

Telecommunications Network Overview

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Telecommunications Principal Engineer



POWERSOUTH™
ENERGY COOPERATIVE

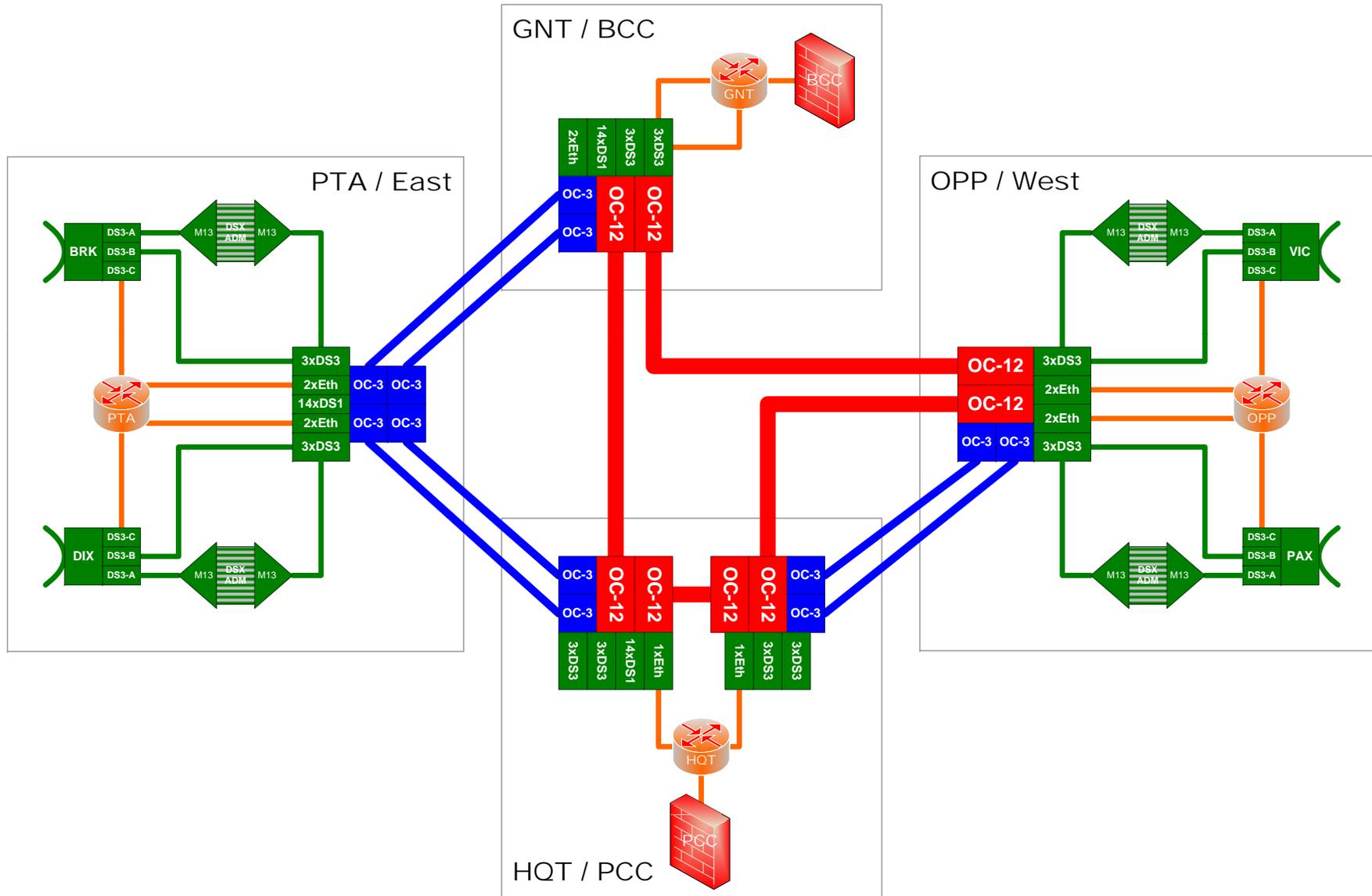
- **Private Transport**
- **Network Architecture**
- **Telemetry Systems**
- **Voice Systems**
- **Network Management**



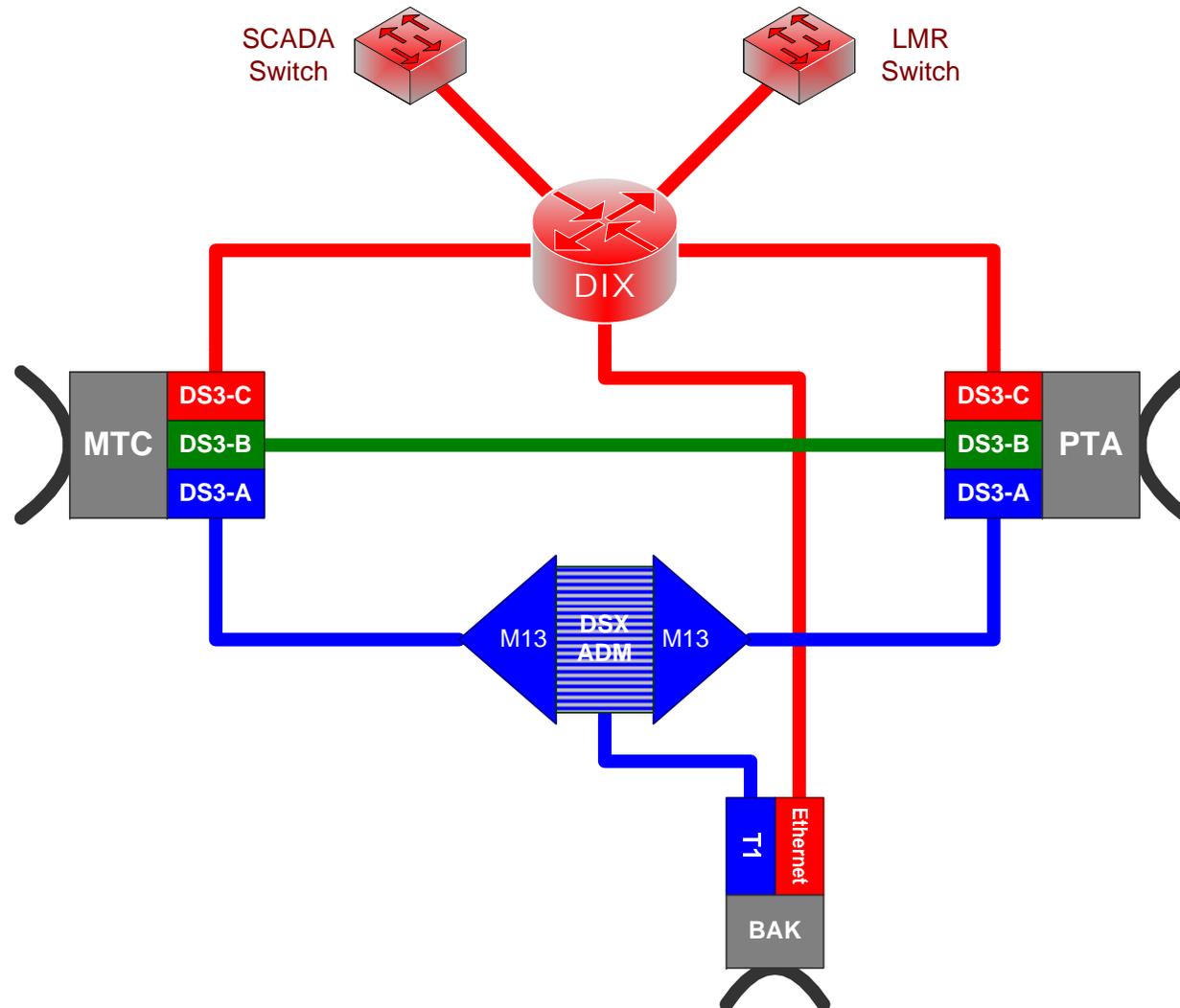
- **Core Network**
- **Backbone Network**
- **Equipment**
- **Fiber Follies**



