

HIGH RELIABILITY COMMUNICATIONS FOR RELAYING AND SCADA

Vincent L. Granquist
Consulting Engineers Group

Robert J. Landman
H&L Instruments, LLC

WMU 115 kV Loop

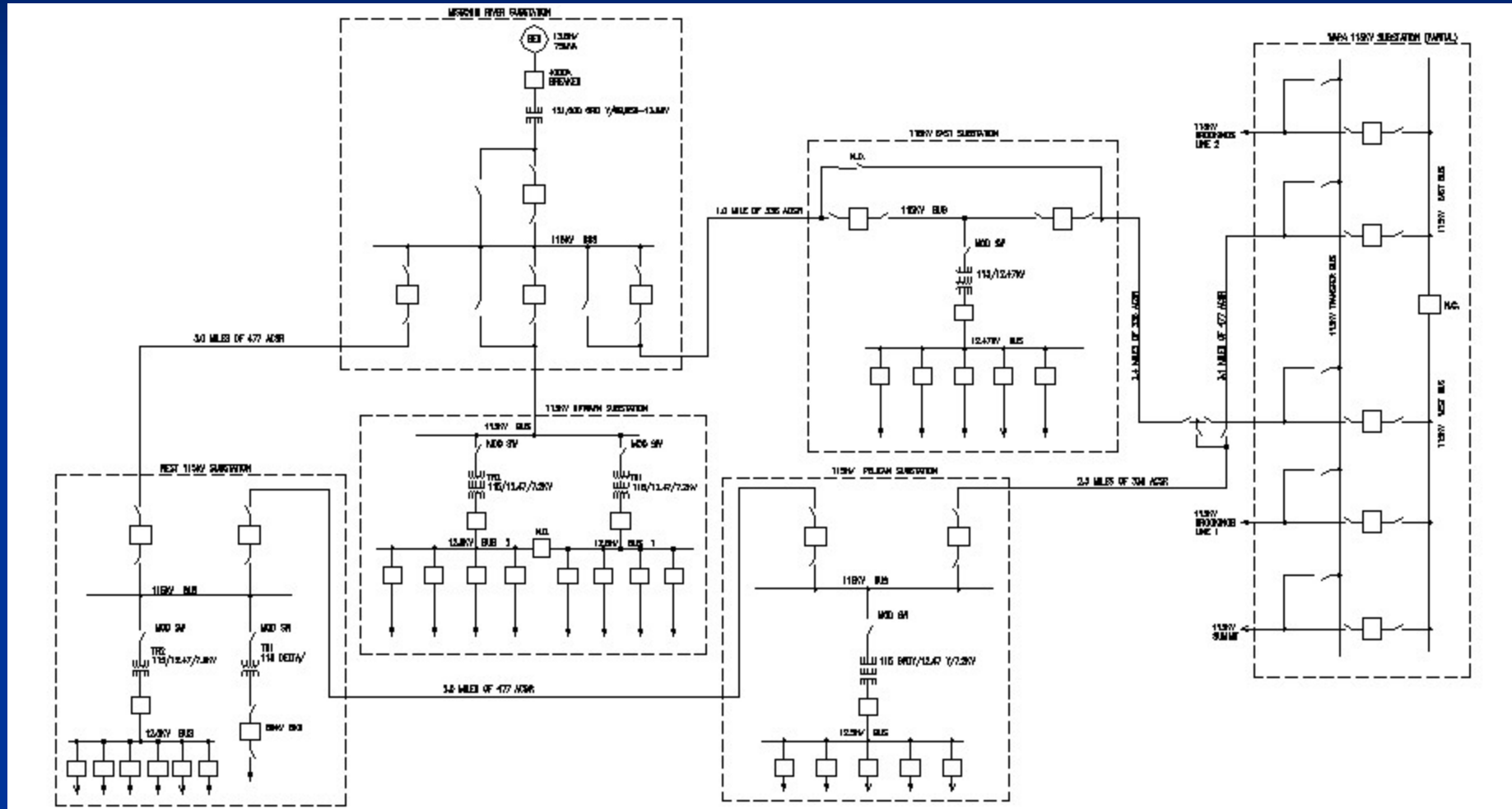


Figure 1

WMU Fiber Loop Topology

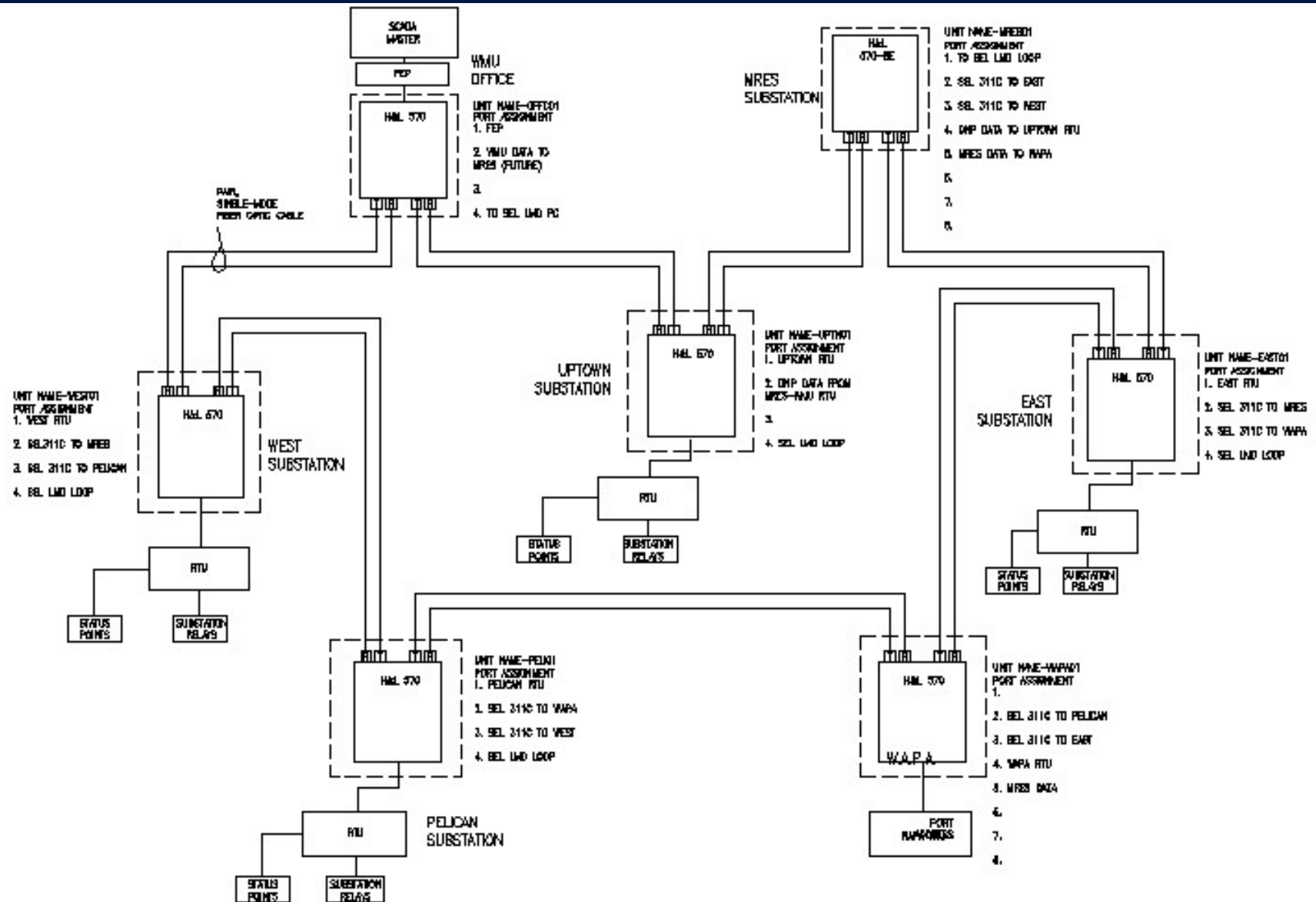


Figure 2

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

