

Information, Communication Technology (P161)

Program Description

This program is designed to promote innovation by identifying, evaluating, and applying emerging Information and Communication Technologies (ICT) for grid modernization and digital transformation efforts. These enabling technologies can be applied to drive radical change in the capabilities of a user or system.

The ICT program addresses these challenges by conducting research in the following functional research areas:

- **Interoperability:** Interoperability fosters innovation, future-proofing, efficiency, cost savings, and a better customer experience. The research accelerates the industry's migration toward interoperability by informing standards development, organizing interoperability tests, and collaborating with utilities on the demonstrations of emerging standards and case studies to communicate the value and lessons learned.
- **Telecommunications:** The research provides leadership in communications standards development, provides tracking and analysis of communications technologies, develops the tools and techniques to effectively plan and design communications networks, and conducts laboratory and field tests to evaluate the performance of evolving and emerging technologies.
- **Data-Centricity:** This research leads effort to an enterprise-wide extensible data model, understanding that specific applications will come and go while the data model remains constant. Data, not applications, are at the core of the enterprise, and they are valuable and versatile assets. Ultimately, the goal of data-centrism is to enable data to deliver maximum business value, improve operational outcomes, and facilitate innovation through data-driven insight.

Research Value

The ICT program is designed to promote innovation by discovering new and more effective solutions to current problems through interoperability, thereby guiding the industry towards highly connected, interoperable future grid value streams. The program is organized into six project sets which are coordinated as an integrated program to enable digital transformation and provide the following benefits to members and the public:

Emerging ICT and Technology Transfer (161A)

- Provides insights into emerging information and communication technologies and issues that could impact utility investments; also enables technology transfer to personnel who can use and benefit from it.
- DER Communication and Data Integration (161D)
- As the penetration of distributed energy resources (DER) on a section of the grid increases, the impacts on grid operations—both positive and negative—may increase. Careful planning and operations are needed to ensure that the growth of DER does not impact grid safety, reliability, and stability. Research conducted by utilities, DER solution providers, and power system researchers over the past decade focuses on what is required to realize the full value of DER. DER must become more visible and controllable. At the heart of these capabilities are information and communication technologies to address DER communication and data integration.

Enterprise Architecture and Integration (161E)

- Puts tools and techniques into the hands of enterprise architecture practitioners and others driving towards the same objectives, with an eye to the unique needs and operating environments of utilities. Informs IT/OT strategies to prioritize investments aligned with utility capabilities. Four primary areas of focus include 1) Organizational Alignment, 2) Information Availability, 3) Application Portfolio Optimization, and 4) Enterprise Architecture (EA) Maturity.

Advanced Metering Systems and SCADA (161F)

- This project provides information and tools for deploying advanced metering infrastructure (AMI) and SCADA protocols, aiding utilities in optimizing existing systems and maximizing data value. With these systems being crucial to performance and reliability, efforts focus on enhancing deployment, accelerating standards for interoperability, and identifying best practices for system operations and monitoring as for optimizing their utilization as AM and SCADA are evolving rapidly.

Telecommunications (161G)

- Provides insights, guidance, and tools to help utilities develop telecommunications strategies and apply emerging technologies and standards that play an increasingly critical role in the operation of the integrated grid. Areas of focus include: planning a scalable, multi-service network; evaluating new business models to make fiber deployment economically viable; addressing industry challenges with potential interference to licensed microwave links; stewarding the standards to enable interoperability and interchangeability; developing approaches to maximize the performance of wireless technologies; developing best-in-class telecom network management, visualization, and control systems while maintaining reliability, resilience, and cyber security; and many more related topics.

Geospatial Intelligence (161H)

- Provides leading practices for optimizing the value and innovative uses of geospatial systems and data in emerging applications such as augmented reality and digital twins. This project focuses on the science and technology of acquiring, storing, cleaning, modeling, analyzing, producing, presenting, and disseminating geospatial datasets as well as developing tools and insights that enable the next-generation GIS, including the support of immersive 3D environments. It also includes assessing emerging geospatial technologies that enable utilities to expand their GIS capabilities for advanced analytics, network management, and process automation.

