JCT Signal Symposium 2013

A short paper by:

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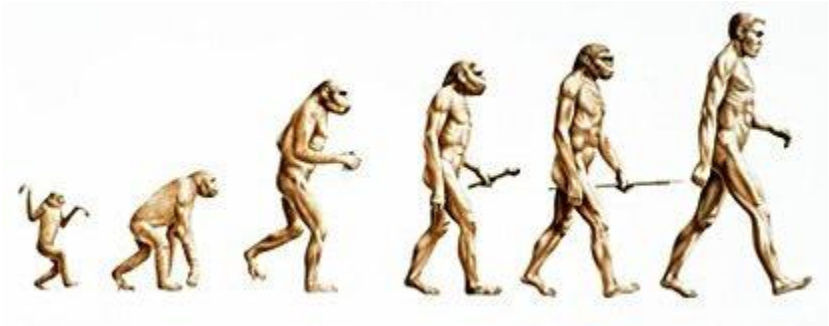
Aspect Traffic Solutions Ltd

'THE MISSING LINK'



VA – CLF – FT UTC – SCOOT – MOVA – LINKED MOVA

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About six or seven years ago having become more involved in MOVA design and implementation with JSTSM and with a background of highways and signal design, SCOOT system commissioning and validation, previously spanning twenty odd years I had the idea and desire to provide a greater integration between SCOOT and MOVA control systems.

The industry has been debating the pros and cons of each system for some time, with comparative live tests and copious modelling, hooked on the search for the holy grail of 'which is the best' operational strategy.

You'll be pleased to know that this short paper doesn't get involved in the comparison of the two systems, because in my view, each has its place. Many local authorities now implement and utilise BOTH strategies providing the opportunity to pick and choose between each as they see fit.

UTMC and UG405 development, now acknowledges parallel system architecture with the integration of OMCU MOVA and Outstation Transmission Units and the relatively new MO, MR, ML & MF ancillary bit mnemonics now forming part of UTC timetable control and fault reporting associated with MOVA / UTC nodes.

Clients with SCOOT systems and with the foresight to implement MOVA as a parallel control strategy may be interested in further integration utilising MOVA and UTC system communications, providing 'traditional' MOVA linking **without** a hard wire link and **without** a bespoke wireless communication system.

In deciding to put pen to paper on this topic I am cautious in assuming that this technique has never been used before. I have consulted with the leading controller configuration engineers and they have declared that their controller conditioning has not included this technique. I have also spoken with some local authorities and they have not used the technique in their control systems.

If we take the example of two or more adjacent SCOOT nodes and add MOVA control to some or all of them, we have two parallel strategies where the traffic engineer chooses to run either, SCOOT, MOVA or even a mix of both: (Martin Wylie's Southampton trials refer).

Depending on the distance between nodes the implementation of MOVA may or may not include the provision of a hard-wire link, to enable relatively close junctions with either integral duct systems or systems that can be easily 'joined up' to utilise 'standard' or 'traditional' MOVA linking techniques as developed by JSTSM. This provides the traffic engineer with TWO systems capable of providing a linked control strategy.

Junctions distant enough to form SCOOT Region Boundaries are unlikely to require 'firm' linking. Whilst SCOOT can and will provide coordination over longer distances, benefit is reduced due to platoon dispersal and the potential for an increase in overall lost time and subsequent reduction in node efficiency.

