
SCTE®
CABLE-TEC EXPO®
FAST FORWARD 2021
ATLANTA, GA
OCTOBER 11-14
SCTE
a subsidiary of CableLabs®
UNLEASH THE POWER OF LIMITLESS CONNECTIVITY
2021 Fall Technical Forum
SCTE® • NCTA • CABLELABS®

SCTE
a subsidiary of CableLabs®

Energy Management and Sustainability on the Road to 10G

Modernizing the Power Grid and HFC: Power Outage Notifications and Advanced Sensing

Dr. Robert Cruickshank, Gridmetrics™ R&D Liaison

CableLabs

2021 Fall Technical Forum
SCTE • NCTA • CABLELABS

SCTE CABLE-TEC EXPO FAST FORWARD 2021

VIRTUAL EXPERIENCE
OCTOBER 11-14

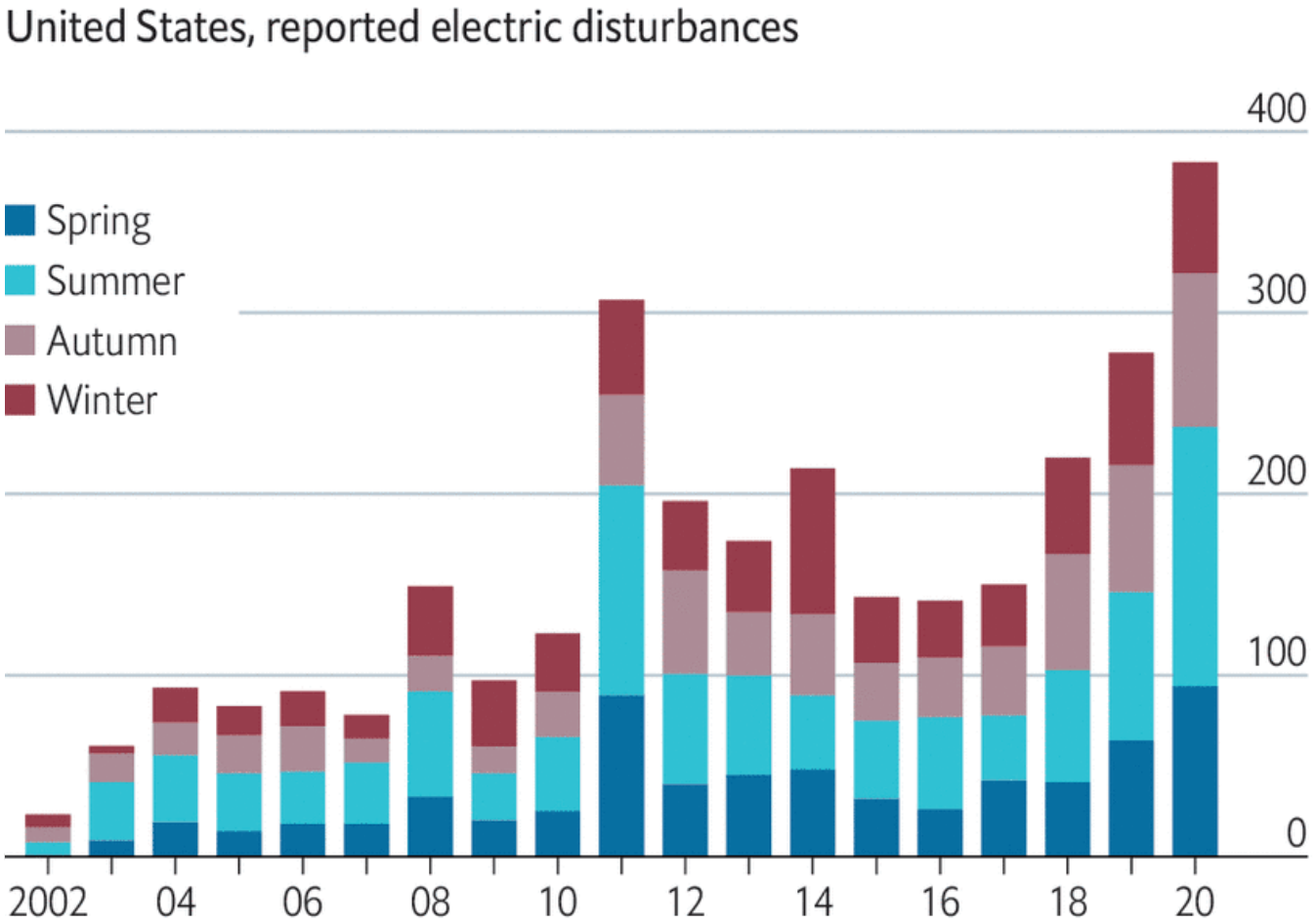
Agenda

1. Motivation: Operational costs and reliability
   - Outages and power quality affects everyone
   - Exponential rise in issues—lots more expected
2. Feb 2021 Texas Power Crisis
   - Related global problems
3. Background on the grid and HFC powering
   - Generation, Distribution, Load (aka Demand)
4. Solution for Monitoring Grid & HFC
   - Gridmetrics™ Power Event Notification System
5. New U.S. National Standards
   - ANSI SCTE 271: Requirements for Power Sensing in Cable and Utility Networks