Core Network



Typical Backbone Repeater



Microwave Equipment



Microwave Networks

CM6 : OC-3, 3xDS3, 1xDS3, 8xDS1
Space Diversity, Hot Standby



Proxim Wireless

Lynx : 1xT1



Exalt Communications

EX-2.4i, EX-5i : 4xT1 + Ethernet



RADwin

Air Mux 400

Multiplex Equipment



Fujitsu SNET

Flashwave 4100

Ethernet, OC-12, OC-3, DS3, DS1



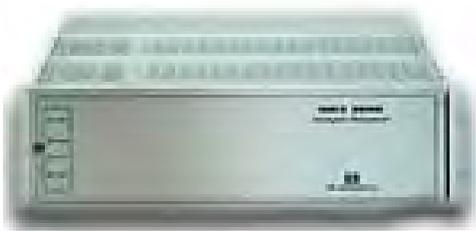
Adtran M13

MX2800 M13 Mux



Adtran Total Access

604, 624, 750



RFL Electronics T1

IMUX 2000

System Protection Functions

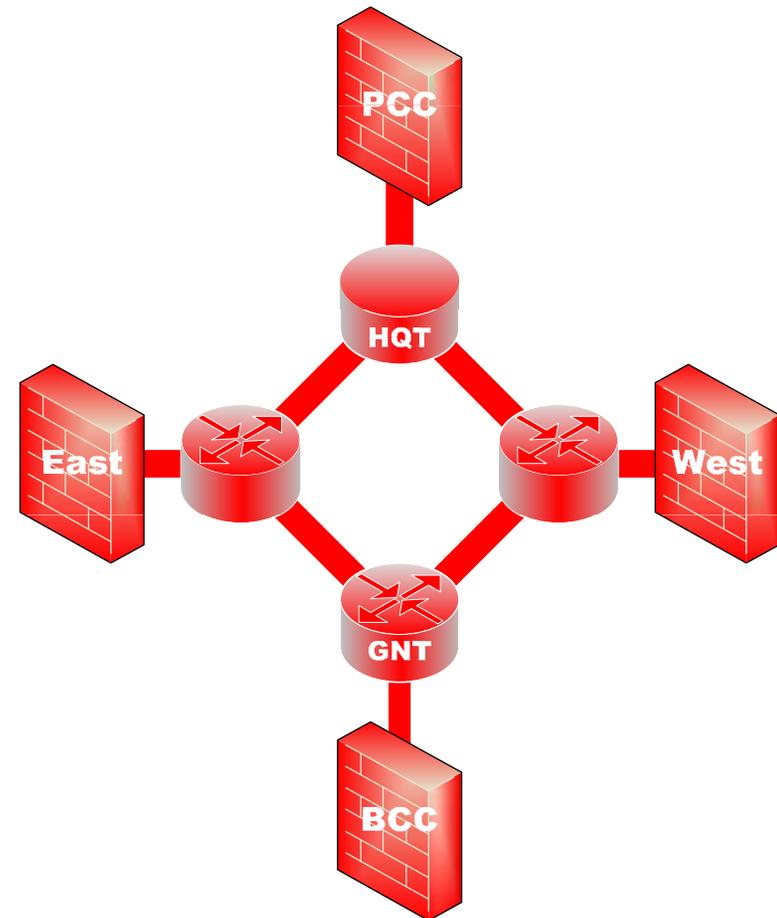
ADSS After Dove Shoot



ADSS Fiber After Crop Duster



- **Dynamic Routing**
- **Equipment**
- **Security**
- **Public Transport**





RuggedCom Firewall Routers
RX1000 : DS3, DS1, Ethernet
OSFP Dynamic Routing

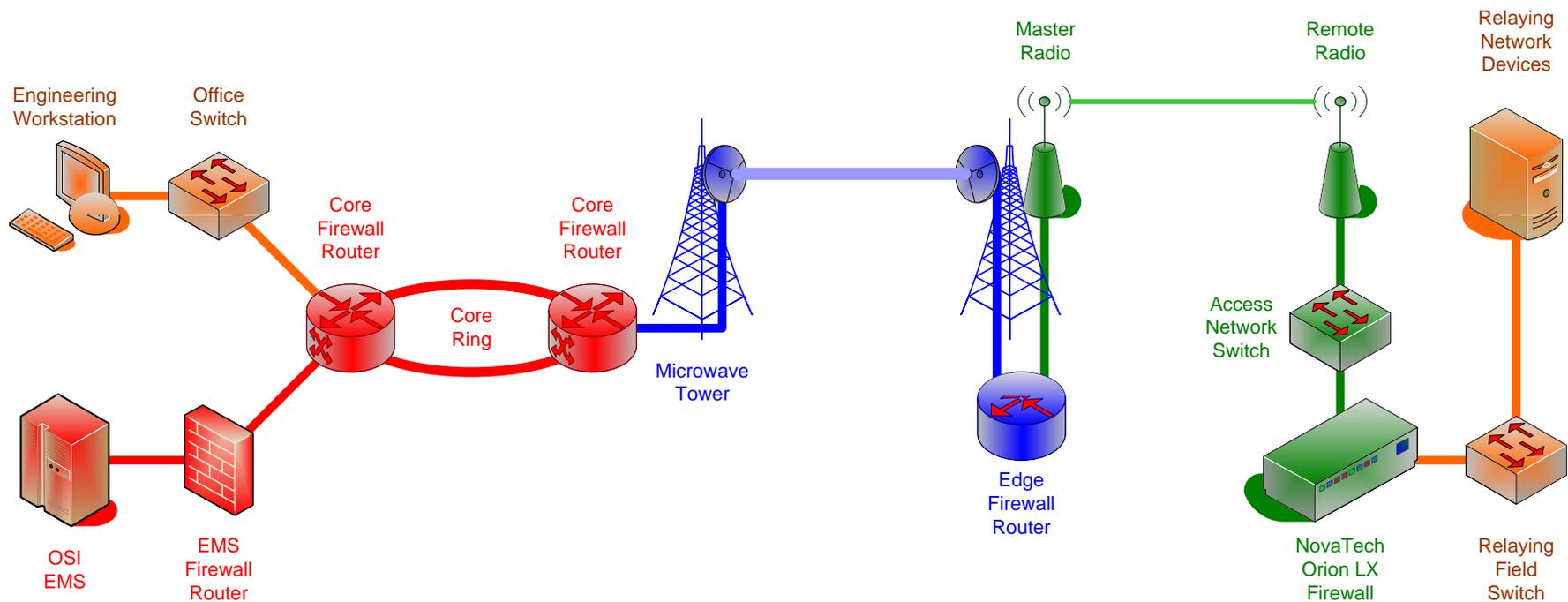


RuggedCom IEEE 1613 Switches
RS1600, RS2100, RS900, RMC40

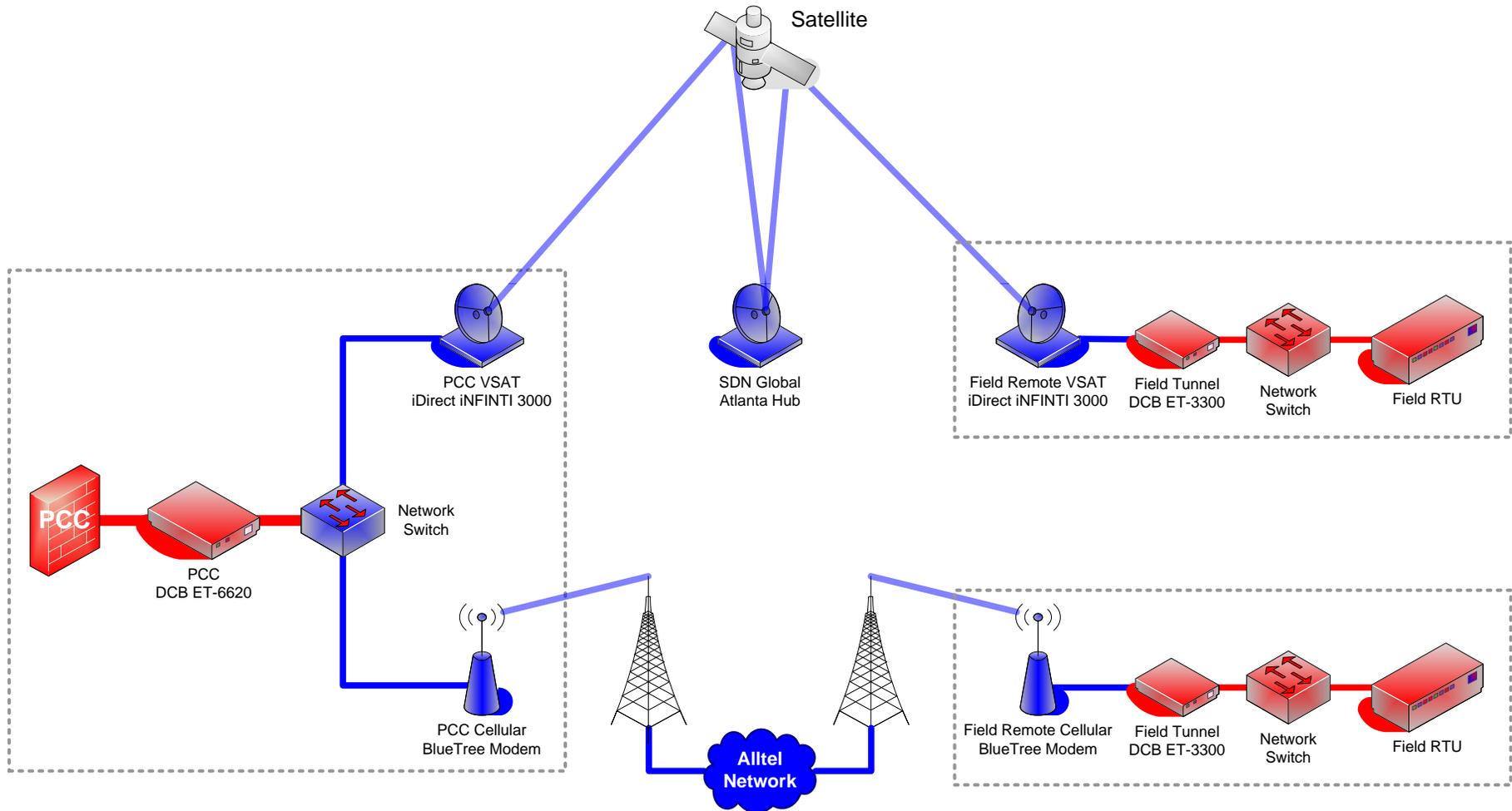


B&B Electronics Switches
ES DS-100T

Layered Security



Public Transport Security



Public Transport Modems



BlueTree / Sixnet Cellular Modems
BT-6600, BT-4600



Service Provider Alltel



iDirect INFINITI 3000 VSAT Modem
256 kbps Up / 1500 kbps Down
SDN Global – Atlanta

7 Single Site Remotes
3 Master Nodes for Backhaul
2 Backup Loops – Alternate Routes
2 Control Center Masters



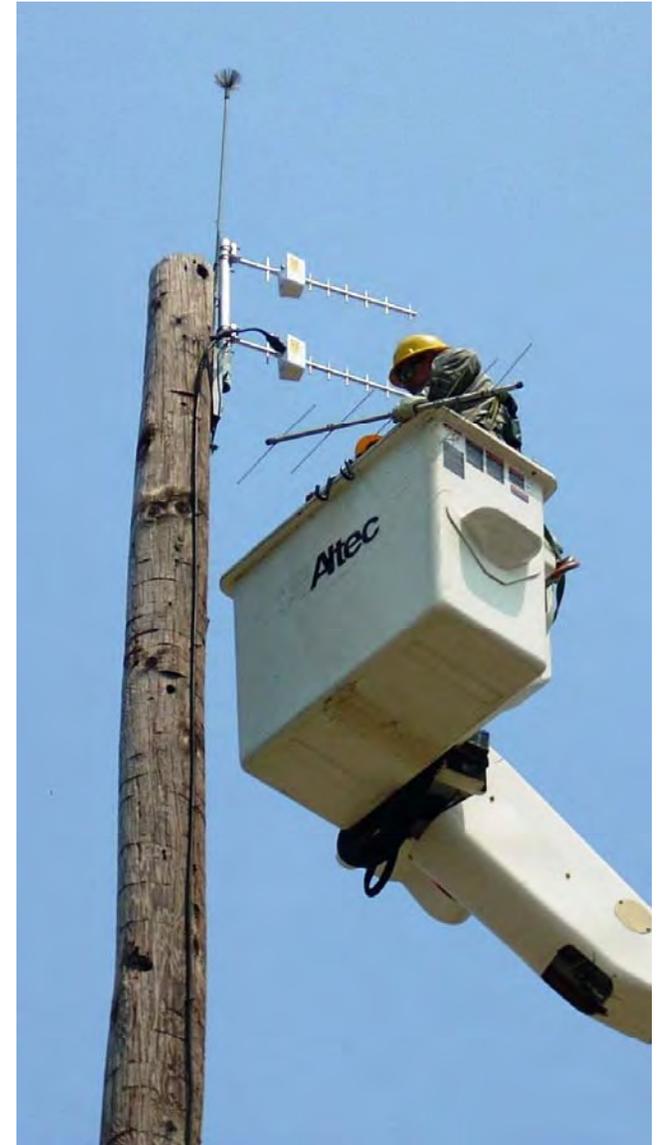
ET-6620 : Encrypted Ethernet Bridge
Throughput > 200 Mbps



