



GE Digital Energy

TELECOMMUNICATIONS for POWER UTILITIES

Your partner for
reliable and secure
communication
solutions

www.gegridsolutions.com

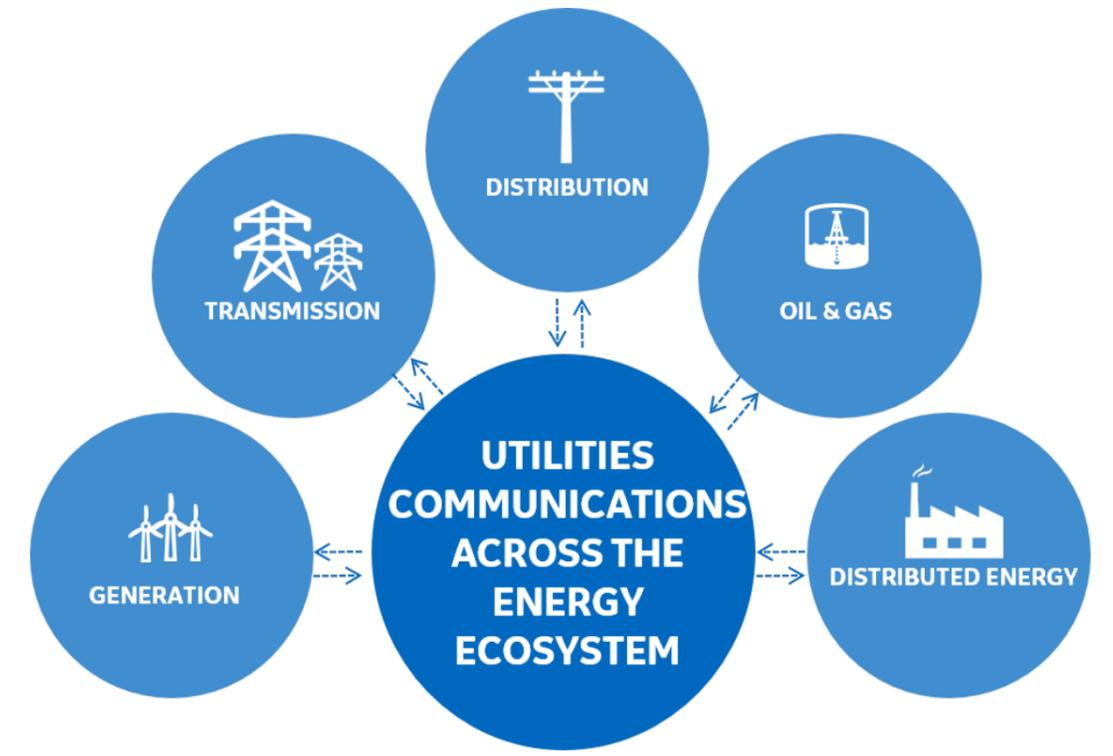


Utilities Communications

Providing Fast, Reliable and Secure Communications for Grid Operations

GE is a full-scope provider of operational telecom solutions and dedicated products for electrical power delivery systems. World-wide experience in large turn-key projects has given GE a utility-grade vision of mission-criticality and real-time performance, as well as an outstanding expertise in the migration of critical telecom network infrastructures. This vision, combining telecom technology, network architecture and operational performance, makes GE a reliable partner for providing power system communication networks.

The GE telecom portfolio is composed of advanced but proven technologies adapted for operation in harsh electromagnetic and climatic conditions encountered in different HV plants across the world and type-tested according to international industrial and electrotechnical standards. Complexity is confined into easy-to-use intelligent operational tools allowing error-free site configuration and commissioning without in-depth knowledge of telecom technologies.



