

A nighttime photograph of a city skyline, likely New York City, viewed from across a body of water. The buildings are illuminated with various lights, and their reflections are visible on the water's surface. The sky is dark blue. The text 'EAS Conference' and 'February 6, 2023' is overlaid on the left side of the image in white.

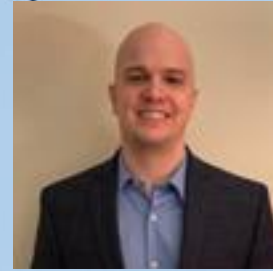
EAS Conference

February 6, 2023



Powering Business Worldwide

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Smart Grid ready capacitor bank control Automation and Efficiency

Presenters: Troy Hedlund Product Manager
Alex Tibbetts CBC Application Engineer



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Trends in VAR control

Business drivers

- Regulation imposes new requirements with the overall goal of reducing energy consumption & demand
- Energy purchase savings
- Demand peak shaving
- Renewables & EV's

Business objectives

- Unity power factor minimizes losses & minimizes purchased kW
- Reduced voltage profile minimizes purchased kW:
 - 1 % reduction in voltage results in 0.5 to 0.8 % reduction in kw

Functional objectives

- Manage feeder VARs to a settable target
- Manage voltage to a settable target
- Flat voltage profile

Technical requirements

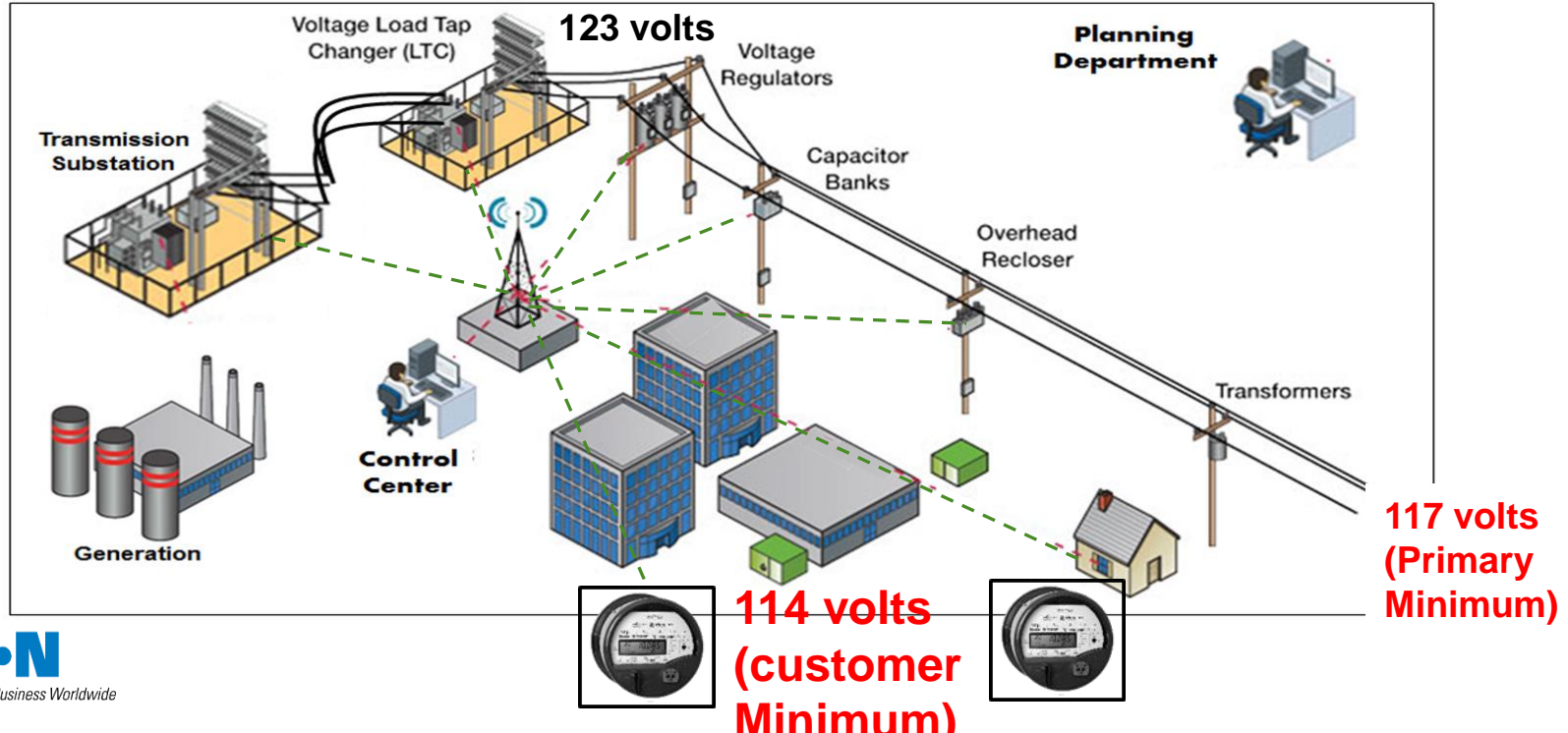
- Monitor & control substation & feeder capacitor banks (cap bank controls)
- Monitor end-of-line voltages to avoid violations (smart meters, sensors)

