Swansea Bay and West Wales Metro – A Bus (User) Priority Story

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Introduction

This paper presents the strategic and technical development of the Swansea Bay and West Wales Metro project, with a particular focus on the implementation of bus user priority systems and intelligent traffic control technologies. Led by Swansea Council in collaboration with AECOM, the project aims to deliver a modern, integrated, and sustainable transport network across four local authorities—Swansea, Neath Port Talbot, Carmarthenshire, and Pembrokeshire. The paper explores the transition from legacy systems to advanced solutions incorporating Automatic Vehicle Location (AVL) data and AI-based detection technologies. It outlines the methodology used to assess existing infrastructure, design and deploy bus priority systems, and monitor performance through innovative tools like RTEM. The dual deployment of local detection and AVL-based systems offers a unique opportunity to evaluate their effectiveness in real-world conditions. Early results indicate improved bus journey times and reliability, supporting the broader goals of the Metro initiative to enhance public transport accessibility and help reduce environmental impact.

What is the Wales Metro?

The Transport for Wales's project is a major public transport initiative designed to enhance public transport across Wales. It represents a modern, integrated transport system that aims to enhance connectivity across the country. The Metro encompasses rail, bus, cycling, and walking infrastructure, aiming to provide faster, more frequent, and more reliable services. It also focuses on improving connections between different modes of transport and promoting greener travel options to reduce environmental impact.

The Metro is being developed through several regional projects. The South Wales Metro serves Cardiff, the Valleys, and surrounding areas. The North Wales Metro enhances connectivity across the northern part of the country, while the Swansea Bay and West Wales Metro is focused on improving transport links in the western region.

Swansea Bay and West Wales Metro

This regional project aims to create a modern, integrated, and sustainable transport network across Swansea, Neath Port Talbot, Carmarthenshire, and Pembrokeshire. Focusing on improving journeys across the region by integrating existing services and improving overall permeability across the network. At its core are plans to deliver faster, more dependable bus services and to introduce intelligent traffic signals that improve journey times and service reliability.

Among the four Local Authorities involved in the Swansea Bay and West Wales Metro, Swansea Council operations a significant proportion of the regions traffic control systems. The Council also has their own in-house signals team, bringing decades of experience in delivering major capital initiatives, as well as operating and maintaining a wide range of traffic control systems. For these reasons Swansea Council took a lead role in delivering the Swansea Bay and West Wales Metro project. Because of the scale of the project Swansea Council recognised the need for external expertise to ensure the project was a success. AECOM, having played a central role in the development of the Department for Transport's LTN 1/24 Bus User Priority guidance, was identified as the ideal partner to support the delivery of a region wide bus priority strategy that meets these modern national standards.

The Legacy System

Past versions of Bus Priority used by the region to support public transport, amongst others, included Siemens Sietag. Originally deployed in the early to 2000s, at the time, Sietag was the preferred solution for many local authorities, including Swansea, offering vehicle detection via RFID tags that communicated with traffic signal controllers to grant priority at junctions. In practice, buses equipped with Sietag transponders were detected as they approached junctions, prompting signal adjustments to reduce delays and improve service reliability, particularly on congested corridors.

However, the Sietag system has long been considered obsolete, presenting several challenges for local authorities. Maintaining the ageing infrastructure has become increasingly difficult due to the scarcity of replacement parts and the limited availability of technicians with the expertise to validate, configure, and repair such legacy systems. As a result, the systems reliability declined overtime, and the bus priority functions were progressively removed from controller configurations.

As transport networks continue to evolve, offering more flexible and data-rich solutions, there is an increasing need for modern technologies that can meet both current and future bus priority requirements. In response, the project sought innovative alternatives capable of integrating with Swansea Council's Urban Traffic Management and Control (UTMC) platform,

Methodology

The methodology used for the Swansea Bay and West Wales Metro project was based on the Department for Transport's LTN 1/24 Bus User Priority guidance document, released in March 2024.