Managing the intersection of Grid and HFC Power

Houston, We've got a problem… and its global

Power outages like the one in Texas are becoming more common — Weather alone is not to blame



Sources:
U.S. Dept of Energy
The Economist

Worse – Limited visibility of the last mile: 96.5% of the grid

Arctic temperatures: 48% failed supply ≠ unprecedented demand

Power cut to ~70% of customers for up to four days: Great economic costs, human suffering, lives lost

Failures: Frozen generation and fuel infrastructure

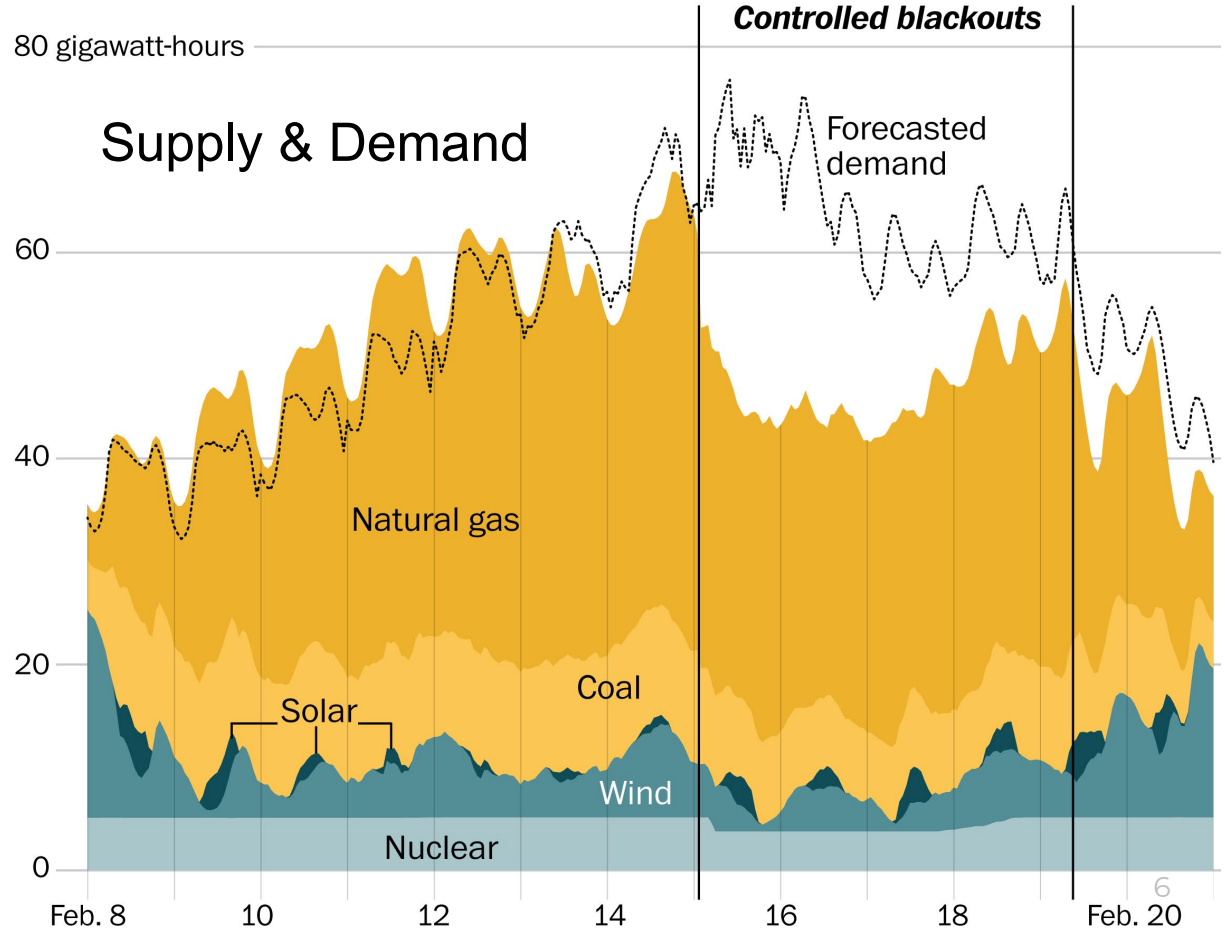
- Focus on nexus of generation & natural gas

