MESA-DER Workshops:
The MESA-DER Profile: IEEE 1815 (DNP3) Key Elements and Comparison with IEEE 2030.5 and Sunspec Modbus

May 31, 2023

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Today’s Presenters

Mark T Osborn, MESA Standards Alliance

Mark T Osborn has extensive energy industry experience developing and managing solar and energy storage projects. Mark is currently focused on the mission to improve interoperability and data integrity reporting for DER communications systems. As an adjunct professor at Portland State University, Mark has co-taught “PA573 The Smart Grid and Sustainable Communities” since 2012. His most recent electric utility experience was as Smart Grid Manager for Portland General Electric.

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Ronald J Farquharson, DNP Users Group

Ronald Farquharson is the President and COO of the DNP Users Group and Principal Consultant with Mount Victoria Consulting. He has over 30 years of experience in transmission and distribution automation technologies and standards with focus on data communications, synchrophasor measurement, precision time, and equipment-condition monitoring. As a consultant, Ron has served many utilities in planning the adoption of a wide range of technologies. He is a Senior Member of the IEEE, Chairs two IEEE working groups (IEEE Std 1815™ and IEEE 1815.1™), was past Technical Champion of NIST SGIP Priority Action Plans and serves on the Advisory Committee for DistribuTECH.

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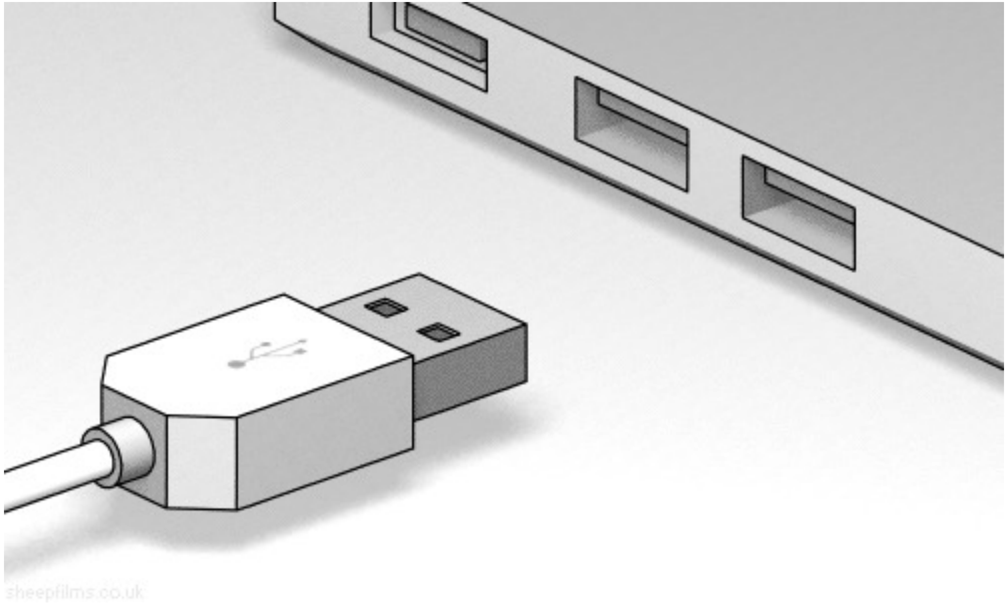
Why Standards?



Animation Courtesy of: **Filippo Sergenti**

Interoperability:

The capability of two or more networks, systems, devices, applications, or components to externally exchange and readily use information securely and effectively.

Communication Standards:

Establishes the rules for information interchange.

Communication Protocols:

Formal definition of the rules, syntax, semantics, and synchronization of communication between systems.

Standard Device Profiles:

The formal definition of the functions, point names, services, and operations between systems.

US Interconnection Standards

Transmission System - IEEE 2800-2020 Interconnection Standard

IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems

Distribution System - IEEE 1547-2018 Interconnection Standard

IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

Additions to the 1547 Standard

IEEE 1547.1 Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces

IEEE 1547.2 Application Guide for Interconnecting Distributed Resources with Electric Power Systems

Other. Dots

UL 1741 – Standard for Safety

Inverters, Converters, Controllers, and Interconnection System Equipment for Use with DER

UL 1741 SB updated to reflect the latest 1547.1 test requirements

Notable DR & DER Communication Standards

European Utilities Follow IEC Standards

IEC CIM Common Information Model represents all the major objects in an electric utility enterprise typically involved in utility operations IEC 61970-301

IEC 61850-7-420 Messaging DER control

US Utilities Follow IEEE Standards & Other

IEEE 1547 Requirements

1. IEEE 1815 (DNP3) - SCADA control of DER
2. Modbus – SCADA control of DER
3. IEEE 2030.5 – Commands posted for DER to follow - Default for CA utilities

OpenADR - Open Automated Demand Response - In use by many utilities

International Electrotechnical Commission (IEC)
Institute of Electrical and Electronics Engineers (IEEE)

IEEE 1547-2018 - Communication Interoperability Requirements

Mandatory communications capability:

A DER **shall have provisions for** a local DER interface capable of communicating…

Communication performance requirements:

Availability of communication (DER is operating in continuous or mandatory operation region)

Information read response times (≤ 30 secs, maximum amount of time to respond to read requests)

Information to be exchanged:

Nameplate: as-built characteristics of the DERs (read)

Configuration: present capacity and ability of the DERs to perform functions (read/write)

Monitoring: present operating conditions of the DERs (read)

Management: information to update the functional and function settings for the DERs (read/write)

Communication protocol requirements:

Shall support at least one of these protocols …(IEEE Std 2030.5, IEEE Std 1815 App Note, SunSpec Modbus)

Protocols vs. Profile or Maps

Protocols

- Communication protocols set rules for interoperability, describing message syntax, semantics, sets of functions, data types, etc.
- In human interaction, think of English and French as being two protocols with similar functions, but different syntax, etc.
- Different protocols have different rules: It might or might not be possible to exactly translate between them

1. **Modbus** is a factory automation/process control protocol
    - Focused on reporting the current state for the purpose of process coordination, with a single "master" monitoring and controlling multiple controller devices. Simple functions and data types (primarily read and write of binary (0/1) and analog values).
2. **IEEE 1815 (DNP3)** is a SCADA protocol, designed for electric power system applications
    - Focused on reporting all changes (current state and history) from field devices to one or more "masters", in the correct order, with optional time stamping; issues control commands with VERY high integrity (< 1 error in 10^{12}) against incorrect operation irrespective of communication system errors. Multiple data types (binary, double binary, integer & floating-point analogs, counters, strings) for monitoring and direct control.