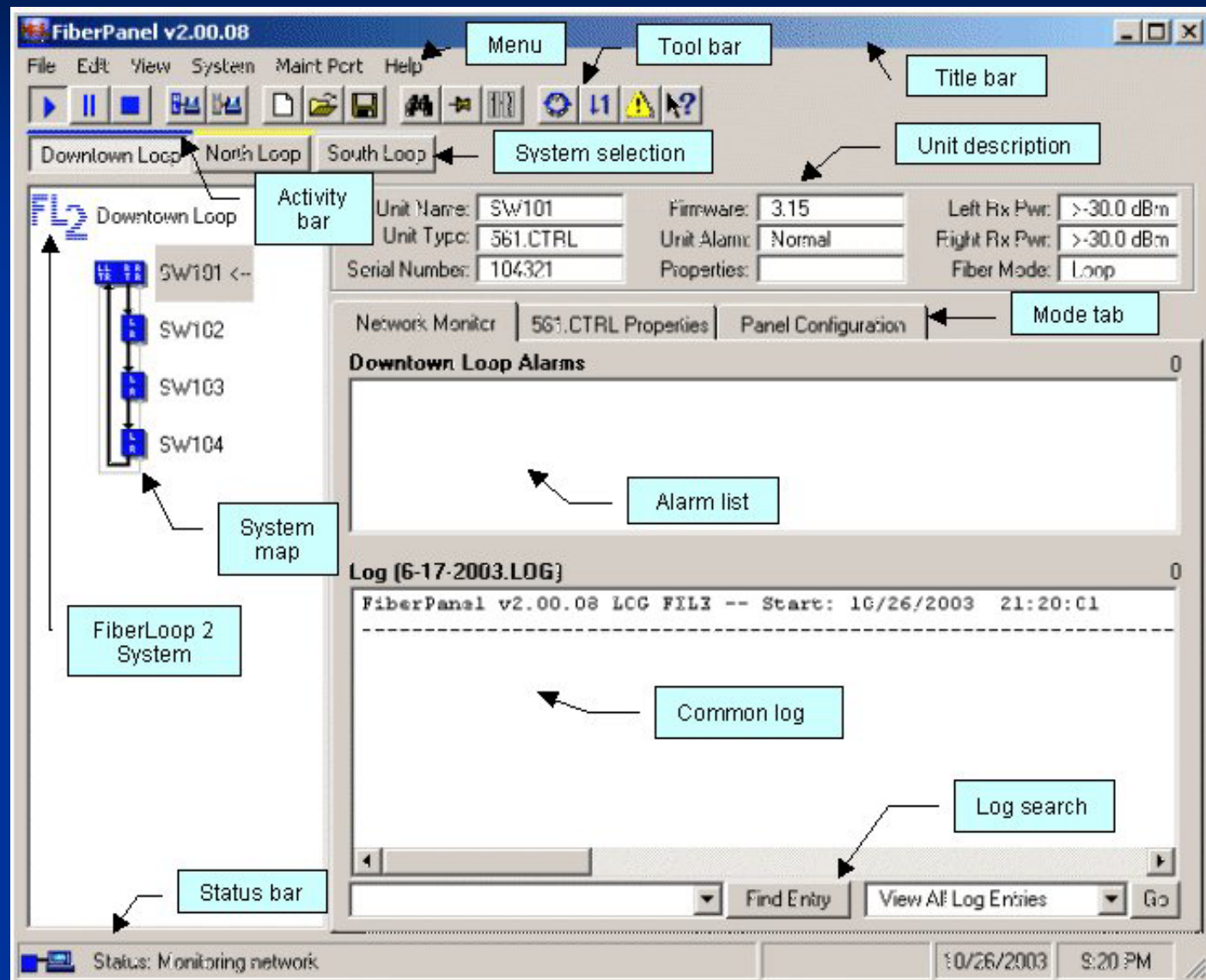
Fiberoptic power monitoring

Alphanumeric display

IEEE C37.90 / -40 to +85C

Network Management System

Network Management System



Paired Peer-to-Peer Virtual Channels

FiberLoop **Chan M Routing**

Unit Name: 105-2 Firmware: 1.06 Left Rx Pwr: -16.0 dBm
Unit Type: 570-16 Unit Alarm: Normal Right Rx Pwr: -17.0 dBm
Serial Number: 222222 Properties: Unit = Map Fiber Mode: Loop

Network Monitor 570-16 Properties Panel Configuration AutoTester

Name: 105-2 Left Optic: 1310L Display: High
SN: 222222 Right Optic: 1310L
Set-to Mode: [Dropdown]

PORT 5 **PORT 6**
Ch M -R 19N81 Ch B -L 19N81

PORT 7 **PORT 8**
Ch D -R 19N81 Ch * - 19N81

M (P2P Channel)

