UG405 in practice

Mark Bodger and Keith Manston of Siemens Mobility, Traffic Solutions

Extensive testing using the UG405 MIB demonstrates that it offers significantly higher tolerance to communication errors than the simple MIB. The conclusion is that the use of UTMC outstations with the UG405 MIB offers a much wider range of potential SCOOT communications solutions allowing traffic system engineers the flexibility to use almost any form of IP based communication with SCOOT.

CONTACT DETAILS

You can contact Mark Bodger on +44 (0)1202 782848 or by email at MARK.BODGER@SIEMENS.COM
Keith Manston can be contacted on +44 (0)1202 782248 or by email at KEITH.MANSTON@SIEMENS.COM

INTRODUCTION

The development of SCOOT and associated Urban Traffic Control systems has continued since the original trial installations in the UK back in the early 1980s. The latest version, SCOOT MC3 included new developments in three main areas looking at the Management of Congestion, Communications and Control for public transport priority. Key to the release of SCOOT MC3 was changes to the internal model and reducing the dependency on data arriving to a very strict schedule from the detectors and controllers on the street.

Earlier versions of SCOOT required second-by-second data in real time to implement adaptive control. Traditionally this would involve the use of private telephone circuits with dedicated connections between the outstations on street and the system in the control room. Often operating at little more than 1200 baud, these circuits are optimised for efficient traffic control but provide little other benefit with increasing cost as telecom providers move to newer technologies. As the communications technology moves away from dedicated connections to packet switched network topologies driven by the increasing desire for bandwidth to surf the internet and satisfy desires for real-time information, the provision of second-by-second data with minimal latency becomes more difficult.

Enhancements to the core SCOOT model in MC3 now allow for small time delays in communications between the UTC software and Outstation Transmission Units. These developments allow the core SCOOT algorithm to tolerate more variation on communications latency and hence increase the options available – particularly opening up the potential use of packet based data communication systems.

Up until now, these developments have had limited application without the corresponding developments in communications protocols to street devices. The advent of the UG405 development finally allows users the full benefits available within SCOOT MC3 and the potential for using a wider variety of communications links and reducing revenue by sharing infrastructure.

UG405 AND SCOOT MC3

The UG405 programme was a research programme from the Department for Transport in 2004/05 which considered 'Optimising Communications Networks for Traffic Management and Control'. Created as a result of the changing market for communications technology and a desire to reduce the dependency of UTC systems on dedicated leased lines, the project was a collaboration between local authorities and industry in the UK with wide experience in both communications and traffic control. Following the initial stages of the project, Siemens, Peek and TRL became involved in the project in an advisory capacity considering the requirements of the SCOOT system and also the developments which were planned at that time (MC3). Following the release of SCOOT MC3, Siemens and Peek became very much more involved with the UG405 partners, reviewing and updating a proposed amendment to the UTMC specifications to support the use of new packet-switched communications networks. This considered both the original simple-MIB developed for UTMC by Siemens and the UTC MIB developed by Peek and how these could migrate to a new consolidated protocol which included support for SCOOT MC3. After much development work and discussions, the final version of the new UTMC UG405 MIB was included in the TS004:2008 release of the UTMC technical specifications at the conference in Leeds in December 2008.

The original simple MIB transferred data on a second-by-second basis using an SNMP format in line with most other UTMC communications links. Whilst this provides equivalent performance to 'traditional' UTC communications links, the stringent latency requirements limit the communications networks it can effectively operate over. Generally this simplifies to a high-bandwidth connection such as fibre or Ethernet. Outstations have also been operated successfully over ADSL but the latency sometimes causes drop-outs which have limited the effectiveness where network traffic has been high – albeit with a corresponding reduction in the revenue costs for an ADSL connection when compared to a traditional leased line.

The developments within SCOOT MC3 enabled the system to remove the reliance on second-by-second communication. Small time delays and irregularities in data transmission times in communication between the UTC software and out station transmission units (OTUs) can now be accommodated, increasing the range of communication options available and in particular allows the use of some of the newer packet based data communications systems.

To maintain efficient traffic control and management, SCOOT still needs to continue to receive and transmit data in a timely manner. Therefore, the aim of time stamping the data is to accommodate short delays in data transmission whilst maintaining current data in SCOOT. The objective is not to allow for frequent long delays in data transmission that would result in poor traffic control.

For detector data transmitted from the OTU to the system, the aim is to maintain the delivery of second-by-second data for good traffic control. Using modern communications systems can introduce uncertainty into the data transmission process, which is allowed for in SCOOT MC3 and supported by the new UG405 protocol. Data may be: delayed, out of order, repeated or missed. However, if a

complete message is received (eg the four bits of detector occupancy in a second), then that data will be correct. Control data transmitted to the street also includes time stamping which allows messages to be sent a short time in advance of any actual stage changes to accommodate potential delays in communication, as well as reducing the bandwidth necessary for control messages.

