



Using Distributed Intelligence to Aid MicroGrid and Distribution Technology Deployment

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Presented by Bob Leigh, CEO of LocalGrid Technologies

Outline

- Who are we?
- Industry Trends
- Why Decentralized Architectures?
- LocalGrid DataFabric™
- Implementation

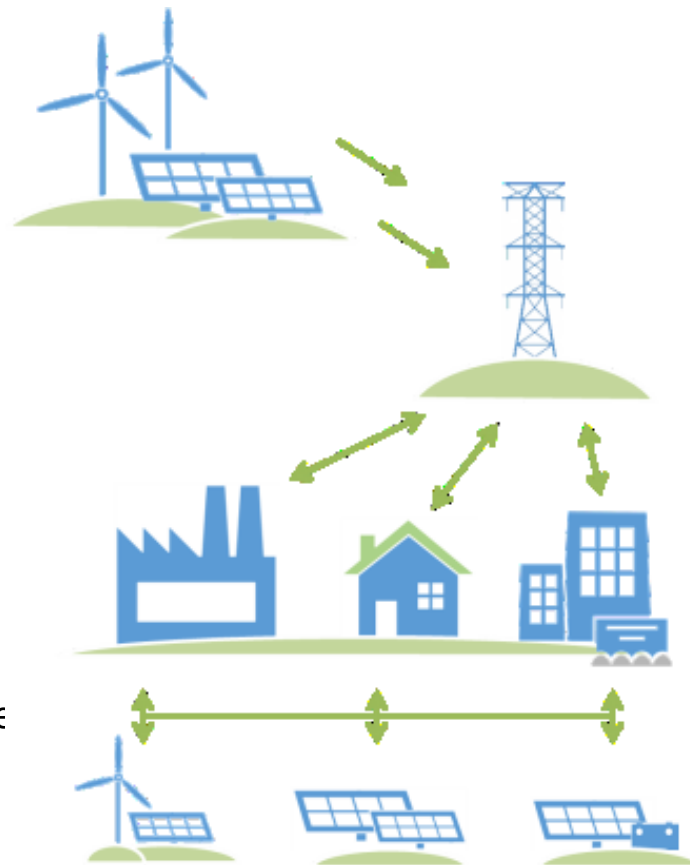




- LocalGrid delivers advanced embedded software for electrical utilities that are looking to improve service levels, reduce operating costs and improve grid availability.

- LocalGrid delivers:

- Embedded software for hardware providers servicing utility customers
- Extremely high resolution grid analysis
- Digital Asset Management (PQM, PMU, DFR)
- Advanced solutions for distributed generation and MicroGrid
- Advanced and automated SCADA security using DDS
- Security Fabric deployment options
- Platform agnostic technology with future proof over the air upgrade functionality



Industry Trends

Power Industry Trends



■ Electric utilities are facing mounting challenges:

- Utilities must bring on renewable energy sources, improve service levels, reduce outages and reduce operating costs
- Existing infrastructure (especially NA & Europe) is reaching end-of-life
- Dated electrical grid designs make it difficult to bring renewables on line and hamper adoption of electric vehicles
- Department of Energy and Department of Homeland Security are demanding tighter security on existing grid infrastructures – SCADA control protocol has over 30 known vulnerabilities – distribution utilities are exposed

■ Utilities are looking for solutions to:

- Improve and maintain service quality while extending the life of existing asset
- Connect renewable generation without investing in new capital
- Increase scalability and functionality of their infrastructure without compromise to security
- Improve cyber security of SCADA, which has over 30 known vulnerabilities. Exploits can take down facilities and assets. Utilities are at security risk throughout their mission critical infrastructure

Transmission and distribution infrastructure requires a \$7 trillion investment by 2025 to keep pace with growth and end of life upgrade requirements

21st Century Grid Applications



Generation



Transmission



Distribution



Low Cost, High Resolution Asset Monitoring

**Increase Load/ Efficiency of
Transmission Infrastructure**

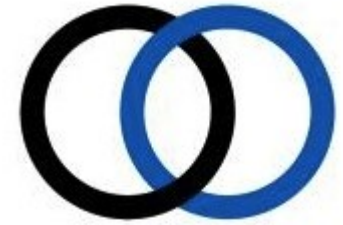
**Increase Data and Better
Information for Planning and
Servicing**

Tools to Manage Renewable & Distributed Generation Power Flow

SCADA Security – Integration of New and Legacy Devices

Interoperability of Legacy Devices & New Applications

Why Decentralized Architectures?

