Real Time Transport Modelling at the City of York

James Guilliatt, City of York Council
Michael Oliver, PTV

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Traffic Signal Innovation in York

The City of York have been exploring how to exploit connected data sources and technologies to enhance its traffic management and control. As far back as 2016, when the council was awarded funding via T-TRIG, they studied together with industry partners how data from vehicles might be used to improve traffic signal performance using co-operative ITS.

The 2016 T-TRIG study concluded that there was significant potential to make use of widely available floating vehicle data (FVD) to either support offline testing and strategizing or supporting online switching of strategies or fixed time plans. The need for a real-world pilot study was identified, and this opportunity was afforded in 2017 when York was awarded DfT funding for the Eboracum project.

Eboracum involved several co-operative Intelligent Transport Systems (C-ITS) projects, including the field testing of combining FVD with the UTC system. An adapter to the current Dynniq UTC allowed for external triggering of a change to a signal strategy, and the council developed business logic which could monitor FVD and trigger a change in plan if journey times exceeded certain thresholds. This prototype FVD-UTC combination demonstrated comparable improvements in terms of journey time reduction to other mechanisms including full SCOOT, with the project concluding that since the FVD-UTC approach does not require on-street sensors, it could be a cost-effective solution going forward.

The learning from Eboracum fed into the council's vision and helped to secure DfT funding in 2018 via the National Productivity Investment Fund (NPIF) for the Smarter Travel Evolution Programme, known as STEP. The programme aims to improve the connectivity and data collection of York's transport technology assets to future-proof how the city deals with changing levels of demand.

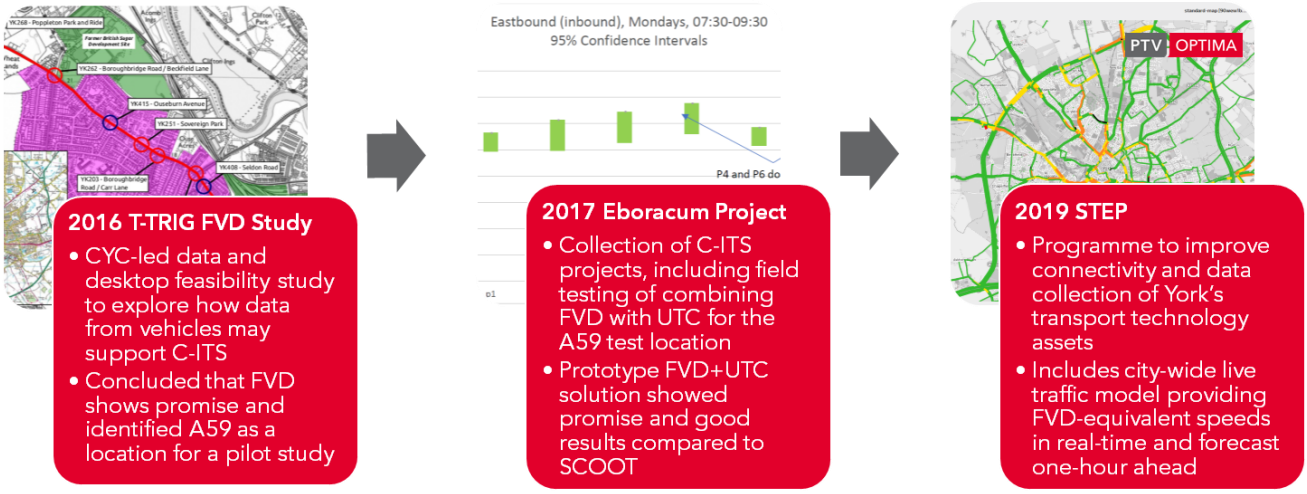

Figure 1 – The STEP Journey

STEP includes investment towards the citywide upgrade of roadside traffic sensors and traffic cameras so that they can send live traffic flow information over the internet. Bringing this data together, STEP also includes a new live citywide transport model which can underpin and support the scaling

of future innovation projects such as Eboracum, as well as provide a foundation for further innovations such as:

- Combining traffic with other policy priorities such as air quality and public transport when it comes to proactively managing traffic
- Testing scenarios based on a live model to support operational decision making
- Updating York's offline strategic and junction-level modelling which will improve the evidence base capability for future developments

In 2019, the council awarded the development and maintenance of the live citywide transport model to a consortium led by Wood Group, supported by PTV and RelativeGap. The live model is currently connected to a prototype live data platform developed by Jon Wade (White Willow Consulting) as a legacy from the Eboracum project. Development of a new data platform that will sit alongside the live model is due to be started soon.

