OpenFMB™: 2016 Grid Modernization Summit Demo Preview and Use Cases

October 18th, 2016 1:00 PM EST
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- Webinar slides and audio will be made available on the SGIP website

October 31, 2016
OpenFMB™: 2016 Grid Modernization Summit Demo Preview and Use Cases

Welcome and Introductions

Gabrielle Puccio
Vice President, Member and Public Affairs
SGIP
Meet the Presenters

Dr. Stuart Laval
Manager, Technology Development
Duke Energy

Aaron Smallwood
Vice President, Technology
SGIP
OpenFMB™: 2016 Grid Modernization Summit Demo Preview and Use Cases

OpenFMB™ Demo Preview

Aaron Smallwood
Vice President, Technology
SGIP
Webinar Agenda

• Welcome and Introductions

• SGIP 2016 Grid Modernization OpenFMB™ Demo Preview

• OpenFMB™ Framework Overview

• OpenFMB™ Distributed Energy Resources Use Case

• OpenFMB™ Collaboration Site Preview

• How to Participate in OpenFMB™

• Q&A
Official launch of the OpenFMB™ collaboration site

• OpenFMB™ participants will be hosting demonstrations using the code available from the collaboration site

• Demonstrations will highlight the OpenFMB™ framework:
  - Business Case and Use Case Requirements Definition
  - Use Case Development and Data Modeling
  - IIoT Publish/Subscribe Protocols
  - Hardware and Software Implementations
OpenFMB™: 2016 Grid Modernization Summit Demo Preview and Use Cases

OpenFMB™ Framework Overview

Dr. Stuart Laval
Manager, Technology Development
Duke Energy
OpenFMB™: The Catalyst for Interoperability

• Open Field Message Bus (OpenFMB™) is a reference architecture and framework for distributed intelligence

• Leverages existing standards to federate data between field devices and harmonize them with centralized systems
  - IEC’s Common Information Model (CIM) for semantic data model
  - Internet of Things (IoT) publish/subscribe protocols
    • DDS: Data Distribution Service
    • MQTT: Message Queue Telemetry Transport
    • AMQP: Advanced Message Queue Protocol

• Scales operations independently, without a system-wide rollout
  - Flexible integration of renewables and storage with the existing grid
  - Accelerates ability to stack operational benefits

• OpenFMB™ standard was ratified in March 2016 by the North American Energy Standards Board (NAESB)
OpenFMB™: Guiding Principles

• Agile and Evolving Architecture
  • No “one-size-fits-all” technology for DERs with existing T&D
  • Any Common Data Model with Any IoT Pub/Sub Protocol

• No reinventing wheel / No duplicating of standards effort

• Focus on business value by solving real problems
• Flexibility, scalability, & backward-compatibility are critical
• Security & configuration built-in at the start
OpenFMB™: Enhancing Grid Edge Integration

Key Observations:
1. Single-Purpose Functions
2. Proprietary & Silo’ed systems
3. Latent, Error-prone Data
4. OT/IT/Telecom Disconnected
5. No Field Interoperability!

Key Observations:
1. Multi-Purpose Functions
2. Modular & Scalable HW&SW
3. End-to-End Situational Awareness
4. OT/IT/Telecom Convergence
5. True Field Interoperability!
OpenFMB™: Federated Message Exchanges

- Periodic Readings - Pub every few secs or near-real-time
- Data-Driven Events – on status change in near-real-time

**Pub/Sub - Readings**
- KW A/B/C
- KVAR A/B/C
- V A/B/C
- I A/B/C
- Phase Angle A/B/C
- KWh
- TimeStamp
- State of Charge

**Pub/Sub - Events, Alarms, and Control**
- Trip / Open
- TimeStamp

**Open Field Message Bus**

- PV
- Battery
- Nodes
- Recloser / Switch
- Meter
- PCC/POI Optimizer
- Grid Edge analytics
OpenFMB<sup>™</sup>: Logical Reference Architecture

- **Field Applications**
- **Client/Server Adapters** (Modbus, DNP3, IEC 61850 GOOSE/MMS, ANSI C12, CoAP, XMPP, Others)
- **OpenFMB<sup>™</sup> Interface Layer** (Data Models and Profiles, Configurations, Interaction Patterns, Security)
- **Layered Security Approaches**
- **Pub/Sub Layer**
  - AMQP
  - DDS
  - MQTT
  - Other Pub/Sub Middleware

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OpenFMB™: Layered Architecture Framework

Legend
- Legacy Protocol Translation
- Common Semantic Model
- OpenFMB IoT Protocol
- Client/Server Polling
- Pub/Sub Messaging

End Points Devices
- Smart Meter
- Line Sensor
- Capacitor Bank
- Solar PV Inverter

Lower Tiers Nodes (e.g. grid)
- Legacy Protocol Adapter
- Common Data Model Profile(s)
- OpenFMB protocol
- Legacy Protocol Adapter
- Common Data Model Profile(s)
- OpenFMB protocol

Middle Tier Nodes (e.g. substation)
- Legacy Protocol Adapter
- Common Data Model Profile(s)
- OpenFMB protocol
- Battery Inverter
- Modbus

Higher Tier Node
- Central Office
- (Utility Datacenter)
- MDM
- GIS
- DMS
- OMS

Virtual Firewall
- MQTT, DDS
- AMQP, DDS, MQTT
- DMS, MQTT

Client/Server Polling
- Pub/Sub Messaging
SGIP OpenFMB™ Framework Life Cycle

- Business Case
  - Business-driven solutions
  - Functional and non-functional requirements
  - Interaction and sequencing

- Use Case
  - Profile of applicable, existing data model
  - Common software definitions and language

- UML
  - Software tools to allow actors to interoperate
  - System integration and validation testing

