FinEst Smart Mobility Final Report

Fleetrange Ltd.

11/2018

This report is created with funding from the Central Baltic Programme 2014-2020:

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1. Executive summary

The aim of Fleetrange Ltd. has been to solve the automated and real-time ETA/schedule tracking of ferry traffic between the West Harbor in Helsinki and the Old Port of Tallinn in order to help streamline the traffic flow for all modes of transport on this route.

The main deliverable was a real-time API-service for use by other service providers or application developers, such as other project partners, the cities' own infrastructure system, traffic lights, taxi services, ferry companies etc.

Automated tracking and data collection also enable data transfer to BI, a Business Intelligence reporting and analysis service that makes it easy to combine data with port systems.

Solution leads to an outcome via FESM API where heavy vehicles can avoid spending unnecessary time in harbor's proximity. This excess time could then be rather spent somewhere else, or for example invested into other parts of that particular transport chain.

The FESM API has in general been operating at a high level of reliability. The large number of tracking data (~8 million data points and ~2400 voyages) collected during the period May-Oct has given us a good dataset for further research into the ETA prediction techniques.

The ferry tracking shows a remarkable schedule accuracy for the ferries on this route and we can state that the ferry service has a very high reliability from the Customer point-of-view even in cases where the ship would have an initial delay in terms of a late departure.

FESM API service is possible to scale across the globe and different ports. The challenge is that the service it is not directly scalable. Every port and ship line must be entered and timed into the code separately.

We believe that FESM API service has brought in a whole new way to see the sea area between Helsinki and Tallinn. We also believe that it is important to include ferries into digital journey planners and smart city open interfaces.

2. Schedule and team

Phases	Schedule	Measures	Status
FinEst Smart Mobility Innovation partnership	06.02.2018	Fleetrange won the bidding – work started.	Accepted
1 Development phase	01.04.2018 – 01.06.2018	Developing prototype – FESM API.	Accepted SG meeting 09.04.2018 SG meeting 30.05.2018
2 Implementation phase	01.06.2018 – 01.08.2018	The development will continue on the basis of a prototype, extending production and deepening co-operation with other players.	Accepted SG meeting 07.08.2018
3 Exploitation phase	01.08.2018 – 01.11.2018	To make a commercially viable product, to deepen customer collaboration and to look at scalability.	Done on time Final report submitted 22.11.2018 SG meeting scheduled 13.12.2018. Waiting for approval.
4 Reporting	Deadline 20.11.2018	The Innovation Partnership Process and Pilot Experiences produce a public final report.	Report submitted
FESM API maintenance	Ends 28.02.2019	FESM API monitoring and maintenance will continue until the end of February.	Planned

Company	Fleerange FESM API TEAM
Fleetrange Ltd.	Teemu Leppälä, Project Manager
	Henrik Ramm-Schmidt, Technical Manager
	Hiski Nuortie, Code Architect

3. Development phase

Developing prototype of FESM API.

The API has been built as a Node.js server application and it fetches data from various publicly available Open Data sources (ship AIS-data, schedules, ship parameters, historical tracks and weather observations).

FESM API analyses the ship sailing parameters and derives the schedule tracking information. The end product is a set of Json-format APIs, which are documented using Swagger UI.

Swagger is an open source software framework backed by a large ecosystem of tools that helps developers design, build, document, and consume RESTful Web services. While most users identify Swagger by the Swagger UI tool, the Swagger toolset includes support for automated documentation, code generation, and test case generation.

We developed an open www-site (https://fleetrange.com/finestapi/) for everyone interested in using the FESM API. In order to use the API, one only needs to request this by messaging Fleetrange, the FESM API key will be provided to all developers.

Licenses and data sources:

https://finestapi.fleetrangelive.com/docs/#/

- AIS-data comes from the Finnish Digitraffic service. Source Liikennevirasto / meri.digitraffic.fi, license CC 4.0
- Weather data comes from the Finnish Meteorological Institute's Open Data. Source FMI / en.ilmatieteenlaitos.fi/open-data license CC BY 4.0
- Schedule data is derived from public webpages of the ferry company

We recruited following ferry companies as partners for FESM API project:

TALLINK SILJA LINE

Vessels: Star, Megastar and Europa

ECKERÖ LINE

Vessel: Finlandia

4. Implementation phase

During the implementation phase, the development continued on the basis of the prototype, extending production, and the deepening of the co-operation with other relevant actors. Other completed tasks:

1) During the implementation phase a version of FESM API is developed, which then can be piloted without disturbance during the recovery phase.

2) During the implementation of the API, have the various parts and functionalities of the API working simultaneously.

