

Reference Interoperability Procurement Language

January 2020

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GRID

MODERNIZATION
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U.S. Department of Energy

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BATTELLE

for the

UNITED STATES DEPARTMENT OF ENERGY

under Contract DE-AC05-76RL01830

Printed in the United States of America

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(8/2010)

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January 2020

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Acknowledgments

This work was accomplished under the Grid Modernization Laboratory Consortium (GMLC) and in partnership with SEPA's Testing and Certification Working Group. The GMLC is a strategic partnership between the U.S. Department of Energy (DOE) Energy Department and the national laboratories to bring together leading experts, technologies, and resources to collaborate on the goal of modernizing the nation's grid. The GMLC was established as part of the DOE Grid Modernization Initiative to accelerate the development of technology, modeling analysis, tools, and frameworks to help enable grid modernization adoption. Similarly, SEPA's Testing and Certification Working Group is helping to advance interoperability for the integration of distributed energy resources for coordinated operation with the electric power system.

This work rests on a foundation of smart grid interoperability-related work established by the GridWise® Architecture Council over the past dozen years and by work done by the Smart Grid Interoperability Panel under the guidance of the U.S. National Institute of Standards and Technology. The vision for interoperability and plan for a strategic engagement with stakeholders follows from recent efforts funded by the DOE to advance interoperability for connected buildings.

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1.0 Introduction

Interoperability has important economic benefits, or to put it another way; lack of interoperability has negative economic consequences. Interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged.¹ Systems composed of advanced devices and applications require an interchange process that necessitates well-defined interfaces for the transfer of information between components and to simplify the integration process.

Interoperability is more imperative than ever before to provide the ease of integration that enables the many benefits of new technology. Systems that integrate simply and predictably have lower equipment and transaction costs, higher productivity through automation, better conversion of data and information into insight, greater competition between technology suppliers, and more innovation of both technology and applications. Such systems propagate faster, use resources more efficiently, and create more value for their users. They consistently prove that interoperability standards and supporting integration mechanisms enhance user choices, because they create a framework within which vendors and their competitors can innovate to provide new products that deliver new functions that previously were unattainable or even imaginable.

The focus of this work includes devices and systems in buildings, devices and systems on the grid with which devices and buildings might interact, and services to integrate them, including existing uses and future uses driven by distributed energy resource and smart device proliferation.

Buying systems and devices without an appreciation of the characteristics of their interfaces will result in paying more later to integrate them later and compensate for lack of interoperability. Preferably, buyers will specify interoperability requirements up front and eliminate costly integration issues before they occur. Despite understanding the benefits of interoperability, integration is still a time-consuming and expensive part of implementing new systems, often costing more than the systems and devices that are being integrated. There is an old saying that you get what you pay for. You also generally get what you ask for, but when you are not specific, what you get can be anybody's guess. Or more to the point, what you get may be in somebody else's best interests. Therefore, it is important to specify what you need during procurement in order to have some surety ahead of time that what you buy will connect and work with minimal effort.

The Smart Electric Power Alliance (SEPA) Testing and Certification Working Group (TCWG) and the U.S. Department of Energy (DOE) Grid Modernization Laboratory Consortium (GMLC) joined forces to create a task force to create reference interoperability procurement language that can be used to help improve interoperability. The GMLC/SEPA goal is to encourage marketplaces to offer goods and services that achieve interoperation with little trouble. As described in the following sections, this involves (1) specifying interoperability procurement requirements; i.e., identifying the many dimensions of interoperability characteristics and acquiring information that informs system and device procurers of the likelihood of their easier or harder integration; and (2) using a common interoperability procurement language tailored to each specific procurement activity.

¹ Interoperability Strategic Vision, a GMLC White Paper, PNNL-27320, March 2018. Accessed January 2022 at <https://gridmod.labworks.org/sites/default/files/resources/InteropStrategicVisionPaper2018-03-29.pdf>.

