

THE SMART GRID INTEROPERABILITY LAB

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- Products can be compatible with each other and coexist on the same network, but not be interoperable
- Products can be compliant with industry specs (such as ANS C12.22, IEC 61850), but not be interoperable
- Interoperability includes multiple aspects of form, fit and function

EnerNex Corporation's Existing Conformity Assessment Program Landscape Version 0.82 states:

- Conformance testing ... “determines whether an implementation conforms to the standard as written, usually by exercising the implementation with a test tool.”
- “Almost all of the available testing programs are for conformity to the standard only; they do not test for interoperability between systems.”

- *“The capability of two or more networks, systems, devices, applications, or components to exchange and readily use information—securely, effectively, and with little or no inconvenience to the user.”*
- *“The Smart Grid will be a system of interoperable systems; that is, different systems will be able to exchange meaningful, actionable information.”*
- *“The systems will share a common meaning of the exchanged information, and this information will elicit agreed-upon types of response.”*
- *The reliability, fidelity, and security of information exchanges between and among Smart Grid systems must achieve requisite performance levels.”*

Draft NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0

- Communications equivalence
- Identical performance in the same environment
- Functional equivalence

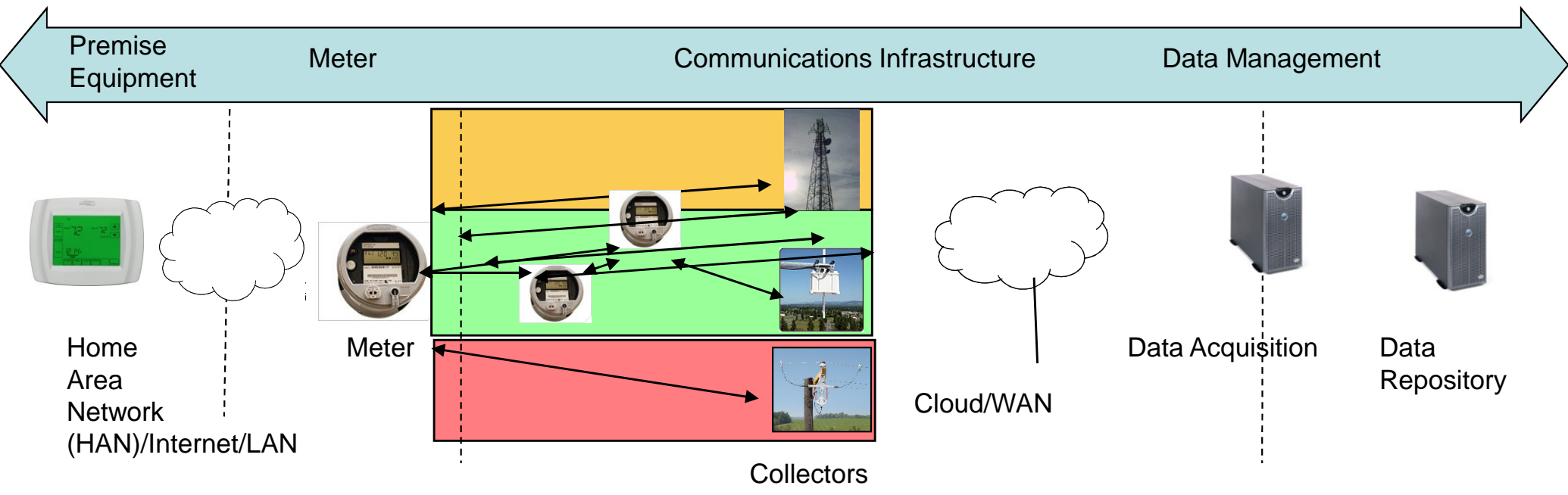
- Create a real-life functional environment
- Generate a complete set of input stimuli
- Test complete multi-device system operation
- Test interaction with all system elements
- Test performance in the presence of normal and degraded communications systems
- Simulate and emulate operation of multiple devices
- Measure and document test results

