EPRI ELECTRIC POWER RESEARCH INSTITUTE

Communications in the Utility Industry

Trends and Examples

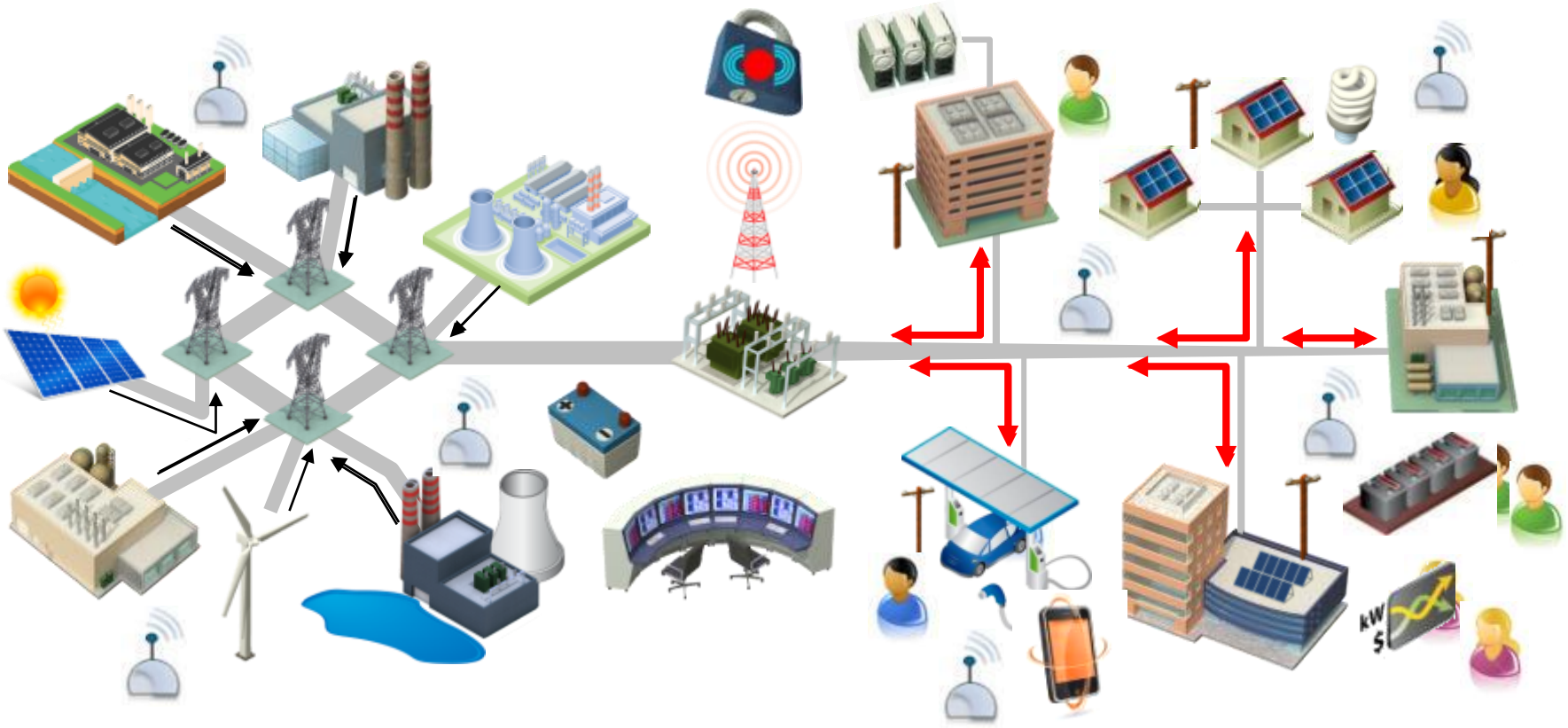
Matt Wakefield
Director, Information, Communication & Cyber Security

NARUC Winter Meeting: Spectrum, Spectrum Everywhere, Who Needs it and Why?