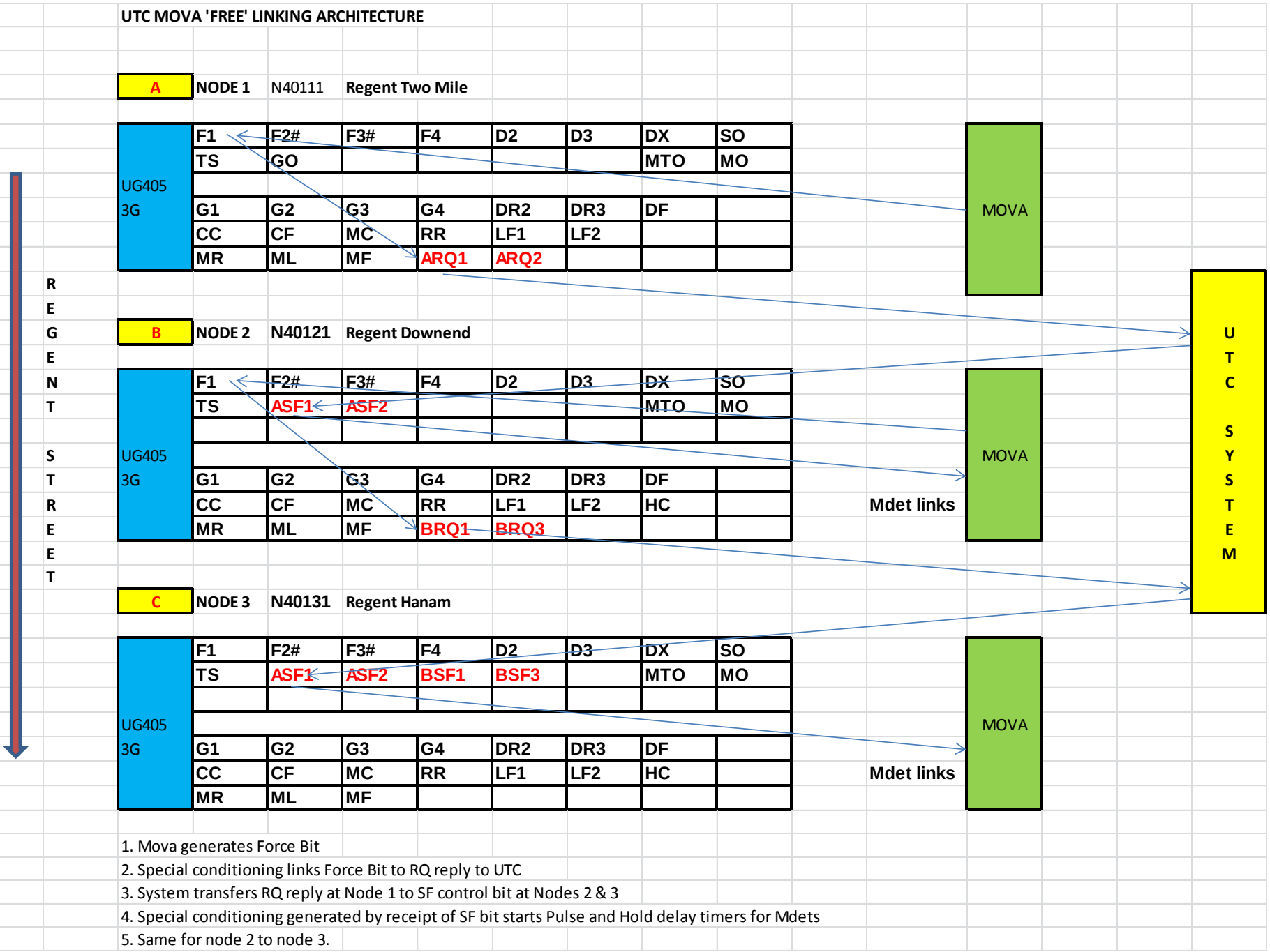
Under current strategies, junctions that are closely spaced say 100m-200m distant, which do not have integrated duct systems and where the project funds cannot afford to enhance the infrastructure, these sites will probably remain unlinked under MOVA 'fall-back' control. We might consider the use of wireless linking in which case, the sites can be linked using this technology.

Let's go back to the analogy where there simply isn't any budget for enhanced infrastructure and a bespoke wireless system cannot be provided.

Here's where the missing link technique comes in.