Two more TX close calls in April & June 2021

- Atypical supply outages, unexpected demand

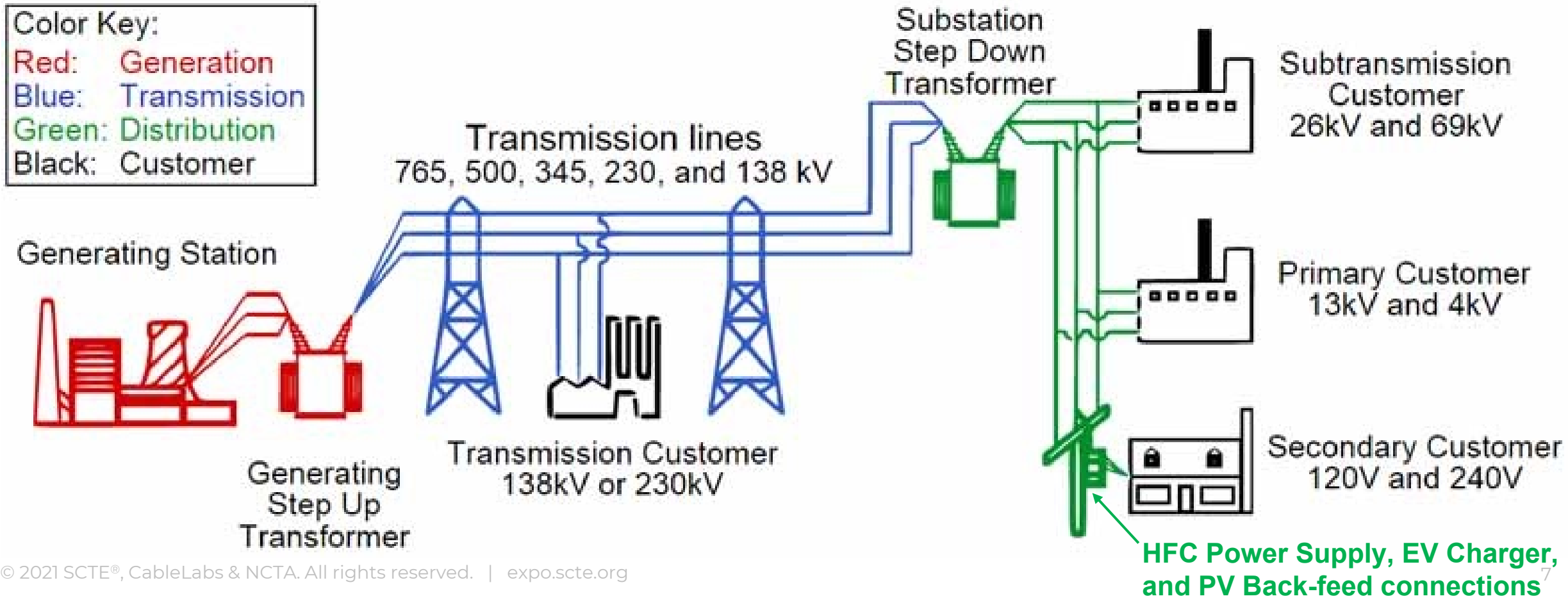
TX Legislature and Public Util Comm has ordered:

- Better public communication, power plant weatherization/protection, transmission



Sources: Alison Silverstein of TX PUC and FERC, Utility Dive, EIA, Washington Post

Grid edge most often doesn't know if: 1) Power lines throw sparks, 2) EV chargers overload grid, 3) Inadvertent (fatal) back-feeding

