Welcome to Bus-elona

Cristina Pou introduces the new interurban, high service level bus network in Catalonia

The bus networks with high levels of service (BHLS) around Europe are mainly characterized by high frequency vehicles using modern, sustainable and accessible vehicles, with (at the very least) real-time information in stops, separated bus lanes and high demand.

In the case of Catalonia, a new interurban bus network called 'exprés.cat' has been implemented since October 2012 in order to respond to the large increase in demand (57 per cent) over the past 10 years.

The interurban bus network of Catalonia is integrated by more than 700 lines with 53.1 million trips per year. The new 'exprés.cat' network is integrated by those 40 lines that represent 40 per cent of the demand, with an average occupancy of 30 passengers per expedition.

The project represents a firm commitment of the Government to promote interurban buses as an efficient and competitive mode of transport to connect the main areas of Catalonia, where there is an increased demand for mobility – quickly, sustainably and economically.

The implementation of the network will be progressive. It began in October 2012 with the first four new lines that connect four different cities with Barcelona. Moreover, these lines run through the HOV-BUS lane with a length of 6.8 km and are located in one of the most congested highways with access to Barcelona (the C-58). This new HOV-BUS lane saw an investment of €80m.

At this time 15 express bus lines have already been implemented: 11 in Barcelona, three in Tarragona and one each in Girona and Lleida.

The 44 'exprés.cat' branded buses aid rapid identification for the user

MAIN CHARACTERISTICS OF 'EXPRÉS.CAT'

- High frequency in peak hours and new direct bus services.
- High and competitive commercial speed: use of HOV-BUS lanes, priority in traffic intersections, etc.
- Real time information to the user: bus stops with dynamic information panels updated in real time as well as information inside the vehicle. Currently, there are 47 real-time information panels installed within bus stops.
- These lines are part of the integrated fare system.
- More intermodality with other modes of transport.
- 100 per cent accessible vehicles for disabled people.
- More sustainable and comfortable vehicles: use of biodiesel and wifi inside the buses.
- New image: the new bus express network will be integrated under a new corporate image, 'exprés.cat', which brings visibility to the user and facilitate their rapid identification. Today 44 vehicles include the new brand.

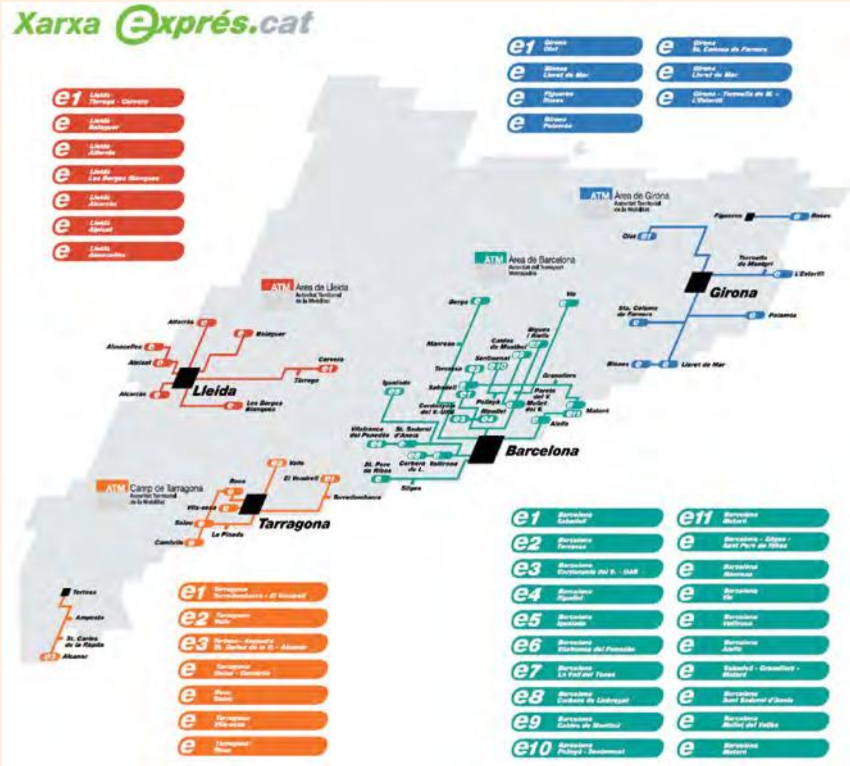
To date, 47 real-time information panels have been installed within bus stops

