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# NIST Testing and Certification Workshop

## Washington DC – July 8, 2018

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# Certification and Testing



## Products

- Physical Interface
- Logical Interface
- Functionality/Algorithms
- Performance/Environmental



## People

- Training
- Proficiency
- Expertise
- Experience



## Systems

- Interoperability
- Integration
- Commissioning
- Deliverables

← COMPREHENSIVE DESIGN AND SPECIFICATION PROGRAM →

# Product Testing and Certification

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- Physical Interface

- Hardware Inputs and Outputs
- Power
- Communication Media
- Connectors
- Environmental Conditions
- Packaging
- Mounting

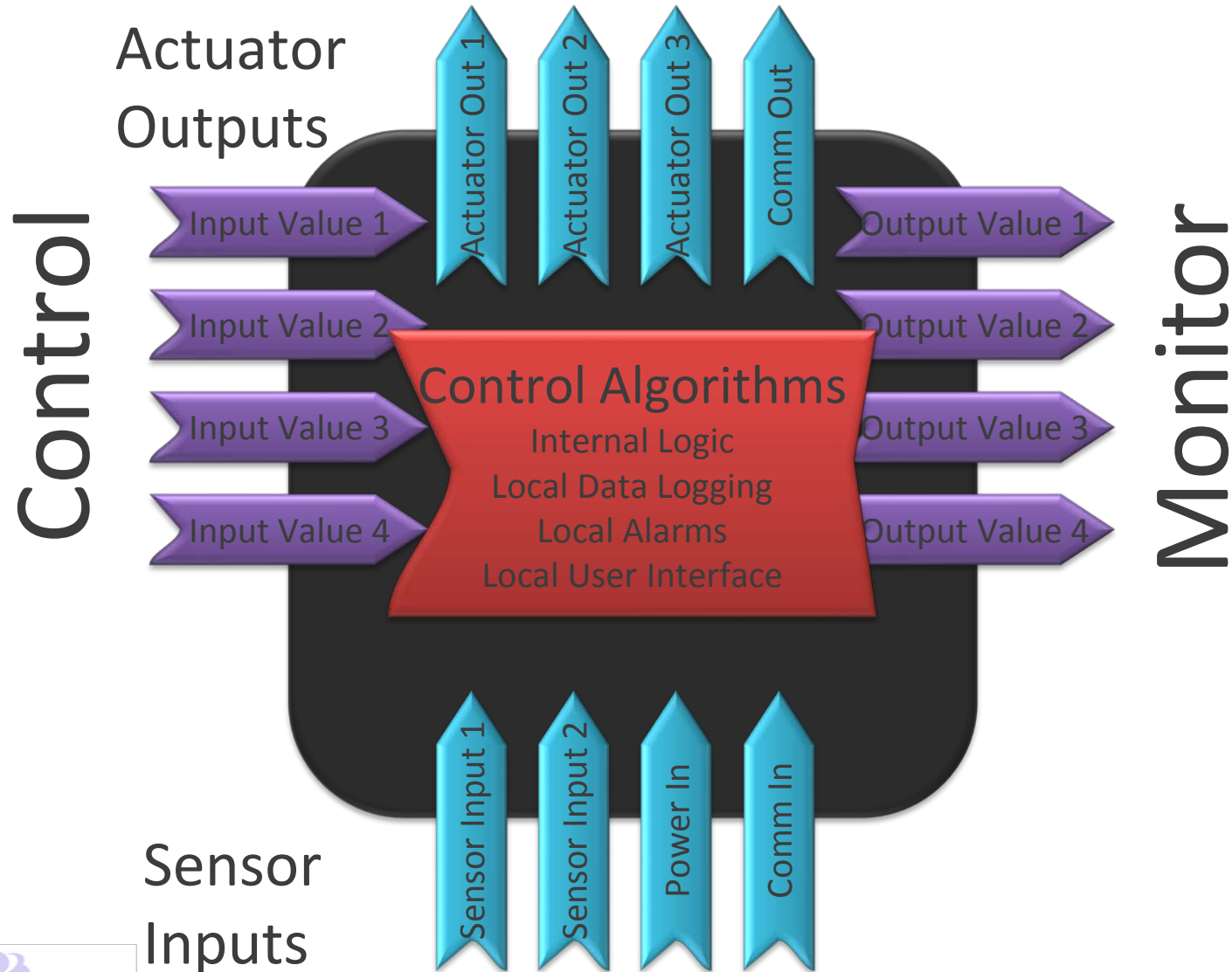
- Logical Interface

- Interoperability
- Communication Protocol
- External Interface File (XIF)
- Functional Profile
- Connectivity
- Data Objects/Points
- Configuration
- Programming

- Functional Interface

- Programming
- Logic
- Controls
- Commands
- Monitoring
- Alarming
- Security
- Access
- Reliability
- Performance

