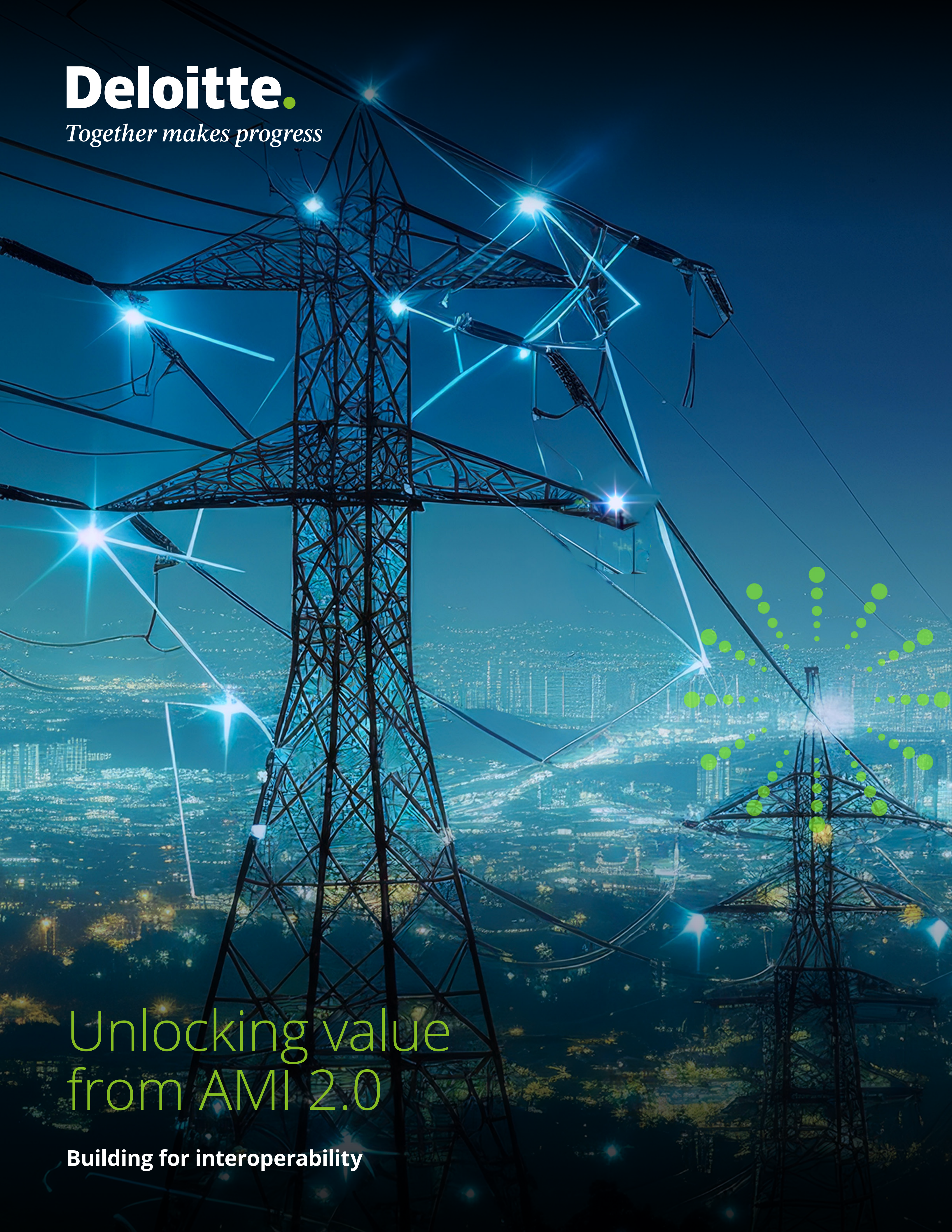

Deloitte.

Together makes progress

Unlocking value from AMI 2.0

Building for interoperability

This paper explores the issue of interoperability of advanced metering infrastructure (AMI) 2.0 and strategic actions utilities can take to drive value and resilience from AMI 2.0 infrastructure investments. This paper builds on concepts explored in "Enabling the clean energy transition: Planning for next-generation advanced metering infrastructure and grid technologies" and Deloitte's experience developing AMI 2.0 roadmaps for utility clients.

Contents

Executive summary

As energy demand rises and the clean energy transition accelerates, utilities face a defining infrastructure decision: how to implement next-generation advanced metering infrastructure (AMI 2.0) in a way that can deliver lasting value rather than new forms of technology dependency.

The central challenge is interoperability—the ability of meters, networks, devices, and enterprise systems to communicate and operate effectively across vendors and platforms. Without it, utilities risk repeating the challenges of the first AMI generation: proprietary silos, vendor lock-in, spiraling integration costs, and constrained innovation. With it, utilities can gain flexibility to select leading-class solutions, adapt to evolving regulations, and leverage emerging capabilities like artificial intelligence (AI), distributed energy resources (DERs), and real-time grid analytics.