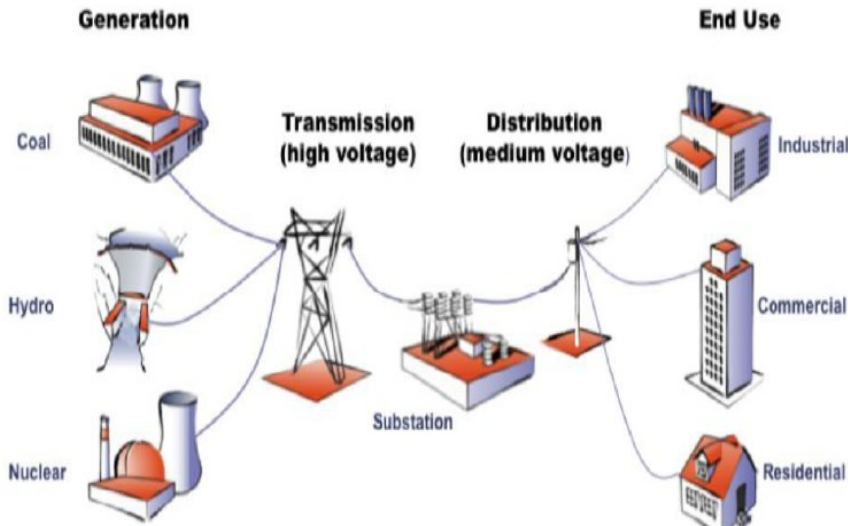


Microgrids are the Future

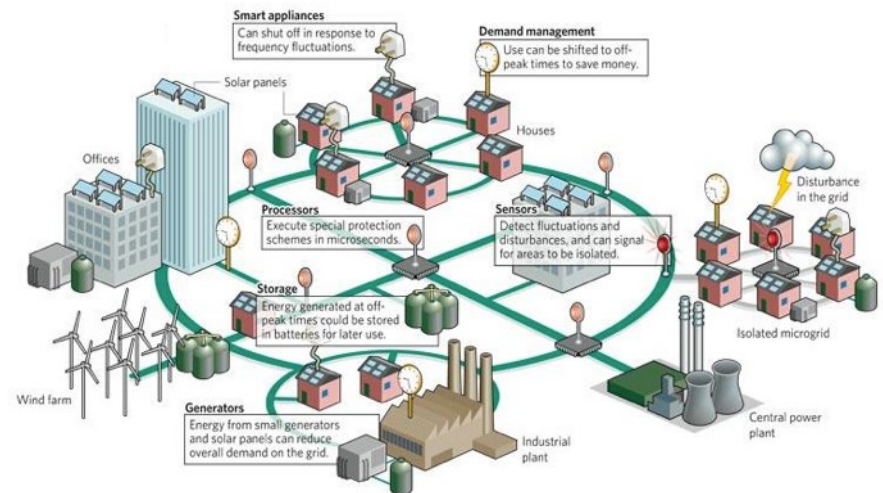
Legacy Bulk Electrical System



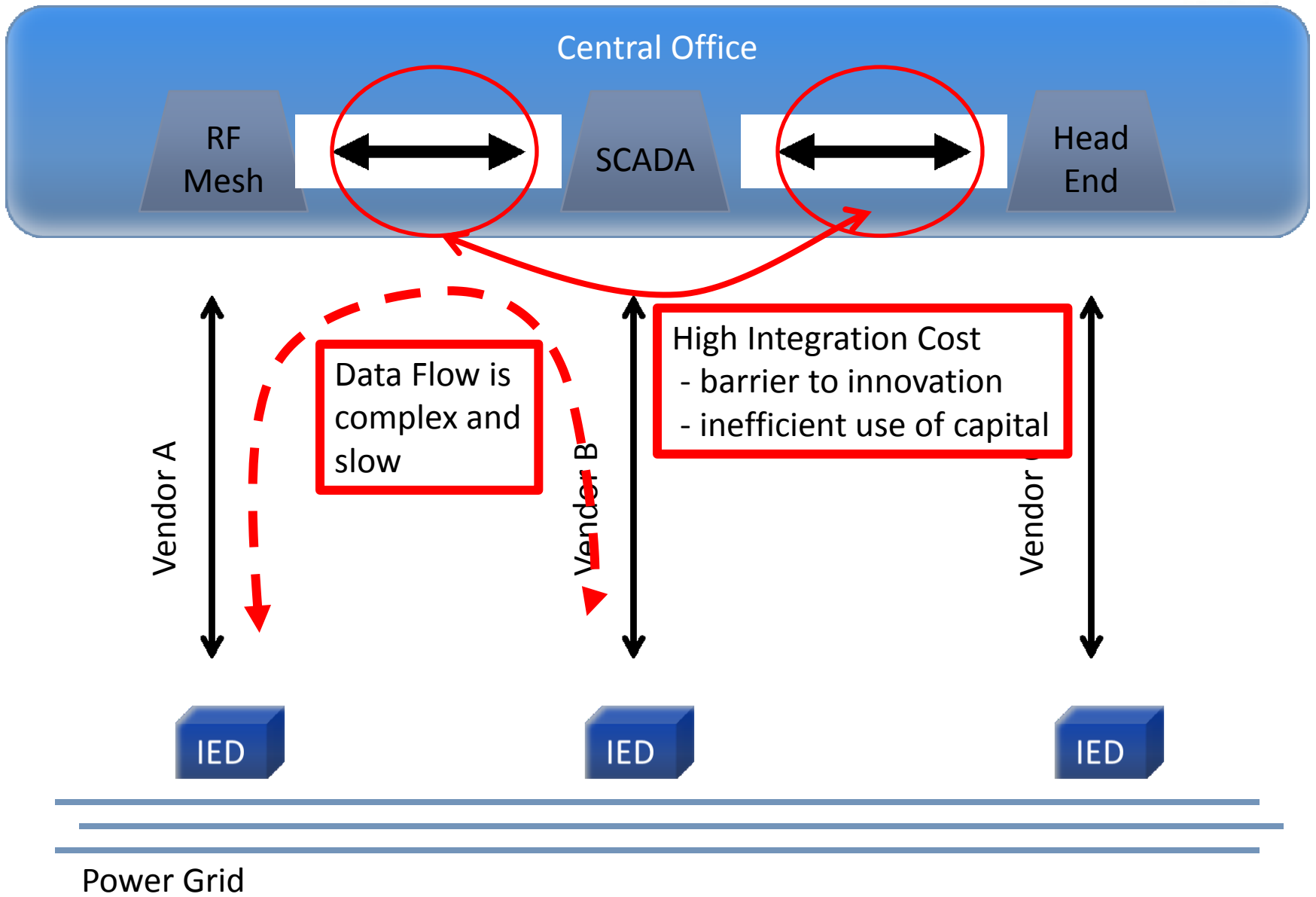
MicroGrids

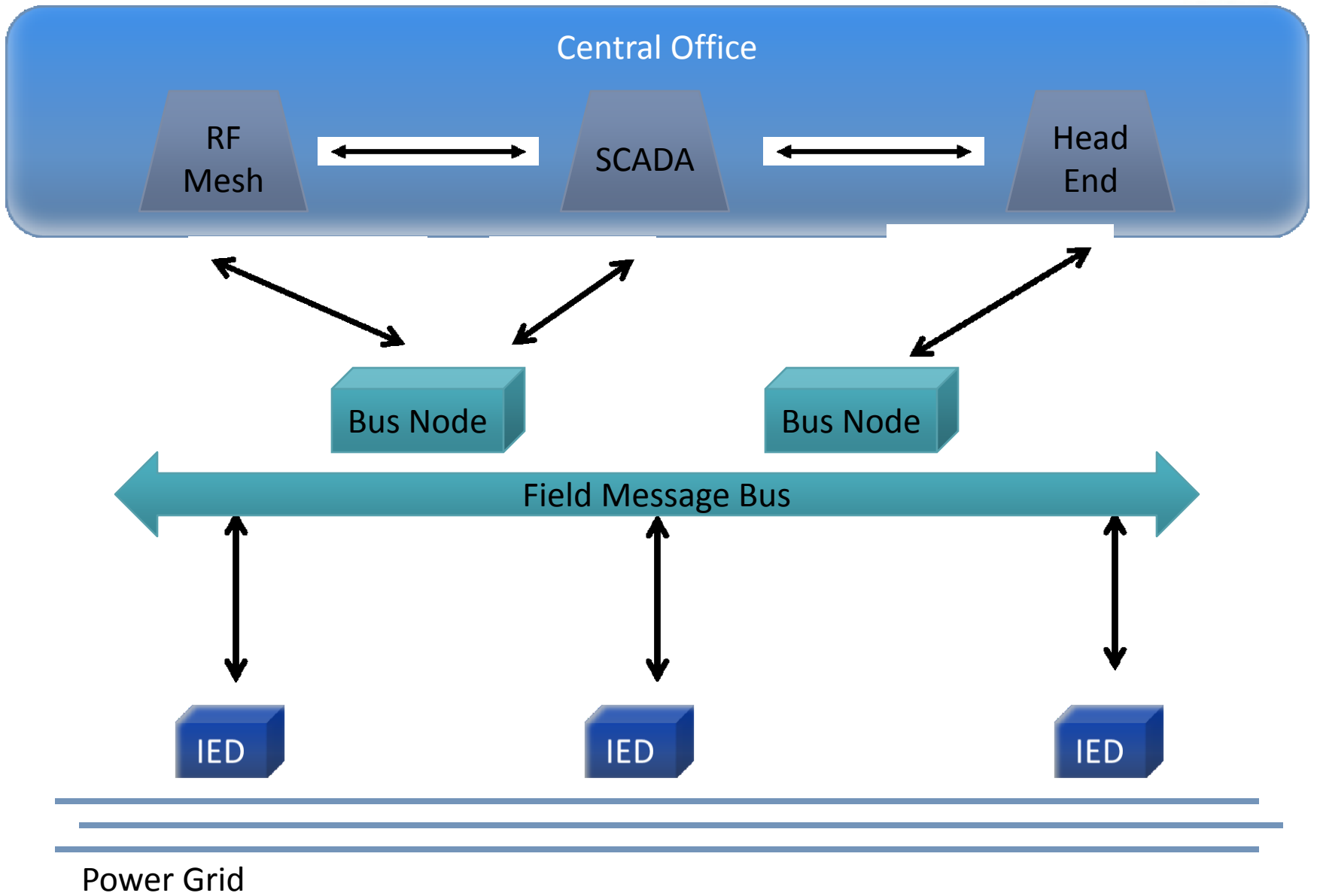


That Was Then...



...This is Now





Decentralized vs. Centralized



