Providing Connectivity for Axle Counters

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Solutions for interconnecting Axle counters having Analog Modem or RS232 interface over Direct Optical Fiber, or over Copper using G.shdsl Modems, or over Railways Shared OFC Backbone accessed through Cable Huts

Axle Counters are a sophisticated equipment which perform the task of tracking the entry and exit of a train in a block section. A pair of axle counters – one at the entry to the block section and one at the exit – count the number of axles passing on the track. A comparison of these two counts at any point of time determines whether a train is present in the block section or not.

The two axle counters need to communicate with each other to exchange axle count information. Serial communication is used for this purpose. The physical medium over which communication takes place is typically a copper circuit. Serial data is sent from one axle counter to the other using either an external or a built-in modem. If the modem is external, the communication interface between the axle counter and the modem is RS232. The modems typically used are analog modems, compliant with standards such as as V.21, V.23 or V.32 on a 2-wire copper circuit.

Since axle counters provide critical inputs to the signalling and safety set up required for running trains, the communication between the pair of axle counters should be reliable and efficient. However this is often difficult to achieve when long copper circuits are used to interconnect axle counters. These circuits can conduct surge currents induced by electrical phenomena such as lightning strikes, proximity to traction wires, etc., causing data errors, or even damage to connected equipment. Performance of copper circuits can be affected by seepage of water and moisture etc. Also copper, being valuable, is vulnerable to theft.

Cygnus offers several solutions to avoid the use of long copper wires between Axle counters, directly or through external modems.

A. Interconnecting axle counters using a dedicated Optical Fiber link

A pair of CYGNUS 855 Fiber Optic Modems can be used to interconnect axle counters over a dedicated fiber link. Depending on whether the axle counters have a RS232 interface or a built-in modem, CYGNUS 855 may be ordered with either RS232 or with an interface conforming to 2-wire V.21, V.23 or V.32 standard. The dedicated optical fiber between the two modems can easily be a few kilometers long.

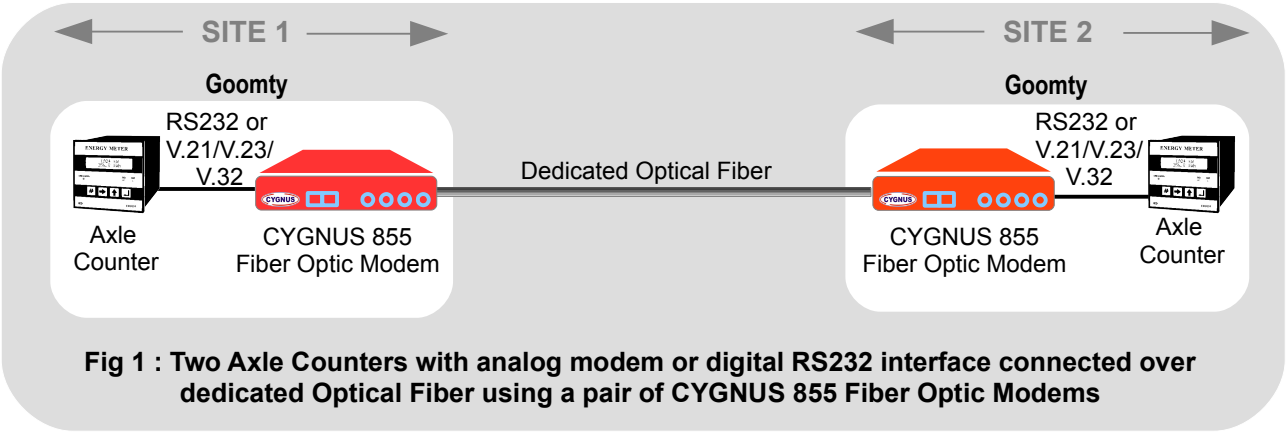

Fig 1 : Two Axle Counters with analog modem or digital RS232 interface connected over dedicated Optical Fiber using a pair of CYGNUS 855 Fiber Optic Modems

B. Interconnecting axle counters using 2 Mbps Link derived from a STM Mux based Fiber network

If a long distance Optical Fiber network based on STM Muxes is available, a 2 Mbps E1 "pipe" can be provisioned over it for interconnecting the two axle counters. Since E1 ports from this network will be available at the STM Muxes located in the "cable hut", two factors need to be tackled to allow the axle counters to use this E1 pipe: (a) the output from each axle counter – whether analog modem or RS232 - must be converted to E1 format, and (b) the axle counter data must be extended to the E1 port in the cable hut. All four solutions shown below achieve tackle these factors. Any of these solutions may be used based on the situation.