Approach

The approach for providing value in the ICT program involves multiple strategies:

- Raise awareness of emerging and potentially disruptive technologies. Information and Communication Technologies such as artificial intelligence (AI), edge computing, cloud computing, augmented reality, virtual reality, 5G and more may create both opportunities and challenges. EPRI's staff identifies these technologies and provides guidance to inform decision makers on potential impacts.
- Tools and resources to enable adoption of emerging ICT. The program develops a variety of tools and resources to help utilities adopt emerging technologies either themselves or with EPRI assistance across all areas of the ICT program.
- Technology and standards evaluation, laboratory testing, and field demonstrations. The program conducts work in EPRI laboratories, where staff take part in assessment of emerging standards, equipment, and communications architectures. The program also

- performs field demonstrations of emerging standards and technologies in coordination with utilities.
- Industry case studies, best practices, and guidebook development. The program documents utilities' experiences as they implement early-generation technologies and applications. Experiences are captured through utility immersions, interviews, and case studies. The program also develops go-to reference books to help utilities plan for, design, deploy, and maintain new technologies or applications.
- Technology transfer. The program uses a variety of approaches to share and apply research results, including technical reports, white papers, software tools, webcasts, workshops, and application of ICT program resources directly for utilities.

Accomplishments

The ICT program delivers valuable information that helps its members, the industry, and the public in numerous ways. The following are select work products that each of the project sets has produced:

Annually, numerous webcasts and newsletters in 161A help utilities in their grid modernization and digital transformation journeys. Examples topics include:

- [Emerging Technology Webcast - Telecommunication](#)
- [Emerging Technology Webcast - GIS Solutions for Electric Grid 2045](#)
- [Connecting the Dots: Integrating DERs via Utility AMI](#)
- [DERMS Reference Architecture](#)
- [Data Management Collaborative - Surviving the Datavalanche](#)
- [Telecommunications - Evolution of Utility Private LTE Towards 5G - Roadmap, Benefits, and Pre-Requisites](#)
- [Emerging Technology Webcast - Enterprise Architecture and Integration](#)

Numerous guidebooks that help utilities apply emerging ICT practices, typically updated annually. Examples include:

- 161D: [DER Protocol Reference Guidebook - 8th Edition, Distributed Energy Resources Interoperability Guidebook – 2024 Edition: Information and Case Studies to Support Utilities in Achieving Interoperability with Distributed Energy Resources and Demand Response Technologies; DER Protocol Reference Guidebook - 8th Edition;](#)
- 161E: [Utility Enterprise Architecture Guidebook, 9th Edition; 2024 EPRI Utility Business Capability Model \(Public Version\); Cloud Integration Guidebook: A Guide for Enterprise Architects, 8th Edition; Utility Business Capability Model Guidebook 3rd Edition;](#)
- 161F: [DLMS/COSEM for North American Utilities; Guidebook for Integrating AMI into Outage Management, Revenue Protection Guidebook, Second Edition: Using Advanced Metering Infrastructure; Guidebook for Advanced Metering Infrastructure \(AMI\) Data Analytics: Second Edition](#)
- 161G: [Wide Area Network \(WAN\) Modernization Guidebook: 2024 H1 Edition; Strategic Fiber Guidebook 2024 Edition; Private LTE Guidebook – 2024 Edition; Satellite and Emergency Communication 2024 Update: Additional Testing of Starlink for Utility Use Cases Strategic Fiber Guidebook; Network Management Guidebook: 2024 Edition](#)
- 161H: [Geospatial Informatics Guidebook: Fifth Edition;](#)

Each project set produces relevant research results based on lab testing, demonstrations, and architectural practices to advance digital transformation. Examples include:

- 161D: [Understanding the Difference in DER Gateways and Plant Controllers](#)
- 161E: [LEAPWorx 5th Edition](#)
- 161F: [Continuous Meter Replacement in Heterogenous Systems](#)
- 161G: [Evaluation of Interference to 6- GHz Microwave](#)
- 161H: [EPRI Geospatial Intelligence Develops Innovation Lab – The Path Forward](#)

Key Activities

In 2026, the ICT program intends to deliver the following:

Emerging ICT and Technology Transfer (161A)

- Monthly webcasts - Emerging Information and Communication Technologies, and Technology Transfer
- ICT Newsletters

DER Data and Connectivity (161D)

- Maturity Assessment of DER Information and Protocol Standards
- DER Interoperability Guidebook
- Utility Experiences in DER Integration
- DER Protocol Reference Guidebook
- DER Data and Connectivity Technology Pipeline
- Promising Technologies report

Enterprise Architecture and Integration (161E)

- Utility Business Capability Model and associated guidebook
- IT-OT Convergence Guidebook
- Impacts of Disruptive Technologies
- Grid Modernization Playbook
- Grid Model Data Management Functional Architecture
- Grid Model Management (GMDM) Guidebook
- Data Management Guidebook
- Cloud Integration Guidebook: A Guide for Enterprise Architects
- Common Information Model Primer
- Utility Enterprise Architecture Guidebook
- Top Ten Indicators of EA Maturity
- LEAPWorx, reference architectures, metamodels, and accelerators

Advanced Metering Systems (161F)

- Advanced Metering Data Analytics Guidebook
- Head-end System Overview: Functions and Interfaces
- ANSI Meter Standards Utilization
- DNP Protocol Tutorial

Telecommunications (161G)

- Smart Grid Communications Intelligencer newsletters
- Telecom Standards Guidebook

- Evaluation of Interference to 6 GHz Microwave
- Network Management Systems Guidebook
- 4G and 5G Architecture approaches for resilient networks
- Emergency / Black Sky Communications Resilience and Planning
- Private LTE Guidebook
- Evaluation of Low Latency Wireless Technologies
- WAN Modernization Guidebook
- Strategic Fiber Guidebook

Geospatial Informatics (161H)

- Geospatial Analytics Use Cases
- Geospatial Innovations
- Geospatial Informatics Guidebook

Estimated Funding 2026

\$4.0M

Program Manager

Sean Crimmins

650.855.7901

scrimmins@epri.com

PS161A: Emerging Technologies and Technology Transfer

This project set is designed to promote innovation by providing strategic insights into emerging information and communication technologies (ICT) that may drive radical change in the capabilities of the grid by enabling interoperability, pervasive telecommunications, and data-centricity. The project set promotes technology transfer for the ICT program with monthly webcasts, periodic newsletters, and interactive forums on emerging topics. This will provide insights to inform utilities on efforts that help prioritize investments in people, processes, and technology to enable digital transformation.

P161.058: Emerging ICT and Technology Transfer

This project will provide technology transfer support for the Information and Communication Technology (ICT) program and will focus on providing frequent strategic insights into emerging information and communication technology through a combination of webcasts, interactive forums, and periodic newsletters.

PS161D: DER Communication and Data Integration

As the penetration of distributed energy resources (DER) on a section of the grid increases, the impacts on grid operations—both positive and negative—may increase. Careful planning and operations are needed to ensure that the growth of DER does not impact grid safety, reliability, and stability. Research conducted by utilities, DER solution providers, and power system researchers over the past decade focuses on what is required to realize the full value of DER. DER must become more visible and controllable. At the heart of these capabilities are information and communication technologies to address DER communication and data integration.

Currently, large numbers of DER worldwide continue to be connected to the grid without direct monitoring and control, or they simply use the internet and vendor systems as an interim solution. The goal of this project set is to conduct research on the evolving needs for DER data and connectivity, including tools and technologies, architectures, and methodologies to support DER and demand response (DR) technologies and services.

This project set can help utilities at any stage of DER/DR deployment and integration. This includes industry leaders targeting full integration (control and monitoring) of both in-front and behind-the-meter DER/DR or utilities more focused on reducing costs and improving efficiency of existing operations, such as the monitoring and operation of large-scale storage or solar plants and DR programs. The project set has activities that support both the immediate future (existing plans) and longer-term (strategic vision) value streams.