2.0 Achieving Interoperability

Systems and components are things we purchase. Buyers specifying interface standards that are then supported by sellers' products and systems simplifies the integration process and ongoing operation over product life. The alternative is using less dependable, customized one-off, piecemeal approaches to get these new systems and components to work together and with existing systems and components. Working together is the goal, yet it is surprising how many times the procurement of devices and the integration of the devices are separate acquisition efforts.

Afterthoughts and add-ons are less effective and more expensive, which is why savvy organizations approach managing their supply chains as they would any other critical asset. They know that supplier performance contributes to the value realized from assets and that to increase that value they need to identify and set objectives for suppliers.¹ A method of improving asset performance is to specify procurement requirements and service level agreements and then to use appropriate performance indicators to monitor and manage supplier contracts. The work of the GMLC/SEPA task force is focused on the first part of this method, i.e., specifying interoperability procurement requirements.

Achieving interoperability involves reaching agreement on common interfaces and promoting interoperability through performance specifications. By deciding on an integration approach that has well-defined interfaces and by selecting systems and devices that conform to that approach and choosing integrators that have experience implementing the chosen approach, many problems can be avoided. No integration effort is seamless, but by specifying interoperability requirements during the procurement process typical problems related to ad hoc approaches can be avoided or reduced.

The Reference Interoperability Procurement Language should be tailored to the specific procurement activity early in the process. This means including the language in Request for Information and/or Request for Procurement documents to motivate suppliers to successfully provide interoperable systems and components. By continuing this approach to its conclusion at the end of the procurement process, these same interoperability requirements may themselves lead to specified performance criteria that can be used to measure interoperability during implementation. The contractual language may contain performance incentives and penalties tied to these requirements, as appropriate.

Avoiding typical integration problems and developing more repeatable and reliable integration strategies is the desired outcome of using interoperability procurement language. Within an ecosystem, multiple buyers using common interoperability procurement language serves several objectives. The objectives of this effort are as follows:

- Demonstrate organizational and broader ecosystem commitment to interoperability and to standards-based integration.
- Expose drivers for interoperability and issues of concern.
- Provide buyers and sellers alike the opportunity to discuss and demonstrate their experience with preferred specifications and standards.
- Create reusable experience and avoid additional effort caused by creating unique implementations.
- Encourage participation in activities that will improve interoperability in future procurements (e.g., standards making, testing, education, interoperability community building).

¹ Institute of Asset Management, Asset Management – An Anatomy, December 2015, Accessed January 2020 at https://theiam.org/media/1781/iam_anatomy_ver3_web.pdf

- Reduce integration costs by purchasing and integrating standards-compliant technologies.
- Reduce capital information technology costs by reducing investment uncertainty and extending the useful life of legacy infrastructure through improved interoperability.
- Reduce installation costs by reducing the need to modify existing systems to interoperate with new technology and standardizing the approaches.
- Reduce upgrade costs by purchasing technology that considers integration with future technologies.
- Provide the ability to select features not technologies, avoiding technology “lock in,” and buying technology “off the shelf.”
- Simplify the pre-qualification of suppliers relative to common interoperability requirements.
- Educate suppliers of goods and services about the importance of purchasers placing them on interoperability preferred lists.

The characteristics of interoperability have many dimensions and looking for or asking for information that informs the acquirer of the likelihood of easier or harder integration is the subject of this document.

3.0 Procurement Language

The following examples of reference interoperability procurement language are inspired by GMLC work to propose an interoperability maturity model (IMM).¹ Each statement includes a reference for the origin of the language to an IMM criterion, the procurement language itself, an explanation (desire) for what we are trying to achieve with the language, and some questions (challenges) that represent issues that the language might help to avoid. The reference language is divided into sections related to the following categories:

- Configuration & Evolution
- Safety & Security
- Operation & Performance
- Organizational
- Informational
- Technical
- Community.

3.1 Configuration and Evolution

3.1.1 GMLC-IMM-01

- The supplier shall provide evidence of the ability to accommodate integration of purchased products with existing acquirer components and systems that use [specify standard/specification details here].

Desire: We are looking for evidence that the supplier specifies interfaces for its products that have been tested or demonstrated to easily integrate with the acquirer's existing product interfaces or support a straightforward upgrade path.

