

Twin-stream linked MOVA capability improves performance

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Buckbarn Crossroads is a complex junction at the intersection of the A24 and A272 in rural West Sussex, the intersection of these strategic routes comprising a high speed dual carriageway crossroads, with an immediately adjacent

signalised 'T' junction. The A24 north/south dual carriageway is speed limited through the junction to 50 mph; the A272 is an important east/west cross country route connecting a chain of Wealden towns. The site supports a large and

busy service station, fast food restaurant and a small number of residential properties in the south-western corner of the junction, served off a minor arm onto the side road, emerging at the T junction only 40m from the crossroads.



The intersection comprises a high speed dual carriageway crossroads with an immediately adjacent signalised 'T' junction.

Traditionally the major crossroads has operated at or above its practical working capacity in the peaks, particularly the morning peak, when there is heavy northbound ahead and right turning traffic. The adjacent minor T junction was added recently to safely accommodate the exit from the improved service facilities, and has more random flows, significant in the evening peak. Individually each junction has quite different operating characteristics, the minor junction with flows for which normally only short green times and hence a low cycle time are adequate, the major junction requiring moderate green times in the off peak and high green times in the peaks

(with some lane flows in excess of a thousand vehicles per hour). Outside the peaks, all four major approaches are high speed. It was imperative the minor junction should not block back into the major junction, for safety and capacity reasons.

The former single stream solution (both junctions running on a common cycle time) created significant delay on the service station exit to the T junction, since cycle time was determined by the major junction; the current arrangement uses the Sentinel Controller's twin-stream capability to run two separate but linked streams, to provide improved flexibility and performance, allowing each stream to operate appropriate green times, achieving optimum performance at the major junction, with MOVA Linking to control co-ordination through the minor junction when needed.

The requirements of this site are readily accommodated in the standard facilities of the Microsense Sentinel Controller, facilities which include an integral 6U rack mounted power supply, CPU, lamp switch cards, integral lamp monitoring unit, and space for a number of additional loop detector, SD/SA or other cards; a rack extension may be added to support additional equipment for larger or more complex sites (the small case Sentinel supports up to 8 phases). This example supports 41 MXED detector channels required for these two junctions, (well within the 96 input capacity of the controller), uses 11 of the 32 phase capacity of this large case Sentinel, eight phases on one stream and three on the minor stream.

The streams each operate validated Linked MOVA, the major junction with effectively independent MOVA operation which when necessary directs stage changes at the minor junction. MOVA operation at the minor junction achieves co-ordinated movement of large flows leaving the major junction through the minor junction, and ensures

that queues waiting on the internal approach to the minor junction cannot extend back into the high speed dual carriageway at the major junction. Detection includes the standard MOVA IN X and stopline loops in the usual configuration; some detection serves both streams simultaneously, some detectors are also used as queue loops, with innovative use of microwave detection on the multiple lane approach from the services.

The operation of MOVA at this junction has greatly improved performance and co-ordination of the two streams compared with the VA alternative. The always-on nature of integral MOVA means there is a high up time with as yet no logs of MOVA dropping offline. The lack of external hardware for MOVA implementation means less equipment to maintain and have available spares for. Detection can be monitored through the normal handset port without the need to have complex wiring duplicating the MOVA loops that would normally go direct to the external unit. Coupled with the initial purchase cost savings compared with the external style units the Sentinel controller offers a very flexible and cost effective unit.

Like its predecessor the MTC, the Sentinel runs MOVA as an integral facility on its main CPU card, not requiring an additional card in the controller, which decreases part count and improves reliability. As well as being compliant with and approved to UK HA specification TR2210A², the Sentinel supports a number of facilities not often required for use in the UK but which make the controller a very versatile product, including LRT facilities for tram and light rail applications, and for instance flashing lamp sequences used at ambulance stations, fire stations, and flashing amber operation for wig-wag and non-uk operation¹.

For non-MOVA applications, 'calendar event' facilities provide a set of tools for changing the operation of the controller to accommodate changes in the traffic due to predictable events, for example the effects of a home football match or peaks in shopping around festivals or holidays, and for these arrangements up to eight different actions (eg mode selection, timing sets) can be associated with any particular day/time setting in the calendar.

MOVA however accommodates changing traffic conditions automatically, and this application in particular has demonstrated the exceptional flexibility which is needed to effectively control two junctions so fundamentally different in operational requirements, including allowing service area traffic to escape into the system flexibly subject only to the requirements to prevent exit blocking from the main junction and achieve co-ordination of traffic from the major junction through the minor junction.