This project set has three recurring areas of focus:

- Interoperability, Information, Protocol, and Connectivity Standards
- Emerging Technologies
- Integration Experiences and Practices

The project set also hosts task force meetings throughout the year. Each call focuses on a particular topic. EPRI presents on new research and then attending members have an open discussion about their thoughts, concerns, and experiences to help inform future EPRI research projects and activities.

P161.049: DER Standards – Interoperability, Information, Protocol, and Connectivity Standards

Utilities, third parties, and utility customers are increasingly connecting distributed energy resources (DER) into the grid. As more DER and demand response (DR) are added, visibility and controllability of DER become key—or even critical—components for grid reliability, flexibility, and resiliency.

Information and communication technologies are core enablers for visibility and control of DER to facilitate the rapid, seamless flow of information among diverse assets and devices. These technologies must be capable of integrating and aggregating multiple types and brands of DER into a utility's various management systems. The key is standards.

In this project, EPRI evaluates today's information and protocol standards through a DER lens to evaluate how these standards can help utilities streamline integration and reduce both initial and ongoing costs.

P161.051: Emerging Topics, Technologies, and Techniques

An industry focus on clean energy has further boosted the popularity of distributed energy resources (DER). In response, an ever-growing number of technology companies, standards groups, and utilities are all looking for the next big opportunity. This is causing an influx of new ideas and technologies.

This project is designed to assess these new technologies, characterize their applicability, and propose next steps for the industry.

P161.052: Integration Experiences and Practices

Utilities are embracing new energy resources and services, with some companies moving to push centralized generation to distributed generation and other distributed energy resources (DER). To address the inevitable challenge of spatial and temporal variability, utilities are increasingly looking to flexibility systems and services from DER, including smart inverter-based DER and demand response (DR) for grid reliability and stability. The secure and reliable end-to-end integration of DER—including DER in the planning and operation of the electricity grid and expanding its scope to include DER operation—is an important research consideration. This capability provides utilities with visibility into DER/DR to enhance planning, the ability to control operating parameters in DER/DR to adjust to changing grid conditions, and dispatch capabilities to call on the flexibility of these systems when the need arises. As utilities develop their DER integration roadmaps to include communicating DER/DR and end-to-end integration of DER, it is important to step back and look at the bigger picture and understand the different technical and business elements that must come together to make it happen.

The research undertaken by this project seeks to understand how the many components of a DER/DR roadmap (including communicating DER/DR) come together—the technologies, processes, and systems that can streamline the end-to-end automation and integration and reduce long-term operation and maintenance costs.

PS161E Enterprise Architecture and Integration

Society demands a cleaner, more equitable, and more resilient electric power grid. This transformation requires:

- Organizational alignment: The organization focuses its resources on executing the strategic vision.
- Data management: All participants in the enterprise have access to the necessary information and toolsets.
- Application portfolio optimization: The systems required to run the business are optimized for performance and cost.
- Enterprise architecture (EA) maturity: EA practice is an integral part of the business, from strategy development to technology evolution.

The research of this project set aims to put the best tools and techniques into the hands of enterprise architecture practitioners and others driving toward the same objectives, with an eye to the unique needs and operating environments of utilities.

P161.029 Enterprise Architecture (EA)

Increase the maturity, influence, and impact of enterprise architecture (EA) practitioners and others who share the same goals at electric power utilities worldwide.

P161.041 Enterprise Systems Integration

The transformation of the industry required to meet demands for a cleaner, greener, and more resilient grid will require the implementation of new enterprise systems in the operational and information technology domains. Interoperability is a key enabler to faster, cheaper, and more functionally complete implementation of these new systems. A clear understanding of the semantics and structure of standards-based data exchanges is foundational to systems interoperability and is also key to enabling innovative applications in the utility industry. As the industry evolves, so should the standards, which are unfortunately lagging behind in key areas such as cloud computing, cyber security, and data modeling. Additional semantics are required for new assets, analysis and business models, and exchanges need to be better defined so they can be automatically tested and validated to shorten the distance to integrate.

P161.062: Organizational Alignment

What frameworks and tools are best suited to ensuring that investments are aligned with organizations' strategic objectives and that the application and technology portfolios are capable of supporting today's business and its vision for the future?