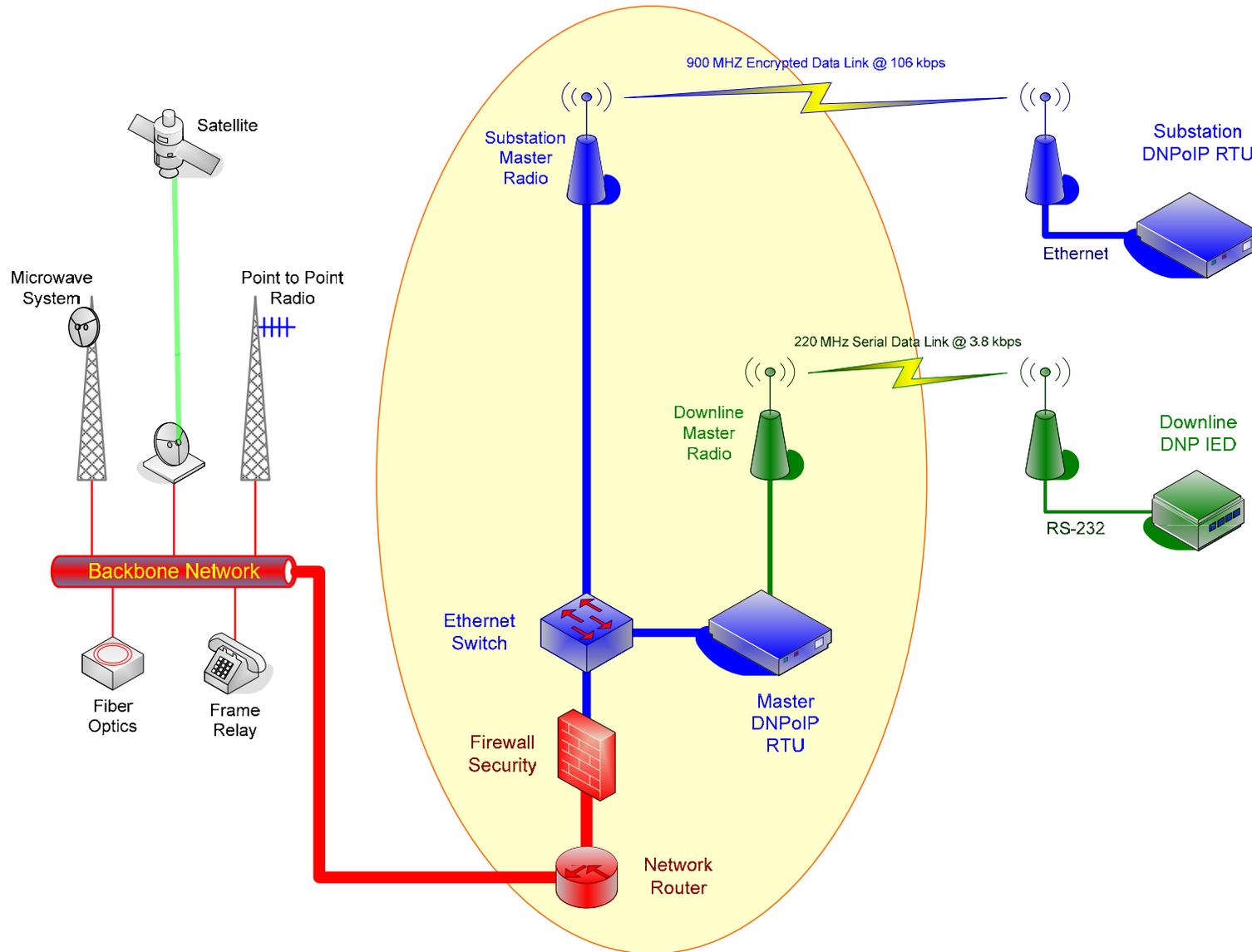
ET-3300 : Encrypted Ethernet Bridge
Throughput 700 kbps

Secure Local Area Network Extension
OSPF Dynamic Routing Support

- **Master Nodes**
- **Telemetry Radios**
- **Data Concentrators**
- **Inter-Tie Telemetry**
- **Ethernet Modems**
- **Proof is in the Pudding**



Telemetry Master Node



GE MDS Telemetry Radios



MDS 2710 : 3.2 kbps, -108 dBm @ 220 MHz

MDS 4710 : 9.6 kbps, -110 dBm @ 450 MHz

MDS 9810 : 22.5 kbps, -110 dBm @ 915 MHz



MDS entraNET 900

106 kbps, -106 dBm @ 915 MHz



MDS iNET 900 : 256 / 512 kbps, -99 / -92 dBm

MDS iNET-II : 512 / 1024 kbps, -97 / -92 dBm

Adapt4 : Cognitive IP Radio



Adapt4 XG1 @ 220 MHz

- 103 dBm @ 38 kbps
- 97 dBm @ 128 kbps
- 95 dBm @ 192 kbps



Adapt4 XG2 @ 220 MHz

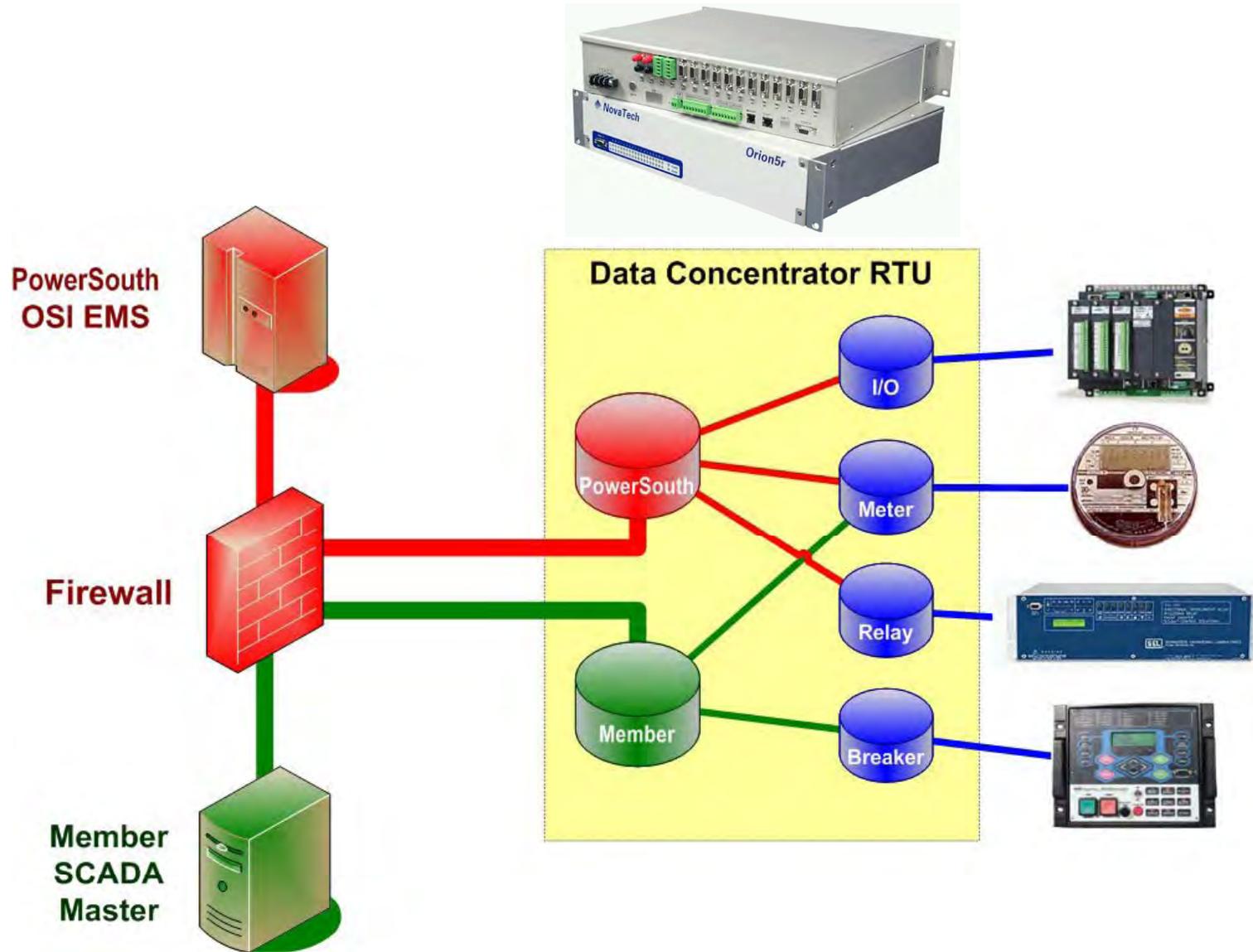
- 108 dBm @ 10 kbps
- 105 dBm @ 20 kbps
- 101 dBm @ 40 kbps

Cognitive Software Defined Radio

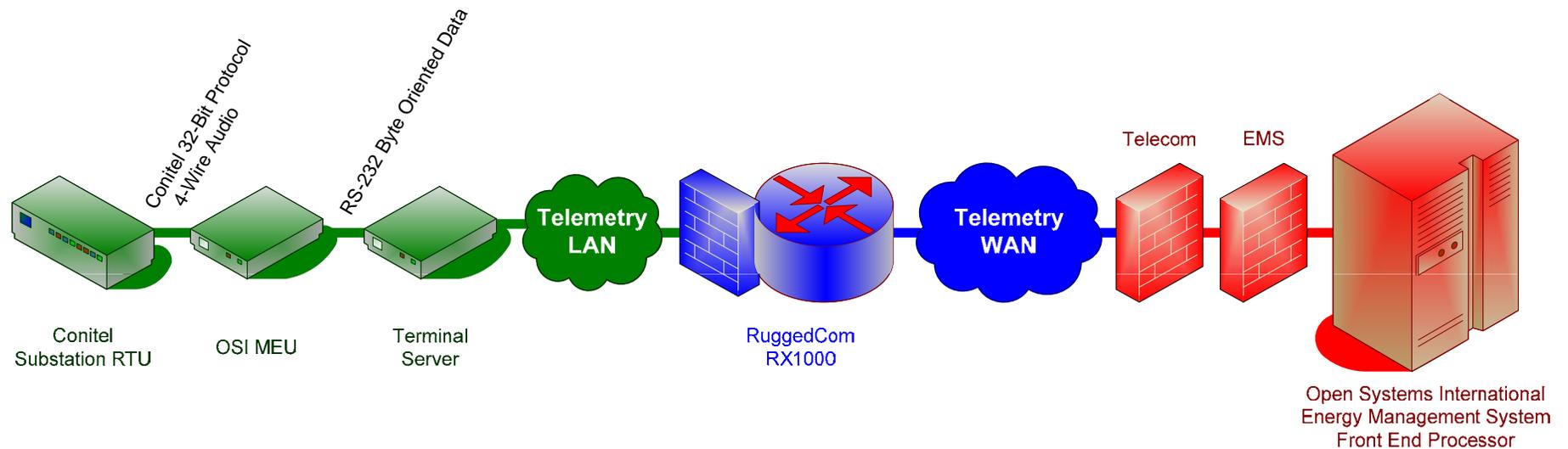
ASAP : Automatic Spectrum Adaptation Protocol