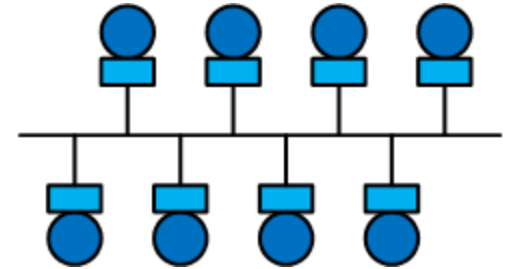
Decentralized

- Direct, peer-to-peer
- Low latency, no in-between servers or brokers
- No single point of failure
- Simple horizontal scalability
- No expensive servers which must scale with number of clients

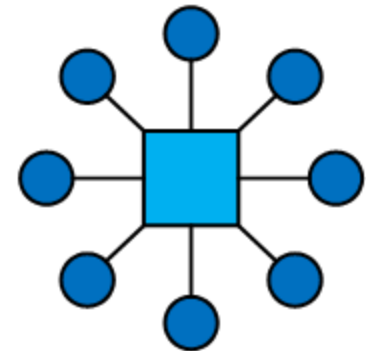
Centralized

- All data passes through a server or broker
- Poor latency, server performance becomes bottleneck
- Assume high-bandwidth and reliable network
- High cost of server hardware as devices scale out

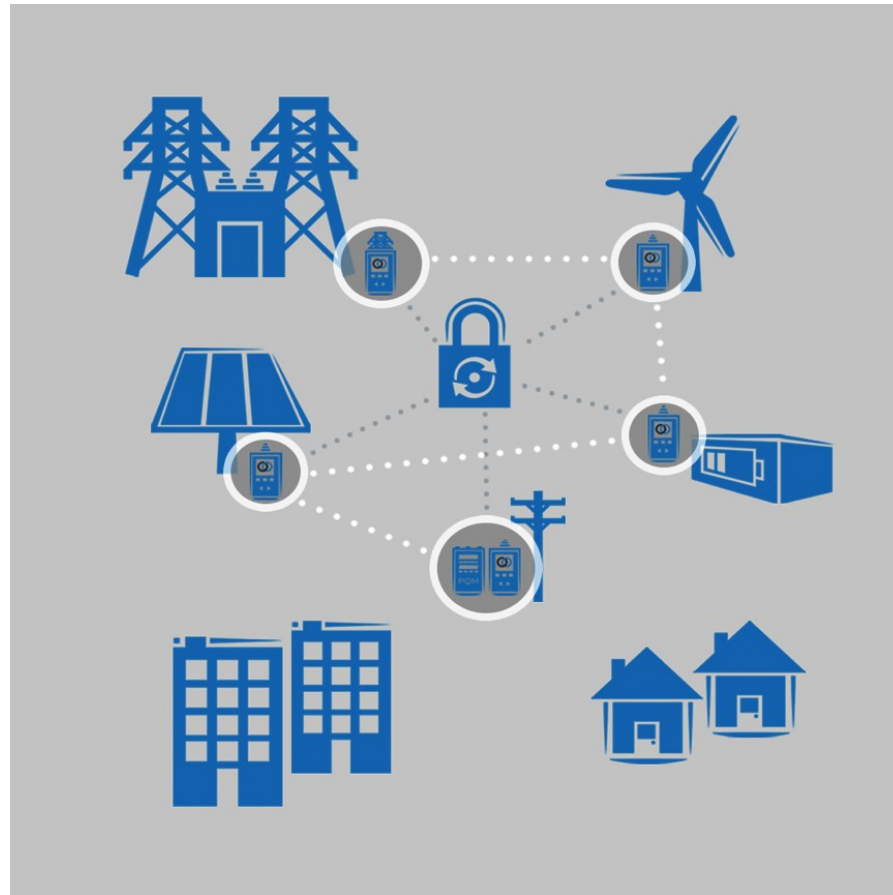
Decentralized



Centralized



LocalGrid DataFabric™





What's a Fabric?