- 105-2 (5) = 19N81
- 105-3 (6) = 96N81

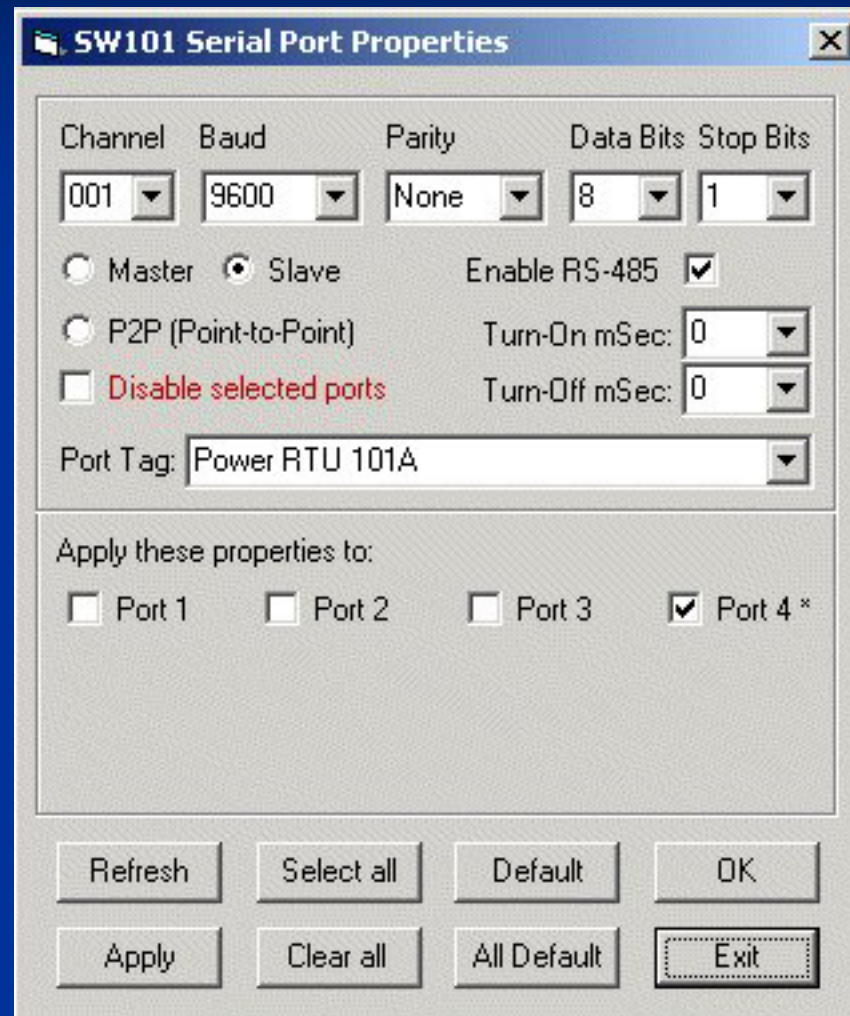
W

- 105-3 (8) = 96N81 - Master
- 105-1 (8) = 19N81 - Slave
- 105-1 (9) = 19N81 - Slave
- 105-1 (10) = 19N81 - Slave
- 105-2 (12) = 96N81 - Slave

X

105-4 <==
105-1
105-2
105-3

Serial Port Properties Screen



A screenshot of the 'SW101 Serial Port Properties' dialog box. The window has a title bar with a close button. The main area contains several configuration sections. The top section has five dropdown menus for 'Channel' (001), 'Baud' (9600), 'Parity' (None), 'Data Bits' (8), and 'Stop Bits' (1). Below these are radio buttons for 'Master' and 'Slave' (Slave is selected), and a checked checkbox for 'Enable RS-485'. There are also radio buttons for 'P2P (Point-to-Point)' and a checkbox for 'Disable selected ports' (which is unchecked). To the right of these are two dropdown menus for 'Turn-On mSec' and 'Turn-Off mSec', both set to 0. A 'Port Tag' dropdown menu shows 'Power RTU 101A'. The bottom section, titled 'Apply these properties to:', contains four checkboxes for 'Port 1', 'Port 2', 'Port 3', and 'Port 4 *' (which is checked). At the very bottom are two rows of buttons: 'Refresh', 'Select all', 'Default', 'OK' in the first row, and 'Apply', 'Clear all', 'All Default', 'Exit' in the second row. The 'Exit' button is highlighted with a dashed border.

SW101 Serial Port Properties

Channel: 001 Baud: 9600 Parity: None Data Bits: 8 Stop Bits: 1

☐ Master ☒ Slave Enable RS-485 ☒

☐ P2P (Point-to-Point) Turn-On mSec: 0

☐ Disable selected ports Turn-Off mSec: 0

Port Tag: Power RTU 101A

Apply these properties to:

☐ Port 1 ☐ Port 2 ☐ Port 3 ☒ Port 4 *

Buttons: Refresh, Select all, Default, OK, Apply, Clear all, All Default, Exit

WMU West Substation



Substation with Relays, RTU, H&L 570

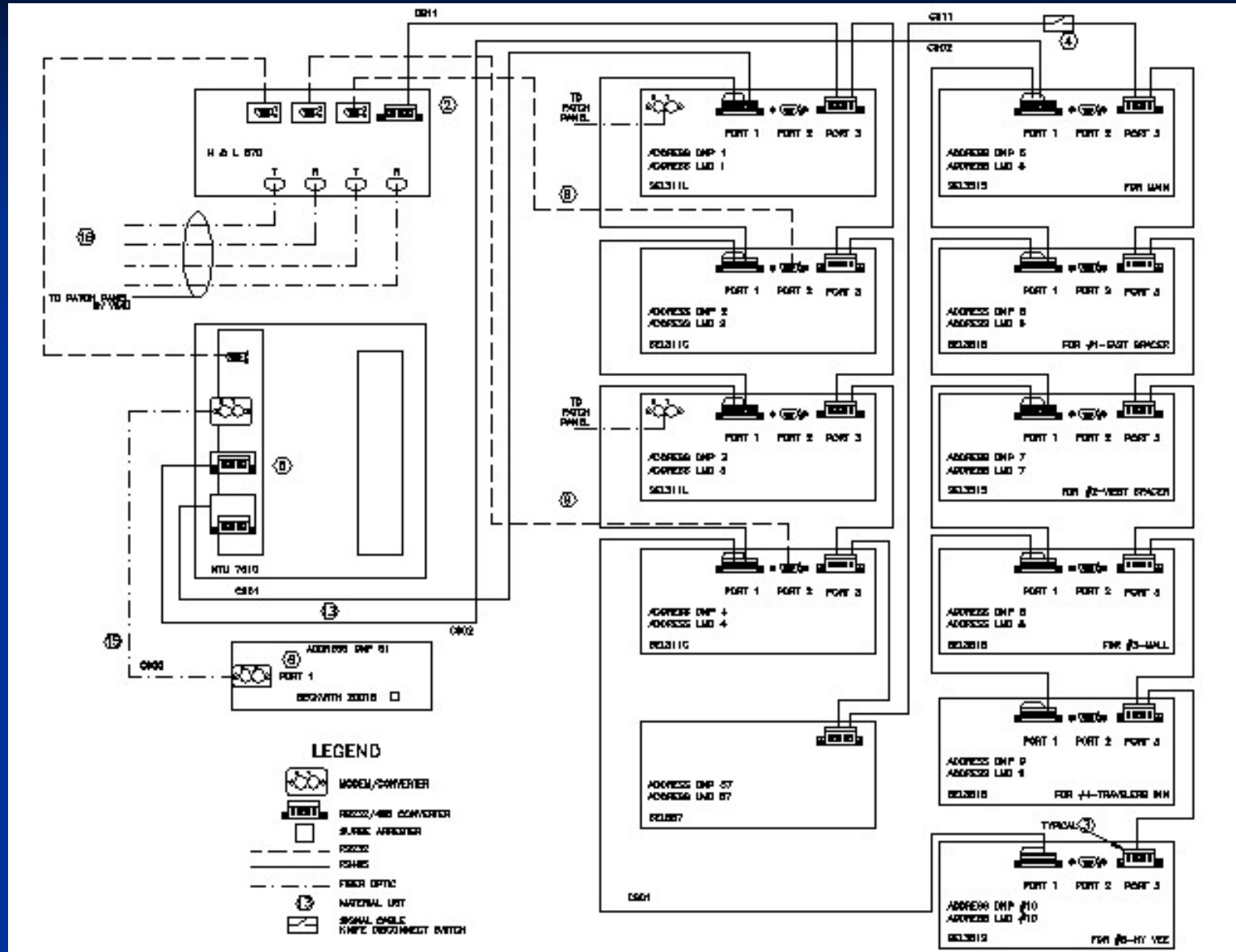


Figure 3

WMU West Substation Panels



Relaying Considerations for Short Lines