Below is the system architecture for MOVA linking using UTC communications:

UTC MOVA 'FREE' LINKING ARCHITECTURE

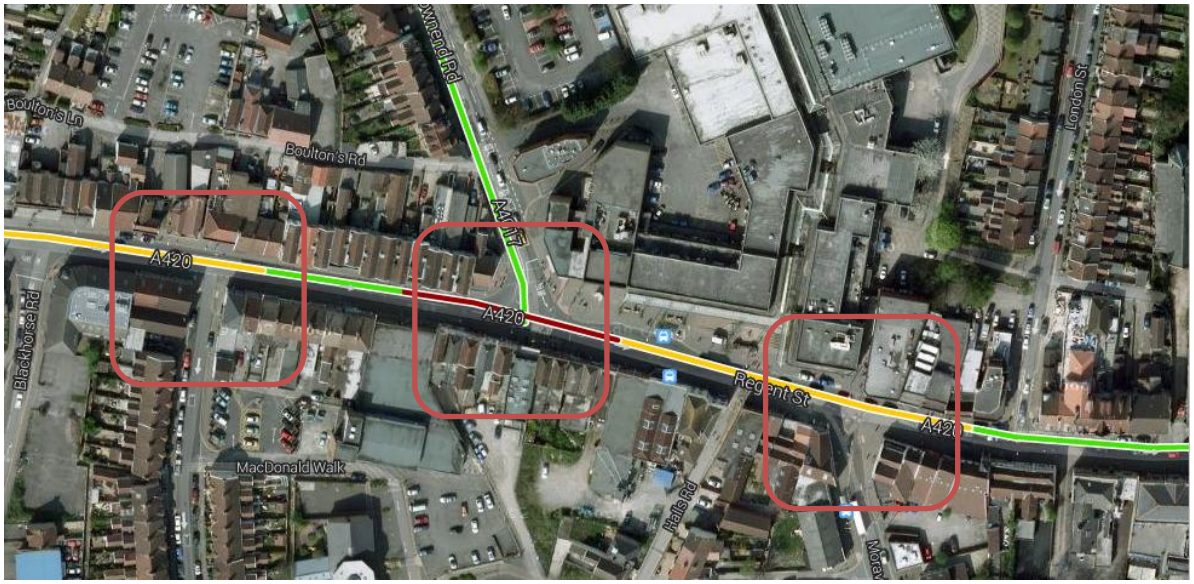


1. Mova generates Force Bit
2. Special conditioning links Force Bit to RQ reply to UTC
3. System transfers RQ reply at Node 1 to SF control bit at Nodes 2 & 3
4. Special conditioning generated by receipt of SF bit starts Pulse and Hold delay timers for Mdets
5. Same for node 2 to node 3.

After several years (a bit like waiting for a red bus to come along) as luck would have it I have two projects in the same financial year both with similar installation time frames and both with similar client requirements.

Two existing SCOOT junctions are to be refurbished in Cheltenham Gloucestershire, both incorporating upgrade to MOVA control. No duct link between the junctions and no cash to extend the infrastructure.

Three junctions in Kingswood South Gloucestershire, previously running DUSC, are to be upgraded to MOVA and SCOOT control with new 3G communications. There are no inter-linking ducts between adjacent nodes. A Wireless linking system is not only an additional cost, but there are line of sight issues to overcome. The installation of 3G routers with UG405's provides communication without the expense of Broadband. In the above South Gloucestershire example, the road network is linear one way. The objective is 'simple'! Clear the traffic in Kingswood High Street as part of a bus priority and air quality management brief.



Google map image

We can pass RQ and SF bits between nodes using the UTC system and its communications, providing **FREE** linking!

This is how it works.

Junction A - Node 40111 O.T.U. X40110

A MOVA Force bit for Stage-1 generates an RQ (remote request) reply bit back to the instation.

The RQ bit is translated to an SF (special facility bit) at the UTC instation which replies to **Junction B - N40121 O.T.U. X40120.**

The receipt of the SF bit supplies a mnemonic input to the controller where via special conditioning delay timers are set and outputs to MOVA link detectors are provided.

The same rationale can be applied between junctions B & C and the same rationale can be applied to any other forced stage from the upstream junction.

The provision of PULSE and or more particularly HOLD outputs can keep downstream main stages active long enough for normal MOVA detector activity to take over control, reducing the likelihood of stop starts whilst maintaining the flexibility and efficiency of MOVA control.