Fabric, Cloud or Platform..

- A fabric is a distributed operating system with a well defined set of data models and protocols
 - Conceptually similar to a cloud or network based operating system
- Software components are distributed across a private cloud of hardware seamlessly using a set of well defined protocols and data models
- Provides a scalable distributed run-time allowing services or components to discover and communicate with each other dynamically
- Services may come and go, this is expected rather than an exception – services can be deployed, started, stopped, and removed at any time

LocalGrid DataFabric™

Secure Peer-to-Peer Network

Data Analysis

Event Capture

Network
Management

Secure Audit



Embedded Hardware

Industrial PC

Enterprise Network

Asset Management

Theft Detection

DFR/ PQA/ PMU

AMI
Visualization

MicroGrid Platform

Linux

Windows

Private Cloud

Solar
Invertor

IED

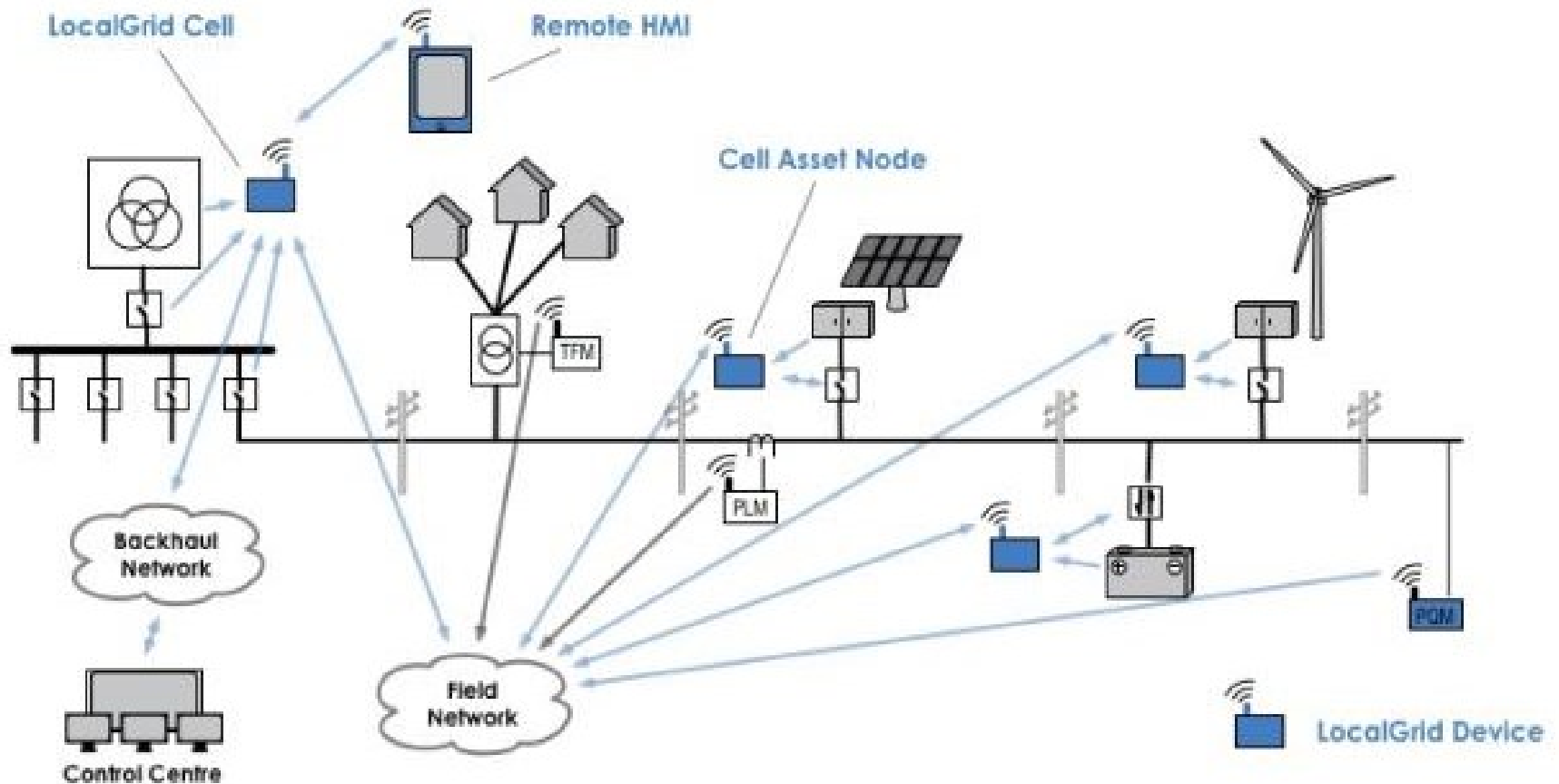
PQA

PMU

Clients

Clients

Anywhere Platform – Multiple Applications





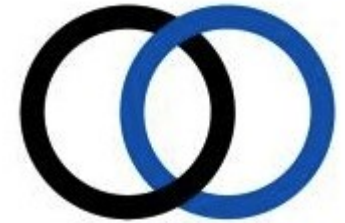
Application

- Decrease Infrastructure Costs
 - Generate more power behind existing transformers and move more power through existing assets in off-peak hours.
- Flexibility
 - Systems upgrades can be made remotely, over-the-air, allowing the electrical grid to evolve with changing standards, applications and user demand.
- Big Data Solution
