

VALUE
**CUSTOMER
SERVICE**
PROPOSITION



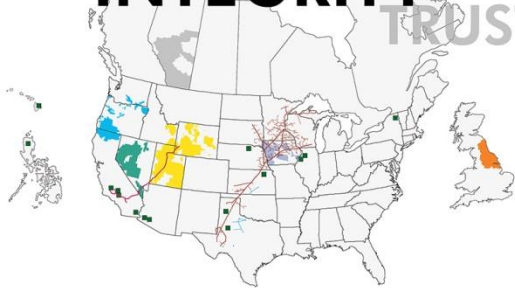
PEOPLE
**EMPLOYEE
COMMITMENT**
SAFETY



REDUCING
**ENVIRONMENTAL
RESPECT**
IMPACT



CANDOR
**REGULATORY
INTEGRITY**
TRUST



EFFECTIVE
**OPERATIONAL
EXCELLENCE**
EFFICIENT



BERKSHIRE
**FINANCIAL
STRENGTH**
OWNERSHIP



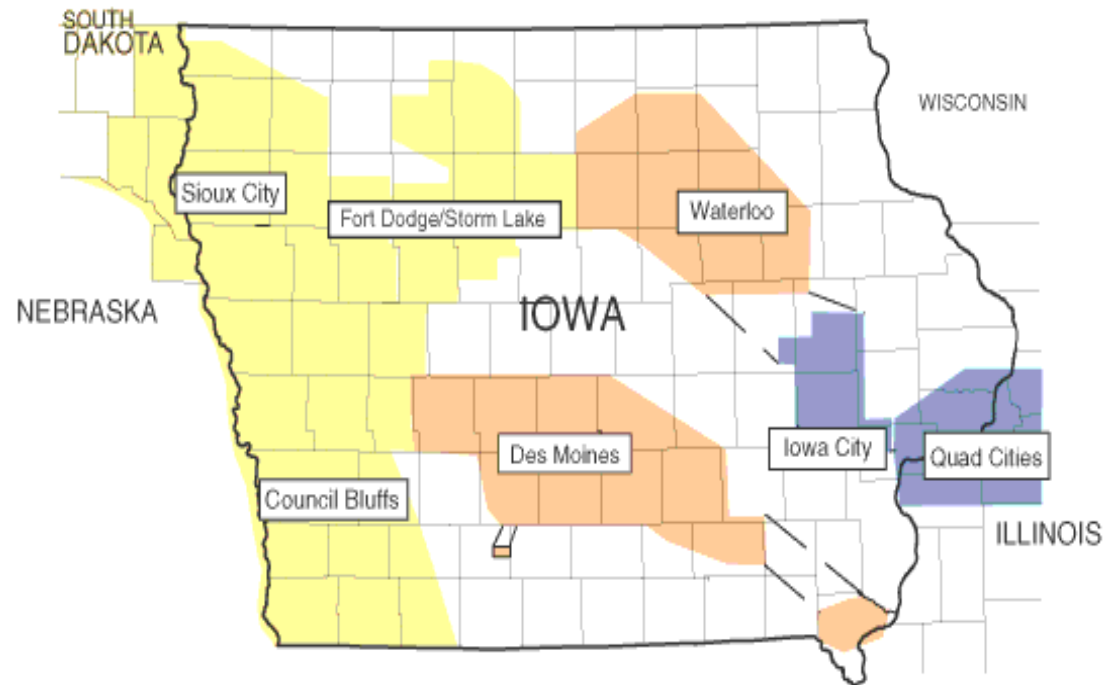
MidAmerican Energy Remote Fault Indicator Experience

Terry Smith – Manager, Distribution Control

MidAmerican T&D Electric System



- Electric provider to ~ 815,000 customers in Iowa, Illinois, and South Dakota
- 12,500 MW of generation capacity, including ~7,400 MW of wind generating capacity installed
- 4,700 miles of transmission (345 kV, 161 kV, 69 kV)
- 25,000 miles of distribution primary
 - 75% Overhead, 25% Underground based on miles
- 1,100 Distribution feeders (13 kV, 4 kV)