The first stage of the works required a review of the network to understand where the biggest delays and journey time variability were occurring. This helped identify the area where the most effective improvements could be made to bus journey times and reliability.

Information of the current operation of the traffic signals was then collected, and a review of current systems and associated assets was carried out as part of the overall assessment to determine the need for additional equipment. Site visits were carried out over several days to establish if the existing equipment was operating as, it should be and noting any faulty equipment. Ensuring the current equipment was operating correctly, and rectifying faulting equipment, provided some improvements to bus journey times, and reduced the need for some specific bus priority interventions. As with any technological systems, it is essential that traffic signal equipment is suitably maintained and kept at an optimal operational state at all times to achieve the most benefit.

The site visits also allowed information to be gathered to understand where and how any proposed bus priority technology would be deployed and determine the suitability of the proposed bus priority technology at each location. Items that were considered when assessing existing assets and locations included -

- Equipment cabinets including space within existing cabinets.
- Ducting and cabling – existing provision suitable for the application of new equipment.
- Communications – is there an existing provision and is it suitable.
- Is there suitable infrastructure for mounting equipment.
- Other infrastructure nearby that may cause operational interference, either physically or passively.

The location of existing bus stops was also noted as the location of bus stops can have a considerable impact of the operation and effect of Bus Priority measures.

Whether the chosen location can provide the required benefit should be considered. For example, placing traffic signal sites close to busy bus stops often do not work well, and sites where regular bus services operate on conflicting routes can be problematic. The benefits of any proposed technology should not be at the expense of other factors, for example, a traffic signal junction regularly called upon to prioritise bus movements may generate significant queues for other traffic, which could create potential impacts on air quality and the local environment.

The LTN 1/24 guidance recommends using Automatic Vehicle Location (AVL) data for the most effective bus priority system both operationally, due to its ability to be very selective in its prioritisation, and cost, minimal equipment required. While using AVL data was once limited to Urban Traffic control (UTC) application only, due to the advancement in communications systems AVL data can now be used to apply advanced bus priority at all locations with a UTMC connection. However, access to the AVL data must be agreed with the local bus companies which can sometimes be an issue in itself.

Design Process

While not originally planned in this way, the design of the Swansea Bay and West Wales Metro bus priority system was completed in two stages.

Stage 1 Design – Local Detection Based System

The first stage was to produce designs using only local detection due to initial issues with obtaining AVL data.

Following the site assessments, we had achieved a good understanding of the equipment located at each site, positions of Bus Stops and any other factors that would affect the use of local detection. It was at this stage we needed to decide on the type of detection to be used at each location. Consideration was made for the reuse of existing equipment, where possible and ensuring we got the best use out of the available technology.

Inductive loops, with RTEM detection equipment, were the preferred detector where there was existing ducting, in useable condition, running up to the location required for suitable trigger points (typically 8 – 10 seconds journey time) or where other detection types were not suitable. The dual use of inductive loops was also considered (e.g. for BP detection and MOVA IN loops) as part of the design process.

Where there was no avaible ducting the use of AI / Video detection was designed. For trigger points that were required to be no more than 25m form the stop line, due to on-site restrictions such as bus stop locations, AGD 650 detectors were applied to the design. For those trigger points that were able to be located further away (8 – 10 second journey time) FLIR Thermicam and Trafficam detectors were applied to the design.

The use of these particular types of AI / Video detection was determined following a period of investigation and discussions with various manufacturers to assess capability and suitability to the design requirements. It was felt that the FLIR detectors were the most suitable for the further trigger points but the AGD650 were more suited to the near trigger points.

In addition to the design of the local bus priority detection, each site was re-evaluated for efficiency and updated to the latest standards, this including introduction / update of MOVA, on some of the sites, and improvements to pedestrian facilities to ensure bus users had suitable access to bus stops.

