

SEL

SMART Protocols and SEL IEDs Add Intelligence to Smart Grid

SEL Metering, Automation, and Remote Telecommunications

MAKING ENERGY POWER SAFER, MORE RELIABLE, AND MORE EFFICIENT

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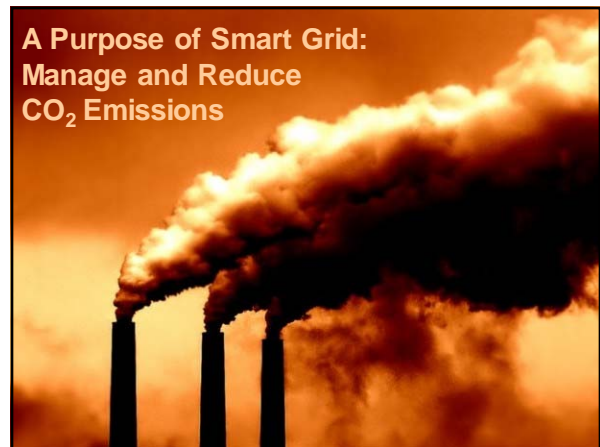
Microprocessor Is Both the Challenge and the Champion

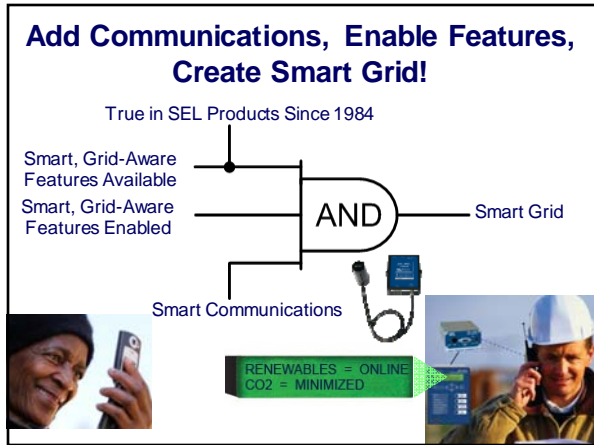
Change in Demand Change in Control

**SEL Vision of Smart Grid:
Add Intelligence via SMART Protocols & IEDs**


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SEL Pioneered Smart Grid Technology and Continues to Add Solutions



1984

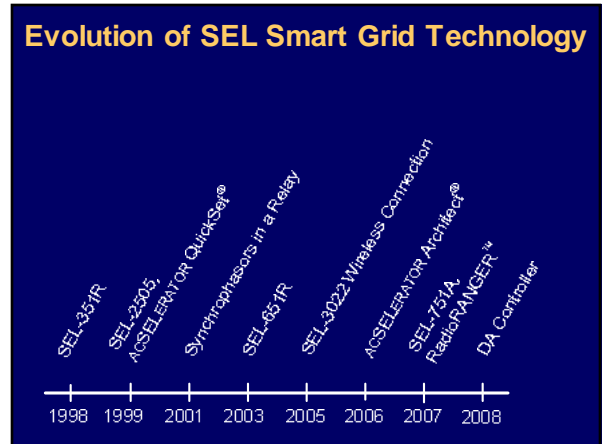
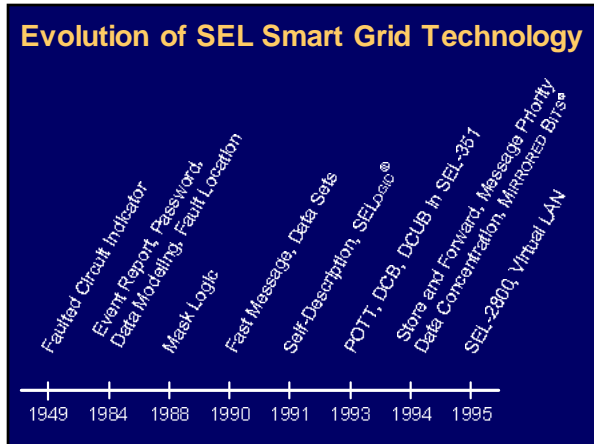


