Executive summary

The advent of modern communications technology has changed the face of urban traffic management and control over recent years. Implementation of internet style technologies offer traffic managers opportunities not previously available to collect information from the roadside as well as disseminating information back to the end user via a range of different technologies. This rapid transition of technology into the traffic management and control environment brings with it unique challenges and an associated change in understanding. This paper will look at some of the issues surrounding the use of modern communications technology within a UTMC system and the different approaches which may be necessary to system design, management and operation.
Introduction

Traditionally the only system available to traffic managers was the Urban Traffic Control system – operating probably at best at around 1200 baud – which limited both the quantity and range of data which could be transmitted in each direction. This was very much driven by the technology available at the time, typically mini-computers or workstations as opposed to the PC environment which we now all take for granted. In turn over the last 10 years, the range of communications options available for the PC has grown probably beyond any original expectations, driven largely by the desire for information and the explosion of the Internet.

As with many technological developments, new markets have been sought by technology providers, local authorities and government looking at how the technology available for the Internet could be adapted for use in a traffic control environment.

How many of us 10 years ago as we dialled-in to our email listening to the modem, thought we would have 8Mbit broadband and faster, at home over basic twisted pair circuits? The adoption of this technology brings with it many benefits in areas around revenue reduction and increased bandwidth but also brings with it a requirement for greater understanding of the limitations. No longer is it possible to simply decide to install a UTC outstation and order the leased line from your local communications provider.

Whilst UTMC offers communications for a range of different equipment associated with traffic management and control, the most demanding is probably the requirements of SCOOT and UTC. The timeliness and quality of service required to maintain effective UTC control is such that it is usually the most demanding application and consequently this is the main focus of this paper. Whilst the issues discussed in this paper are applicable to all systems, if they can be solved for UTC it is unlikely that any other type of equipment will be unable to communicate using UTMC techniques.

UTMC

The Urban Traffic Management and Control project from the Department for Transport was aimed at creating modular solutions which are capable of expansion and interoperation with other systems to provide quality information and the means to use this information, particularly to influence travellers. This in turn allowed service providers to maximise their flexibility and introduce new technology into the traffic control centres. It does however, recognise that there is a large infrastructure of existing legacy systems installed which would require a significant capital investment to replace which would not necessarily be cost effective in terms of the improved facilities available in the control centre. Therefore, any evolution of systems must always consider the transition process from old to new.
UTMC originally undertook a series of research projects which looked at different aspects of traffic management and control as well as in some cases, areas of technology which could be adopted in traffic management. This was then followed by a series of demonstrator projects which put into practice practical implementations of the technology. For the UTC system the primary example of this was in Lancashire, where an existing Peek UTC system was replaced by a Siemens system driving both the existing Peek OTUs (via a Front End Processor) as well as a mixture of Siemens and Peek UTMC outstations.

Subsequently continued development of communications technology has led to a range of different options being available now for UTMC communications for SCOOT in addition to the SDSL solution used in Lancashire. This flexibility provides a range of options which can be implemented, each of which has its own capital and revenue cost but also provide different levels of service and support.

Communications considerations

Traditional leased lines, whilst slow in comparison to most alternative offerings today, offer a simple, reliable solution which is relatively free from interruption. Whilst some circuits will suffer occasionally from communications loss, this is generally minor and normally solved relatively easily by the communications provider (eventually!). However it is probably reasonable to say that communications availability for UTC using a leased line is probably better than 99.5%. This in turn sets the benchmark for our expectations of UTC communications and this level of service is typically what a UTC/SCOOT system will assume for effective control.

The advent of new UTC communications protocols such as that being developed by the UG405 project team will reduce to a certain extent the current reliance on second-by-second communication. This will not change the need for reliable communications significantly. For effective SCOOT control to be maintained, overall communications reliability still needs to be good and the detection data needs to arrive at the instation with only a few seconds latency to allow the system to respond accordingly.