Stage 2 Design – Addition of AVL

During the preparation stage to implement the original designs carried out in stage 1, we were informed that AVL data would now be available for the area. It was decided that the design would therefore be updated to include for AVL data driven bus priority. It was agreed that the local detection systems previously designed would remain as a back up to the additional AVL bus priority system. This was partially due to the local detection equipment already in the process of being implemented and also due to the expected delay before the AVL data would be available for full use (6 months). This would allow the local detection to provide priority for the first few months and then be on standby if the AVL system failed due communications, etc.

Due to AVL systems operating from virtual trigger points no additional equipment was required. However, the configuration data for each controller required updating to include for the AVL inputs. In addition, special conditioning was added to monitor the AVL inputs and if the AVL data was lost, for more than 30 mins, then the local detection would take over. Once the AVL inputs returned the local detection would then be ignored.

The inclusion of the AVL inputs also allowed some of the site, which were in close proximity of each other, to provide forward calling to give a green wave effect for buses.

Implementation

While a majority of the implementation was straight forward, some of the works required a trial-and-error approach. As with any new technology there was some teething problems with the setting up of the local detection at some of the sites, but with good technical support from both the manufacturer and the installation contractor these issues were suitable addressed, and validation of the bus priority detection was successfully completed.

Another challenge of this project was the traffic signal controller configurations. While the application of bus priority can be fairly straight forward, combining both local and centralised systems with VA, UTC and MOVA controlled junctions required a lot of thought into how each mode would handle the BP inputs and how the sites would switch between the two BP systems. The type of controller also played a big part in how this was approached. Again, just like the implementation of the on-street detection, a trial-and-error approach was needed. Using local priority mode on certain types of controllers was not as straight forward as expected, we found ‘bugs’ that prevented normal configuration for local priority being deployed with inhibit timers being one of the biggest issues however after a few tests a work around was found.

Despite the various issues that were found during the implementation process, the experience allowed us to refine the design and operation process to produce a unique bus priority system.

Monitoring (inc RTEM trial)

Swansea City Council initially collected Bluetooth journey time data at the beginning of this project to establish a base for overall journey times along one of the key bus route corridors. This base data was then compared against the journey time data collected after the designs were implemented to analyse the impacts of introducing bus priority on the wider highway network.

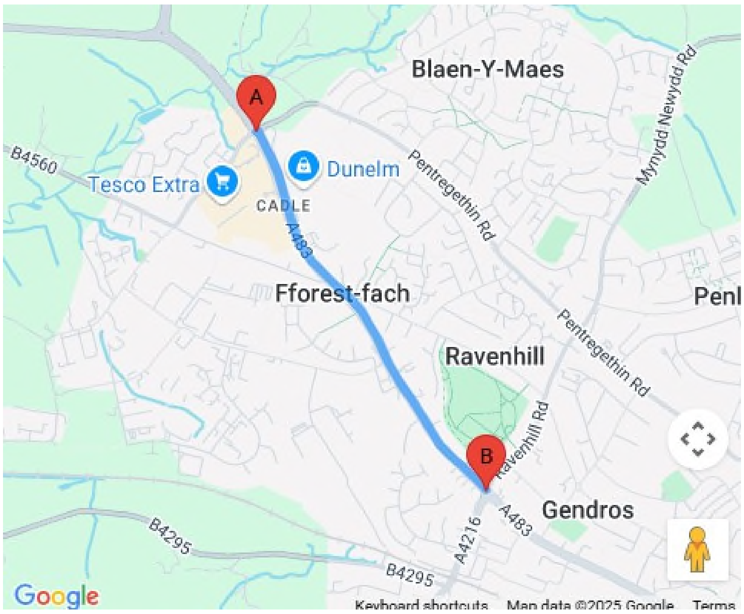


Image 1: Bus corridor route (Carmarthen Road)

