A Railway Track Monitoring System Using RS485 Multidrop network over Resilient Fiber Optic Ring
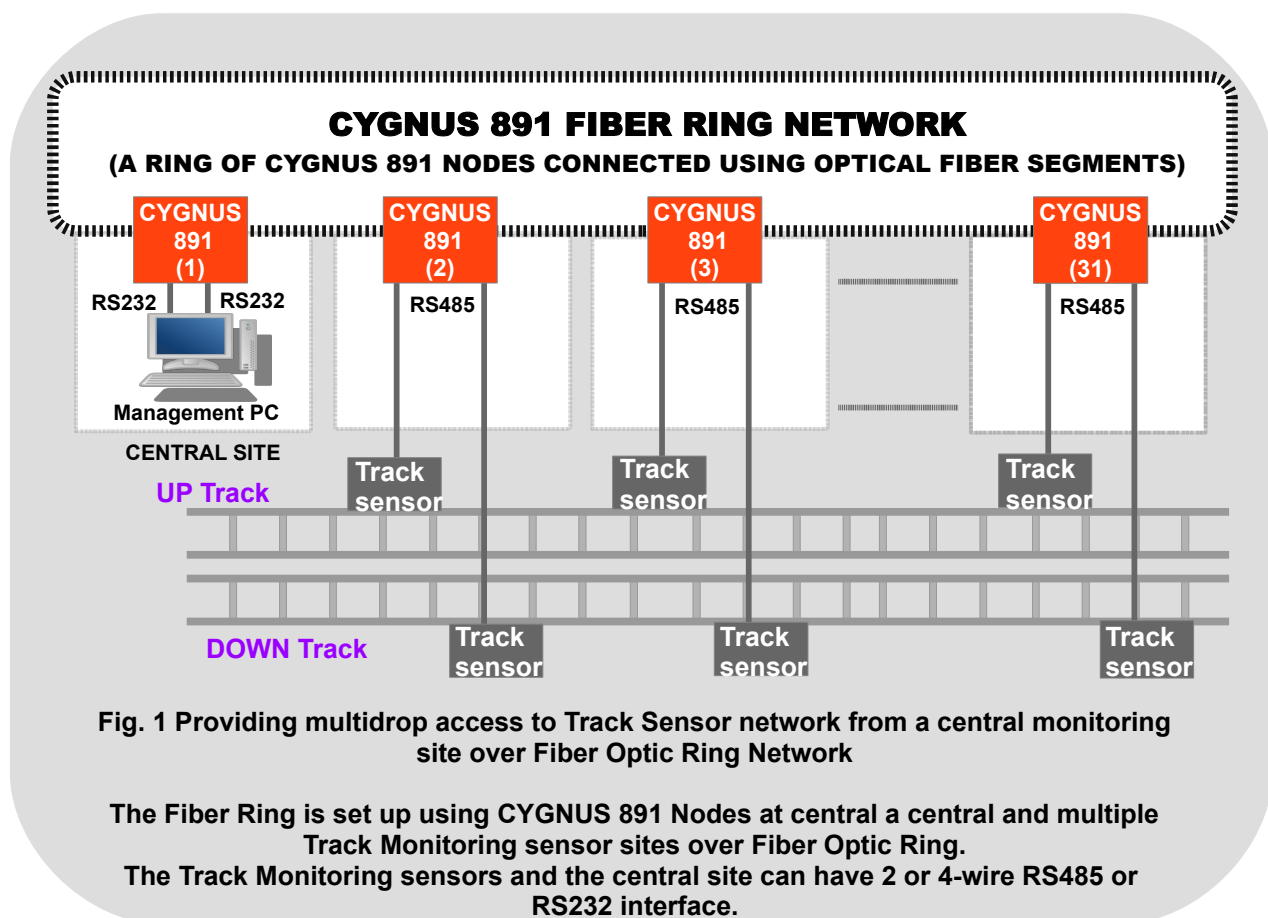
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A system that allows centralized monitoring of railway track using track sensors that are connected to a Fiber Optic Ring and accessed through a multidrop RS485 protocol between host system and sensors.

A Railway Track Monitoring System will essentially consist of sensors located along the track which would monitor certain characteristics of the railway track and communicate them to a central site.

Because the system will involve a large number of sensors, it is important that a mechanism be worked out that will allow the central site to query all sensors one by one and obtain data. It is also important that copper be avoided as the physical medium of communication since it has problems such as vulnerability to interference from electrical phenomena, and is also prone to degradation of performance due to moisture and seepage of water.

CYGNUS 891 Multidrop RS485 Network on Optical Fiber Ring offers a viable solution for the track monitoring system. A typical arrangement is shown in Fig 1.

Fig. 1 Providing multidrop access to Track Sensor network from a central monitoring site over Fiber Optic Ring Network

The Fiber Ring is set up using CYGNUS 891 Nodes at central a central and multiple Track Monitoring sensor sites over Fiber Optic Ring.
The Track Monitoring sensors and the central site can have 2 or 4-wire RS485 or RS232 interface.

Sensors with 2/4 wire RS485 interface are placed at regular intervals along the track. These sensors have selectable addresses so that each sensor can be uniquely identified in a network. Each sensor is connected to a CYGNUS 891 node located near it using a copper circuit. The CYGNUS 891 nodes (up to 31) are interconnected in a ring formation using segments of Optical Fiber (the ring is completed by connecting the last CYGNUS 891 Node back to the first one). One of the CYGNUS 891 nodes is located at the monitoring site where it is connected to the monitoring equipment using RS485 or RS232 interface. A speed of up to 115.2 kbps is allowed depending on the number of nodes in the ring network.

The monitoring station acts as a master of the network and sends data packets on its RS485 (or RS232) port to the CYGNUS 891 node. The CYGNUS 891 node broadcasts these data packets to all other nodes in the ring which reproduce the packet on their RS485/RS232 interface. Typically the packet sent by the master station is a "poll" packet, such as a query for data from a sensor whose ID is mentioned in the packet. Since sensor addresses are unique, only the intended sensor recognizes the poll while other sensors ignore the poll. The selected sensor node encapsulates its "response" in the form of a frame and sends it to the CYGNUS 891 node to which it is connected. This reply is broadcast to all other nodes, including the one at the master station. The master identifies it as a response to its query and processes it, while other nodes ignore it. A number of such poll-response transactions are carried out cyclically between the master and individual sensors.

The ring network provides redundancy, allowing the network to continue operating even if a fiber segment is broken. Ring protection also means that if a CYGNUS 891 node fails, only operations pertaining to that node are affected. The rest of the network keeps functioning uninterrupted.

The actual number of CYGNUS 891 nodes that may be allowed, depends on the following factors:

Speed of communication of the serial ports: The CYGNUS 891 allows upto 115.2 kbps speed on its serial ports. By selecting a lower speed, number of nodes can be increased.

Amount of data expected from each Track sensor: The smaller the amount of data to be received from the track sensors, the quicker can be a transaction between central device and the track sensors, and therefore more number of nodes can be accommodated in the network.

Desired frequency of access of the track sensors: The more often data from sensors needs to be collected, the lesser is the number of nodes that can be accommodated in the network.

Length of the Track to be monitored: In order to provide resilient ring operation, a return fiber path is necessary to close the ring. Since the track is linear in nature, the length of fiber from the farthest CYGNUS 891 node to the central monitoring facility is likely to be substantial, and should not exceed what is permitted. This may put restriction on the maximum number of nodes in a ring.

Contact Cygnus today for further information

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