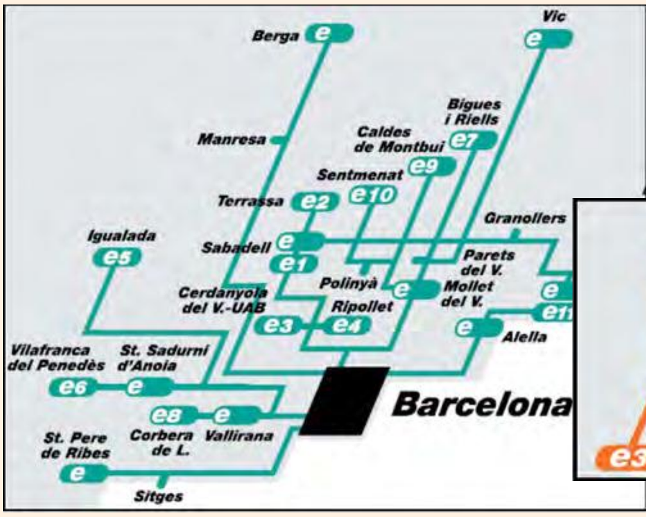
– Public-private financing. The financing implementation of this network will involve public-private participation, which will be jointly undertaken by public transport operators (private companies) providing service in these corridors and the Government. Specifically, the new vehicles will be funded by the operators (66 per cent) and the Government (33 per cent), while the production and implementation of the new image will be assumed by operators, with the real-time information equipment assumed by the Government.

'EXPRÉS.CAT' NETWORK: 40 LINES AROUND CATALONIA

The 'exprés.cat' network is integrated into 40 interurban bus lines which represent 40 per cent of demand and connect different sized cities with the four main cities of Catalonia: Barcelona (19 lines), Girona (seven lines), Tarragona (seven lines) and Lleida (seven lines).

The first 16 lines (the lines with a number in the above graphic have been implemented).





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EVALUATION OF THE NETWORK

The evaluation of the network has been very positive after almost two and a half years. All the lines are seeing an increase in the number of passengers. For example, line e3 Barcelona – Cerdanyola – UAB has increased by 14 per cent, line e4 Barcelona – Ripollet increased by 29 per cent and line e6 Barcelona – Vilafranca increased by 4 per cent in all the corridors. These lines are also very appreciated by the users, receiving an average of more than 8 out of 10 points in the satisfaction surveys. For example, e4 received an evaluation of 9.1m while e1 and e2 received a score of 8.5.

The new normal

In 2015 real-time traffic management requires demand modelling, say **Johannes Schlaich, Thomas Otterstätter** and **Sonja Koesling**

Around 50 per cent of all Germans have a smartphone[1]. Three quarters of those access Internet content on the go and 50 per cent use apps for different aspects of day-to-day life: and these numbers are rising. Transport-related applications are in the top five of the most-used apps[2]. This includes the latest traffic information, navigation and route planning tools and timetable information. The current availability of real-time data is increasing people's expectations. "Real-time" is no longer just a buzzword but is part of the here and now, and modern traffic management can no longer shy away from it. But how can data streams be processed smartly, what are the limits to big data and how can demand modelling fill this gaping void?

Worldwide, 2.5 exabytes (or 2.5 billion billion bytes) of electronic data are produced per day. It is hard to imagine, but entirely true, that 90 per cent of all electronic data has been produced in the past two years[3]. And this statement will remain true in the future as the numbers of data sources and the volumes of information they generate are set to grow exponentially. Data on mobility behaviour make up a portion of this: With each piece of information on timetables and each route planning query, travellers disclose information on their mobility behaviour and contribute to the rise in data volume. And yet today this information is still often not available to transport managers. Their real-time information is fed from data from detectors, floating car data (FCD), automatic number plate recognition systems (ANPR) and accident- and road works reports. This is how they obtain an overview of the current traffic situation of the observed area and can react to regular disruptions thanks to their many years of experience (see image 1).

STATISTICAL VERSUS MODEL-BASED

Thanks to traffic forecasts, the transport manager is getting more and more room for manoeuvre for choosing the best measure to take. Today there are two main distinct approaches in traffic forecasting: the statistical and the model-based approach[4] (see image 2). The statistical approach uses interpolation, interference, data collection, artificial intelligence and mathematical models to compare observed time periods with historical patterns. The traffic flow and speed variables are analysed and predicted without explaining and reproducing the underlying phenomena, i.e. the interaction between the vehicles and the driver behaviour. Statistical

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techniques are suited to projecting low-volatility traffic measures or recurring traffic patterns. They come up against their natural limits, however, if there is not enough historical data from sufficiently similar situations. This happens in particular with unusual situations, when accidents occur or road works are set up.

If someone wishes to react to these situations in real-time, model-based approaches can be used for the forecasting. In contrast to statistical processes, the model-based simulation approach relies on a physical interpretation of the traffic network and conditions. This is added to the supply through an explicit simulation of the interplay between travel demand and the transport network. Model-based solutions such as PTV Optima, which can output dynamic forecasts for a time horizon of up to 60 minutes, combine for proven off-line traffic modelling with real-time data and algorithms.