The contacts created with relevant stakeholders:

FESM pilots:
Coreorient
Tilgi
Infotripla
Kyyti

FESM partners or affiliates:
Forum Virium
Port of Helsinki
Port of Tallinn

Other:
Ultrahack – The Talsinki Hack
https://ultrahack.org/ultrahack2018sprint1/the-talsinki-hack-hack-the-commute-and-cross-border-business

Fleetrange also initiated cooperation with Ampron, who provided led screens for real-time info screen testing at the Port of Helsinki's Office during 3 months. Ampron had developed an system that could visualize Fleetrange's API information on the screens.

Fleetrange also kept all project innovation partners informed of the developments, and deepened the co-operation with them. Most of the cooperation has been with Port of Helsinki and Infotripla. Fleetrange also negotiated with several companies outside of the FinEst Smart Mobility project.

5. Exploitation phase

The exploitation phase was dedicated to make a commercially viable product, to deepen customer collaboration and to look at scalability.

The FESM API exploitation phase data statistics can be summarised as follows:

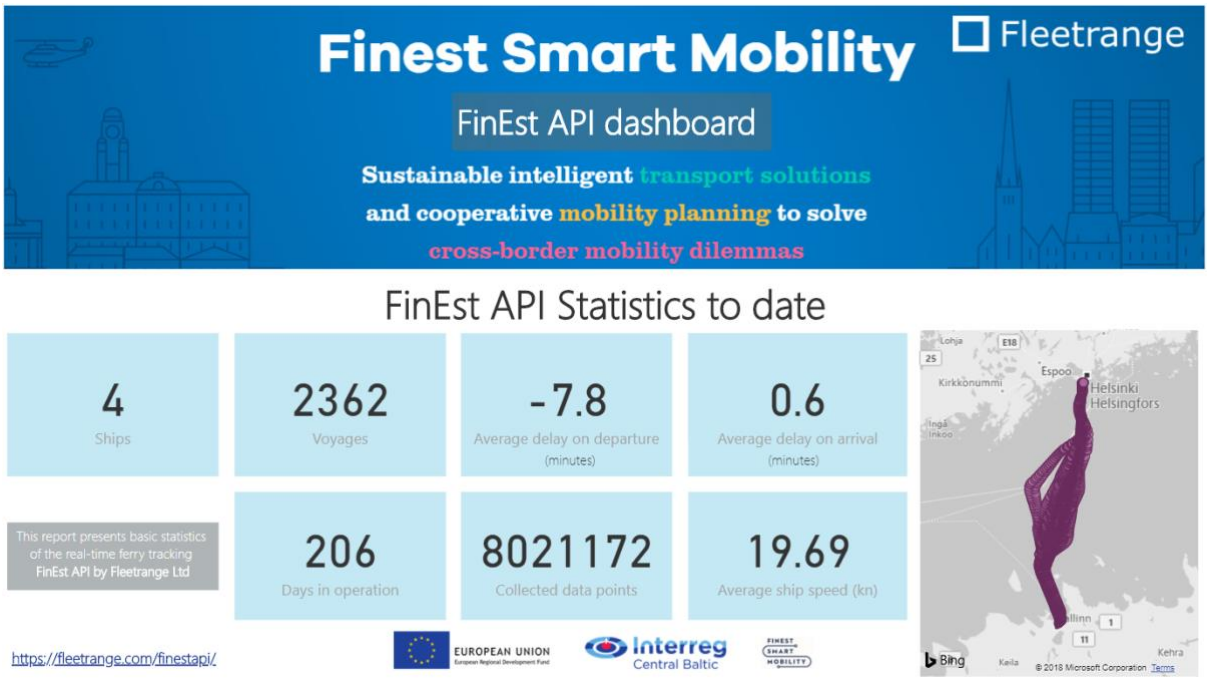


Figure 1 - FinEst API general statistics

5.1 FESM API quality

The API has in general been operating at a high level of reliability. However, the system encountered following two issues:

1. Two larger problems with the availability of the API and its online access (early July/Aug and 19-21 Oct)
2. Issues with the schedule prediction accuracy shortly before the ship's arrival in Helsinki (see next item "Feedback and improvements")

5.2 FESM API KEY statistics

The FinEst API KEY has so far been generated to 5 users, of which one in particular (Infotripla) has been actively accessing the data. The API KEY statistics are as follows.

name	company	lastQuery	queryCount
Aleksi Vesanto	Infotripla Oy	30/10/2018 16:15	148085
Ollar Roovik	Ampron	15/08/2018 19:46	5
Tapani Moilanen	Kyyti Group Oy	23/08/2018 08:41	6
Jussi Malm	Helsingin Satama	21/07/2018 06:25	15
Test user	Fleetrange Ltd	31/10/2018 12:20	207