Protocols vs. Profile or Maps

Semantics

- Modbus and DNP3 both define data types but do not define the semantics (name or meaning) of the data values
- The system integrator is usually free to assign any semantic meaning to the data as required in the specific system

Profiles

- A profile of a protocol defines a subset of the possible protocol data types and functions and may assign specific semantics to the data as appropriate for the specific application
- MESA-DER and SunSpec Modbus are examples of a profile

Standard Profiles

- IEEE P1815.2 will be a standard profile of IEEE 1815 (DNP3)
- A standard profile has been peer-reviewed and approved by an international standards body such as the IEEE
- Standard Profile or “Mapping” can create consistent naming conventions, interpretation, and performance requirements
- Profiles that establish standard semantics and data maps simplify integration and improve interoperability between devices

Some Features of Modbus and DNP3 Protocols

Comparison Summary		
Feature	**Modbus**	**DNP3**
Open Domain	✓	✓
Active Users Group	✓	✓
Active Technical Committee	✓	✓
Comprehensive Certification Procedures	✓	✓
Multiple Data Types	✓	✓
Standardized Data Formats		✓
Time-Stamped Data		✓
Data Quality Indicators		✓
Report By Exception (RBE) — only need to send changes		✓
Unsolicited RBE — Polled or spontaneous operation		✓
2-Pass Control Operations — rejects communication errors		✓

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IEEE 1815™ (DNP3) — Overview

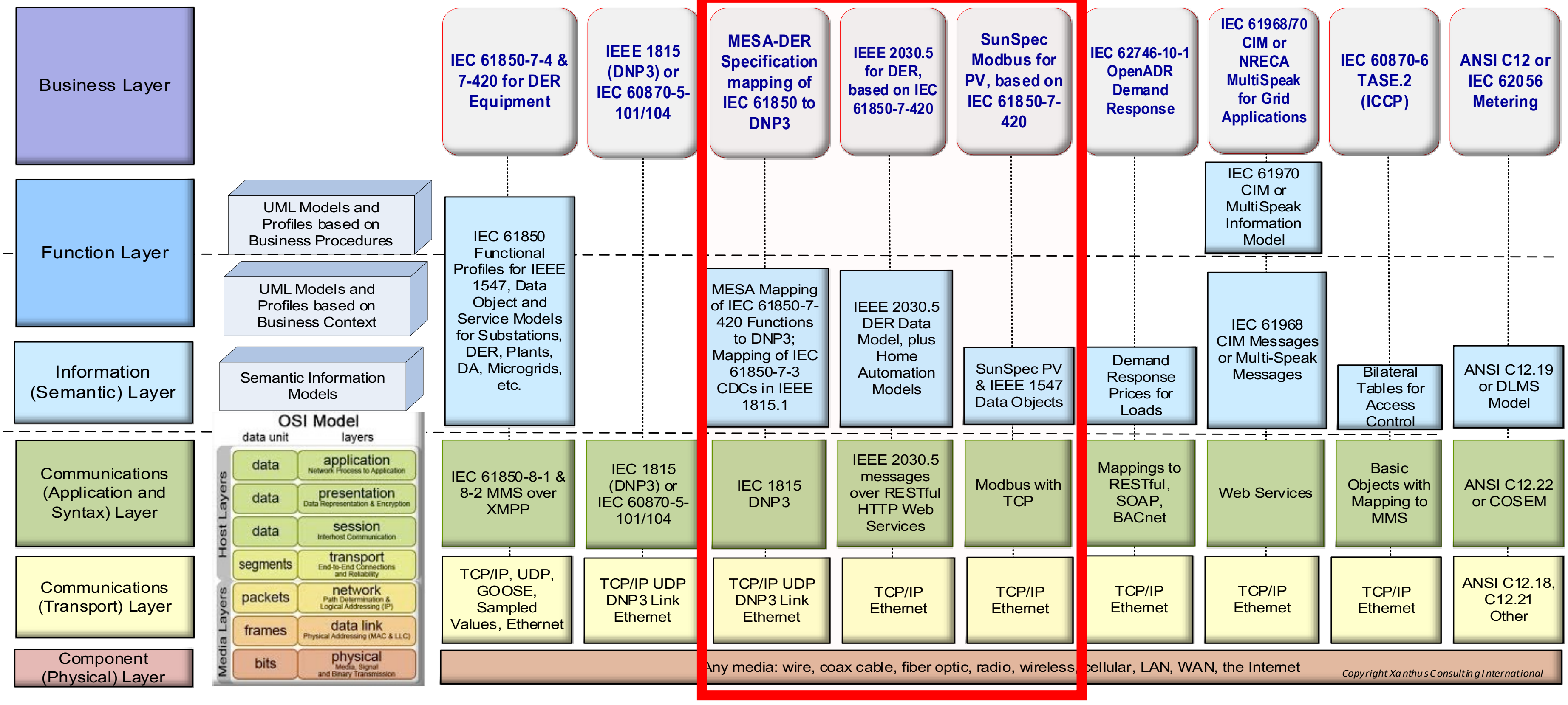
- **A (short) History of DNP3:**
  - Developed in the early 1990s by Westronic Inc. and opened for others for royalty-free use
  - Ownership and responsibility for maintenance were handed to the DNP Users Group, formed in 1995
  - Standardized as IEEE 1815 in 2010 (Intellectual Property still owned and managed by DNP-UG)
- **Key Benefits of DNP3:**
  - Designed as a “superset” of all electric power SCADA functionality in use at the time
  - Focused on high-integrity reporting of time-series event data (a common requirement in electric utilities)
  - Widely adopted in the electric, water, and wastewater utilities and is used elsewhere
  - Direct control center-to-field device; multi-level hierarchical (control center-data concentrator-field device) multi-master-to-field device and device-to-device (peer-to-peer) architectures
  - Monitors a variety of data types (single & double binary, counters, integer, and floating-point analogs, strings) and provides high-integrity (2-pass) commands for binary and analog data
  - DNP3 is highly resilient against typical errors that occur in wide-area communication networks

IEEE 1815 — Why Use DNP3?

- Most widely-adopted SCADA protocol in the North American power industry (~94% of utilities use DNP3)
- Defined mapping to/from IEC 61850 (Substation automation/power system protocol)
- **Designed for highly efficient SCADA data transmission**
  - Layered protocol structure supports very small or very large messages
  - Standard Report by Exception mode of operation significantly improves message efficiency compared to the cyclic "report all" format used by older protocols
  - High integrity message framing, 2-pass control commands, and RBE confirmation process minimize errors and data loss, even under conditions of high communication system errors
- Report by exception for minimal communication loading
- Strong cryptographic message authentication and validation supported since 2007
- Ongoing management and extensions, with a commitment to backward compatibility
- Good interoperability achieved through well-specified test procedures and conformance test review process
- Standard format "DNP3 Device Profile" for vendors to document each device's DNP3 implementation
- Well-specified protocol subsets: Widely-adopted profiles of protocol capability enhancing interoperability