Modelling the city and its signals in real time

PTV Optima is a platform for real-time traffic prediction. For the City of York, Optima has been implemented within a cloud environment, connected via API with the city's data platform, and pulling live FVD from TomTom. The data platform collects traffic flow information from connected traffic counters and traffic cameras across the city every minute and sends this information on to Optima for use in its predictions. The data platform also gathers information from all connected traffic signals regarding stage start times to build a picture of each cycle as it is completed. This information too is sent on to the live model.

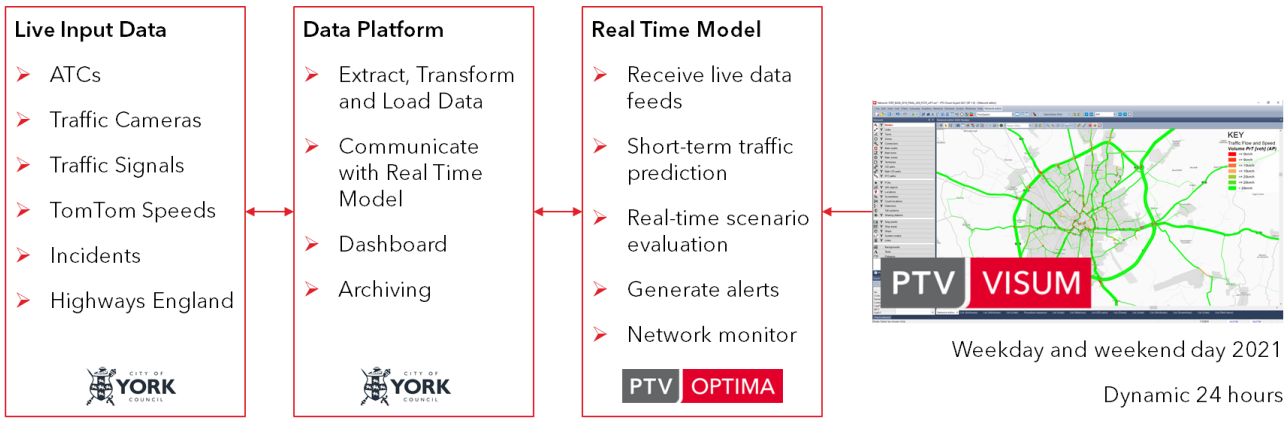

Figure 2 – PTV Optima provides real-time traffic data fusion, prediction, scenario analysis and alerts for the Data Platform and the Network Monitoring Officers

The live model works to a regular 5-minute schedule of combining all flow, speed and signal data received in the last 10 minutes, harmonising that data to smooth out volatilities, and fusing those field measurements with an underlying traffic model to produce a citywide forecast of traffic conditions from the present time to one hour ahead. This whole process takes only a couple of minutes and is repeated every five.

The underlying traffic models, developed with PTV Visum and closely linked to the city's new strategic model in that software, provide baseline traffic patterns across the city for different types of day which create a 7-day picture. The live forecast uses these traffic patterns to perform a dynamic simulation downstream of where traffic has been detected, of how traffic will interact with infrastructure and other road users. This complex calculation is performed every 5 minutes creating a rolling horizon of traffic conditions.

The model-based prediction is useful for several reasons. It provides a forecast across the entire model network which has greater coverage than FVD alone and provides flow information across the full network rather than only where flow is detected from counters or cameras. It also provides the capability to do what-if assessments using the current conditions, near-future conditions, or using the baseline model conditions.

The strategic and live transport models include a representation of signalised junctions including how lane-to-lane movements are allocated to phases, how phases are allocated to stages, and the rules regarding minimum green times and interstages. The changes to traffic signal timing plans in the live system for real-time modelling or scenario planning are made by changing the interstage start times and cycle length. Communication of this traffic signal-related information between the data platform and the live model requires unique identification of signal controllers and their interstages, and therefore new naming conventions needed to be defined.