This project seeks to provide enterprise architects, business architects, and strategic planners with the frameworks, tools, and processes necessary to capture the extent of the organization's alignment with current and future strategic objectives and to make a technology-agnostic plan to close any gaps.

P161.063 Data Management

The evolving utility industry is experiencing a surge in data sources such as grid and behind-the-meter sensors, weather data, and customer information. This influx, coupled with increasingly intricate grid operations and the widespread adoption of data analytics, underscores significant challenges in data management. These challenges encompass the sheer volume and diversity of data, its quality, and concerns regarding security and privacy. Additionally, the industry grapples with the legacy of siloed systems and inaccessible datasets.

To navigate these complexities effectively, the utility sector must possess robust capabilities to manage, comprehend, process, share, and appropriately dispose of data. Confidence in data relies on ensuring its provenance, quality, definition, location, security, and suitability for specific purposes.

PS161F Advanced Metering Systems and SCADA Protocols

Advanced metering infrastructure (AMI) and SCADA systems are being deployed by utilities worldwide. The performance of these systems, their reliability, and consumer trust in them, especially AMI, are crucial to the utility business, and many challenges must be addressed. Both metering and communication capabilities in AMI and SCADA are evolving rapidly, and the methods for optimizing their utilization and value are still developing. AMI assets exist throughout the full extent of a utility's service area, and replacing them can be disruptive to end users, resulting in a need for high-quality asset management throughout the system life cycle. Because many current systems are still largely custom-designed or proprietary rather than standards-based, the potential consequences are vendor lock-in, heightened risk of obsolescence, and poor interoperability.

This project set consists of the whole of EPRI research in metering, advanced metering systems, and SCADA protocols, bringing together communications and meter-specific research previously conducted in

separate programs. This project set aids utilities in optimizing existing system utilization and in discovering the full value of AMI-collected data; accelerates and informs the development of emerging standards and architectures to enhance interoperability, innovation, and marketplace competition; and identifies best practices for the support of system operations and monitoring of systems. Finally, the project set will investigate AMI meters with regard to accuracy, reliability, and tamper resistance.

P161.032 Achieving Open, Interoperable Advanced Metering Systems

The present state of the advanced metering industry and advanced metering infrastructure (AMI) depends heavily on custom designs and proprietary systems. Although standards have been created, the maturity and quality of the standards and their application vary widely, and adoption has been selective. As a result, interoperability and interchangeability of devices have not occurred, leading to unnecessary costs and complexity in system design, selection, and integration. Another concern is vendor lock-in, which could inhibit innovation and limit functionality. Technology improvements and third-party communication systems are rapidly changing the landscape of available options and architectures, exacerbating the challenges in selecting next-generation technologies.

This project will assist utilities in designing, selecting, integrating, and deploying AMI systems based on standards, helping to reduce lifetime costs and improve performance. The research aims to improve the open options that are possible and accelerate availability in the marketplace. The project will provide technical references, performance assessments, and evaluation tools for AMI system components. Through software “upgradeability,” existing assets can be more readily integrated with products and software from other manufacturers, and potential dependencies on existing vendors can be reduced.

P161.044 Optimizing Advanced Metering System Value and Utilization

Advanced metering infrastructure (AMI) systems have the potential to support a wide range of uses. AMI data can provide value across the utility enterprise and can be processed in innovative ways to improve distribution operations, planning, distributed resource integration, customer service, and more. The industry is only beginning to study these ancillary uses. Performance and capabilities vary from system to system, making it difficult to know what options are practical for any individual system. Specific algorithms and system configurations that yield the best performance for each system need to be developed and published so that they can be freely and consistently implemented by manufacturers.

This project helps utilities optimize the use and value of AMI. The research is aimed at discovering the full range of applications that can be supported by a given system type, documenting optimal algorithms, and using them to transform AMI data into actionable information. The project also seeks to identify applications that cannot be effectively supported, saving members time and effort.

P161.045 SCADA Protocols

Many utility systems use SCADA protocols, and increasingly, disparate devices such as distributed energy resources (DER) that may or may not be owned by the utility have begun to use these protocols. Performance characteristics, interoperability, security, and the usability of these protocols over different underlying physical media are all of interest to utility personnel. The effective use of such protocols as well as their interoperability contributes to more efficient use of resources, benefitting the general public. The focus of this research is to examine SCADA protocols to better understand all the aspects listed above.