Remote Fault Indicators at MEC

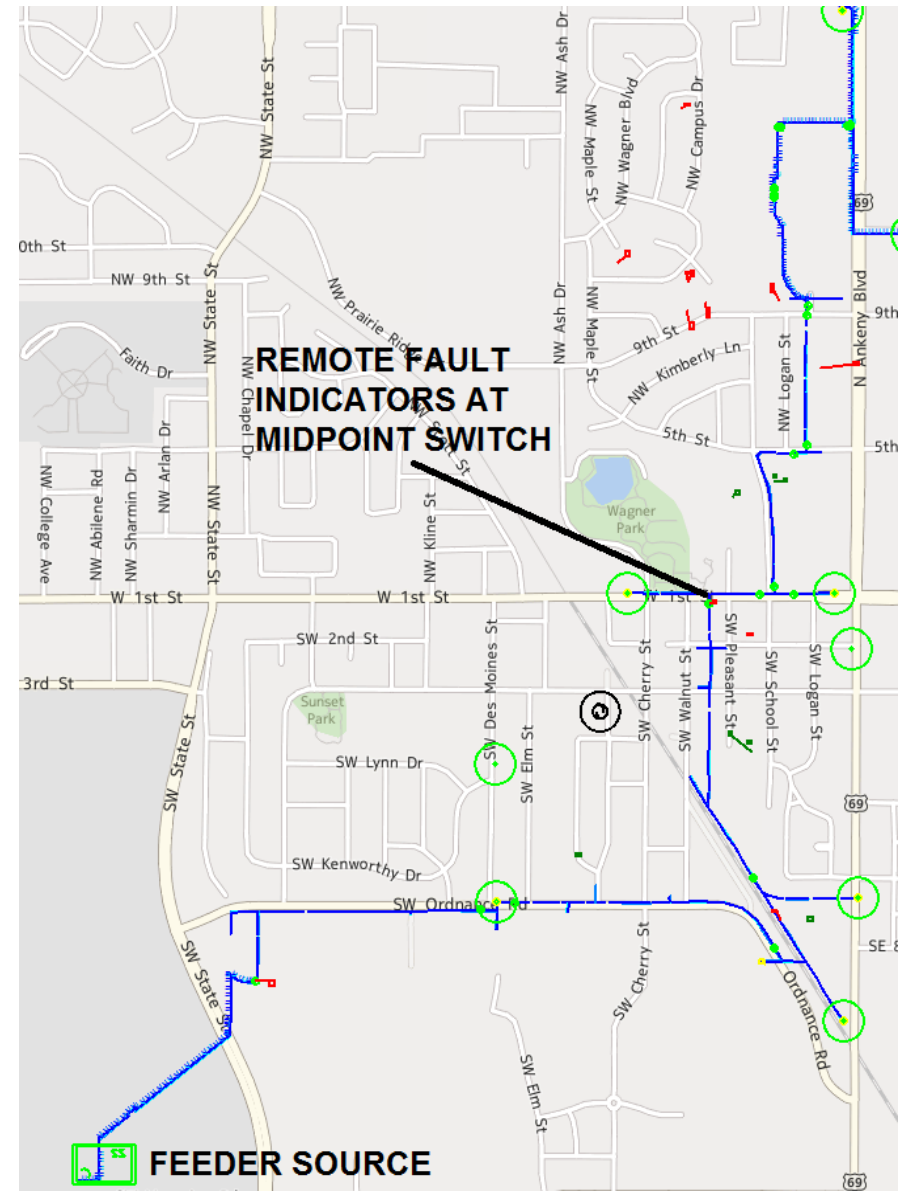


- Low-cost opportunities to improve reliability
- Pilot of Remote Fault Indicators in 2014
 - 60 devices (20 locations) overhead distribution feeders only
 - Cellular communications to locally hosted software
- Pilot needed to validate
 - accuracy of devices
 - availability of communications
 - establish field and control room acceptance
- History of inaccurate info, low confidence in flashing fault indicators