SGAM OSI & UML

Standards for Information Models and Protocols for DER



MESA

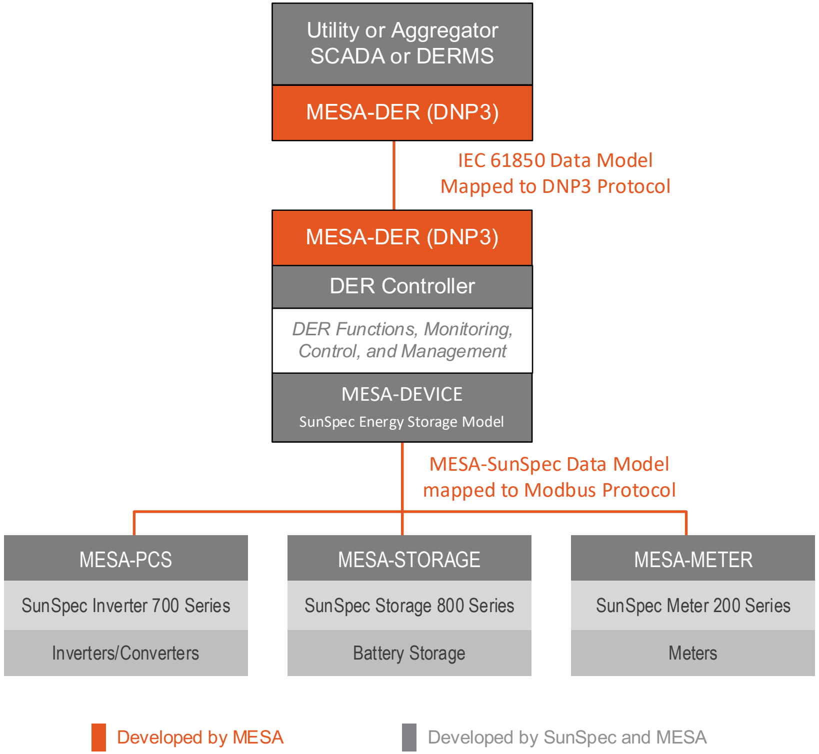
Key DER Standard Device Profiles

- MESA-DER (IEEE P1815.2 / DNP3)
  - Testing & Certification - MESA Standards Alliance
- SunSpec Modbus
  - Testing & Certification - SunSpec Alliance

Note: DNP3 is the popular name for IEEE 1815 communications protocol

MESA Standards Alliance

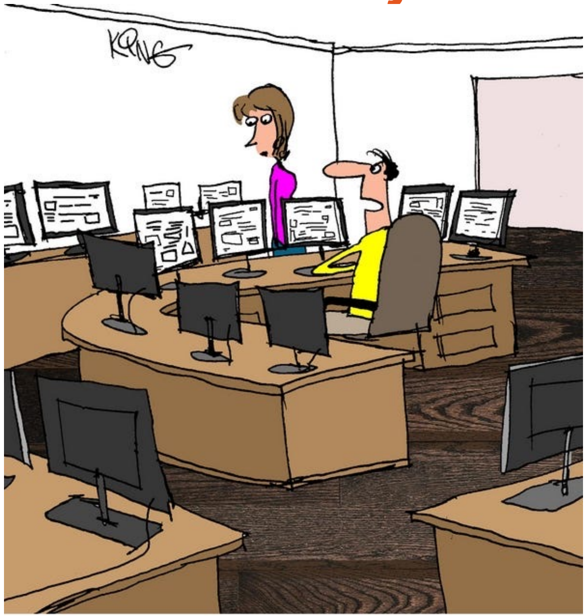
MESA-DER: IEC 61850->DNP3 Data Model for IEEE 1547, California Rule 21, and Market-based Functions



IEEE P1815.2 (MESA Testing & Certification)

- Describes a profile for DER communications using IEEE 1815 (DNP3) protocol as referenced in IEEE 1547-2018.
- Maps a fixed list of DNP3 data points to selected data objects from (IEC) 61850-7-420 Ed2 2021.
- 1815.2 Describes:
  - Standard data point configurations
  - Protocol services and settings for communicating with DER devices
  - Structured communication data objects for any type of DER
  - Structured data objects needed for many DER functions, including those in IEEE 1547-2018.
  - A mapping to detailed equipment-related data objects, primarily for logging and historical purposes.
- Based on the work of MESA (MESA-DER) and the DNP-UG (Application Note AN2018-001, prior application notes and mapping standard (IEEE 1815.1)
- Including updates to the latest version of IEC 61850-7-420
- Involving industry experts from MESA, DNP-UG, IEEE standards participants and IEC standards participants

DERMS Life

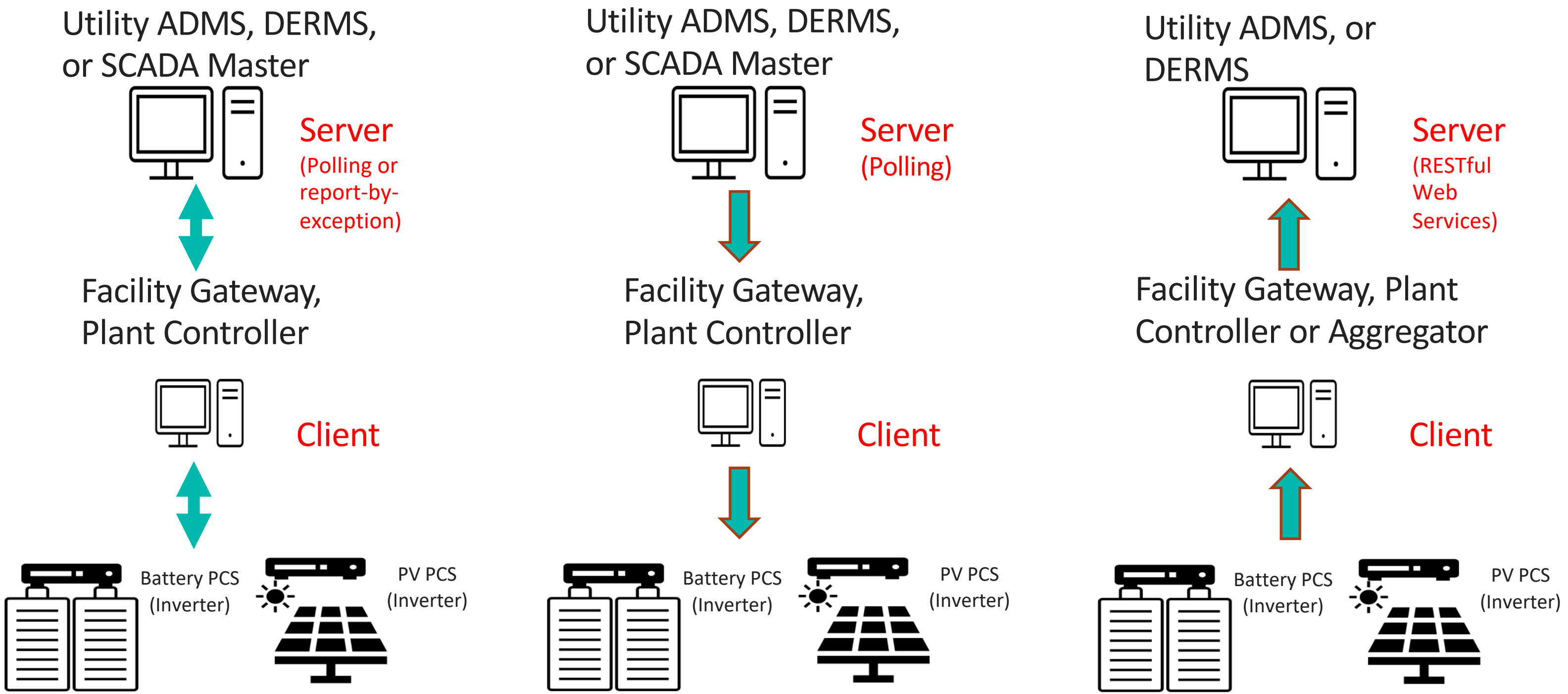


“We should have Standardized with MESA”