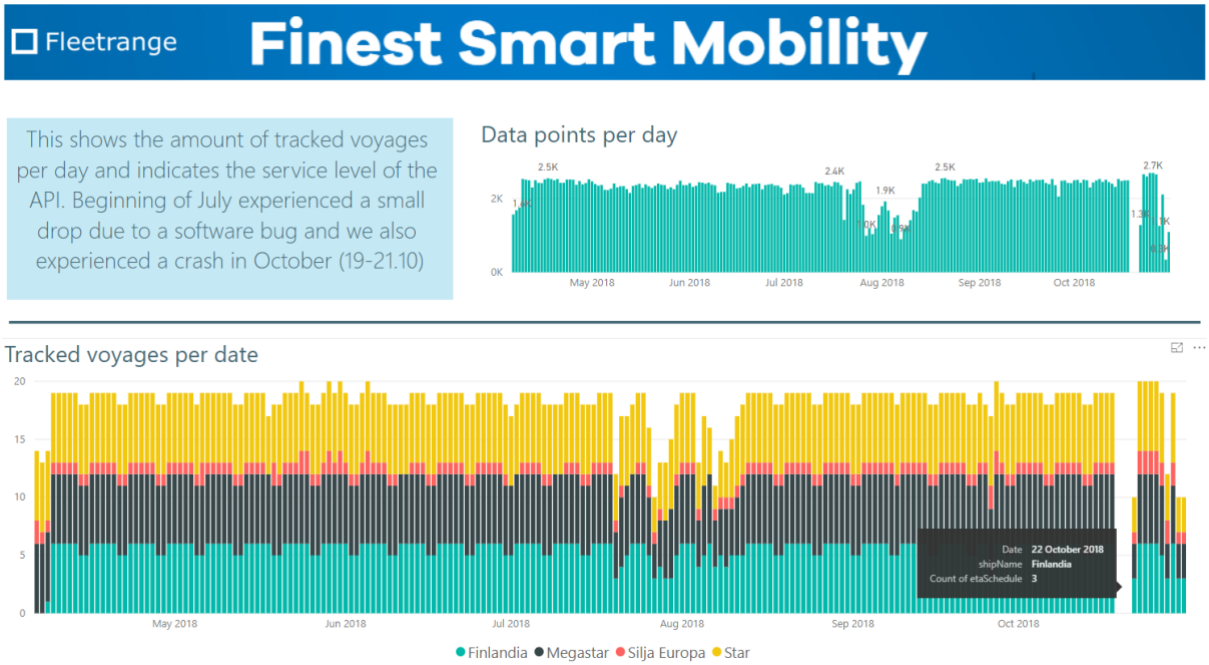


Figure 2 - FinEst API availability

5.3 FESM API issue in late July/early August

In late July/early August Fleetrange experienced problems with the database connections between the AWS MySQL database and the server itself, causing a number of voyages to drop from the tracking.

5.4 FESM API issue 19-21 October

October 19-21 also showed issues with the tracking and the reason in this case was a combination of errors in the vessel schedule data and a subsequent escalation and overflow of database connections between the database and the server

5.5 FESM API feedback and improvements

We have received improvement suggestions from the API user Infotripla, with the main suggestion relating to the ETA prediction accuracy in Helsinki.
We also started to design a new type of self-learning statistical ETA prediction solution at the end of this reporting period. The work with this improvement is ongoing at the time of writing and it will be interesting to see the effect of this prediction solution.

5.6 FESM ETA prediction accuracy issue in Port of Helsinki

On 22th of October, Infotripla reported a discrepancy in the accuracy of ETA predictions for ship arrivals in Helsinki. The problem seemed to be that the API's schedule accuracy prediction starts to deviate when the ship approaches the port. From Infotripla's point of view, the most important timeframe for obtaining accurate ETA is approximately 5 minutes before ship arrival.