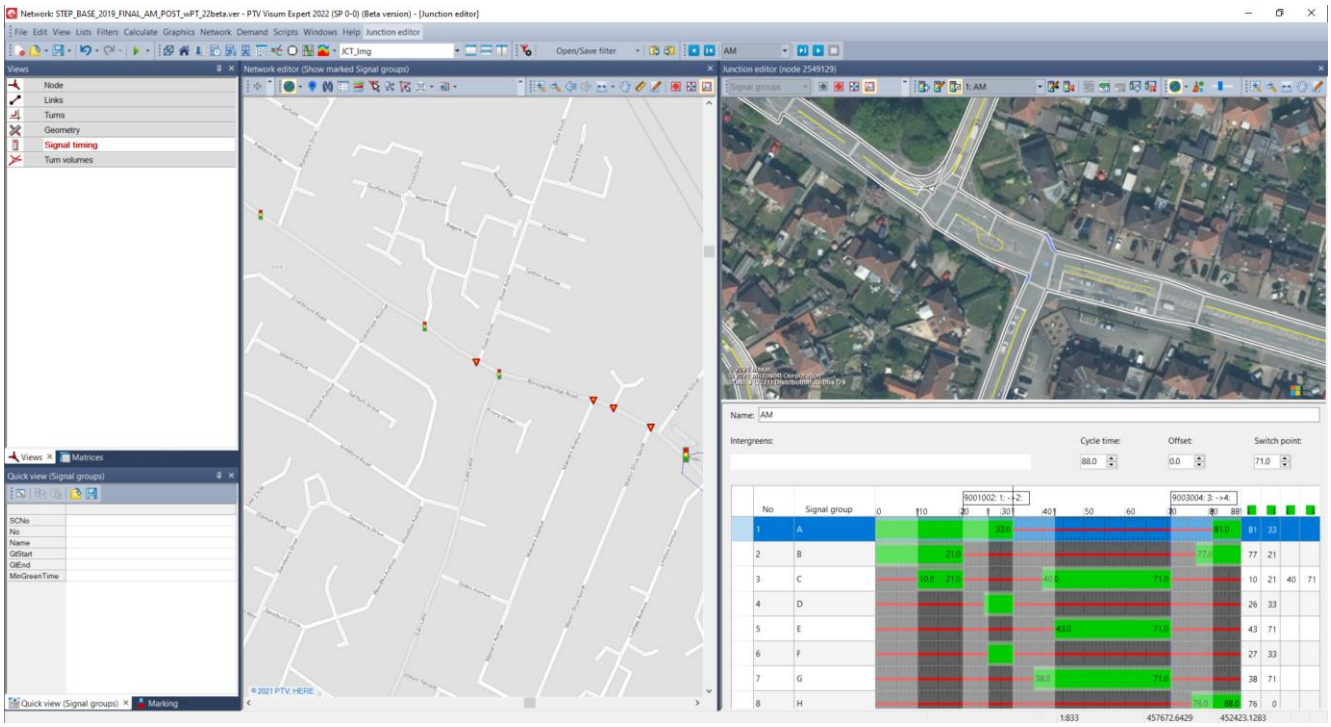

Figure 3 – Junctions and signal timings are digitally replicated within the PTV Visum and PTV Optima models to match both the LinSig models and the referencing within the Data Platform

Integrating traffic signals for the York live model was a complex task for the data platform and council. It required a high level of digitisation of signal plans and consistency between systems. In York, as for most authorities, signal timing plans are derived and modelled using specialist tools such as LinSig, and then implemented on the ground.

However, as operational and maintenance changes are made over time, original models can soon be out of date. To that end, each site had a digital monitor put on UTC to capture what was happening on the ground, compared with the latest known configuration documents, and then checked against design models. Once happy that everything held the same version of the truth, this could be shared with Optima.

A more complex task was getting live timings from each controller out to Optima. This involved some signal site reconfigurations to bring back extra UTC bits and the implementation of a Data Platform to integrate the live data to Optima.

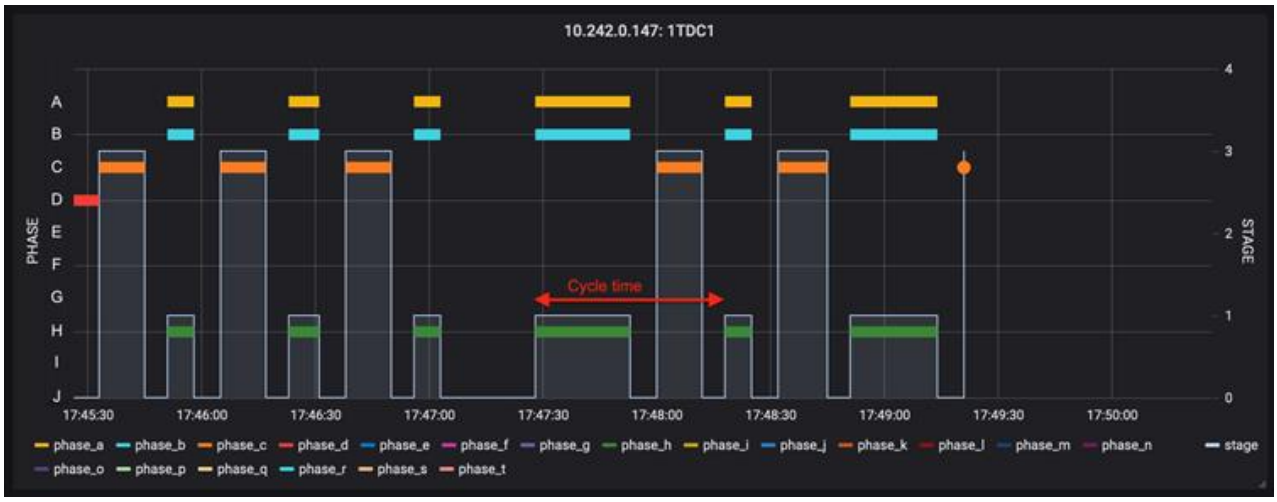

Figure 4 – Example of the live monitoring by the prototype Data Platform of signal phase, stage and cycles for each controller which is pushed to PTV Optima after each cycle and used in the live traffic forecast

With this integration in place, the city is in an exciting position to be able to explore how changes to signal plans might affect typical or live traffic conditions and use this information to inform its policy and management actions.