Variations in the controller special conditioning can allow for the presence of demands or extensions in order to set pulses and holds appropriately and take account of revert to all red or revert to main stage conditions. The controller can also utilise timetable events to add or remove outputs by time of day, remembering that UTC time synchronisation will ensure that these events are correctly applied.

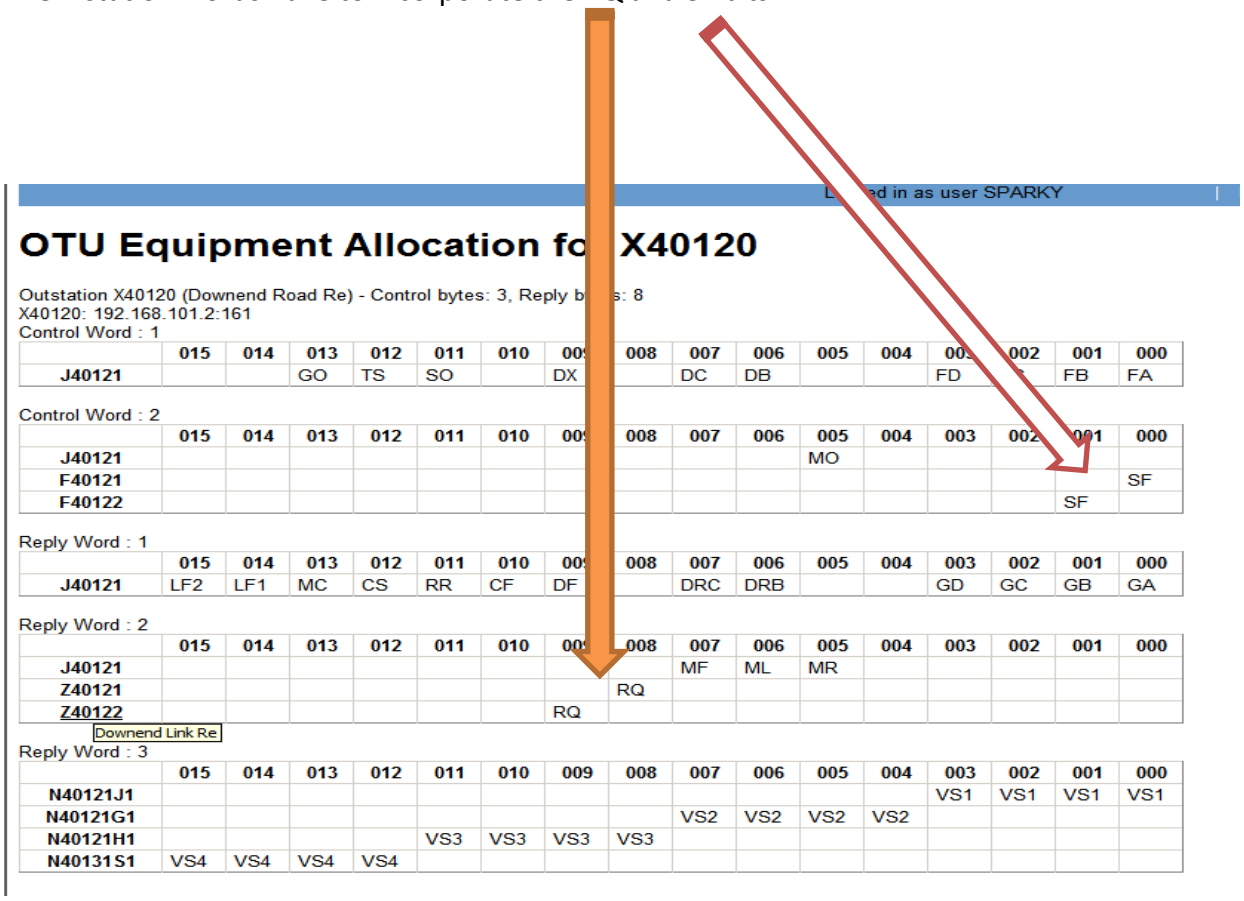
Setting the RQ and SF data has been an 'experiment'. I have found a method that works in terms of bit transfer and translation at the Siemens UTC instation. There may be other methods of achieving this unknown to the author. In the fullness of time, if the benefit of utilising this system is proven, there would undoubtedly be scope to incorporate linking bit transfer data as part of the UTC system database.

