Adding a ‘little’ extra intelligence at the roadside

Martin Wylie Senior Traffic Signals Engineer
East Sussex County Council

Forward

Over the past 3 years I have been developing a concept for delivering intelligence to the roadside for the purposes of traffic data analysis and strategic decision making. Working with partners including ITSPE, JSTSM, PTC and RTEM a Local Intelligence Unit (LIU) has been developed along with a collection of strategic tools for use in managing and analysing the road network.

This paper explains the process which was undertaken, the deliverables achieved along with early outcomes and a look into the future use of the system and its development.

High level concept

Having worked with and studied road networks for many years I knew that more intelligence at the roadside was required to further the potential for the strategic control and analysis of traffic networks. By using an architecture which collected and analysed the traffic data at the roadside central processing power and communications overhead could be minimised and where these are not available local strategic decision making can still take place. It should therefore be possible to make better use of local information locally as long as this is implemented with an overarching strategic vision in place when appropriate.

I subsequently developed a concept for a data processing unit located at the roadside which would be used to collect traffic data, analyse the data and make local interventions as required strategically. Working with my technology adviser Dr Mark Pleydell of PTC I floated the concept of using an open source computing platform which would allow generic and bespoke routines to be developed and run locally to the controller. Following some initial design meetings we started the process of developing the architecture for the LIU and the relevant industry approvals required.

Developing the Concept

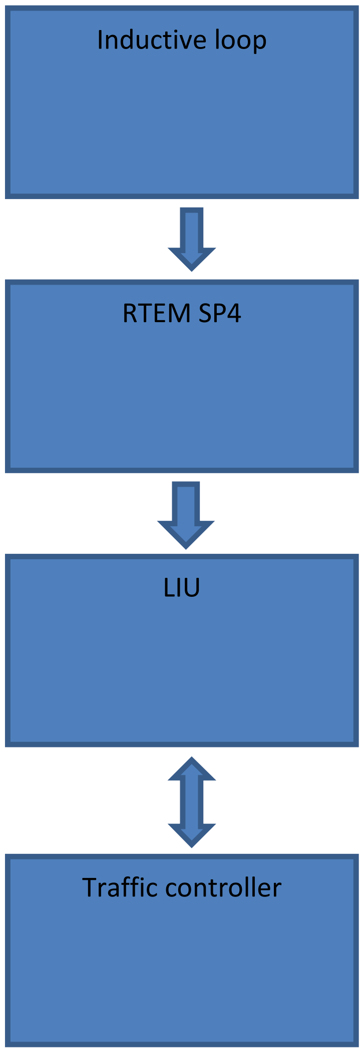
Having defined a base architecture for the LIU Mark began by building a prototype which we duly tested on an offline traffic signal controller, following some refinements to the LIU specification Mark started to look for a manufacturer interested in producing the LIU. I had been working with JSTSM on local improvements to traffic signal timings as part of a review of signals in Southampton to refine operation and reduce the costs of communications back to the Central UTC system by implementing local control rationales and removing intersections from SCOOT control, having discussed the LIU concept with them it seemed a logical fit to the work which they were undertaking. Dan Preece of JSTSM agreed to work with us in developing the potential of the LIU along with supplying and installing the devices on street. ITSPE agreed to manufacture the LIU as it fitted in with other ITS work that they had and were undertaking.

The LIU in operation

The basic functionality of the LIU is to collect data from the roadside, analyse the collected data and then use the data for either informing a central system and or making local interventions. The following sets out some basic functionality which has been developed. The LIU architecture uses a Perl scripting environment for delivering the various routines along with two text based input files one which is used for defining the input and output allocations and another for defining the operational parameters, thereby making the LIU very versatile in delivering a wide range of solutions.

Data collection, working with RTEM Ltd we used their SP4 data collection device which uses inductive loops to collect traffic metrics such as classified flow, vehicle speed, vehicle headway, vehicle gap etc. we connected the LIU via a serial interface to the SP4 in order to read the collected data, a profile of the data is then stored in the LIU and triggers are generated when the actual data being received is higher or lower than that of the profile thereby delivering a thresh holding function which can be used for instance to change timing sets in the controller, introduce CLF, UTC or VA control or inform a central system of a deviation to the normal characteristics of the network. The RTEM SP4 can work with existing loops such as SCOOT loops a well as conventional count loops. It produces a parallel output of the loop activation so that the existing loops can be used for their original purpose i.e. SCOOT occupancy as well as providing a rich source or traffic data.

The output from the inductive loop passes to the RTEM SP4 which in turn outputs flow, speed, headway, etc. to the LIU which in turn compares the received values against a profile and produces trigger outputs to the traffic controller. These triggers can be used for influencing the current method of control and informing the centre of operational network status.