Remote Fault Indicators at MEC



- Typical Pilot Applications
 - Midpoint switch of larger feeders (>1,000 customers), and active history
- Following an event, route first responder to midpoint switch
 - Open Midpoint Switch
 - If fault was detected downstream, remotely close breaker
 - If no fault detect downstream, first responder instructed to close normal open tie
 - In either case, half of customers are restored as soon as responder arrives
 - Reduces patrol area to faulted half



Remote Fault Indicators at MEC



- Great success of pilot over ~2-year period
- Additional 150 devices installed in Q1 2017
 - Pilot of five UG distribution feeder mainline locations, three 69 kV locations (radial)
- Additional 500 devices installed in Q1 2018
 - Additional UG locations, and eight additional 69 kV locations
- System-wide deployment 2019-2021
 - 500 devices installed in 2019
 - 1,000 devices installed in 2020 (4G)
 - 500 installed in 2021 (4G)
- Total of ~2,600 devices (800 locations)

Remote Fault Indicators at MEC



- Practical other uses deployed
 - UG feeder exits
 - Non-telemetered substations
 - Critical loads (hospitals, key accounts, etc)
 - Easy to move (overhead applications), have used for temporary applications, i.e. state fair, mobile substations, etc.
 - Circuits with mystery operations (multiple locations)
 - 69 kV, radial and networked
- No False Indications, hundreds of operations experienced

Remote Fault Indicators at MEC



Underground Distribution Application (Padmounted Switchgear)



Remote Fault Indicators at MEC



- No DMS to route fault indicator data directly
- Initial use of email/text as “interim” solution

Yukon GridServer - Transmission\SUB 108TAP - 1003-C (FACING TOWARD SUB 107)\ s...

Timestamp of Event

Wed 4/11/2018 9:52 AM

Type of Event Detected

noreply@midamerican.com

Yukon GridServer - Transmission\SUB 108TAP - 1003-C (FACING TOWARD SUB 107)\ saw Loss of Current I

To: Custer, Daniel E; General Account, Transmission Control Center; Sys Oper - DMCC - Shift Supervisors; Smith, Terry D; Exline, Richard K; Albright, Mark W; Bruce, Roger; Sys Oper - DMCC - Operators

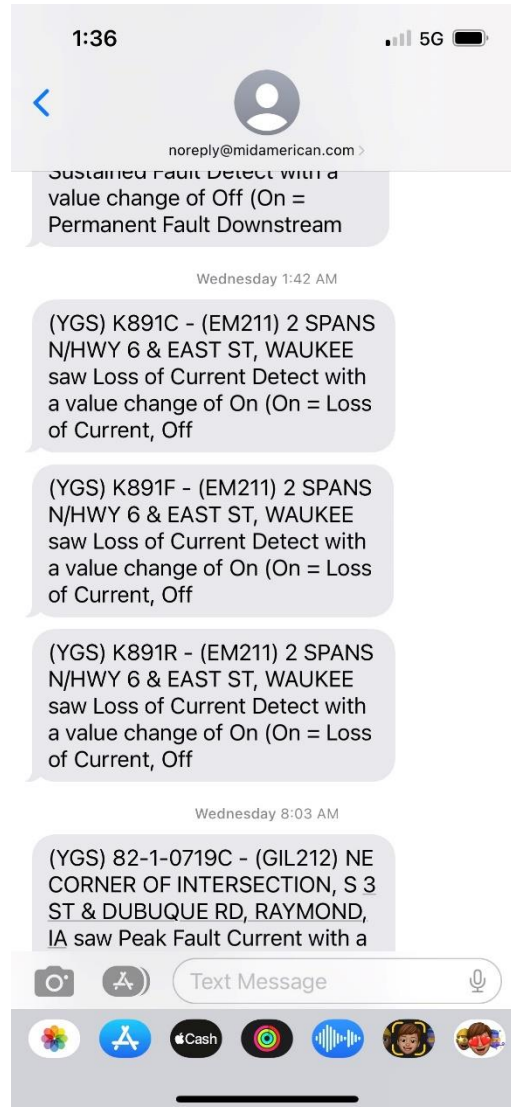
Device (Switch 1003 Center Phase)