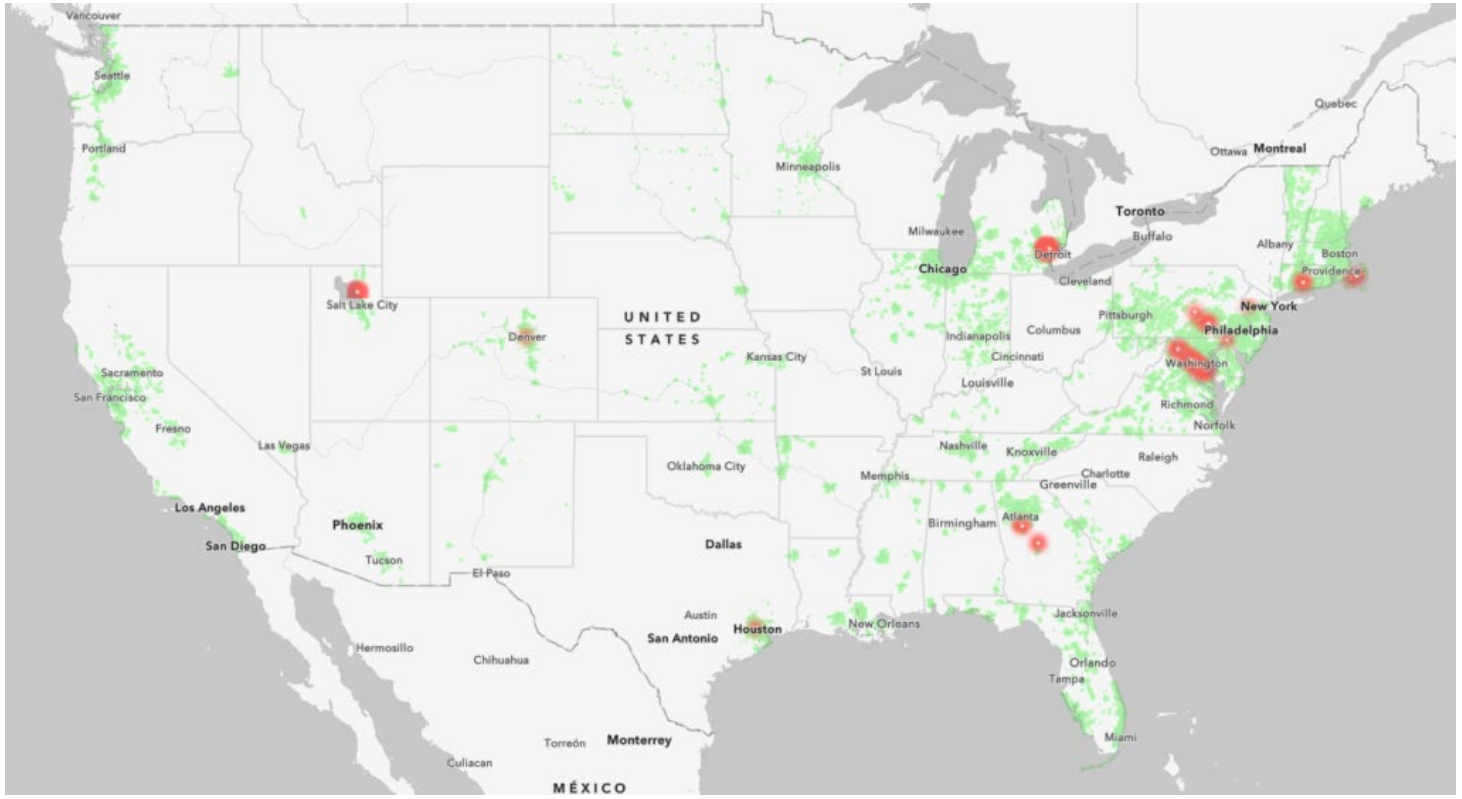


Gridmetrics™ is the premium supplier of power event notifications

Born at CableLabs. Inspired with 2017-2021 conversations at the National Renewable Energy Laboratory

Power Event Notification System (PENS™)

- Aggregates unique data from ~300,000 sensors in HFC node power supplies
- Uses sensors tightly aligned with populations
- Provides unmatched observational view of the state of power in the last mile of the distribution grid
- Alerts available via email, Esri, and API for emergency response, public safety, FEMA, DHS, business resilience, etc.



Source: www.gridmetrics.io

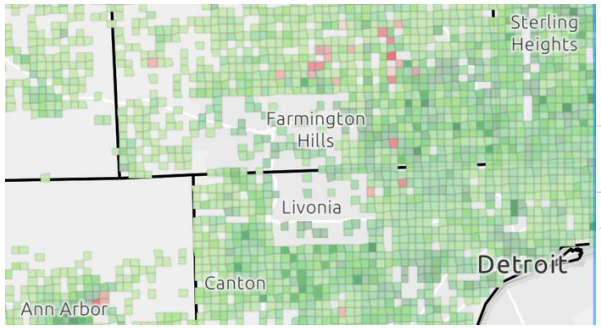
New Sensors, analysis, and reporting capabilities added every day

Why

- Today, there is no comprehensive, independent source for power event insights.
  - Each of 3,200 distribution utilities have their own solution
- Most solutions offer insights only at the county level.
  - PENS™ provides insights using the USNG projection, a 1km x 1km U.S. overlay
- Most solutions only have county-level updates every 15 minutes
  - PENS provides neighborhood-level updates every 5 minutes or less