Challenges:

- Q1.1 - Do you have a migration path for integration of legacy systems and components with new components?
- Q1.2 - Do you have documentation showing how the integration of new components should be accommodated within your existing systems and components?

3.1.2 GMLC-IMM-02

- The supplier's product shall include documented mechanisms and processes that allow for interface capabilities to be revised based on open standards, while accommodating previous versions of such interfaces, without disrupting overall system operation (such as supporting a rolling upgrade process).

Desire: We are looking for evidence that the product or integration services being offered include interface specifications that can adapt to foreseeable changes. For example, the IEC 61970 CIM portion has well-documented support for version control and methods to extend the CIM for organizations to adopt.

Challenges:

¹ U.S. Department of Energy, GMLC Interoperability Project, "Interoperability Maturity Model," January 2020, PNNL-29683. Accessed January 2020 at <https://gmlc.doe.gov/projects/1.2.2>

- Q2.1 - Have you ever run into issues revising an interface to extend its capabilities over time?
- Q2.2 - Have you ever faced system updates that required you to support multiple versions of interfaces, including previous versions?

3.1.3 GMLC-IMM-03

- The supplier shall describe the interface standards that are followed, how they support regional and jurisdictional differences for interface(s), and how differences are managed and tracked.

Desire: *We are looking for evidence that the supplier has considered the impacts of implementation across multiple requirements (as might be required by jurisdictional variances). This includes the ability to track and relate different ways to implement the same service/interface and manage changes (and versions) over time.*

Challenges:

- Q3.1 - Have you ever experienced situations that need to accommodate differences for the same interface based on the operating jurisdiction or location of the technology being integrated?
- Q3.2 - Do you have the flexibility to account for jurisdictional and/or regional differences in interface specifications or use?

3.1.4 GMLC-IMM-04

- The supplier shall provide documented configuration options for interfaces, referencing applicable specification/standard sections, and how user overrides are implemented. Where the standard/specification includes options, the default setting used by supplier shall be indicated.

Desire: *We are looking for evidence that the supplier supports interface configuration options and the ease with which the user can set up these configurable options from a documented default.*

Challenges:

- Q4.1 - Have you had to change interface specifications in the past where a configurable interface would have negated the need for this?
- Q4.2 - Do your interfaces support one or more modes of operation?
- Q4.3 - Have you experienced situations where user overrides are supported for an interface but are not documented?

3.1.5 GMLC-IMM-05

- The supplier shall provide the evidence of standards-based capability to scale the integration of components and systems without disrupting overall system operation.

Desire: *We are looking for the capability to deploy the technology at scale without issues. An approach that requires increasingly complex integration time or system redesign for large-scale implementation adds additional cost and is unacceptable.*

Challenges:

- Q5.1 - Have you experienced situations related to your ability to scale component integration from a test case to large-scale deployment?
- Q5.2 - If large-scale integration cannot be achieved without disruption of service, what would you do?

3.1.6 GMLC-IMM-06

- The supplier shall provide evidence they can ensure that continued operation and quality of service is maintained as interfacing actors enter or leave the system according to the standards they support.

***Desire:** We are looking for an integration approach that allows for dynamic changes with respect to participating systems and devices such that the entering or leaving of the system is a part of normal operation and does not affect the quality of service.*

Challenges:

- Q6.1 - Can your system operate without disruption as actors enter or leave the system, or does adding/removing participants cause operational issues?

3.1.7 GMLC-IMM-07

- The supplier shall provide evidence (citing standard/specifications) of the way that resources (objects and their relationships) used in its product are unambiguously identified and how these identifiers are managed through creation, changes, and retirement.

***Desire:** We are looking for the capability to uniquely identify each resource. We are interested in how uniqueness is enforced and how the identifiers are tracked after the resources are no longer being used so that the identifiers do not get reused and historical reference can be preserved.*

Challenges:

- Q7.1 - Have you ever experienced problems due to devices having the same identifier?
- Q7.2 - How do you avoid the creation of duplicate identifiers for devices?
- Q7.3 - Do you have documentation describing the identifiers and how they are assigned, managed, and retired?