February 17, 2015

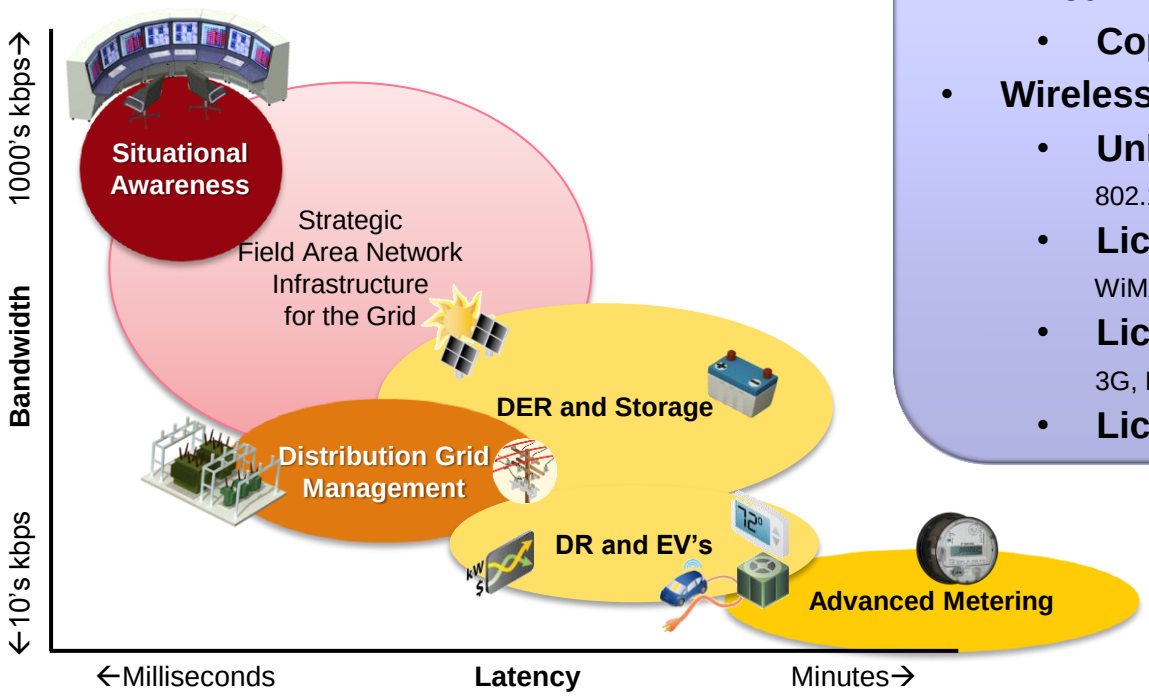
How the Grid is Transforming

Increasing Amount of Connected Devices



Communications is a Key Enabler for a Flexible, Resilient and Connected and Power System