 - Real-time, high-resolution data analysis and autonomous control actions create a distributed grid that is less susceptible to point failures and becomes more fault-tolerant with local event detection and analysis.

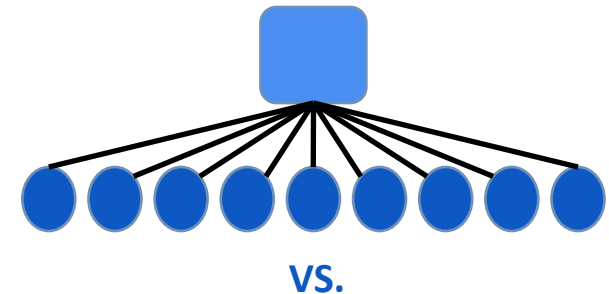
LocalGrid DataFabric™

Real-Time Private Data Cloud

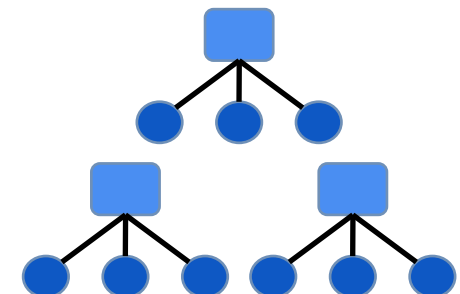
- Based on Open, Standards Based Architecture
- Peer-to-Peer Distributed Communication
- Operates well in high speed networks and poor quality links
- Purpose-built Smart Grid Security
- Communications Agnostic (IP based, serial, etc.)
- Third-Party Application Platform
- Distributed Analytics Engine
- Big Data Solution with Reduced Bandwidth



20th Century: Central Assets
-> **Central IT Structure**



21st Century: Distributed Assets
-> **Distributed IT**



Open Standards Based Protocol



OMG Data-Distribution Service for Real-Time Systems (DDS)

- Designed from the ground up for real-time distributed systems for mission critical applications
- Used extensively in military, aerospace, and industrial applications
- Open standard with 10+ vendors of compliant protocol stacks
- Built in Quality of Service parameters for all data to enforce reliability, timing, redundancy, and persistence
- Features:
 - Low latency and high throughput
 - Deterministic even under load and at scale
 - Reliable multicast for efficient data distribution
 - Peer-to-peer architecture with no message brokers or servers
 - Non-stop availability with live upgrades and no single point of failure





