Newsletter no. 2

By Dr Alice Bullas - Newsletter Editor

Established in 2016, SETA is an EU funded project that studies, develops and creates technologies and methodologies to change the way mobility is organised, monitored and planned in large metropolitan areas. The solutions are based on large, complex dynamic data from hundreds of thousands of citizens, thousands of connected cars, thousands of city sensors and hundreds of distributed databases.

Since the last newsletter the consortium has met on multiple occasions across Europe. The latest meeting being held in Krakow, Poland, in June 2018. The meetings allow the consortium to gather together to discuss the projects progress. As well as allowing the members to visit the beautiful city of Krakow and taste the delights of pierogi (Polish Dumplings). We hope the next meeting in Milan, Italy, on 10, 12 and 12 December 2019 - to be equally successful.

As we approach the final phase of the project, this newsletter reviews some of the progress made by the consortium so far.

Figure 1. Krakow

Work package 1

Smart Mobility in three diverse metropolitan areas

By Work package 1 Coordinator - Sonia Floris

SETA is founded on real world requirements and data, thus it has implemented cases study cities: Birmingham, UK; Turin, Italy and Santander, Spain. The three areas are complementary as they provide different social and technical challenges, as well as different mobility objectives. They are regarded as extreme congestion locations, with two of them ranked within the most extreme of congestion locations across all of the EU cities. This newsletter update will outline the progress in Birmingham, UK and Turin, Italy.

Birmingham, UK. (D1.1).

The SETA project assists the city of Birmingham to face transport issues, such as the significant rise in traffic and increasing congestion - more intense and for longer.

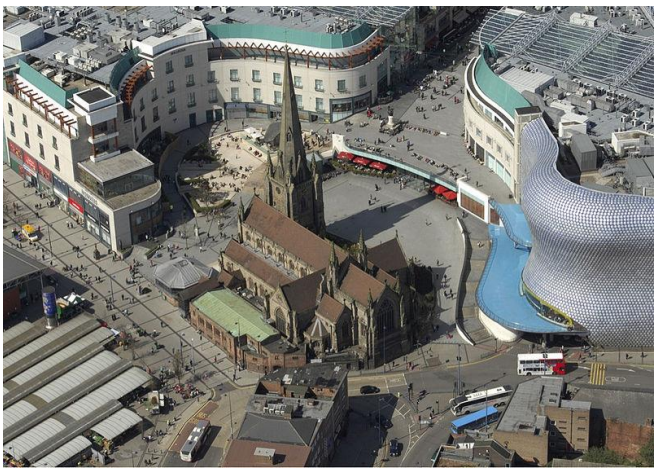


Figure 2. Birmingham City.

Birmingham has adopted the SETA technology to support planning their mobility. A critical success of the project has been the adoption of the SETA tracking technology to track the thousands of free bikes that the City Council gives to people in need. The SETA mobile technology replaces an existing GPS technology with a potential cost of around ½ million a year for the City Council.

Over the final phase of the project, Birmingham city council will aim to:

- Continue roll out of the Big Birmingham Bikes give way – possible expansion of scheme subject to funding approvals.
- Use the intelligence gained from Big Birmingham Bikes to inform Birmingham City Council about the behaviours and attitudes of cyclists and users
- Increase understanding of journeys in/ out of city centre
- Continue to re model city transport modes through various scenarios
- Plan new bus and cycling lanes using the data provided by SETA

Turin, Italy (D1.2).

The City of Turin has collected data from mobile phones cells, floating cars, traffic cameras and sensors that give the position and the availability of public transports in real time. All data is shared with the project stakeholders.

Figure 3. Turin City.

AizoOn has developed a Logistic technology for parking bays within the city; drivers communicate via mobile phone which bay they are occupying and for how long, allowing other drivers to appropriately plan their journeys based on bays booking and availability. The technology is being released across the city to the commercial users of the inner city.

Over the next few months Turin will continue to promote and develop the SETA technologies and to share the data collected.

Santander, Spain (D1.3).

Seta App for Schools - Living Lab Strategy

The City of Santander has carried out a gambling experience following Santander Living Lab's strategy in line with the strategy of Santander as an integral Smart City and favouring an open innovation ecosystem

From the citizen's perspective, the aim of this initiative is to foster non-motorized mobility in the city, making users aware of how they move in their daily activities and encourage the change to a healthier mode of transport.

