Interconnecting Data Loggers / RTUs

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Interconnecting Data Loggers and RTUs using G.shdsl Copper based modems or Fiber Optic Modems on Direct Optical Fiber or shared OFC Backbone accessed through Cable Huts using E1 converters or Over Resilient Fiber Optic Ring Network

Data Loggers and RTUs are vital track side devices which monitor various equipment and parameters. These devices are typically connected in a chain and transfer data to a central unit using point-to-point links that are formed using analog modems connected over copper cables. In some cases Data Loggers have been provided an E1 interface which converts the internal RS232 signal into E1 for outside connection. CYGNUS products allow a number of options for interconnection of Data Loggers and RTUs as described in the following sections.

A. Interconnecting Data Loggers/RTUs over G.SHDSL based Copper or direct Optical Fiber Links

There is scope to improve the communication used in the Data Logger system by replacing the analog modem-copper wire infrastructure with G.shdsl based modems on copper or Fiber Modems. G.shdsl technique used on copper can also provide better noise immunity upto a distance of few kilometers as the communication is digital. Optical Fiber can provide even better performance due to long range – 15 km or more – and at low error rate. Optical fiber is a medium that is immune to electrical disturbance, threat of theft, or performance degradation due to weather changes.

Fig 1 describes a simple replacement of analog copper modems with G.shdsl Modem CYGNUS 850 for copper. The required speed of 57.6 kbps can be easily obtained using these modems.

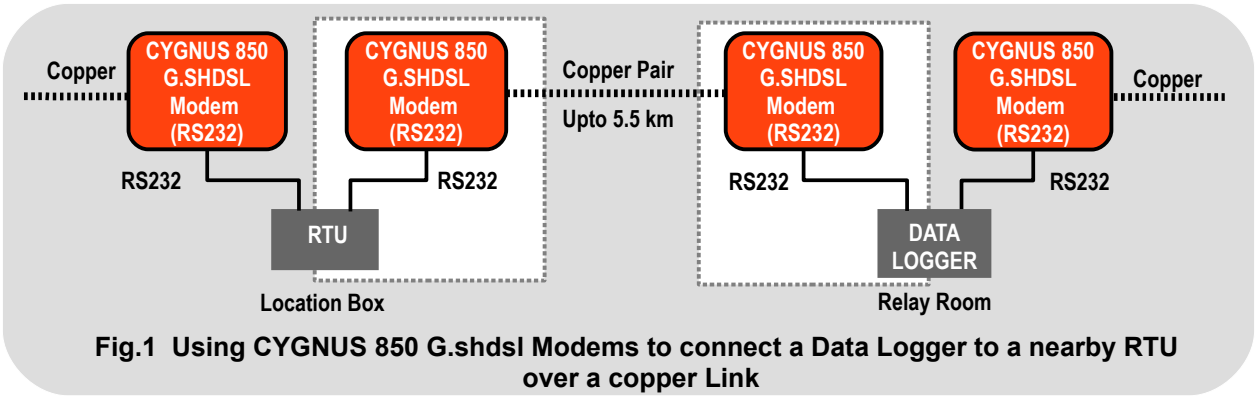

Fig.1 Using CYGNUS 850 G.shdsl Modems to connect a Data Logger to a nearby RTU over a copper Link

Fig 2 describes a simple replacement of analog copper modems with Modular Fiber Optic Modem CYGNUS 855 over direct optical fiber between the two. The required speed of 57.6 kbps can be easily obtained using these modems.

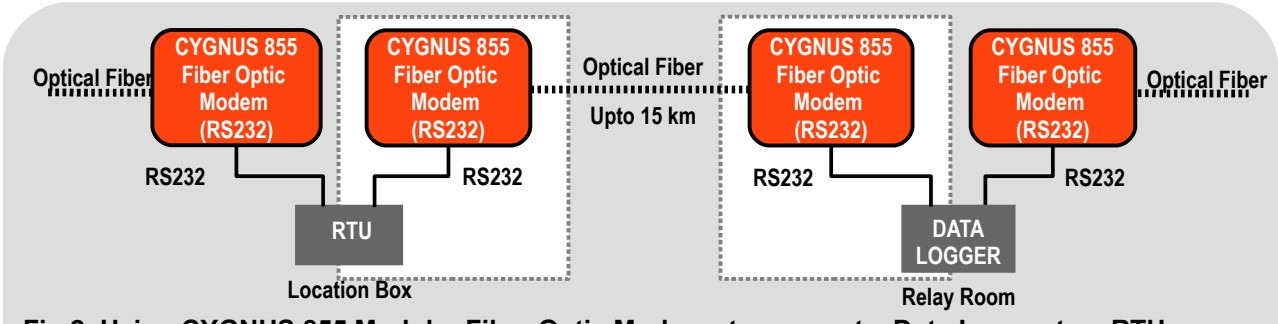

Fig.2 Using CYGNUS 855 Modular Fiber Optic Modems to connect a Data Logger to a RTU over a directly laid Fiber Optical Fiber Link

CYGNUS 883M RS232 port extender is a low cost solution for connecting two RTU/Data Loggers. The setup is shown in Fig 3. CYGNUS 883M can also be optionally ordered with hot standby fiber link. This link can be routed separately so that during the failure of the main Fiber link it can take over the communication transparently.

