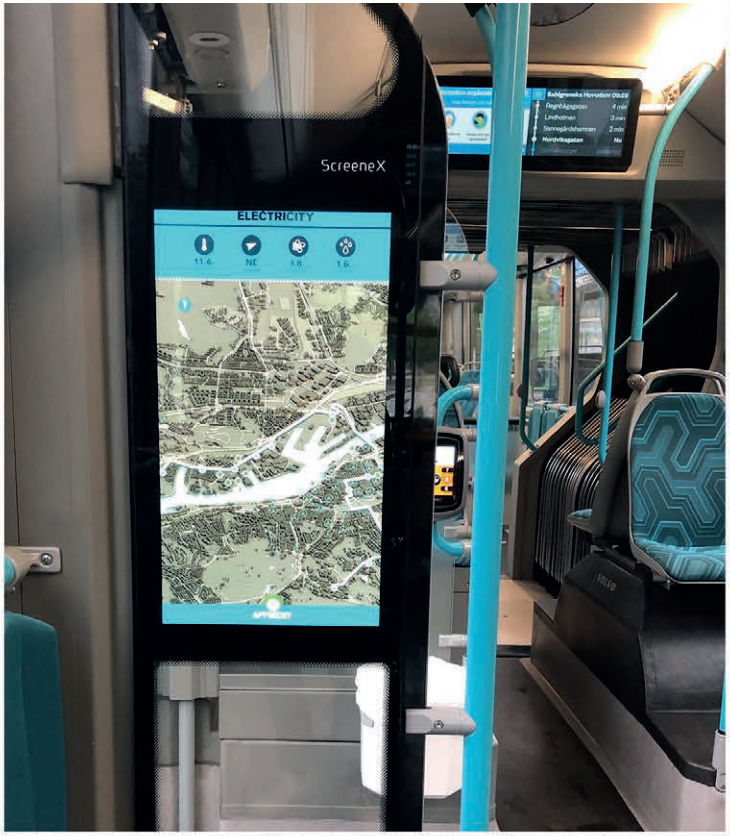





OCTOBER 2020

RIVSILON CASE STUDY

ITXPT

A demo project in the streets of Gothenburg

ITxPT, together with Lindholmen Science Park, Volvo and Västtrafik, the transport authority of Gothenburg, initiated the Rivsilon project in 2017. The main objective was to test and demonstrate the standardized ITxPT IT architecture in operating vehicles. The project implemented and evaluated several digital services based on the ITxPT specifications. And an essential complementary outcome was the project model itself.

By testing the interoperability of hardware and software from different suppliers in real-life, Rivsilon could assess the robustness of the IT architecture. It could also evaluate how far the specification has come towards a Plug and Play functionality, where modules are truly interchangeable.

The project formed a trustful collaboration between competing public transport stakeholders contributing to an open and innovative climate that will surpass the project's lifetime. The establishment of a local ITxPT lab gave the participants an arena to test and develop valuable test methods, tools, and procedures, which creates sustainable value for future projects, and for ITxPT.

Since the Scandinavians are early IT adopters, as individuals, industries, and the public sector, western Sweden provided a perfect ground for a broad scope ITxPT implementation test. The positive results of Rivsilon open to replicate the project model in other regions.

What is **ITxPT?**

With the evolution of information technology moving towards a data-centric approach, there is great value in accessing standardized data. The non-profit association ITxPT enables an open architecture, data accessibility, and interoperability between IT systems within all areas of mobility. The heart of ITxPT is the technical specification – based on standards and best practices for an open IT architecture.