SRT : Spectrum Reuse Technology

DNPoIP Data Concentrator



Legacy RTU Transport





Digi PortServer TS 8
8 RJ-45 RS-232 Serial Port

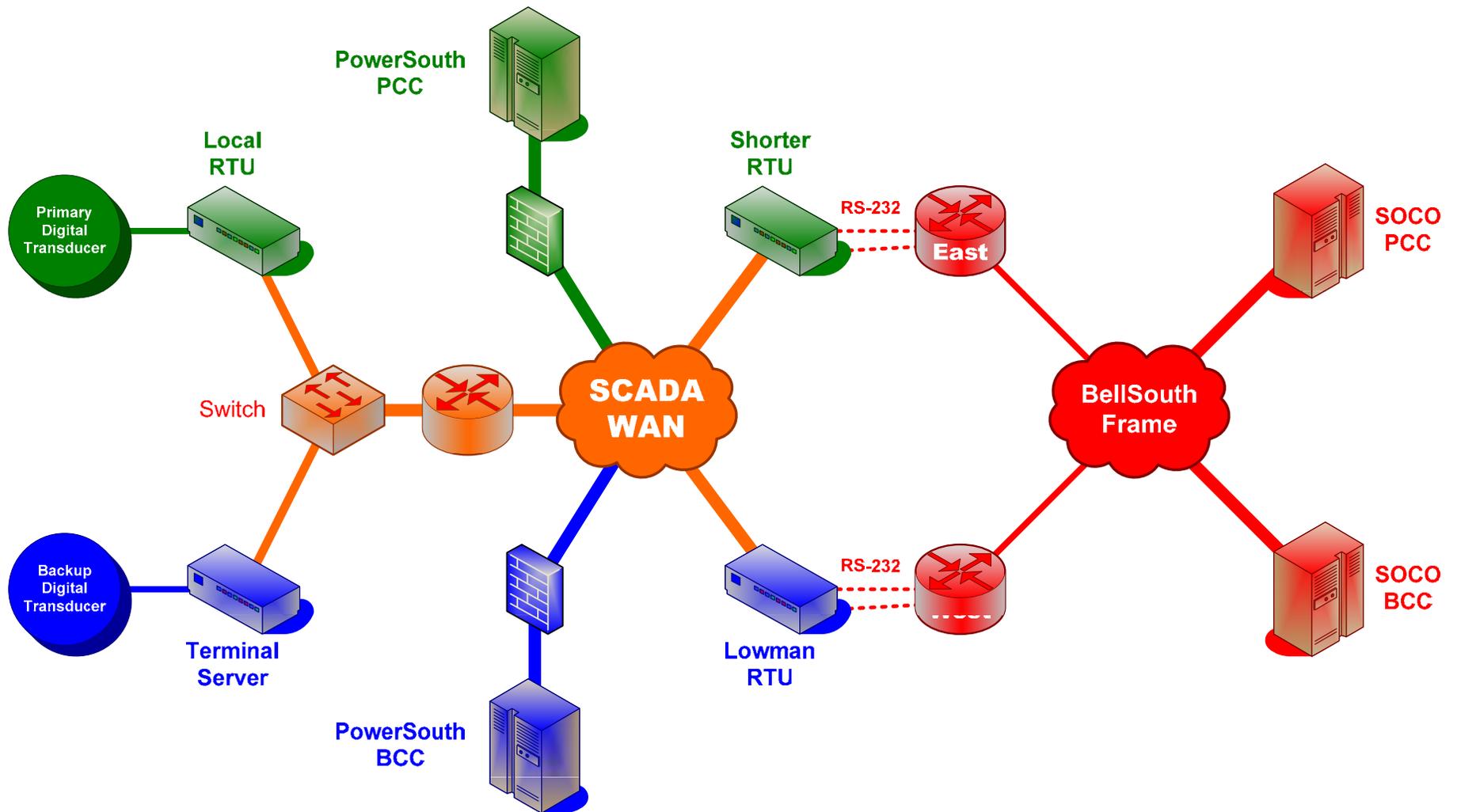


DCB EtherPath : Single Port Serial Server
DCB EtherBridge : Convert Serial Radio to Ethernet



NovaTech Orion 5R / LX
16 DB9/Fiber Serial Ports

Inter-Tie Telemetry



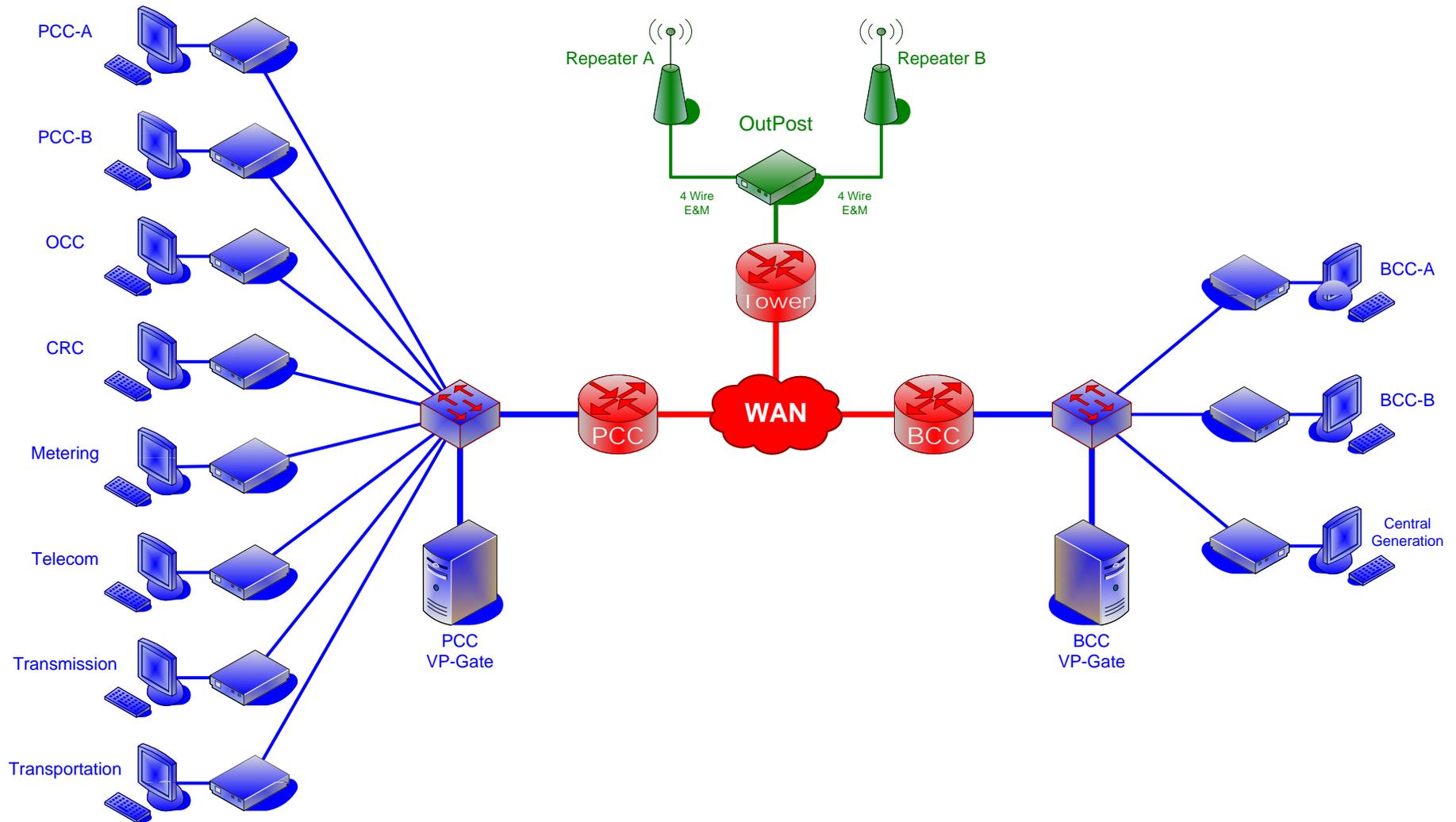
- **Private Mobile Radio**
- **Telephone System**
- **Voice Recorder**



- **100% IP SCADA Telemetry December 2008**
 - Full Telemetry Support at both PCC and BCC
 - OSPF Dynamic Routing

- **Voice over IP**
 - Private Mobile Radio Console System
 - Internal Phone Systems
 - Universal Voice Recorder

Avtec Console System



Avtec Scout : PowerSouth Tab



| | | | | | | |
|--|---------------------------------|--------------------------------|---------------------------------|------------------------------|---------------------------------|-------------------------------|
| Baker Tower Channel 01 | Belleville Tower Channel 01 | Capps Tower Channel 01 | Central Tower Channel 01 | Chastain Tower Channel 01 | Chatom Tower Channel 01 | Dublin Tower Channel 01 |
| Freeport Tower Channel 01 | Gaskin Tower Channel 01 | Graceville Tower Channel 01 | Mexia Tower Channel 01 | McIntosh Plant Plant | Lowman Plant Plant | Oak Grove Tower Channel 01 |
| Paxton Tower Channel 01 | Point A Tower Channel 01 | Scyrene Tower Channel 01 | Turkey Hill Tower Channel 01 | Victoria Tower Channel 01 | Y Community Tower Channel 01 | |
| Baker Tower Channel 02 | Belleville Tower Channel 02 | Capps Tower Channel 02 | Chastain Tower Channel 02 | Chatom Tower Channel 02 | | |
| Freeport Tower Channel 02 | Gaskin Tower Channel 02 | Graceville Tower Channel 02 | Oak Grove Tower Channel 02 | Paxton Tower Channel 02 | | |
| Point A Tower Channel 02 SELECT | Turkey Hill Tower Channel 02 | Victoria Tower Channel 02 | | | | |



Central Standard Time
17:47:25
 Sunday, February 28, 2010
 Transmit

Maintenance [X]

PATCH 1 PATCH 2 PATCH 3

PATCH 4 PATCH 5

TEST TONE ALERT TONE

RELEASE UNSELECT

Cancel Shut Down

PowerSouth Members LINC History Diagnostic Help

Avtec Scout : Members Tab



The interface displays a grid of 16 green buttons, each representing a different cooperative. Each button has a white bar at the top, the cooperative name in the center, and 'Co-Op' at the bottom. The cooperatives listed are:

- Baldwin EMC
- Central Alabama
- Clarke Washington
- Coosa Valley
- Covington Electric
- Dixie Electric
- Escambia River
- Gulf Coast Southport
- Gulf Coast Wewa
- Pea River
- Pioneer Electric
- South Alabama
- Southern Pine
- Tallapoosa River
- West Florida
- Wiregrass Electric

On the right side, there is a control panel with the following elements:

- PowerSouth Energy Cooperative logo
- Central Standard Time: 17:49:26
- Sunday, February 28, 2010
- Transmit button
- Calls (0)
- Answer Call button
- HEADSET MONITOR (red)
- UNSELECT (green)
- NEXT CALL (red)
- SIMUL SELECT (red)
- RELEASE (grey)
- HOLD (orange)
- ALL MUTE (brown)
- MUTE (brown)
- Maintenance (blue)

At the bottom of the interface, there is a navigation bar with the following tabs: PowerSouth, Members, LINC, History, Diagnostic, Help.