# Device Profile

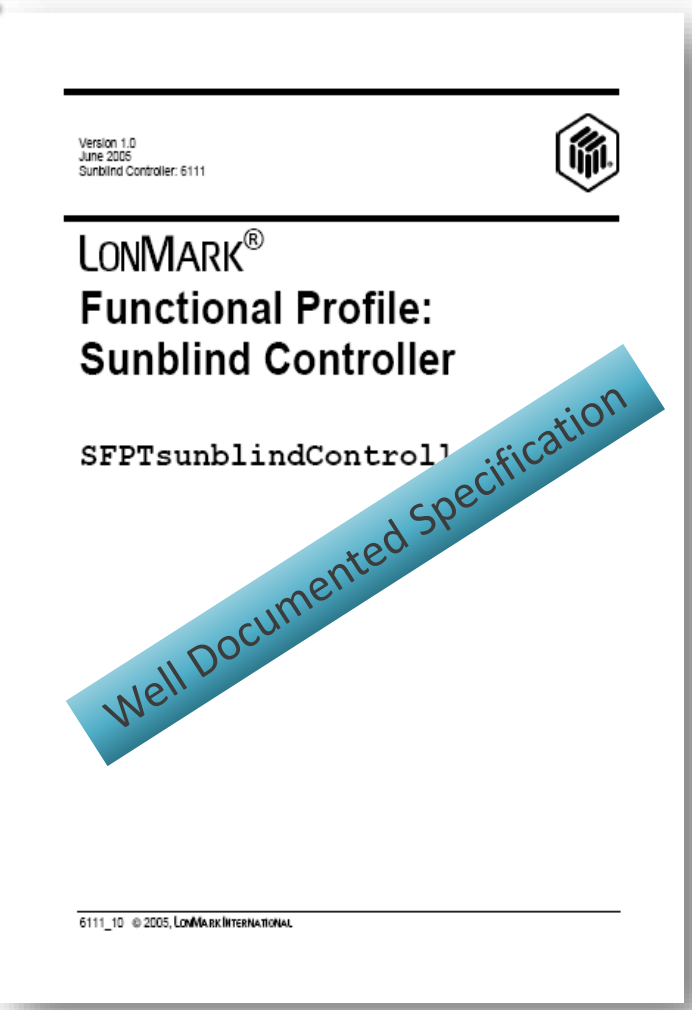
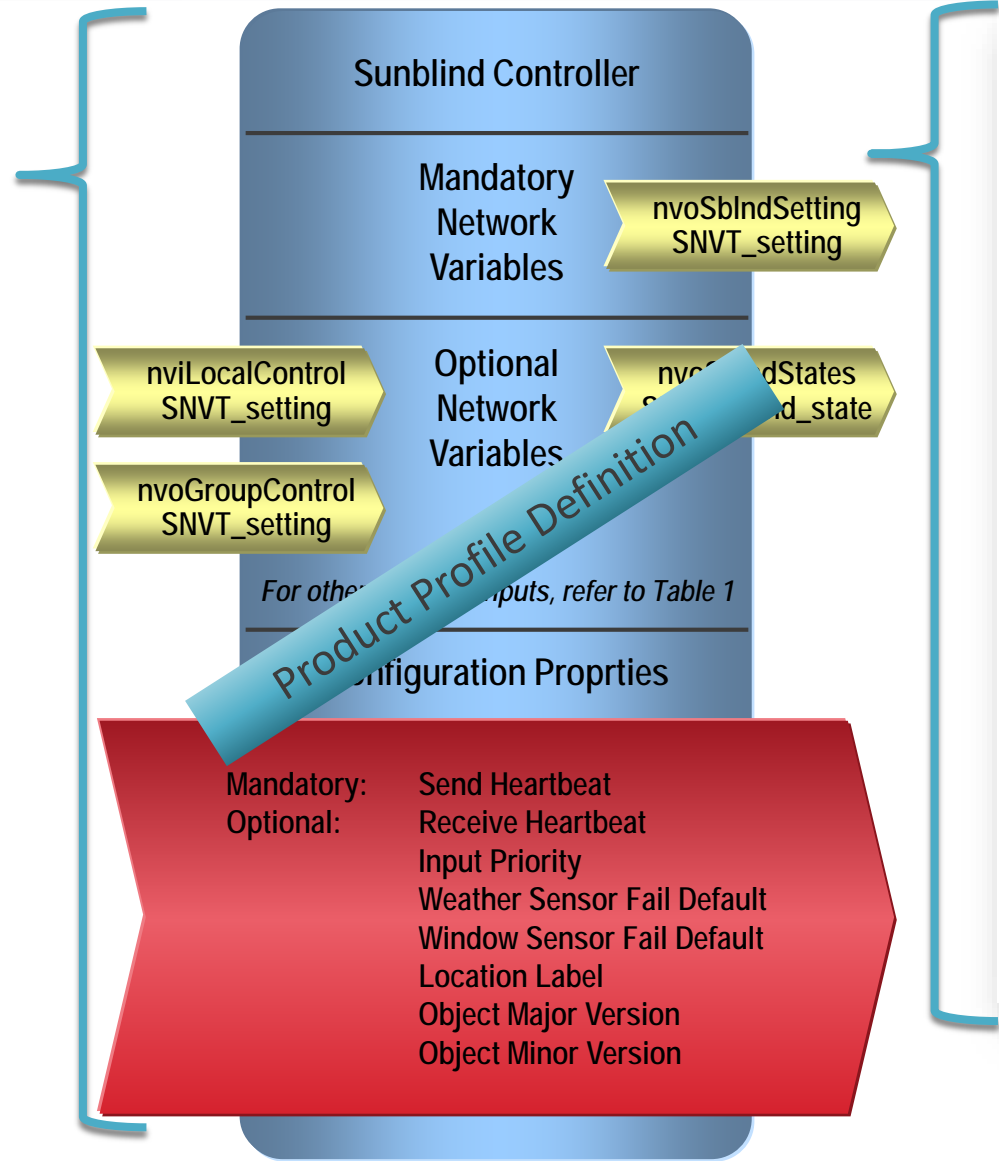
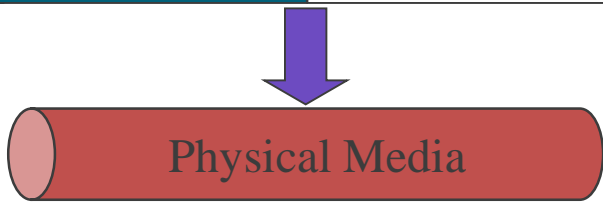


- What does it do?
- How do I install it?
- How do I interface to it?
- How do I configure it?
- Where do I find its external interface information?
- How do I address it?
- What can it tell me?
- How do I control it?
- What is its current status?

# Well Defined Product Interface – Profile

7 Layer OSI Model		
7	<b>Application</b>	Program
6	<b>Presentation</b>	Network Variables
5	<b>Session</b>	Network Management
4	<b>Transport</b>	Message Service
3	<b>Network</b>	Addressing and Routing
2	<b>Data Link</b>	Media Access
1	<b>Physical</b>	Physical Connection

Common Communication Protocol



# ANSI/CTA 709.6 - 153 Device Profiles

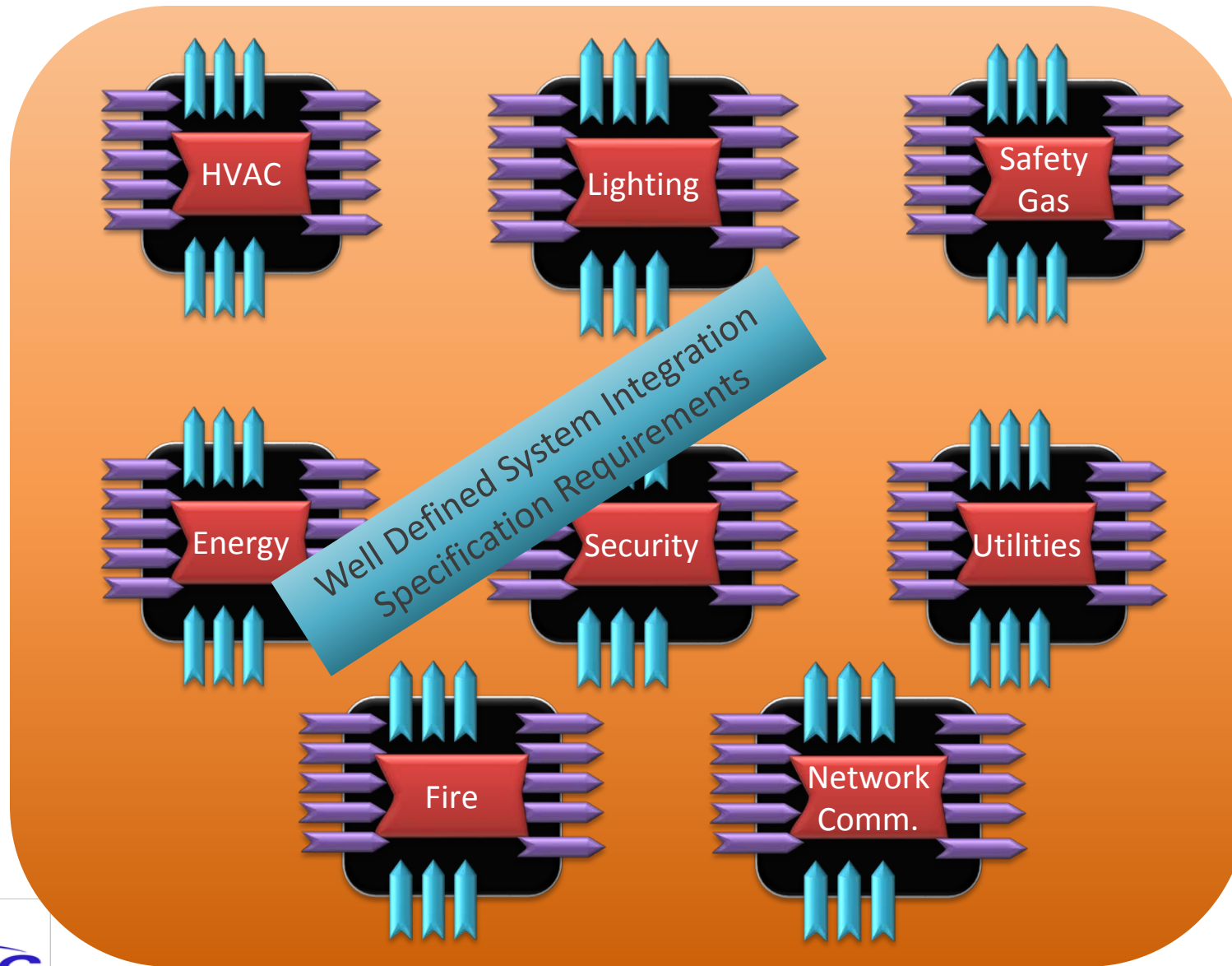
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SFPTactuateDriveFan  
SFPTactuateLight  
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SFPTactuateTemperatureSetpoint  
SFPTairQualityControl  
SFPTairQualityMeasurement  
SFPTairTemperatureSensor  
SFPTairVelocitySensor  
SFPTanalogInput  
SFPTanalogOutput  
SFPTaudibleFireIndicator  
SFPTautomaticLightController  
SFPTautomaticSolarControl  
SFPTautomaticThermalControl  
SFPTautomaticTransferSwitch  
SFPTautomaticTwilightControl  
SFPTboilerController  
SFPTcalendar  
SFPTchannelContinuityMonitor  
SFPTchannelMonitor  
SFPTchilledCeilingController  
SFPTchiller  
SFPTclosedLoopActuator  
SFPTclosedLoopSensor  
SFPTclothesWasherDomestic  
SFPTco2Sensor  
SFPTconstantLightControl  
SFPTconstantLightController  
SFPTcontrolDriveActuator  
SFPTcontrolDriveActuatorFan  
SFPTcontroller  
SFPTcontrolRoomUtilisationTypes  
SFPTdamperActuator  
SFPTdataLogger  
SFPTdaylightDependentLighting  
SFPTdeviceMonitor  
SFPTdewpointMonitoring  
SFPTdischargeAirController