B.1 The axle counter has either RS232 or analog modem interface, the axle counter goomty is located close to the cable hut, and a 4-wire copper circuit is available from the goomty to the cable hut

The scheme shown in Fig 2 may be used in this case. CYGNUS 835 Converter is used to convert the RS232 or analog modem signal of the axle counter to E1 format. The E1 signal is then carried to the cable hut over a 4-wire copper circuit between the goomty and the cable hut. This scheme can be used if the length of the copper circuit between the goomty and cable hut is small (not more than a few hundred meters).

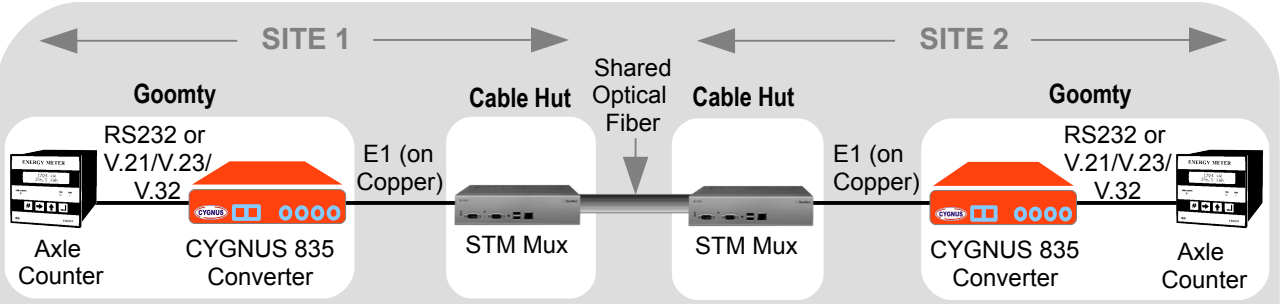

Fig 2 : Two Axle Counters with analog V.21 or digital RS232 interface are converted to E1. The E1 signal is carried to the cable hut over a copper circuit and connected to STM Muxes there. Note: The distance over which E1 is carried on copper wires should not be more than a few hundred meters so as to avoid E1 signal degradation

B.2 The axle counter has analog modem interface, and a 2-wire copper circuit is available to transport this analog modem signal to the cable hut

Fig 3 shows a solution. A CYGNUS 835 Converter in the cable hut converts between analog modem output of the axle counter and E1. The copper circuit carrying the analog signal from goomty to cable hut should be less than a kilometer long to minimise the chances of electrical interference affecting communication.

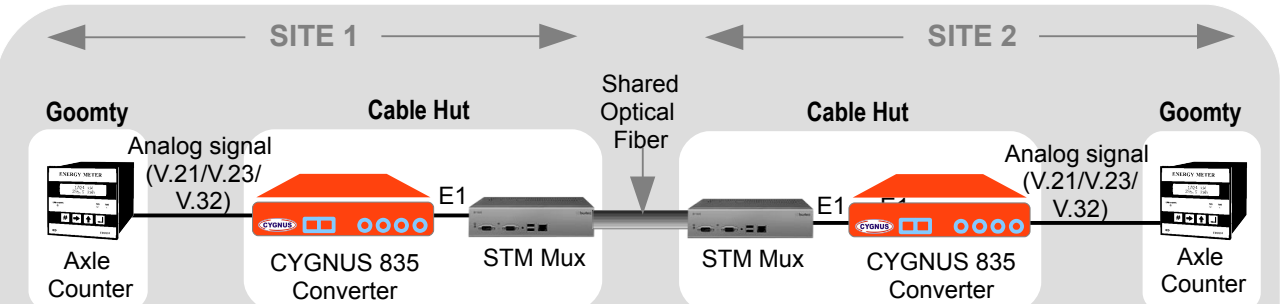

Fig 3. Axle counters' analog output is carried to cable hut over copper and is converted to E1 using CYGNUS 835 converters. The resulting E1 streams are interconnected over shared fiber using STM Mux

B3. The axle counter has either RS232 or analog modem interface, but the goomty some distance away from the cable hut. A 2-wire copper circuit is available from the goomty to the cable hut.