How

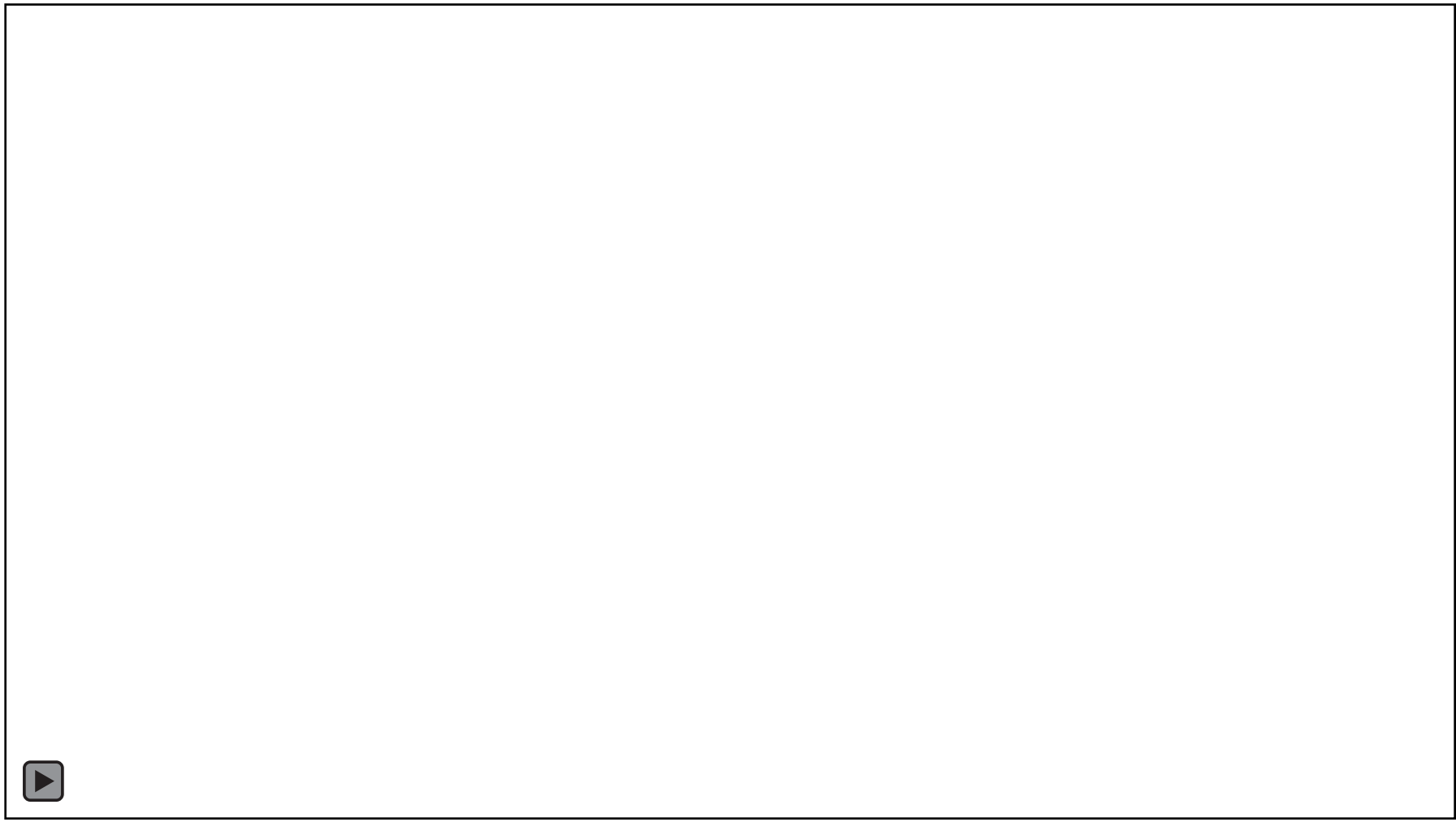
- Gridmetrics partners with communications and infrastructure providers to leverage their network of power sensors
- Because those facilities are nicely aligned with population densities, Gridmetrics is able to garner a unique view of the grid
- A secure out-of-band comms infrastructure consolidates status of thousands of utilities to a single IP address, User Interface and API



Gridmetrics™

PENS™ in action

- Email Alerts
  - Updates over time
  - Issue resolved
- Esri Feature Service Layer view
- Sign up for alerts and more information at www.gridmetrics.io



Situational Awareness of Grid Anomalies:

Near Real-Time Cyber-Physical Resiliency through Machine Learning

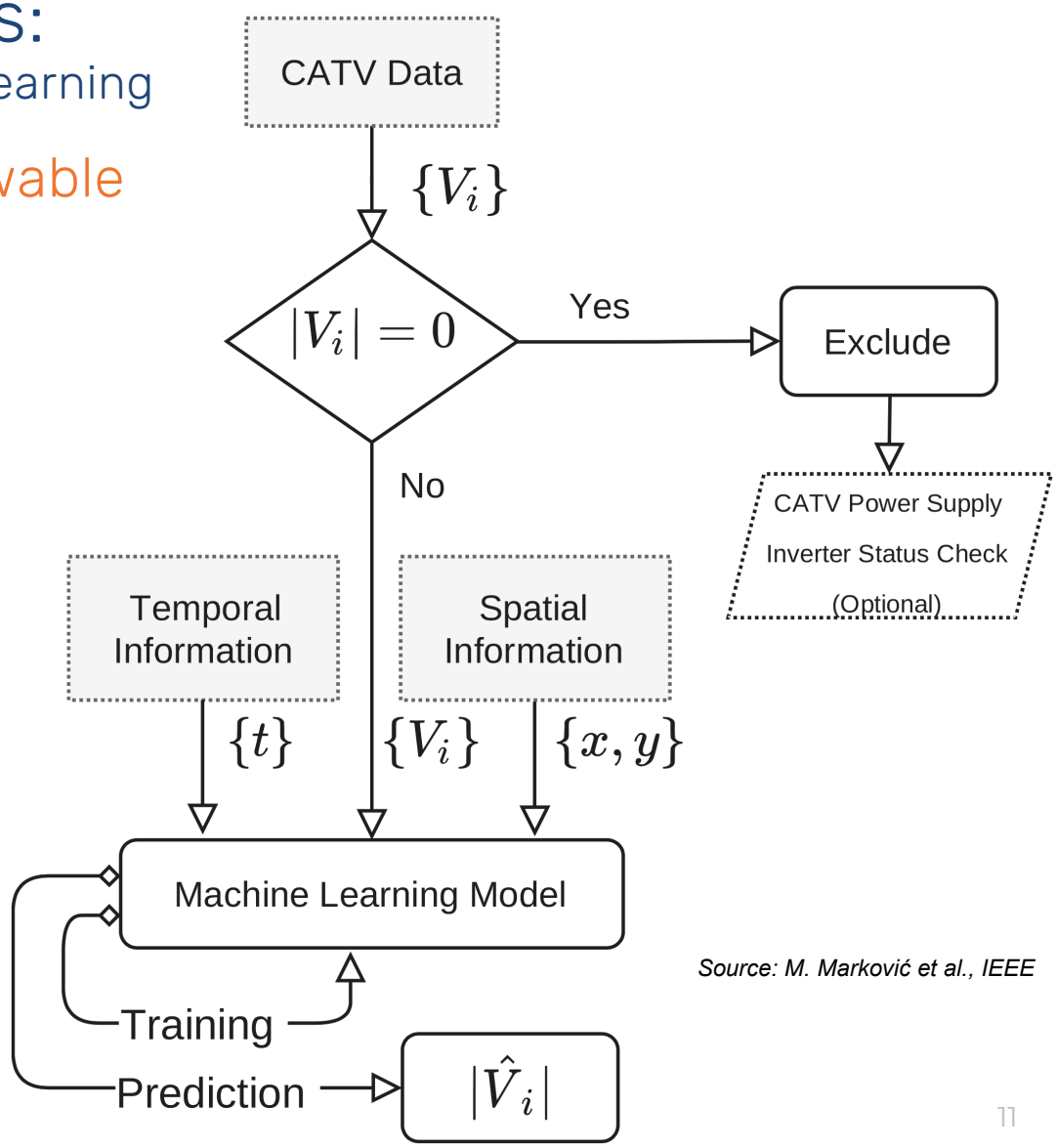
Yr 3 Project: U.S. Dept of Energy and National Renewable Energy Lab