Read more on itxpt.org

ITxPT **drivers and benefits**

Interoperability

Strategic value of data

Flexibility to implement new services

Scalability

Access to maintenance data

Multi-vendor purchasing

Simplified tender process

Open architecture opens the market

Standardized installation

Less hardware

The ITxPT label as a quality seal

Interchangeable vehicles over regions

ITXPT
INFORMATION TECHNOLOGY
for PUBLIC TRANSPORT

Rivsilon project - highlighted results

The Rivsilon project resulted in many different outcomes like:

- Achieving a broad scope testing and demonstration of the whole ITxPT architecture in operating vehicles
- Delivering tools and procedures - which makes the project possible to replicate elsewhere
- Establishing a local ITxPT lab in Gothenburg
- Enhancing collaboration between several local stakeholders
- Discovering the importance of the Integrator role – responsible for integrating the entire system in an open ITxPT architecture

Rivsilon - short facts

Suppliers
Actia, Consat, Ericsson, Triona, Hogia, Icomera, Luminator Technology Group and Pilotfish

Research institute
RISE

Coordinator/project leader
Lindholmen Science Park

Project duration
July 1, 2018 – June 30, 2020

Vehicle manufacturer
Volvo

PTA
Västtrafik

PTO
Keolis and Transdev

Project budget
4,5 MSEK of which 1,9 MSEK from FFI/VINNOVA research foundation

The project model - **a result in itself**

The project was finished within the timeframe and produced quite a few valuable results. The project model is a result of its own – a model for future projects.

To get so many different stakeholders engaged in the project, to get to know and trust each other was an accomplishment and the foundation for being able to examine the ITxPT specification from many different angles. It contributed to a more open and innovative climate between regional public transport stakeholders, which will live on past the project.

Challenges to consider:

- Having many participants poses a timing challenge since all parties cannot always allocate resources simultaneously due to their daily business.

- All involved parties must get the attention they deserve, especially when joining actors of vastly different sizes in the same project.

A local ITxPT lab established

To perform the tests during the project, Rivsilon established an ITxPT lab at Lindholmen Science Park in Gothenburg.

Although being a mirror of the Paris lab, the lab in Gothenburg can focus specifically on integration testing and on developing strategies for a gradual implementation of the specification with a mix of legacy and standardized solutions.

The lab will also supply a much-needed increase in labeling capacity to meet the market demand and the needs of a fast-growing ITxPT organization. It includes a new ITxPT office in Gothenburg and will also function as a model for future local ITxPT labs.

Broad scope **testing**

The project performed tests of end-to-end chains to create a more real-life situation, not just testing component by component, but the whole system.

The broader scope approach also allowed testing the robustness of the system. What happens if a signal does not show up in the way it is supposed to? Does the unit freeze? Can it handle the situation? These issues are possible to test when evaluating the whole system.

Tests while the vehicle is in service

One of the Rivsilon project benefits was to use the electric buses on route 16 in Gothenburg for tests and demonstrations while in daily operation. As a part of the ElectriCity cooperation, www.electricitygoteborg.se/en, focusing on testing and evaluating electric buses, Volvo delivered the two articulated buses already prepared according to the ITxPT specifications.

Five **focus areas**

The project focused its work on five areas:

- **Plug and Play – interchangeability of modules**
- **Digitalization/Virtualization of services**
- **Cybersecurity**
- **Cloud services**
- **Business models**

Plug and Play – interchangeable modules

The Rivsilon project tested the interchangeability of hardware and software.

