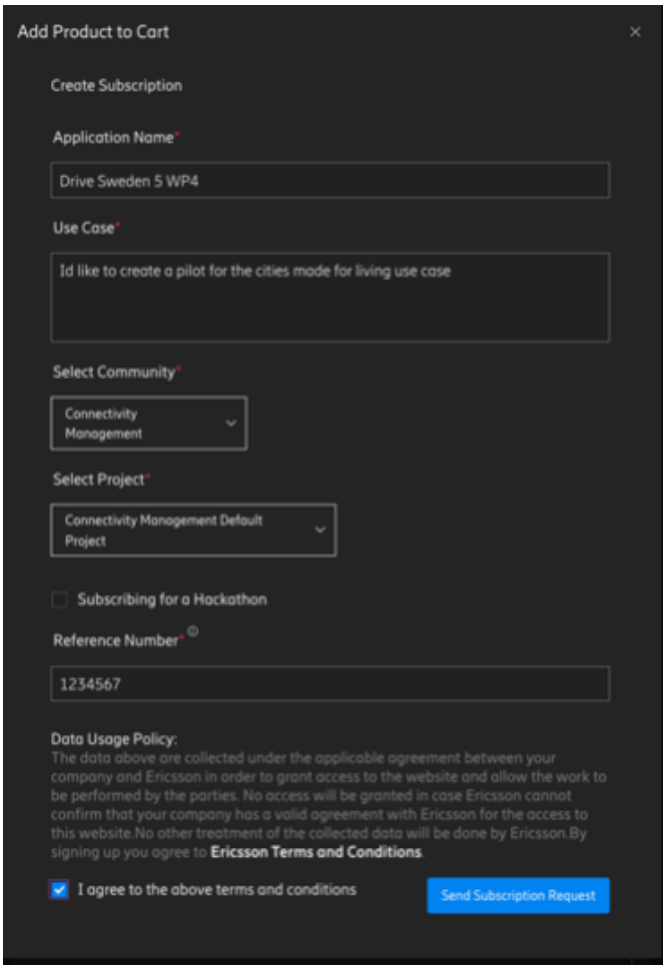


Figure. The screenshot demonstrates how a consumer is purchasing an asset such as micro mobility data from VOI using the e-commerce platform by filling in a request (similar to a travel request), where the request goes both to the partner manager from the consumer partner (that shall pay) as well as the producing partner (that like to sell).

With the subscribed token the data can then be accessed from the marketplace for either e.g., e-scooter data or any other data that one subscribed too like weather warnings.