MESA-DER (DNP3) Standard

SunSpec Modbus

IEEE 2030.5 Standard



	MESA-DER (DNP3) Standard	SunSpec Modbus	IEEE 2030.5 Standard
Pros:	• Commonly used protocol (94%) • Supports unsolicited messaging • More efficient than Modbus • High integrity messaging • Best Energy Storage Functions Built in • Scheduling fully supported • Supports control / write messages • Available option – secure authentication • Available option – auto-discovery	• Easiest to implement • All inverters speak Modbus, many support SunSpec Modbus • Many low-cost HMIs for self-developed applications	• Device Discovery • Well established processes for working with Aggregators • Very Secure • Transactive Energy operating model rather than direct control
Cons:	• Requires existing investment in DNP3 tech and support personnel • Requires private and secure network – if DNP3 Secure Authentication is not used	• Little or no security in the protocol • Requires private and secure network • Polling many devices may slow operations at scale (high traffic)	• High latency (slow) • DERMs requires the implementation of new web-based client(s) • All communication is done through Internet Technology (HTTP & Data payload XML) • Transactive Energy operating model, not direct control
Use:	Larger scale DERs operated as part of real-time SCADA or NERC transmission connected Dispersed Generation; also Microgrids	Local gateway to inverter control system that supports SunSpec Modbus standard	Internet based, behind-the-meter DER where greater security and group management are required

It's all about DERMS-DER functions…

Note: Modbus can do all the functions, but it must be specially programmed to do so

Key IEEE 1547.1 Functions

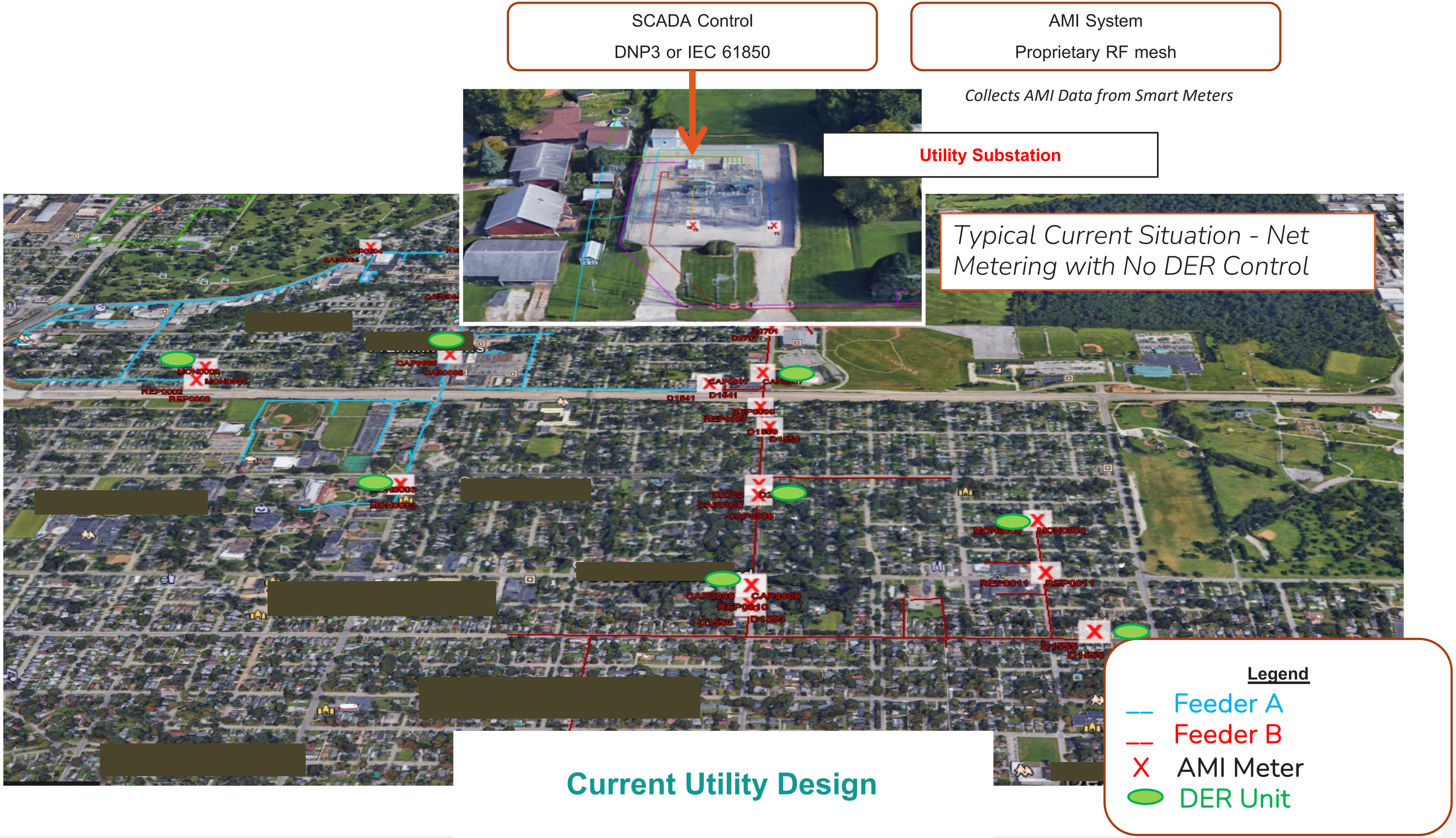
- Low/High Voltage Ride-Through
- Low/High Frequency Ride-Through
- Dynamic Volt-Watt Function
- Frequency-Watt Function (Droop)
- Limit Active Power Function
- Volt-Watt Function
- Constant VArs Function
- Fixed Power Factor Function
- Volt-VAr Control Function
- Watt-VAr Function
- Dynamic Reactive Current Support