One of the major issues to be considered when selecting a communications infrastructure is the quality of service. This needs to include both the performance of the connection (number of lost or missing packets) as well as maintenance and reliability. The maintenance of the network is a key consideration in ensuring efficient day to day traffic management.

In order to successfully be used for UTC/SCOOT communications these issues must be resolved to maintain effective control. Whilst it may be acceptable when uploading data from a traffic counter or air quality monitor, or sending control messages to a VMS for these to be delayed in transmission by 10 or 20 seconds, this is not acceptable for SCOOT control, even in the future with enhancements proposed by UG405. In order for SCOOT to continue to work effectively, the data still needs to be received in "near real-time". Studies have shown that the SCOOT system will accept data which is received from the detectors up to 4-5 seconds late and still maintain effective control.
There are many options for communications media utilising UTMC – each of these will offer some advantages as well as some restrictions. The successful implementation of a UTMC communications system will need a careful assessment of the requirements of the individual system taking into consideration issues such as data rate, quality of service, impact of communications failure and likely time to repair following any failure.

As with any system developments and enhancements, the implementation of UTMC will also require a compelling business case. In the environment today with continuing pressure to drive down revenue budgets, no solution will be popular which after implementation actually costs more to run than the traditional, legacy system. It is also important to consider the “hidden” costs associated with alternative forms of communication system. Sometimes these no longer mean that there is a single network provider to whom complaints can be addressed! Instead the local authority must consider how they manage the various providers of individual communications paths to ensure that any faults can be quickly identified and rectified. If this is not the case, the system will very quickly fall into disrepute and in preventing this it sometimes requires additional staff resource and effort.

ADSL offers an attractive solution because it does not involve distance based charging and at the data usage required for most typical UTMC applications is unlikely to reach any more than the minimum charge bands. However it does require a physical line installation; easy if the site is being converted from an existing monitored site using RMS and a PSTN line exists already but less so if a new line is required in a remote location. Also, typical broadband connections using ADSL only offer a contended service which means the data rate and quality of service is likely to reduce at times of high demand. Non-contended services are available, but as with any data communications service, this improved level of performance introduces a premium to the revenue costs.

Fibre links offer a very high-speed, reliable service where they are installed, however the cost of installation unless shared with other areas of the authority can be prohibitive. They do have the advantage that a wide range of equipment is readily available to connect up and provide standard Ethernet connectivity from a wide range of suppliers, but also suffer from the potential to be disrupted during civils work on street and the associated interruptions in communications this may bring. Whilst this can be relatively easily resolved, the management and resources involved in following up such incidents can be time-consuming and costly.

Existing copper circuits can be used with DSL modems in a point to point link but this will typically be limited to within an existing exchange area where the circuits are rented from BT. Also, whilst such links can provide a short-range high speed connection, the further apart the modems become the slower and potentially less reliable the connection becomes. This solution was used in some of the original UTMC demonstrator projects and has been used on successfully since but it is likely that this will be overtaken in the future by other forms of communication, probably implemented in combination.

Wireless communications can sometimes appear to be the panacea to all problems! Whilst this is not necessarily true, when used within the known constraints and laws of physics, they can be used to provide a high-speed, reliable communications infrastructure with a minimum of physical installation on street. The IDT iMesh Router has been designed specifically for UTMC applications with an operating range of up to 500m, supporting multiple hops.
Each iMesh Router runs as an access point, client or a repeater and using the mesh technology will operate as all three simultaneously using only open standards (802.11b/g). The iMesh Router is designed for installation in the traffic controller environment, rack or wall mountable, rugged construction with an extended temperature range of -15 to +60C and only requires a coax connection to an external antenna. Configuration of the unit is easily achieved via a web browser with configurations and maintenance able to be carried out remotely using the same network installed for UTMC communication.

GMUTC – Bury

The SCOOT system in Manchester was originally upgraded during a process which started in 1998 and saw the installation of around 1200 traditional OTUs which use a mixture of multipoint and radial leased line circuits. As part of a continued development of the system installed in Manchester, a trial is being undertaken in Bury to look at using a variety of different forms of communications based upon a UTMC infrastructure.