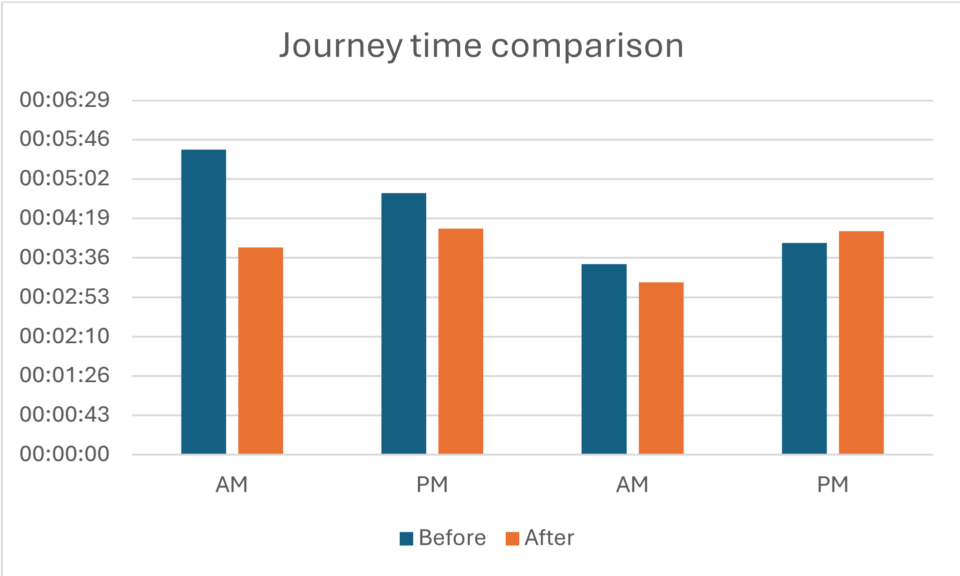
To evaluate the impact of the bus priority measures introduced along the Carmarthen Road corridor, data was collected over two-month periods both before and after implementation. This corridor included upgrades at five separate intersections, making it a key testbed for the new technology.

The analysis focused on peak travel periods:

- AM Peak: 08:00–10:00
- PM Peak: 16:00–18:00

More than 820,000 Bluetooth journey records were captured during the monitoring period. Providing a statistically robust dataset to evaluate the effectiveness of the bus priority interventions.

		Journey time (mm:ss)		
Route	Period	Before	After	JT change
Route 1	AM	05:35	03:47	01:48
	PM	04:47	04:08	00:39
Route 2	AM	03:29	03:09	00:20
	PM	03:52	04:05	00:13



Key insights:

- Route 1 (AM) saw the most significant improvement, with a reduction of 1 minute 48 seconds. Route 1 also benefited from improvements in journey times in the PM by 39 seconds.
- Route 2 (AM) still received a 20 second improvement whilst the (PM) period slightly increased by 13 seconds.

In addition to the comparison of bus journey data, an understanding of when the priority calls were being made and serviced was collected. This data was collected using a new monitoring system. Through collaboration with RTEM, for the loop-based bus detection solutions, a standalone monitoring system was developed. The RTEM system can monitor most types of Bus Priority detection methods. Combined with special condition written into the controller configuration, the RTEM card can monitor the mode of the controller when the BP demand was activated to determine the performance of the Bus priority at each site. It should be noted that through further (later) development of this monitoring system, and with the application of additional detection, the RTEM monitoring system can also monitor the progress of the bus e.g. did the bus complete its journey through the junction or not.

Conclusion

The primary aim of this project is to enhance the overall bus user experience by improving journey times, increasing the reliability of services, and enhancing access to bus stops. While the project is not yet fully implemented, early results are promising—bus journey times have already shown improvement and are expected to continue improving as the Automatic Vehicle Location (AVL) system becomes fully operational. It is recognised that the project has largely focused on technology-based interventions;

however, in line with guidance from LTN 1/24, a holistic approach combining multiple measures would have most likely delivered the greatest benefits along the bus corridor.

While deploying both an AVL-based bus priority system and a local detection-based system may seem excessive to some, the decision was influenced by the project timeline. Implementing both systems in parallel provided a valuable opportunity to compare their performance in a real-world setting. Additionally, having a local detection-based system as a fallback ensures continued operation in the event of UTC communication failures or loss of AVL data.