Key MESA Functions

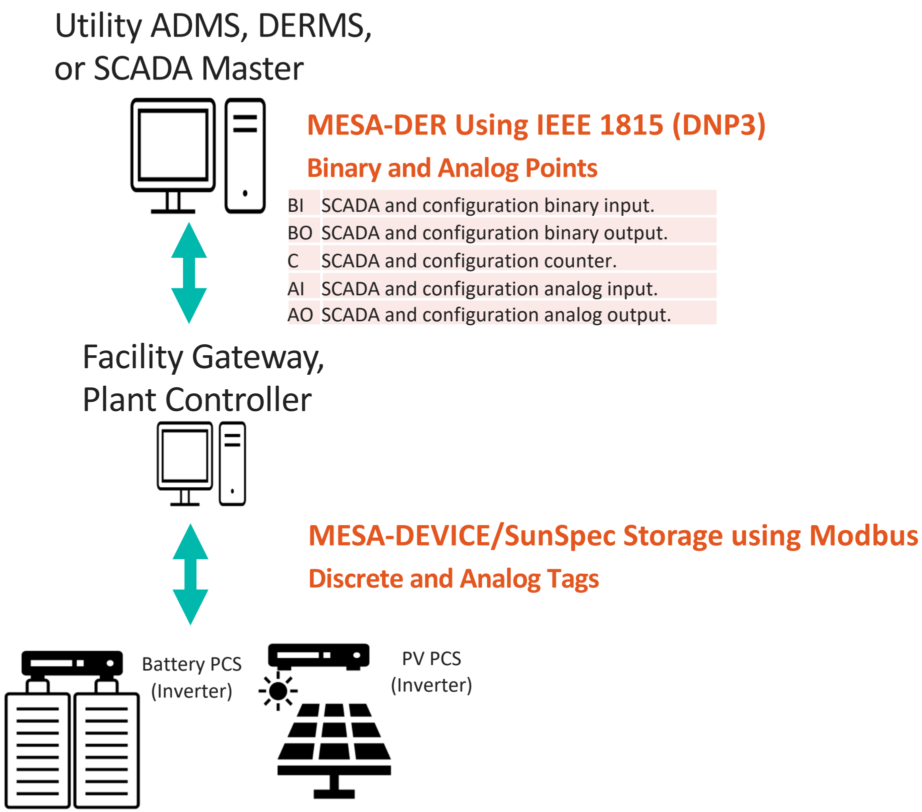
- Scheduling Function
- Charge/Discharge Function (Set Active Power)
- Coordinated Charge/Discharge Function
- Active Power Response Function #1 (Peak Power Limiting)
- Active Power Response Function #2 (Generation Following)
- Active Power Response Function #3 (Load Following)
- Automatic Generation Control (AGC) Function
- Active Power Smoothing Function
- Frequency-Watt "Curve" Function (Artificial Inertia, Fast Frequency Response)
- Pricing Function

Key IEEE 2030.5 Functions

- Scheduling Function
- Aggregator Dispatch Orders
- Demand Response Load Control
- Voltage & Frequency Control
- Dynamic Reactive Power Support - Modifies reactive power based on rate of voltage change.



Current Utility Design

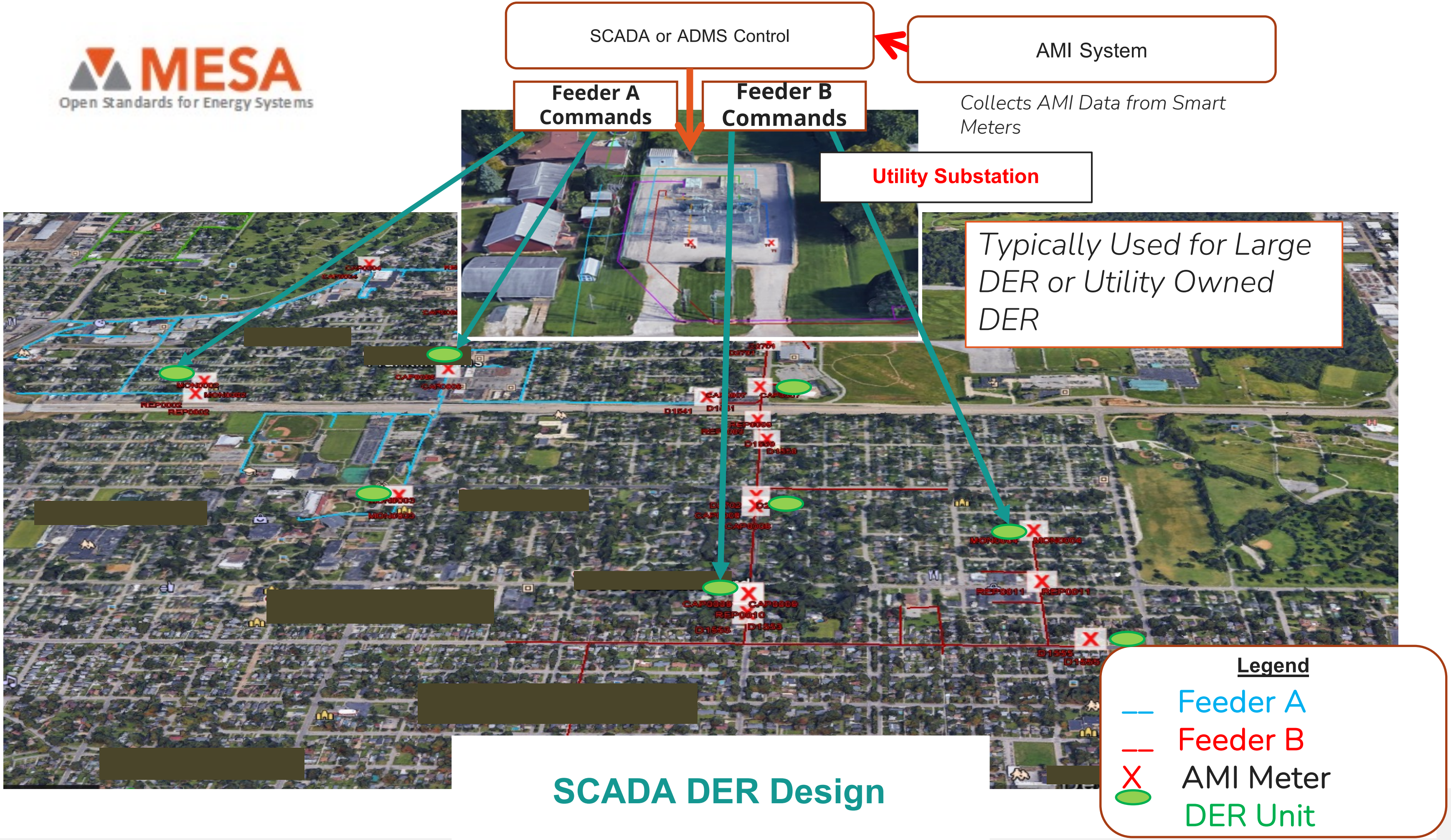


DNP3 utilized by 94% of US Utilities and has been around since 1993

MESA-DER (DNP3) Standard Profile (since 2018) is best suited for larger scale DERs operated as part of real-time SCADA