Solutions to improve grid efficiency



Generic Utility Electrical System

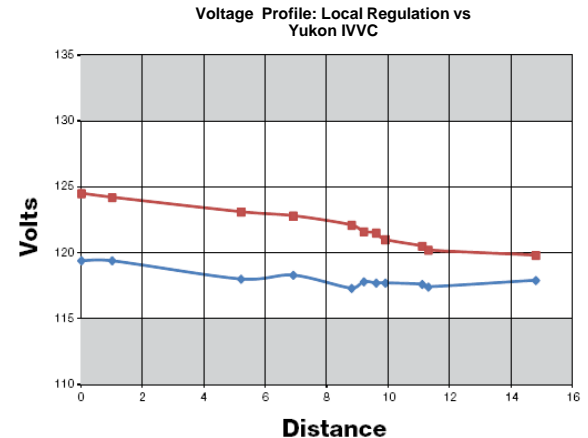
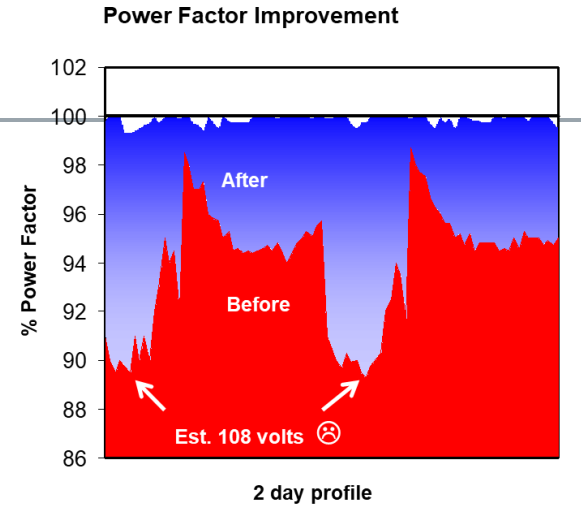
$$\text{Volts (V)} \times \text{Amps (I)} = \text{Watts (or Kwh)}$$



Energy efficiency

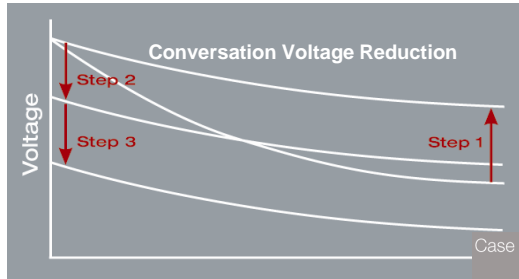
- Release system capacity
 - Eliminate VAR flow
 - Mitigate power factor penalties
 - On demand VAR support
- Increase KWh sales with improve feeder voltage profile
- Reduce energy purchases while maintaining system power quality

Intelligent solutions improve distribution system voltages & power factor



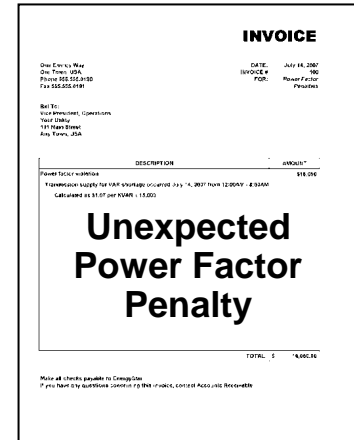
Energy Efficiency

VAR WORKSHEET					12 % reduction per feeder				
POWER CAPACITOR APPLICATION									
	MW	MVAR	MVA	Power Factor	KVA savings	Feeder Amps	Line Impedance (ohms)	Line Loss (ISQR) KW	Released KW capacity due to line losses
Original	5.000	2.000	5.385	0.928		249.336	5.000	310.842	
Corrected	5.000	0.800	5.064	0.987	321.569	234.447	5.000	274.827	36.015



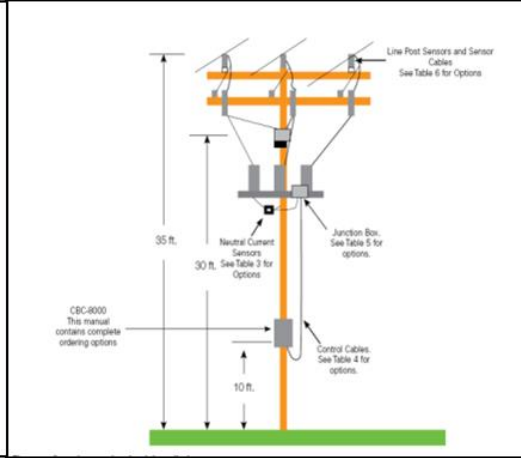
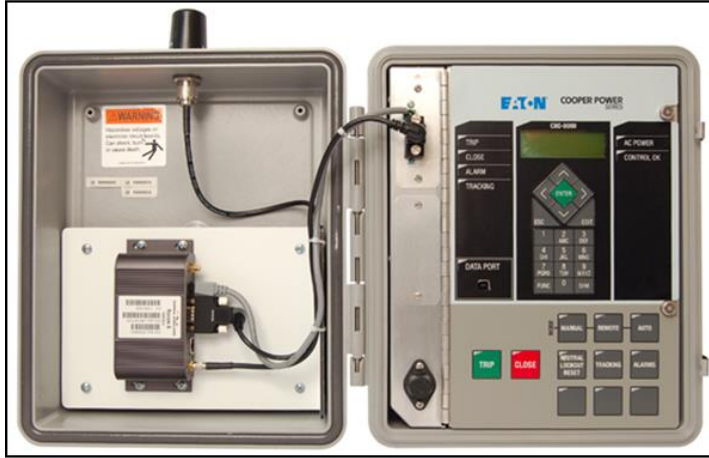
Case	Substation Voltage	Substation Power Factor	kW Losses	Capacity Released (kW)
No Caps	126	0.879	466	n/a
With Caps	123	0.994	377	n/a
CVR with Caps	118	0.999	374	528
CVR with no Caps	124	0.877	467	252