Avtec Scout : Linc Tab



**PowerSouth**
ENERGY COOPERATIVE

Central Standard Time
17:50:36
Sunday, February 28, 2010

Transmit

Calls (0)



Answer Call

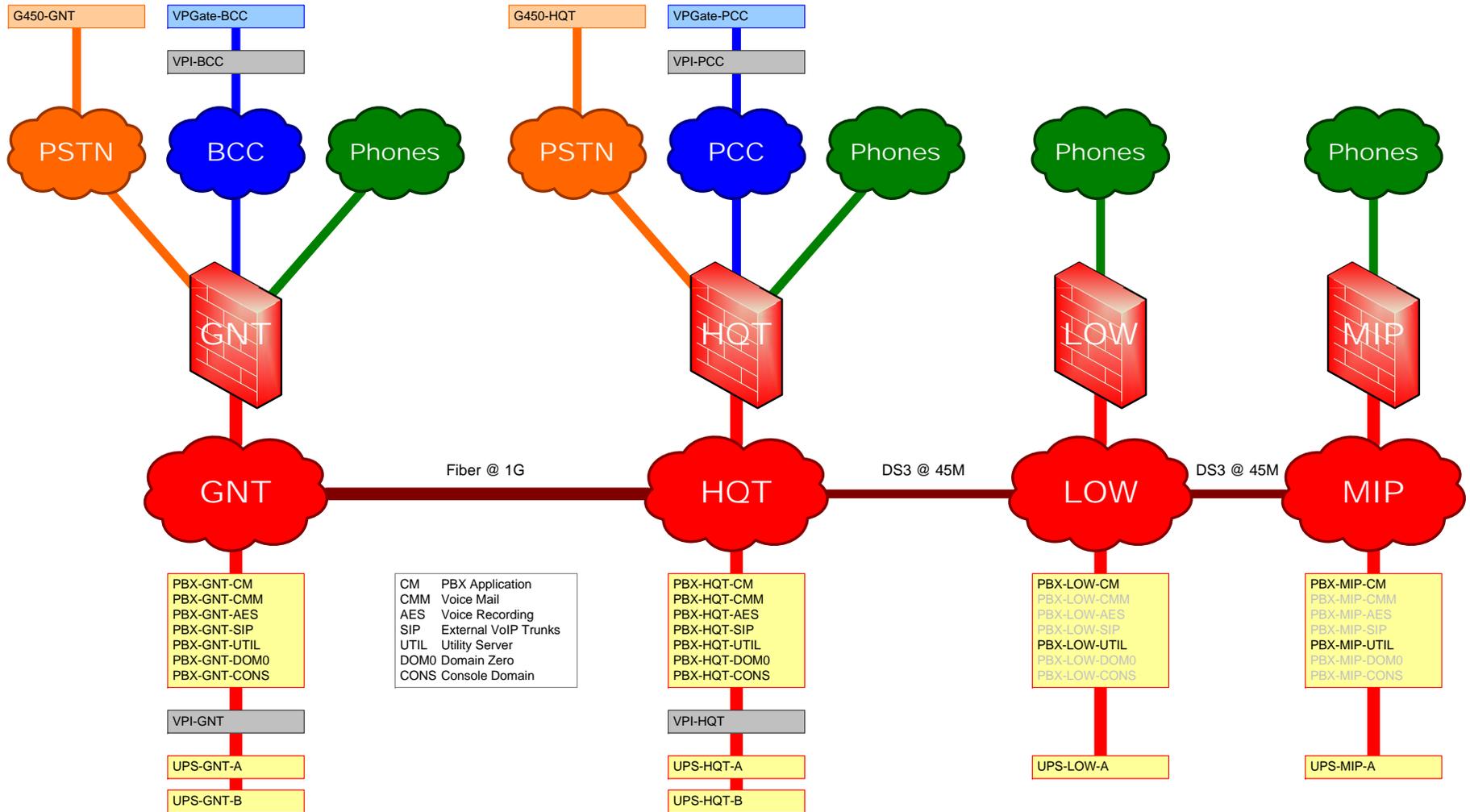
| | | |
|-----------------|----------|-------------|
| HEADSET MONITOR | UNSELECT | NEXT CALL |
| SIMUL SELECT | RELEASE | HOLD |
| ALL MUTE | MUTE | Maintenance |

| | | | |
|--------|------|--------|----------|
| Recall | | | |
| 1 | abc | def | |
| 2 | ghi | jkl | mno |
| 3 | 4 | 5 | 6 |
| 7 | pqrs | tuv | wxyz |
| 8 | * | 0 | # |
| Clear | Back | Commit | |
| | | | Group |
| Alert | | | Contacts |

| | |
|-----------------|----------------|
| Baldwin LINC | Chastain LINC |
| Graceville LINC | Kyzar LINC |
| Mexia LINC | Point A LINC |
| Shorter LINC | Shorter Nextel |

PowerSouth | Members | LINC | History | Diagnostic | Help

Phone System Upgrade



- **Survallent NMS**
 - Alarm Management
 - Performance Monitoring
- **Other Monitoring**
 - Kiwi Syslog Server
 - PRTG Latency Measurements
- **Reporting & Notification**



Survallent NMS



PowerSouth Energy Cooperative

Telecom NMS

| | | | | | | | | | |
|-----|------|------|-----|------|-----|-----|-----|-----|-----|
| A15 | ARN | ASH | ATM | BAK | BEL | BRE | BRK | BRN | BSC |
| BWB | CAP | CHT | CNT | CORP | CRY | CSH | DAL | DEF | DIX |
| DUB | ECH | ELS | EVG | FRE | GAS | GNT | GRC | GRN | GRS |
| HQT | ICCP | KYZ | LAF | LIB | LMR | LOC | LOW | MEM | MEX |
| MIP | MIS | MTC | OAK | OPP | PAX | PBX | POR | PTA | SCY |
| SEL | SHT | SYSS | TKH | UPS | VIC | VST | WGR | WYE | YCM |

Alarm Menu

Report Menu

Help Menu

Version 2010.02.01

Alarm Priorities

- **Priority 0 – Normal**
 - Green = Good
 - Also Used for Events
 - Swap from Receiver A to B
- **Priority 1 – Warning**
 - Blue = Warning
 - Pre-Acknowledged Abnormal Condition
 - Example : Errored Seconds
- **Priority 2 – Minor**
 - Yellow = Caution
 - Requires Manual Acknowledgement
 - Example : Backup Failed
- **Priority 3 – Major**
 - Orange = Bad
 - Requires Manual Acknowledgement
 - Example : Traffic Down
- **Priority 4 – Critical**
 - Red = OH CRAP!
 - Requires Manual Acknowledgement
 - Example : Essential AC Failed

| | |
|---|-----------------------|
|  | Priority 0 - Normal |
|  | Priority 1 - Warning |
|  | Priority 2 - Minor |
|  | Priority 3 - Major |
|  | Priority 4 - Critical |
| +100% | Analog - HR |
| +50% | Analog - HH |
| +10% | Analog - HI |
| 0% | Analog - Normal |
| -10% | Analog - LO |
| -50% | Analog - LL |
| -100% | Analog - LR |

Alarm Menu



| | ALL | SON | -BRK | -DIX | -VIC | -PAX | -SHT |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| ALL | ALL Alarms | 050 Alarms | 051 Alarms | 052 Alarms | 053 Alarms | 054 Alarms | 055 Alarms |
| Active | Active | Active | Active | Active | Active | Active | Active |
| Unacknowledged | Unacknowledged | Unacknowledged | Unacknowledged | Unacknowledged | Unacknowledged | Unacknowledged | Unacknowledged |
| Acknowledged | Acknowledged | Acknowledged | Acknowledged | Acknowledged | Acknowledged | Acknowledged | Acknowledged |
| Prioritized | Prioritized | Prioritized | Prioritized | Prioritized | Prioritized | Prioritized | Prioritized |
| Blocked | Blocked | Blocked | Blocked | Blocked | Blocked | Blocked | Blocked |
| Current Hour | Current Hour | Current Hour | Current Hour | Current Hour | Current Hour | Current Hour | Current Hour |
| Previous Hour | Previous Hour | Previous Hour | Previous Hour | Previous Hour | Previous Hour | Previous Hour | Previous Hour |
| Current Day | Today | Today | Today | Today | Today | Today | Today |
| Previous Day | Yesterday | Yesterday | Yesterday | Yesterday | Yesterday | Yesterday | Yesterday |
| Shelter | Shelter | Shelter | Shelter | Shelter | Shelter | Shelter | Shelter |
| Power Systems | Power Systems | Power Systems | Power Systems | Power Systems | Power Systems | Power Systems | Power Systems |
| Tower Systems | Tower Systems | Tower Systems | Tower Systems | Tower Systems | Tower Systems | Tower Systems | Tower Systems |
| Microwave | Microwave | Microwave | Microwave | Microwave | Microwave | Microwave | Microwave |
| Multiplex | Multiplex | Multiplex | Multiplex | Multiplex | Multiplex | Multiplex | Multiplex |
| Network | Network | Network | Network | Network | Network | Network | Network |
| Bandwidth | PRTG | Bandwidth | Bandwidth | Bandwidth | Bandwidth | Bandwidth | Bandwidth |
| RTU | RTU | RTU | RTU | RTU | RTU | RTU | RTU |
| Summary | Summary | Summary | Summary | Summary | Summary | Summary | Summary |