Today

SEL Application Guide Volume VII AG98-06

Using SEL-351s and SEL-351Rs to Provide Automated Load Restoration for Distribution Feeders

Karl Zimmerman, Jeff Roberts, David Dolezilek




**Florida's International Drive 1999 Project:
Distribution Automation at Transmission Speeds**




Asset Information Communicates System Performance and Health




Situational Awareness Allows People and Processes to Prepare and React



Knowledge of Speed, Speed Limit, and Bridge Height Are Useful, But ...

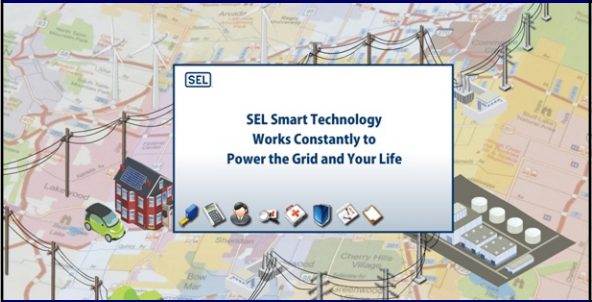


Full Awareness Includes Height of Payload

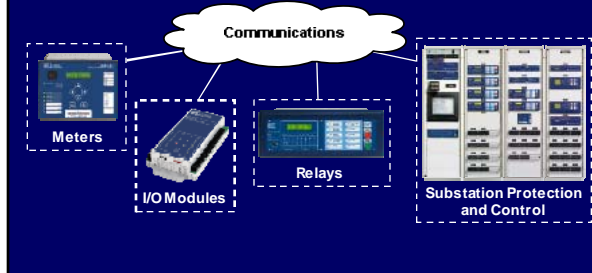


02/14/2006

Today's Performance of the Smart Grid

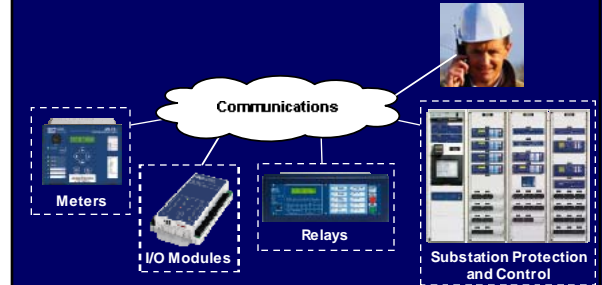


Smart Grid Begins With Communications To and Among Networked IEDs

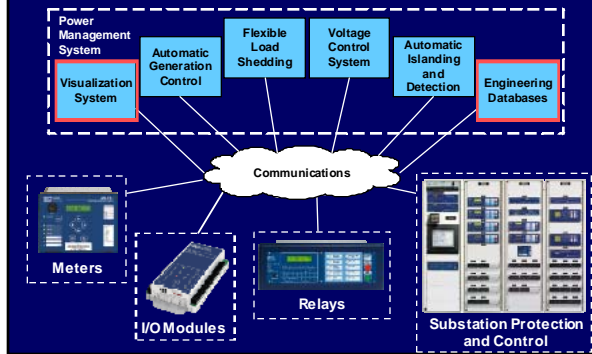


Next, Communication Directly to People Who Need to Know

Ethernet Transceiver and Event Messenger Support Email, Text, and Voice Messages



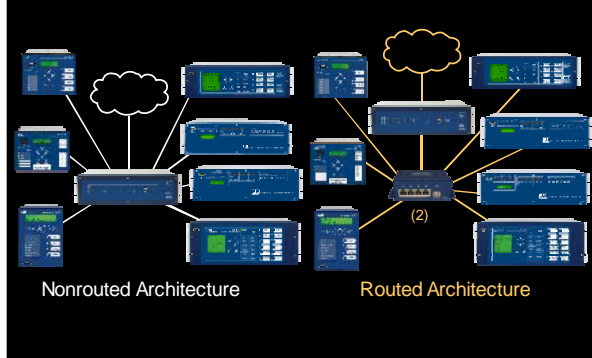
Then Communications to Visualization and Engineering Tools