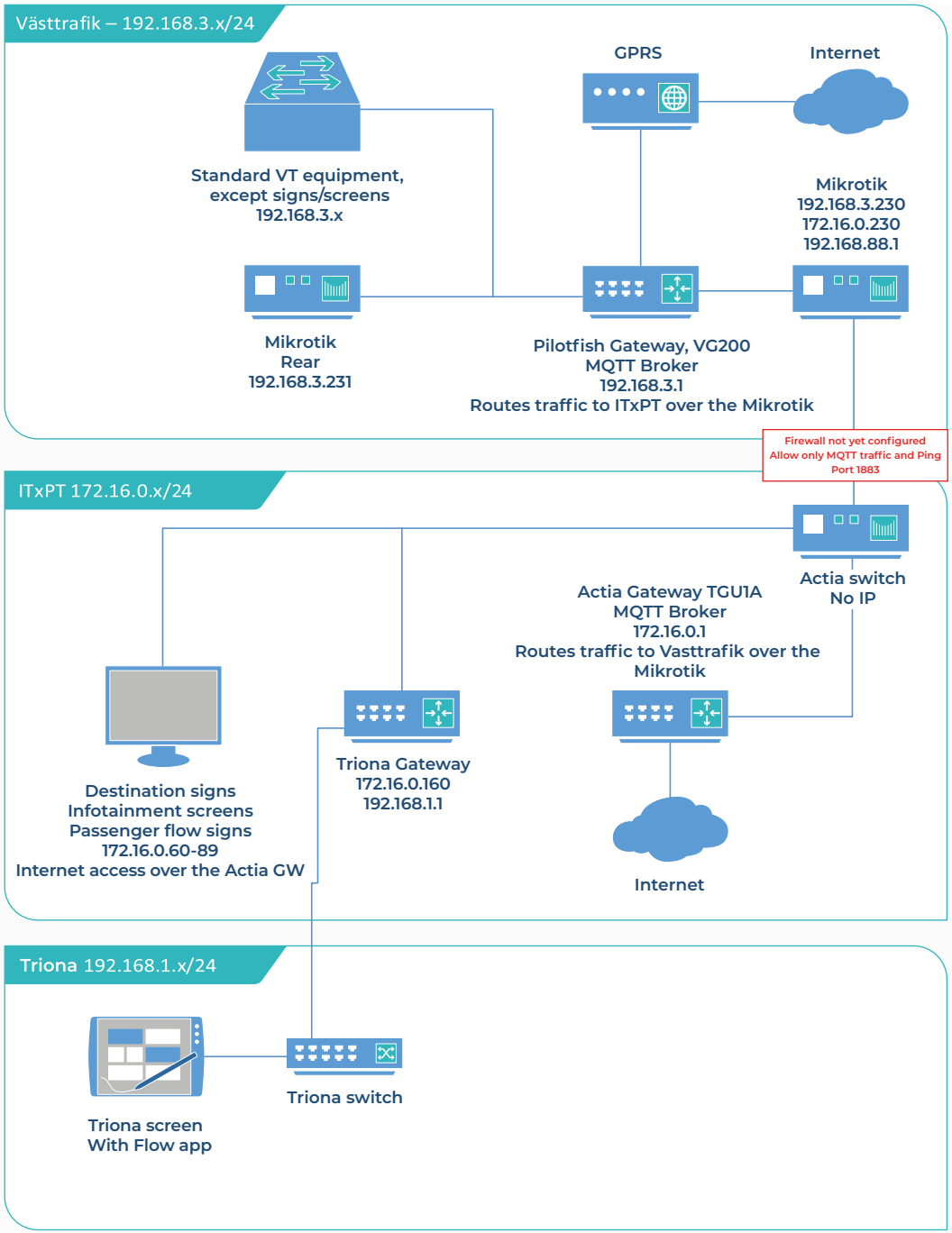
Would the system continue to work the same way after exchanging the Vehicle Gateway to a Gateway from another supplier? Although the answer in many cases was yes, maybe the most important discovery was the definition of a methodology on how to perform the tests. The learning improves future evaluations of components against the whole system. Actia, Consat, Icomera, Luminator, and Pilotfish, all suppliers of Gateway hardware, participated in the pilot.

Five **focus areas**

Digitalization / Virtualization of services

Through virtualization, hardware units can perform several tasks each. It makes it possible to implement software from one supplier in hardware from another and thereby streamlining the hardware used. This topic would be hard to examine without a broad-scope project like Rivsilon.

Among other tests, a Virtualization pilot successfully ran applications from one supplier in another supplier's Gateway. During the trial, ITxPT services were able to discover each other regardless if they ran on a Virtual Machine in the Gateway, were native in the Gateway, or ran in another hardware unit on the vehicle network.



Five **focus areas**

Cybersecurity

With increasingly intelligent travel systems, cybersecurity becomes more and more critical. There must be no way to reach the back-office or any system-vital functions of the bus, for example, through passengers' Wi-Fi. The risk of someone hacking vital systems poses a challenge in reducing the number of onboard networks.