Communication Requirements & Options



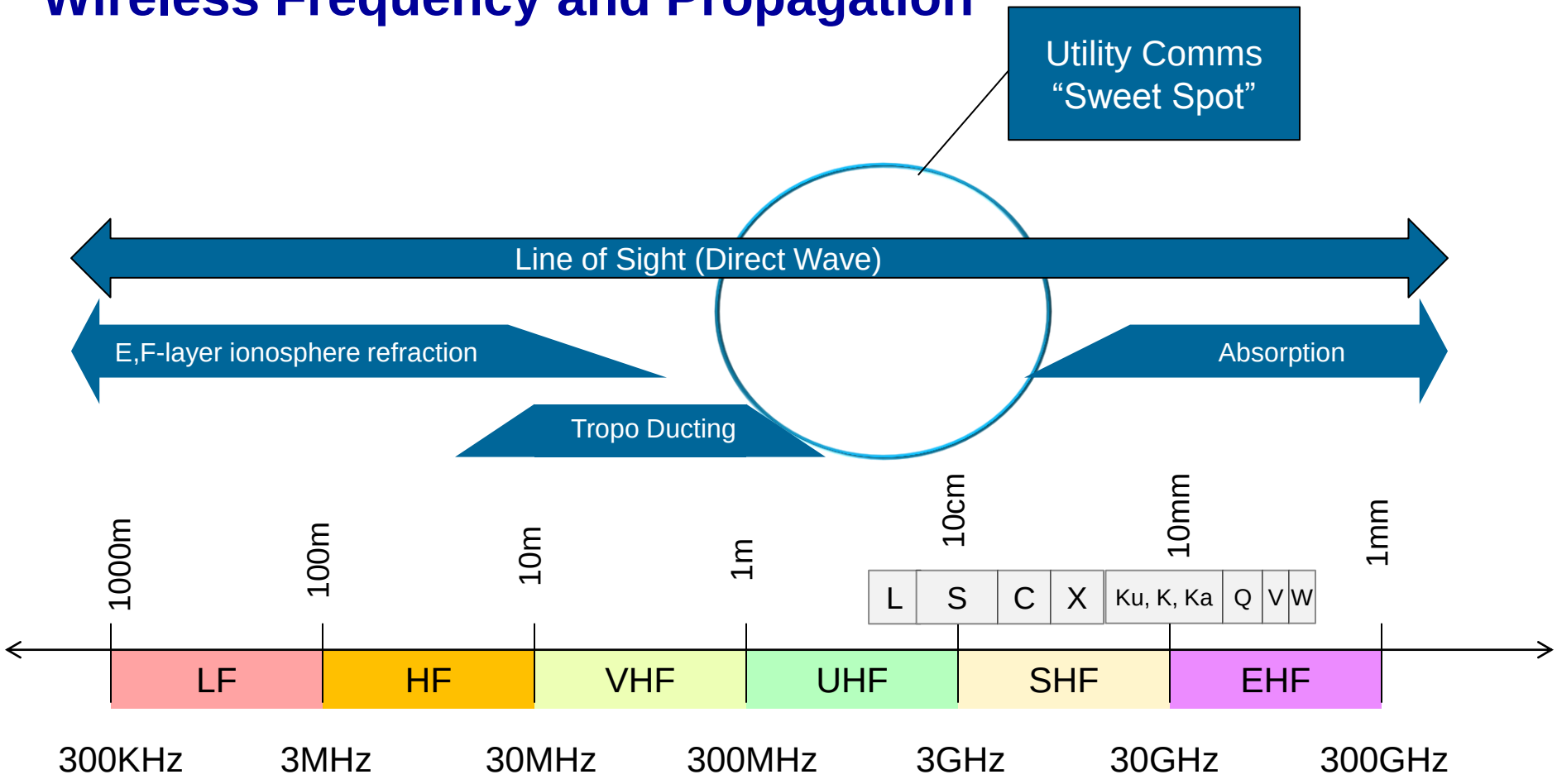
Options:

- **Wired:**
  - **Copper, Power Line Carrier, Fiber**
- **Wireless:**
  - **Unlicensed Private**
    802.11 (2.4GHZ, 5GHz), 802.15.4g Mesh (900MHz)
  - **Licensed Private**
    WiMAX 1.4, 1.8, 3.65GHz, LTE 700MHz, 1.8 GHz
  - **Licensed Public**
    3G, LTE
  - **Licensed Public Safety Sharing**

Communication Requirements:

- **Available**
- **Affordable**
- **Reliable**
- **Resilient**

Wireless Frequency and Propagation



Key Drivers and Applications to Determine Optimum Frequency

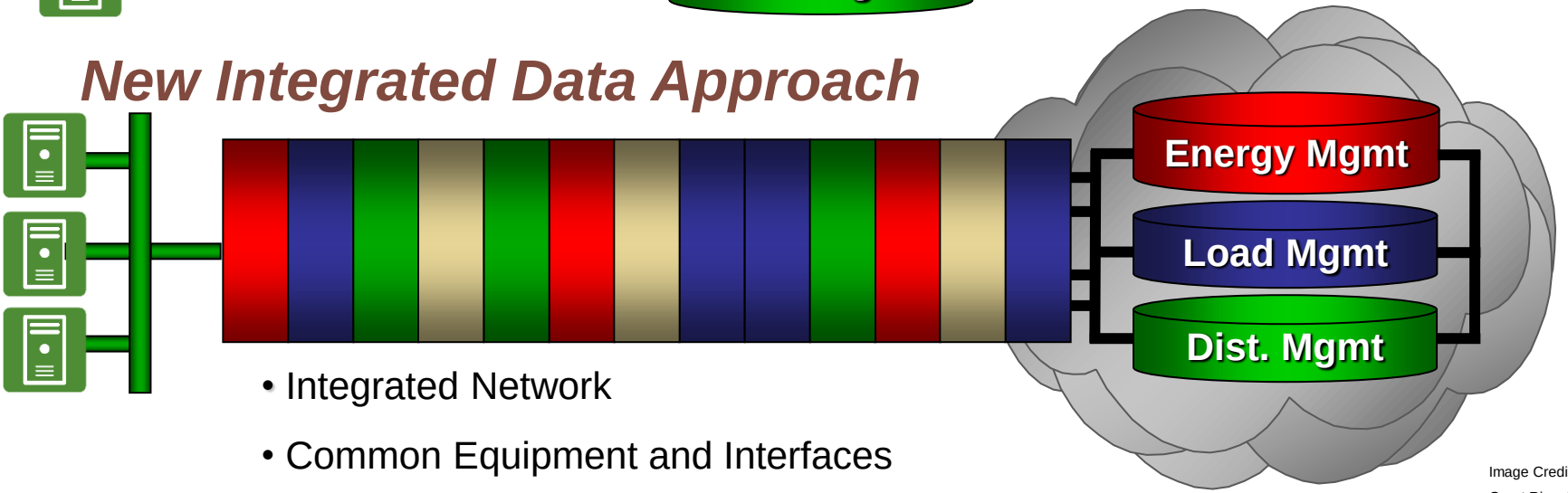
- **Grid Reliability (Outage identification, restoration & analysis)**
- **Grid Health – Predictive Analytics**
- **Renewable Integration**
- **Technology Stability & Convergence (Utility Assets – Long Lifecycle)**