- Utilities:

- Evaluate smart grid options without having to run many technology pilots;
- Reduce their risks by demonstrating interoperability of various vendor's offerings against industry standards;
- Optimize configurations by benchmarking performance and enabling managed tests and evaluations;
- Conduct regression tests to validate design or firmware changes

- Vendors:
 - Create “fair play” environment with independent baselines
 - Demonstrate compatibility and suitability of products and services for utility needs
 - Refine offerings to meet emerging needs
 - Gain valuable information on key client performance expectations

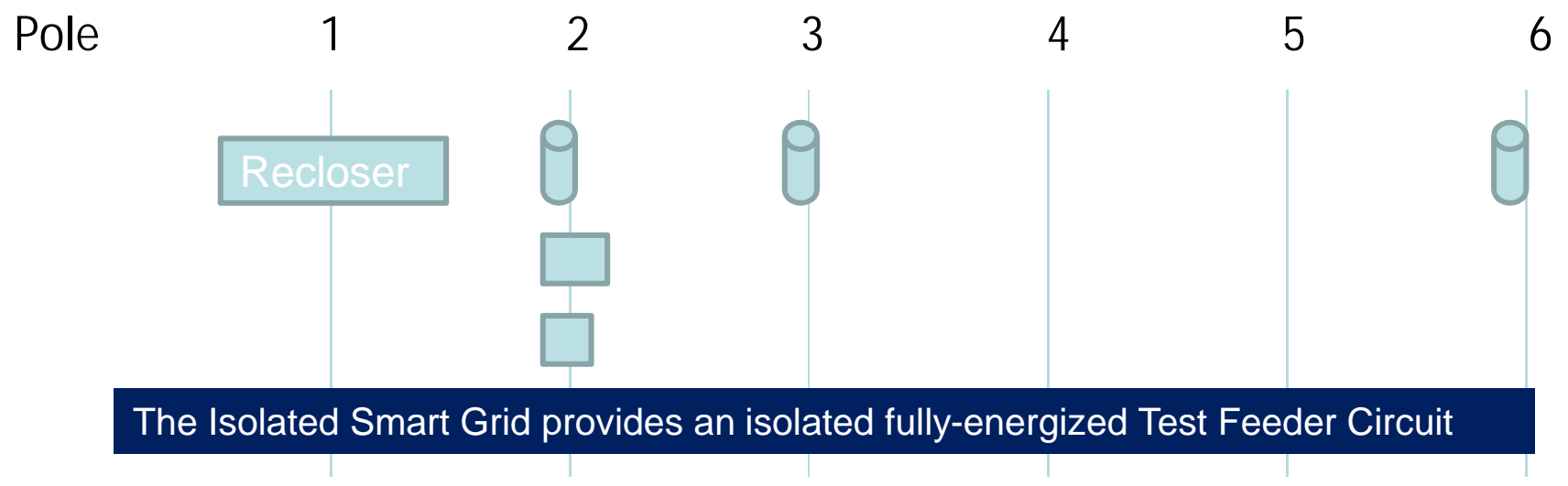
What is the end-to-end system?



The following options are some of the more commonly considered options. This model would provide the framework to select those that are most appropriate to the needs of our clients

- Interfaces to in-premise devices, including home area networks (HAN) and load control devices and communicating thermostats
- Interval recording
- 200-amp reconnect/disconnect switches
- Power outage/restoration reporting
- Tamper and theft notification
- Remote reprogramming
- Load Control
- Device Monitoring
- Licensed RF point-to-point
- Unlicensed RF mesh
- PLC
- Internet
- SGIL LAN/WAN
- Commercial cellular services
- Leased line data service
- PJM Signals
- Echelon Head End
- eTender system
- Typical commercially offered systems plus integration
- Emulation of interface to existing CIS