On this basis, a traffic model created in the traffic planning software PTV Visum, for example, shows the "typical" day (e.g. workdays or weekends) in the transport area under consideration. The transport supply and demand are then represented in the form of demand matrices. Dynamic traffic assignments calculate the time-dependent volumes and turn proportions on the network from the travel demand[5,6,7,8] (see image 3). PTV Visum passes all this information on to PTV Optima.

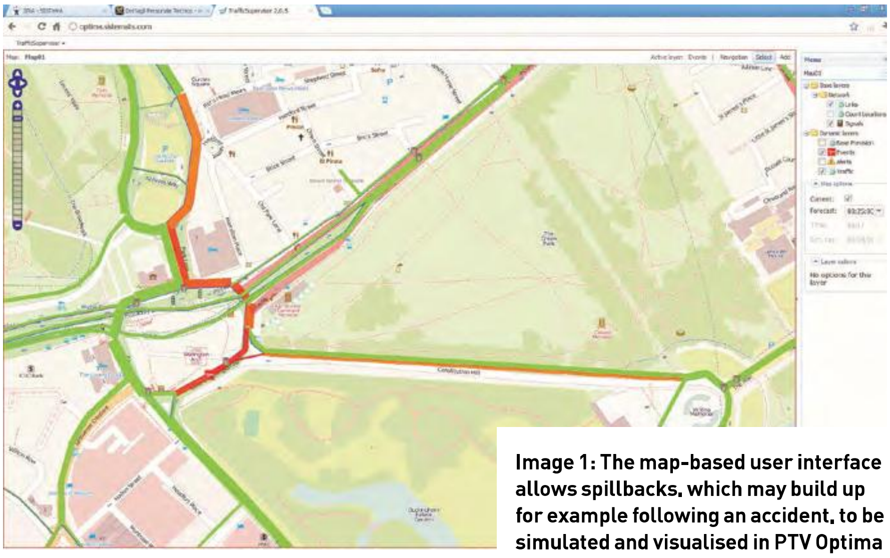

Image 1: The map-based user interface allows spillbacks, which may build up for example following an accident, to be simulated and visualised in PTV Optima

Image 2: Statistical and model-based approach in direct comparison

	Observed Data	Statistical approach	Model based approach
Traffic estimation - „What is going on?"	Maybe, with extensive measures	Yes	Yes
Traffic forecast - „What is going to happen?"	No	Only „usual" conditions	Yes
Scenario evaluation &			

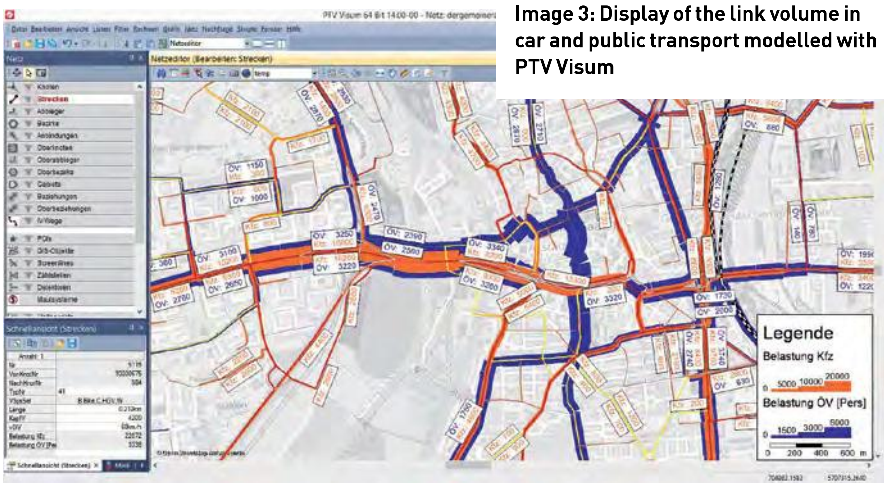

Image 3: Display of the link volume in car and public transport modelled with PTV Visum

In PTV Optima, the online data therefore comes into play. The data is used in real time in PTV Optima to adjust base model capacities, speeds or volumes from PTV Visum locally to the latest circumstances. As PTV Optima explicitly takes into account the network structure, traffic flow dynamics and travellers' route choice behaviour, it also reproduces the traffic situation for links on which no detectors have been installed (spatial distribution) and can furthermore predict the effects of planned and unexpected results (temporal distribution) and then evaluate and compare different strategic measures.