The strategic imperative

Technology is advancing faster than standards are being set. Now is the moment for utility companies—and their leadership—to act decisively. Choosing and influencing interoperable, open-standard architectures today will influence whether AMI 2.0 investments compound in value or risk becoming the next generation of costly technical debt.

Six areas requiring leadership attention

This paper examines six key areas where interoperability is critical and warrants focused attention from utility leadership. Addressing these areas can help utilities meet essential operational needs, integrate AMI with grid operations platforms, enable secure data exchange across diverse devices and vendors, and maintain the flexibility to adopt emerging technologies. It also supports more informed decision-making for distribution system modernization and positions utilities to take strategic actions that shape evolving interoperability standards in the market.

1. **Metering data exchange** The industry is shifting from legacy American National Standards Institute (ANSI) C12 standards to the globally aligned International Electrotechnical Commission (IEC) 62056 (Device Language Message Specification and Companion Specification for Energy Metering [DLMS/COSEM]) framework. DLMS/COSEM enables consistent cross-vendor data modeling, stronger security, and a unified approach across electric, gas, and water metering. **Executives should direct procurement teams to evaluate and encode this standard preference now.**
2. **Edge computing and distributed AI** Meters are evolving into intelligent edge computing nodes capable of running AI/machine learning (ML) models in real time. The Grid Edge Interoperability and Security Alliance (GEISA) is developing open standards that allow applications to run across devices from multiple vendors—reducing audit burden, cutting integration costs, and enabling faster deployment of analytics and DER orchestration. **Investment in GEISA-aligned platforms protects against proprietary lock-in at the grid edge.**
3. **Field area network (FAN)** Proprietary radio frequency (RF) networks are giving way to internet protocol (IP)-based, open-standard alternatives such as wireless smart utility network (Wi-SUN) and private long-term evolution (LTE)/5G (3rd Generation Partnership Project [3GPP]). This shift enables network interface cards to be sourced from any vendor, reduces supply chain risk, and supports the low-latency, high-bandwidth requirements of modern grid operations. **Utilities should require full IP support in all new FAN procurements.**

4. **Behind-the-meter communications** The grid of tomorrow depends on real-time coordination with customer-sited assets—electric vehicles (EVs), solar, storage, and smart appliances. Multiple protocols (Institute of Electrical and Electronics Engineers [IEEE] 2030.5, Distributed Network Protocol Version 3 [DNP3], Matter, and others) serve distinct roles, and no single standard dominates. **Utilities that define clear rules of engagement for vendors, and support a certified set of protocol options, will likely recruit more devices into demand response programs and gain operational consistency across a fragmented device landscape.**
5. **Interoperable headend systems** The headend is the operational nerve center of AMI—managing meter communications, firmware, security, and data delivery to back-office systems. Traditional headends built on single-vendor architectures are a liability. Open-standard headend platforms that support multi-vendor meter fleets, integrate edge applications, and enforce consistent security controls are essential. **Leaders should insist on plug-and-play architectures as a non-negotiable procurement requirement.**
6. **Systems integration** Enterprise integration standards—primarily common information model (CIM) from IEC for large-scale, future-oriented architectures and MultiSpeak for operational efficiency—reduce the complexity and cost of connecting AMI with billing, outage management, meter data management systems (MDMS), and grid operations platforms. **Moving from point-to-point integrations to middleware-powered, standards-based connectivity makes systems faster to build, cheaper to maintain, and more resilient to change.**

The bottom line

Interoperability is not a technical nicety—it is a strategic and financial imperative. Utilities that build AMI 2.0 on open standards can lower total cost of ownership, accelerate innovation, reduce vendor dependency, and be better positioned to meet evolving regulatory and customer expectations. Those that do not may find themselves locked in to today's ecosystems as the grid continues to rapidly evolve around them.

Recommended leadership actions:

- Establish interoperability as an explicit, board-level commitment in grid modernization strategy.
- Require open-standard compliance in AMI 2.0 procurement language.
- Participate actively in shaping emerging industry standards like GEISA, IEEE, and IEC.
- Pilot interoperable solutions with clear effectiveness metrics before full-scale deployment.

The interoperability challenge

Interoperability is the ability of different systems, devices, and applications to communicate, exchange data, and operate effectively together, regardless of manufacturer or technology platform. **In the context of the AMI 2.0 landscape, interoperability is critical for enabling utilities to integrate diverse metering devices, communication networks, and data management systems.**

Key challenges

Vendor lock-in and proprietary standards	AMI vendors using proprietary protocols offer interoperability—but within their product ecosystem—complicating acquisition of new technology from other vendors and raising switching costs.
Technology silos	The modern grid involves diverse stakeholders, from independent power producers to customer-owned solar and storage, each with different technical requirements and ownership models. If not orchestrated through interoperability standards, diverse grid participants can result in technology silos.