4/11/2018 9:51:24 AM - Loss of Current Detect: Transmission SUB 108TAP - 1003-C (FACING TOWARD SUB 107) Loss of Current Detect changed to Off (On = Loss of Current, Off = Current Restored)

Status and English Description of Event

- Currently using event driven text and email notifications to real-time desk
 - Permanent Fault
 - Loss of Current
 - Momentary Fault
 - Additional notifications emailed to management for Loss of Communication or Battery Issues

Remote Fault Indicators at MEC



Visual T&D for Network 69 kV Application



- Need to include fault direction for network situations (not possible via text/email approach)
- Visual T&D Application
 - SCADA-like interface
 - Schematic development, and point association
 - Will use for next 2-4 years while transitioning to DMS

Visual T&D for Network 69 kV Application



Transmission

Sherrard

Sherrard (Quad City) Sub
102. Sub 101. Sub 111

Inwood Tap - Inwood & Hudson Jet -
Sioux River

Sherrard (Quad City) Sub
104. Sub 108. Sub 107

Sac County - Schaller - Odebolt - Lake
View

Sac County - Schaller -
Odebolt - Lake View

Red Oak - Enron - Griswold

Eastside - Lawton - Merville - Kingsley

Clarinda - New Market - Bedford

Pomeroy

Blackhawk - Dewar - Jesup

Little Sioux - Grand Meadow -
Correctionville

Clarksville - Allison

Humboldt East - Rutland Tap - Gilmore
City



Visual T&D for Network 69 kV Application

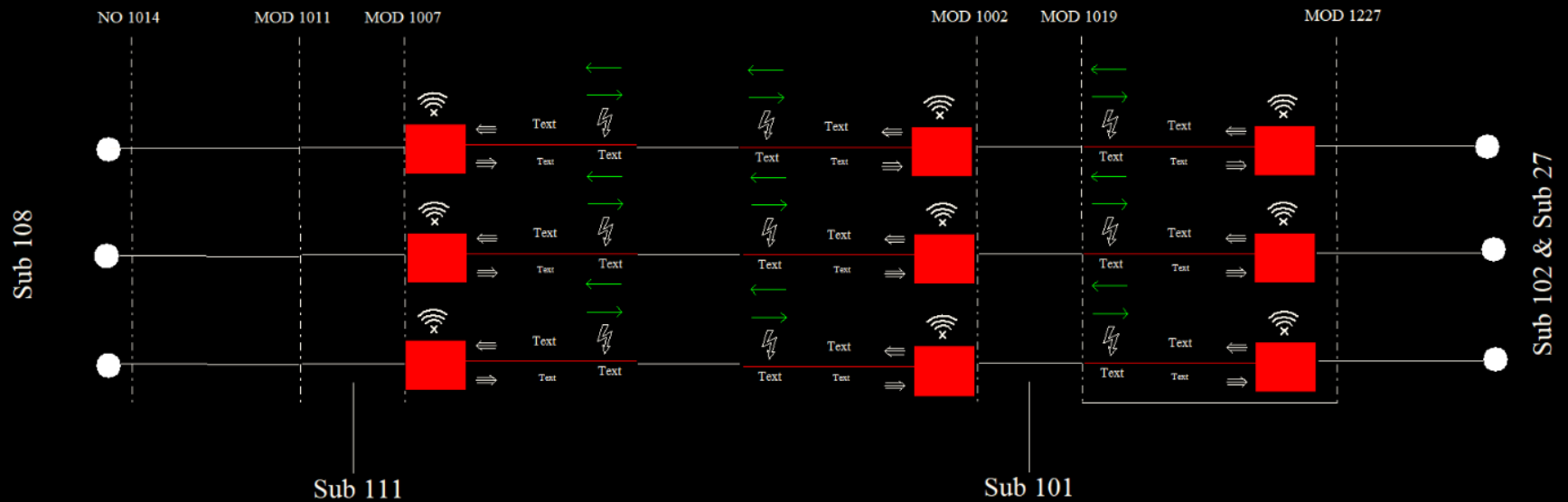


HOME

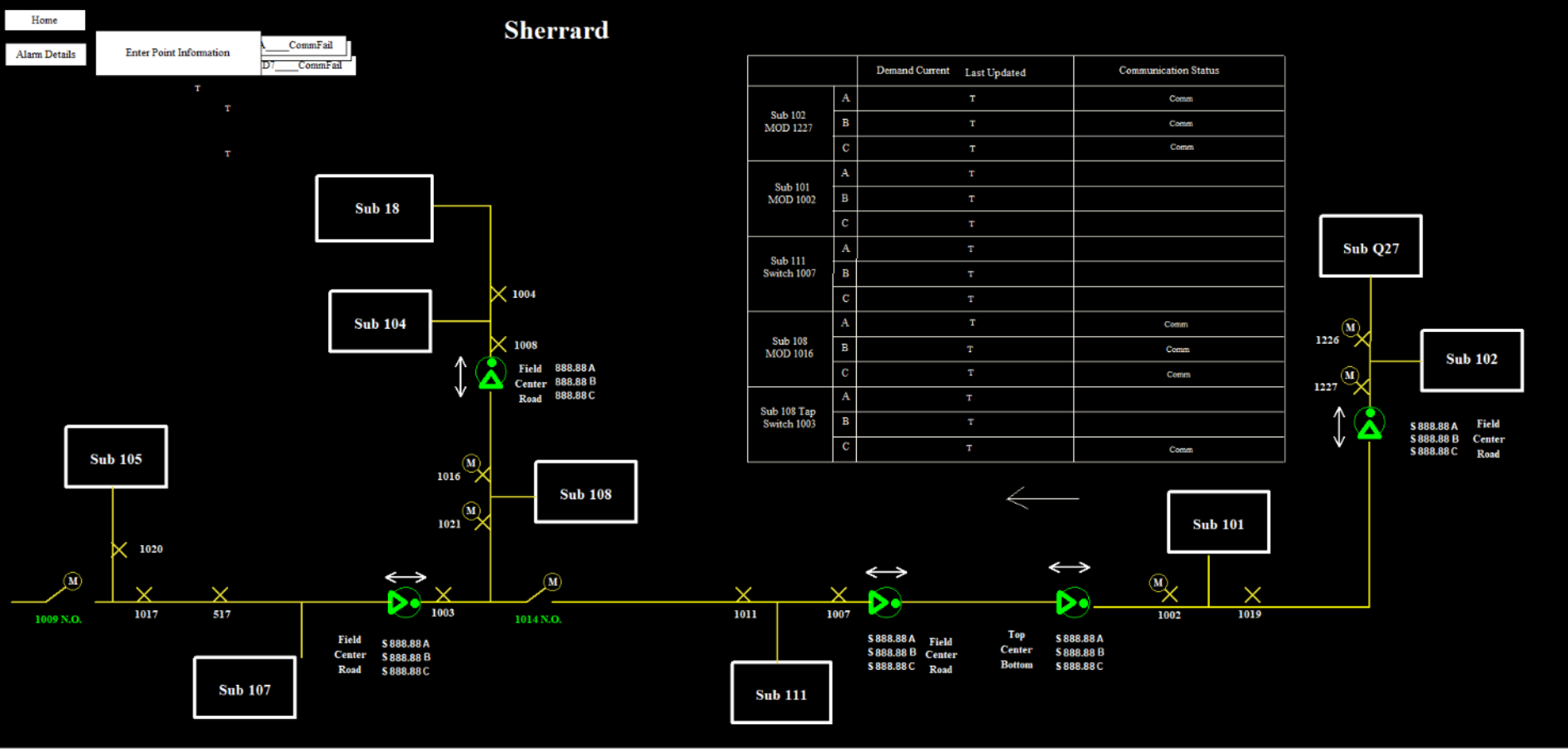
SHERRARD STATIONS SUB 102, SUB 101, SUB 111