SCOOT MC3 will operate successfully with communications that do not guarantee the time for transmission or order of data delivery and has been designed to operate efficiently with possible delays up to 4-5 seconds in communication. The integration of SCOOT MC3 into UTC system also maintains support for current communications systems, or a mixture of current and new, without the need for users to make any changes thereby providing ongoing support for legacy installations and avoiding the need for any 'big-bang' changeover.

The new UG405 MIB integrates time-stamping which allows communications networks to be used with less predictability in latency and network performance. The UG405 MIB with time-stamping, used in conjunction with SCOOT MC3 allows packets which arrived delayed or out of sequence to be dealt with effectively whilst maintaining the benefits associated with SCOOT adaptive control.

INTEGRATION INTO THE SYSTEM

In parallel with the specification development and following the release late last year, Siemens has invested heavily in the development of the Gemini UTMC outstation. This has been a complex development which offers a number of significant new features around the use of alternative communications as well the support of multiple applications within a single unit, allowing for the first time the option of MOVA or SCOOT controlled by the UTC system.

The execution of major changes to any well established and reliable system must always be managed carefully so as to ensure that unexpected problems are not introduced along with the desired new features. In the case of the Siemens UG405 development this is particularly the case as extensive changes have been necessary to both Instation and outstation components of the Siemens UTC system.

To help ensure that users that who take delivery of UG405 systems can have confidence in their operation going forward extensive laboratory testing has been undertaken followed up by several 'on-street' trial deployments. These have been designed to test out the operation of the system using a range of different communication media and operational configurations and also, where possible, to quantify the improvement (if any) provided by the use of UG405. To facilitate the gathering of meaningful data the trials have been conducted in 3 defined steps:

1. Where existing sites are operating UTMC using the current 'simple' MIB, gather communication statistics to act as a baseline against which the performance of the new system can be measured.
2. Install the new UTMC OTU, but retain communication using the simple MIB, to confirm that no changes in performance (either better or worse) are delivered just by changing the equipment base.
3. Switch over to using the new UG405 MIB and record the performance obtained.

In any communication system there are usually communication errors and up to a certain level these will be tolerated. For UTC, where second by second communication is traditionally used, a small number of errors are accepted, although they may impact slightly on the overall performance of the system by potentially delaying a signal change on-street or the receipt of timely SCOOT detector data. Normally however these errors are transparent to the user, but are nevertheless reported so that communication quality can be assessed. Only if the number of errors becomes excessive does the system take serious action, usually to isolate the offending OTU. This does not generally happen very often so if only this measure were to be used the results obtained might be rather coarse. Consequently for the purpose of the trial data both single communication errors and instances of OTU being taken off-line have been recorded.

ON-STREET TRIALS

Several trial-sites have been installed to date utilising a variety of communication options as described in the table here.

Ferndown - Dorset	
Site	15SC SCN J10121 Tesco
Comms type	SDSL (Nexcomm) - Initial trial
Comms type	Wireless (802.11g) – Additional trial
Surrey	
Site	J13521 A321 Marshalls Rd / Laundry Lane
Comms type	ADSL Internet (Westermo providing VPN)
Surrey	
Site	J13911 Marshals Rd / Tesco
Comms type	Leased Line Modem (TC12 replacement)
Perth	
Site	Isla Rd / Strathmore Street
Comms type	Fibre
Perth	
Site	Dundee Rd / Queens Bridge
Comms type	Fibre

In addition to these other trial installations are scheduled to extend the performance validation to cover:

UTMC SYSTEM FOR INVERNESS

Mott MacDonald's transport technology services team has been commissioned to provide a UTMC system by the Highland Council of Inverness in Scotland. The new system, which will be installed as part of the Highland Council's local transport strategy for Inverness, will enable the co-ordination of a variety of traffic systems and sources of travel information through a single common database. The strategy aims to improve the region's interconnectivity with transport services and destinations, with a view to supporting greater social inclusion and economic growth.

Elaine Rodgers, Mott MacDonald's project director, said the new UTMC facility would help the Highland Council achieve its local transport aims and objective. 'A high quality database management system will better inform people travelling in the area, enabling them to make smarter travel choices which it is hoped will yield benefits to the environment by reducing congestion as well as improving road safety.'

Mott MacDonald's solution uses their established common data management facility, which has been developed over the last nine years and which is fully compliant with the latest UTMC standards. Elaine added that it would deliver all the immediate needs for the Inverness UTMC system and provide a long-term integration platform for the future.