SYSTEM DATABASE SETTINGS

(A Siemens system is used. It is acknowledged that the Peek UTC system will be equally capable)

There is most likely more than one way to configure the UTC system bits. I can see two ways of preparing the Remote Request elements of the database, no doubt there are others and quite possibly the potential to 'overlay' bits to achieve the same outcome; although I would not recommend the latter.

The instation words have to incorporate the RQ and SF bits.



Logged in as user SPARKY

OTU Equipment Allocation fo X40120

Outstation X40120 (Downend Road Re) - Control bytes: 3, Reply b s: 8
X40120: 192.168.101.2:161

Control Word : 1

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121			GO	TS	SO		DX		DC	DB			FD		FB	FA

Control Word : 2

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121											MO					
F40121																SF
F40122															SF	

Reply Word : 1

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121	LF2	LF1	MC	CS	RR	CF	DF		DRC	DRB			GD	GC	GB	GA

Reply Word : 2

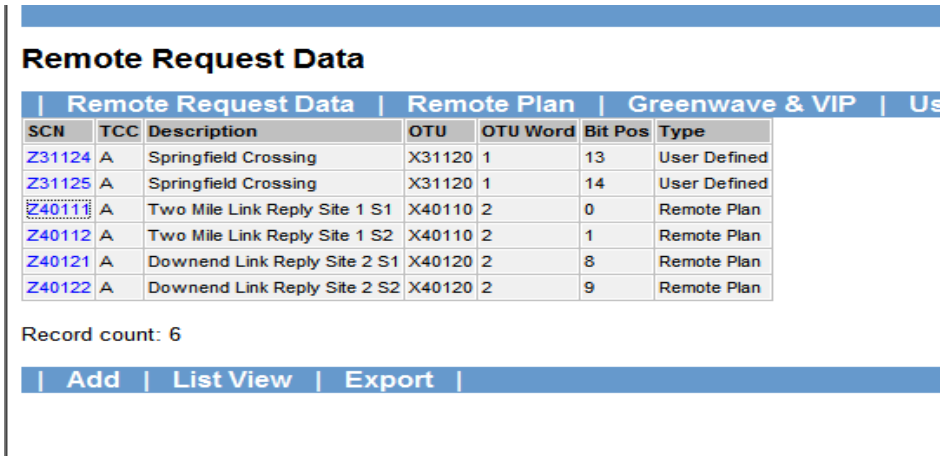
	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121									MF	ML	MR					
Z40121								RQ								
Z40122							RQ									

Downend Link Re

Reply Word : 3

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
N40121J1													VS1	VS1	VS1	VS1
N40121G1									VS2	VS2	VS2	VS2				
N40121H1					VS3	VS3	VS3	VS3								
N40131S1	VS4	VS4	VS4	VS4												

The detail for the position and format of the bits is prepared in the Remote Request Data page. The html database screens are shown, but you can use DBAS.