From the technical perspective the target is to test SETA tracking technology in order to obtain citizens' OD matrix in Santander to assess mobility policies for the "Home to School" based trips (i.e. "walking bus", "kiss and ride" infrastructure, special public transport services…).

WP5 has developed the APP SETA for schools using tracking technology that records the activity of each user anonymously, reporting the daily minutes of walking/running/cycling or any motorized activity, (BUS/car or train) using an app able to access a mobile phone's sensors.

SETA proposes a challenge to the citizens and visitors of Santander, with the aim of involving as many users as possible in the initiative.

To participate, citizens have to download the APP SETA for schools, select Santander and select one of the participating schools and donate their daily activity minutes to the chosen school during the four weeks of the challenge.

The total number of students in the 15 schools participating amounts to 7,131 and represents 49% of the total number of primary students in Santander.

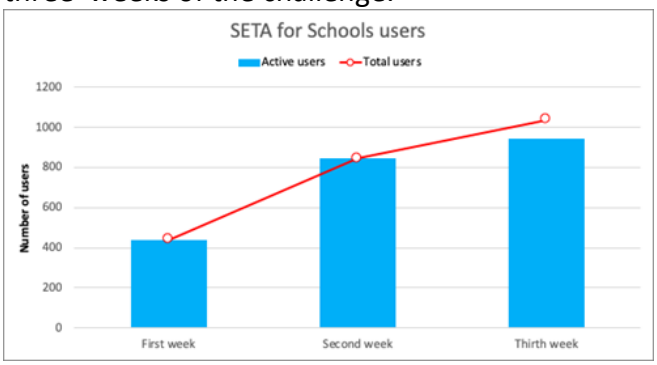
Location map of the 15 participating schools

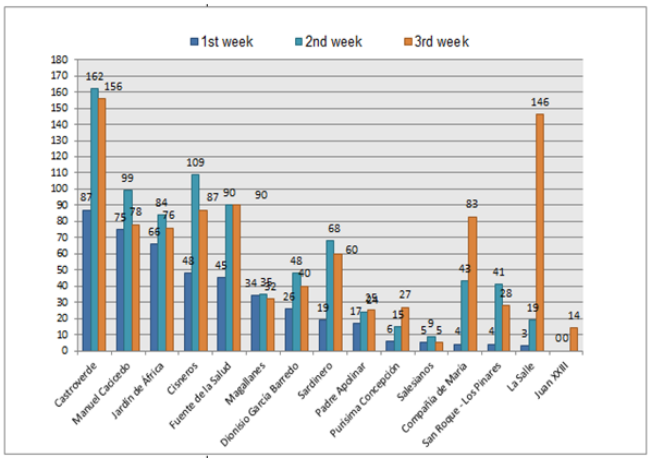
The challenge has been carried out over 4 full weeks Monday to Sunday, from 7 January 2019 to 4 February 2019. In order to avoid the lack of school participation due to the Christmas holiday period, it was decided to start the challenge on the first day back from the Christmas holidays, although previously in the month of December we worked with schools to start spreading the initiative prior to the school holidays that lasted from 21/12/2018 to 7/01/2019.

The month of January, thanks to the beginning of the year and the "New year resolutions", is an appropriate month to promote healthy mobility among citizens.

The number of users who have downloaded the APP has been growing throughout the weeks of the challenge.

The following graph shows the evolution of active users by school at the end of the first, second and third week of the challenge, achieving of 439, 846 and 947 active users respectively with a maximum of 1,040 active users throughout the three weeks of the challenge.





Feedback collected by the schools as well as the good reception of the initiative, makes us include the schools actively in the innovative ecosystem of the city and that we can work with them in other pilots in the city in projects that are currently underway as for example EMPOWER related to energy efficiency in buildings.

Santander has carried out since 2009 several pilots in the city involving different sectors of citizens, traders, people with disabilities, waste managers, travellers, tourists and so on in the framework of different European innovation projects. Based on these experiences, we can affirm that the number of users who have participated in SETA for schools is greater than expected and we consider the initiative as a success.

Work package 2

Pervasive social and physical sensing for smart mobility

By Work package 2 Coordinator - Professor Fabio Ciravegna

SETA has developed, implemented and deployed a number of low cost environmental sensors and sensing technologies. In particular we have been focussing on passive (WiFi/Bluetooth monitoring and video image analysis to determine public transport occupancy), opportunistic (social media monitoring of traffic incidents) and participatory (mobile activity monitoring and citizen reporting app) sensing. Technology has been tested both in the lab and with real users in the three cities.