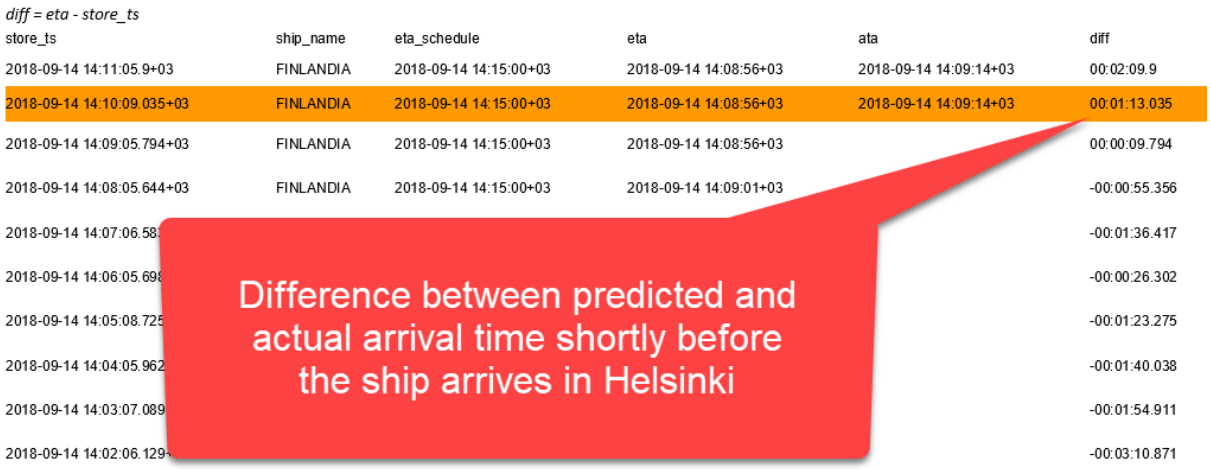


Figure 3 - Infotripla API log

This issue was investigated in detail and we found following:

- The original ETA algorithm was constructed to work in the same way in both Helsinki and Tallinn and estimated ETAs based on the ships' speed and location and how far it is from either port
- However, at closer investigation we see that there is in fact a difference in how the ships arrive in the ports, i.e. the ships always turn in Helsinki on arrival, while they go straight in in Tallinn -> the original algorithm did not account for this fact in the correct way and subsequently the ETA prediction was off in Helsinki.

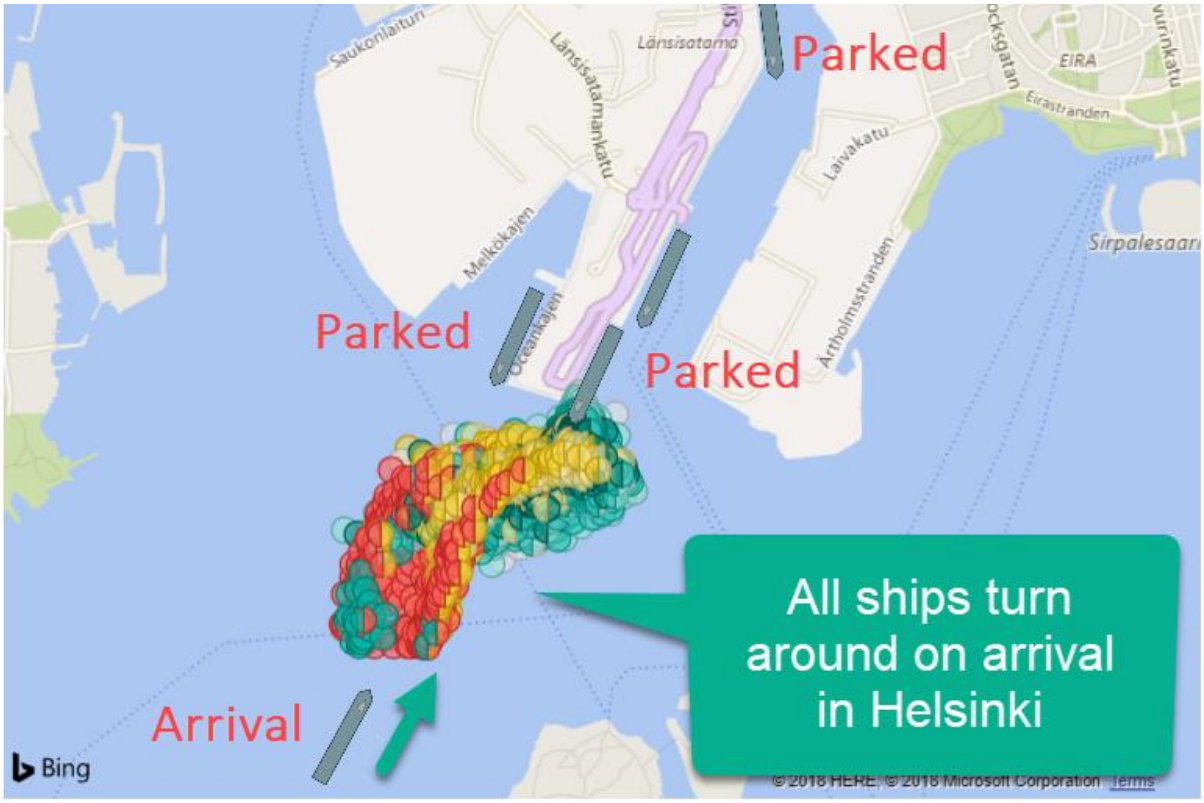


Figure 4 - ships turn around on arrival in Helsinki

Figure 5 - ships go straight in w/o turning in Tallinn

Following our investigation, we made an improvement to the algorithm in order to improve the estimation of the arrival time in Helsinki. The main change was to add in

a better function to estimate the time it takes to turn around the vessel in Helsinki. The results of the improvement are not yet available at the time of writing this report.