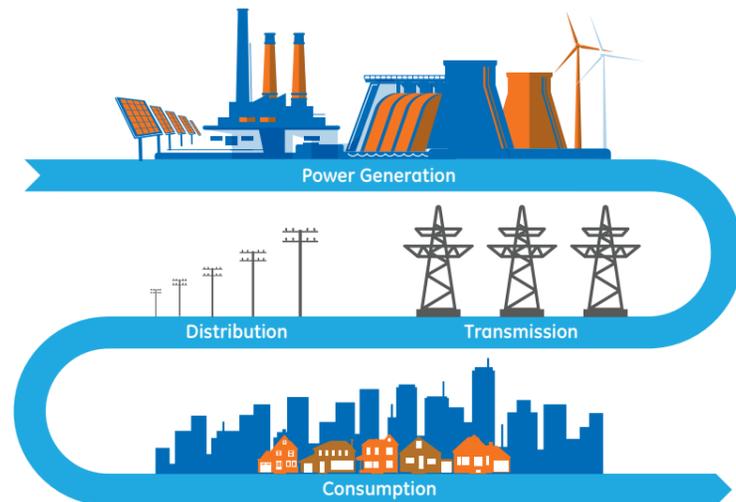
Telecom Challenges for T&D Power Utilities

Whatever the scope and scale of your electrical power utility, the secure operation of your power system relies on the prompt and reliable exchange of information between electrical installations and decision platforms. Your facilities generally spread over a wide area and may include various economic and technical feasibility contexts leading to a network implemented through multiple technologies.

The overall telecommunication network must constitute a well-coordinated, maintainable, stable and standard-based infrastructure delivering a predictable and secure communication service for the operational mission-critical applications of the power system. The on-going “smart” evolution of the power grid further requires the network to be ‘future-open’ while assuring optimal operation of legacy systems during the long phase of migration.

Particularly challenging issues in this operational network are:

- Prompt information transfer – Protection & control services require low latency and low delay variation
- Deterministic operation– Keeping tight control of time and path across the network and fast restoration of services after disruption
- High operational service availability in harsh conditions and despite very low active-to-idle state
- Long power autonomy in case of power outage for dependable communications
- Preserve the level of cyber-security of the information system across the network
- Maintain the complexity of substation telecom network at a level compatible with field-worker skills
- Assure life-cycle stability for network components installed at substations to avoid continual upgrades and updates disturbing critical applications



1.5bn
connected
devices
managed by
utilities by 2020

Over \$31bn
investment
in smart grid
projects by 2020 in
Asia-Pacific region

Substantial
loss of revenue
and legal
consequences
due to grid
failures



Telecom Solutions for Critical Utility Services

Committed to the Utility Domain

Deploying an appropriate telecom solution is not just assembling blocks of advanced technology. It assumes proper understanding of applications, requirements and constraints, their evolution in time, and following adequate migration paths to avoid any loss of service continuity during “transformation phase” operations and anomalies. Some essential aspects are:

- Proven technologies to allow utility full control of its network
- Adapted to harsh electromagnetic and environmental conditions
- Reliable and secure building blocks
- Confined complexity for error-free O&M without in-depth specialized skills

GE as an energy specialist with a long history of experience in every aspect of the electrical power system, provides telecom solutions for these particular frameworks. Our aim is to enable utilities’ investments optimization, while meeting functional requirements and capabilities at the right time with appropriate architecture, technologies and associated processes and skills.

GE telecom solutions for transmission and distribution grid networks comprise both portfolio-based recurrent sub-system and market-selected and validated project-specific products and solutions.



Transmission Grid Solutions

Designed By Energy Experts

For transmission grids, GE solutions include optical transport platforms providing SDH/PDH as well as packet switched connectivity catering to different operational network situations. Ethernet over SDH, native Gigabit Ethernet (GbE) transport over fiber, or over wavelength as well as MPLS can be implemented in this way. Complete with multi-service TDM/Packet Access platforms and L2/L3 GbE substation aggregation switching, GE optical networks for transmission grids can cover any network requirement from the core to substation access, and from purely conventional multiplexing to pure packet networks with all the necessary intermediate migration steps.

The proposed solutions emphasize the key issue of smooth and gradual network migration of services from the time division multiplexed payload into a secure and deterministic packet environment. Coarse and dense wavelength multiplexing and associated optical amplification allow the co-existence of operational and corporate, legacy and new, or protection and other services on the same fiber infrastructure where extra fibers are not available.