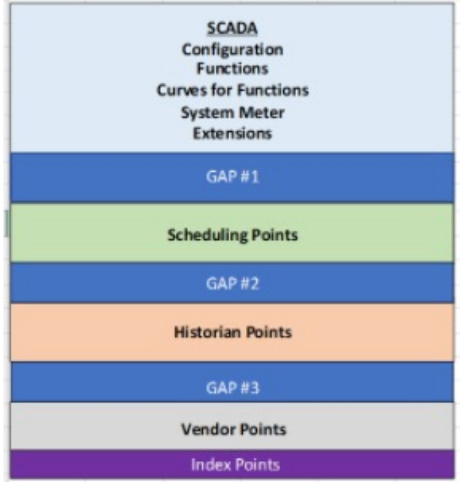
MESA and SunSpec teamed to develop MESA Device models/SunSpec Storage 200, 700 & 800

MESA
Open Standards for Energy Systems



SCADA DER Design

MESA-DER (IEEE P1815.2) Profile Point Table



IEEE 1815.2 Standard Profile Companion Data Point Tables: Version 1.1

DNP3 Points		Index	BO	BI	AO	AI
SCADA						
Configuration & Control Points		0	0	0	0	0
Functions		x	12	31	22	71
Curves	Max of 100 x,y pairs per Curve	x	-	107	244	328
System Meter		x	-	94	449	533
Extensions in IEEE 1815.2-2024		x	42	108	461	569
Gap #1	Reserved for future extensions	x	44	111	476	586
Schedules (SCH)	Max of 100 x,t pairs per Schedule	2000	2000	2000	2000	2000
Gap #2	Reserved for future extensions	3000				
Historical Points						
HM	Start of historical meter points.	5000	5000	5000	5000	5000
HDU	Start of historical DER unit points.	x	5000	5026	5024	5074
HI	Start of historical inverter points.	x	5000	5038	5024	5116
HB	Start of historical battery points.	x	5000	5178	5072	5248
Gap #3	Reserved for future extensions	30000				
Vendor Points (VP)		50000	50000	50000	50000	50000
Index Points	Used for optional Auto Discovery	65000	65000	65000	65000	65000
Maximum Index Value		65535				

MESA-DER (IEEE1815.2) Profile Point Table

Analog Inputs for the Frequency-Watt Function

	A	B	P	R	S	T	U	V
1	**Analog Input DNP3 Point Index**	**Name / Description**	**IEC 61850**	**For Phase 1 Conformance Testing**				
2			**UniqueString**	**Assoc. AO**	**Mandatory: Yes or specific**	**Purpose/Mode/Function**	**1547-2018**	**Supported by EUT?**
3	**System Analog Inputs**							
119	**AI115**	**Frequency-Watt Mode Priority**	DHFW1.ModPrio	**AO57**	Yes	Freq-Watt		
120	**AI116**	**Frequency-Watt Enabling Time Window**	DHFW1.WinTms			Freq-Watt		
121	**AI117**	**Frequency-Watt Enabling Ramp Time**	DHFW1.RmpTms			Freq-Watt		
122	**AI118**	**Frequency-Watt Reversion Timeout Period**	DHFW1.RvrtTms			Freq-Watt		
123	**AI119**	**Frequency-Watt Signal Meter ID**	DHFW1.EcpRef		Yes	Freq-Watt		
124	**AI120**	**Frequency-Watt Frequency Reference Input.** Frequency measurement read from the meter and used as an input to the mode.	MMXU3.Hz		Yes	Freq-Watt		
125	**AI121**	**Frequency-Watt High Starting Frequency.** Delta frequency between start frequency and nominal grid frequency for high frequency events.	DHFW1.HzStr		Yes	Freq-Watt	Yes	
126	**AI122**	**Frequency-Watt High Stopping Frequency.** Delta frequency between stop frequency and nominal grid frequency for high frequency events.	DHFW1.HzStop		Yes	Freq-Watt	Yes	
127	**AI123**	**Frequency-Watt High Discharging / Generating Gradient**	DHFW1.WGra	**AO64**	Yes	Freq-Watt	Yes	
128	**AI124**	**Frequency-Watt High Charging Gradient**	DHFW1.WChaGra	**AO65**	For Storage	Freq-Watt	Yes	
129	**AI125**	**Frequency-Watt Low Starting Frequency.** Delta frequency between start frequency and nominal grid frequency for low frequency events.	DLFW1.HzStr		Yes	Freq-Watt	Yes	
	AI126	**Frequency-Watt Low Stopping Frequency.** Delta frequency between stop frequency and	DLFW1.HzStop		Yes	Freq-Watt	Yes	

Part of name	What it means	Example of an alternative
Logical Device Name	Chosen by the utility	Feeder3
Logical Node Prefix	-- not used in this example --	
Logical Node Class	Metering Measurement Unit	PDIS – Protection, Distance
Logical Node Instance	Feeder number 3	7
Data Name	Phase-to-Ground Voltages	PPV – Phase-to-phase volts
Data Attribute Name	Phase A	PhsB – Phase B Neut – Neutral
Data Attribute Name	Complex value after deadbanding	instMag – Instantaneous value
Data Attribute Name	Magnitude of the complex value	ang – angle in degrees
Data Attribute Name	Floating point value	i – integer value

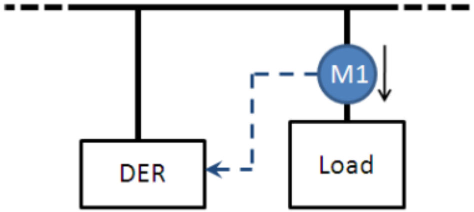
Data Attribute Names – defined in a Common Data Class (CDC)

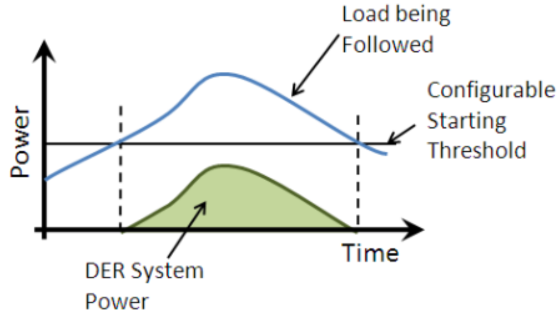
Bay12Unit2/MMXU3.PhV.phsA.cVal.mag.f

Figure 8: Example of an IEC 61850 Name

MESA-DER Functions

Example of Load Following Function





IEC 61850	Description	DNP3 Binary Input	DNP3 Binary Output	DNP3 Analog Input	DNP3 Analog Output
DWFL.ModPrio	Mode Priority			AI 176	AO 115
DWFL.WinTms	Set Time Window			AI 177	AO 116
DWFL.RmpTms	Set Ramp Time			AI 178	AO 117
DWFL.RvrtTms	Set Timeout Period			AI 179	AO 118
DWFL.ECPRefId	Set the Load Following Function Referenced ECP			AI 180	
DWFL.LodFolThsh	Set threshold for starting Load Following			AI 182	AO 120
DWFL.LodFolPct	Set the Load Following percentage as percent of the external real power signal			AI 183	AO 121
DWFL.FctEna	Enable Load Following function and receive response	BI 72	BO 20		