PS161G Telecommunications

Telecommunication is essential to utilities and has an increasingly critical role in the operation of the integrated grid. In grid modernization, telecom supports higher penetrations of distributed energy resources (DER) and a greater reliance on sensors to provide situational awareness. No single

technology can meet all the widely varying requirements, resulting in complex and heterogeneous telecom networks that are challenging to manage.

The project set addresses challenges that utilities face with respect to telecommunications:

- Planning a scalable, multi-service network that meets current and future needs.
- Leveraging technologies and best practices from commercial telecom operators (both wireline and wireless).
- Resolving barriers to complete the transition of the wide area network (WAN) to packet technologies.
- Evaluating new technologies, including artificial intelligence (AI), business models, and partnerships to make fiber deployment in more locations economically viable.
- Addressing industry challenges with potential interference to licensed microwave links.
- Enabling wider use of wireless networks by identifying suitable licensed wireless spectrums and optimizing the use of available spectrum with AI and machine learning (ML).
- Stewarding the standards to enable interoperability and interchangeability.
- Identifying the options available with commercial wireless and shared networks and navigating the transition to 5G networks.
- Evaluating wireless technologies and network configuration approaches to deliver low-latency communications to support DER protection and other latency-sensitive use cases.
- Developing approaches to maximize the performance of wireless technologies in unlicensed spectrums and developing strategies for alternatives when unlicensed bands can no longer support desired utility applications.
- Evaluating the role of AI in improving telecom network operational efficiency.
- Leveraging AI to improve telecom project risk management.
- Developing resilient telecommunications infrastructure and evaluating satellite and other technologies for backup and emergency operations.
- Developing best-in-class telecom network management, visualization, and control systems that take advantage of advances (such as AI, software-defined networking, software-defined WAN, and network functions virtualization) while maintaining reliability, resilience, and cyber security.

P161.053 Wide Area Networks

The wide area network (WAN) is the backbone of the utility telecommunications infrastructure. As new requirements and applications are deployed to support grid modernization, the WAN must expand in capacity and geographic presence.

The WAN physical plant is increasingly built on fiber, while microwave links and leased services continue to play an important role in many networks. With the opening of the 6-GHz band to unlicensed devices, maintaining the reliability of licensed utility microwave systems poses an increasing challenge. For many utilities, the long-term goal is to migrate the WAN to incorporate more fiber, but the economics are challenging. New approaches are needed to enable a viable business case for fiber. These approaches involve innovative materials and construction techniques, leveraging opportunities with other entities that also need fiber-rich metropolitan networks, predictive maintenance with artificial intelligence (AI), and providing capacity for broadband services. Leased dark fiber and bandwidth from communications service providers will likely remain necessary for some portion of many utility WANs for multiple reasons. The next-generation optical network architecture becomes possible when the physical plant is fully fiber. Regardless of ownership, similar challenges and best practices apply.

In the network architecture, the transition to fully packet-based networks is still underway. There is a need to understand the available technologies, best practices, and the role of AI for network architecture, configuration, and operation. These include the use of packet networks for protection and evaluating the use cases for software-defined networking (SDN) and network function virtualization in the WAN for

information technology (IT) and operations technology (OT) networks, as well as evaluating the role of AI across the various system life cycle stages.

The objectives of the project include:

- Identify and mitigate interference to 6-GHz microwave systems from Automated Frequency Coordination (AFC)-controlled standard power and very low power (VLP) outdoor, and Low Power Indoor (LPI) unlicensed equipment
- Understand trade-offs between private and leased WAN circuits
- Ensure that latency requirements for teleprotection and precision time synchronization are met when running over packet networks under normal and abnormal circumstances
- Identify, analyze, and quantify business cases for expanded fiber deployment, including opportunities arising from IT/OT convergence, AI tools and techniques, and broadband service opportunities
- Identify, analyze, and evaluate best practices for WAN operation and management and for improving WAN reliability, availability, and optimizing service provisioning and orchestration via AI/machine learning (ML)