Trends Impacting Utility Communications

- Transition from application-specific (overlay) networks, to integrated and unified networks

Past Overlay Approach

New Integrated Data Approach



- Integrated Network
- Common Equipment and Interfaces
- Redundant at Critical Sites

Image Credit:
Great River Energy

Field Area Networks - How EPRI is Assisting Utilities to Assess

		SRP	Duke	H-One	UI	GRE	NPPD	HQ	Ameren
1	Securing the FAN (connecting devices to the FAN)	☑	☑	☑	☑			☑	☑
2	High reliability network architecture	☑	☑	☑	☑	☑	☑	☑	☑
3	QoS w/ shared and/or impaired network	☑	☑	☑	☑	☑	☑		☑
4	AMI vs. broadband FAN technologies for DFA				☑				
5	Reliability of public carrier networks, network entry	☑	☑		☑	☑	☑	☑	
6	Long-term reliability, Netwk Mgmt (monitoring/metrics)	☑	☑		☑	☑		☑	☑
8	Distributed vs. centralized processing		☑						
13	Private networks: Requirements and Propagation	☑		☑	☑	☑		☑	☑
16	Integrating applications beyond electric delivery	☑							
18	Sharing Networks with Public Safety					☑	☑	☑	
19	Operation in the 3.65 GHz band	☑				☑			☑

A Case Study on

A Field Area (communications) Network Pilot

3.65GHz equipment tested - WiMAX

Today, Multiple Communication Systems for Different Applications

- **Distribution Feeder Automation:** Unlicensed 900MHz
- **Field Emergency Comm's:** 150MHz Licensed Paging
- **Capacitor Control (Volt/VAR):** 150MHz Licensed Paging
- **Advanced Metering:** 900MHz Unlicensed Mesh w/Cell Backhaul
- **Vehicle Location:** Commercial Cellular
- **Water SCADA:** Licensed & Unlicensed 900 MHz
- **Truck Mounted Laptops:** Commercial Cellular