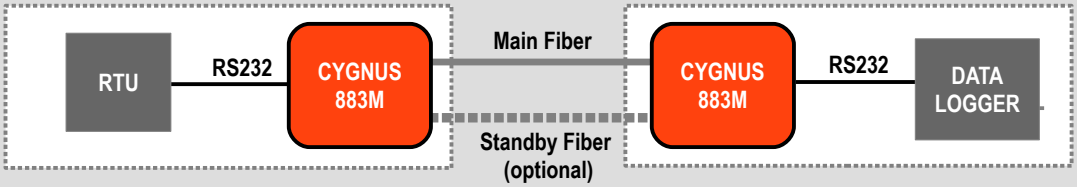

Fig. 3 A pair of CYGNUS 883M Fiber Optic Port Extender is used for connecting RTU and Data Logger (A standby optical Fiber is also provided for link redundancy if the same can be laid over an alternate route

B. Interconnecting Data Loggers/RTUs over E1 using RS232-E1 converter

This solution is useful if Data Loggers/RTUs have RS232 interfaces for connecting to each other. If when the Data Loggers/RTUs to be interconnected are at a distance from each other, signals between them need to be sent using track side E1 channels. A simple solution is to convert the RS232 interface to E1 using CYGNUS 835 Converter, and carry the E1 signal to a nearby cable hut over a 4-wire copper circuit. At the cable hut the E1 signal can be connected to an E1 port of the STM Mux for onward transmission. This is shown in Fig 4. It must be kept in mind that the E1 that is carried over copper is not immune to electrical disturbances,which can introduce data errors, specially over long copper circuits. Hence it is not recommended to have a distance of more than a few hundred meters between the converter and the cable hut.

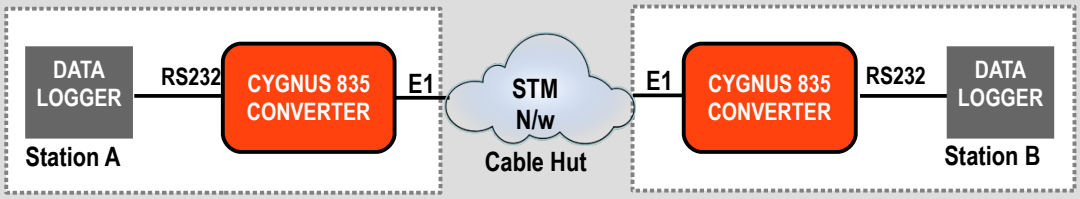

Fig. 4 A pair of CYGNUS 835 RS232 to E1 Converters can be used to connect the RS232 port of a Data Logger to an E1 port from the STM Mux at the cable hut.

C. Interconnecting Data Loggers/RTUs over E1 using Fiber Optic modems or G.shdsl Modems

If the distance between Data loggger/RTU and the cable hut is more than few hundred meters, it is recommended that either a G.shdsl based copper modem or a Fiber Optic modem is used between Data logger/RTU and the cable hut. G.shdsl modems can be used up to a distance of few kilometers. However optical fiber is better than copper as far as range and immunity to electrical disturbances is concerned. Both CYGNUS 850 G.shdsl modems and CYGNUS 855 Fiber modems are available with RS232 and E1 DTE interface. The complete communication path between the communicating systems can be divided into three sections – fiber/copper segments between the data logger/RTU and the cable hut at the two ends, and an E1 segment in between. The fiber/opper segments at the two ends can be driven by using a pair of CYGNUS 855 or CYGNUS 850 modems. In each pair the modem that is connected to the Data Logger or RTU can have RS232 DTE interface and the modem at the cable hut has E1 interface. Fig 5 shows this arrangement.