5.7 Alternative statistical ETA prediction model- work started

The large number of tracking data (~8 million data points and ~2400 voyages) collected during the period May-Oct has given us a good dataset for further research into the ETA prediction techniques.

We have started to work on a statistical model, which would take into account historical operational data and the different characteristics of the different departures in an improved and a more automatic manner. As can be seen from below, the three fast ferries (vessel Europa is discounted from this group) have quite different average sea speeds and the speed seems to correlate with the time of departure (UTC time).

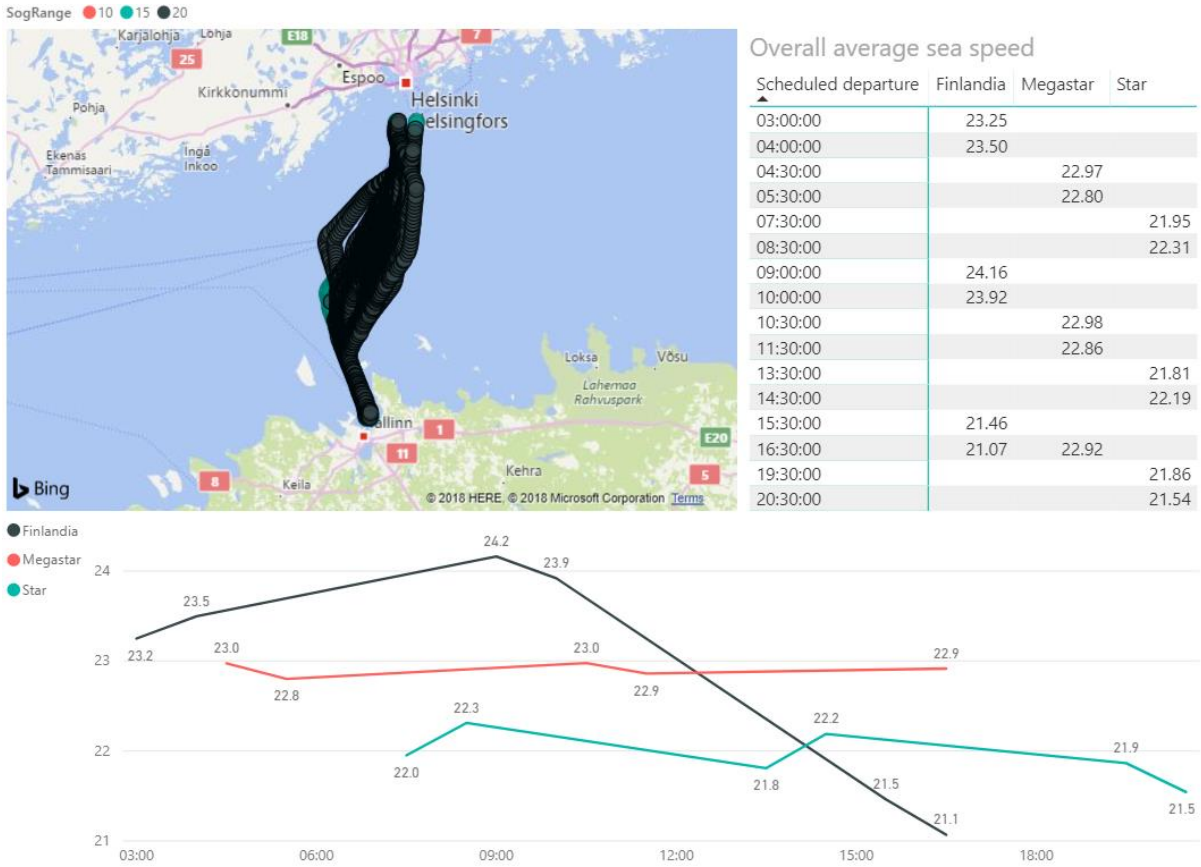


Figure 6 - Average sea speed per scheduled departure

Our ambition is to capture this difference and apply it to the API's ETA predictions.

5.8 Other findings

Below we present some general findings about the ferry traffic.

Schedule accuracy:

The ferry tracking shows a remarkable schedule accuracy for the ferries on this route and we can state that the ferry service has a very high reliability from the Customer point-of-view even in cases where the ship would have an initial delay in terms of a late departure.