Interoperability has been a persistent challenge for utilities since the early days of automated meter reading (AMR) and the first generation of AMI. Significant risks utilities face from the lack of interoperability standards are vendor lock-in, or dependence on a single supplier's proprietary technology. Vendor lock-in can limit flexibility, increase integration costs, and constrain future innovation.

Selecting solutions, software, and device models that adhere to open interoperability standards directly addresses this challenge by enabling systems, devices, and network solutions from different vendors to communicate and work together effectively. When utilities prioritize interoperable solutions based on open standards, they are not restricted to a single vendor's ecosystem. Instead, utilities gain the freedom to select leading-class products and services that align with their specific needs and modernization objectives.

As AMI 2.0 introduces advanced functionalities such as Generative AI for real-time data analytics at the edge, strong interoperability enables utilities to enhance the value of their investments, adapt to evolving regulatory requirements, and drive efficiency and resilience across the grid.

Advancing interoperability

This paper discusses interoperability across six areas of the grid:

- **Metering data exchange—**Protocols that define what data is exchanged between meters and operating systems.
- **Edge computing and distributed artificial intelligence—** Computing power that exists within a meter to process data coming from or being sent to one or more connected devices.
- **Field area communication networks—**Communication protocols used to transmit meter data over long distances.
- **Behind-the-meter devices—**Devices that generate or consume electricity, connected to one another through protocols developed for short-distance communications.
- **Interoperable headend—**Operational control systems that orchestrate communications between different types of meters and operational control systems to achieve goals including remote connect/disconnect, firmware updates, configuration changes, management of behind-the-meter devices, and processing data from smart meters to publishing it to other back-office systems.
- **Systems integration—**Data standards developed to facilitate integration among enterprise technology systems used by utilities, which may include MDMS, enterprise analytic systems, distribution operations systems, and other enterprise systems including billing, load forecasting, and asset management.

Metering data exchange standards

The choice of metering data exchange standards has direct consequences for cost, billing accuracy, vendor flexibility, and long-term program agility. Without a common, enforced standard, utilities face fragmented integrations that can drive up implementation costs and extend project lead times, as well as create billing exceptions that create revenue leakage and customer disputes; inconsistent security postures that increase regulatory and cyber risk; and constrained vendor choice that inflates procurement costs over time. Conversely, utilities that standardize on an open, globally aligned framework—particularly one that spans electric, gas, and water—reduce the custom integration work required with each new meter vendor, accelerate deployment of new meter classes and DER-adjacent devices, and position themselves to negotiate more competitively at contract renewal. The financial exposure from delayed standardization compounds over time: Every year of deferred action can increase the integration debt that should eventually be unwound.

A deeper dive

Metering standards and protocols determine how AMI data is transported and defined. Establishing interoperability in metering data exchange means plug-and-play compatibility: One system can interpret and use another vendor's metering data and commands without custom mapping for every integration.

For the last 25 years, many North American utilities have standardized based on the ANSI C12 family, driven by regional requirements, mature vendor support, and a large installed base.

Today, many utilities are shifting toward IEC 62056, which is built on the DLMS/COSEM framework. Practically, DLMS/COSEM provides a common information model that can operate across a range of devices and transport options.

Compared with ANSI C12.x approaches, DLMS/COSEM typically enables more consistent cross-vendor, multi-utility (electric/gas/water) data modeling, richer standardized event/log/profile handling, standardized remote operations (connect/disconnect, configuration, firmware life cycle hooks), and scalable IP-based interoperability patterns. With ANSI, many of these outcomes can be achieved but are more likely to depend on vendor-specific interpretations and custom integration work rather than a uniformly implemented, testable object-and-service model.

The DLMS/COSEM interoperability standard enables meters and data collection systems from different manufacturers to communicate more predictably. It accelerates integration testing and makes it easier to introduce new meter classes, sensors, or DER-adjacent endpoints over time. Another operational advantage of DLMS/COSEM is that it provides a common standard across gas, water, and heat, in addition to electricity, enabling a consistent approach to data and device management across commodities.

For executives planning for AMI 2.0, the choice of which meter data exchange standards to follow will depend on current operating model and future direction. ANSI C12 may remain fit-for-purpose for certain legacy or regionally constrained environments. However, DLMS/COSEM (IEC 62056) is positioned as a global standard that can support scalable, technology-agnostic architectures as the smart metering landscape evolves.

Key takeaways

The DLMS/COSEM framework interoperability standard enables meters and data collection systems from different manufacturers to communicate more predictably. It accelerates integration testing and makes it easier to introduce new meter classes, sensors, or DER-adjacent endpoints over time. Many utilities are actively evaluating a shift from legacy ANSI C12 standards to the global IEC 62056 (DLMS/COSEM) framework to gain greater flexibility, stronger security, and cross-commodity interoperability.