Remote Request Data

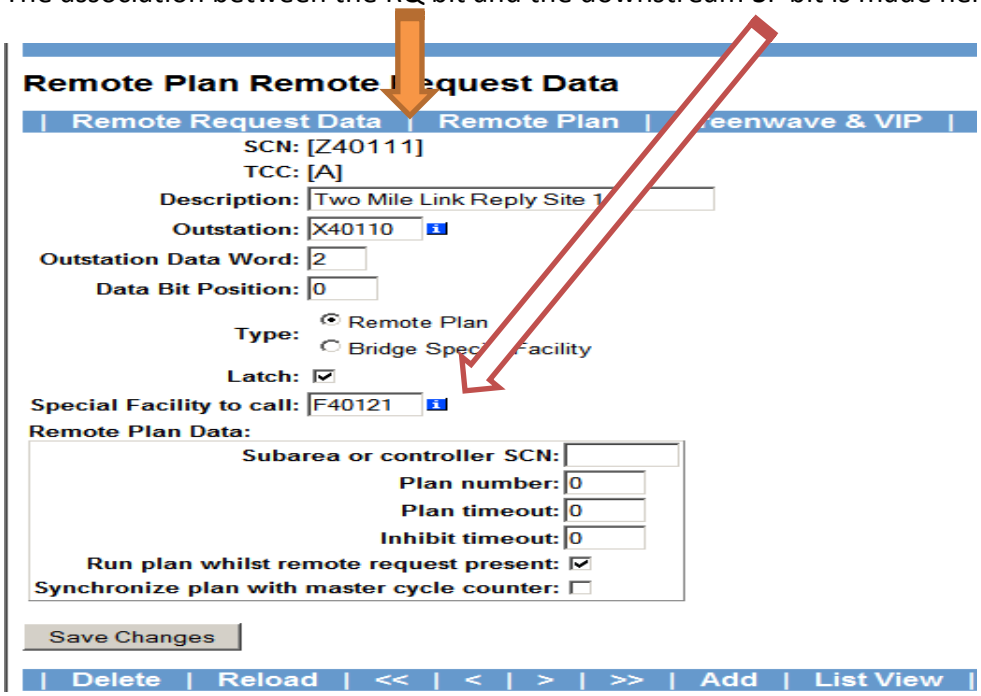
| Remote Request Data | Remote Plan | Greenwave & VIP | Us

SCN	TCC	Description	OTU	OTU Word	Bit Pos	Type
Z31124	A	Springfield Crossing	X31120	1	13	User Defined
Z31125	A	Springfield Crossing	X31120	1	14	User Defined
Z40111	A	Two Mile Link Reply Site 1 S1	X40110	2	0	Remote Plan
Z40112	A	Two Mile Link Reply Site 1 S2	X40110	2	1	Remote Plan
Z40121	A	Downend Link Reply Site 2 S1	X40120	2	8	Remote Plan
Z40122	A	Downend Link Reply Site 2 S2	X40120	2	9	Remote Plan

Record count: 6

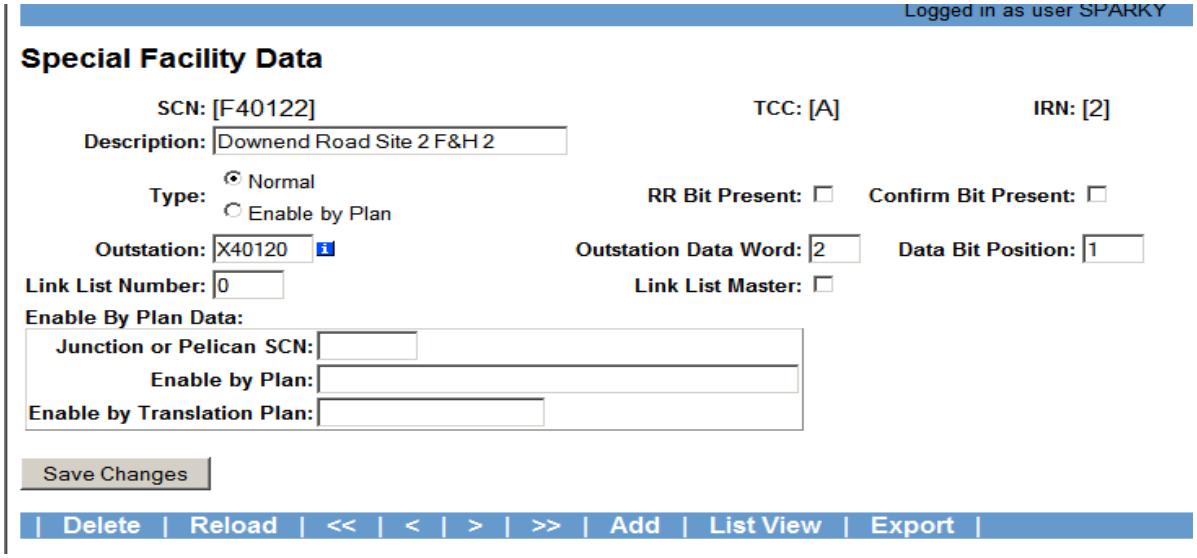
| Add | List View | Export |

The association between the RQ bit and the downstream SF bit is made here.