SFPTelevatorArrivalGong  
SFPTelevatorDirectionLantern  
SFPTelevatorFireSystemsPort  
SFPTelevatorHallLantern  
SFPTelevatorPositionIndicator  
SFPTelevatorVoiceAnnouncer  
SFPTenergyModeSelection  
SFPTenergyModeSelectionWithStartOpt  
SFPTentryExit  
SFPTfanCoilUnit  
SFPTfanControl  
SFPTfireSmokeDamperActuator  
SFPTfrostSensor  
SFPTfunctionSelection  
SFPTgeneratorSet  
SFPTglobalSolarRadiation  
SFPThardwiredFireAlarmShutdown  
SFPThardwiredFullVentilation  
SFPThardwiredGasDetectionShutdown  
SFPThardwiredRecirculation  
SFPThardwiredSafetyInstrumentedSystem  
mSIS  
SFPTheatPump  
SFPT HVACRelativeHumiditySensor  
SFPT HVACTempSensor  
SFPT HVACValvePositioner  
SFPTidentifierSensor  
SFPTisiKeypad  
SFPTisiLampActuator  
SFPTisiMonitorPoint  
SFPTisiOccupancySensor  
SFPTisiSunblindActuator  
SFPTlampActuator  
SFPTlightActuator  
SFPTlightControl  
SFPTlightingPanelController  
SFPTlightSensor  
SFPTmanipulatedValueLimiting  
SFPTmodemController

SFPTnightTimeCooling  
SFPTnodeObject  
SFPToccupancyController  
SFPToccupancyEvaluator  
SFPToccupancySensor  
SFPTopenLoopActuator  
SFPTopenLoopSensor  
SFPToutdoorBrightnessMeasurement  
SFPToutdoorLuminairController  
SFPTpartitionWallControl  
SFPTpartitionWallController  
SFPTprecipitationDetection  
SFPTpresenceDetection  
SFPTpressureSensor  
SFPTpriorityControl  
SFPTpullStationFireInitiator  
SFPTpumpController  
SFPTrailcarAudioController  
SFPTrailcarAudioSensor  
SFPTtrainSensor  
SFPTrealTimeBasedScheduler  
SFPTrealTimeKeeper  
SFPTrefrigDisplayCaseControllerDefrost  
SFPTrefrigDisplayCaseControllerEvaporator  
SFPTrefrigDisplayCaseControllerThermos  
SFPTroofTopUnit  
SFPTroomBrightnessMeasurement  
SFPTroomSupplyAirTemperatureMC  
SFPTroomSupplyAirTemperatureSC  
SFPTsccAHU  
SFPTsccChilledCeiling  
SFPTsccCommandModule  
SFPTsccFanCoil  
SFPTsccHeatPump  
SFPTsccRadiator  
SFPTsccRooftop  
SFPTsccSelfContained

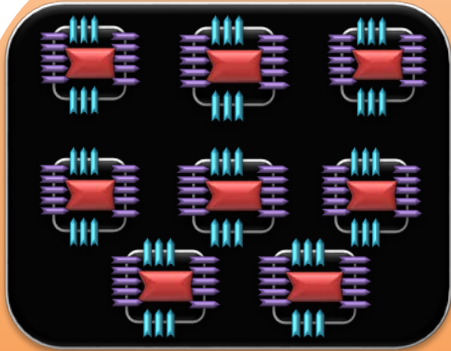
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SFPTshadowCorrection  
SFPTsignalPresence  
SFPTsinglePhaseSubMeter  
SFPTslatTracking  
SFPTsmartLuminaireController  
SFPTsmokeFireInitiatorConvent  
SFPTsmokeFireInitiatorIntelli  
SFPTspaceComfortController  
SFPTstairwellLightControl  
SFPTstaticProgrammable  
SFPTsunblindActuator  
SFPTsunblindController  
SFPTsunshadeActuator  
SFPTswitch  
SFPTtelephoneDirectory  
SFPTtemperatureControl  
SFPTthermalFireInitiator  
SFPTthermostat  
SFPTtimeProgram  
SFPTtwilightControl  
SFPTunitHeater  
SFPTunitVentilatorController  
SFPTuniversalFireIndicator  
SFPTuniversalFireInitiator  
SFPTutilityDataLoggerRegister  
SFPTutilityMeter  
SFPTvariableAirVolume  
SFPTvariableSpeedMotorDrive  
SFPTvisibleFireIndicator

# System Testing – Building Example

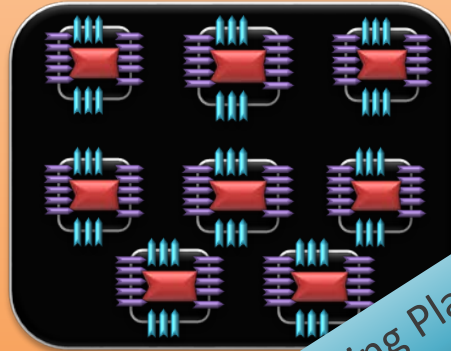


- Interoperability
- Subsystem to Subsystem Integration
- Network Communication
- Peer-to-Peer
- Supervisory System
- Graphical User Interface
- Alarm Management