Proactive traffic management

The live model is an exciting tool that can form the basis for future innovations, but it is already providing benefits. The enhanced live picture of traffic conditions, available to network monitoring officers in the control room, significantly improves their visibility of traffic conditions as they evolve. Before, they would be reliant on CCTV and social media to know where congestion is occurring, but now they can be more informed and proactive in making changes.

Moving forward, since the live model is implemented with API and can raise alerts to external systems when certain KPIs (such as journey times) exceed thresholds, it is a natural basis to continue the work of Eboracum and the city's vision to use cutting edge data and technology to enhance the UTC. A project is already in the pipeline to use the live model in place of FVD to automate signal plan changes, but now with the citywide model in place, the impacts can be much more broadly assessed and can be scaled to other corridors across the city.

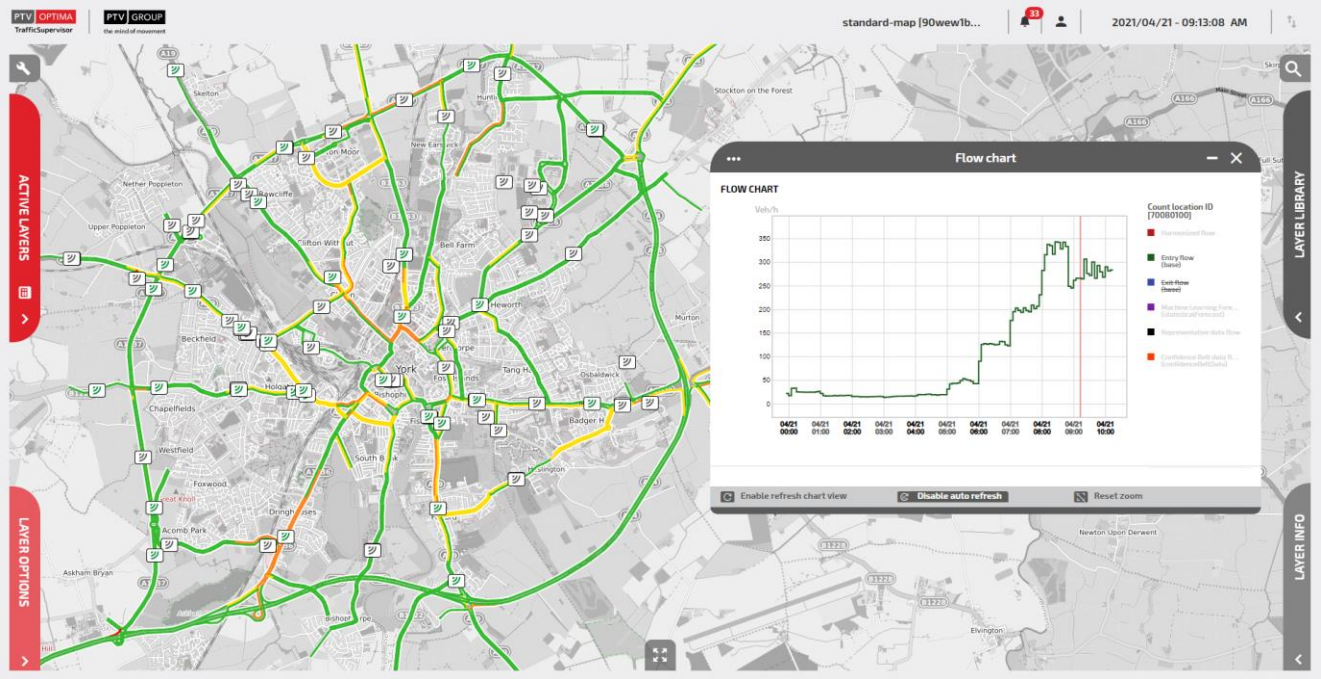

Figure 5 – PTV Optima provides the York Network Monitoring Officers with a decision support tool, offering a visual of congestion across the city in real-time and the capability to test scenarios ahead of time

There are other exciting innovations in the pipeline too, with the potential to use air quality, or live bus location data to combine with traffic indicators so that traffic management strategies and actions can be considerate of wider policy priorities. The City of York has made great strides in making its vision, started back in 2016, a reality.

PTV UK Ltd
5 Centre Court
Vine Lane
Halesowen
B63 3EB

info.uk@ptvgroup.com

ptvgroup.com