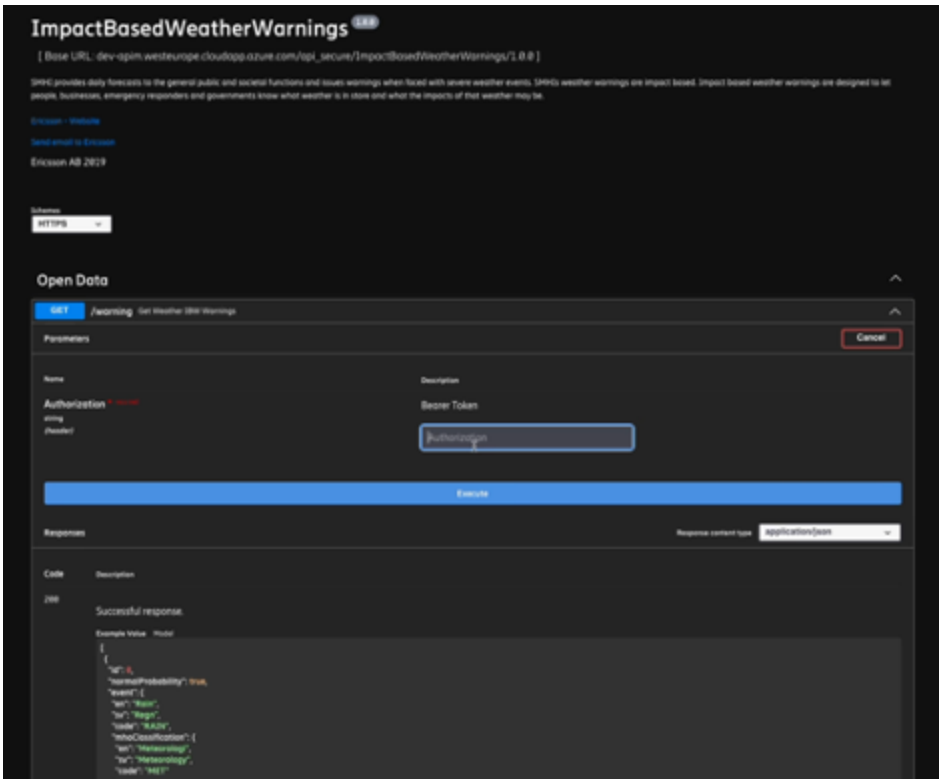


Figure. Using the newly purchase token, unlocks the ability to subscribe or request data from the partner using the Innovation Cloud data brokering platform.

This information can be shared then back to the Innovation Cloud – Control Tower application, or Innovation Cloud map.

Or it could be consumed by any of the embedded data exploration software which is hosted inside Innovation Cloud digital infrastructure so that one can keep control over potential sensative data.

One example of the data exploration tools is Notebook Jupyter.

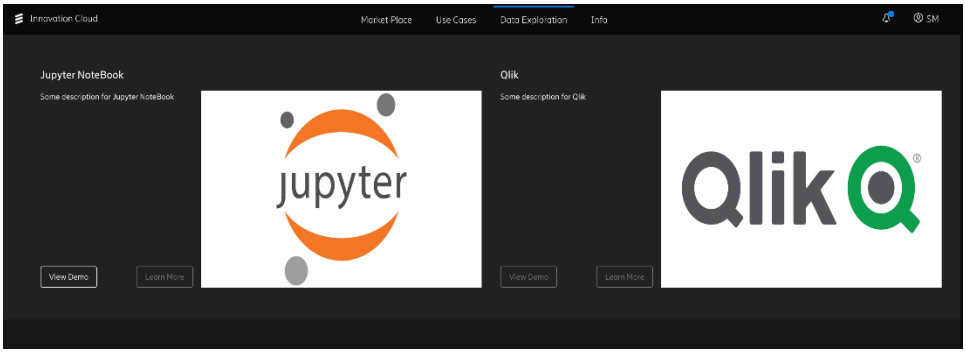


Figure. Screenshot of the data exploration tools hosted on Innovation Cloud [Notebook Jupyter and Qlik].

Examples of what one can do with Notebook Jupyter.