Generation Savings
Reduced Carbon Foot Print



Conservation Voltage Reduction

Operational Algorithms Supporting Automation



- Time
- Temperature
- Voltage
- Current
- Kvar (Power Factor)
- Neutral Current Alarming & Lockout

- 3-phase V&I Metrology, Analysis & Operation
- Remote Operation from Automation
- Communication Loss Fail Safe modes
- Renewables Penetration Issues – Eaton's Co- Generation Mode is an answer

Communications



Protocols

- DNP 3
- DNP3 SAV5
- TCP/IP
- UDP
- TLS1.2
- **Communication Modules**
 - RS-232
 - Ethernet
 - Ethernet Option with “POE”

Example Radios

- Cellular (Public Network) – Sierra Wireless, Cisco, BlueTree,
- Point-to-Point (Private Network) – MDS/SD9, ELPRO, Tropos, MiMoMax
- AMI Providers (Mesh Networks)

Communications Data log

Level	Time Stamp	Data
Level 1	10/30/2013 19:15	DNP Message Frame sent
Level 3	10/30/2013 19:15	Raw Data 05 64 FF 44 E8 03 04 00 6B BC 0D 00 01 28 00 01 0A 00 01 0A 00 01 00 00 01 00 93 C6 00 01 98 FE 01 00 00 01 00 00
Level 1	10/30/2013 19:15	DNP Message Frame sent
Level 3	10/30/2013 19:15	Raw Data 05 64 B5 44 E8 03 04 00 7D AE 8E 00 01 3D 00 01 3D 00 01 00 00 01 3D 00 01 3D 6C CB 00 01 00 00 01 3D 00 01 3D 00
Level 1	10/30/2013 19:15	DNP Message Frame sent
Level 1	10/30/2013 19:15	DNP Message Fragment sent
Level 2	10/30/2013 19:15	Raw Data 05 64 14 C4 04 00 E8 03 37 D1 E0 C1 01 3C 02 06 3C 03 06 3C 04 06 3C 01 06 A4 68
Level 1	10/30/2013 19:15	DNP Message Frame received
Level 1	10/30/2013 19:15	DNP Message Fragment received
Level 3	10/30/2013 19:15	Raw Data 05 64 FF 44 E8 03 04 00 6B BC 4F C1 81 00 00 01 01 00 00 76 01 00 00 00 00 00 AB 49 00 00 00 04 20 00 00 00 0A
Level 1	10/30/2013 19:15	DNP Message Frame sent
Level 3	10/30/2013 19:15	Raw Data 05 64 FF 44 E8 03 04 00 6B BC 10 01 00 00 01 00 00 01 00 00 00 00 01 00 00 C3 AF 01 00 00 01 00 00 01 00 00 01 0

Level 0

- IP Address, port and connection status

Level 1

- DNP message statistics

Level 2

- Raw hex incoming

Level 3

- Raw hex outgoing

- No longer will utilities today need to deploy special routers in the field near the CBC to troubleshoot messages being sent to the capacitor bank control

Saving time and money



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Solving Renewable Challenges

Problem:

As customers see more and more renewable penetration on their feeders, reverse power flow caused by Distributed Energy Resources becomes a real possibility that customers must account for