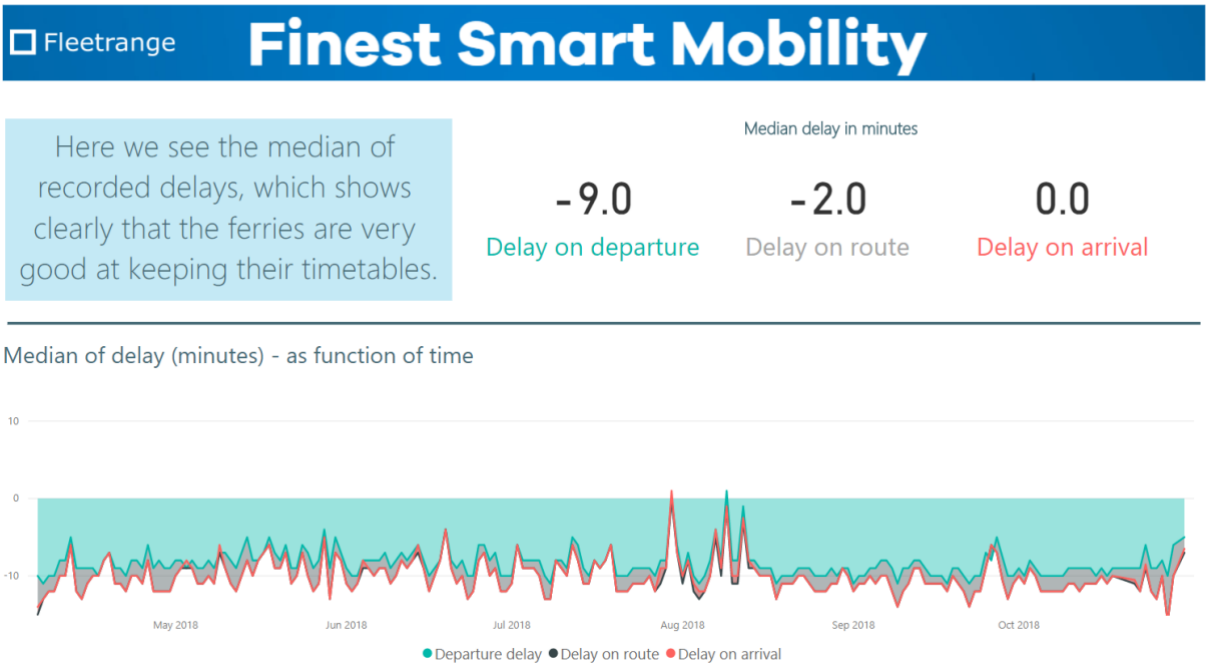


Figure 7 - median schedule accuracy

5.9 Ferry routes between Helsinki and Tallinn

The ships have slightly different routes over the Gulf. Finlandia vessel seems to be the only ferry, which occasionally takes the Harmaja route (the reason is probably to maintain the pilot certificates for this alternative route).

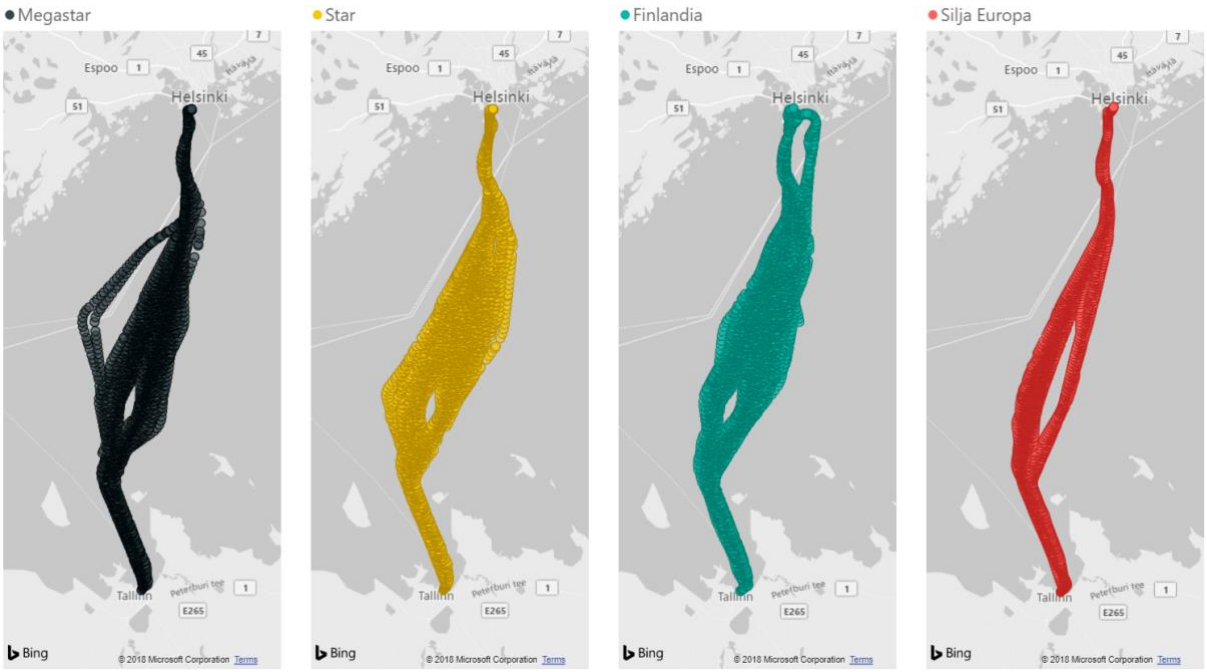


Figure 8 - ships' routes

6. Scalability

FESM API service is possible to scale across the globe and different ports. The challenge is that the service it is not directly scalable. Every port and ship line must be entered and timed into the code separately. This requires a great deal of coding and continuous monitoring of possible timetables, the berths of vessels on the route and, for example, docking. At the same time, even the FESM API requires continuous monitoring and development work. The clearer the routes of the ships are, the easier the development of the service becomes.