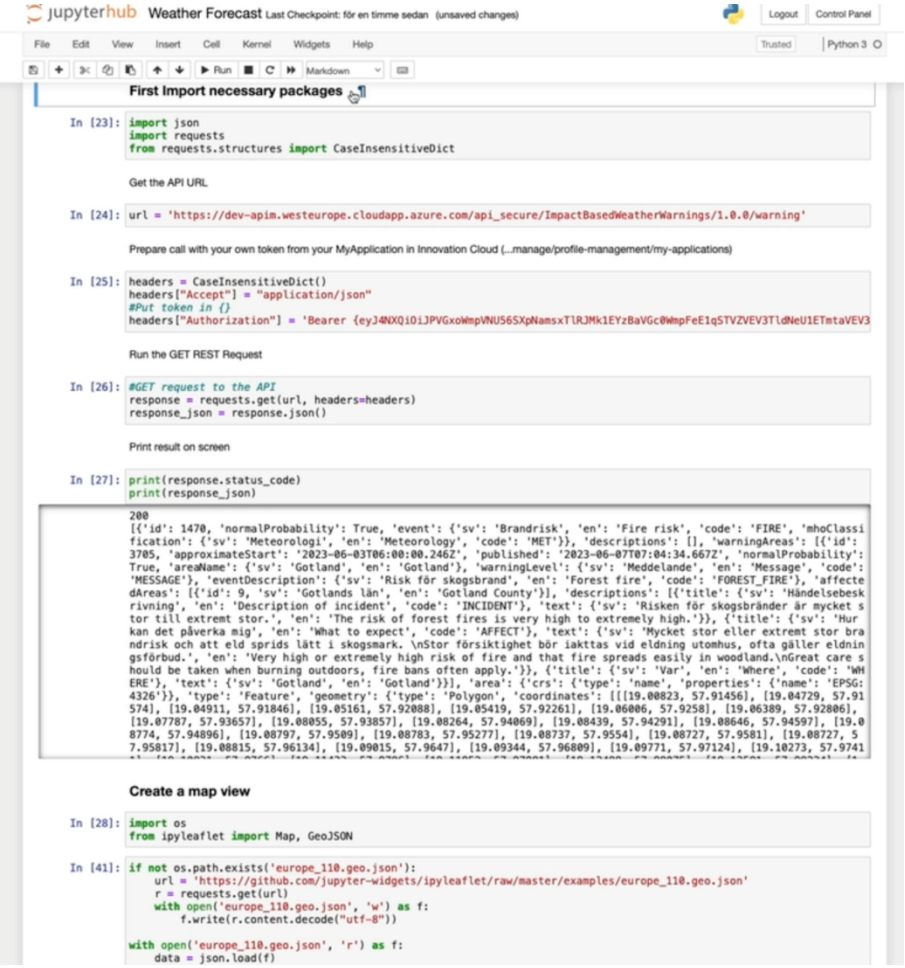


Figure. Screenshot example where weather data is subscribed to from the Innovation Cloud marketplace and consumed by Python code in the hosted software enricher Notebook Jupyter.

Where the results can be presented e.g., on list, tables or in a map.

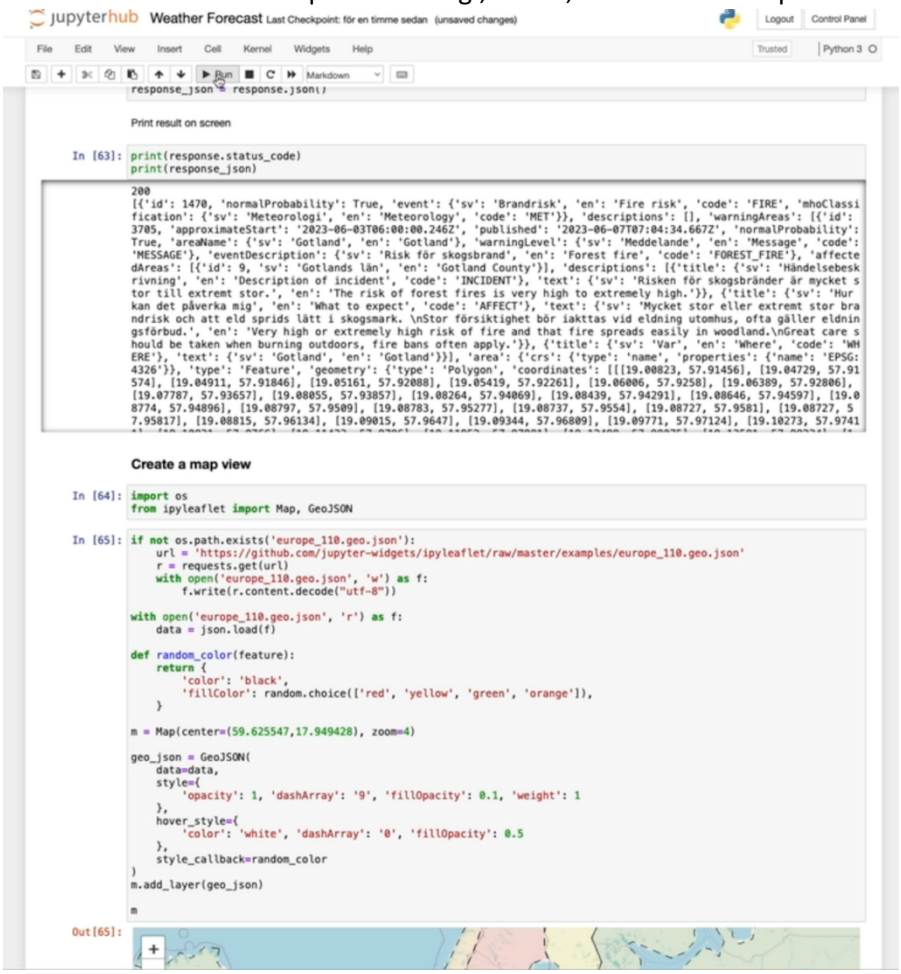


Figure. The data can also be presented on the map

Another data exploration tool comes from our partner Stretch on Sense, that leverage the data exploration software Qlik, embedded and hosted by Innovation Cloud WP1.