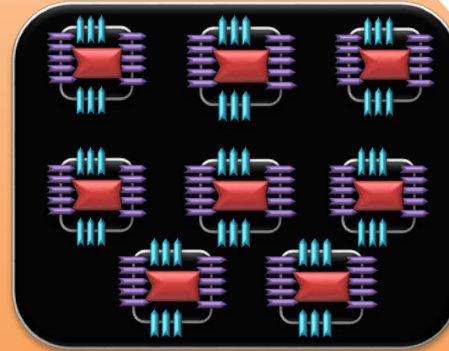
# Testing and Certifying Enterprise Systems



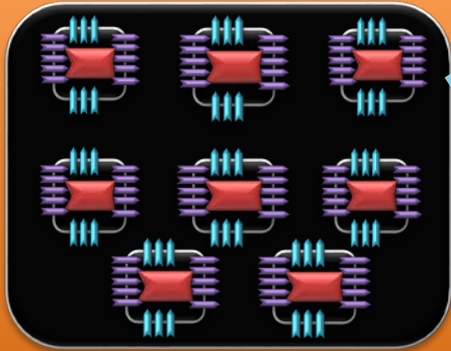
Campus 1



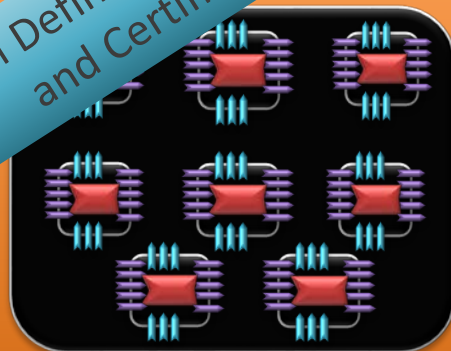
Campus 2



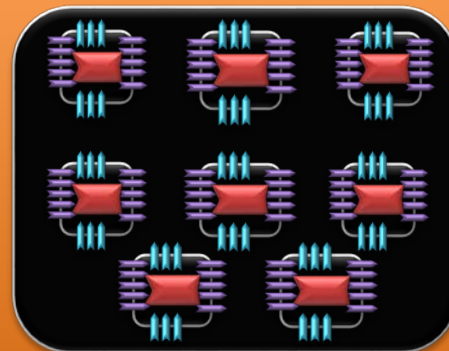
Campus 3



Remote Site 1



Remote Site 2



Campus 4

Well Defined Commissioning Plan  
and Certification Process

- Convert Data to Information
- Contextual, Temporal, Location
- Historical/Real-Time
- Shared Information
- Common Infrastructure
- Operations and Maintenance Focused
- Documentation and Training



# Testing and Certifying People

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## Who

- Product Designer
- System Designer
- Integrator
- Maintenance
- Operations
- Management

## What

- Proficiency
- Professional Credential
- Qualifications
- Subject Matter Expertise
- Skills and Abilities

## How

- Training classes
- Hands On Experience
- Online/Lecture
- Credentialing Test
- Continuous Education

# Professional Credentials



Specified in project criteria  
Verifiable online  
Continuous enhancements to programs

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# THANK YOU!

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# IEEE Conformity Assessment Program (ICAP) – Test Program Development

Value Proposition for Testing & Certification

Ravi Subramaniam

July 9, 2018

# The IEEE Standard's Lifecycle

The IEEE Conformity Assessment Program (**ICAP**) is part of Standards Implementation within an IEEE Standard's Lifecycle.

Conformity Assessment can take the form of Product Certification, Commissioning, Interoperability, Accreditation, etc.



## Conformity Assessment

- Provides assurance and confidence a product or service meets requirements
- Empowers the user to make better purchasing decisions
- Benefits the supplier as products may gain market acceptance

# Evolution of Conformity Assessment Programs

- How do Testing & Certification Programs get formed within IEEE?
  - Spurred by a stakeholder community
  - Testing requirements implemented within standards
  - Emphasis on Interoperability
- Challenges to stand up a testing, certification & interoperability program
  - Establishing the value proposition “Demand Driver”
  - Expertise does not exist within standards working group
  - Programs take time & resources to develop
- IEEE Certification Committees
  - Program specific committees (volunteer-driven) lead T&C initiative
  - Advise ICAP on specific program elements
  - Act as advocates for the testing and certification program



# Why Certification is important?

- ARRA funded deployment of Synchrophasor technology
- NIST.IR.8106 indicated 8 out of 10 PMUs tested were not compliant to IEEE Synchrophasor Measurement TSS.
  - Tested to M & P class settings under various configurations
  - Test Program allowed for vendors to improve products and resubmit for testing – results are reflective of improvements
  - PMU performance varies significantly from model to model, configuration to configuration
- Testing and Certification helps differentiate between compliant and non-compliant PMUs
  - IEEE initiated the Synchrophasor Conformity Assessment Steering Committee
- Uncovers gaps in standards (TSS) allowing for improvement and revisions to standard
- Ability to operate applications that utilize PMU data as inputs more confidently
- ***TRUST BUT VERIFY***

# IEEE – Conformity Assessment Program (ICAP)

## Power and Energy Portfolio:

- Phasor Measurement Unit (PMU) – IEEE C37.118
- PTP Power Profile – IEEE C37.238
- COMTRADE - IEEE C37.118
- Distributed Energy Interconnection – IEEE 1547/1547.1
- Smart Energy Profile – IEEE 2030.5
- IEEE Nuclear Equipment Standards – IEEE P60780 – 323
- EV Charging – IEEE 2030.1.1





# Thank You!

IEEE Conformity Assessment Program

<http://standards.ieee.org/icap>

**Ravi Subramaniam**

r.subramaniam@ieee.org

# Benefits of Implementing a Conformity Assessment Program

- Benefits of conformance test before deployment implementation
  - Early identification of non-conformances
  - Exact functionality of the protocol is identified
  - Multi-vendor solutions will have interoperability issues – helps identify such issues
  - New offerings will have bugs – helps to catch to catch them
- Reduces the vendor's cost / need for re-tests for different end-users
- Establishes a baseline for performance expectation
- Eases interoperability
- Transparency based on common implementation / Test Authority

# C37.118 - Synchrophasor Certification Program

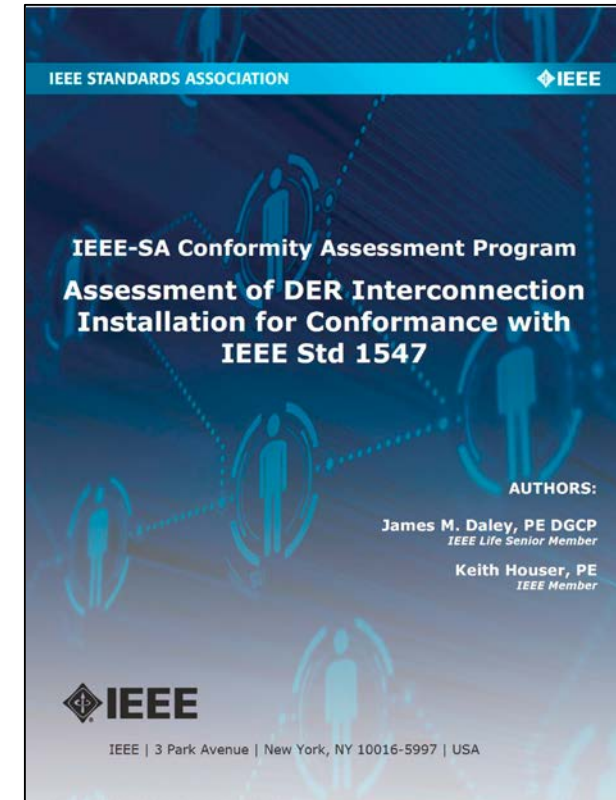
- Purpose of the program is to enable PMU Manufacturers to demonstrate conformance to IEEE C37.118.1a – 2014
- Three certified PMUs to the 2014 version of C37.118 on the ICAP Certified Registry.