3.1.8 GMLC-IMM-08

- The supplier shall provide evidence (citing standard/specifications) of the resource discovery mechanisms supported in its product and how these capabilities can be used to configure and ease the integration of its product.

***Desire:** We are looking for the capability of devices and services to announce themselves to the system so that they may be easily found and help automate the integration process. Different types of devices may also need specific configuration steps that resource discovery could help support. This criterion is also related to unique identification and system entry/exit.*

Challenges:

- Q8.1 - Do your systems support the initial handshake for the discovery of new resources or is this performed manually?
- Q8.2 - Do the resource discovery methods support the ability to understand the capability of the device being integrated?
- Q8.3 - Can you automatically configure devices based on type?

3.2 Safety and Security

3.2.1 GMLC-IMM-09

- The supplier shall provide evidence (citing standard/specifications) that supports auditing and logging of exchanges of information with their product.

***Desire:** We are looking for the ability to verify what information has been exchanged and to use it for resolving potential technical, business, or policy conflicts.*

Challenges:

- Q9.1 - Do you have the capability to log information exchanges?
- Q9.2 - Do you have the capability to audit your information exchange logs?
- Q9.3 – Do you provide documentation describing the auditing and logging processes?

3.2.2 GMLC-IMM-10

- The supplier shall provide evidence that the privacy policies supported for exchange of data among interoperating parties meet privacy policies as specified in [standard/specification/legislation/regulation].

***Desire:** We are looking for evidence that the supplier understands the privacy issues around the data being exchanged and that privacy policies followed by the acquirer and its business partners are supported and implemented.*

Challenges:

- Q10.1 - Do your interface payloads and the handling of that information conform with your privacy policy?
- Q10.2 - Do your business partners have privacy policies that align with the business being conducted?
- Q10.3 - Do all your information exchanges take place with partners who have a privacy policy that aligns with the business being conducted?

3.2.3 GMLC-IMM-11

- The supplier shall provide evidence that the security policies related to the exchange of data are defined, maintained, and aligned among interoperating parties as specified in [standard/specification/legislation/regulation].

***Desire:** We are looking for evidence that the supplier understands the security issues around the acquirer's data and that security policies followed by the acquirer and its business partners are supported and implemented. We want to make sure that the boundaries of the proposed system are secured and within the control of the acquirer and supplier. Suppliers shall not cede responsibility for cybersecurity to the external boundaries of their proposed solution, nor shall they propose that it be added on at some later stage¹.*

Challenges:

¹ As specified in DE-FOA-0001495, (Enabling extreme real-time grid integration of solar energy), Accessed January 2020 at <https://eere-exchange.energy.gov/FileContent.aspx?FileID=059448a7-63a8-4f65-8def-15a3965227a5>

- Q11.1 - Do your interface payloads and the handling of that information conform with your security policy?
- Q11.2 - Is there a baseline security policy that you and your business partners conform with?
- Q11.3 - Do any of your information exchanges take place with partners who do not have security policies that align with yours?
- Q11.4 - Have you ever had situations where your security policy was not aligned with those of interoperating parties?
- Q11.5 - Do you have occurrences where information into and out of the internal operational network includes sensitive information?

3.2.4 GMLC-IMM-12

- The supplier shall provide evidence of the failure mode policies in its products/services and documentation regarding how they are to be implemented as specified in [specification/standard].

***Desire:** We are looking for evidence that failure modes have been considered and integrated into the purchased product and that documentation exists to describe the options and how to manage them.*

Challenges:

- Q12.1 - Do you understand the failures mode of devices you purchase and their expected reaction to system failures?
- Q12.2 - Is there a documented approach to addressing failure modes?
- Q12.3 - What would happen if your business partners suffered a failure?
- Q12.4 - Is your failure mode policy aligned with those of interoperating parties?

3.3 Operation and Performance

3.3.1 GMLC-IMM-13

- The supplier shall show evidence of conformance with all performance and reliability requirements of the interfaces as specified in [standard/specification].

