Traffic signal priority for buses

P. J. Symonds
Norwich Area Transportation Strategy
Norfolk County Council
http://www.norfolk.gov.uk/
peter.symonds@norfolk.gov.uk

Abstract

Traffic signal priority for buses is a work stream within Better Bus Area (BBA) 2012. All traffic signal installations in the Greater Norwich area were reviewed and appropriate works implemented with the aim of improving the reliability and punctuality of bus services. The following paper illustrates an existing, and new technique for delivering traffic signal priority.

Introduction

BBA funding was intended to support local authorities who take a partnership approach to bus services in congested urban areas where increasing bus occupancy and achieving modal shift can release valuable road space and reduce carbon emissions.

The brief was to maximise benefits to bus services by the following:

- Review and assess 224 traffic signal installations
- Implement appropriate works depending on control strategy
- Minimise effect on other road users
- Ensure whole life costs are minimised
- Improve reliability and punctuality of bus services
- Reduce overall congestion on the highway network

Background

Norwich is one of the most important city regions in the east of England. It has the region's largest economy and the highest ranking retail centre. Heavy commuting flows into Norwich place a considerable strain on the transport system at peak times.

Norwich is also an ancient city with much of the centre still retaining the medieval street layout. It is vital that the most efficient use is made of this limited capacity and transport systems develop in a sustainable way that meet present and future demands.

Differential priority has been deployed through smaller projects over several years in King's Lynn and isolated areas of Norwich. It utilises the existing traffic control and bus tracking systems with no additional infrastructure or communications.

Of the 224 installations within BBA, 12 had differential priority enabled, 162 were connected via Siemens UTC (Urban Traffic Control). LSTS (List Status) during peak periods showed 21 crossings and 76 junctions ran SCOOT control. 11 of the remaining junctions were selected to provide localised priority.

Phase 1 – Differential Priority 2012-2013

A list of SCOOT (Split Cycle Offset Optimisation Technique) links was created detailing location, direction, installation number, region, stage to be called and link letter. The incumbent bus tracking provider created 279 additional virtual detectors 100 metres, or 10 seconds journey time before junction stop lines. This dataset was broadcast to bus operators whose equipment send RTIG messages via an XML gateway to the SCOOT server. Schedule adherence software categorises buses so vehicles which are late and very late are able to request priority.

Traffic signal designers were invited to quote for setting up the SCOOT database and validating the installations. Norfolk policy is to use extension and recall only, not stage skipping or reordering which can cause frustration to motorists and pedestrians. All approaches were included despite some not currently being used by scheduled bus services.

SCOOT messages were exported into Excel to identify any links not being triggered. A County Council vehicle fitted with a transmitter and programmed to show as late was used in conjunction with a remote terminal to check any remaining approaches. Buses were also monitored on links using SCOOT messages and CCTV.

Extension and recall messages were collated and analysed for March 2014, showing 11,595 priorities granted with a split of 17% extensions and 83% recalls. This accounted for around ¼ of late requests as priority is not granted when a bus will get through in normal green time, if a junction is oversaturated or if exit blocking would occur.

Analysis has been carried out measuring average lateness for bus services around the most active junctions. It shows inbound buses receive most benefit, with lateness reducing as services reach their final destination.

Koblenz Avenue is a heavily signalised area containing the train station, football ground, a retail and entertainment centre. During March 2014 service 25 was on average 7 minutes late entering, gaining on average 2.48 minutes by the end of the route.

Phase 2 – Localised Priority 2013-2014

Following feedback from bus operators, a list of signal controlled junctions not within SCOOT control were selected for a new approach using existing inductive loops to classify vehicles to Euro6 and implement localised hurry calls. Approaches were selected which had loops at a suitable distance, and no bus stops between the loops and stop lines. It was also a requirement to only prioritise main roads.

A detector card is replaced within the controller which carries out the function of the loop and uses signature profile technology to recognise buses. It also provides various survey data in .dmp format which can be used by the Network Management team. This approach required a change in priority objectives as all buses and coaches were granted priority and not just tracked, late buses.

A trial site between the University and Hospital with regular bus movements was chosen and a 3G CCTV camera installed to monitor its effectiveness. A new controller specification and PROM was commissioned which included hurry calls using speed assessment loops. This required the hurry calls to have a hold time of 10 seconds and prevent time of 2 minutes.

16 Approaches at 11 junctions now use various loop types, different journey times to stop lines require varying hold times. Junctions on UTC report a ‘Z’ message while junctions using RMS (Remote Monitoring System) can be set to alert of mode change. One of the junctions uses MOVA (Micro processor Optimised Vehicle Actuation) so this was used to grant sophisticated priority as opposed to Hurry calls.

This technique does not require on bus equipment and has proven to be reliable and accurate. For the same period of March 2014 an estimated 21,400 priorities were granted. The hurry call is received regardless of whether the bus would have got through in normal green time.

Results

Both techniques can save up to 1 minute per junction should a bus arrive at the end of green and receive priority during a 120 second cycle time.

Initial analysis shows improved journey times for buses; reducing emissions by either minimising or completely taking away stop/start scenarios. The day of the week with most actions was Saturday and the most active time period was 10:00 – 13:00. Further detailed analysis will be carried out into average lateness of services and feedback given to bus operators, who may adjust timetables accordingly.

Total priority actions for around 300 buses during March 2014 were in excess of 33,000 equating to an average of >1,000 per day.

Benefits

Bus operators have given positive feedback with requests for absolute, as opposed to differential priority. This would make journey times faster but would mean more layovers for early buses, therefore not improving reliability or punctuality.

The main advantage of these techniques is making the most of current systems and infrastructure. This reduces communication and maintenance costs and once set up requires no manual input.

As part of the wider BBA scheme, traffic signal priority will be well advertised and bus passengers will enjoy more reliable services. Passenger number information has not been received, which has large variations depending on external factors such as weather and fuel prices. It is also difficult to gauge whether this project has encouraged modal shift or reduced congestion.

Costs

Various savings and initiatives allowed cost to be well under initial estimates, the table below shows how the money was spent:

Initial budget	£180,000
Revised budget	£105,000
Phase 1 cost	£20,421
Phase 2 cost	£82,221
Total cost	£102,642

Table 1: Budget and costs

Next steps

Norfolk County Council has moved away from legacy radio equipment and is now only tracking buses by GPRS. There are 2 remaining junctions in King’s Lynn and the SCOOT area in Great Yarmouth which is still to be configured. Currently only detect virtual triggers are used and the system could be enhanced with register and clear triggers.

The latest version of SCOOT (V33.0) allows priority by remote request, so new or upgraded signal installations will be able to use phase 1 technology when not under SCOOT control.

Absolute priority which includes stage reordering, giving bus passengers a similar experience to those on trams may have a greater impact on modal shift. Another option would be to slow down an early bus, a smart ticket machine which informs the driver when running early, would allow extra time for passengers to get seated and for the driver to progress at a more leisurely pace until back on schedule.

Conclusion

With a large carrying capacity buses make effective use of limited road space and priority given to buses gives a benefit to far more people than other transport modes. Greater reliability of bus services using traffic signal priority provides a positive incentive to use buses. The technology deployed through this project is making best use of available systems to provide low cost solutions.

Traffic signal priority was only a small part of BBA which included upgrading the majority of passenger transport infrastructure. Increased bus patronage has a huge benefit for the travelling public and businesses using the highway.

Reports

Reports have been written by the suppliers who were awarded each phase of the project and are available upon request.