- Revision of the *IEEE Synchrophasor Measurement Test Suite Specification* (TSS) coming soon in order to align with updated standard
- IEEE PMU Certification Pricing guide available on line for testing and certification fees. [http://standards.ieee.org/about/icap/icap\\_form.html](http://standards.ieee.org/about/icap/icap_form.html)
- Consumers Energy (Jackson, MI) was the first ICAP Accredited Lab and offers complete testing capabilities to the TSS
  - More Info on Consumers Energy at [www.laboratoryservices.com](http://www.laboratoryservices.com)

# 1547 Commissioning Conformity Assessment

- ICAP has completed two IEEE 1547 Commissioning Pilot's that showcase the CA program's Commissioning Template and Checklist's in-depth review of the DER Interconnection's ability to meet the requirements of IEEE 1547.
- The program is led by a Steering Committee representing all facets of the DER community.
- Recently published White Paper summarizing the IEEE 1547 Commissioning Conformity Assessment Program and how it relates to the current 1547 efforts.
  - Available on the [ICAP Website](#)
- IEEE 1547 Workshops
  - Minnesota Public Utilities Commission and the Organization of MISO – March 2018.
    - Content and discussion geared toward Regulators and Policy making for IEEE 1547
  - Additional Workshop conducted with FERC in Washington, D.C. (Aug. 2017) and PacifiCorp in Portland, OR (Oct. 2017)
  - Presentations included IEEE 1547 experts from NREL, NERC, EPRI, National Grid, and IEEE
- Revision IEEE 1547-2018 was published April 2018 – [IEEE Xplore](#) and [Techstreet](#)