ResolveAlias
Visual Basic Objects

SUB 108, SUB 107



Visual T&D for Network 69 kV Application



Remote Fault Indicators at MEC



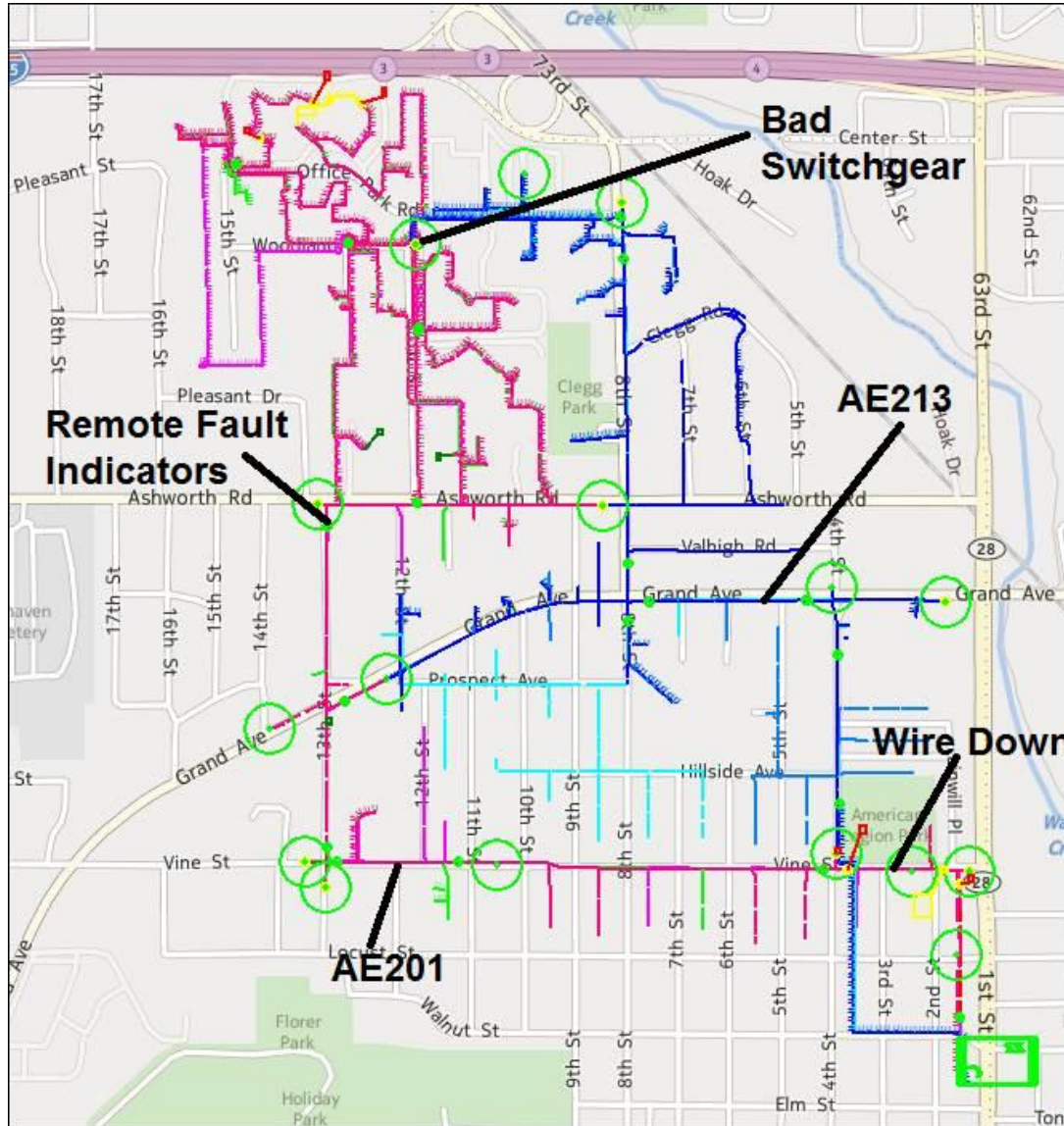
- Challenges with fleet of 2,600 devices
 - Initialization to cell network and downloading settings, multiple steps and time to setup individually
 - Firmware upgrades
 - Incompatible external sim cards (4G) vs. onboard
 - Device status/health-check
- Opportunities
 - Firmware updates, device management
 - 4G lifecycle
 - Line disturbance, fault waveforms
 - Pre-programmed from factory IP, Cell provider... Plug in battery and install
 - Speed up interface