***Desire:** We are simply looking for documented confirmation (e.g., test certification) that the supplier will meet the performance and reliability requirements stated by the acquirer and linking that to relevant specifications, if appropriate. (e.g., IEEE 1547-2018 and UL 1741).*

Challenges:

- Q13.1 - Are performance and reliability requirements specified when you purchase devices?
- Q13.2 - Which reliability requirements are specified by the entity or entities that govern your business processes?
- Q13.3 - Have you experienced problems with interfaces not meeting the performance and reliability requirements?

3.3.2 GMLC-IMM-14

- The supplier shall provide evidence (citing standard/specifications) of exchanged data error handling. The supplier shall provide documentation describing how error-handling expectations are met, and how this is achieved for typical problem examples.

***Desire:** We are looking for integrated error handling and appropriate behavior in the event of unexpected problems.*

Challenges:

- Q14.1 - Has error-handling performance from systems ever failed to live up to expectations?
- Q14.2 - Have you revised interfaces in the past without revising the error-handling documentation?

3.3.3 GMLC-IMM-15

- The supplier shall provide evidence (citing standard/specifications) of how they comply with time-order dependency and sequencing requirements.

***Desire:** Where there are process dependencies to be coordinated, we are looking for descriptions of how these are managed.*

Challenges:

- Q15.1 - Have you experienced problems related to incorrect time-order dependency and sequencing of data flows?
- Q15.2 - Do you specify time-order dependency and sequencing requirements during purchasing of devices and systems?
- Q15.3 - Have you had situations where different time-order dependency and sequencing assumptions exist between systems?

3.3.4 GMLC-IMM-16

- The supplier shall provide evidence (citing standard/specifications) of how message transactions and state management shall be performed.

***Desire:** Where there are state transition management factors to be coordinated or multi-step transactions, we are looking for descriptions of how these are managed.*

Challenges:

- Q16.1 - Are the transactions and state management specified?

3.4 Organizational

3.4.1 GMLC-IMM-17

- The supplier shall provide evidence that the acquirer's business processes and procedures are supported by the interfaces with citations of conformance to relevant standards or specifications.

***Desire:** We are looking for interfaces that support the associated business processes and are designed for those purposes.*

Challenges:

- Q17.1 - Have the interactions across your interfaces not been well suited to the business processes that need to be supported?
- Q17.2 - Have you experienced issues where the requirements of the business process were not supported by the interface's ability to convey those requirements?

3.4.2 GMLC-IMM-18

- The supplier shall provide evidence that specified technical, economic, and regulatory policies (see attachment) are fully supported by its interfaces by citing conformance to relevant standards or policies.

***Desire:** We are looking for support of the relevant technical, economic, and regulatory policies of the acquirer's organization by the interfaces. This is to make the supplier aware of such policies and to see evidence of any supported policies.*

Challenges:

- Q18.1 - Have any data exchanges previously run afoul of the technical, economic, or regulatory policies of your organization?
- Q18.2 - Are you keeping your policies up to date and aligned with the state of the industry so that procurements go more smoothly?

3.5 Informational

3.5.1 GMLC-IMM-19

- The supplier shall provide evidence that the data (information) exchanged across the required interfaces is formally defined using standard information modeling languages.

***Desire:** We are looking for interfaces that have been specified using information modeling techniques that provide documented descriptions of the data elements and their relationships to each other, and that permit consistency checks and auditable updates.*

Challenges:

- Q19.1 - Have you experienced problems due to unspecified or ambiguously specified data elements in interfaces or in information model(s)?
- Q19.2 - Have you had trouble with ad hoc information modeling in interfaces that were defined without formal modeling languages or techniques?

3.5.2 GMLC-IMM-20

- The supplier shall provide evidence that the information exchange elements (i.e., message content) of its interfaces map to elements in the standard/specifications of the relevant domain information models).

***Desire:** We are looking for use of standards-based information models and mapping between interface data elements and those standards (e.g., IEC 61970 CIM).*

Challenges:

- Q20.1 - Have you had situations where there were disagreements about the meaning of data in an interface and have you sought an authoritative source to resolve the disagreements?