What

- Identify anomalous behavior using cable broadband's secure out-of-band in-service network
- Rapidly detect cyberattacks dynamically and in near real-time through machine-learning
- Demonstrate a disruptive technology for power system data analytics using existing infrastructure
- Provide commercialization and feature roadmaps

How

- Build upon NREL's power system tools and mapping
- Integrate the growing set of Gridmetrics 'situational' data
- Assimilate other time-series geospatial data such as weather and cyber-physical phenomena
- Create new standards for global impact ☺

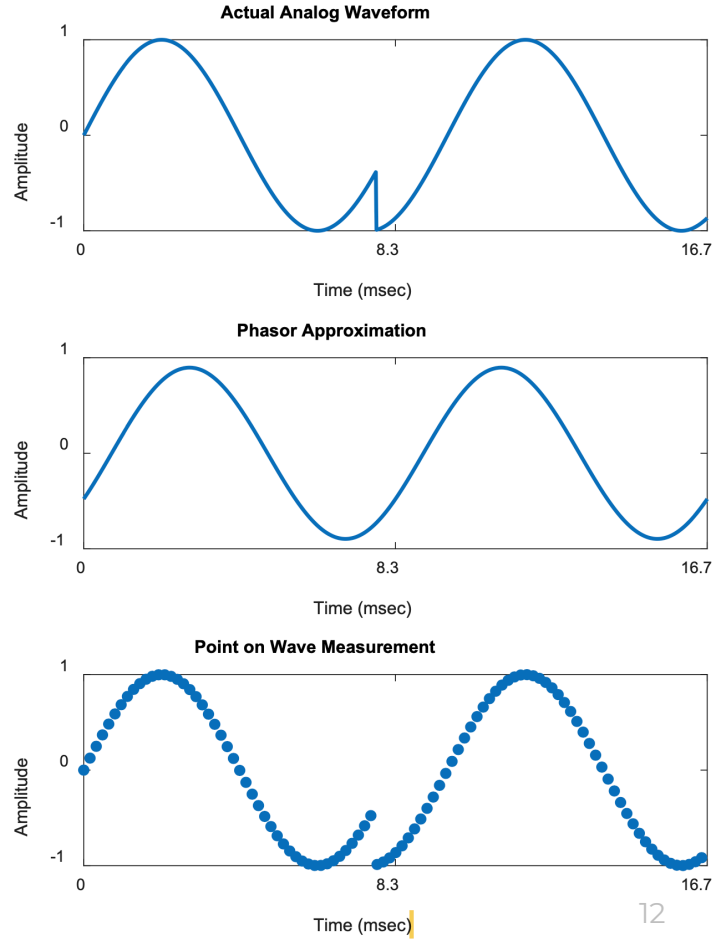


Source: M. Marković et al., IEEE

271: Requirements for Power Sensing in Cable and Utility Networks

Motivated by the successes of PENS and recognizing that existing sensing capabilities are out of date

1. If voltage or current is sensed, it *shall* be measured with a
   Precision of 0.002 per-unit (0.2% of nominal value), e.g., +-0.24 volts at 120 VAC
2. If CPOW capture is provided, the sampling rate *shall* be a
   Minimum of 10k samples/second = 166 samples/period at 60 Hz (more better)
3. If observation timestamp provided, the resolution *shall* be <= 1 microsecond.
   Clock accuracy *shall* be <= ½ microsecond, which is ~ 1/100th of a degree at 60 Hz
   (1 sec / 60 cycles) * (1 cycle / 360 degrees) * (1 degree / 100) = .46 microsecs
4. If configurable remote reporting is provided, control plane *shall* enable:
   a) a 1-time poll reply, b) continuous replies and/or c) fixed interval replies
5. If a communication plane is provided, it *shall* use IETF/APSIS YANG model and SSL or TLS for authentication & encryption. No SNMP is required.