Among these, the technology for monitoring and tracking active mobility (walking, cycling, etc.) has been released to hundreds of thousands of users in England. A body of the National Health System has adopted the technology for a major program of promotion of physical activity, which has been publicised with television advertising, live programs involving TV stars, etc. Investment in this process has been in terms of millions of Euros.

The technology for tracking active mobility has also been released to support the Birmingham program of free bikes.

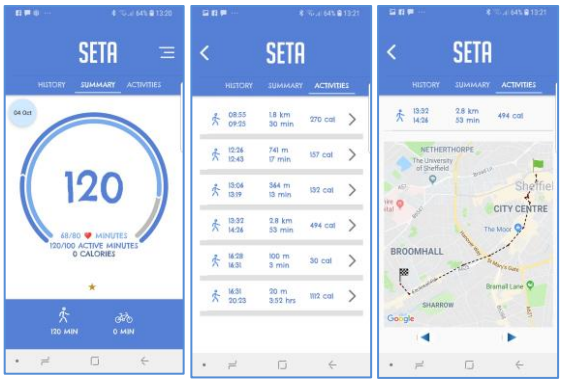


Figure 4. SETA App

Recent Publications:

- Fabio Ciravegna; Jerry Gao; Chris Ingram; Neil Ireson; Vita Lanfranchi; Humasak Simanjuntak: Mapping Mobility to Support Crisis Management In: Proceedings of the 15th ISCRAM Conference. 15th Annual Conference for Information Systems for Crisis Response and Management, 20-23 May 2018, Rochester NY, USA

As for motorised mobility, SETA has continued developing technologies that are now able to provide precise origin destination matrices and routes using data from hundreds of thousands of cars, which in turn enable modelling traffic at very high level of precision

Figure 5. FLOOW data maps

Work package 3

Data Fusion Methods in High Dimensional Mobility Systems

By Work package 3 Coordinator - Dr Mihaylova Lyudmila

Work package 3 has developed efficient approaches for traffic flow prediction. The main focus is on the case study of Santander. Compared to the mainstream solutions proposed, one novelty of the developed method lies in that the spatial structure, also known as directed graph deduced from the road network, is taken into consideration. Figure 6 shows the road network of Santander city with red lines indicate one-way roads and two directional roads otherwise. The road network is then partitioned into road segments. The standards to partition can be flexible, among which segment the road network according to the junctions is quite intuitive.

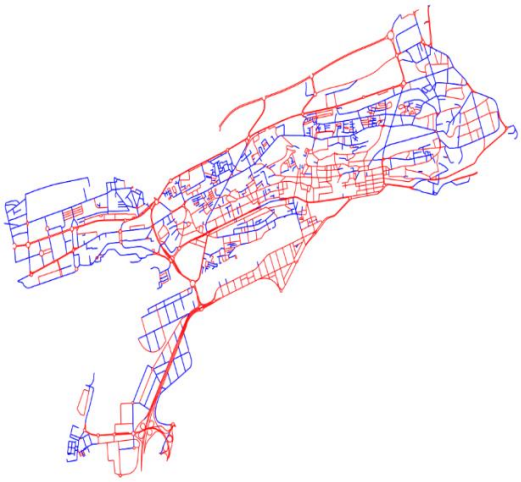


Figure 6. Road network of Santander.

With a segmented road network and the direction information of the road in hand, the directed graph is built as shown in Figure 7a. For clarity, only 300 nodes are considered. Based on the directed connection graph, a dissimilarity matrix is computed as shown in Figure 7b.