Customers need a robust solution that accounts for this use case

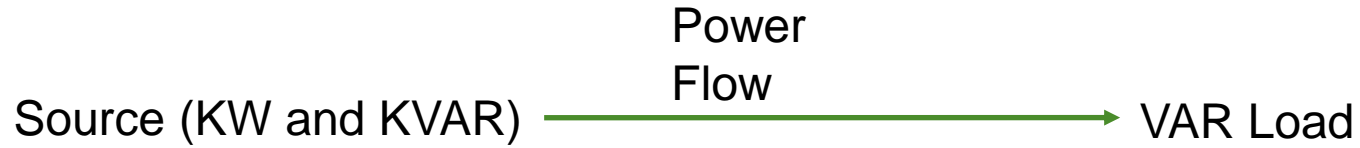


Co-Generation Mode

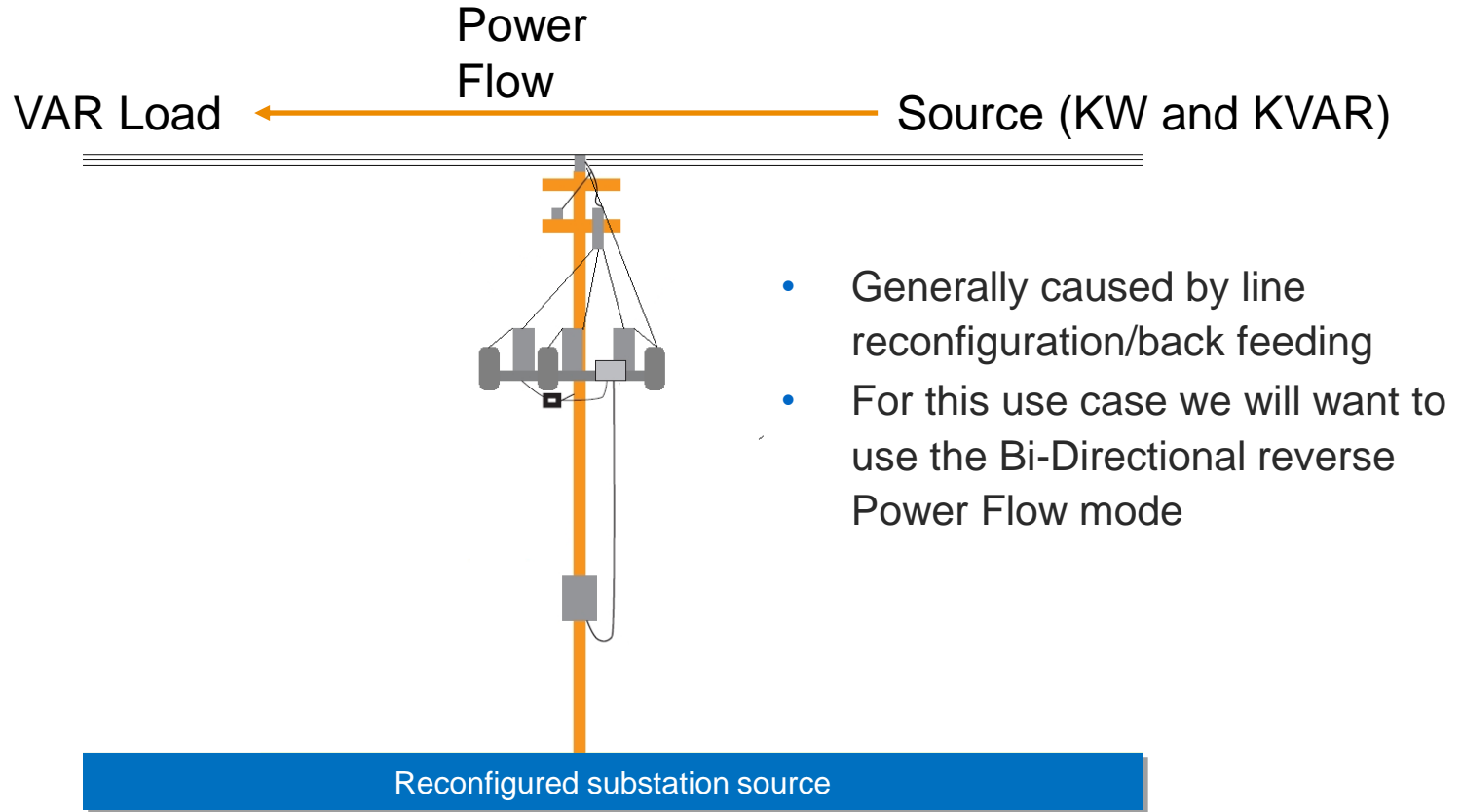


Allows for a CBC-8000 to operate correctly when it sees reverse power flow due to Distributed Energy Resources (DER)

Normal Power Flow



Reverse Power Flow (Bi-Directional)



Reverse Power Flow (Co-Generation)



- Caused by Distributed Energy Resources (DERs) generating more KW than is needed downstream
- VARs are still sourced from normal generation sources
- For this use case we will want to use Co-Generation Mode