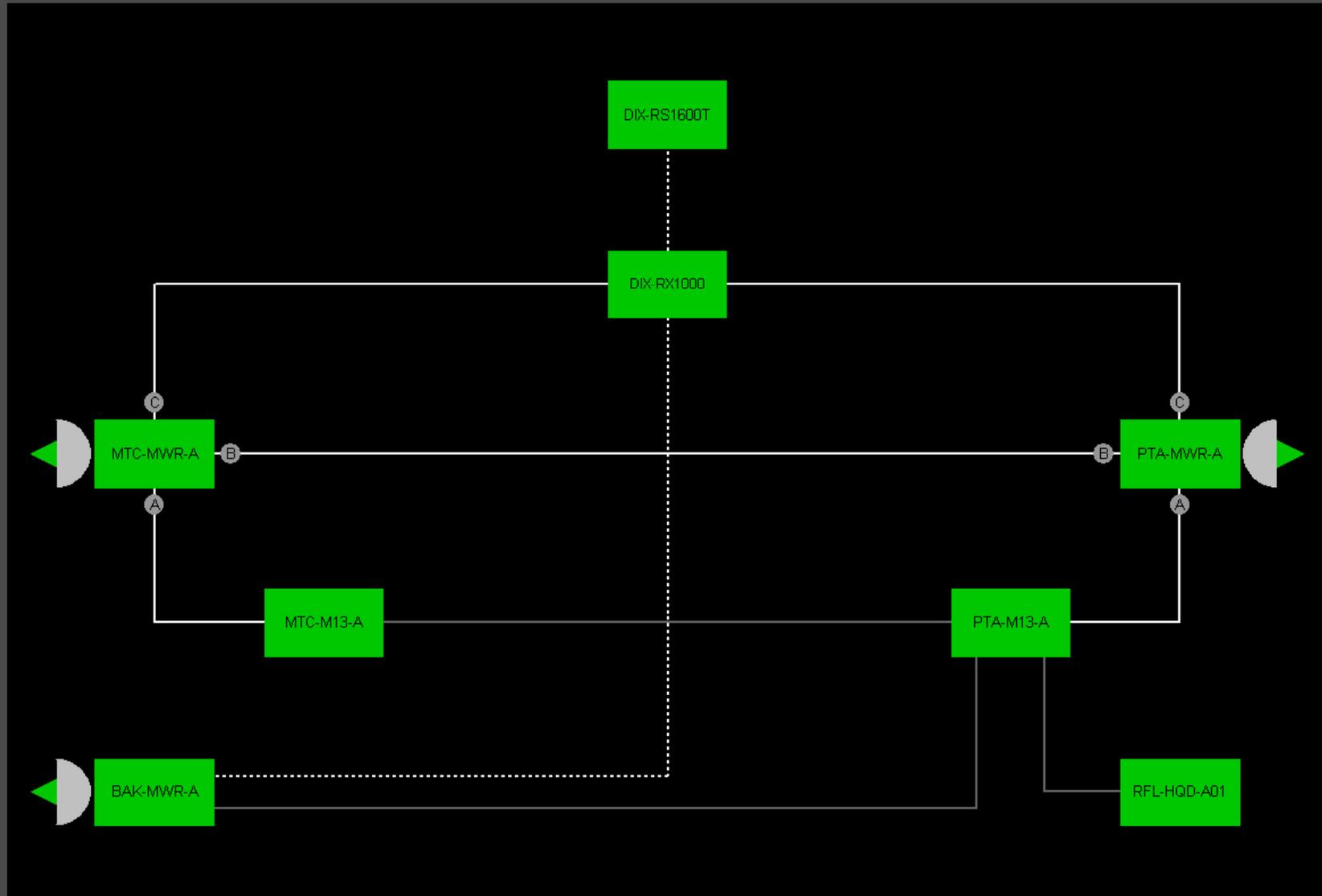
SNMPs117

DNP RTU

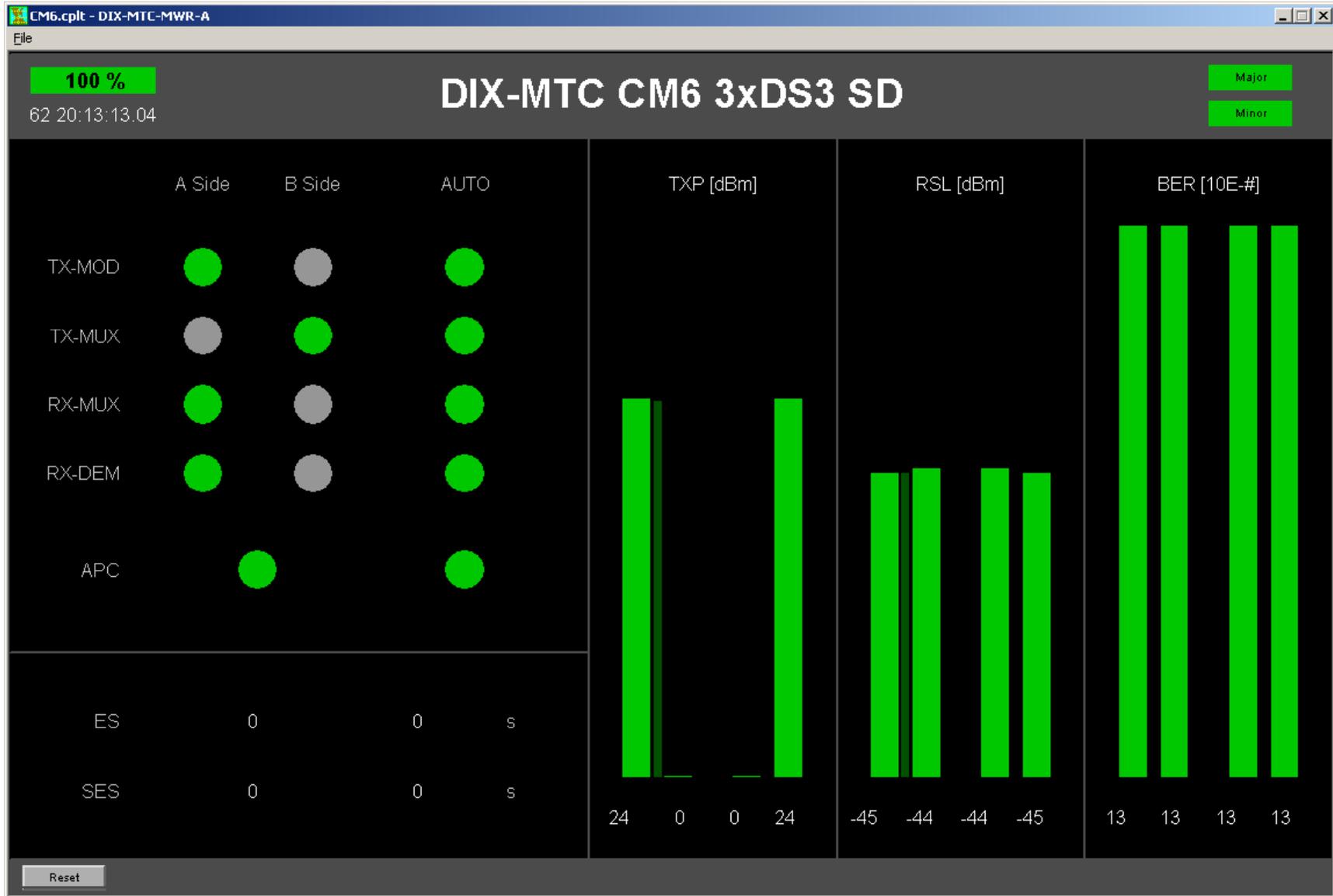
Dixie Tower

Alarm View

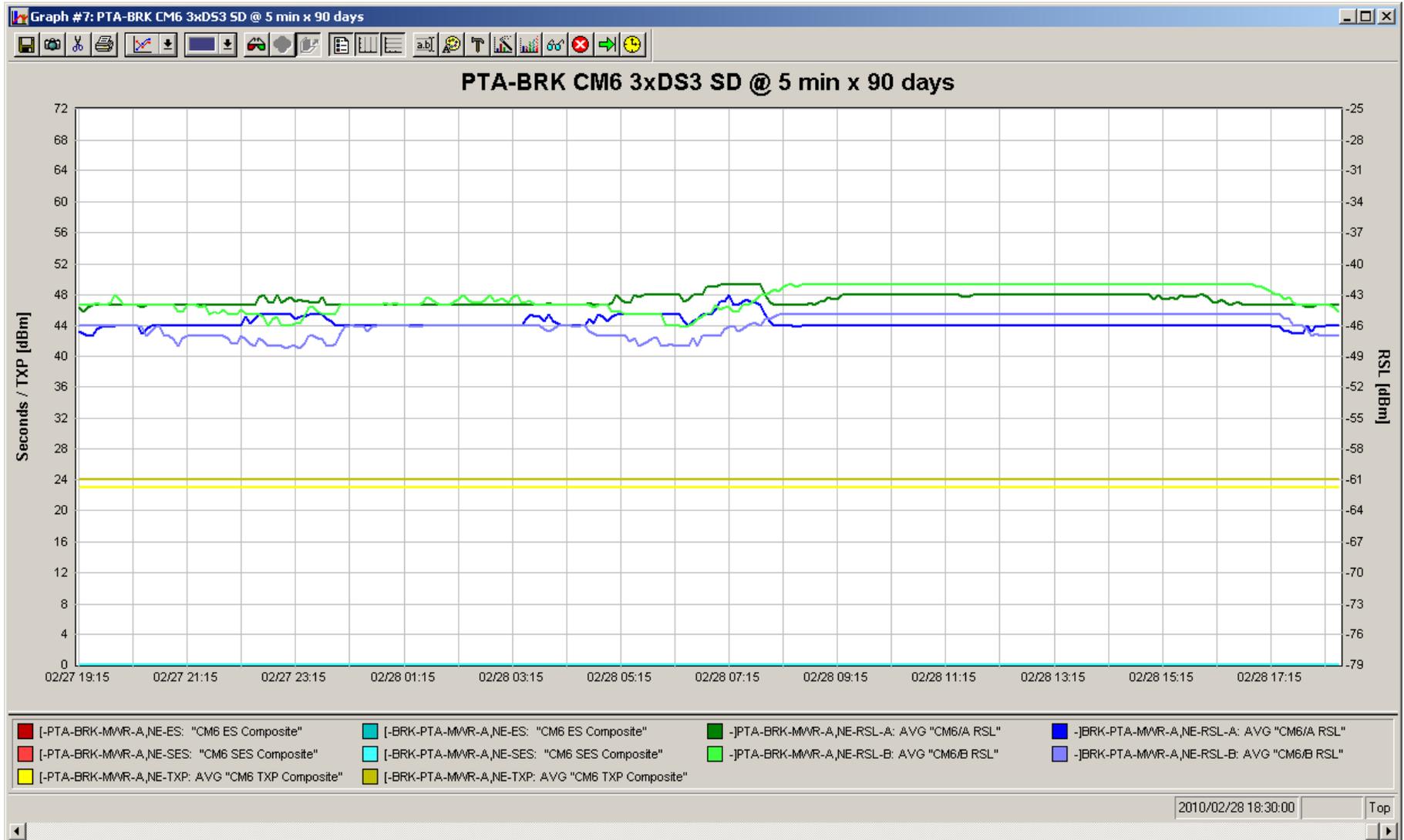
Drawings

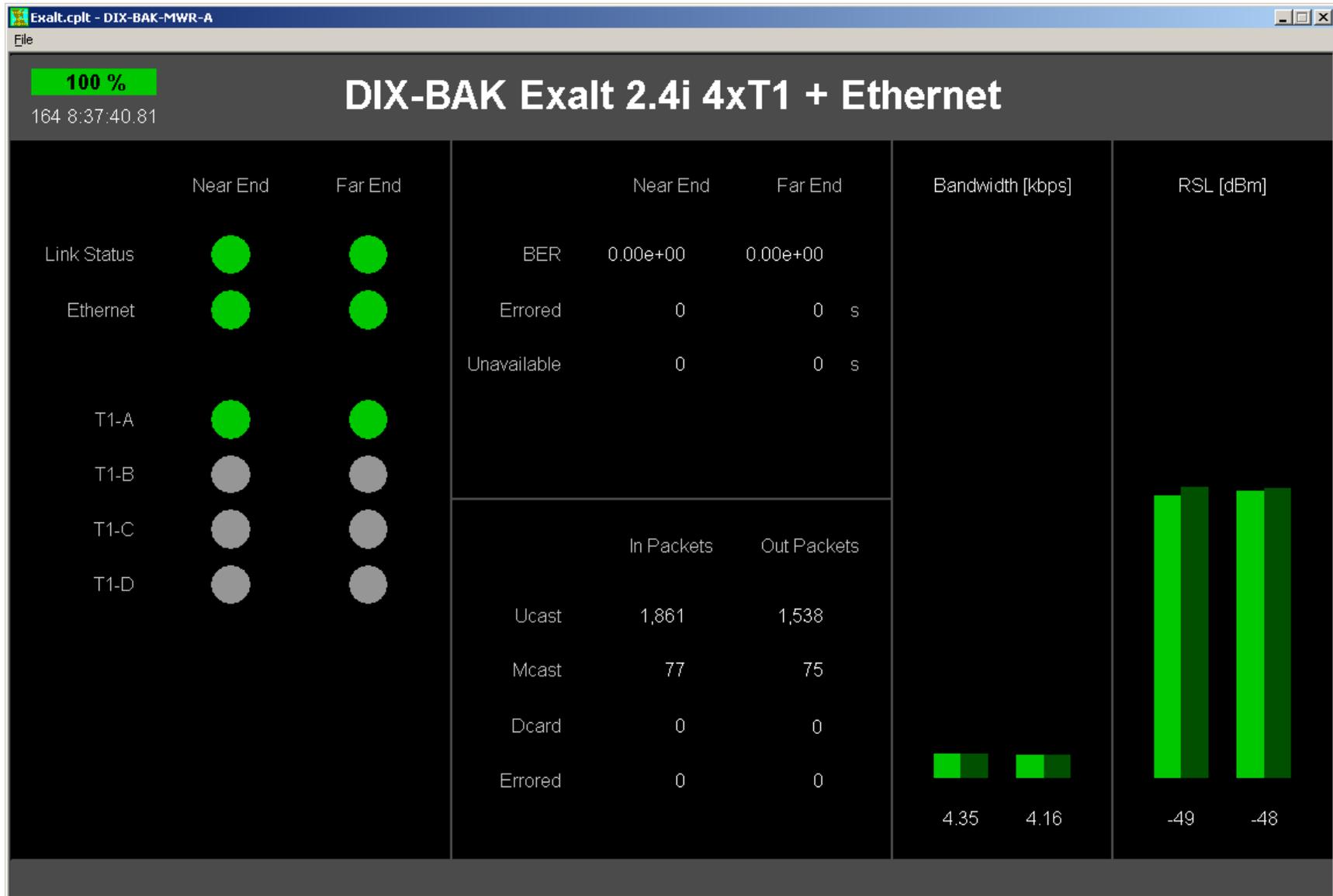


Microwave Networks CM6



RSL Historical Data





Adtran MX2800



MX2800.cplt - DIX-MTC-M13-A

File

100 %

61 21:41:55.66

DIX-MTC MX2800 DS3-A

| | DS3-A | DS3-B | | Status | BPV | LOS | LAIS | CAIS | Circuit Label |
|-------------------------|-------|-------|---|--------|-----|-----|------|------|-----------------|
| LOS | ● | ● | 0 | 01 Off | 0 | 0 | 0 | 0 | HQD-A01 |
| | | | | 02 OK | 0 | 0 | 0 | 0 | RFL HQT-MTC-BRE |
| | | | | 03 OK | 0 | 0 | 0 | 0 | RFL HQT-WYE |
| OOE | ● | ● | 0 | 04 OK | 0 | 0 | 0 | 0 | RFL HQT-OAK |
| | | | | 05 OK | 0 | 0 | 0 | 0 | RFL HQT-ATM |
| AIS | ● | ● | 0 | 06 OK | 0 | 0 | 0 | 0 | RFL HQT-BSC-ELS |
| | | | | 07 OK | 0 | 0 | 0 | 0 | RFL HQT-TKH |
| IDLE | ● | ● | 0 | 08 OK | 0 | 0 | 0 | 0 | RFL HQT-BDO |
| | | | | 09 Off | 0 | 0 | 0 | 0 | HQD-A09 |
| RAI | ● | ● | 0 | 10 Off | 0 | 0 | 0 | 0 | HQD-A10 |
| | | | | 11 Off | 0 | 0 | 0 | 0 | HQD-A11 |
| XCV | ● | ● | | 12 Off | 0 | 0 | 0 | 0 | HQD-A12 |
| | | | | 13 Off | 0 | 0 | 0 | 0 | HQD-A13 |
| TX-LOS | ● | ● | | 14 Off | 0 | 0 | 0 | 0 | HQD-A14 |
| | | | | 15 Off | 0 | 0 | 0 | 0 | HQD-A15 |
| DS3 Card | ● | ● | | 16 Off | 0 | 0 | 0 | 0 | HQD-A16 |
| | | | | 17 Off | 0 | 0 | 0 | 0 | HQD-A17 |