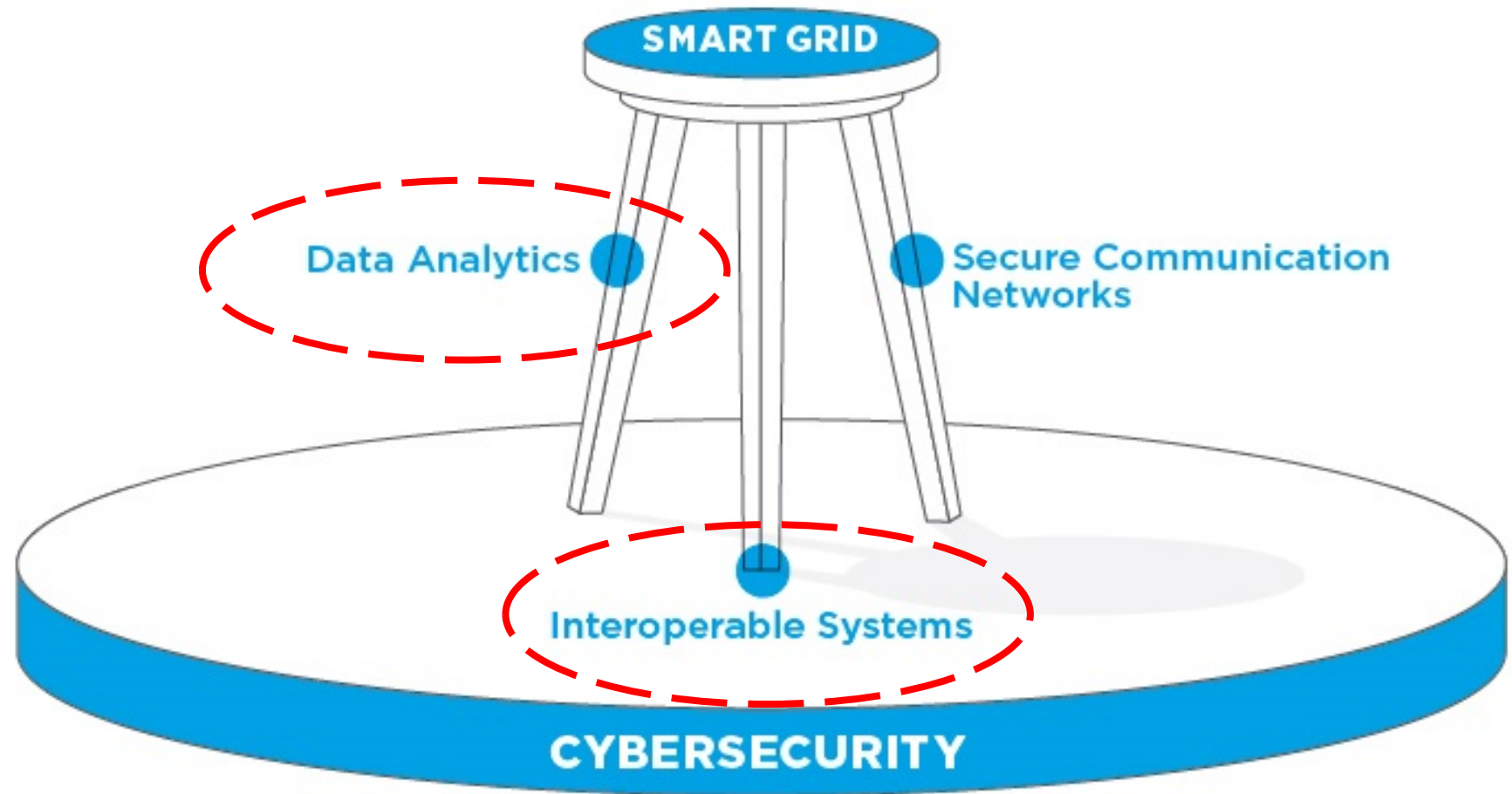


# Enabling Distribution Optimization Through MultiSpeak

*Yesterday, Today & the Future*

Alvin Razon, Senior Director Distribution Optimization

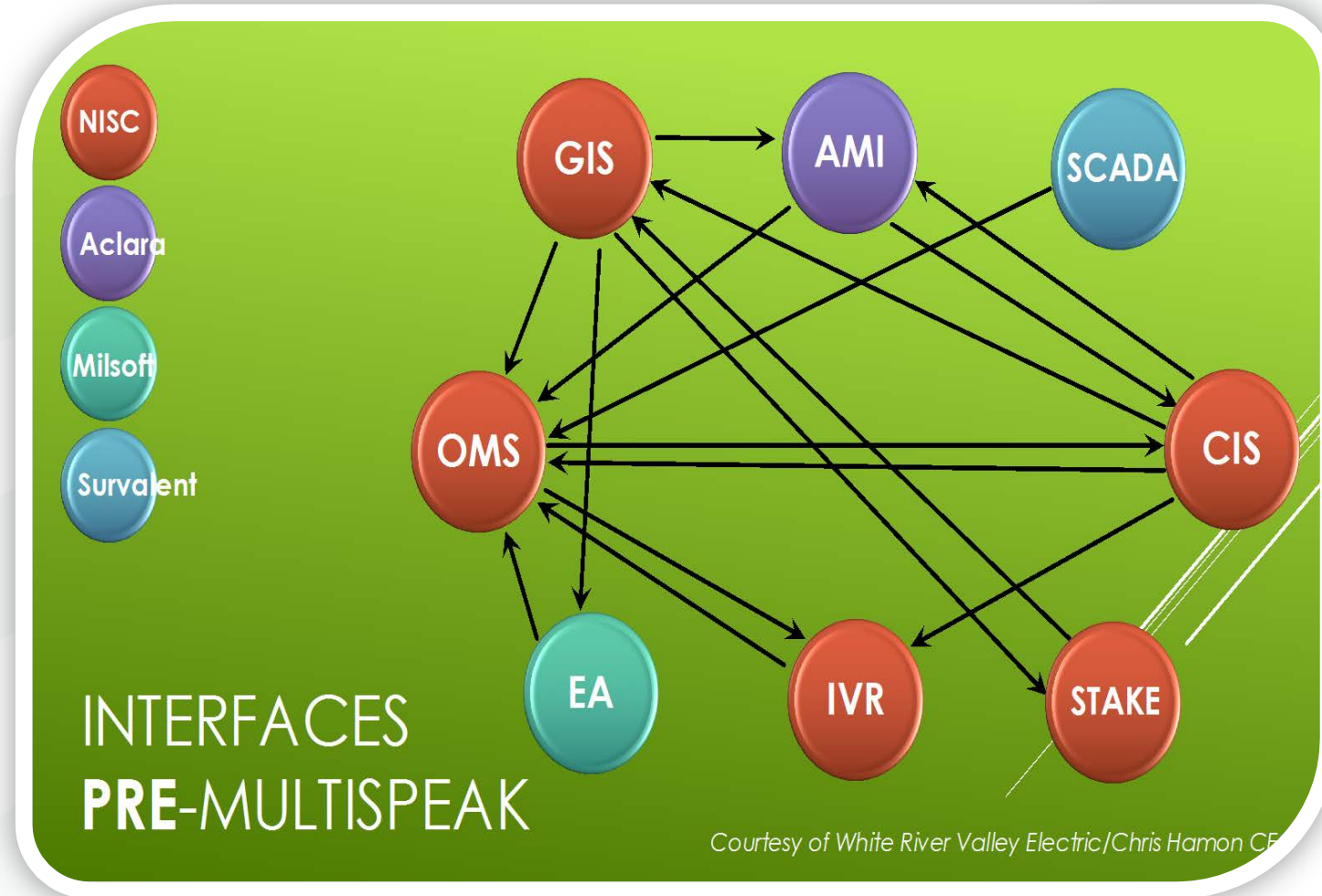
# Foundational Attributes of Future Grid



DSO functionality is built on the Smart Grid concept supported by Data Analytics, Secure Communication Networks and Interoperable Systems. All resting on a solid base of Cybersecurity.

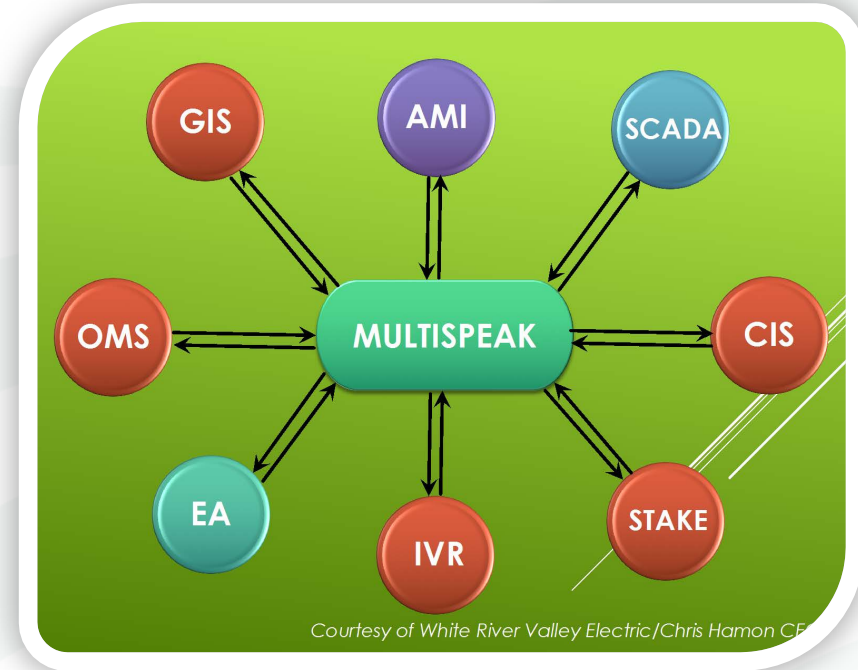
# YESTERDAY: Expensive & Unsecured Custom Interfaces

- Expensive Custom Integration (**\$300 per line of code**)
- **\$3Billion** out of \$9B DOE ARRA Grant Spent on **Custom Interfaces**
- Potential **Attack Vector** for each Custom Interface
- **Unsecured!** No Testing & Certification



# TODAY: NRECA Distribution Optimization (DO) Team

Ecosystem of Practical Solutions  
"Enabling Value of DATA"



1. SAFETY  
IEEE 1547, NESC, NEC, TDEC,  
Cybersecurity, Testing &  
Certification

2. Distribution Reliability  
SAIDI Outages, Power  
Quality, Data Analytics,  
Reliability Benchmarking,  
DER, Dynamic  
Planning/Operations

3. Cost Effective Integration  
MultiSpeak connectivity,  
De-Risking Technology  
Integration, Innovative  
Apps/Tools





# MultiSpeak: ECOSYSTEM of Solutions



## *DE-RISKING Technology Integration*

- **Used by 800+** Utilities in **21+ Countries** Worldwide
- Cost-effective, Real-time, Cybersecure, Scalable, Testable & Certifiable

# What's in it for YOU?

## Increasing VALUE to our members – Online WEB PORTAL

### i3MS Membership Management System with Credit Card Payment (**NOW LIVE!**)

The screenshot shows a web portal interface with a navigation bar at the top containing 'Subscription', 'Payment', 'Confirm Payment', and 'Receipt/Invoice'. Below the navigation bar are four membership options, each in a colored box with a 'Subscribe' button at the bottom.

Membership Type	Price	Description
Vendor Membership	\$5,000/year	Access to the latest developments in the specification – non-members have access only to older, public releases. Early access permits quicker time-to-market with MultiSpeak-compatible products.
Auditing Membership	\$1,200/year	Auditing membership is: (i) \$1,200/year, or (ii) \$400/year for NRECA voting members that are not software vendors or utilities.
Utility Membership	\$500/year	Utility Membership is \$500/year for NRECA voting member electric cooperative utilities and \$1,200/year for non-members.
Sponsorship		For trade organizations or governmental entities that may wish to provide significant funding to advance the MultiSpeak specification.