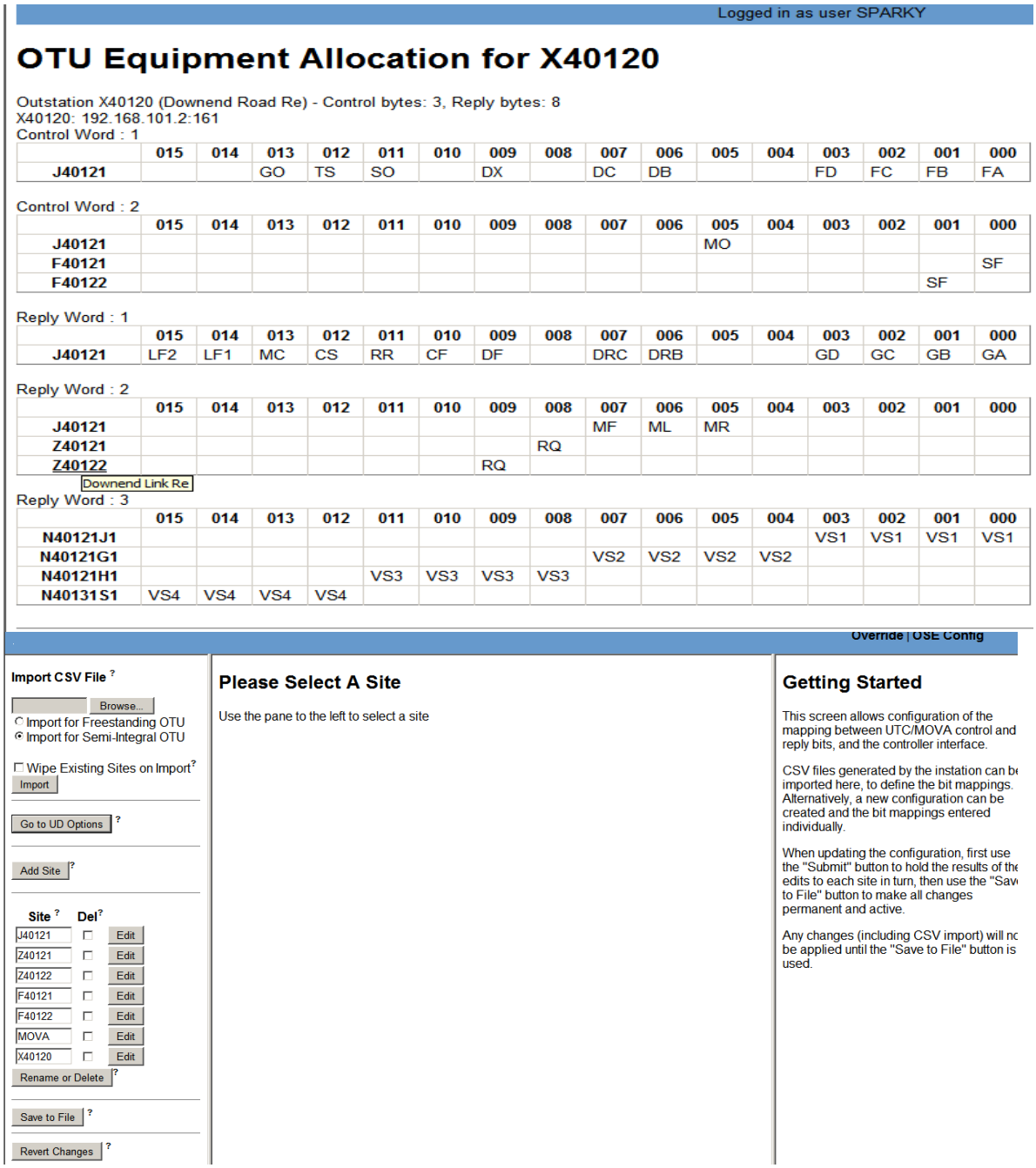


To complete the linking association, the RQ bit is set in the UPSTREAM O.T.U, and the SF bit is set in the DOWNSTREAM O.T.U. The two bits are 'latched' together.