Remote Fault Indicators at MEC



- Future state
 - Increasing DA capabilities at midpoints (includes built-in fault indication)
 - Padmount retrofit
 - Overhead
 - Generally in locations where fault indicators were previously installed.
 - Repurpose the fault indicators from these locations to other circuits or, midpoint of the midpoint
 - Build-out of ADMS system to integrate all field devices, and further expand (visibility, customer service, etc)
 - Will incorporate fault indicators as part of this to support future automation (FLISR)

Interesting Events



Remote Fault Indicators at MEC



- Device Setup

The screenshot displays the Yukon GridServer Manager interface. The top navigation bar includes icons for Sensors, Publication, Notification, Administration, Create, and Delete. The left sidebar lists various distribution areas: Unassigned, CB-Distribution, DM-Distribution, FD-Distribution, IC-Distribution, QC-Distribution, SC-Distribution, STLK-Distribution, Transmission, and WAT-Distribution. The main content area shows a table of sensors with columns for Serial Number, Type, and Description. Below the table, the 'Properties' tab is active, showing details for the selected sensor (000780B38F2A).

Serial Number	Type	Description
000780B38F2A	GridAdvisor Series II smart sensor revision 1.5	PD235C - (WB202) 1210 OLD LINCOLN HWY, CRESCENT, IA
000780B38FCE	GridAdvisor Series II smart sensor revision 1.5	SX027R - (SH212) 909 MAPLE ST, SHENANDOAH
000780D4DF41	GridAdvisor Series II smart sensor revision 1.5	WR274R - (WR221) 17220 HUBBARD RD POTTAWATTAMIE COUNTY
000780D4DF47	GridAdvisor Series II smart sensor revision 1.5	PD96R - (WG211) IN FRONT OF 1646 MADISON AVE,COUNCIL BLUFFS
000780D4DF56	GridAdvisor Series II smart sensor revision 1.5	PD96C - (WG211) IN FRONT OF 1646 MADISON AVE,COUNCIL BLUFFS
000780D4DF90	GridAdvisor Series II smart sensor revision 1.5	UG345R - (WD201) 2 POLES N OF S 315T ST & 1ST AVE,COUNCIL BLUFFS
000780D4DF9E	GridAdvisor Series II smart sensor revision 1.5	PD34C - (WD203) IN FRONT OF 821 S 35TH ST,COUNCIL BLUFFS, IA
000780D4DFA6	GridAdvisor Series II smart sensor revision 1.5	UG345F - (WD201) 2 POLES N OF S 315T ST & 1ST AVE,COUNCIL BLUFFS
000780D4DFCB	GridAdvisor Series II smart sensor revision 1.5	UG345C - (WD201) 2 POLES N OF S 315T ST & 1ST AVE,COUNCIL BLUFFS
000780D4DFCC	GridAdvisor Series II smart sensor revision 1.5	PD450R - (WN218) 241 5 AVE, COUNCIL BLUFFS, IA
000780D4DFDE	GridAdvisor Series II smart sensor revision 1.5	PD34E - (WD203) IN FRONT OF 821 S 35TH ST,COUNCIL BLUFFS, IA

Properties - Communication

Serial Number: 000780B38F2A

Type: GridAdvisor Series II smart sensor revision 1.5

Description: PD235C - (WB202) 1210 OLD LINCOLN HWY, CRESCENT, IA

Buttons: Update Type, Replace

QUESTIONS??