Another problem is the availability of cost-free AIS position data of the ships. In Finland, the Finnish Transport Agency distributes free AIS position information from ships but this is not a standard in the rest of the world. If port cities want to build intelligent ports and thus promote the flow of traffic, they should definitely invest in this kind of real-time FESM API service.

7. Service continuity

Further maintenance of FESM API service is highly recommended. The API service and the information that has been developed are very important when combining different traffic and service modes. From the traffic flow point of view, it is very important to all developers to have access to information about the actual arrival and departure times of ferries. FESM API will be maintained until the end of 2019.

8. Communication

We used broadly the media of social media in the project. We received hundreds of viewers for our news. We believe that because of our news coverage, the project received much more visibility and awareness. Below is copies of our LinkedIn and Twitter postings.

LinkedIn 03/2018
https://www.linkedin.com/feed/update/urn:li:activity:6375376103451824129

Our Fleetrange API has been selected for the Helsinki<>Tallinn **hashtag#FinEstSmartMobility** pilot project, where we will create sustainable intelligent transport solutions and be part of cooperative mobility planning to solve cross-border mobility dilemmas.

Our **hashtag#SmartMobility** solution will consist of a real-time ferry scheduling and tracking API built on the best of our Fleetrange IoT technology. This API will fill in the currently existing gap in easy to use M2M (Machine-to-Machine) data for the sea voyage between Helsinki and Tallinn. Application providers will now be able to create more complete transport chain solutions for all transport modes in the Tallinn and Helsinki transportation systems. **https://lnkd.in/g2A2wVG**

EUROPEAN UNION
European Regional Development Fund
Interreg
Central Baltic
FINEST SMART MOBILITY

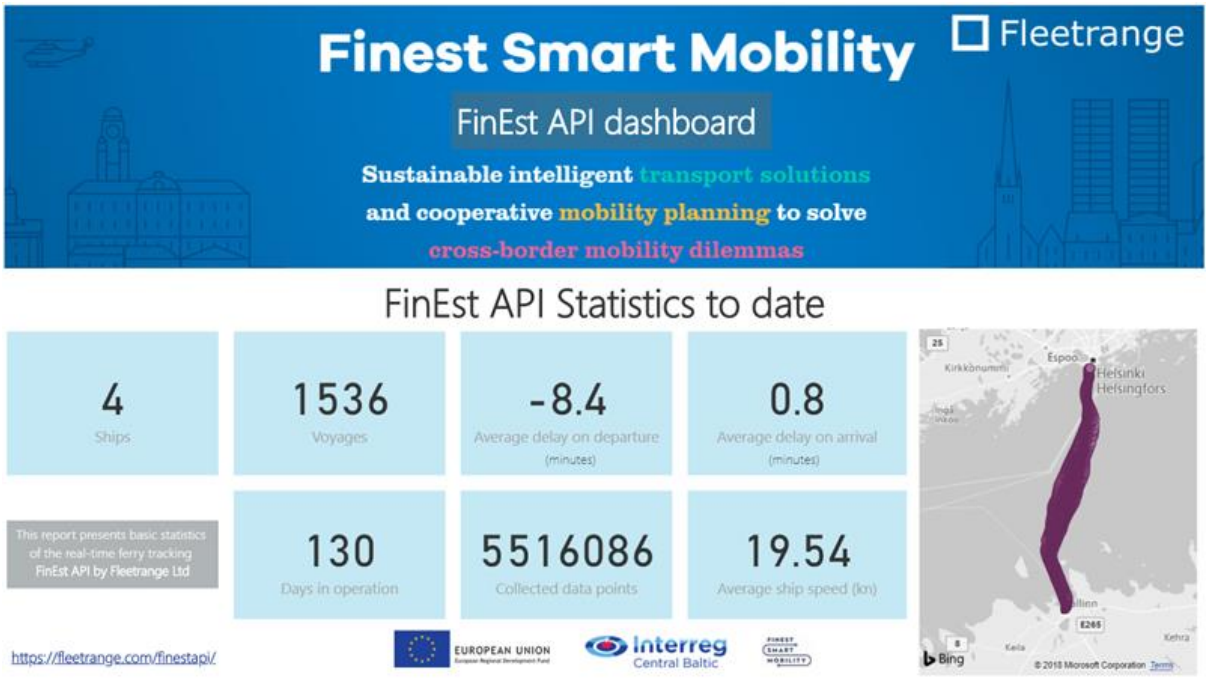
LinkedIn 08/2018
https://www.linkedin.com/feed/update/urn:li:activity:6435375117051666432

We have collected around 6 million data points during 130 days of operation. We have tracked successfully 1536 voyages. We are improving traffic flows between Helsinki West Harbor and Tallinn Old Harbor.