Actions to consider:

- During early AMI 2.0 planning and design, evaluate which standard, DLMS or ANSI, is most appropriate for your smart metering journey, based on regional regulations, legacy integration, and migration timelines.

- As a future meter data exchange becomes clear, use procurement language to require compatibility with the preferred standard.

- Pilot DLMS/COSEM in smart meter refreshes with clear metrics for effectiveness.

Technical considerations:

- Set interoperability requirements by defining the DLMS/COSEM conformance level, COSEM object coverage, and multi-vendor compatibility goals.

- Plan protocol coexistence by using bridges or gateways, enabling dual-stack headend support, and phasing the migration to avoid jolting cutovers.

- Validate communications by confirming DLMS support across RF mesh and cellular, and by testing latency constraints and remote read and connect/disconnect behavior.

- Confirm headend and MDMS readiness by validating adapters, parsing, validation rules, impacts to VEE (validation, estimation, and editing), and downstream integrations.

Early and thorough assessment will confirm the selected standard aligns with both current operations and future growth.

Edge computing and distributed AI

Grid edge computing represents one of the highest-return investment opportunities within AMI 2.0—but only if edge platforms are interoperable. A midsize investor-owned utility (IOU) leveraged grid edge data to identify granular voltage dips by circuit 5–10 minutes before an outage, enabling targeted reliability interventions before customers are impacted. A large IOU used AI predictive models to calculate ideal dispatch levels for behind-the-meter DERs, directly reducing peak demand costs. These outcomes—avoided outage costs, improved reliability indices, and optimized DER dispatch—represent tangible, measurable financial returns on grid edge investment. However, when edge platforms are proprietary, these gains are locked to a single vendor's ecosystem. Utilities cannot deploy applications uniformly across their meter fleet, cannot competitively rebid edge application contracts, and face compounding cybersecurity audit costs as each vendor requires independent review. Adopting open, interoperable edge standards transforms the edge from a vendor-controlled asset into a utility-controlled platform—one where application innovation, third-party development, and competitive procurement are possible.

A deeper dive

Edge computing and grid edge platforms produce responsive, real-time intelligence that can be used to manage grid operations and enhance energy use within a home network. Adopting meters that align to interoperability standards set by the GEISA expands customer choice for home energy management systems (HEMS). For utilities, adopting GEISA standards facilitates:

- Secure deployment of multi-vendor edge applications (e.g., analytics, localized detection, customer program logic) without bespoke integration per meter vendor.
- Faster rollout of analytics and DER orchestration by decoupling edge intelligence from legacy headend/MDMS release cycles.
- Reduced cybersecurity audit burden via standardized controls and a more uniform security posture across vendors.
- Lower total cost of ownership and improved future-proofing by avoiding proprietary lock-in and enabling a broader third-party ecosystem to innovate on consistent edge capabilities.

In the past, meter vendors supported application hosting on electricity meters and other grid edge devices, typically enabling static, script-based applications built on open-source Linux platforms without support for continuous learning or adaptive intelligence. These grid edge solutions, while powerful, often lacked interoperability, as APIs and environments differ across manufacturers. Technological fragmentation prevented utilities from deploying applications uniformly across different meter manufacturers, increasing operational complexity and supply chain risk.

Grid edge platforms can also train and manage AI/ML models between the edge and the cloud and integrate local or remote data for predictive analytics (such as solar irradiance forecasts that influence photovoltaics [PVs] and energy storage behavior).

GEISA, a project led by Linux Foundation (LF) Energy, is coordinating efforts to standardize inside-the-meter edge computing platforms, and the applications that run on them, by developing interoperable solutions that support open standards.

Specifically, GEISA covers standards for hardware, application management and deployment, application isolation, shared network access management, security services, common services, and direct access to edge-device sensors. GEISA is also working toward a testing program to develop an industry-wide approach to securely deploying applications on a grid edge platform, thereby significantly reducing the audit burden on IT teams and accelerating the deployment of innovative, cybersecure solutions.

Voice from the field:

"The forward-thinking partners of GEISA will collaboratively establish a strong foundation for scalable grid edge computing."

—Marissa Hummon, Chief Technology Officer, Utilidata®

By driving industry alignment around open, standardized platforms, the vendor and utility-led GEISA collaboration helps utilities reduce integration costs and leverage the full potential of grid edge platforms.

Key takeaways

GEISA standards provide an open, secure, multi-vendor computing environment at the grid edge with standard layers for device/app management, APIs, and implemented environment, so applications can run across devices from different vendors and access sensors/actuators consistently. Adopting meters that align to GEISA interoperability standards expands customer choice for HEMS and facilitates deployment of powerful applications at the grid edge, including AI/ML models.