IEEE P1815.2 Update

Testing & Certification Recommendations

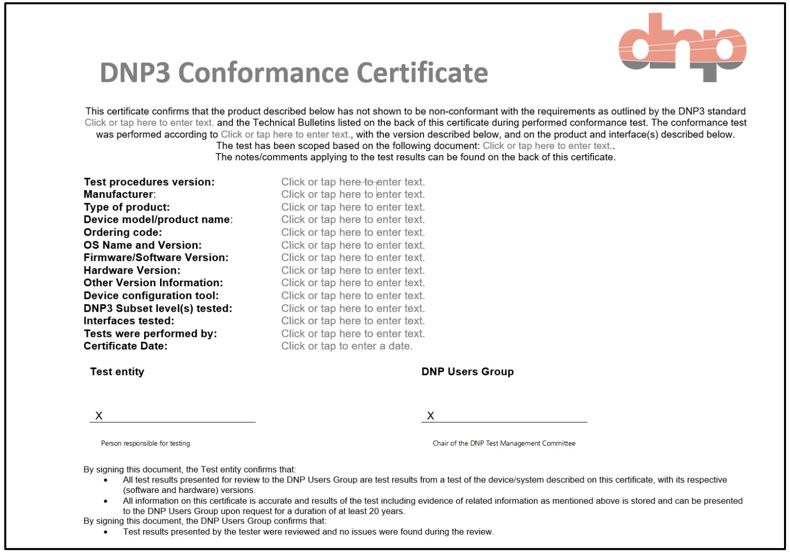
Conformance Certification Program

DNP Users Group – Mission and Activities

- **Mission:**
  - Support members and industry
  - Maximum possible interoperability (SCADA, DER, Water, and other industries)
  - Maximum possible cybersecurity
- **Activities:**
  - Work with MESA on Test and Certification
  - Work with MESA to support IEEE 1815.2
  - Conformance Certification Program
  - Updating IEEE 1815
- **Activities continued:**
  - Next-generation cybersecurity – SAv6 and AMP
  - New test procedures
  - New user guides
  - Application notes
  - Technical bulletins
  - Optional consulting

Conformance Certification Program (CCP) – Conformance Test Review (CTR) Process

- Expert review of Device Profile and Test Logs
- Conformance Certificates issued
- Improves assurance of interoperability including SAv5
- Reduced program risk
- Recommended for all new or updated products



DNP3 Conformance Certificate

This certificate confirms that the product described below has not shown to be non-conformant with the requirements as outlined by the DNP3 standard Click or tap here to enter text. and the Technical Bulletins listed on the back of this certificate during performed conformance test. The conformance test was performed according to Click or tap here to enter text., with the version described below, and on the product and interface(s) described below.
The test has been scoped based on the following document: Click or tap here to enter text..
The notes/comments applying to the test results can be found on the back of this certificate.

Test procedures version:	Click or tap here to enter text.
Manufacturer:	Click or tap here to enter text.
Type of product:	Click or tap here to enter text.
Device model/product name:	Click or tap here to enter text.
Ordering code:	Click or tap here to enter text.
OS Name and Version:	Click or tap here to enter text.
Firmware/Software Version:	Click or tap here to enter text.
Hardware Version:	Click or tap here to enter text.
Other Version Information:	Click or tap here to enter text.
Device configuration tool:	Click or tap here to enter text.
DNP3 Subset level(s) tested:	Click or tap here to enter text.
Interfaces tested:	Click or tap here to enter text.
Tests were performed by:	Click or tap here to enter text.
Certificate Date:	Click or tap to enter a date.

Test entity	**DNP Users Group**
X	X
Person responsible for testing	Chair of the DNP Test Management Committee

By signing this document, the Test entity confirms that:

- All test results presented for review to the DNP Users Group are test results from a test of the device/system described on this certificate, with its respective (software and hardware) versions.
- All information on this certificate is accurate and results of the test including evidence of related information as mentioned above is stored and can be presented to the DNP Users Group upon request for a duration of at least 20 years.

By signing this document, the DNP Users Group confirms that:

- Test results presented by the tester were reviewed and no issues were found during the review.

Conformance Certification Program – Getting Started

- DNP-UG employs a CTR coordinator to handle the day-to-day management of the CTR process, as overseen by the TMC
- DNP-UG strongly recommends that devices are certified periodically to ensure compliance
- Two phases in the CTR Process:
  - Device Profile review
  - Test Logs review
- Get started by contacting: conformancetesting@dnp.org or contact:
  - Deryk Yuill at deryky@ieee.org
  - Ron Farquharson at r.farquharson@ieee.org

DNP-UG Support of MESA-DER Test and Certification Program

- The DNP-UG & MESA strongly recommend DNP3 **Protocol** Conformance Certification prior to conducting MESA-DER or IEEE 1815.2 **Profile** Certification.

- Vendor Options for DNP-UG Conformance Certification:
  - Use Case 1 – (current) - The manufacturer engages with the DNP-UG first. DNP-UG issues Conformance Certificate. Manufacturer provides Conformance Certificate to UL as DCB (designated certification body).
  - Use Case 2 – (planned) - The manufacturer engages with UL as MESA DCB. DCB sub-contracts protocol certification to DNP-UG.

Business Case for DNP-UG Conformance Certification

- **Confidence:** Product certification testing can help build confidence in your utility customers by demonstrating that your product is conformant to the latest DNP3 specifications.
- **Quality:** A manufacturer that invests in product certification is displaying a commitment to overall quality.
- **Competitive advantage:** Product certification testing can give a manufacturer a competitive advantage by demonstrating that your product meets the required quality standards.
- **Credibility:** Product certification testing can enhance your credibility by demonstrating that you have met the required quality standards.
- **Regulatory compliance:** Product certification testing can help you meet regulatory requirements and differentiate your products in the market.
- **Risk reduction:** Conformance certification reduces the risk of impacts on project performance (budget and schedule) and reputation should problems arise.
  - Cost to correct prior to manufacture and shipment to the customer (industry adage = 1X)
  - Cost to correct after shipment to the customer (industry adage = 10X)
  - Cost to correct once installed in the field (industry adage = 100X)

Refer to the DNP-UG CCP Conformance Issue Summary Table

DNP-UG Protocol Conformance Issue Tracking Summary

No.	Device Type	Issue Found	Impact
1	Outstation	No class support	Master is not able to read data from outstation
2	Outstation	Partial Event Class Polling	Outstation fails when polled by master
3	Outstation	Data Link Reset is incorrectly required	Outstation will not communicate with some masters
4	Outstation	Broadcast not supported	Outstation will not participate in a system-wide freeze commands and might not permit correct time setting via DNP3
5	Outstation	No support for UDP	Some expected functions will not work
6	Outstation	SBO command process not implemented correctly	A command may be operated in response to receiving an invalid or corrupted message
7	Outstation	Incorrect unsolicited configuration	Depending on network topology, configuration of timeouts, etc., all communications between the master and outstations stopped
8	Outstation	When replying to an integrity poll, static data is sent before event data	Operators could be shown incorrect data on their displays, which could lead to wrong actions.
9	Master	Unable to issue valid integrity poll	Operators could be shown incorrect data on their displays, which could lead to wrong actions.
10	Master	Reads frozen counter, never issues counter freeze	Unable to read frozen counter data from some devices

Members Matter!