KVAR sourced from Sub; KW sourced from DER

Cyber Security

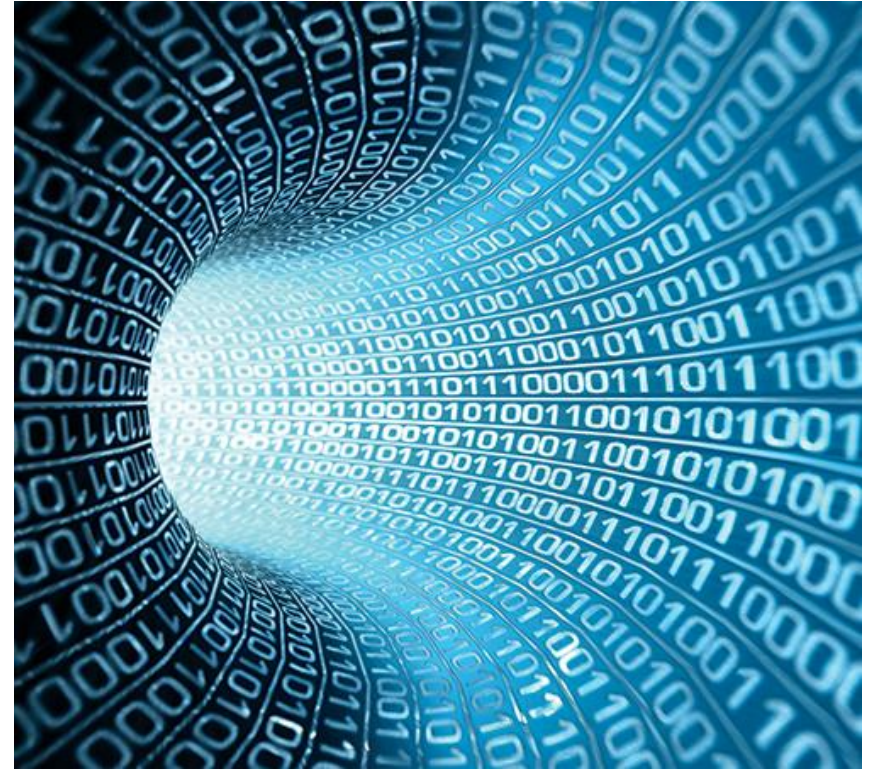


Trends: Increased Emphasis on Cyber Security

- Access Alarms
- Communications Encryption
 - TLS Encryption, certificates
- DNP3 Secure/SAV5
- Secure Supply Chain
 - Unique Device Password
- IEEE 1686
 - Role Based Access
 - Audit Log
 - Etc



Trends: Advanced networking solutions

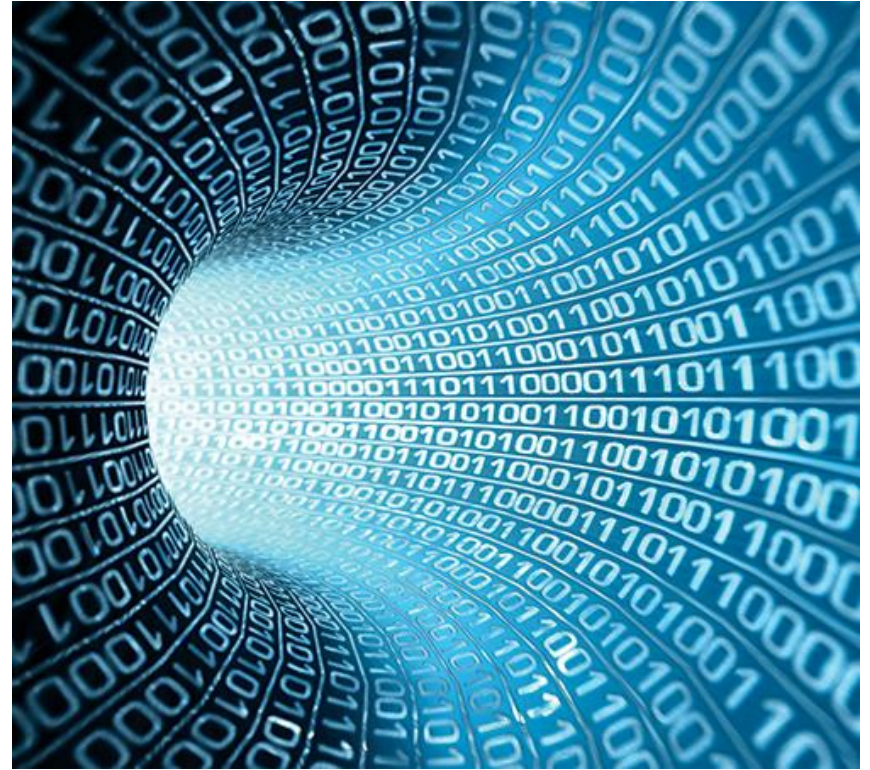


Trends: Advanced networking solutions

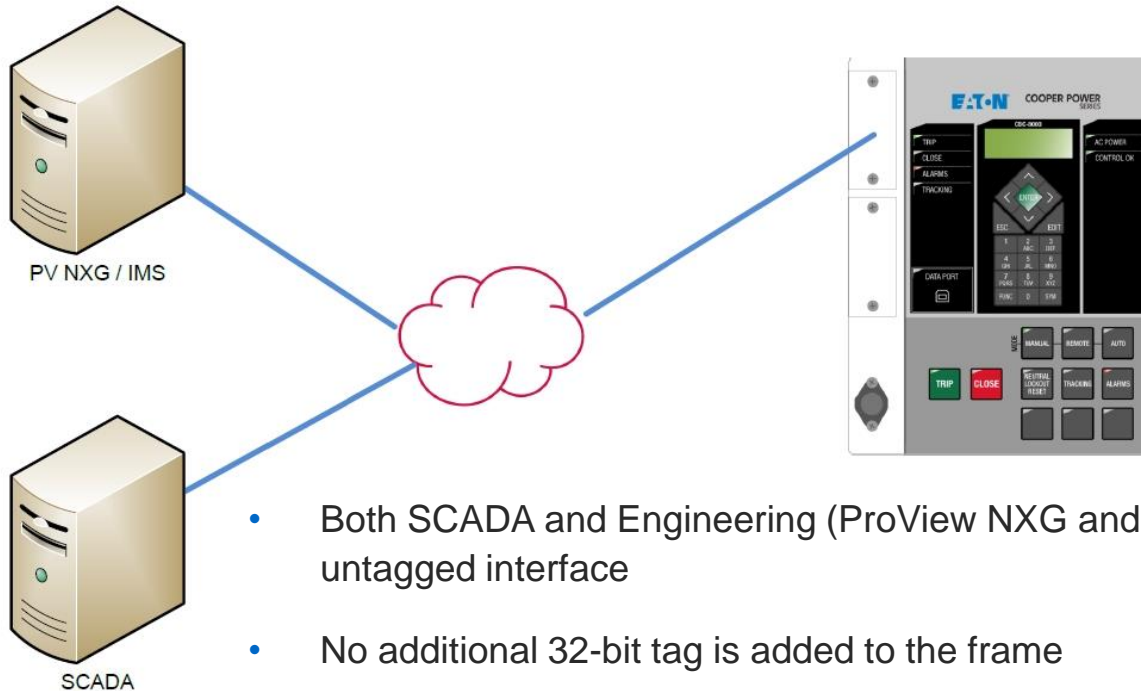
Problem:

As Field Area Networks get larger and more complex, utilities are looking for ways to intelligently and securely manage networking for an increasingly large number of devices

Communications engineers are looking to proven IT technologies to help solve this problem



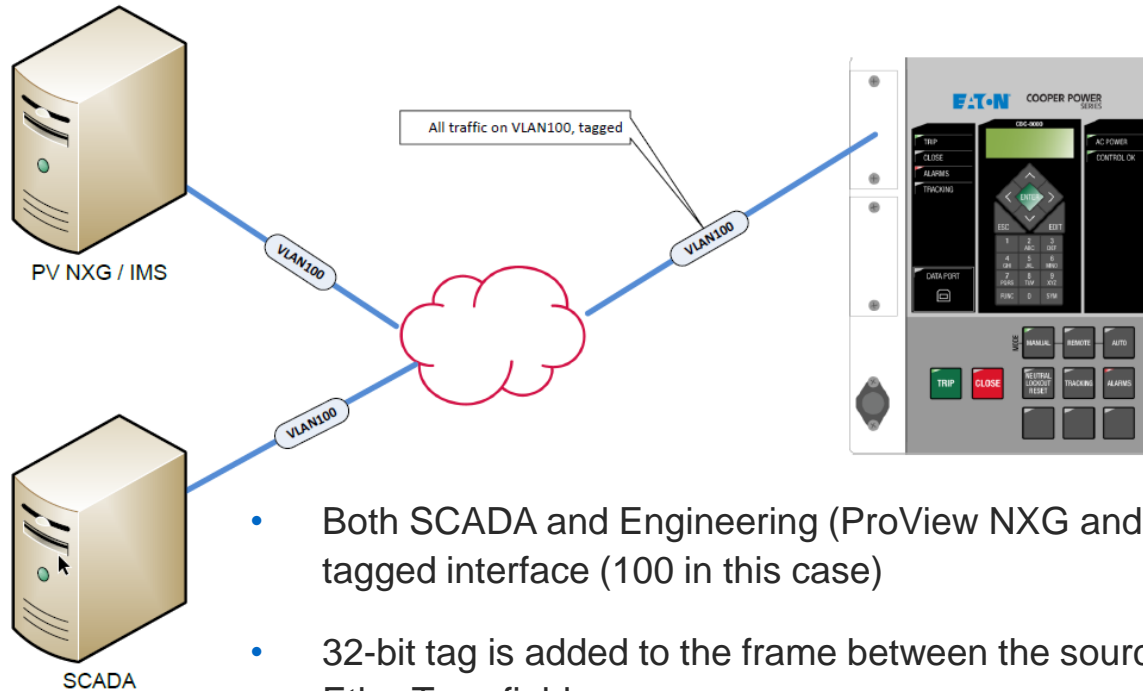
CBC-8000: One Untagged Interface



- Both SCADA and Engineering (ProView NXG and IMS) use the same untagged interface
- No additional 32-bit tag is added to the frame
- The vast majority of implementations of the CBC-8000 use this setup