P161.054 Field / Neighborhood Area Networks

Utilities are faced with demands to provide communication to an increasing number of field devices, and the average amount of data from each device is also increasing. At the same time, there is a critical shortage of suitable spectrum to operate a field area network (FAN) using wireless technologies. Unlicensed spectrum is crowded and unpredictable, and there are ongoing concerns about the cost and availability of commercial cellular services. Utility FANs must continue to perform at a high level, especially during man-made or natural disasters. This highlights the question of the appropriateness of relying on commercial service providers versus a utility's investment in its own communications infrastructure.

Private long-term evolution (LTE) and 5G are emerging as leading solutions for the integrated FAN. The standards-based technology has an extensive product ecosystem. For operating a FAN in spectrums not suitable for LTE, there is a wide variety of appropriate wireless products available, but standards and interoperability are more limited. Because of the wide range of cost, reliability, and performance requirements, no single FAN technology can be considered universal. Multiple-tier architectures and ongoing development of standards for specialized FAN requirements provide a path forward, but the tradeoffs of the overall system architecture are still challenging. As 5G technology matures, commercial network operators are able to offer new capabilities on the spectrum between public and private networks, such as 5G network slicing, which expand the set of options to utilities.

The objectives of this project include:

- Understand and define the tradeoffs and various technologies and service offerings between private wireless networks and commercial cellular
- Achieve reliability and resilience in a multi-technology wireless network
- Improve interoperability and coexistence (understanding how wireless technologies work together, identify potential conflicts) in the FAN
- Research the role of artificial intelligence (AI) in each stage of the FAN system life cycle; help utilities develop and implement an AI strategy as part of FAN deployment efforts
- Understand the specific communication requirements for distributed energy resources and the related systems for protection, such as direct transfer trip (DTT)
- Evaluate options for licensed and shared spectrum for FAN applications and private (LTE) networks
- Understand the role of AI to manage prioritization and quality of service (QoS) on constrained or impaired wireless networks

- Utilize the unlicensed spectrum, understanding current capacity limits and future trends that could impact capacity
- Understand low-power, wide-area sensor networks (LPWANs); Internet of Things (IoT) networks; and 5G networks—and their effectiveness and fitness for utility purposes

P161.055 Telecommunications Planning and Management

Modern utility telecommunication networks are heterogeneous and complex. Various types of network technologies are used to implement different network tiers and to optimize for application- or location-specific requirements. Long-term success requires best-in-class processes, systems, and tools for management and planning, which are continually evolving. Utility telecommunications managers need an understanding of the best approaches for network planning and management. This includes incorporating visualization techniques and identifying actionable network performance metrics as part of ongoing reliability management efforts.

New networking technologies developed for commercial carriers (such as software-defined networking [SDN] and network function virtualization [NFV]) can play a role in multi-service utility information technology (IT) and operations technology (OT) networks. The strategic planning processes must be considered carefully to ensure that network expansion and upgrade cycles are aligned with grid infrastructure and operational upgrades that rely on the telecommunications network. Similarly, ongoing advancements in artificial intelligence (AI) and machine learning (ML) is expected to have a significant impact on the operational efficiency of critical communications infrastructure.

The objectives of this project include:

- Understand the current status of telecom network planning and operation in the utility industry.
- Develop insight and analysis on best practices for utility telecommunications network management.
- Research network planning, engineering, and operation developments and practices recommended by telecommunications industry forums and investigate applicability to the utility industry.
- Investigate the rapidly evolving AI/ML landscape and explore how it can help utilities improve the operations efficiency of their telecommunication networks.
- Investigate the role AI/ML can play in helping utilities address skills shortage challenges in the field of telecom network planning and operation.
- Investigate the roles that tools, techniques, and processes for fault management, performance management, geospatial informatics, dispatch management, etc. play in managing the “operational availability” of a utility telecom network.
- Identify how SDN and NFV can be applied to improve flexibility and resilience and reduce costs, without sacrificing cyber security.
- Build more accurate network modeling, planning, and simulation tools.
- Explore techniques and develop frameworks to quantify the economic value derived from the integrated telecommunications network.
- Explore techniques to quantify the value to be gained from investments in telecom network operation. This includes both financial value as well as technical value in terms of system effectiveness and reliability management.
- Identify and implement best tools for automation and documentation (logical network inventory as well as physical), including identification of naming conventions from carrier best practices.
- Evaluate communications requirements and technology solutions for digital worker, augmented reality/virtual reality (AR/VR), and related use cases for training, inspection, and remote workers.
- Understand best practices for utility telecommunications organizational capabilities, structures, and life cycle management.