A 1MB ADSL line is used to link the UTC computer in the centre of Manchester (at GMUTC offices) with a communications centre in Bury some 10 miles to the north of the central system. The communications centre, co-located in the town’s CCTV control room links to 7 spare fibre optic lines from the Bury CCTV system. These fibre optic lines extend the ‘digital’ network to 7 communications hubs around the town centre in cabinets located on street.

The communications hubs then link to 23 Gemini UTMC OTU's using a combination of wired Ethernet (up to 100m) and wireless connections using mesh from IDT. The full system will incorporate 19 wireless mesh links including single and multi-hop links over distances from 75 to 250m.

Under a traditional UTC scheme, the system in Bury would have required several multi-point or point-to-point analog circuits. These were difficult to obtain and would have proved very costly from the centre of Manchester, north to Bury. Instead the use of existing, spare capacity in the town centre CCTV fibre installation, along with wireless and ADSL connections provides an effective link at minimal additional revenue cost – especially when compared to the alternative options.
Cumbria

The Cumbria UTC system was originally installed in the late 1990s in Carlisle using a traditional leased lines installation and TC12 OTUs. During 2007, an expansion of the system to Barrow has begun comprising 4 Siemens Gemini UTMC OTUs. These have been installed at strategic junctions and pedestrian crossings located on Abbey Road, Barrow and are linked together locally using a wireless mesh network from IDT. The link distances vary between 150 and 200m and the wireless mesh supports data rates of up to 36kbps.

The centre point of the network is cabled to a firewall/router and connected to the county’s WAN in an adjacent local authority building. The UTC computer is located in Carlisle, some 55 miles away as the crow flies.

The overall revenue cost to the authority in implementing UTC in Barrow is therefore small, as the main link using the council WAN – which supports all of the IT links between Carlisle and Barrow, not just traffic - required no additional infrastructure and as such effectively makes use of spare capacity on the link already available.

The system, although small at present is seen very much as a trial with the potential to roll out to further junctions by extending the wireless network and also to other locations where appropriate via the council WAN.

Surrey

A recent trial in Surrey has started using a standard ADSL circuit from BT in conjunction with a dedicated router which provides both the connection for the OTU as well as the VPN for transmission over the internet. Currently this trial has a single OTU connected in Esher with further OTUs being added to the system shortly via an ADSL connection from Siemens in Poole. This will allow further testing to be carried out regarding the suitability of the ADSL circuit (using a single connection at the instation) and multiple OTUs connected via this circuit. The current instation modem supports up to 5 VPN connections simultaneously allowing this to be a cost effective solution for replacing leased lines.

One of the major benefits of ADSL is that there is no element of distance to the charging unlike traditional leased lines. This means that this type of solution should be particularly beneficial to larger authorities where OTUs in several towns are controlled from a single instation.
Summary

UTMC offers many possibilities for new and innovative communications networks to be used – saving revenue by sharing links between different applications. The implementation of these however, requires a greater understanding of some of the issues associated with communications network design. Many of our systems are quite tolerant of communications interruptions or in some case failure for limited periods of time but the implementation of any new network requires consideration of the likely effect for temporary and longer periods of communications disruption.

Whilst initially it may seem that implementing a UTMC communications network offers a very attractive business case, this is sometimes tempered by hidden costs associated with network maintenance and management – tasks traditionally carried out by the communications supplier. Whilst the business case in most situations is probably still feasible, the overall process may require some contingency to be in place in the event of a critical network failure which in the past may have been rendered unnecessary by the facilities of the communications service provider.

As we have seen from the examples here, UTMC offers a range of flexible alternatives which can be combined in an almost infinite number of combinations. This allows a modern, innovative communications infrastructure to be implemented in any local authority to reduce revenue costs and improve the information available both to the network manager and the public.