Power line carrier (PLC), a technology employed in the HV grid and provided by GE since the early days of power system communications, is still a viable part of GE’s telecom solution. In its innovative design and modern technology, the PLC allows a robust back-up solution for the most critical services, an economical way to carry protection signaling and an Ethernet bridging solution to substations with no optical fiber access.

Teleprotection signaling, another longstanding part of GE telecom solutions, can accompany a power utility’s gradual migration from conventional substation protection and control to networked IEC 61850 automation.

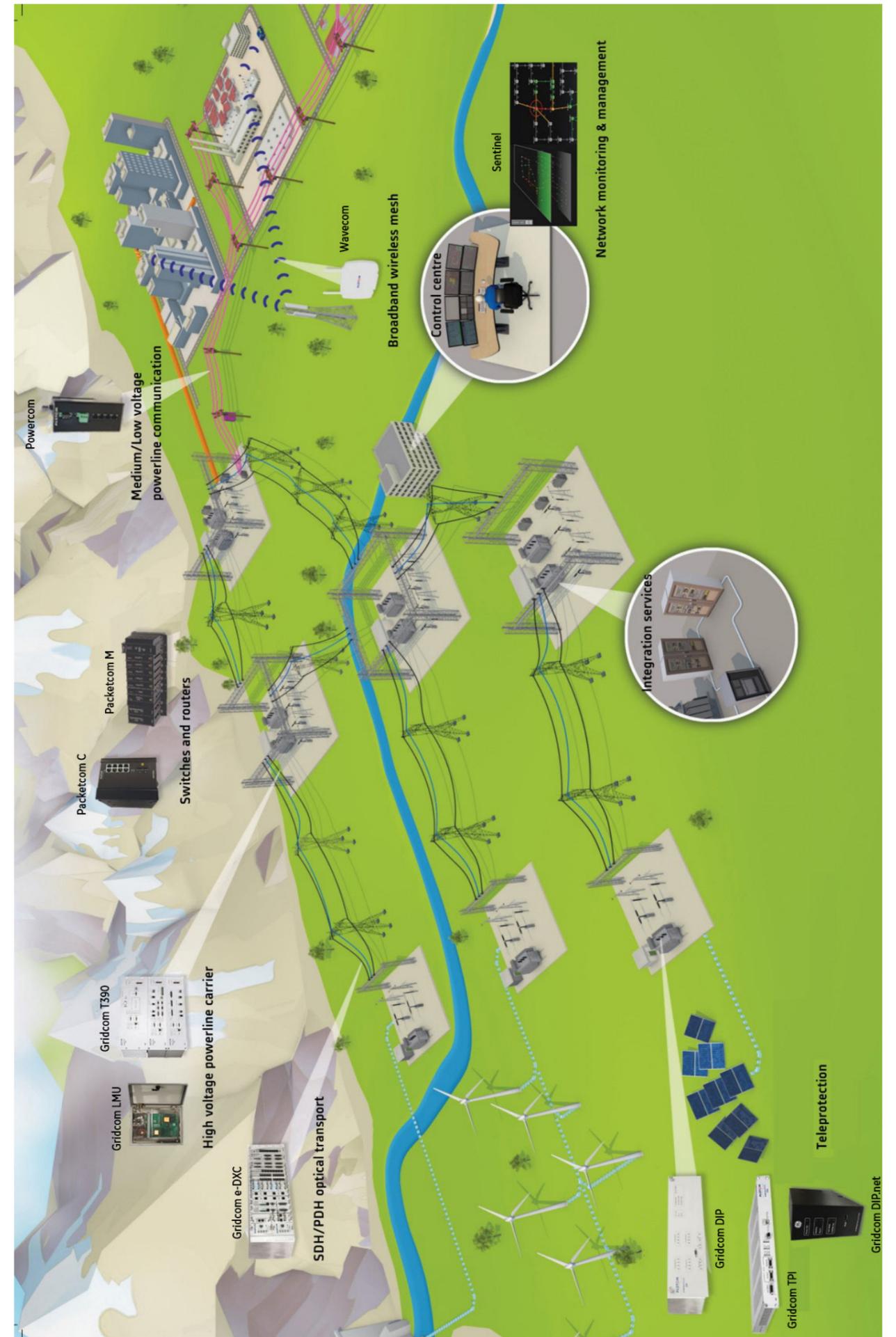


Distribution Grid Solutions

In the distribution grid, the key issue is not legacy systems and migration, but economical, reliable, resilient and secure coverage of a large number of sites and assets dispersed over a constantly evolving electrical grid. This situation is further amplified with the deployment of distributed renewable energy resources in the grid. GE's multi-tier distribution telecom solution provides a scalable infrastructure that can grow together with the gradual deployment of smart applications, while remaining at all times under the power utility's full control and provided with adequate power autonomy to assure service continuity even under power blackout situations. In order to cover the diversity of encountered situations, GE based its solution on three complementary system building blocks combining their strengths to overcome the diversity of distribution environments. These systems can be associated as necessary to work together as a single solution.

- Optical fiber constitutes a gigabit backhaul level for many distribution networks or in some particular cases such as smart cities it can constitute the main building block of the communication solution. Native switched Gigabit Ethernet and MPLS-TP in larger networks constitute the optical part of Alstom's distribution communication architecture.
- Broadband power line allows the coverage of MV and LV distribution grids with particularly low initial investment, providing an easy-to-deploy multi-megabit Ethernet infrastructure. It is also the solution for less accessible points of the grid such as underground premises.
- Broadband wireless mesh systems provide highly secure, self-organizing IP networks with up to hundreds of Mbps bandwidth over license-free or licensed frequency bands.

GE's telecom network management and monitoring platform is common to transmission and distribution solutions and is specifically designed for utility networks and operation and maintenance practice.



Telecom Offering

A Comprehensive Portfolio

From power line carrier to optical fiber, wireless and access products, GE's Utilities Communications is your trusted source for power system communication network solutions and services. GE provides reliable, leading edge solutions, technical expertise, and project execution capabilities to meet your communication needs.