P161.056 Telecommunication Standards Engagement

Although standards such as long-term evolution (LTE) and Wi-Fi have revolutionized consumer and commercial wireless service, many utilities remain constrained by proprietary communications systems. Standards development is an ongoing process because existing standards continue to evolve, and new standards are proposed and developed. A two-way flow of information is needed to ensure a desirable outcome for utilities and their telecom needs. First, the standards groups need input from participants who can contribute and articulate the requirements and desires of the utility industry. Second, the utility industry needs to be informed of the standards development pipeline and its relevance and impact to their own planning cycles and procurement.

Utility telecom networks use a combination of wireless, copper, and fiber media and operate wireless networks in both licensed and unlicensed spectrums. The licensed spectrum may be utility-owned or accessed through a commercial cellular operator. Standards-based communications technologies enable interoperability, vendor choice, a broader product ecosystem, and, ultimately, lower costs. Of the wide range of wireless communications technologies that are deployed today or might be deployed in the future, many originate from standards development activities that this project participates in and tracks.

PS161H Geospatial Intelligence

This research focuses on providing utilities with leading practices for optimizing the performance of geospatial systems and data. Geospatial technologies provide unique capabilities utilities can leverage to integrate data from multiple systems to make better-informed decisions, create operational efficiencies, reduce costs, and increase safety and grid resiliency. Geographic information systems (GIS) are an essential tool for the electric utility industry's transition to net zero by 2050.

The Geospatial Intelligence project set focuses on the science and technology of acquiring, storing, cleaning, modeling, analyzing, producing, presenting, and disseminating geospatial data sets. Collaborative research in this project set will help enable utility GIS professionals to:

- Expand the enterprise value of GIS data, geospatial systems, and platforms at electric utilities
- Develop effective geospatial analytic capabilities
- Effectively manage large geospatial data volumes
- Enhance GIS data quality and develop consistent processes
- Deliver new geodata services for advanced planning and operations applications

P161.059 Geospatial (GIS) Data Practices

This project focuses on optimizing geospatial data performance for electric utilities worldwide. Geographic information systems (GISs) consolidate data from multiple disparate systems, internally and externally, based on location. Developing a comprehensive data strategy that includes geospatial data is imperative for electric utilities to rely on their data portfolio as an asset.

P161.060 Geospatial Innovations

Utilities are facing significant challenges in reducing fossil fuel generation, escalating the growth of distributed energy resources connecting to the grid, and the electrification of transportation. The grid transition requires adding new network devices, sensors, and data feeds. This unprecedented change in the industry will require more advanced tools and methodologies to manage a successful transition. Geographic information system (GIS) applications provide utilities with a common operating picture by integrating numerous systems into a single view.

This project provides insights into innovative geospatial applications that electric utilities can leverage to optimize the value of their geospatial investments.

161.061 Geospatial Intelligence Analytics and Visualization

Geographic information systems (GIS) at electric utilities support many grid operations and planning applications by providing a spatially accurate network model and detailed facility information that is valuable for planning studies and operations. GIS arose from the need to support facilities management, design, construction, and work management. The power industry will need to develop effective geospatial network analysis techniques to meet the growing grid challenges utilities face.

The focus of this project is on developing innovative geospatial analysis techniques to support multiple utility business processes.

To join, contact your Information, Communication, and Cyber Security Technical Advisor

West: Brian Dupin bdupin@epri.com

Northeast: Barry Batson bbatson@epri.com

Southeast: Chuck Wentzel cwentzel@epri.com

Canada: Warren Frost wfrost@epri.com