Actions to consider:

- Invest in meter platforms with open, standardized edge-application hosting.
- Use advanced analytics at the edge for predictive maintenance and customer programs.
- Estimate cost by sizing integration effort, licensing, field labor, and cybersecurity uplift to avoid vendor lock-in.

Technical considerations:

- Plan coexistence between legacy technology and new capabilities. Migrate by running pilot workloads in parallel with existing centralized analytics, introducing routing and fallback paths, and phasing cutover by site, feeder, or device class.
- Validate communications by testing bandwidth, latency, intermittency, and store-and-forward behavior, and by confirming secure update channels for data, policies, and software.
- Confirm platform and operations readiness by validating edge provisioning, remote management, patching, observability, and incident response for distributed deployment and rollback.

Evolving communication networks for a broader, interoperable field area network

Field area networks represent some of the largest capital commitments in grid modernization—and their expected useful life of 15–20 years means that architectural decisions made today will shape procurement flexibility, operating costs, and integration options for a generation. Utilities that have deployed proprietary RF networks have learned this lesson at significant cost: Network interface cards (NICs) sourced from a single vendor create supply chain dependencies, eliminate competitive tension at contract renewal, and require costly redesign when a vendor exits the market or changes its roadmap. The shift to IP-based, open-standard networks fundamentally changes this dynamic. When network interface cards can be sourced from any standards-compliant vendor, utilities can gain procurement leverage, reduce supply chain concentration risk, and create the conditions for meters to become interchangeable infrastructure components rather than one-off integration projects. For executives, the business case is straightforward: Open-standard FANs can reduce the long-run total cost of ownership, protect against supply chain disruption, and future-proof the network for the low-latency, high-bandwidth demands of real-time grid analytics, DER coordination, and advanced automation.

A deeper dive

Interoperability of field area networks means the ability to add or replace endpoints, selecting meter brands and network components without needing to redesign the network, rewrite integrations, or accept degraded performance or security, over the 15-to-20-year expected life of FAN infrastructure. Historically, utilities deployed proprietary communication networks tailored to specific applications such as smart metering, supervisory control and data acquisition (SCADA), and distribution automation. These networks included wired solutions like Power Line Communication (PLC), wireless options such as RF, point-to-multipoint (using licensed spectrum), mesh (using unlicensed spectrum), cellular, and long-range wide area network (LoRaWAN). While multiple types of networks created reliable connectivity, they often resulted in vendor lock-in and integration challenges by requiring NICs to be sourced from a single vendor. This siloed approach led to inefficiencies, increased costs, and difficulty incorporating new technology.

With the advent of AMI 2.0, transitioning to IP-based networks that leverage open, interoperable standards such as 3GPP and Wi-SUN provides many benefits. IP-based, open-standard networks enable NICs to be sourced from any vendor, reducing supply chain risk and fostering competition. Private LTE and 5G networks, built on IP-based networks, deliver low latency and high bandwidth to support real-time metering and analytics. Wi-SUN's self-forming, self-healing mesh network enhances scalability and interoperability while avoiding the constraints associated with proprietary solutions.

Adopting open standards-based networks, such as Wi-SUN (IEEE 802.15.4g/e), is necessary but not sufficient to achieve interoperability goals. Effective multi-vendor meter onboarding also depends on building compatible link/mesh behaviors, security/authentication, provisioning, headend/MDMS integration patterns, and consistent operational tooling (monitoring, diagnostics, upgrades).

Embracing open standards enables utilities to accelerate technology adoption, increase flexibility, and enable seamless integration with future advancements. Additionally, the move toward standardized, interoperable networks including public and private 4G LTE and 5G, both based on 3GPP standards, allows utilities to achieve economies of scale and streamline operations.

Key takeaways

The pivot from proprietary RF to IP-based, open-standard networks (3GPP, Wi-SUN) is essential for advanced grid management, scalability, and multi-vendor integration. Adopting IP-based, standards-aligned FAN, with explicit interoperability requirements related to profiles, conformance tests, and operational interfaces, is a necessary step towards building a technology ecosystem in which meters become replaceable parts instead of one-off integration projects.

Actions to consider:

- Prioritize IP-based, standards-driven procurement for new field area network investments.
- Require full IP support in RFPs, focusing on scalability and security.

Technical considerations:

- Define supported technologies, protocols, and vendor interoperability targets; test coverage, latency, reliability, and capacity in representative areas.
- Plan phased deployment with coexistence between legacy and new technologies, and fallback options; confirm operations readiness for provisioning, monitoring, and troubleshooting.