### Online (E-learning) Video Training (2018)



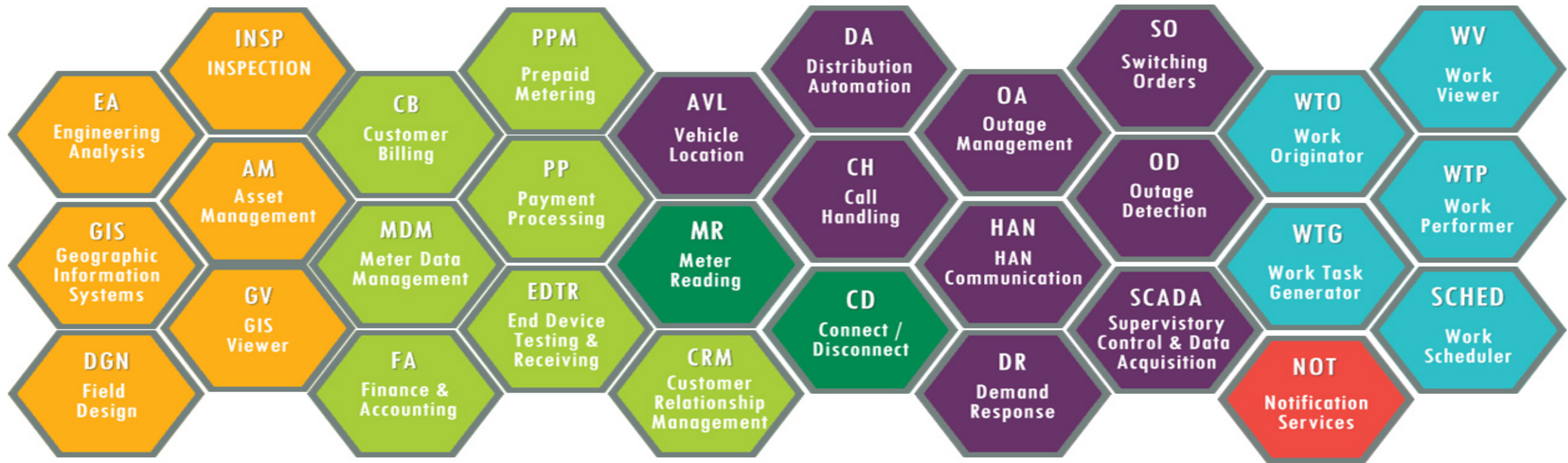
### Online Testing Harness Beta (2018)



### INTERNATIONAL Membership



# Increasing VALUE to our members



**MultiSpeak Marketplace, MultiSpeak Ecommerce Store & More...  
2018**

# Use Case Studies

## Value of Enabled MultiSpeak® Processes

- **WIN Energy**

- CIS to Staking = \$4,000/yr Savings
- AMI to CIS = \$6,000/yr
- AMI to OMS = \$60,000/yr
- GIS to CIS = \$3,000/yr

- **Wake EMC**

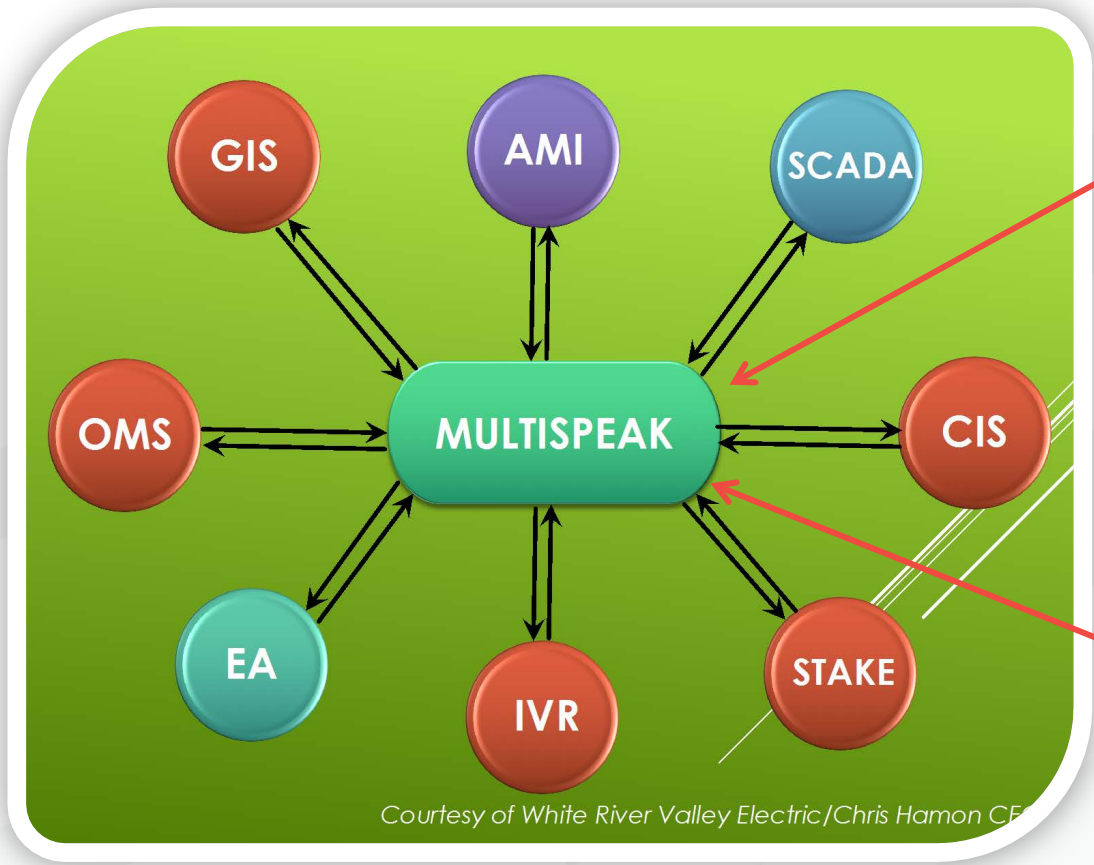
- AMI to CVR = \$658,000/Yr Savings

- **More MultiSpeak® story to come....**



# FUTURE “Tomorrow” (DO):

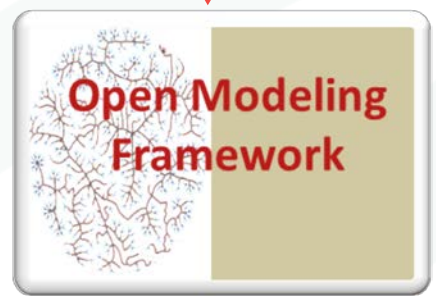
Interconnected systems ENABLING Real-Time 2 way DATA and ENERGY



Courtesy of White River Valley Electric/Chris Hamon CE



GridState



**VALUES & BENEFITS:** *Reduction of Losses in Capital Expenses, Outage/Restoration Cost, Custom Integration Cost, Cybersecurity and Resiliency*

# Backup

# JOIN the MultiSpeak® Family!

**Alvin Razon** [alvin.razon@nreca.coop](mailto:alvin.razon@nreca.coop) 1-703-217-2199

*Senior Director – Distribution Optimization*

4301 Wilson Blvd.

Arlington, VA 22203

Visit NEW website [www.MultiSpeak.org](http://www.MultiSpeak.org)



# Utility CEO's CONCERNS & Feedback!

- **CONCERNS:** “*De-risking Technology Integration, Cost Avoidance, Compatibility, Risk Mitigation & Cyber Security*”
- “By utilities investing in MultiSpeak today, we are **securing OUR Technology Integration & Cyber Security** challenges of tomorrow”
- “**Invest Now** and Avoid **expensive Retrofits** tomorrow”
- “MultiSpeak is **like electricity**, the value is NOT realized until it TURNS-OFF”