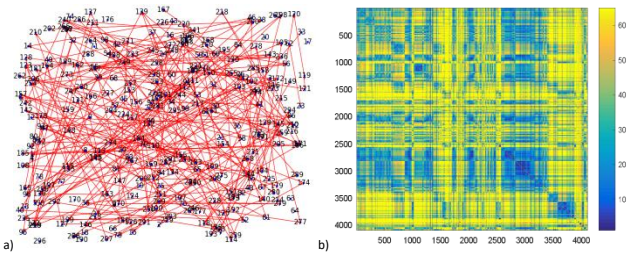


Figure 7. a) Directed graph b) The dissimilarity matrix

One basic explanation of the dissimilarity matrix is that the more significant the difference between road segments A and B, the less possible that vehicles would transfer from A to B. The matrix will be fed to the machine learning methods like Gaussian Processes and Deep learning, with high possibilities to improve the prediction performance of the machine learning models. The prediction results will be communicated to a server, for traffic monitoring and congestion avoidance. The developed approaches are able to fuse data from large-scale traffic networks and also provide real time estimates of the traffic flows. Work has focused also on detection, recognition and monitoring of the traffic flow at

microscopic level and counting vehicles, registering their speed and tracking (Figure 8a and 8b). The developed algorithms include capsule networks for recognition and Gaussian process filters for tracking objects with non- regular shapes (Figure 8b).

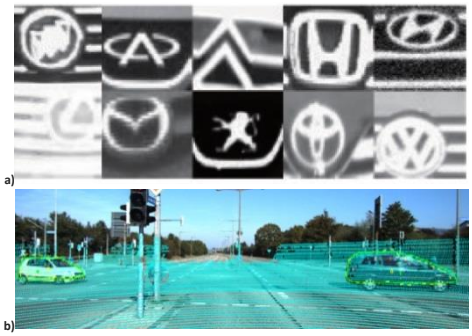


Figure 8. a) Vehicle logo recognition from noisy images,
b) Traffic monitoring, vehicles counting and speed registration

For more details, please refer to the publications that have resulted from this work:

- K. Offor, M. Hawes, L. Mihaylova Short Term Traffic Flow Prediction with Particle Methods in the Presence of Sparse Data, *Proceedings of the 21st IEEE International Conference on Information Fusion*, July 10-13, 2018.
- W. Aftab, A. de Freitas, M. Arvaneh, L. Mihaylova, A Gaussian Process Convolution Particle Filter for Multiple Extended Objects Tracking with Non-Regular Shapes, *Proceedings of the 21st IEEE International Conference on Information Fusion*, July 10-13, 2018.

Work package 5

Large scale Visual Analytics and Decision Making for Mobility in Metropolitan Areas

By Work package 5 Coordinator - Dr Neil Ireson

Within SETA the work on visual analytics and decision making for mobility has resulted in the development of a number of both specific and generic technologies and tools. These include:

- A multi-objective routing engine, which allows users to optimise their route selection depending on their specific criteria, e.g. distance, speed, pollution, risk, etc.
- Graph Visualizations based on traffic prediction: both TSS (traffic model approach) and Delft (data driven approach) are visualize in order to support decision makers.
- Mobile applications, in conjunction with WP2, have been developed to both capture and report citizen's mobility. Users can visualise their mobility data and the developed technology allows the setting and rewards for goals (e.g. periods of vigorous active mobility) which facilitates positive behavioural change.
- A large scale GIS framework which provides visual analytics on data from the SETA mobile tracking app. The technology allows interactive analytics with data provided by thousands of users. Data analytics are used to clean the raw data, calculate common origin-destination points and likely journey routing and visual analytics provides visualisations able to handle large scale data (e.g. heat maps which can display >billion locations) and faceted interaction allowing analysts and decision makers to identify areas of interest and visualise other regions connected with the identified area.

The evaluation of these technologies was carried out through a Simulation Exercise in Santander, under the coordination of The University of Sheffield and of Santander City Council and The University of Cantabria (local organisers and project partners) and a set of the short-term evaluations carried out to understand the technical viability and the users satisfaction of the technologies before their release to a wider

audience. Further evaluation of the decision makers' interfaces was conducted in Birmingham, with members of city council. The interfaces for the load / unload bays and the routing engine were also evaluated in the city of Turin.

Work package 6

Management of large scale data for large scale pervasive smart mobility

By Work package 6 Coordinator - Marcin Sieprawski

Work package 6 prepares the final version of Software Mind SETA Data Management Platform, with advanced prototyping, defining of business-ready platform, continuing privacy by design approach as well as further work on scalability, high availability, performance and use of cloud resources.