Performance at Scale

Microseconds not Milliseconds

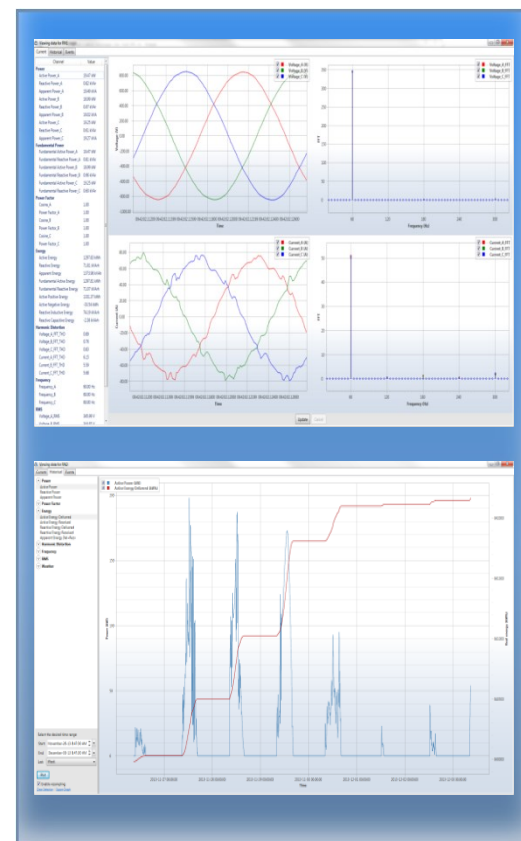
	Brokered Protocols (MQTT, IEC 61850, DNP3, Modbus etc..)	LocalGrid DataFabric™
Message Rate*	10's of messages per second per device	10,000's of messages per second per device
Latency*	100's of milliseconds to seconds	100's of microseconds to milliseconds
"Real-Time"	As responsive as possible, timing not strict	Deterministic, timing enforced through strict QoS
Fault Tolerance	Server and broker can not go down	No single point of failure, simple fail-over
Scalability	As system scales, server processing power must also	As system scales, performance is negligibly affected

Distributed Analytics Engine



On Device and Distributed

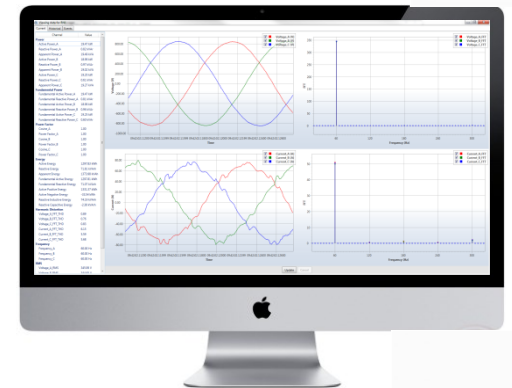
- Save bandwidth by performing data analysis on-device in the field
- Create complex multi-device distributed analytics without incurring server overhead
- Share high speed raw measured values as well as parametric data between devices
- Simple deployment of analytics modules with pre-packaged options for:
 - PQA/PQM, PMU, DFR, and more..



Solution Delivery



- Asset Manager
 - Power Quality Analyzer
 - Digital Fault Recorder
 - Asset Monitoring
- MicroGrid Integration Platform
 - Integrated Energy Devices
 - Renewables Integration
 - Field Messaging Bus
 - Integration to Operational Systems
- Secure SCADA Transport



Implementation



Utilities Leading the Way

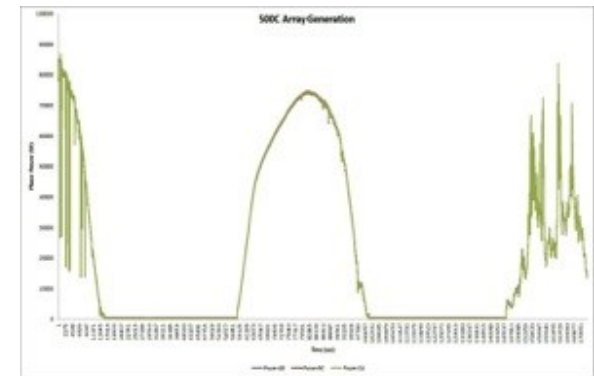


- Industry leading utilities are transforming the way data is used to manage grid operations
 - Existing client-server methods do not scale – utilities are thus looking to deploy distributed architecture solutions
 - LocalGrid’s approach is not unique, and has been validated through industry leading partners– Fraunhofer, NREL, EPRI, Leidos
 - LocalGrid is the only company that has deployed distributed architecture solutions in a grid environment
 - Vendor integration and standards definition is key to moving forward