In this case a pair of CYGNUS 850 G.SHDSL modems may be used to connect each axle counter to the E1 port. These modems can carry digital signals at 2 Mbps on a single copper pair. The arrangement is shown in Fig 4. The modem at the goomty interfaces with the Axle counter through analog modem or digital RS232 interface. It links up with a modem at the cable hut over 2-wire copper circuit. The modem at the cable hut has E1 interface, which directly connects to the STM Mux. The same arrangement is repeated at the second axle counter. Though the copper circuit length between axle counter and cable hut can be in kilometers as per G.shdsl standard, for superior performance it would be better if the length is restricted to a smaller distance. Since G.SHDSL uses multilevel digital modulation, its performance is better than the scheme described in section B.2 above.

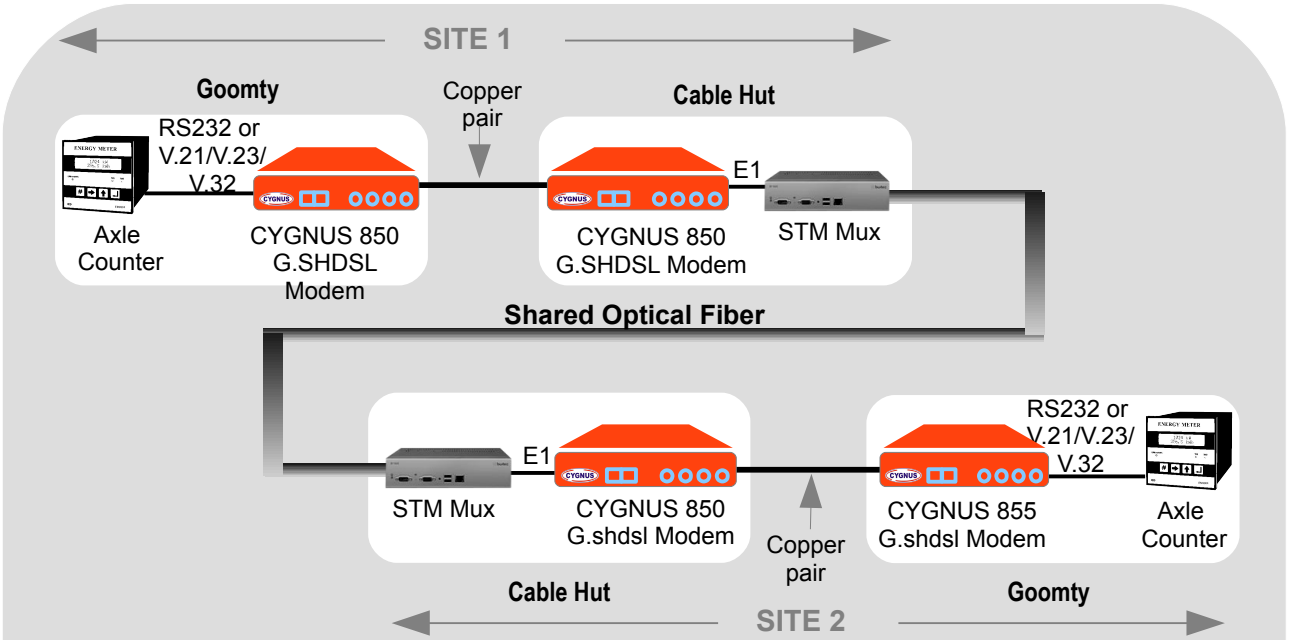

Fig 4: Axle counter analog or RS232 output is driven to the cable hut over copper circuit. At the cable hut the signal is connected to the STM mux over an E1 port. The link between the two axle counter sites is provisioned over the shared Optical Fiber Network

The solutions described in B.1 – B.3 above provide the connectivity required to establish communication between two axle counters. However each of these solutions has at least one segment of copper circuit in the overall path - in the connection from the goomty to the cable hut. As already mentioned, copper circuits have several problems associated with them from an operational point of view.