A direct comparison between SDSL and Wireless linking has been undertaken at the Ferndown site.

- Combined UTMC / MOVA operation (Fibre Commu nication)
- Operation on a 3G Network3G modem

INITIAL RESULTS

One of the most interesting and eagerly awaited set of data is for the wireless trial site in Ferndown, where a direct comparison between SDSL and Wireless linking has been undertaken. This site (Tesco) has been set up so initially it can be controlled by a direct SDSL link but also via a wireless link from an adjacent gateway site.

For the first period of the trial the site was controlled with a standard UTMC OTU running the Simple MIB. Typically during this period between 30 and 50 TX errors were recorded (Figure 1), but only a small number of these were contiguous such that they resulted in 'no reply' errors which take the UTMC OTU off line. (Figure 2).

The new UTMC OTU was installed on the 27th July and baselined against the existing standard UTMC OTU but continuing to run using the simple MIB. As expected this resulted in no significant change in the number of TX errors experienced. However switching to the UG405 MIB on the 13th August completely eliminated all TX errors, demonstrating that, at least in this installation configuration it is far more tolerant than the Simple MIB!

Following an approximately three week running period using the UG405 MIB on SDSL the link was re-configured to use an 802.11g wireless link driven from an adjacent controller site which had been configured in conjunction with these trial. Operating over a range of between 230-250m, this wireless link has been used for a number of trials and provides a real world installation upon which different configurations of street equipment can be tested. In order to provide a robust test environment, the wireless equipment is installed 'as-is' with little customisation and standard antenna mounted at traffic signal height – rather than antennas mounted on extended poles to gain better line of sight. As a result, the wireless link provides a representative trial for some of the more difficult installation likely to be found in reality and a good test site for the work which has been undertaken.

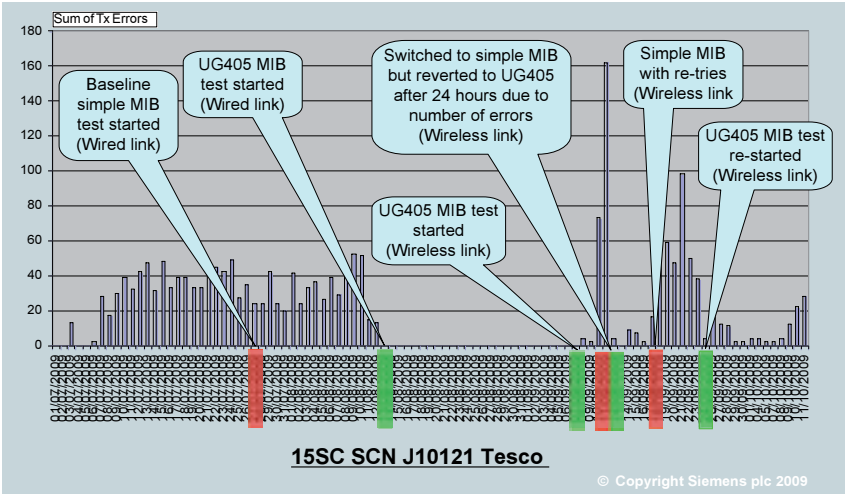
The first part of the UG405 over wireless trials was completed just before the JCT Symposium in September and initially took the form of a couple of days using each MIB to provide some initial feedback in time for the symposium presentations. In the initial wireless trial configuration, the link was set-up to use the new UG405 MIB. Given the non-optimised wireless installation, as we expected this configuration did not prove to be error free and it was decided to switch back to the simple MIB to assess its performance. Unfortunately this demonstrated again the superiority of UG405 as with the simple MIB the wireless was so error prone that Dorset required it be put back to UG405 control after only 24 hours.