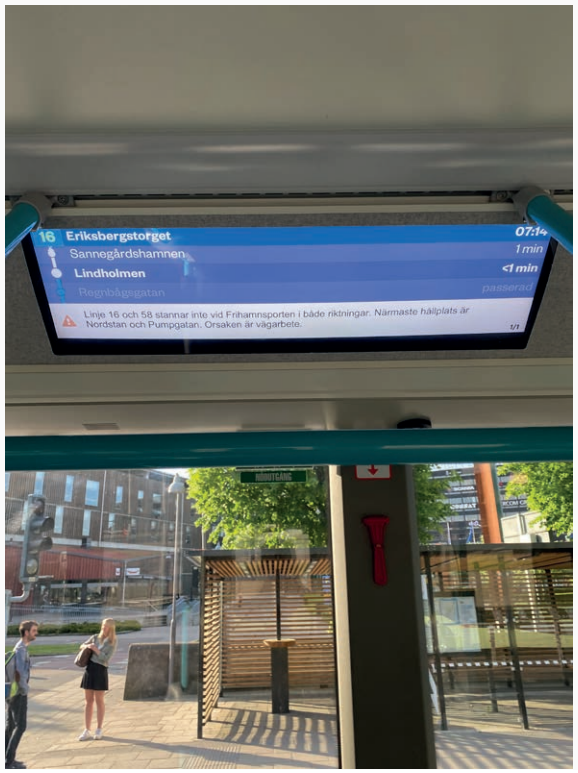
Total network integration – desirable or not?

The ITxPT community has been striving to consolidate the vehicle networks for some time. However, right now, there can be four or five different networks active on a bus.

1. The existing network – Legacy (Public Transport Authority)
2. The ITxPT network
3. The operator network
4. Vehicle network
5. Passenger Wi-Fi

In a silo system, the networks are separate, while in an ITxPT platform, information moves between networks through firewalls with the help of the MQTT communication protocol.

Although the goal is to reduce the number of onboard networks through integration, they might never merge into one for security reasons. Maybe the best and safest solution is to keep them separated and develop the MQTT communication protocol specification? Future investigations and projects will tell.



Five **focus areas**

Cloud services

With cloud-based systems, a great deal of computing power can move from the vehicle to the cloud or the back-office. The Rivsilon project delivered demos with considerable technical insights, with login and traffic clearance, line description to the bus with progress reports sent back, generating real-time information to the onboard signs. The events were communicated with and processed by the back-office system.

Intelligence on board or in the cloud?

The possibility to move the intelligence to the cloud and back-office raises a strategic question of where to allocate the computing power. Should it stay on the bus or move to the cloud? The matter is not decided through the ITxPT specification, but rather a strategic choice when implementing an ITxPT architecture.

Five **focus areas**

From a legacy of silo systems – **ITxPT enables integration**

Business models

When migrating from a silo-based system to an open platform, a new situation appears. One of the project objectives was to evaluate new business models.

Tenders – streamlined procurements

The ITxPT specification reduces the time and the costs of specifying the IT system in tenders for both buyer and seller.

- **Purchaser** – can refer to the ITxPT specifications and only needs to specify add-ons or exceptions.
- **Supplier** – can focus on the add-ons and exceptions and does not have to specify how they will deliver the functionalities already described in the ITxPT specifications

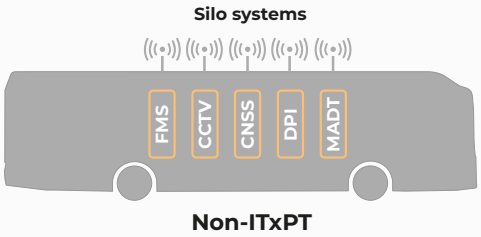
Migration requires the coexistence of legacy and ITxPT

The possibility to run legacy systems parallel to the ITxPT platform is essential to cater to an economically sound transition. It often takes years to make the full transition from one system to the other, and during that time, the systems must be able to coexist within the ITxPT architecture.