Most common deployment

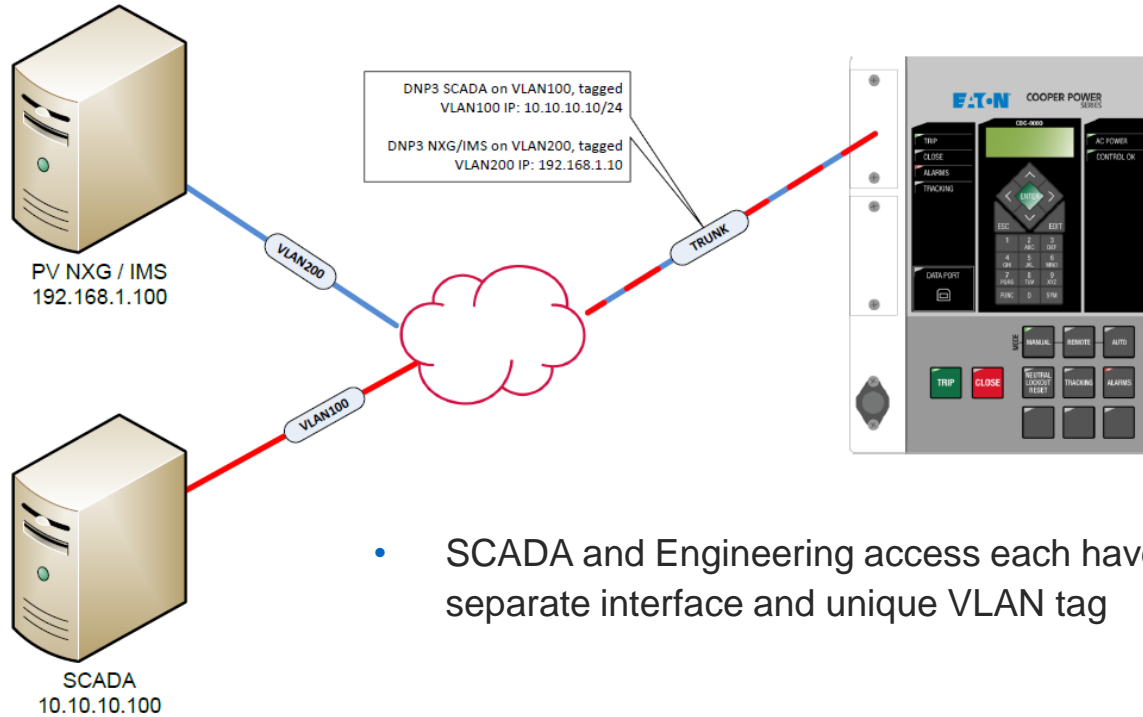
CBC-8000: One Tagged Interface



- Both SCADA and Engineering (ProView NXG and IMS) use the same tagged interface (100 in this case)
- 32-bit tag is added to the frame between the source MAC address and the EtherType fields