Presence detection, The LIU can be used to generate outputs based upon single or multiple inputs, using logical functions to combine the inputs to produce the required output state, for instance queuing traffic can be detected by either above, at ground or below ground detection and a timing change made to the traffic controller, by using logical arguments a number of inputs can be combined to influence the current method of control for example a queue in two locations and the controller in stage 4 and a demand for stage 5.

Local linking, The LIU can communicate with other LIU devices through a number of standard communication protocols, IP, Serial, wireless, and via a central server. This allows for linked functionality to be deployed, for instance a corridor of traffic signals can be made aware of what its neighbouring intersections are doing thereby providing the ability to influence their decision making based upon what is happing up-stream and or down-stream thus allowing for method of control changes to be made for strategies such as linking or plan changing.

The central server link, The LIU has Ethernet capability which allows the device to be connected to a central server for the purposes of centrally collecting data gathered from the roadside and instigating central strategies, so that logical groups of intersections can be influenced with a common strategy, for instance in the event of a diversion prioritising traffic flows on a certain route or assisting with the movement of traffic to and from an event.

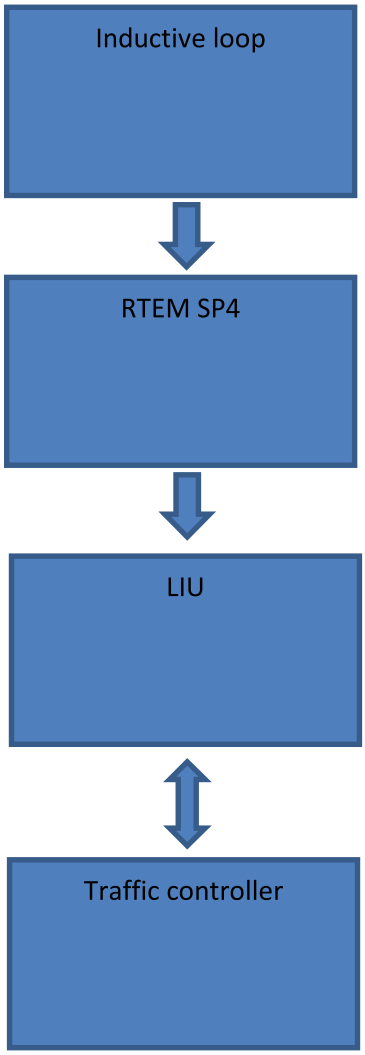
Bus priority and local compensation, The LIU is capable of running a routine which monitors an intersections operation and compensates movements which are affected by the delivery of bus priority to a conflicting movement thereby providing an appropriate level of re-balancing to the intersection in an attempt to reduce delays caused to movements prematurely terminated in order that bus priority can be provided. Due to the flexibility of the LIU is possible to define which movements are provided compensation for a specific bus priority demand and by how much the opposed movement is compensated following the provision of bus priority. The LIU can be programmed to monitor the movement being compensated and looks for gaps in the traffic demand on that approach during its compensation period, if a gap of sufficient duration in the vehicle demand is detected compensation ceases or is reduced by a definable factor. The factors could for instance be varied by time of day or external influence such as a strategic intervention.

For locations where the bus priority request comes from an RTI (Real Time Information) server one of the wired or wireless IP communications solutions can be used to send the bus priority request to the LIU. Following a centrally requested bus priority demand being serviced compensation can then be provided as described above.

We used the link to an RTEM SP4 for locations where the detection of buses is undertaken locally, as the SP4 can detect the presence of a bus even from a single loop such as an existing SCOOT loop or similar. It is also possible to use the SP4 in a centrally optimised solution such as SCOOT as the detection of the bus can be fed to the UTC system via the O.T.U along with the parallel raw detector data used for SCOOT quarter second occupancy.

By utilising a central server linked to an LIU it is possible to send locally generated bus priority requests to a UTC server for use in a SCOOT system or similar. The central server can also be used to manage how bus priority is delivered either by the UTC server or locally with compensation being applied as required.

The output from the inductive loop passes to the RTEM SP4 which in turn produces the bus priority demand if a bus is detected crossing the loop. The output is sent to the LIU for passing to the traffic controller and delivering the post priority compensation.



Conclusions and future work

What has been delivered is an overarching architecture and hardware platform for providing strategic control rationales together with some basic software applications. I hope that others will find the LIU of use in their work to manage the traffic network as the scope for usage would seem expansive and as we integrate more information gathering devices to our arsenal of tools for traffic management so the functionality provided by the LIU can be expanded.

I am currently working on more functionality including emissions sensing and strategic triggering, pedestrian volume priority and probably most interesting a binary traffic data pattern generator and recognition system but more about that next year.

Acknowledgements

I would like to thank all those that have helped in delivering this vision but specifically

The staff at Southampton ROMANSE

Dr Mark Pleydell PTC

Dr Rajesh Krishnan ITSPE

Dr John Spence JSTSM LTD

Dan Preece JSTSM LTD

Anup Lekshmanan RTEM LTD