Behind-the-meter communications: Current state and the path to standardization

Behind-the-meter (BTM) assets—EVs, rooftop solar panels, battery storage, smart thermostats, and smart appliances—represent the fastest-growing segment of grid-connected devices, and their commercial potential to utilities is substantial. Demand response programs that effectively coordinate these assets can reduce peak capacity costs, defer infrastructure investment, and generate new revenue streams. However, the commercial opportunity is directly limited by interoperability. A utility whose demand response programs depend on a single original equipment manufacturer (OEM) ecosystem can only enroll devices from that ecosystem—leaving significant load flexibility untapped and potentially creating customer experience friction for those with incompatible devices. Utilities that adopt open BTM standards and certify multiple protocol options expand their addressable enrollment base, improve program performance consistency across device types, and reduce dependence on any single device manufacturer. The ability to coordinate EVs with thermostats, solar inverters, and storage systems through common signals is not just an operational improvement; it's a prerequisite for delivering grid flexibility services that regulators and wholesale markets are increasingly requiring and rewarding.

A deeper dive

Interoperability behind-the-meter means setting standards that enable choice of grid edge devices and applications that accelerate enrollment and performance for demand response (DR), managed charging, and electrification programs.

The utility's role is to set the rules of engagement for vendors, so that the utility can securely expose standardized interfaces from grid edge devices and applications, certify a set of compatible device/protocol options, and design programs that do not depend on a single OEM ecosystem. While establishing interoperability standards increases consumer choice, a significant benefit is operational. Interoperability standards at the grid edge enable utilities to recruit more device types for DR, coordinate EV charging with thermostats/solar/storage, and use common signals so performance is consistent across vendors.

Multiple BTM protocols exist, including IEEE 2030.5, DNP3, Modbus, Matter, Thread, MQTT, and Wi-Fi. Each has unique strengths and best use cases, as outlined in table 1.

An effective approach to building comprehensive BTM communication systems involves the strategic integration of multiple protocols, leveraging the strengths of each to enable efficient, reliable, and secure data transmission. By selecting protocols suited for specific use cases, utilities and solution providers can enhance performance, enhance scalability, and address evolving security requirements.

Table 1: Purposes, strengths, example use cases, and business enablement of common BTM protocols and standards

Protocol/ standard	Purpose	Strengths	Example use cases	Business enablement
Data exchange protocols				
IEEE 2030.5 (SEP 2.0)	Facilitates communication between the smart grid and consumers, especially for DERs like smart inverters and EV charging stations.	Scalable, secure, robust for DER integration; mandated in regions like California (Rule 21) for smart inverter communications.	Utility-grade communication and control of DERs; grid stability; demand response; energy management programs and internet native.	Enables compliance with DER mandates; supports large-scale DR and DER revenue programs.
DNP3 (IEEE1815.2)	Widely used in utility and industrial SCADA systems for reliable data exchange over long distances.	Strong, efficient with large data volumes, supports event-driven communication (unsolicited messages), designed for harsh environments.	Communication between field devices (e.g., smart meters, remote terminal units) and central monitoring systems in critical infrastructure.	Reduces outage duration and maintenance cost through reliable field-to-control-center data exchange.
Modbus	An open protocol that enables reliable data exchange between utility devices, supporting seamless integration and control across equipment from different vendors.	Simple implementation, wide compatibility, operates over serial and Ethernet.	Simple BTM communications, device-to-device interactions, building automation where large data or advanced security is not critical.	Low-cost integration path for non-critical devices; broad equipment compatibility reduces procurement constraints.
Communication technologies/standards				
Matter	Application-layer standard to enhance interoperability among smart home devices, building on Wi-Fi and Thread.	Focus on interoperability; leverages existing connectivity technologies.	Emerging use for integrating various BTM devices into smart home ecosystems; direct BTM application is still developing.	Positions utilities to engage with mainstream consumer smart home ecosystems; expands DR enrollment potential.
Thread	IPv6-based mesh networking for low-power IoT devices.	Self-healing mesh, IPv6 addressability, power-saving for sleepy nodes.	Connecting multiple low-power BTM devices (smart sensors, lighting controls) in homes and buildings.	Enables cost-effective, large-scale deployment of low-power BTM sensors without per-device connectivity costs.
Wi-Fi	Wireless technology for high-bandwidth, short-range connections.	Ubiquitous and supports high data rates.	BTM devices with higher bandwidth needs in environments with reliable Wi-Fi coverage; less suitable for low-power or long-range needs.	Leverages existing customer infrastructure; reduces deployment cost for high-bandwidth BTM applications.

Future direction: Emphasizing standardization

Looking ahead, the utility industry is recognizing the need for greater standardization in behind-the-meter communications. As the electric grid evolves to accommodate distributed energy resources, demand response, and greater customer engagement, the need for continuous, reliable, and secure communication between devices has become increasingly important.