POWERMAX® Adds "Power System Aware Automation"



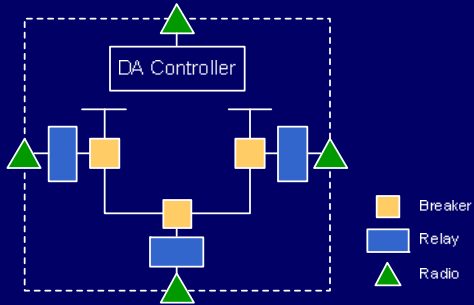
Choose Your Architecture: SEL Provides Routable and Nonroutable Protocols



Routed and Nonrouted Protocols Use Different Address Types

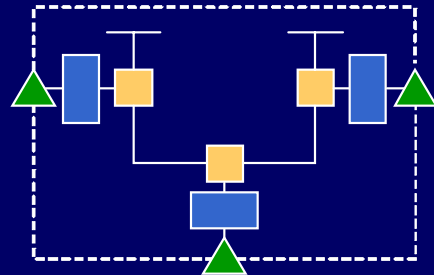
- Nonrouted *David Dolezilek*
2350 NE Hopkins Ct 
- Internet routed *Occupant*
2350 NE Hopkins Ct 
- Intranet routed  

Centralized Communications via DA Controller



Decentralized Communications via DA Controller

Shared Decision Making



SEL Partners With Xcel Energy (XE) to Build SmartGridCity™

XE SmartGridCity Communications Connect Substation and Pole-Top IEDs



News Releases

05/15/2008

Xcel Energy begins work on SmartGridCity in Boulder

DENVER - The design phase is complete, equipment is ordered and construction has started on SmartGridCity, Xcel Energy announced today.

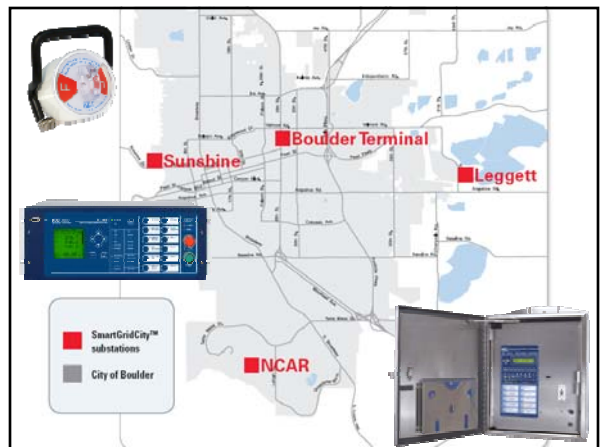
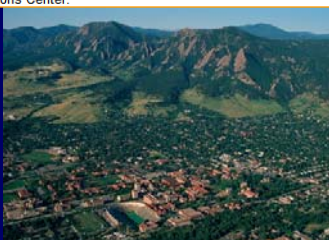
In April, Xcel Energy and its Smart Grid Consortium partners completed their study of Boulder, Colo.'s electricity infrastructure, and developed a scope and design plan for implementing the changes. The company then placed equipment orders, including an order for 15,000 smart meters. In May, the company began implementation of the smart grid network and construction on the SmartGridCity Control and Operations Center.

Phase I: Mar. – Aug. 2008

- 2 substations
- 5 feeders

Phase II: Sept. – Dec. 2008

- 2 substations
- 20 feeders



SEL Adds Intelligence to SmartGridCity

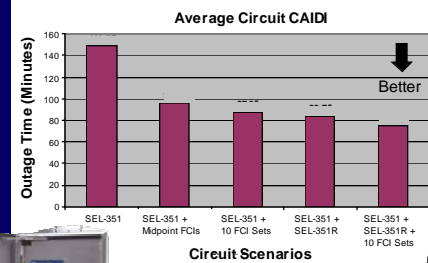
One of the goals of SmartGridCity™ is to provide a state-of-the-art electric power distribution monitoring, automation and control system running from transmission lines, through the substations and to the meters.