The Smart Grid Interop LAB provides a view of data end-to-end



Purpose	Switch Circuit On/Off	Comm Node	Future Test Multi-Lug Shared Meter	Line Sensors	Test Comm Framework	Test Comm nodes
Equipment	Recloser; Sensor	Transformer, Comm Node, Smart Meter	Transformer; Tropos Unit	Snap-On S&C Sensors		Transformer; Sensor
Options	Signage	Power indicator		Signage		Signage

Sample Test Conditions

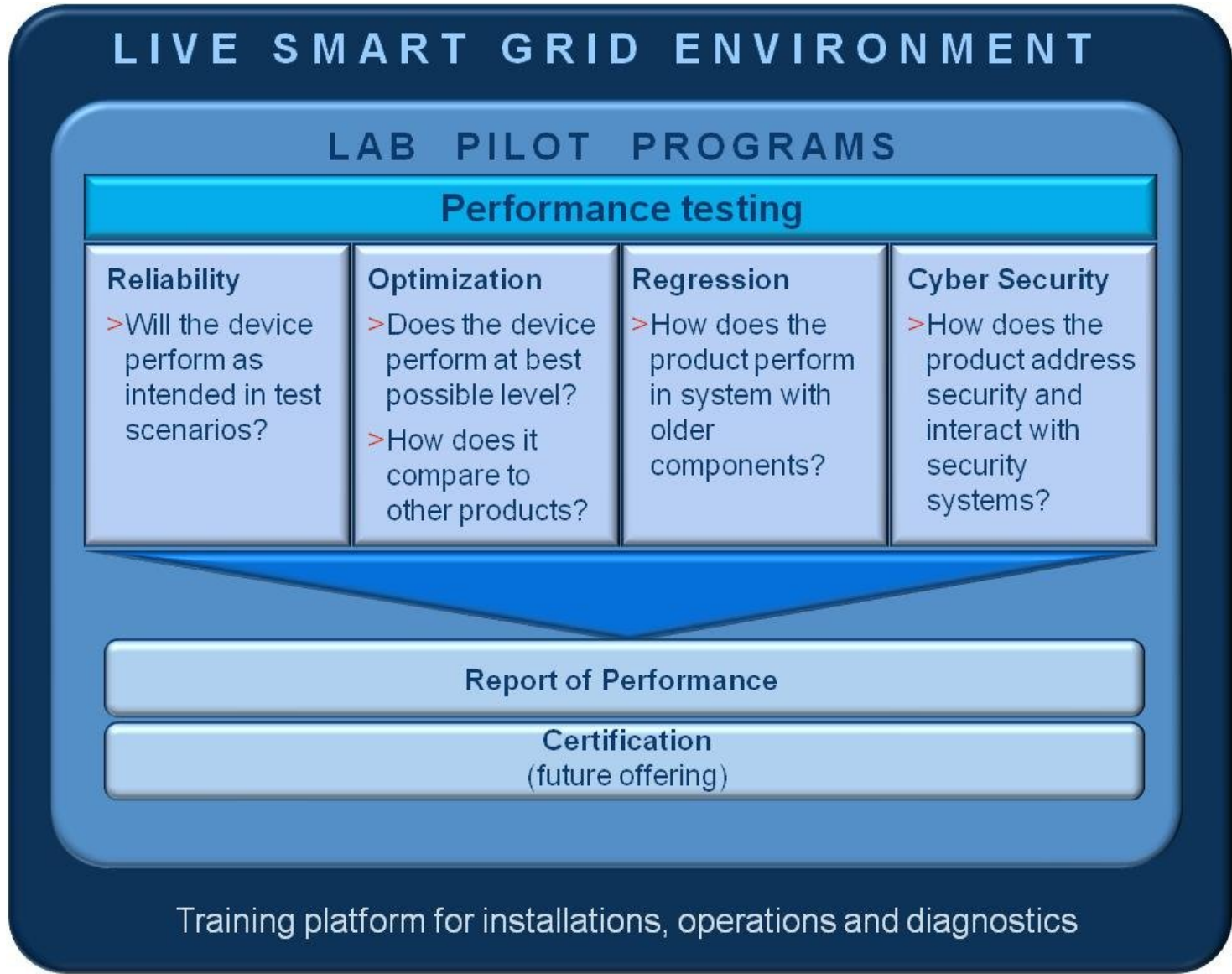
Test Objective	Home Area Network Devices	HAN Network	Electric Meter	Gas Meter	Field Area Network	Aggregation Point	Wide Area Network	Head End	MDM/Back Office
Simulated HAN Device Compatibility/Performance	Unit under Test	Unit under Test	Simulated Condition	N/A	Simulated Condition	Simulated Condition	Simulated Condition	Simulated Condition	Simulated Condition
HAN Device Compatibility Performance Test	Unit under Test	Unit under Test	Physical Device	N/A	Physical Device	Physical Device	Physical Device	Physical Device	Simulated Condition
Simulation Electric Meter Compatibility	Simulated Condition	Simulated Condition	Unit under Test	N/A	Simulated Condition	Simulated Condition	Simulated Condition	Simulated Condition	Simulated Condition
Electric Meter Performance Test	Physical Device	Physical Device	Unit under Test	N/A	Simulated Condition	Simulated Condition	Simulated Condition	Simulated Condition	Simulated Condition