Adopting open, widely supported standards, aligned with requirements such as those set forth in IEEE 1547, will be critical to overcoming interoperability challenges, enabling scalability, and “future-proofing” investments. Standardization enables utilities to support a broader ecosystem of devices, streamline integration, and deliver enhanced services to customers as the grid continues to evolve.

Key takeaways

Utilities set the rules of engagement for behind-the-meter devices, including enabling multiple device and protocol options that expand the reach and sophistication of demand response programs. Tomorrow's grid hinges on uniform integration with behind-the-meter assets (DER, storage, smart appliances). This requires an agile, standards-based approach incorporating protocols like IEEE 2030.5, DNP3, Modbus, and emerging IoT standards.

Actions to consider:

- Map and prioritize behind-the-meter use cases (demand response, DER).
- Develop a protocol roadmap; where possible, harmonize with leading open standards.
- Engage with emerging standardization initiatives and regulatory guidance (e.g., IEEE 1547).

Technical considerations:

- Confirm onboarding and identity for devices, apps, and gateways and standardize security for local and cloud connectivity and updates.
- Validate data quality and control behavior for timing, accuracy, and safety and confirm integration paths to home gateway, utility systems, and partner platforms.

Voice from the field:

"Creating a unified framework for edge computing with interoperability and security at its core enables our grid to be flexible and dynamic while also supporting faster innovation."

—Marissa Hummon, Chief Technology Officer, Utilidata®

Interoperable headend

The headend system is the operational and financial hub of AMI—and its architecture determines whether AMI 2.0 investments can deliver compounding returns or compounding costs. Interoperable, open-standard headend platforms deliver lower integration and operating costs, faster meter onboarding, fewer data-quality issues, and improved security and operational control at scale. Traditional headend systems built on proprietary, single-vendor architectures invert each of these benefits: They multiply integration costs as new meter types are added, slow onboarding timelines, introduce data quality inconsistencies that ripple into billing and analytics, and create security posture gaps that are expensive to audit and remediate. Perhaps most significantly, a proprietary headend turns every AMI evolution decision—a new meter class, a new communication technology, a new edge application—into a one-off integration negotiation with an incumbent vendor, rather than a managed platform decision. **For executives, the business case is clear: Investing in open, standards-based headend architecture converts AMI from a series of custom integration projects into a scalable, competitive, vendor-neutral platform.**

A deeper dive

Interoperability of headend systems means enforcing standardization of key meter and operational data (including reads, events, firmware, security credentials) across multiple meter brands and communication technologies, enabling utilities to change vendors, add new meter types, or modernize networks without multiplying integrations. The headend system is at the core of the AMI landscape, integrating diverse solutions and technologies to manage meter exchange protocols. Headend systems utilize multiple communication networks to perform critical control functions, including remote connect/disconnect, firmware updates, configuration changes, and the dispatch and management of behind-the-meter devices. These systems also collect, verify, and process data from smart meters, publishing data to the MDMS and other back-office systems, such as analytics and OMS. However, headend systems have often relied on proprietary solutions and single-vendor NICs, limiting flexibility and hindering true multi-vendor integration due to the lack of open, standards-based solutions.

By adopting open, standards-based hardware and software, these systems support upgradable communication and edge cards, minimize vendor lock-in, and streamline integration. Enhanced security is a core focus, with standardized solutions enabling strong, consistent security controls across the network.

Wi-SUN, when supported in an interoperable headend system, enables effective communication across devices from multiple vendors by adhering to open standards. This fosters a truly multi-vendor environment, giving utilities greater flexibility and choice in selecting metering and network solutions.

The growing acceptance of CIM (IEC 61968-9) as the de facto standard and data model for integration is significantly transforming how headend systems interface with back-office platforms such as ADMS, DERMS, MDMS, and CIS. This standardization streamlines data exchange, enhances interoperability, and reduces integration complexity across the utility ecosystem.

Key takeaways

Establishing and enforcing interoperability from end to end requires multiple components, including standards-aligned meters/interfaces (e.g., common data models/protocol profiles), a headend that supports those standards, and governance (conformance testing, versioning, and a normalized enterprise data model) so implementations maintain interoperability goals. Interoperable headend systems orchestrate and enforce interoperability standards, enabling faster meter onboarding, reduced integration costs, and greater security and operational control.

Actions to consider:

- Consider transition to interoperable, open-standard headend platforms to manage multi-vendor meter fleets, integrate new edge apps, and centralize data security and analytics.
- Insist on plug-and-play headends flexible enough for multiple meter vendors and evolving standards.
- Prioritize vigorous security controls and compliance features from the outset.

Technical considerations:

- Define required device and protocol coverage and multi-vendor support.
- Validate key functions such as reads, events, alarms, and remote connect/disconnect.
- Confirm performance and operations readiness for scale, monitoring, and upgrades.

Voice from the field:

"Network-agnostic headend software, open architecture, and device-level interoperability to support emerging technologies like AI, 5G, IoT, and intelligent automation are a key part of AMI 2.0 interoperability strategy."