CBC Traffic segmented from other traffic

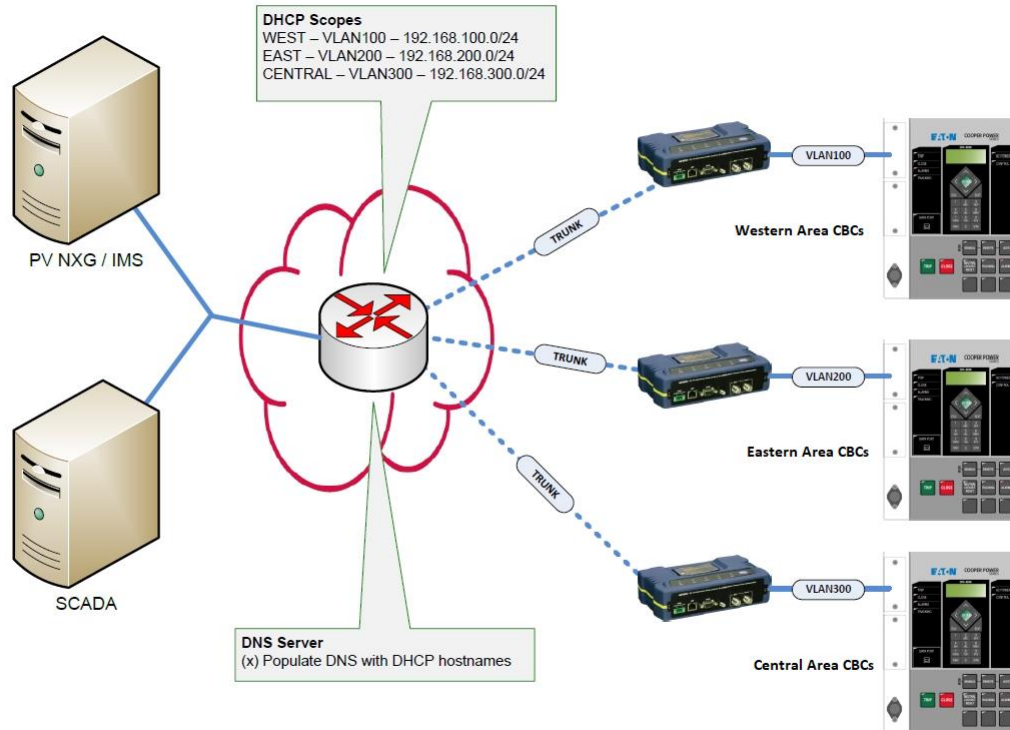
CBC-8000: Two Tagged Interfaces



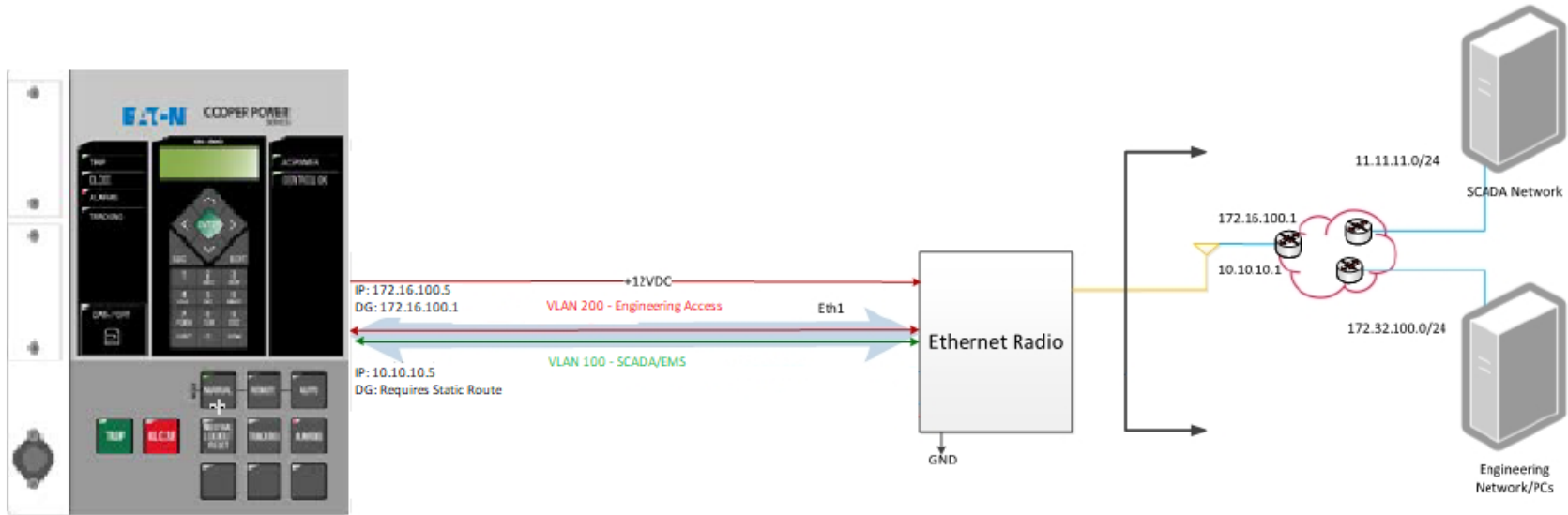
- SCADA and Engineering access each have their own separate interface and unique VLAN tag

One physical connection for two separate networks

CBC-8000: One Tagged Interface Use Case



CBC-8000: Two Tagged Interfaces



One physical connection for two separate networks

Trends - Work force Efficiency



CBC-8000 & Eaton's Control Family

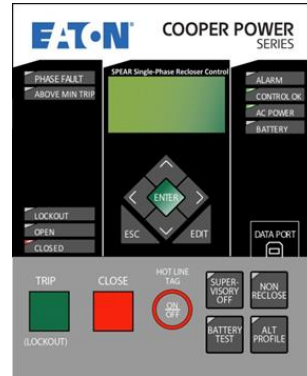
Form 7
Recloser



F4D
Recloser Control



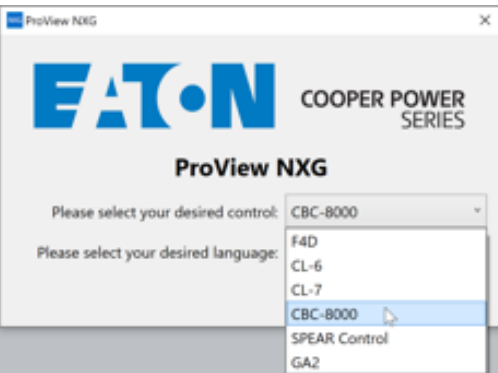
SPEAR
Single-phase
recloser control



CL-7
Regulator Control



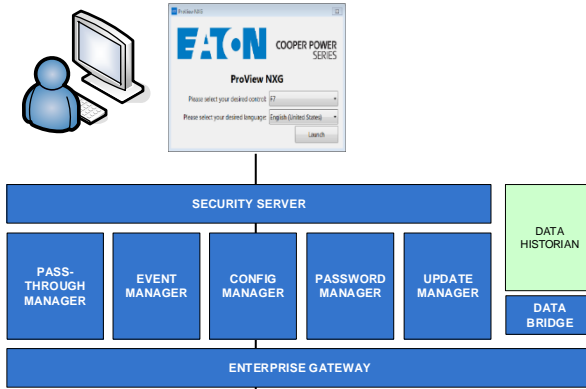
CBC-8000
Capacitor
Bank
Control



GridAdvisor II
Fault Indicator

Eaton Control Family – Fleet Management

Eaton's IMS Software



Form 7 Advanced Recloser Control



CL-7 Regulator
Control



CBC-8000
Capacitor Control



SPEAR 1ph
Recloser Control



GridAdvisor II
LTE/Band 26

- Common platform – consistent look and feel
- Unified software – ProView NXG
- Simplified training and operator familiarity
- **Eaton's IMS Software – asset management and Fleet management for Eaton controls, and competitors' controls.**
- **Yukon IMS Software- Firmware Management, Setting Management, Password Management Audit logging**



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CBC-8000 Models

Base Catalog/Model Number

- Many mounting options available
- C8002xxx \$1399/ea. USD
(no comms card)
- C8024xxx \$1425/ea. USD
(w/Serial port)
- C8020xxx \$1598/ea. USD
(w/Ethernet port)
- Custom ETO Radio solutions



Standard Lead-time
8-12 weeks



ETO Radio integration
Common Lead-times
8-14 weeks

Manufactured in Minneapolis MN, USA



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Questions



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