FORECASTS SOLELY BASED ON TRAVEL DEMAND

Travel demand is very often produced in the transport planning using a classic demand model. This covers the trip generation (how many routes are done for each trip purpose?), the trip distribution (what destination has been selected?) and the choice of transport (with which means of transport is the destination reached?). By modelling the decision-making behaviour in this way, the model can be made more sensitive to measures connected with typical transport planning issues[9,10]. For traffic management which emphasises private transport, on the other hand, purely empirical matrices can be used, such as those obtained with mobile data[11]. With the steady rise in the availability of real-time data, the demand matrix calculated in advance can be replaced in the long run by real-time demand from data sources which actually come about by optimising individuals' mobility (apps, navigation services, and so on). In this way, real-time data can detect not only the current traffic situation, but also the current destinations of travellers who are potentially deviating from their "typical" day. In this case too, a forecasting model is essential for predicting the traffic flow using fast assignment

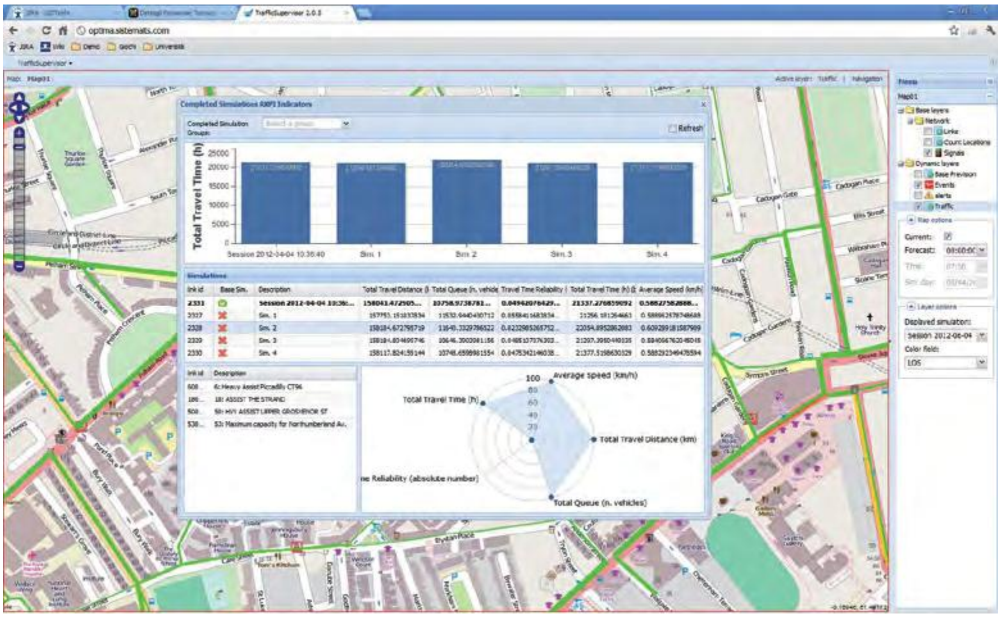

Image 4: With PTV Optima, different scenarios can be simulated in parallel and compared in real time. Parameters can be defined for this individually

procedures. These are processes that are currently used in real-time traffic management.

THINK STRATEGICALLY, DEVELOP SCENARIOS

When disturbances are modelled into the forecasts on the network, it is necessary to react and rectify the situation. Cities and regions have different objectives in this. Transport for London (TfL), for example, measures its success by the reliability of the transport network[12]. PTV Optima is flexible in its use of Key Performance Indicators (KPI) which deliver aggregated information on the overall network status in addition to the graphical feedback, and displays the basis for a decision that can be assessed quickly (see image 4). The KPIs can be adjusted flexibly and it makes no difference whether the user has set the avoidance of traffic, the minimising of travel time or the reduction of negative effects of planned or unpredictable events as the main criteria. Typical tools for reacting to this include traffic light signals, the unblocking of traffic

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lanes, variable message signs and traffic information reported on the radio and Internet.

To resolve traffic jams, these tools are often used directly "on the living object". Through their experience, experienced employees in traffic management offices can of course already now choose effective strategies. However, this way makes it impossible ever to find out whether a different strategy might not have been better. Seen from this angle, is it not better to test these and their alternatives in a virtual world? Offline, in PTV Visum for example, strategies which have been developed can be introduced to the PTV Optima online environment, assessed, compared and ranked on the basis of the current traffic situation, before they are then sent onto the streets. PTV Optima is therefore capable of calculating many combinations of strategies simultaneously within a few minutes, including for large networks. This means that the best possible strategy can be applied as soon as possible. Using this process, the transport manager builds up his wealth of experience with unforeseen circumstances, develops confidence about the different scenarios and can choose from the optimal measures recommended by PTV Optima so that the traffic on the road network returns to "normal".

Traffic jam in Tokyo

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