—Exelon®

Systems integration

Poor systems integration is one of the most persistent and underappreciated sources of cost and risk in utility operations. When AMI, billing, outage management, MDMS, and grid operations platforms are connected through custom, point-to-point interfaces, every system upgrade becomes a multisystem integration event. Testing cycles can be long, maintenance costs high, and data quality issues—missed interval reads, failed outage signals, delayed billing—accumulate into material financial and customer experience problems. Utilities that have adopted common information models report integrations that are faster to build, cheaper to maintain, and more resilient when upstream systems change. The strategic value extends beyond cost: A utility with a standards-based integration architecture can onboard new technology partners, respond to regulatory data requirements, and adopt new analytics platforms in weeks rather than months. In an environment where regulatory change, DER growth, and customer expectations are all accelerating, that agility can be a genuine competitive and financial advantage.

A deeper dive

Interoperability for system integration means adopting common information models (e.g., CIM and/or MultiSpeak, where applicable), based on common meaning of terms (such as customer, premise, service point, outage event, interval read, and device status). The benefits of common information models include higher speed and reduced cost: integrations are quicker to build, cheaper to maintain, easier to test, and more resilient when any upstream system changes. The system integration journey in the utility sector has progressed from basic point-to-point connections, where each system requires a custom interface with every other system, to more scalable enterprise application integration using middleware tools. This shift, alongside the evolution from flat files to structured XML files, and now to standards-based web services, has significantly streamlined data exchange, reduced complexity, and improved reliability. Middleware platforms, guided by industry standards, facilitate automation and secure data sharing across multiple systems.

Standards such as CIM and MultiSpeak play a critical role in this integration landscape. CIM, developed by the IEC, is a generation, transmission, and distribution standard developed to allow application software to exchange information about an electrical network. CIM offers a comprehensive, extensible framework for representing power system resources and business processes, making it well-suited for large-scale, enterprise-level integration and future scalability. However, its complexity and resource requirements can be challenging for smaller utilities.

Voice from the field:

"Interoperability...means a standards-based environment that enables integration that is as seamless as possible, enabling multiple meters on one network, one headend and/or one set of back-end systems. Ideally it would provide us with the ability to run apps at the edge from multiple vendors as well. An end-to-end interoperable system."

—BC Hydro®

In contrast, MultiSpeak is distribution-focused and widely adopted in North America. It provides straightforward, practical interfaces for integrating operational systems such as AMI, outage management, and customer information systems. Its narrower focus, however, limits its extensibility and international applicability compared to CIM.

CIM and MultiSpeak both advance system integration and interoperability goals. CIM is recommended for organizations seeking strong, enterprise-wide integration, while MultiSpeak is better suited for operational efficiency and quick implementation. In some cases, a hybrid approach may be beneficial, leveraging MultiSpeak for operational integration and CIM for broader enterprise interoperability. Ultimately, adopting standards-based integration enables flexibility, vendor neutrality, and adaptability to evolving grid requirements, enhancing the value of AMI and grid modernization investments.

Key takeaways

Middleware-powered integration based on common standards offers significant advantages over point-to-point integration in cost, speed, maintainability, and resilience.

Actions to consider:

- Assess current integration architecture against common information model standards (CIM, MultiSpeak).
- Prioritize migration to middleware-based integration for systems with high change frequency or data quality risk.
- Evaluate CIM for enterprise-wide integration and MultiSpeak for operational system integration, or a hybrid of both.

Technical considerations:

- Map data flows across AMI, MDMS, OMS, billing, and analytics to identify point-to-point integration risk.
- Confirm common data model coverage against current and planned system interfaces.
- Confirm governance processes for versioning, conformance testing, and data model maintenance.

Conclusion

The foundation of the power grid of the future will be built on standardized, interoperable networks. By moving away from proprietary, siloed systems and adopting open standards, utilities can create a connected, digital, and intelligent grid that can deliver broad benefits to both utilities and customers.

The business case for interoperability is clear and urgent. Across every layer of the AMI stack—from metering data exchange to systems integration—the choice between open standards and proprietary architectures determines whether utilities pay integration costs once or repeatedly, whether they can competitively procure technology or negotiate from dependency, and whether their AMI investments compound in value or accumulate as technical debt.

Realizing interoperability goals will require continued collaboration between utilities, technology companies, and industry associations. Utilities have an opportunity to both build interoperability into grid modernization planning and participate in shaping the standards themselves.

Those that act now—embedding interoperability requirements in procurement, piloting open-standard solutions, and engaging in standards development—can build the grid flexibility and commercial agility that the energy transition needs.

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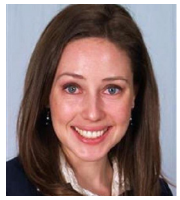

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