Simulation Field Area Network Compatibility	Simulated Condition	Simulated Condition	Simulated Condition	N/A	Unit under Test	Simulated Condition	Simulated Condition	Simulated Condition	Simulated Condition
Field Area Network Performance Test	Physical Device	Physical Device	Physical Device	N/A	Unit under Test	Physical Device	Physical Device	Physical Device	Simulated Condition
Simulation Aggregation Point Compatibility	Simulated Condition	Simulated Condition	Simulated Condition	N/A	Simulated Condition	Unit under Test	Simulated Condition	Simulated Condition	Simulated Condition
Aggregation Point Performance Test	Physical Device	Physical Device	Physical Device	N/A	Physical Device	Unit under Test	Physical Device	Physical Device	Simulated Condition
Wide Area Network Evaluation	Simulated Condition	Simulated Condition	Simulated Condition	N/A	Simulated Condition	Simulated Condition	Unit under Test	Simulated Condition	Simulated Condition
Wide Area Network Performance Monitoring	Physical Device	Physical Device	Physical Device	N/A	Physical Device	Physical Device	Unit under Test	Physical Device	Simulated Condition
Head End Performance Benchmark Test	Simulated Condition	Simulated Condition	Simulated Condition	N/A	Simulated Condition	Simulated Condition	Simulated Condition	Unit under Test	Simulated Condition
Head End Performance Evaluation	Physical Device	Physical Device	Physical Device	N/A	Physical Device	Physical Device	Physical Device	Unit under Test	Simulated Condition