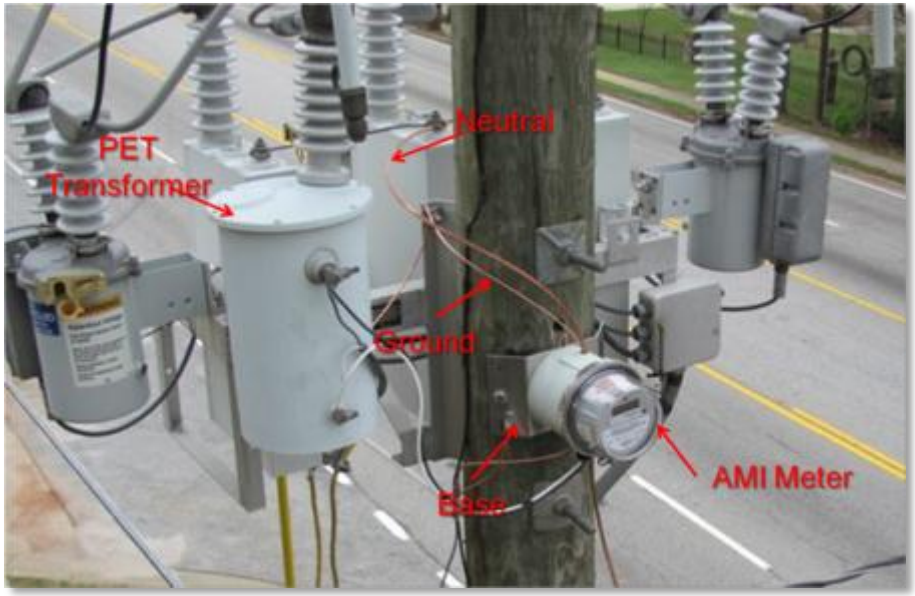
Drivers

- **Reliability: DFA Expansion**
- **Renewable Integration**
- **Efficiency: Volt/VAR**
- **Fault Identification**
- **Outage Response & Restore**
- **Automation**
- **Physical Security (Video)**

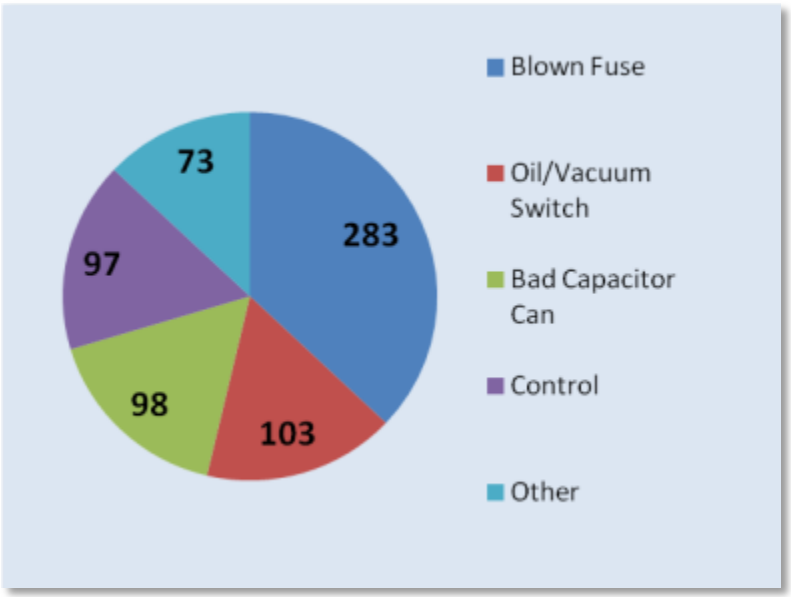
A wireless broadband network can be integrated across a utility to serve as the unifying infrastructure.

A Case Study on

A Capacitor Bank Health Monitor



Installation of Advanced Meter Capacitor Bank Health Monitor



Issues Causing Failure of Capacitor Banks

AMI capacitor bank health monitors identified over 650 problems in the first 6 months and changed the inspection schedule from once a year to once a day.

Communications can ENABLE innovations we haven't thought of

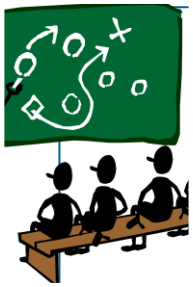
EPRI Smart Grid Demonstration Case Studies

Report on http://smartgrid.epri.com/Demo.aspx

What's Next? Challenges Successes

Rich Set of Results and Sharing – Take Advantage of it
DER Architecture Framework, Use Cases & Standards Contributions
Conservation Voltage Reduction
Customer Engagement Learnings (Behaviors & Technologies)
Cost Benefit Analysis Framework & Guidebooks

Communication & Cyber Security Infrastructure
Most types of DER (Loads and Resources) not using standard protocols
Vendors going out of business & stranded Assets (utilities & customers)
Regulatory Uncertainty
Data Analytics
Quote: "Utility Culture Eats Strategy for Lunch"



Be Aware – No Single Solution Fits All
These are Strategic Activities (Impacts multiple business units)
Integrated Grid Pilots and Demonstrations, Unified Utility Architecture
Industry Collaboration (International, Government, Vendors, Academia, Labs, etc.)

Together….Shaping the Future of Electricity