B4. Optical Fiber used between goomty and cable hut

The problems associated with copper circuits can be eliminated in an assured way if the goomty-to-cable hut section is also on optical fiber. This will ensure that only fiber is used on the entire path between the two axle counters. This solution is shown in Fig 5. The reliability of interconnection is much higher as fiber to electrical interference, and the signal quality over fiber is also superior than that over copper. Of course this solution requires fiber to be laid between the goomty and the cable hut. The solution shown in Fig 5 has a CYGNUS 855 Fiber Optic Modem in the goomty, which interfaces with the axle counter through analog modem or digital RS232 interface. The counterpart CYGNUS 855 modem kept at the cable hut has E1 interface, which is connected to the STM Mux. STM Muxes provide E1 interconnection over the Shared Optical Fiber, thereby completing end-to-end fiber connection.

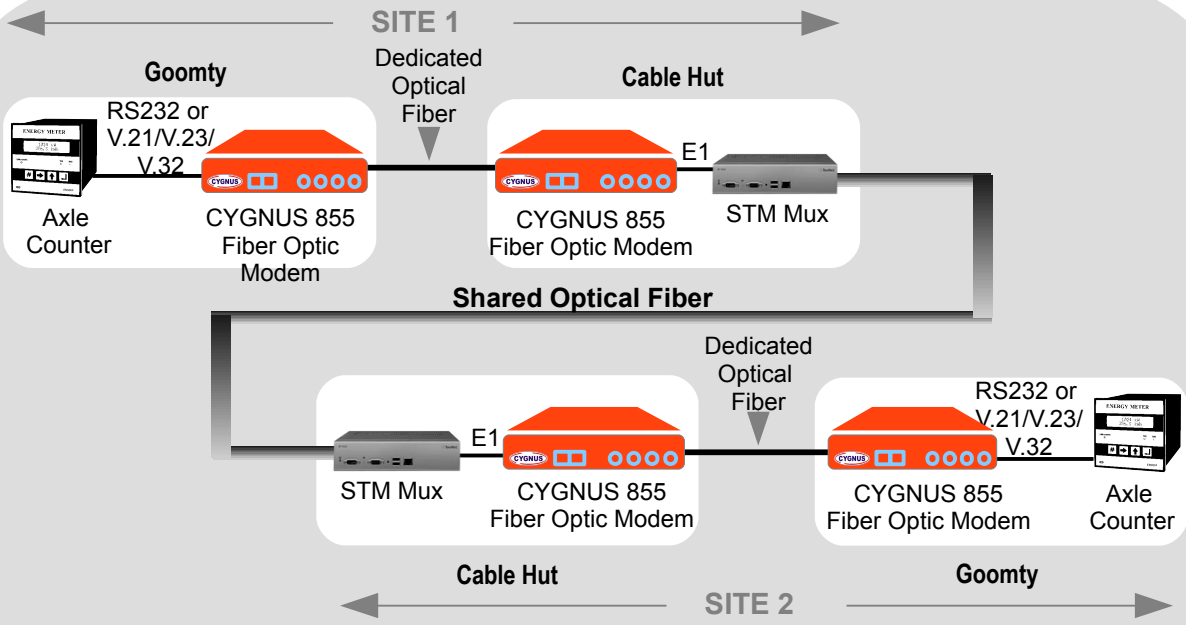

Fig 5: Axle counter analog or RS232 output is driven to the cable hut over dedicated fiber. At the cable hut the signal is connected to the STM mux over an E1 port. The link between the two axle counter sites is provisioned over the shared Optical Fiber Network

Note that it is possible to use any of the solutions described in sections B.1-B.4 on either end of the end-to-end connection between axle counters. The solution used at one end is independent of the one used at the other end. The decision of which scheme to use at a site will be based on distance between the goomty there to the cable hut, and availability of copper or fiber circuit between the goomty and the cable hut. All the above solutions use a common scheme of conversion of analog modem signal or digital RS232 signal to E1. All products – CYGNUS 855 Fiber Optic Modem, CYGNUS 835 converter and CYGNUS 850 G.SHDSL modem are capable of interfacing to the axle counter using analog modem or digital RS232 interface. However it should be kept in mind that the axle counters to be interconnected should have an identical interface.

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