HIGH RELIABILITY COMMUNICATIONS FOR RELAYING AND SCADA

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WMU 115 kV Loop

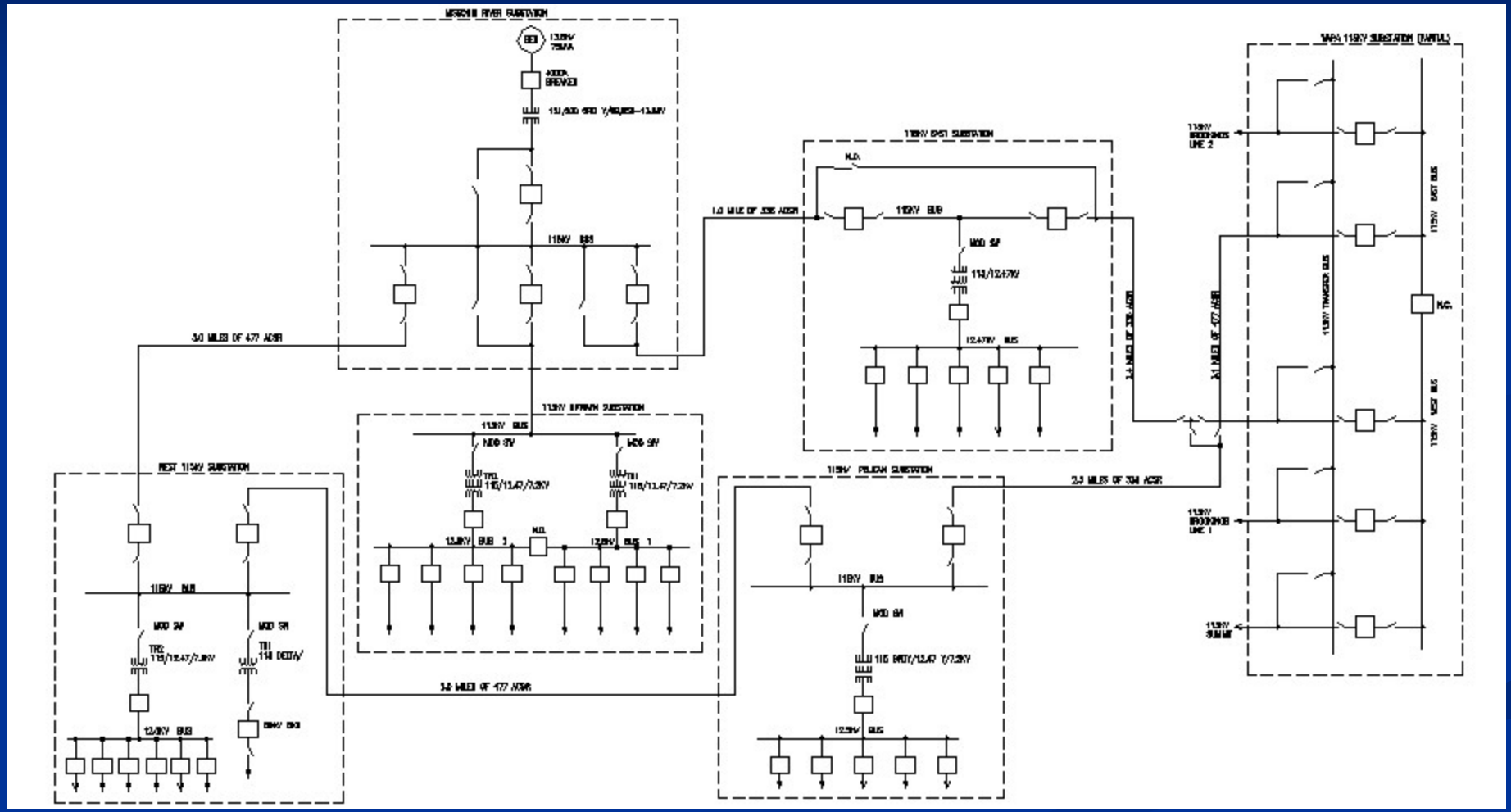


Figure 1

WMU Fiber Loop Topology

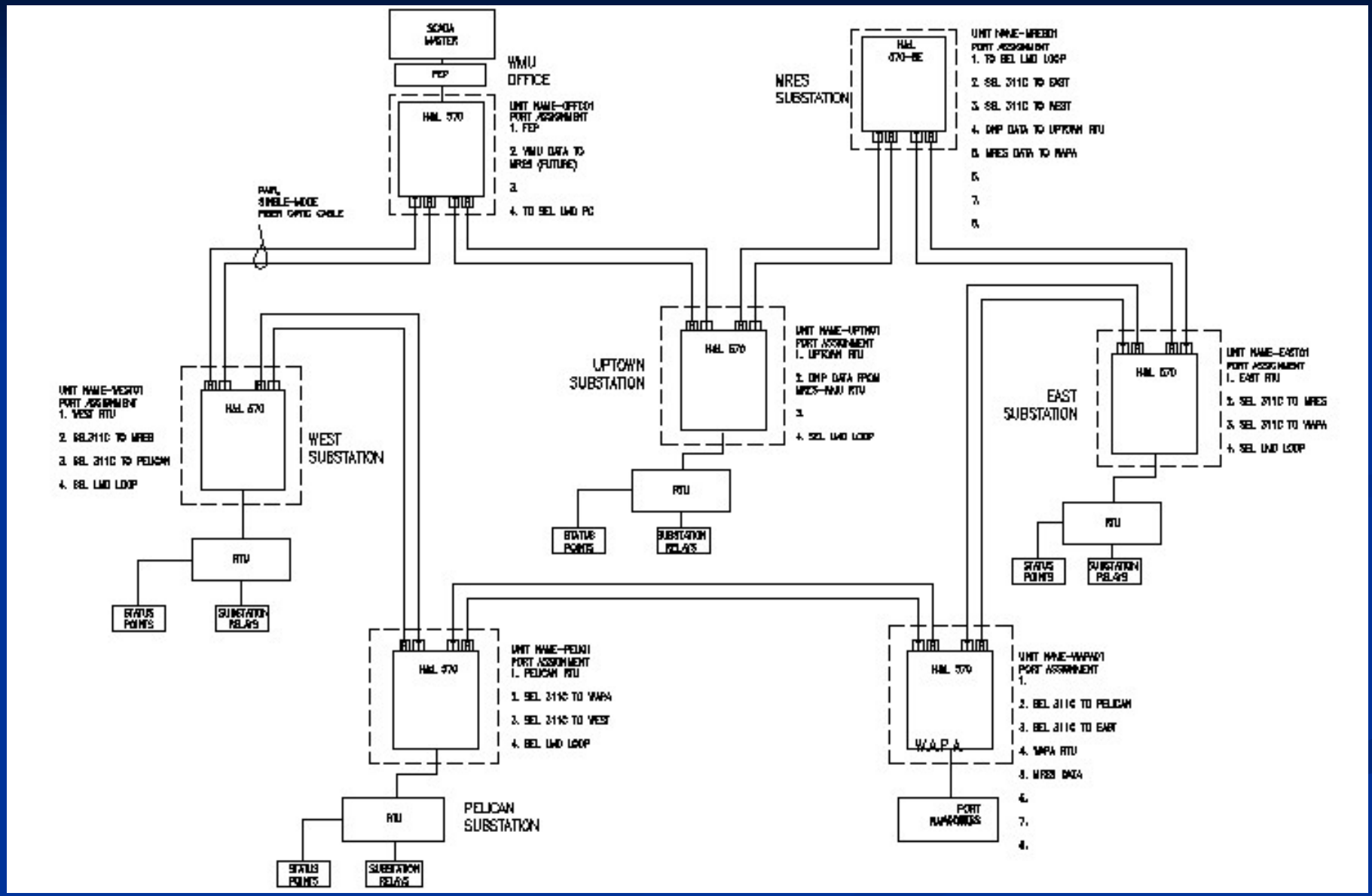


Figure 2

New networking concepts

FiberLoop II – Designed for SCADA – a head end controller manages the connection of all remote slave transceivers to the network and only master slave communications is supported.

FiberLoop III – Masterless design – each transceiver manages its connection to one or more transceivers anywhere on the network.