Smart Substations: Infrastructure upgrades will create more sophisticated intelligence in the substation, which will allow the utility to better monitor and adapt to customer needs, while making real-time decisions based on current grid conditions (see map below.)

Smart Feeders: The feeder distribution system will consist of communication-enabled smart reclosers and switches as well as smart feeder assets to provide power system information and perform automated functions. These assets will allow Xcel Energy to monitor power flow, outages, and overall asset device health.

Smart Distribution System: Power analyzers will be installed at each distribution transformer and incorporated into smart meters to provide real-time data on power consumption, outages, restorations, and fault locations.

Information and Automatic Reconfiguration Improve Response



SEL Partners With Xcel Energy to Build the Substation of the Future

Our Rugged Devices in the Yard

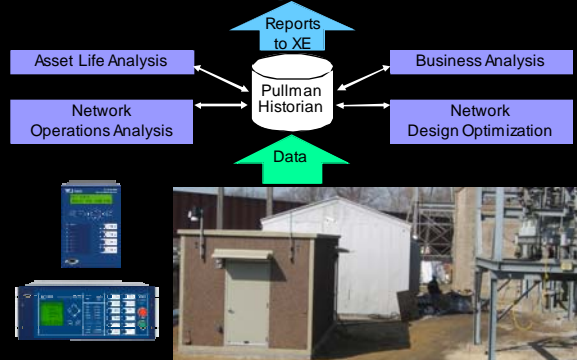


Includes New Transformer Monitor

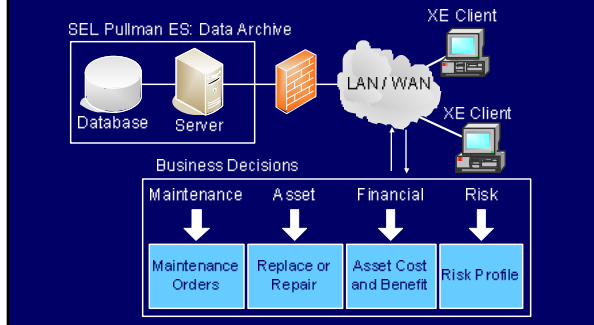


- Increase operational knowledge
- Display critical indicators and local controls
- Retrieve pressure, temperature, oil level, LTC position, and other values
- Gain situational awareness via HMI and SCADA

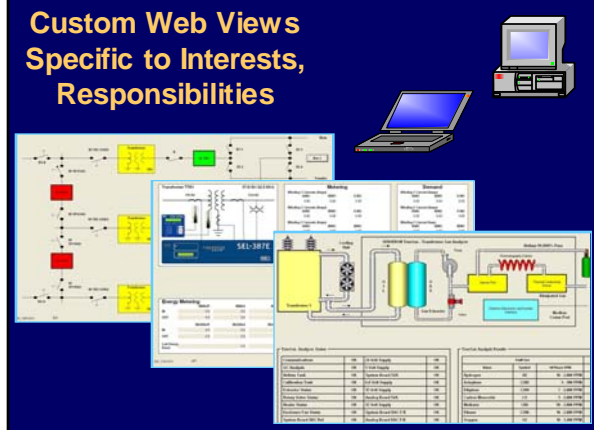
Engineering Services (ES) Collects Data, Creates and Reports Information



SEL ES Sends Decision-Making Information to Groups Within XE



Custom Web Views Specific to Interests, Responsibilities



Software "Learns" Typical Values, Spots Anomalies, and Alerts Personnel

Send Send and File Save As Draft Address Delivery Options Follow Up Show Tools

02/08/2008 10:46 AM

To: Smith
cc: Maintenance Log
bcc:
Subject: XFMR 3 Oil Temperature Repair Alert

ALERT - immediate action required

Top Oil Probe 1 on XFMR3 exceeded high-limit point.