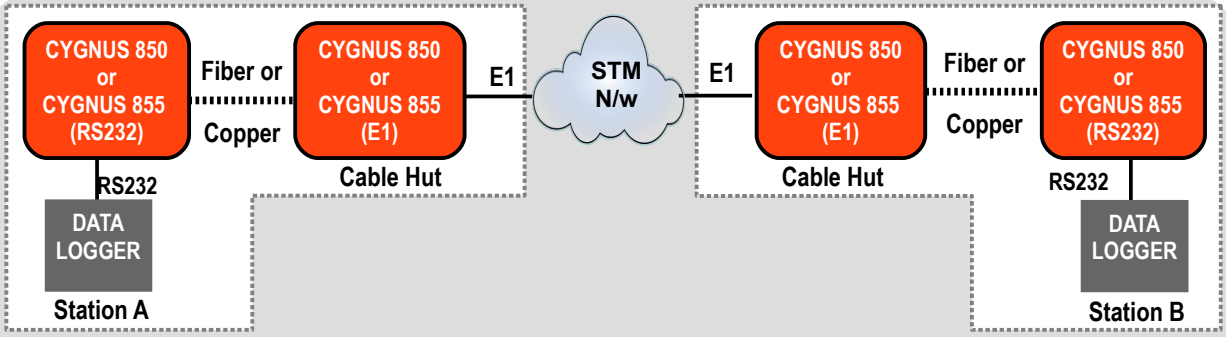

Fig. 5 A pair of CYGNUS 850 G.shdsl Modems or CYGNUS 855 Fiber Optic Modems with RS232 and E1 interfaces can be used to interconnect two Data Loggers Over an E1 link provided by STM Muxes at cable hut

Typically a Data Logger or RTU uses 2 circuits for communication with adjacent Data Loggers/RTUs. One circuit goes to the upstream Data Logger/RTU, and the other to the downstream device. Another CYGNUS product - CYGNUS 882 Dual Port Fiber Optic Modem - offers two RS232 or two E1 interfaces. These dual interfaces can be used for extending both ports of the Data Logger/RTU to the cable hut over a single fiber, where the two data streams can be connected to two separate E1 channels. This arrangement is shown in Fig. 6.

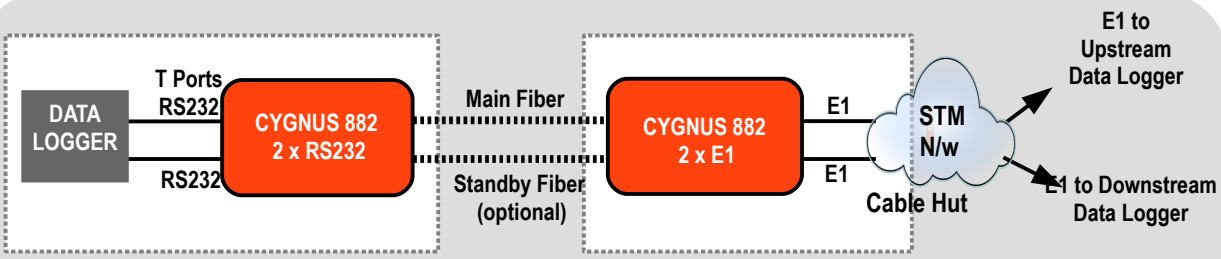

Fig. 6 A pair of CYGNUS 882 Dual-Port Fiber Optic Modems with 2xRS232 and 2xE1 interfaces can be used to extend two RS232 ports of a Data Logger over two E1 circuits from STM Mux

Note that in case the Data Logger / RTU has a E1 interface, then the corresponding CYGNUS 855 or CYGNUS 850 or CYGNUS 882 modems should have an E1 Interface towards this equipment.

Note also that if the Data Logger/RS232 has more than two ports, CYGNUS 880 Fiber Modems can be used. CYGNUS 880 can simultaneously carry as many as four RS232 signals across the fiber or over E1.

D. Connecting Data Loggers /RTUs over a resilient Fiber Optic Ring

As is well known, the performance and up time of the Data Logger network is largely determined by the quality and reliability of the communication links between the Data Loggers and RTUs. Copper circuits are is prone to electrical disturbance from lightning, or induction due to switching of high voltages on traction lines as trains pass on track. The performance of copper is also affected due to moisture and seepage of water etc. Periodic testing of copper cables is also necessary. And after all this, the data rates that can be achieved on copper cables rarely exceed 9600 bps.

Fiber does not have these drawbacks. CYGNUS offers another cost effective way of interconnecting Data Loggers and RTUs along the track used direct optical fiber connected. A ring network of interconnected fiber segments can be created using CYGNUS 891 Fiber Optic Ring Nodes. Fig 7 shows this interconnection.