SCTE 271 Executive Summary: Oh, the places you'll go!

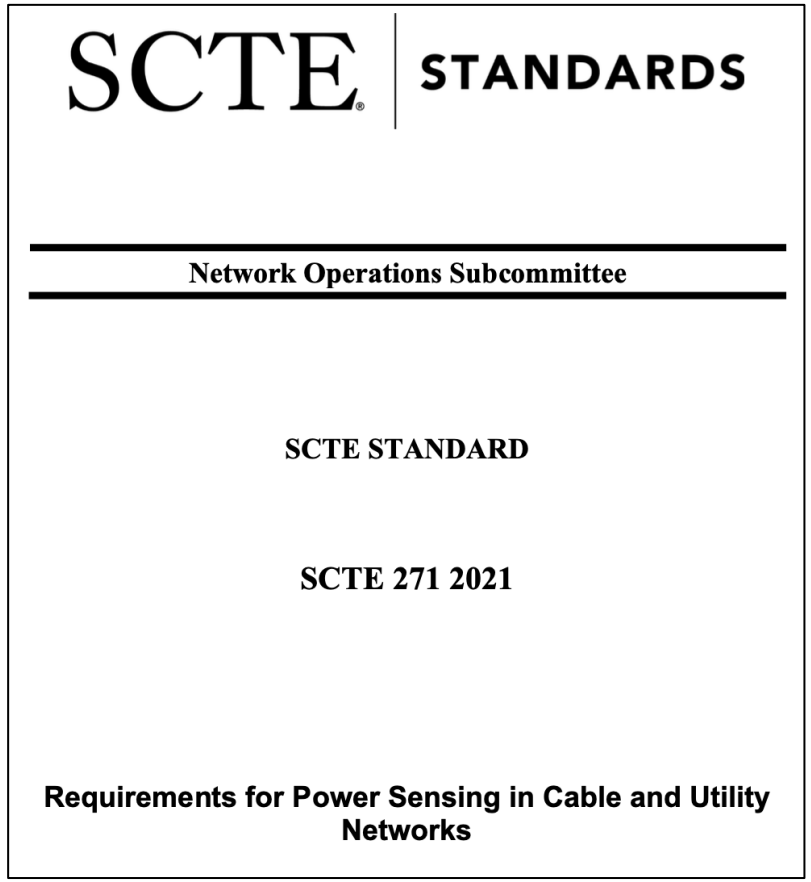
Additions, without replacing the prior sensor spec developed in the late 1990s alongside DOCSIS

Monitor HFC & Grid for voltage & current anomalies; send results to cloud

- 60/75/90 VAC quasi-square wave HFC network
- 120/240 VAC power grid
- ↓Reboots, Outages, Wildfires
- ↑Customer experience, Lifespan of HFC, CPE, and grid
- Identify Highs, Lows, Fluctuations, Outages, Grid Congestion
- Future: Manage load and increase use of renewables

Observe, communicate, and cloud-compare voltage & current in real-time

- Secure backhaul of streaming continuous point-on-wave (CPOW) power observations is a quantum leap beyond phasor measurement units that assumed a sine wave, compressed, and distorted wave before backhaul


SCTE | STANDARDS

Network Operations Subcommittee

SCTE STANDARD

SCTE 271 2021

Requirements for Power Sensing in Cable and Utility Networks

The aging and failing grid – the need for advanced grid sensing

Identify the locations of grid infrastructure that are:

- In need of repair
- Overloaded at certain times of the day
- Forecast to be overloaded in the future

The changing grid

Grid design 1882-1978

- Predictable 1-way delivery of central power
- Organic load growth, one "normal" state

- 1978+ PURPA … present day Renewable Portfolio Standards
  - Unpredictable 2-way flows of distributed renewable energy
  - Intermittent, variable, uncertain production