H&L Model 570 Fiberoptic Transceiver

100 MHz Packet Switch Engine

Ethernet 10/100BaseT

128 RS-232 serial channels

1310 nm lasers

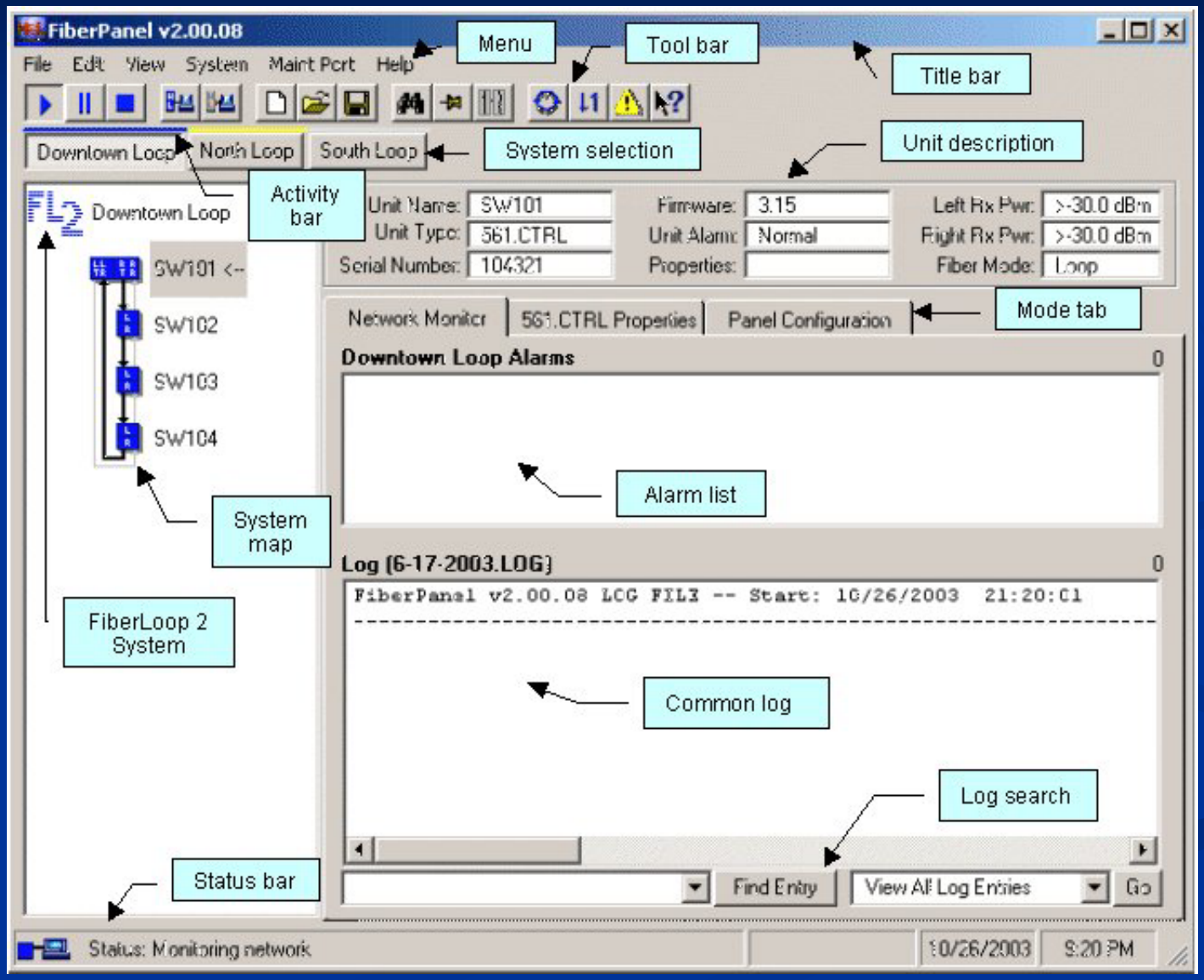
Fiberoptic power monitoring

Alphanumeric display

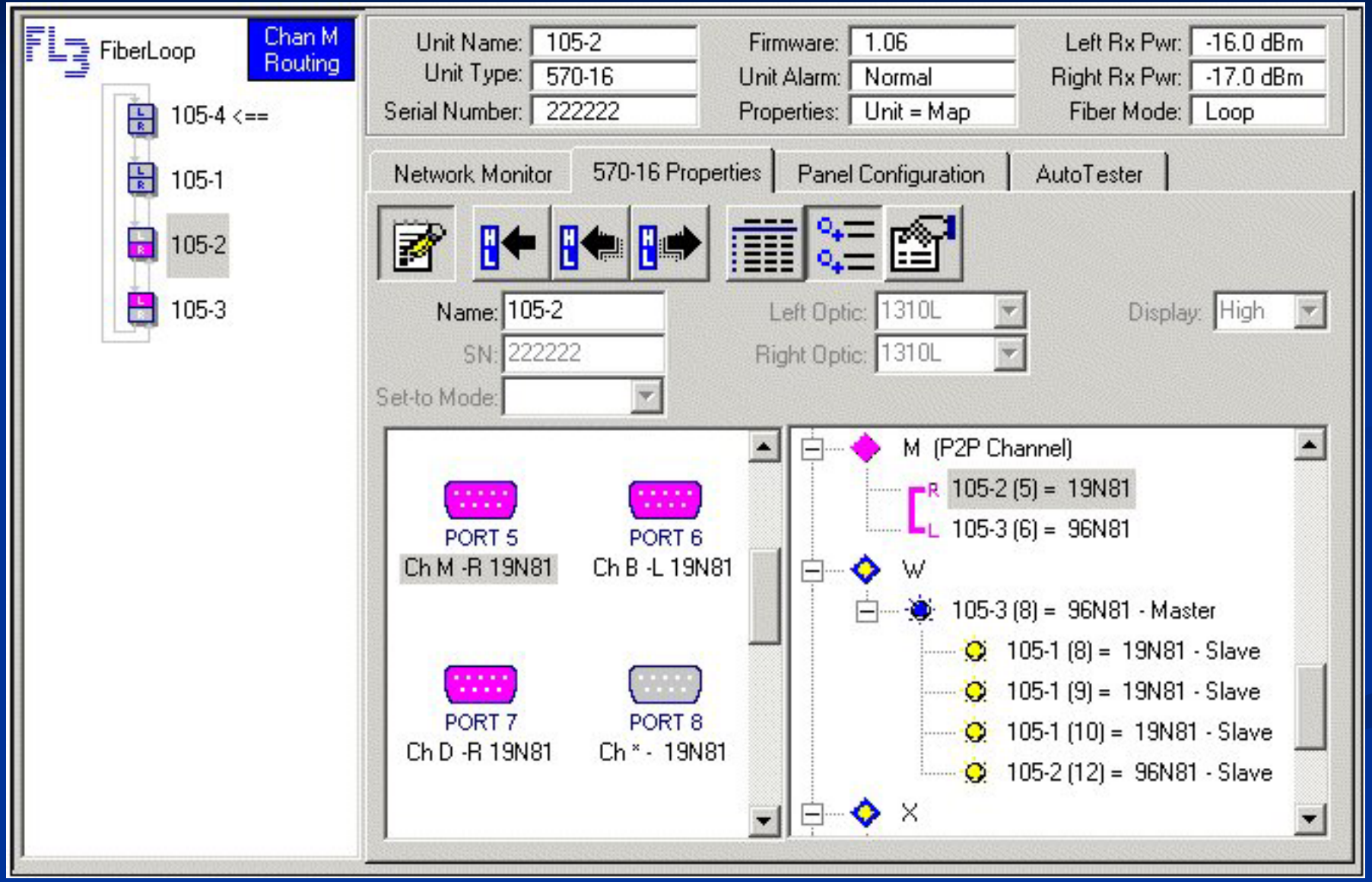
IEEE C37.90 / -40 to +85C

Network Management System

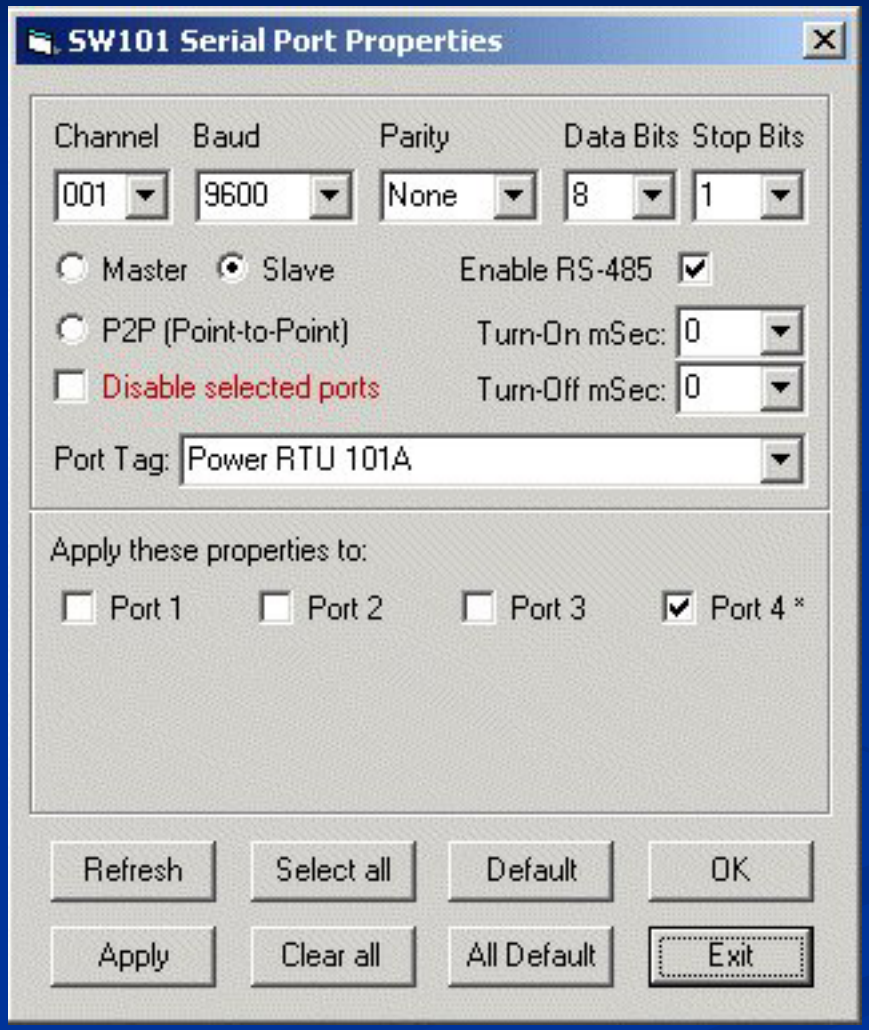
Network Management System



Paired Peer-to-Peer Virtual Channels



Serial Port Properties Screen