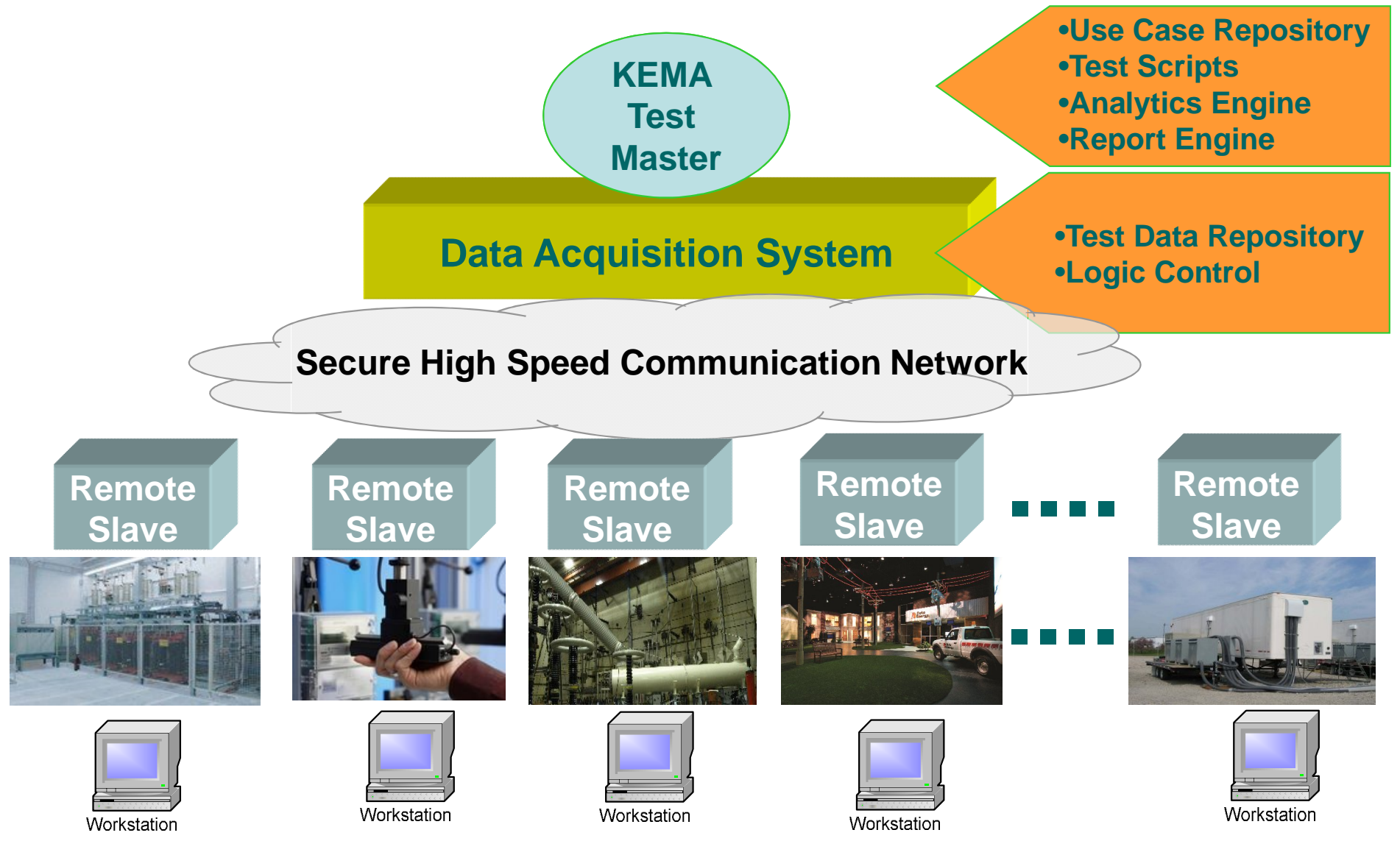
- Create a limited-scale, but technologically advanced, ***test facility to validate compliance*** of low-voltage automation devices, meters, and consumer products with evolving Smart Grid standards
- Establish ***a reference architecture*** that is representative of typical smart grid field implementations
- Permit various ***elements to be either tested or simulated under controlled and repeatable environments***

- Enable utilities and vendors to test and ***optimize the performance of smart grid elements to achieve their business objectives***
- Form a system-level smart grid baseline that will be used for ***ongoing compliance and regression tests***
- Facilitate the evaluation of new and existing products that may could be included in future configurations and ***assess these new offering performance against defined baselines***

- ***Test the compliance of products to established and evolving interface and security standards, including the NIST interoperability framework.***
- ***Allow equipment to be appropriately exercised in a live electrical distribution environment, prior to deploying these assets into the field***
- ***Further the understanding how best to specify and deploy smart grid elements to meet current and future business needs***

- Malicious Intent
- Device level vs. End-to-End
- Enforceability – No standards against which to audit or certify
- Pass/Fail vs. Degree of Risk
- HAN Challenges
- Cloud Computing
- 3G Cellular
- Lack of Utility Involvement in Standards Groups





QUESTIONS?