The project proved the possibility to maintain different networks, generations, and legacy systems within an ITxPT architecture, and thereby be able to migrate in an economically sound manner.

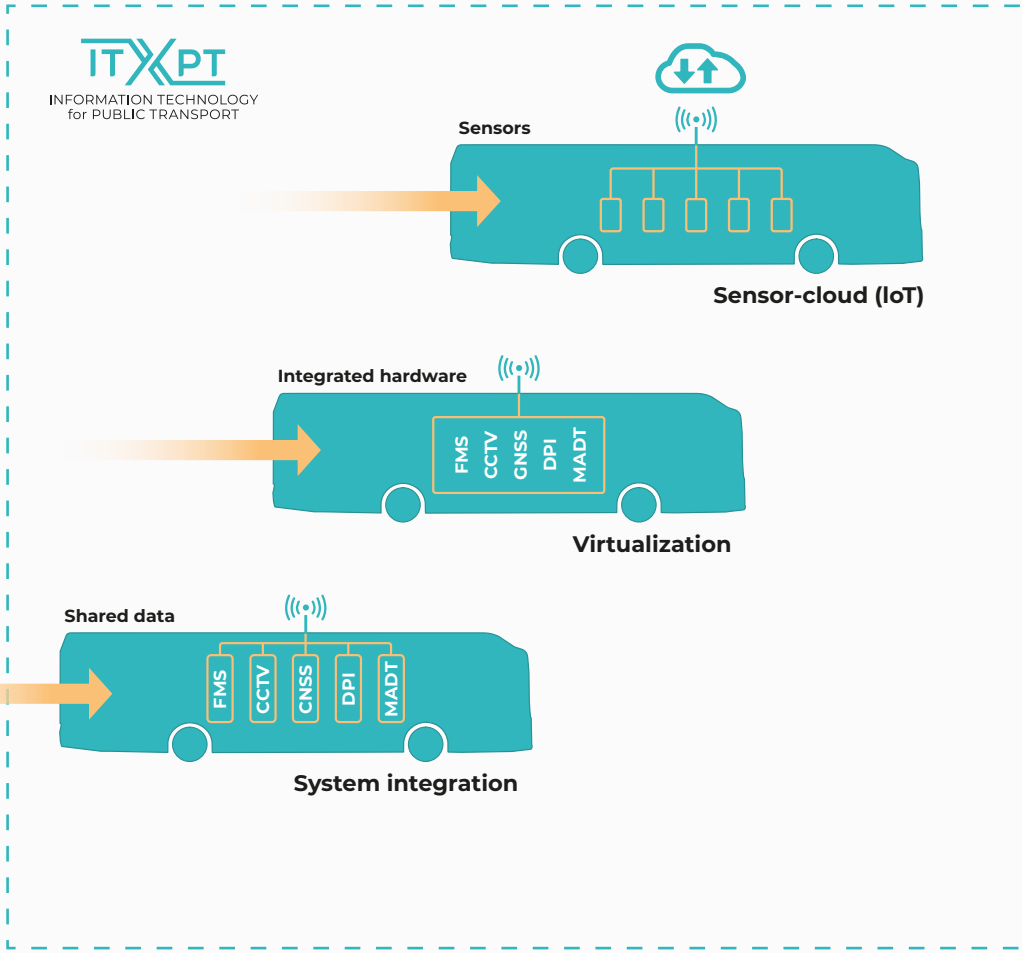
It is also vital to handle different generations of the same system and ensure that the interfaces are well defined and do not malfunction because older or newer connectors or software are not recognized.

Possible onboard IT evolution



From a fully silo-based system, the evolution moves towards an ITxPT platform with shared data. From there, through virtualization, the development might continue towards integrated hardware. A fully developed Internet of Things situation with little computing power on board might be the next and possibly final step, where cloud solutions execute all calculations. Ruter, the Public Transport Authority in Oslo, is moving in that direction. Regardless of which way the evolution moves, standardized data will play a vital role. It is also crucial that the ITxPT specification caters to more than one model in the same system.