4.1.3 Qlik Software powered by Stretch on Sense hosted in Innovation Cloud

For the non python coders Innovation Cloud powered by a white labled Qlik Software enricher give the possibility for the Innovation Cloud users to explore data and learn the stories from the numbers hidden in the code using the simple graphical user interface software from Qlik.

The micro mobility data in Innovation Cloud was in WP1/4 connected to the deployed Qlik software, hosted as an “enricher” in Innovation Cloud, where we could do further analysis on the micro mobility data, powered by Stretch Qonnect.

This is done in the same “Data Exploration” view in Innovation Cloud, where Innovation Cloud supports Notebook Jupyter.

Examples of what one can do with Qlik can be found below.

Figure. Screenshot of the Qlik application with the WP4 micro mobility application connector.

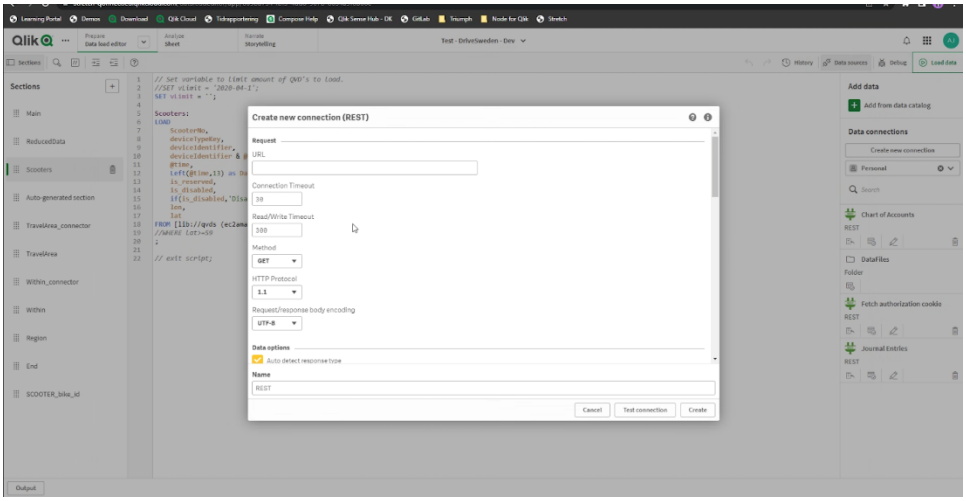


Figure. Screenshot of how to connect data from REST APIs which e.g. could come from Innovation Cloud marketplace.

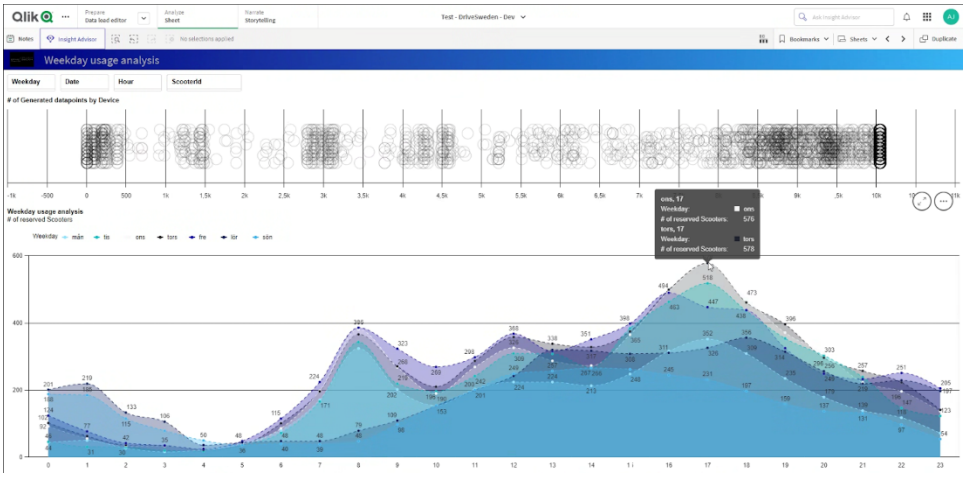


Figure. A screenshot example of how to explore trends from the VOI data.