The Special Facility Data page is used to input this data.



The UG405 outstation is configured with Reply (Zxxxxx) inputs which need to be manually inverted and SF (Fxxxxx) bits. Corresponding bit positions have to be used in the instation and outstation setup.



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OTU Equipment Allocation for X40120

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Control Word : 1

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121			GO	TS	SO		DX		DC	DB			FD	FC	FB	FA

Control Word : 2

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121											MO					
F40121																SF
F40122															SF	

Reply Word : 1

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121	LF2	LF1	MC	CS	RR	CF	DF		DRC	DRB			GD	GC	GB	GA

Reply Word : 2

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
J40121									MF	ML	MR					
Z40121								RQ								
Z40122							RQ									

Downend Link Re

Reply Word : 3

	015	014	013	012	011	010	009	008	007	006	005	004	003	002	001	000
N40121J1													VS1	VS1	VS1	VS1
N40121G1									VS2	VS2	VS2	VS2				
N40121H1					VS3	VS3	VS3	VS3								
N40131S1	VS4	VS4	VS4	VS4												

Override | OSE Config

Import CSV File ?
Browse...
Import for Freestanding OTU
Import for Semi-Integral OTU
Wipe Existing Sites on Import?
Import
Go to UD Options ?
Add Site ?
Site ? Del?
J40121 Edit
Z40121 Edit
Z40122 Edit
F40121 Edit
F40122 Edit
MOVA Edit
X40120 Edit
Rename or Delete ?
Save to File ?
Revert Changes ?

Please Select A Site

Use the pane to the left to select a site

Getting Started

This screen allows configuration of the mapping between UTC/MOVA control and reply bits, and the controller interface.

CSV files generated by the instation can be imported here, to define the bit mappings. Alternatively, a new configuration can be created and the bit mappings entered individually.

When updating the configuration, first use the "Submit" button to hold the results of the edits to each site in turn, then use the "Save to File" button to make all changes permanent and active.

Any changes (including CSV import) will not be applied until the "Save to File" button is used.

Controller special conditioning is used to enable the issuing of the RQ bits to the system and the SF bits out to the MOVA unit as link detectors. Force and Hold delay timers and use of extension conditioning is managed in the 'normal' way. The main difference between this and cable linking is the communications transmission delay, which from experience and observation is consistent enough not to significantly implicate the linking as long as it's taken into account. The whole transmission cycle from appearance of RQ to SF is between 3 & 4 seconds.

THE SYSTEM IN ACTION

Using instation IP addressable connectivity is it now possible to view the Instation MONI / NFTD message screens and the MOVA commissioning screens at the same time.

Real time monitoring via the UTC Instation and on-street validation of the MOVA linking system is undertaken to reduce or remove stop-starts in traffic platoons, whilst maintaining the flexibility of control provided by MOVA. Improved traffic flow between the upstream entry node and subsequent junctions has removed congestion, aided bus movements and will have hopefully improved air quality. (The subject of further testing).

The ability to 'move' between SCOOT and MOVA strategies has yet to be further developed in this particular Region of control. South Gloucestershire in conjunction with Siemens is looking at UTMC Strategy Manager to provide dynamic movement between control strategies. Based on a mixture of monitoring techniques it is envisaged that both SCOOT and LINKED MOVA will be employed to ensure comprehensive management of traffic.

This system is brand new as of August 2013. It is work in progress and experimental. If successful, it is hoped that the application may be useful at many UTC junctions with unlinked MOVA fall-back. Depending on outcomes, it is hoped that the UTC Instation database can be upgraded to incorporate specific MOVA linking RQ & SF bits.

SUMMARY

Linked MOVA using existing or new UTC communications equates to FREE-LINKING, providing a new level of integrated network control with ultimate flexibility when applied to suitably spaced junctions.

Health Warning: Critically spaced or very closely spaced junctions may need to be hard-wired. No system communications means no linking under this strategy!

DWW August 2013 JCT Symposium