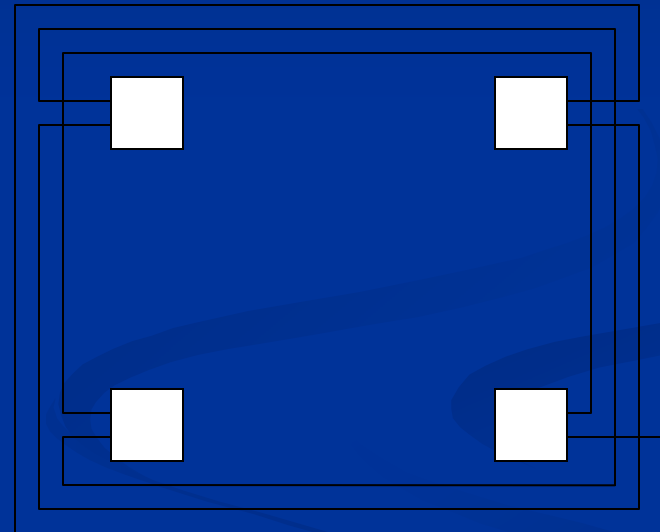
- Standard Distance relays can overreach
- Piloted relaying prevents over-tripping, but requires communications channel
- For security, different communications channels for primary and secondary relay

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.