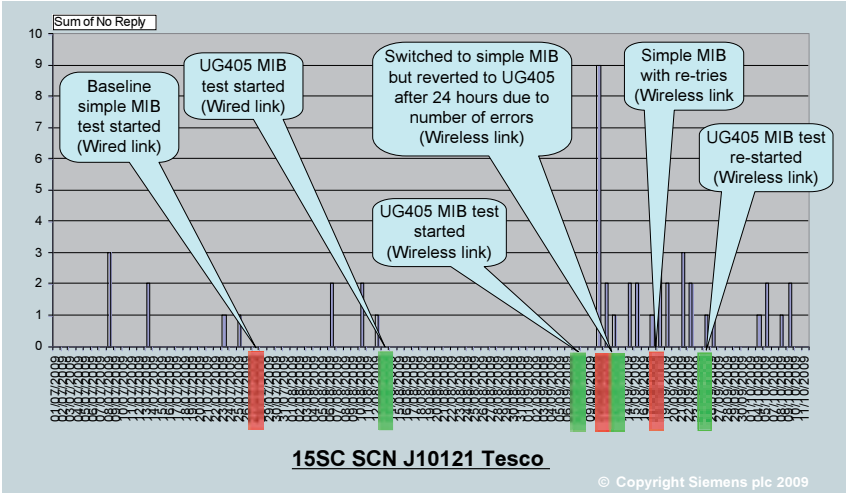
Following the initial trial with different wireless configurations before the JCT Symposium, some more detailed results have been gathered comparing the performance of the old simple MIB (with retries in the event of missed messages) against the new UG405 MIB. These have shown that whilst the performance of the old style MIB (with retries) can be made to work, performance is still limited by the number of transmission errors and occasions when the OTU drops off control as a result of too many missed messages. In some cases during the trial this resulted in 100 transmission errors daily and up to five occasions in one day where the OTU would drop off control and generally at least one or two occasions daily where control was lost for a period of time.

With the UG405 MIB, the raw number of transmission errors is significantly reduced – even when using the non-optimised wireless network connection. Some UTC transmission errors still occur, but overall these are at a level of around 30-40% of the total under the old style UTMC MIB. More importantly, the number of occasions when the OTU drops off control are reduced to a worst case of twice a day (2 days during the trial), one loss of control daily (2 days during the trial) and eight days during the trial where no loss of control occurred.

The final stages of the trials which have yet to be completed will review the potential use of the new UG405 MIB

Top: Figure 1 – Sum of Tx Errors Bottom: Figure 2 – Sum of 'OTU No Reply' failures





with SCOOT operating over a 3G network connection which has the potential to share SCOOT control at some more remote sites previously only considered for MOVA control.

CONCLUSIONS

To date the results which have been gathered from the UG405 trial show that implementation of the UG405 MIB offers significantly higher tolerance to communication errors than the simple MIB (which in turn is similar to the older legacy TC12 communications system). This demonstrates the potential for effective use of alternative communications media with SCOOT MC3 whilst maintaining all the benefits traditionally available with SCOOT adaptive control.

The use of a non-optimised wireless configuration is felt to provide the most stringent test of the new UG405 MIB and this has been shown to provide an acceptable level of service for normal day to day SCOOT control.

Using the UG405 MIB over other communications links is generally less of an issue as most fixed communications networks (fibre, DSL, local authority LAN) will provide a reliable connection without significant periods of dropout. The most common issue with fixed networks of this kind are communications latency but the 4 second tolerance which UG405 introduces accommodates almost all configurations, as borne out by the results of the original SDSL trial in Ferndown.

The use of UTMC outstations with the UG405 MIB offers a much wider range of potential SCOOT communications solutions for use in UTMC congestion management schemes today.

Allowing traffic systems engineers the flexibility to use almost any form of IP based communication with SCOOT opens up possibilities of SCOOT in locations which previously would have been too costly as well as greater opportunities for revenue savings by sharing existing or planned UTMC communications networks with the latest generation of UG405 SCOOT outstations.

Deny the criminal the road

A new protocol for local authority ANPR systems has been extended to ensure that data can be shared with the police.

Automatic Number Plate Recognition (ANPR) provides a powerful tool in the drive to 'deny criminals the use of the road'. Vehicle intelligence can link criminals to vehicles and vehicles to crime scenes. ANPR enables the police to intervene when these vehicles are identified on the public highway.

The underlying proposition is very simple. There is a strong correlation between those people who are guilty of various types of vehicle crime and those people who engage in criminality. In short, criminals are more likely to drive untaxed and uninsured vehicle, actions which are easily detectable using ANPR. As a result the odds on a criminal using a vehicle being the subject of positive action by the police rises from very slim to very high and even if not caught immediately, ANPR will continue to detect their presence and increase their vulnerability and risk each time they use the road.

To be effective, the national ANPR network has to be comprehensive and a lot of work has gone on over the last couple of years both to extend the primary network but also to work with partners using ANPR for other purposes. Since the launch of Project Columbus in 2006, a concerted effort has been made to extend the national ANPR network to cover private-sector sites including car parks, shopping centres and petrol stations.

The aim is to expand the system to 100 million 'reads' per day, all of which will be stored by the National ANPR Data Centre in Hendon. These reads will provide the time, data and place of each vehicle sighting and will be stored for five years providing a valuable source of intelligence for the future.

An additional source of ANPR data has become available over the last couple of years as local authorities all over the country invest in journey-time measurement systems. They are doing this because the Traffic Management Act 2004, which requires local authorities to tackle congestion and disruption on their road network, is now