| Power Supply A : Normal | | | | 18 Off | 0 | 0 | 0 | 0 | HQD-A18 |
| Power Supply B : Normal | | | | 19 Off | 0 | 0 | 0 | 0 | HQD-A19 |
| | | | | 20 Off | 0 | 0 | 0 | 0 | HQD-A20 |
| Controller A : Normal | | | | 21 Off | 0 | 0 | 0 | 0 | HQD-A21 |
| Controller B : Stand-By | | | | 22 Off | 0 | 0 | 0 | 0 | HQD-A22 |
| | | | | 23 Off | 0 | 0 | 0 | 0 | HQD-A23 |
| DS3 Card A : Normal | | | | 24 Off | 0 | 0 | 0 | 0 | HQD-A24 |
| DS3 Card B : Normal | | | | 25 Off | 0 | 0 | 0 | 0 | HQD-A25 |
| | | | | 26 OK | 0 | 0 | 0 | 0 | IP SPEC |
| Protection Switches : 0 | | | | 27 OK | 0 | 0 | 0 | 0 | IP2 HQT-BSC |
| | | | | 28 OK | 0 | 0 | 0 | 0 | IP1 HQT-BSC |

RuggedCom RX1000 Router



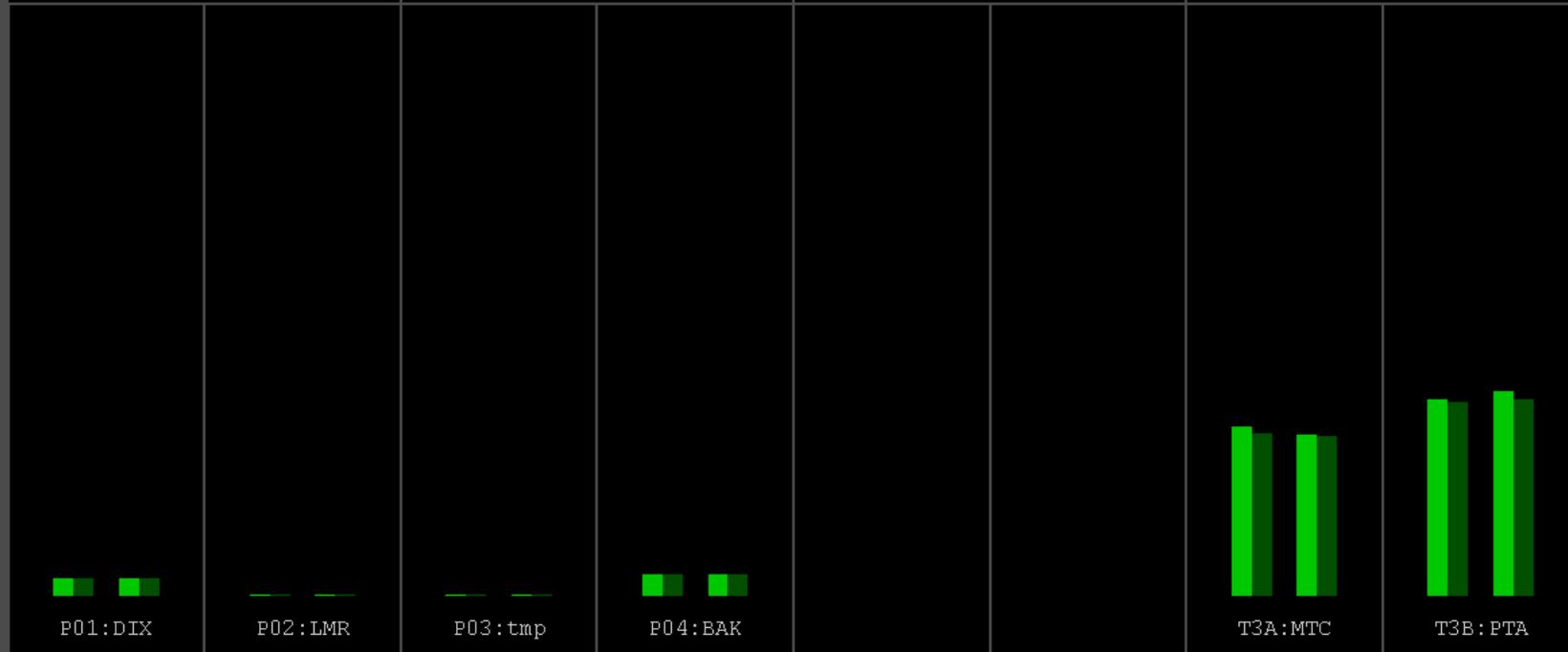
100 %

51 9:57:12.90 28 %

Dixie Router

BW - 5 min Alarm View
 BW - 1 hour Drawings

| Port Status & Label | INCOMING TRAFFIC | | | OUTGOING TRAFFIC | | | Primary Links BW | |
|---------------------|------------------|--------|-------|------------------|--------|-------|------------------|--------|
| | kbps | Ucast | Mcast | kbps | Ucast | Mcast | Avg Val | % Diff |
| P01:DIX | 3.12 | 538 | 0 | 3.22 | 703 | 0 | 3.07 | 1.73 |
| P02:LMR | 0.00 | 0 | 0 | 0.00 | 0 | 0 | | |
| P03:xxx future | 0.00 | 0 | 0 | 0.00 | 0 | 0 | | |
| P04:BAK | 3.94 | 1,591 | 0 | 3.99 | 1,914 | 0 | 3.92 | 0.51 |
| T3A:MTC | 30.22 | 10,209 | 0 | 28.83 | 12,294 | 0 | 28.93 | 4.47 |
| T3B:PTA | 34.99 | 14,812 | 0 | 36.38 | 12,242 | 0 | 34.58 | 1.19 |