2 August 2008 10:46 a.m.

Actual 372.3 degrees C
High Limit 378.0 degrees C




Substation Health and Performance Information Become Report by Exception

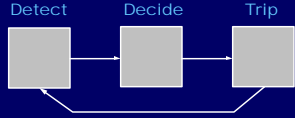
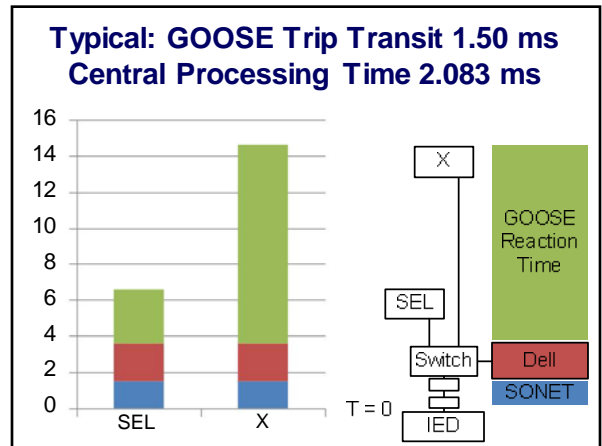


SCE Tested Digital Communications Speed

Strive to mitigate thermal overload and instability throughout transmission territory

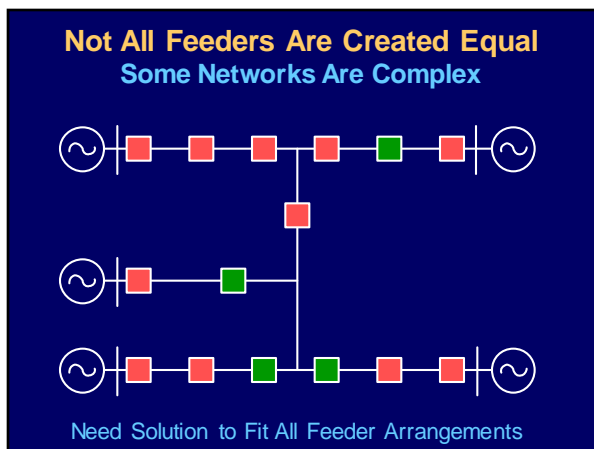
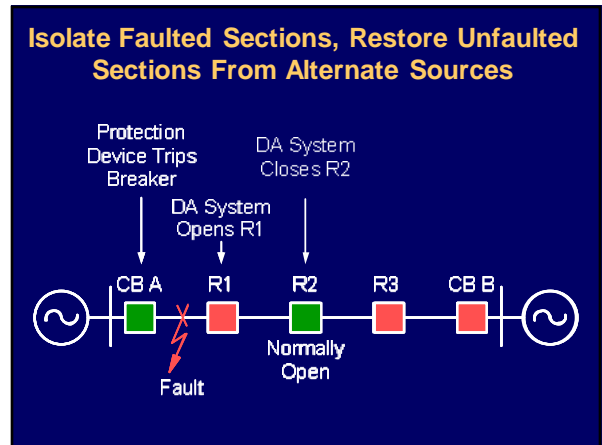


Detect Decide Trip

And So the DA Discussion Road Map Unfolds

- Overview
- DA without communications
- New SEL DA controller
- DA design with centralized communications
- DA via peer-to-peer communications
- Automatic collection of event data



Increase Situational Awareness



Optimize Assets, Share Communications



Be Careful!



HOT LINE TAG	
Substation: SEL1	Equipment: H2
Applied By: SEL	Removed By:
08/2003 9:09:29 AM	
Comment: None	
APPLY HOT LINE TAG?	
<input type="button" value="Yes"/>	<input type="button" value="No"/>

Show Me the Data



The Data Are Available in Smart IEDs



Feeder relays

SEL-451

SEL-351S



Switch controller

SEL-2411



Recloser controls

SEL-651R

SEL-351R