The solution implemented provides both safe closures of the high speed approaches, and high capability control of the high volume in the peaks, the most able mode capable of providing effective and safe control in these operating conditions, making this controller and this technique a powerful tool for optimising traffic control at closely spaced as well as free standing junctions^{1pp67 - 69}).

The following summarises current and projected Sentinel controller capabilities:

- MOVA: Up to 8 Streams available, of which two streams are capable of providing MOVA control, allowing linked operation within a single controller. The MOVA version currently incorporated, V4.2, achieves unlatching pedestrian facilities and bus / emergency vehicle priority working, with up to 64 Detectors, 20 lanes, 24 links and 10 stages, with the Compact MOVA application currently under development.



The A272 is an important east/west cross country route.

- UTC: Most UTC inputs can be monitored and overridden if signals remain active too long; LRT may be inhibited from UTC.
- CLF: Plans may be tested from the handset interface. The Sentinel's Clock Reference timing system may be derived from a crystal oscillator or from counting mains cycles. It can transfer from the crystal reference to mains reference at a selected time of day, to synchronise CLF plans.
- Ripple Change Stage Moves are available; a stage move can be marked as a ripple change to allow the controller to decide to move to a different stage during interstage; interphase green times and minimum greens are respected, as are the normal rules about not missing demanded stages.
- Special Conditioning statements in the junction configuration gives the user the scope to implement sophisticated logical control of the signals and other attached equipment, limited only by the imagination of the designer. Special Conditioning configuration has been designed to give a wide range of access to and influence over the controller's facilities, presented entirely in terms

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of traffic facilities ie no knowledge of the controller's code structure is required. Facilities include, for instance, specific timetable functions (controller influences are grouped so that a number of them can be applied as a group from a single timetable entry, and a wide range of timetable influences are available including setting flags, which may then be used in special conditioning statements), of particular interest in advanced design, enabling Control to respond to traffic conditions reported by MOVA, for instance end of saturation flags.

- A comprehensive set of pedestrian linking conditions is defined, allowing prioritised UTC and local link operation. Pedestrian Intergreens can be defined with respect to the pedestrian phase so that intergreens to each conflicting phase need not be specified individually (although they may be).
- Audible and tactile signals may be limited in duration (to less than the pedestrian green period). Interlock signals can be generated to inhibit audible signals. Confirmation signals from the audibles / tactiles can be monitored.
- Detector Self Reset: Following the failure of a detector due to detector fault monitoring, it can happen that the detector will start working again, usually resulting from inactivity on street rather than a genuine fault; DSR allows the detector's fault state to be cleared automatically if a defined amount of activity is seen, hence enabling improved response to genuine faults.
- Timetable Calendar Priority Slots: The calendar year can be split between a number of prioritised levels. Several blocks of time can be allocated to each priority level, any time not explicitly allocated remains in level 1, the base level. The calendar divisions are to a resolution of one hour. Any timetable entry can be hooked up to none, one or more of these priority levels, and the event is then active when that priority level is operational.
- Integral Lamp Monitoring provides general lamp failure monitoring as well as the mandatory red lamp monitoring features of TR2210A; it includes monitoring multiple bulb displays of LRT heads as well as more normal halogen or tungsten filament bulbs. Flashing signal states can also be monitored.

- Speed Measurement: This facility can be used for general speed measurement as well as giving the features required by SD/SA, opening the possibility of its use in traffic surveys. The results are visible to special conditioning, enabling counters and timers to be used in analysing flow patterns.
- Manual Panel: extra switches and indicators can be fitted to provide additional facilities through special conditioning. A next stage facility (nudge) can be implemented in this way.
- Bus Priority and LRT: In addition to the features provided for TR2210A, the sentinel provides 'intelligent compensation' whereby the skewed distribution of time to stages is automatically corrected with the minimum requirement for configuration data. This compensation method will also be available to use with LRT. LRT mode is provided to give flexible operation with trams, allowing them priority without unnecessarily disturbing the normal junction operation. LRT events may be identified by a set of detector transitions, and fault patterns can be recognised on detector inputs.
- When used with an IFC card the CPU is able to provide monitoring data over the handset port connection while still maintaining the engineer handset port connection, via the IFC port. The IFC can collate and report data to an instation.
- A wide range of handset commands are available over the Engineer's port allowing inspection and amendment of controller parameters. The LMP handset command allows the commissioning engineer to check the street wiring connections and to verify ILM assignment. When signals are switched off, the controller Mimic Mode continues to process input data and to drive the led mimic displays on the LSC front panels as if it were controlling the junction, allowing the commissioning engineer to confirm that the controller is operating correctly whilst lamps are off.

REFERENCES

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