WMU West Substation

Substation with Relays, RTU, H&L 570

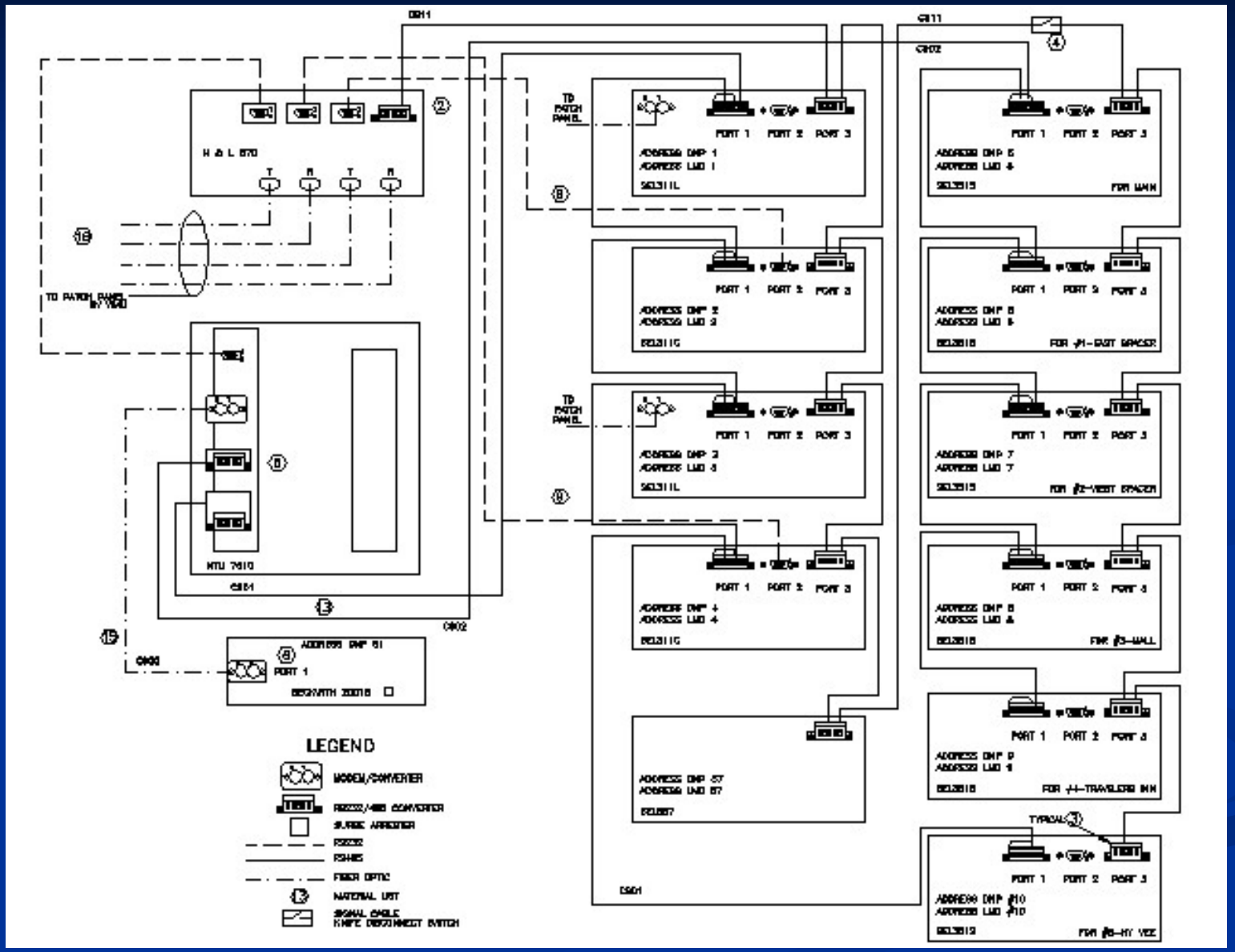


Figure 3

WMU West Substation Panels

Relaying Considerations for Short Lines

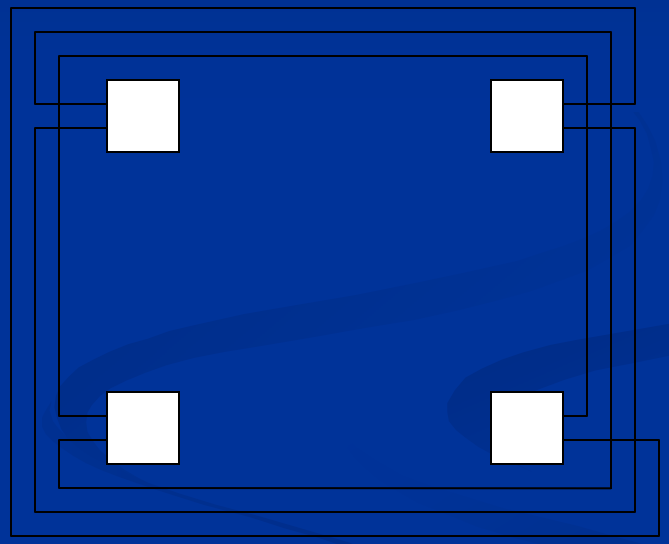
- Standard Distance relays can overreach
- Piloted relaying prevents over-tripping, but requires communications channel
- For security, different communications channels for primary and secondary relay

Relay communications on the fiber Loop

- Primary relays point-to-point (SEL-311L) current differential
- Secondary relays POTT (SEL-311C) using mirrored bits via Fiber Loop – H&L
- H&L loop heals in 10mS or less
- Secondary relaying survives failure of one fiber segment

Avoided use of fiber

- Alternative – backwards around the loop
- Significant cost, modems terminations
- Limits future use of installed fiber optic cable



Conclusions

- Loss of a single section of cable would compromise only the primary relaying between two terminals rather than the primary relaying between those terminals and the backup relaying for all the other line segments.
- The additional channels provide a simple, reliable path for data sharing between the utilities in town.
- The available Ethernet capability to each substation will be of use to the owner.
- A reasonable number of dark fibers remained for future projects.
- The original schedule and budget were not changed.