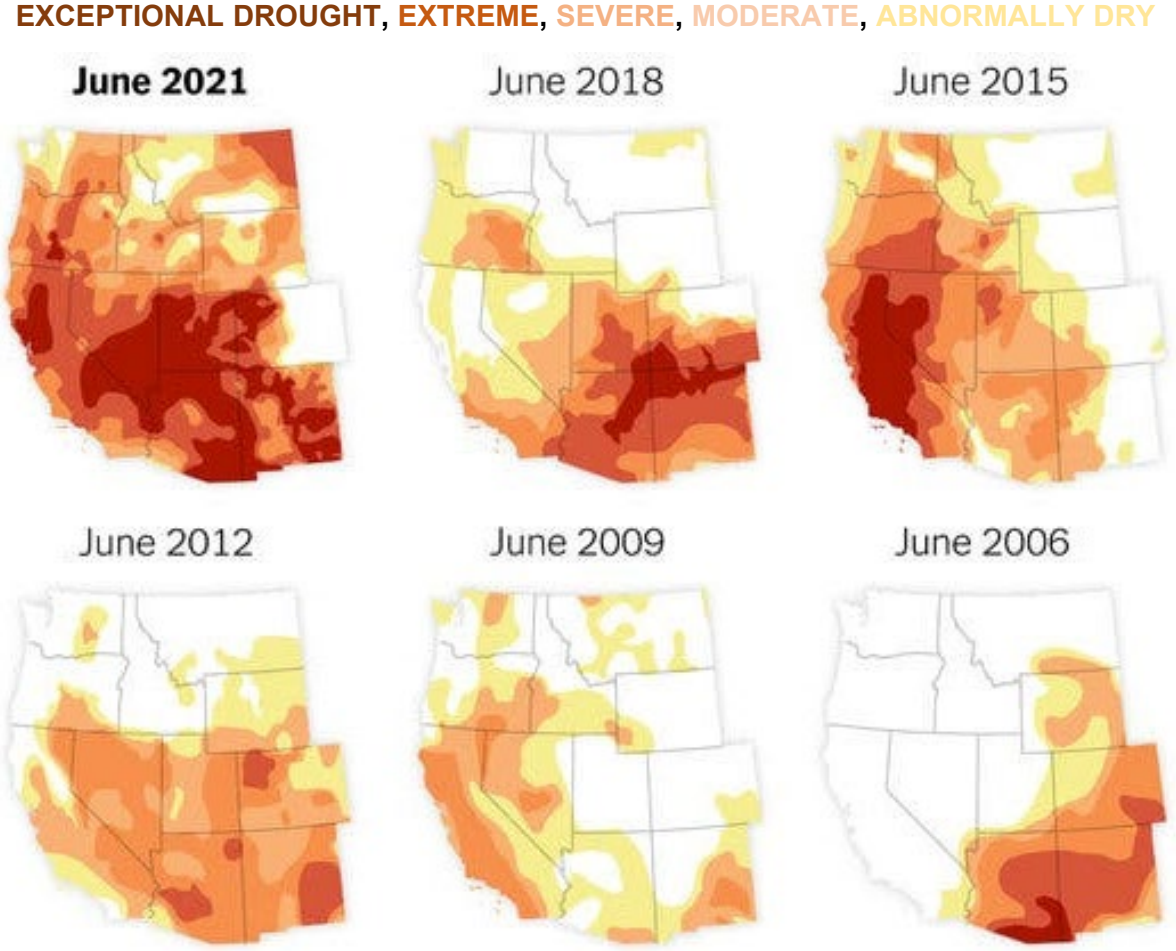
Going forward: Its much harder to see/discern what's going on

- Unlimited number dynamic 'normal' states thwart 'non-normal' detection
- How to identify failures and cyberattacks?

Summary & Questions

1. Motivation: Increases in operations cost and managing outage coordination with utilities
2. Feb 2021 Texas Power Crisis – global impacts
3. Background on the grid and HFC powering
4. Solution for monitoring Grid & HFC
5. New U.S. National Standard ANSI/SCTE 271
   - Predicting the location/severity of outages
   - Identifying congestion locations and severity
   - Improving rural broadband business case with line extensions that support more sensors
   - Better managing microgrids and communities

Early June Drought Conditions in the West



Source: NY Times, July 2021

References

1. https://www.bloomberg.com/news/articles/2020-08-27/as-wildfires-rage-the-pyrocene-age-is-upon-us
2. https://www.electricaleasy.com/2016/01/electrical-power-grid-structure-working.html
3. M. Marković et al., Voltage Estimation in Low-Voltage Distribution Grids With Distributed Energy Resources, IEEE Transactions on Sustainable Energy, 12, 3, July 2021
4. https://www.wsj.com/articles/pg-e-knew-for-years-its-lines-could-spark-wildfires-and-didnt-fix-them-11562768885
5. https://www.wsj.com/articles/this-old-metal-hook-could-determine-whether-pg-e-committed-a-crime-11583623059
6. https://www.mantecabulletin.com/opinion/local-columns/pge-failure-replace-56-cent-hook-led-deaths-85-people/
7. https://www.ucsusa.org/resources/public-utility-regulatory-policy-act
8. https://www.energy.vic.gov.au/data/assets/pdf_file/0025/426733/Fault-Signature-Final-Report.pdf

SCTE® CABLE-TEC EXPO® FAST FORWARD 2021

ATLANTA, GA
OCTOBER 11-14

SCTE
a subsidiary of CableLabs®

Thank You!

Dr. Robert Cruickshank, Gridmetrics™ R&D Liaison

CableLabs

2021 Fall Technical Forum
SCTE® • NCTA • CABLELABS®