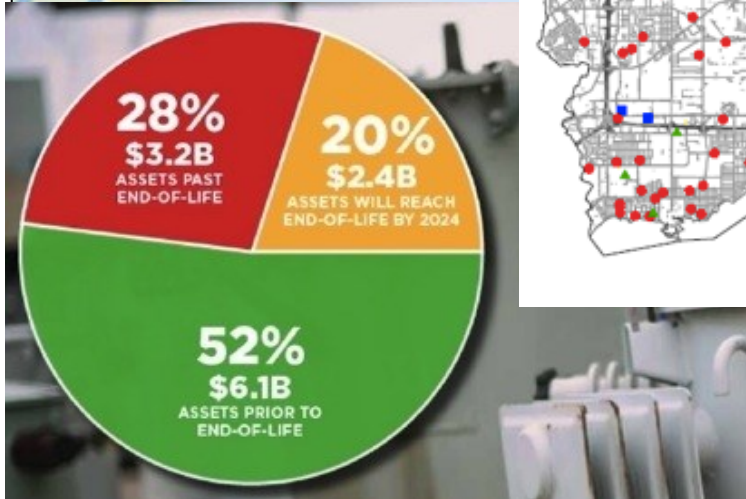
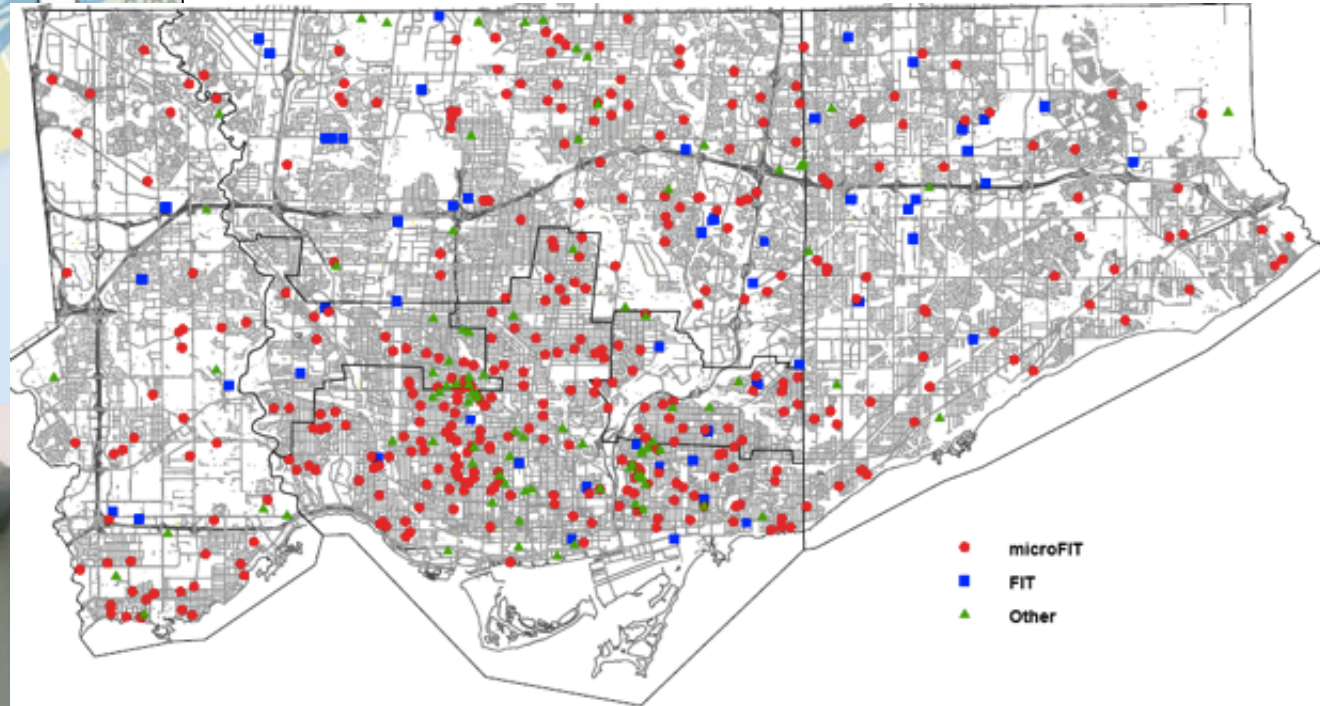
Case Study: Distribution Electric Utility



- Delivery of DataFabric™ Architecture
- Deploy custom applications to manage increasing complexity of distribution system
- Management and dispatch of Distributed Energy Resources



Case Study: Renewable Generation & Aging Infrastructure



● Distributed Generation Connections

Images are courtesy of Toronto Hydro ©2012

¹ Navigant Report to Toronto Hydro (May 2011) "Toronto Hydro System Connection Capacity and Enabling Options for Distributed Generation"

Decentralized Architecture Advantages



- Modular Roll-out
 - By area of greatest need
 - Incremental benefits as new solutions are development
 - Customized solutions
- Common hardware with multiple application and multiple benefits
- Retro-fit to existing Equipment
- Lower Integration Costs
- Simplified IT Infrastructure



Next Steps for the Industry

- Develop a Standard Field Messaging Bus
 - Common Data Model
 - Set of open standards
 - Extensible Architectures
- Grid Application Deployment
 - Multiple Vendor Solutions
 - Abstract the Application from the devices & equipment
 - Start with monitoring and Asset Management
- MicroGrid Build-out



Thank you

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