The DNP Users Group invests over 4000 hours per year of volunteer time to support our members and the industry. You can benefit from our knowledge and experience while also helping us continue in our work.

- Stay informed on the technology
- Improve cybersecurity
- Learn new time-saving methods
- Maximize interoperability
- Access:
  - Protocol Standard
  - Application Notes
  - Security Notices
  - Test Procedures
  - Our Technical Experts

Join at: dnp.org

MESA-DER (IEEE P1815.2) Testing and Certification Program

Profile Communications → IEEE 1547.1 Interop → Commissioning

MESA-DER Profile Communications Test:
Verifies MESA-DER Profile Communications DNP3 Conformance:

- Prerequisite: DNP3 **protocol** certification attestation*
- Requires: Passing score using the MESA-DER test tool
- Moves to: DNP3 interoperability testing for IEEE 1547.1 and UL 1741 with a NRTL
- *Or, for applications not requiring smart inverter functionality testing, this may be the only MESA certification required*

** DNP Users Group Certification Strongly recommended*

MESA-DER Interoperability For IEEE 1547.1 Test:
Verifies IEEE 1547.1 Functions using DNP3:

- Prerequisites: IEEE 1547-2018 and UL 1741SB by NRTLs
- Prerequisite: MESA-DER (DNP3) Profile Communications Test
- Requires: Passing score on the NRTL 1547.1 test tool using DNP3

Optional MESA-DER Site Test:

- For systems that cannot reasonably be verified through Lab type tests, verification will be through other means such as DER evaluations and commissioning tests.
- These evaluations will be performed on-site by qualified personnel and utility interconnection supervision

Business Case for MESA Certification

MESA-DER is soon to be an international IEEE standard so it should be utility required or followed broadly in the next year. Benefits over other communication standards:

- One of the required IEEE 1547 grid interconnection communication methods
- Focused on DER and specifically energy storage grid functions
- Makes the future transition to IEC 61850 easier with Point names directly mapped to IEC 61850-7-420 logical nodes & unique strings
- Provides robust DER scheduling than other options
- Includes functions directly related to grid operations and storage

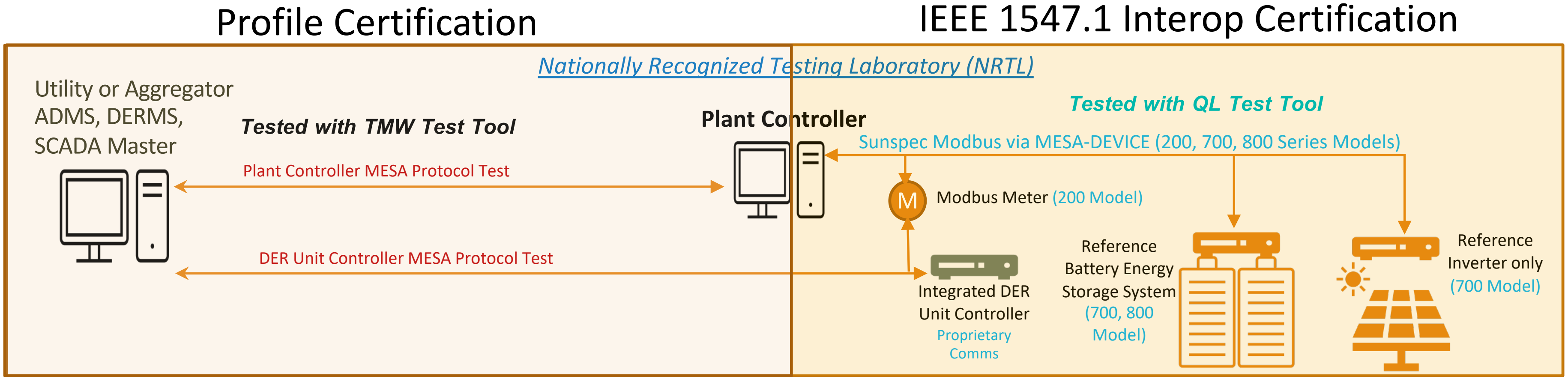
Strong utility base and growing…

- MESA members include Duke, SoCal Energy, Austin Energy, Salt River Project, and others
- Manufacturers can already target existing MESA utilities to purchase MESA-certified projects

Benefits to Utilities -

- Easy SCADA integration for the DER project simply involves a commitment to the MESA-DER device profile
- MESA members get access to detailed information on the profile, the opportunity to shape profile grid-based additions, and direct access to MESA implementations by other members

MESA-DER Testing Communications/Functions for Plant Controllers & DER Unit Controllers



- Triangle Microworks, Inc. (TMW)
- QualityLogic, Inc. (QL)
- Nationally Recognized Testing Laboratory (NRTL)
- Underwriters Laboratories (UL)

- *For these tests, UL will certify that IEEE 1547.1 functions work properly with the MESA-DER (DNP3)*
- *Plant Controllers may communicate with inverter using Agreed-To protocol, we recommend they communicate via SunSpec Modbus/MESA DEVICE.*

MESA Certification Marks

MESA
PROFILE COMMUNICATIONS CERTIFIED

MESA
PROFILE COMMUNICATIONS CERTIFIED

MESA
IEEE 1547.1 INTEROP CERTIFIED

MESA
IEEE 1547.1 INTEROP CERTIFIED

MESA
PROFILE COMMUNICATIONS CERTIFIED

MESA
PROFILE COMMUNICATIONS CERTIFIED

MESA
IEEE 1547.1 INTEROP CERTIFIED

MESA
IEEE 1547.1 INTEROP CERTIFIED

UL & Certifications Moving Forward

- Calling for BETA Test Clients
  - If you have or know of a device/software – Bring it to us to start the process

- Need Utilities to Specify MESA-DER Certification in Vendor Agreements

Active MESA Members

Utilities

Austin Energy

DUKE

LADWP

SMUD

San Diego Gas & Electric

Snohomish PUD

SoCal Edison

Salt River Project

Manufactures / Vendors

Avantus, formerly 8 Minute Energy

Arevon

Camus

Doosan

Hitachi Energy

Hyosung

Mitsubishi Electric Power Products, Inc.

Nextracker

Nuvation Energy

QualityLogic, Inc

RRC SCADA Solutions, LLC

Stem, Inc.

Trimark Associates, Inc.

Why Support MESA, DNP-UG & SunSpec Certification?

1. Independent member driven organizations that writes, modifies, edits and publishes standards requirements beyond the IEEE 1547
2. Continually develops test procedures and testing tools
3. Provides for independent 3rd party testing and certification not provided by IEEE
4. Allows for public input and modifications of standards
5. Promotes the standards and encourages wide-scale adoption
6. Coordinates Testing with UL and NRTLs
7. Certifies DER Communications Standards

8. They All Need Your Support!