RuggedCom RS1600 Switch



RS1600.cplt - DIX- [REDACTED]

File

100 %

82 8:16:38.48

DIX RS1600 @ [REDACTED]

| Port Status & Label | Kbps-OUT | Kbps-IN | Ucast | Mcast | Bcast | Under | Over | Frag | Jabber | Errors | Drops | Colison |
|---------------------|----------|---------|-------|-------|-------|-------|------|------|--------|--------|-------|---------|
| 01 CM6 3DS3 to PTA | 0.27 | 0.26 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 02 CM6 3DS3 to MTC | 0.27 | 0.25 | 45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03 M13-A to PTA | 0.82 | 0.83 | 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 04 M13-A to MTC | 0.88 | 0.87 | 77 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 05 Exalt T1 to BAK | 0.28 | 0.26 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 06 NovaTech/Moscad | 0.72 | 0.39 | 191 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 07 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 08 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 09 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 Digi-TS8 | 0.03 | 0.00 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 ToolBox | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 RX1000 @ P1 | 3.20 | 3.37 | 704 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

DNP75
SNMP

Dixie Tower

Alarm View
Drawings

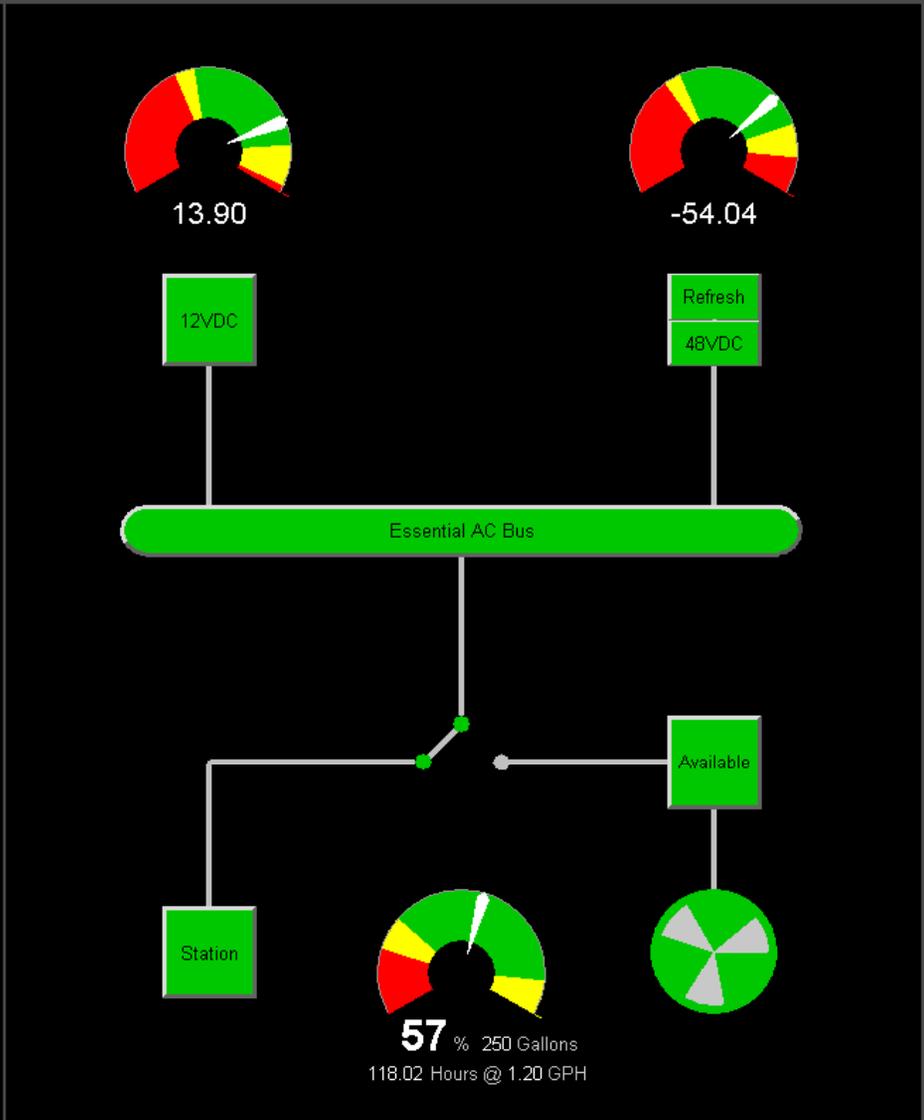
DNP RTU Comm : **Normal**
DNP Comm Quality : **100 %**

MOSCAD Comm : **Normal**
MOSCAD Restart : **Normal**
MOSCAD I/O : **Normal**

House Door : **Closed**
Smoke Detector : **Normal**
Building Temp : **Normal**

Tower Light Mode : **NIGHT**
Beacon Status : **Normal**
Strobe Status : **Normal**
Side Lights : **Normal**

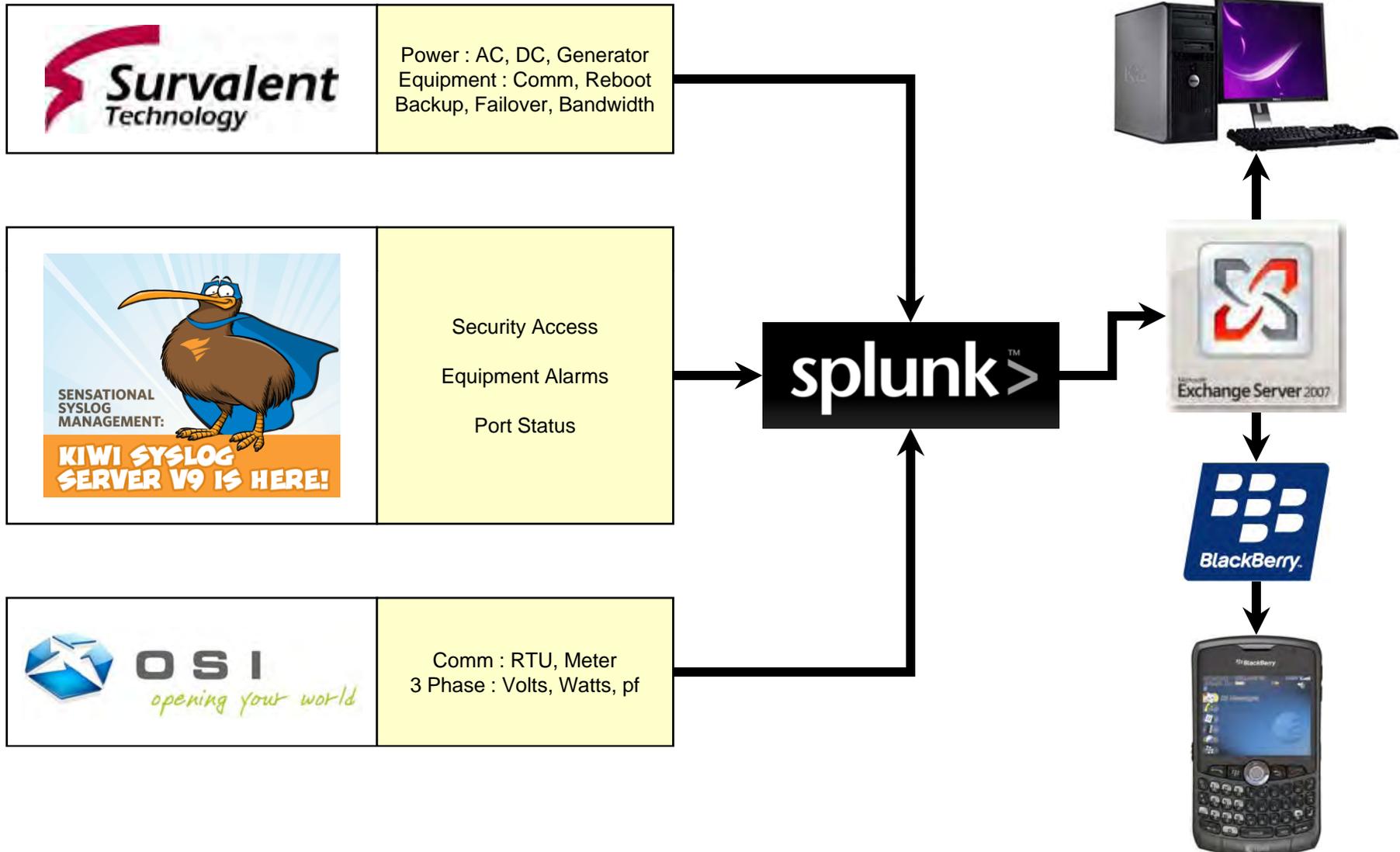
Waveguide Pressure : **Normal**
Waveguide Pump : **Stopped**



- **Active Alarms**
- **Bandwidth Delta**
- **Blocked Alarms**
- **CPU Utilization**
- **Errored Seconds**
- **FAA Tower Lighting**
 - Detail, Exceptions
- **Generator**
 - Fuel Estimate, Run Time
- **Loss of Frame**
- **Rebooted in Last 72 Hours**
- **Waveguide Pump**



Logging & Notification



- **Core Router Upgrades**
- **NERC CIP Security**
- **Microwave Expansion in Northern Territory**
- **Phone System Upgrades**
- **Private Mobile Radio Narrowbanding**
- **Smart Grid Communications**
- **Voice Recorder Installation**