- XSD and IDL
  - Updates and versioning

- Apps and Adapters

- Test and Field

- Maintenance
OpenFMB™: 2016 Grid Modernization Summit Demo Preview and Use Cases

DER Circuit Segment Management Use Case

Dr. Stuart Laval
Manager, Technology Development
Duke Energy
OpenFMB™: Distributed Energy Resources

• OpenFMB™ enables distributed intelligence for the efficient, flexible, and scalable management of DERs

• Local device coordination harmonized with centralized system control for layered DER management
OpenFMB™: Distributed Energy Resources

Substation

Feeder

Energy Storage System

Load

POI = Point of Interconnection

PCC = Point of Common Coupling

Microgrid

Solar Inverter

Energy Storage System

Load

Advantages of OpenFMB™

- Scalability
- Flexibility
- Interoperability

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OpenFMB™ SGIP Use Cases

• Updated 2015 Microgrid Use Cases
  ▪ Microgrid Unscheduled Islanding (Grid-to-Island)
  ▪ Microgrid Reconnection (Island-to-Grid)
  ▪ Circuit Segment Optimization (Connected Segment or Islanded Microgrid)
    • Markets, Weather, Dispatch/Load Forecasts

• DER Circuit Segment Management
  ▪ Primary Scenario: Voltage, Frequency, Power Factor Support
    • DER Point of Interconnection (POI) Coordination
    • Point of Common Coupling (PCC) Coordination with Microgrid Use Cases
  ▪ Secondary Extensions
    • Solar Smoothing: Reduce Circuit Segment Volatility
    • Volt-VAr Management: Power Factor Optimization
    • Peak Demand: Shaving/Shifting
  ▪ Tertiary Extensions
    • Distribution Transfer-Trip
    • Anti-Islanding: Inadvertent Island Detection
OpenFMB™: 2016 Grid Modernization Summit Demo Preview and Use Cases

OpenFMB™ Collaboration Site:
Code, Use Cases, Wiki, Blog, Community

Aaron Smallwood
Vice President, Technology
SGIP
OpenFMB™ Collaboration Site Launches Soon

Simplified OpenFMB microgrid demonstration from 2016 DistribuTECH conference

OpenFMB

- Framework
- Reference Architecture
- Grid Edge Interoperability
- Distributed Intelligence
OpenFMB™ Collaboration Site: Code

• OpenFMB™ Developer’s Toolkit:
  ▪ Downloadable turnkey executable file
  ▪ Simplified example of the Microgrid Demo shown at DistribuTECH 2016 based on the NAESB OpenFMB reference implementation
  ▪ Instructions and Wiki
OpenFMB™ Collaboration Site: Code

• Full version of OpenFMB™ code including:
  ▪ Adapters (DNP3, Modbus, etc.)
  ▪ Available in:
    • MQTT
    • DDS
    • AMQP
OpenFMB™ Collaboration Site: Code

• Do it yourself OpenFMB™ code for advanced users
  ▪ Configurable options
  ▪ Security extensions
  ▪ Supports multiple instances
  ▪ Load simulator
  ▪ More...

• openfmb-simulators - https://github.com/openfmb/openfmb-simulators
• openfmb-hmi - https://github.com/openfmb/openfmb-hmi
• openfmb-adapters https://github.com/openfmb/openfmb-adapters
• openfmb-common-mqtt https://github.com/openfmb/openfmb-common-mqtt
• openfmb-loadpublisher https://github.com/openfmb/openfmb-loadpublisher
• DNP3 - https://github.com/gec/dnp3
• Modbus - https://github.com/gec/modbus
OpenFMB™ Collaboration Site: Resources

- Community and Resources:
  - OpenFMB™ Use Cases and related UML, upcoming events, publications, blog, technical white papers, more...

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**RESOURCES**

**Publications**
- Duke Develops True Interoperability
- Overview of 25 vendor Duke Energy Coalition of the Willing Phase II microgrid
- Unlocking the grid edge: Open Standards are closer than you think
- OpenFMB participants and activities by SGIP VP of Operations
- OpenFMB™ Brings a Standard and a New Tool Set to the Grid's Edge
- OpenFMB lead-up to SGIP 2016 Grid Modernization Summit

**Use Cases**
- DER Circuit Segment Management
- Primary scenario and five extension scenarios for managing DER including islanding microgrids on a circuit segment
- Circuit Segment Optimization
- Optimization and circuit segment coordination
- Microgrid Unscheduled Islanding
- Seamless microgrid islanding
- Microgrid Grid Reconnection
- Seamless microgrid reconnection

**Conferences**
- OpenFMB Cartoon
- From 2015 SGIP Annual Conference

**Reference Implementations**
- Duke Energy’s Mt. Holly Site
- Coalition Web Site
- Interoperability Brochure
- Video
- Distributed Intelligence Platform Reference Architecture Vision Overview
Official launch of the OpenFMB™ collaboration site at the:

2016 SGIP Grid Modernization Summit

will also feature

• OpenFMB™ participant demonstrations utilizing the code available on the collaboration site

• OpenFMB™ team in person meeting

• Networking with OpenFMB™ experts
Upcoming OpenFMB™ Webinar

*OpenFMB™ Collaboration Site Introduction and Walkthrough*

- **November 17th** at 1pm ET

  - Review of collaboration site resources: OpenFMB™ Code, Use Cases, Wiki, Blog, and Community
Learn More & Participate

OpenFMB™ Information:
www.sgip.org/openfmb

What you can do now:
• Join SGIP!
• Join OpenFMB™!
• Attend November 7-10 Grid Modernization Summit

Contact SGIP for more information:
www.sgip.org/about-us/contact-us
Q&A
Thank you