ITxPT supports various physical architectures



Plug and Play evolves the market

Through exchangeable modules, a market can evolve, where the system owner can exchange one module or update part of the system without changing the whole system. It also makes it possible to update, upgrade, and add modules and services over time and use standardized hardware and software, gaining cost benefits compared with specialized solutions.

Who is responsible?

It was made clear that the ITxPT specification creates a new situation. To face the challenges of several suppliers, someone needs to take the final responsibility for integrating the whole system – the Integrator.

The Integrator should be responsible for integrating equipment and solutions - on board, in the back-office, and in the cloud.

The Integrator role

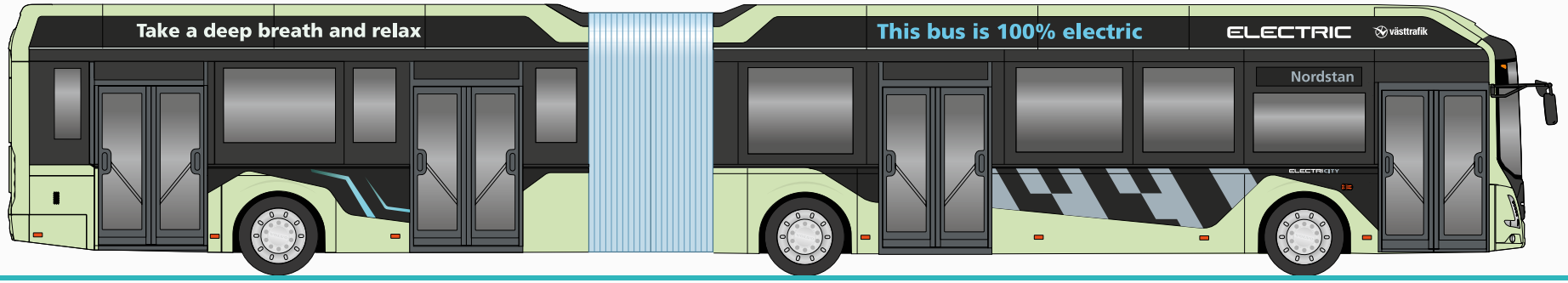
The Integrator needs to have an appropriate set of skills to handle the ITxPT platform, but several different setups can be applied, for example:

- The purchaser owns the Integrator role and takes the full responsibility
- A system supplier takes the role of the complete supplier
- A third party, separated from other system suppliers, takes on the Integrator role

Other models or a mix are possible, but the main thing is to appoint the responsibility for integration from the start.

Training – a field of opportunities

The parties involved in the project identified a need for training regarding public transport IT among authorities and operators. Knowledge is strategic for the purchaser to remain in the driver seat as a buyer and Integrator of IT systems, which offers opportunities to provide relevant training programs, seminars, and discussion forums.



Future **projects**

The project has gained international attention, and Public Transport actors in regions and countries across Europe discuss the possibility of replicating the Rivsilon project.

The project participants have also expressed an interest in continuing the collaboration within a new project.

Suggested topics for further studies:

1. What is the optimal number of networks in the vehicle? What is the tradeoff between security challenges and the benefits of reducing the number of networks?

2. Further development of MQTT solutions to improve data accessibility between networks, units, and services on board.

3. 5G – how will it affect public transport?

4. Evaluate compliance testing of information-consumers to ensure producer-independent functionality.

5. What functions should be on the bus? What processes are well suited for the cloud? How can the specification be written to be agnostic to the bus/cloud?

6. Other modes of transport, like trams, trains, and ferries, what gaps need to be bridged to implement the ITxPT specification?

7. How will the electrification of vehicle fleets be reflected in the specification?

8. Autonomous vehicles, what data is needed? How to handle communication with other vehicles and infrastructure?

Projects like Rivsilon are a cornerstone for the ITxPT collaborative community, and ITxPT will support and act as a catalyst for future projects. Please contact us for more information.

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