- Q20.2 - Have you experienced challenges linking different information about the same entity across multiple systems to create a full description of the entity?

3.5.3 GMLC-IMM-21 (essentially a specific example of GMLC-IMM-20)

- Where information exchanged in messages through the required interface derives from multiple information models, the supplier shall provide evidence (citing standard/specifications) that shows the map between the information elements, including overlaps between information models

***Desire:** This is closely related to the previous statement, except in this case we are looking for evidence that terms are correctly mapped between the models to avoid misuse of incorrect data.*

Challenges:

- Q21.1 - Does the data you are exchanging involve different information domains (such as a power system representation and an electric vehicle representation)?
- Q21.2 - If so, does the data from each area map to a standard information model for their respective area?
- Q21.3 - If similar data are represented in each model, are the modeling overlaps identified?

3.6 Technical

3.6.1 GMLC-IMM-22

- The supplier shall provide evidence (citing standard/specifications) that describes the structure, format, and management of the communication protocol for specified interfaces.

***Desire:** We are looking for support for common and open standards for communications and seeking to make sure that the communications protocol is clearly specified.*

Challenges:

- Q22.1 - Do you have existing systems for which the use of the communications protocol was not clearly specified before implementation?

3.6.2 GMLC-IMM-23

- The supplier shall provide evidence (citing standard/specifications) that the information exchanged and business process interactions at the interface are cleanly layered (described separately) from the technical (communication networking) layers in the interface specification.

***Desire:** We are looking for separation of the message payload from the communication method. In other words, does the interface specification separate the communication protocol from the message content so that the same messages can be used over different communications protocols or changed over time.*

Challenges:

- Q23.1 - Do you have situations where you need to change the communications protocol layers used in any interfaces?

3.7 Community (Multi-category Criteria)

3.7.1 GMLC-IMM-24

- The supplier shall provide evidence that they adopt openly available standards, specifications, or agreed-upon conventions for the interfaces they develop, unless explicitly required to not do so by another requirement.

***Desire:** We are trying to encourage supplier adoption and participation in standards development efforts that will have broad community support and will consider upgrade paths for legacy products.*

Challenges:

- Q24.1 – Have you ever experienced problems with specially defined interfaces that were not supported by a broad number of technology suppliers?

3.7.2 GMLC-IMM-25

- The supplier shall provide evidence of past and continuing participation in the development of the cited interoperability standards over the previous (three) years.

***Desire:** We prefer to work with suppliers that are familiar with the standards being used in a broad community and can show involvement in their development and adoption.*

Challenges:

- Q25.1 - Have you hired suppliers who only use proprietary/custom interfaces?
- Q25.2 - Do you know which of your suppliers participate in developing and promoting interoperability standards?

3.7.3 GMLC-IMM-26

- The supplier shall provide evidence of participation in interoperability test and certification efforts related to the supported interfaces over the previous three years.

***Desire:** As with the previous statement, we are looking for evidence of certification to relevant standards using recognized tests and a track record of developing and using the interfaces to be implemented, as well as experience of where issues may arise and why.*

Challenges:

- Q26.1 - Do you normally perform testing and certification for the interoperability of interfaces or ask for evidence of testing and certification?
- Q26.2 - Have you clearly defined the testing and certification roles for accepting products in your organization, as well as the responsibility of each of your users for every interface?
- Q26.3 - If you have overall responsibility, how do you ensure your stakeholders participate?

3.7.4 GMLC-IMM-27

- The supplier shall provide evidence related to the supported interfaces of their sharing improvements and best practices resulting from interoperability experiences and lessons learned.

***Desire:** We are looking for a partner that is committed to using and improving interoperability by sharing lessons learned for the benefit of the broader community.*

Challenges:

- Q27.1 - Have you experienced interface/communications failures due to the same issues in different systems?
- Q27.2 - Have you developed corrective approaches and shared these practices for general community advancement?

4.0 Contact for Feedback

For more information or to inquire about participation, please contact,

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