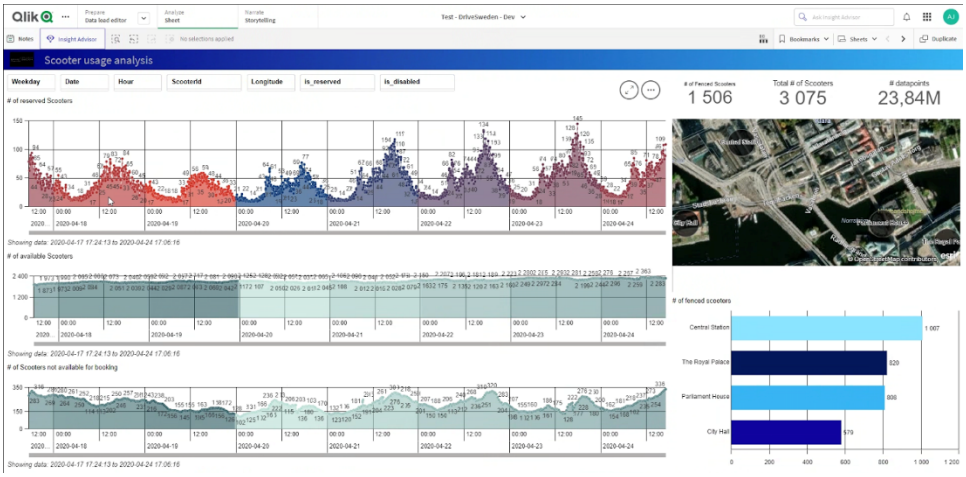


Figure. Another example on how to further work on the application to find patterns and signatures from the connected data, and how to map it back to something that one can relate too, such as city hall etc. Or placed on a map.

With this data exploration tool, it is easy to do self-discoveries of trends, anomalies and find patterns that without the tool is difficult to discover.

Furthermore, with Stretch Qonnects help we have been able to see how to leverage Qlik software embedded in another software as a white lable solution, here exemplified by Innovation Cloud application.

This means that any other Drive Sweden partner could also easy replicate and these lessons learned and with e.g., Stretch help get a data exploration tool too embedded in their respective software application for their use cases.

<u>Conclusion</u>:

Internet of Things visions are easy to understand and grasp, but when it comes down to practical applications it is easy to get lost. The work package 4 in Drive Sweden 5 project resulted in the need for a clearer best practice blueprint for how to support micro mobility use cases when it comes to

1. Connectivity management
2. Precise Location
3. Data Monetization

Out of this the project reached a better understanding on 1) connectivity management which resulted in that VOI could remove 35% of the unnecessary active SIM cards cutting cost in their daily operation.

The result was also disseminated at Mobile World Congress spreading the knowledge to a plurality of organizations world-wide.

Also 2) precise location was worked on during the project, but the practical applications could not fit within the scope of the project and is therefore recommended to pick up in another application.

Likewise with 3) data monetization, was discussed and work on using the Innovation Cloud marketplace functionality for both producers (sellers) as well as consumers (buyers) could meet. However, we did not find enough tie to fully test the business models of the said use case. The embryos and ideas were surfaced where the consortium hope to find new avenues to study these applications further to create a better holistic sustainable micro mobility solution leading to a city made for living.

5 Overall conclusions and recommendations

Overall, the project Drive Sweden 5 with the work packages focusing on cyber security (WP2), smart logistics (WP3) and micro mobility (WP4) has demonstrated that a blueprint best practice is needed to build a sustainable solution based powered by cellular network advantages.

This blueprint was demonstrated using Innovation Cloud (https://demo.innovationcloud.ericsson.net , accessed 2023 June 28) and acts as a minimum viable product, MVP, of how a digital infrastructure may look like and disseminated at e.g. Mobile World Congress 2023 in Barcelona and with its results in this report and shared with Vinnova.

The project hope to reuse the lessons learned in new projects and hope to see the applications of the control tower and innovation cloud put into more commercial practices in a near future.