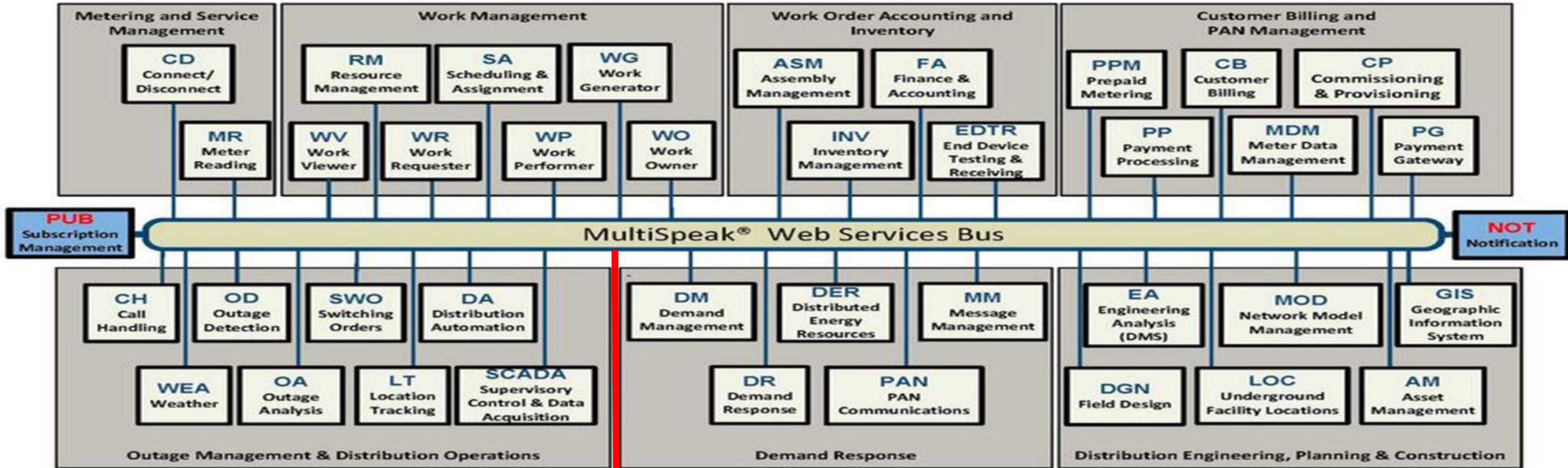



# New V5 Testing and Certification

- New T&C program is **Function Set** based
  - **Comprehensive** Interoperability Testing
  - Eliminate time consuming **Pair-Wise** testing
  - Provide Tech Support (use case library) via **new Web Portal**
  - **Reduce Cost - Man Power & \$ Money**
- Beta Version by Q3 2018
  - Complete **function sets/Business process**, not individual methods
  - **Use Cases with Complete Testing Requirements**
- **Tested & Certified products & vendors** **posted** at [MultiSpeak.org](http://MultiSpeak.org)



# Cybersecurity for ICS





JULY 10, 2018

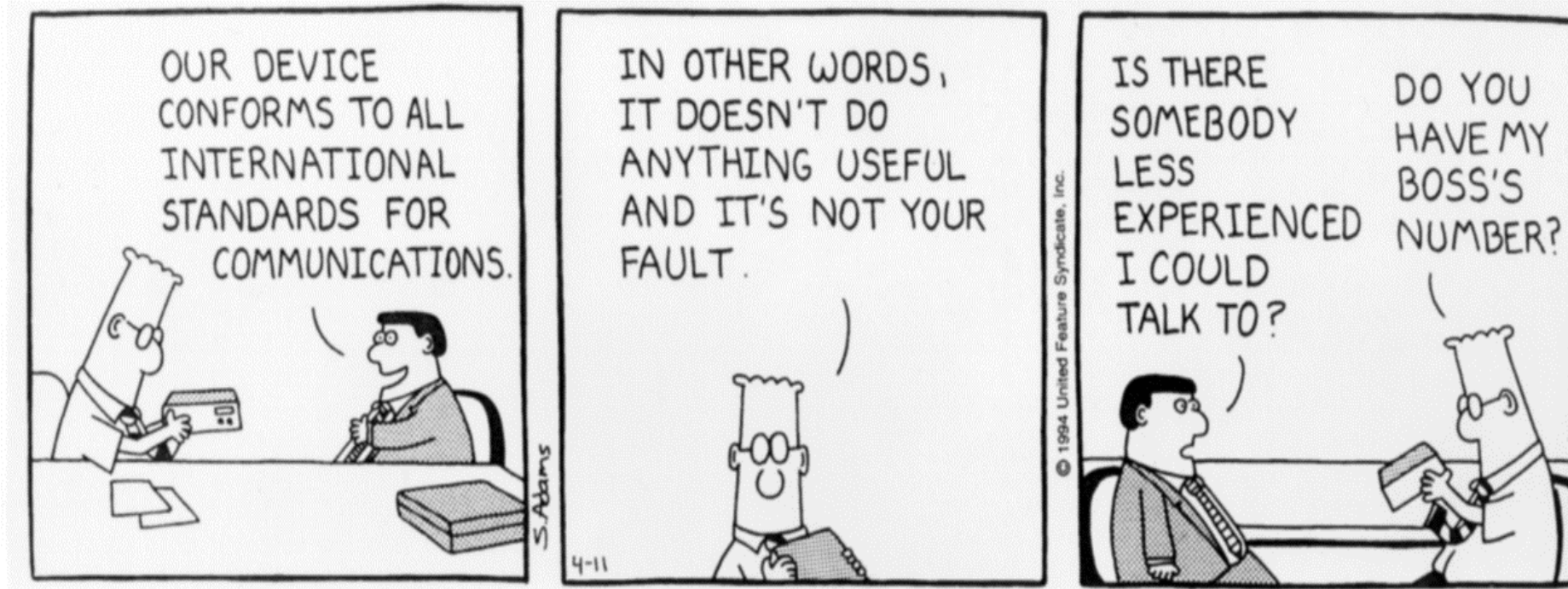
**ABB**

Interoperability – Testing and Certification

**Howard Self**



# Interoperability Goals



## IEC 61850 – Interoperability Goals

*The goal of the IEC 61850 series is to provide interoperability* between the IEDs from different suppliers or, more precisely, between functions to be performed by systems for power utility automation but residing in equipment (physical devices) from different suppliers.

Interoperable functions may be those functions that represent interfaces to the process (for example, circuit breakers) or substation automation functions such as protection functions.

61850-7-1 © IEC:2011



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## ABB System Verification Center (SVC) – Why do we test?

- Ensure a common understanding for the system integration of products
- Ensure a common understanding for the engineering process based on system tools and product native tools
- Aim at a consistent philosophy within systems & products
- Identify and document gaps between system requirements and product deliveries
- Improve the quality of the system solution in architecture, integration and performance
- Decrease demand for specialized expertise within a system project
- Build up integral know how in testing and system integration of third party products
- Reduce the negative financial impact on project execution when using new or updated technology in customer projects

## What test should be run?

Conformance Type Test

Product System Test

System Verification & Validation

### ***Stand-alone Product test***

- Performance test for local functions like:
  - Trip times
  - VRT/FRT

### ***Single Product Verification in a small, stable system***

- Baseline set of tests performed to assure the product integration into a system does not impact system performance
- Conformance against the standard (IEEE, UL, DNP, IEC 61850, etc.)

### ***System integration test in a reasonably large system***

- Long-term stability test
- Engineering integration tests
- Engineering guideline tests
- Network loading
- Functional applications
- Startup time
- Time synchronization

**ABB**