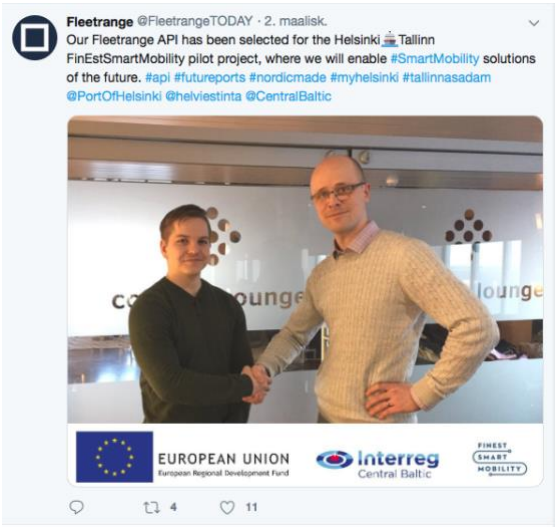
FinEst Smart Mobility project gives you programmatic access to the ferry schedules and real-time monitoring of ferry locations and schedule accuracy. The API is designed to be used by SmartMobility solutions and also offers a way to study the statistical data of the ferry traffic between Helsinki West Harbour and Tallinn Old City Harbour.

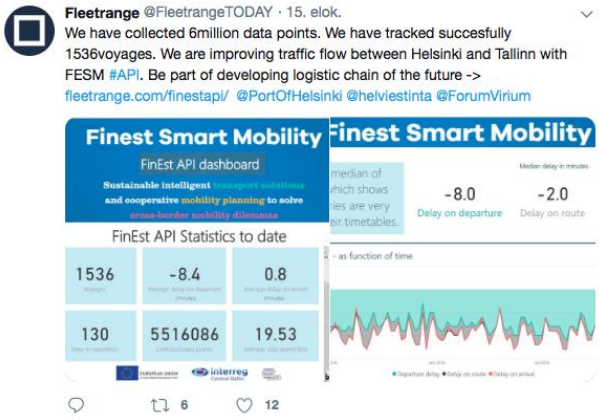
The API uses fully and freely accessible public Open Data. Be part of developing logistic chain and solutions of the future. You can find our FinEst Smart Mobility **hashtag#API** HERE -> **https://lnkd.in/dyvebvT**

Also if you are interested in developing future API for your City Harbor or for your Ferry lines - please contact us.



Twitter posts:





9. Conclusion

The purpose of the FESM API project was to get real-time information about ferry movements between the ports of Helsinki and Tallinn. The developers have a very solid experience of previous ship based spatial projects that were very helpful in development this work. The scope of the code project was much greater than originally estimated. Changing timetables for ferries and managing and processing millions of data points requires a great deal of insight. Nonetheless, everything was completed according to the schedule.

We believe that through this project City of Helsinki and Tallinn has better understood what and how to develop information to achieve this 5-10%/20 minutes goal to speeded up vehicle transportation in the city per truck. In the future, it is possible to improve the fluency of travel if, for example, traffic lights use the information provided by the API service.

FESM API real time info will help create a safer, greener, more easily flowing traffic for all forms of transportation. Even the attractiveness of non motorised transportation is increased when other forms of traffic run smoothly.

Many cities have developed residential areas around ports. Smart traffic makes neighbor hoods around ports safer and more pleasant places to live and spend time in. FESM API data may also enable the cities to utilize it in their real-time public transport control and even traffic light control systems (when/where available) and through these they can improve the overall traffic flow both in and out of the harbors. With better traffic AQ and noise did not impact so much our wellbeing.

Better knowledge on ferry arrival and departure enables, among other things, better traffic flow to and from port. This benefits citizens, passengers, logistic providers and the environment. The ferry traffic API data is a minimum requirement for smart traffic and logistics solution developers to build working solutions.

API service scaling is possible even in the most important ports of the world, but each port and ferry line requires a lot of development work and the service itself also requires continuous monitoring and maintenance. FESM API service has brought in a whole new way to see real-time ferry traffic between Helsinki and Tallinn. Now it is possible to get the same information about the ferries as well as trams and their movements. We also believe that it is important to include ferries into digital journey planners and smart city open interfaces.

In Espoo 22.11.2018

With best regards,

Teemu Leppälä
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