Traffic Signal Communication Resilience

TfL Lane Rental Industry Publication

TRANSPORT FOR LONDON

Introduction

With a population of 9 million and 6 million journeys on average carried out by car each day, being able to maintain the flow of the road network in London is essential. One way Transport for London (TfL) does this is through the 6300 traffic lights they maintain. Using Urban Traffic Control (UTC) systems, TfL are able to change the length of time a light is green or red to clear an unexpected queue and alleviate vehicles moving into congested areas.

To carry out these changes in green and red timings, the UTC system uses a Split Cycle Offset Optimisation Technique (SCOOT), which is an adaptive system that responds automatically to fluctuations in traffic flow through using on-street vehicle detectors embedded in the road. Reliable communication links are therefore needed to ensure optimal performance of this control algorithm to minimise congestion and pollution.

Done through telecoms, these communication links provide a connection between traffic sites and centrally based servers. In London these telecoms links are generally IP based and route back to TfL via a telecoms network. Traffic signal intersections and pedestrian crossings are grouped together to form regions and within those regions lie subgroups, which are the smallest unit of control within UTC. For SCOOT to work effectively all sites within a subgroup must have a working connection to the UTC system. If there is no working connection to the UTC, then the subgroup reverts to locally saved fixed plans. The rest of the region, if not also within that subgroup, will attempt to continue to optimise. Generally, regions are made up of multiple subgroups.

Of all the traffic signals TfL maintains, approximately 4,500 are controlled by SCOOT, with the servers connected to the traffic controllers on the street. It is essential that these connections are maintained, which can be impacted by traffic incidents or street works, as changes in signal timings need to be undertaken. Technology was found, called ‘wireless mesh’ which claimed to mitigate signal failures by creating multiple connections between traffic signals, strengthening the network. To establish if this type of innovation could be used on the Transport for London Road Network (TLRN), three trial areas were selected.

The Trial

The trials areas were selected given their geographical location within the three maintenance areas. This was to ensure that as many lessons as possible could be captured for any potential roll out in future. In addition, two different suppliers were selected with varying products.

Using point to point radio links was found to be the most efficient way of linking sites using the wireless mesh technology but although there were many suppliers of radio and wireless mesh technology, there were only two suppliers who had implemented and installed this equipment for use in a road traffic control environment.

A virtual data centre was implemented for both suppliers' mesh control servers which was then connected to the UTC field network. Once links were made to the on-street mesh network and tested, the routing tables were updated to ensure the UTC traffic was routed via the virtual data centre and mesh, which was tested to monitor performance.

Outcomes

From the testing carried out, technology from both suppliers performed well, with interruption kept to a minimum (I-2 seconds)

The approach to longer term testing was to evaluate UTC errors over the three trial regions. Observations included:

- More errors occurred in the area which had more trees and topography. One of the testing sites was hit by vehicles on three separate occasions.
- The two other trial areas were in a moderately busy urban environment, with no trees or road inclines/declines enabled, which improved signal transmission.

Benefits of the mesh technology included:

- Improved resilience through multiple routes
- Reduced operating costs – less equipment needed
- Flexibility – once a mesh network is set up, additional assets can easily be connected using mesh. Examples could include portable traffic signals during street works, variable message signs or CCTV cameras

In addition to these, the extended availability of sites under mesh communication would ensure the continual ability to manage incidents and events in the area through altering signal timings and fault monitoring.

Lessons Learnt

Learnings from this project include:

- Using cloud-based infrastructure for the mesh control system significantly reduced implementation time and operational cost.
- Not all areas are suitable for wireless mesh and successful implementation can be impacted by landscape and local structures like trees.
- While implementation of this kind of system would require significant investment, there is a potential significant saving in annual operational costs. A conservative financial model suggests that operational savings would be around 15%.

Conclusion/ Recommendations

Linking traffic signal sites together using radio technology and intelligent telecommunications software provides the building blocks for a wireless mesh system for surface assets. The trial demonstrated that incorporating this technology into business as usual would provide an opportunity for TfL to make significant operational savings, however, it has also highlighted several challenges that would need to be to overcome to implement this kind of system. More work is needed to further understand how this could be approached, with recommendations to explore a commercial model.

TfL Lane Rental Scheme

Optimising customer journeys through the delivery of safer, innovative and sustainable roadworks

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