In the last period much of work package 6 has focused on new microservice architecture for integration with SETA app and developing SETA app scalability as well as preparing the Platform for final evaluation. This resulted in the preparation of a business-ready version of Software Mind SETA Platform - a cloud-based smart mobility data management software and hardware infrastructure supporting and integrating technologies for organising, monitoring and planning mobility in large metropolitan areas. It provides scalability and high availability to solutions which need to be based on data from millions of citizens, thousands of connected cars, thousands of city sensors and hundreds of distributed databases.
It is a state of the art solution for the management of geo-located data and low-latency services, including GPU-based acceleration of geospatial indexes, offering:

- Specialised API, architecture and infrastructure to support low-latency, scalable management, analysis and development of multimodal mobility with smooth and scalable collection, indexing, manipulation and sharing of heterogeneous, multimodal, dynamic mobility data.
- Flexible integration: the platform can be integrated and extended in line with a well-defined agile software development process and technical procedures, enabling rapid development, prototype evaluation and effective testing, maintenance and integration of external components.
- Privacy by Design and GDPR compliance
- Large scale sensor data collection and integration
- User tracking, social sensors and citizen observatories at huge scale.
- Scalable backend for mobile applications
- GPU cloud computing: employing GPUs for accelerating spatio-temporal queries and indexing, as well as other CPU-intensive operations.

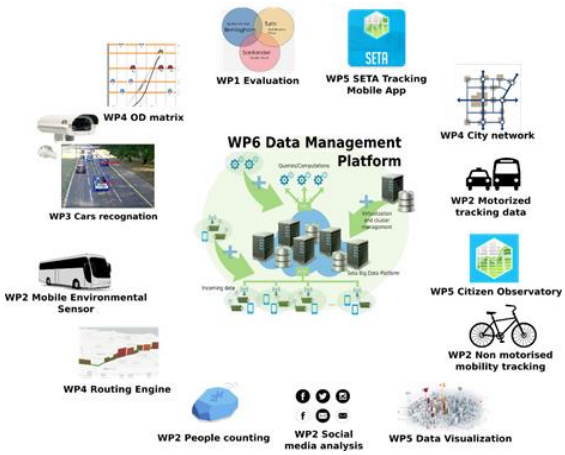


Figure 9: SETA data management platform.

The Software Mind SETA Platform provides effective integration of all SETA modules, prepared to scale to handle increasing number of users, data streams and queries. As integration experts, Ailleron will cooperate with other project partners in joint ventures, strengthening the joint

SETA Project offer by world class integration, DevOps and agile development services. Depending on actual needs, peaks of the data as well as higher demand on computation power, the architecture enables platform to be extended with additional resources, which makes it scalable and ready for big data challenges. The customers of the joint offer can instantly gain high availability and scalability (e.g. scaling mobile apps with millions of users), as well as support, maintenance and services including (depending on customer's requirements) storage administration, cloud resource management, Infrastructure as a service and GDPR compliance. Integration of those solutions with the SETA Platform will allow elastic processing of peak requests, meeting quality of service without requiring up-front investment for server infrastructure.

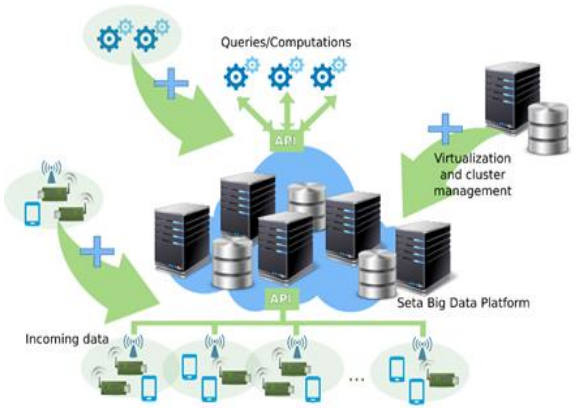


Figure 10: SETA API structure.

In next period WP6 will focus on scalability tests, ensuring stability and high availability of the Platform and supporting final evaluation.

Work package 7

Dissemination and exploitation

By Work package 7 Coordinator - Sonia Floris

To ensure effective dissemination of the results of the SETA project, the following tasks will be undertaken up until its completion:

- To support a Living Lab approach during user requirements and goal definition and to define ways to involve the citizens in adopting the SETA apps;
- To maintain multi-channel dissemination & communication;
- To maintain the SETA Web & Social involvement;
- To organise dedicated hackathons to involve the community in developing their own services;
- To monitor SETA take-up via dedicated KPIs.

Contact details

If you would like more information about the SETA project please see our website and Twitter for more information.