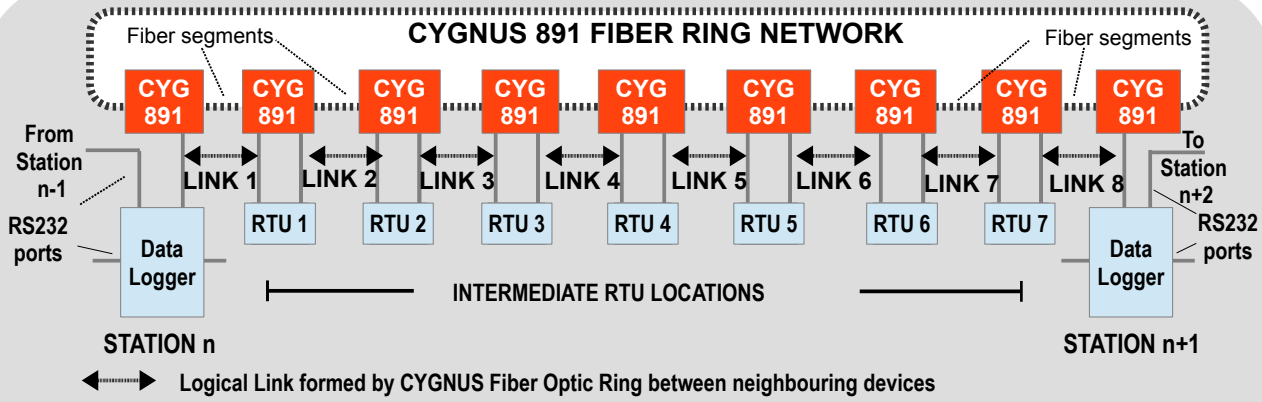

Fig. 7 Connecting a chain of up to 7 RTUs between 2 stations to Data Loggers at either station over a resilient Optical Fiber Ring

CYGNUS 891 Ring nodes are connected to each other using fiber segments. If the last node is connected back to the first one, a Ring structure is created. Each CYGNUS 891 node has two RS232 ports, which can be connected to two ports of a Data Logger or RTU. The network shown above establishes point-to-point connections between adjacent Data Logger/RTU devices, which can deliver speeds of up to 57.6 kbps. Though the CYGNUS 891 nodes appear to connect in a ring, actual communication path offered to the Data Loggers and RTUs is always point-to-point. The fiber segment between the first and the last CYGNUS 891 node is used as a backup path Should a fiber link between two adjacent CYGNUS 891 fail, the traffic between them is routed via the backup path, which otherwise is kept on standby. Even if any of the CYGNUS 891 nodes fail, only the Data Logger/RTU directly connected to that node is affected. Other Data Loggers/RTUs in the chain continue to communicate with their adjacent devices. This is the "resilient ring" operation of the CYGNUS 891 network. Up to nine CYGNUS 891 nodes can be interconnected to each other using Optical Fiber segments between them.

If the number of Data Loggers/RTUs exceeds nine, a second CYGNUS 891 fiber optic ring can be deployed with its own backup path. This is shown diagrammatically in Fig 8. In fact as many rings can be deployed as are necessary, taking into account the manageability of rings.

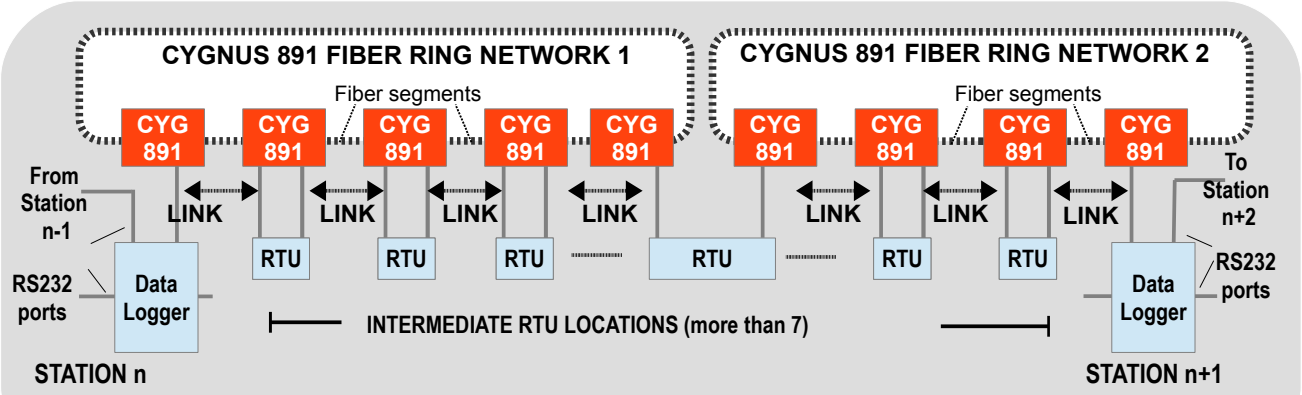

Fig. 8 Connecting more than 7 RTUs between 2 stations using multiple fiber rings

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