GE offers a complete portfolio of advanced hardware and software, as well as comprehensive services to help successfully deploy and maintain equipment and business solutions globally.

Network and Service Management

GE's **sentinel** delivers a management solution for supervising multi-technology complex networks. Providing a platform that aggregates, correlates and visualizes telecom data from multiple network layers and technologies into user-oriented views, driving operational decisions to restore services, notify users of potential service impacts, and meet KPIs and performance metrics.

- Integrates event management, performance monitoring, incident management and other tools needed for the delivery of operational telecom services
- Federates all information exchange between O&M actors, keeping track of interactions
- Provides an information exchange tool between telecom "service using" entities (e.g. P&C, EMS, Voice, etc.) and the "service providing" entity
- Generates reports and statistics for planning network extensions and continuous process improvements



The result? Greater efficiency and productivity, assure mission-critical applications through enhanced monitoring of communication services and infrastructures, and reduced down-time and maintenance costs.

Complete, Consistent, Cost Effective and High Performance Systems

Delivering Reliable, Leading Edge Solutions to Enable Grid Information Connectivity

Technology Category	Solution
Protection & Control	Gridcom DIP. Prompt, dependable and secure transmission of protection commands in harsh electromagnetic substation environments
	Gridcom DIP.net. IEC 61850 teleprotection enabling critical communications for power system automation architectures including substation to substation exchanges
	Gridcom T390. Universal analog and/or digital power line carrier for transmission of voice, data, teleprotection and any kind of Critical and non critical signal over HV transmission lines
HV Powerline Communications	Gridcom LMU. Coupling device designed to insert and extract PLC signals from high voltage lines under optimum impedance matching
	Gridcom TPHF. High frequency teleprotection allows direct transmission of protection commands over HV transmission lines through integrated Power Line Carrier system
	Gridcom DXC. Service multiplexing and cross-connect Platform integrating HV Substation legacy interfaces and new IP routing applications
Optical Networks	Gridcom eDXC. Versatile access and transmission Platform with high service optimization
	Gridcom DXC-S. Broadband SDH transmission of information over optical fibers Associated to the HV grid
	Powercom. Broadband power line modem with integrated switch designed for communications on medium and low voltage grids
Smart Grid Communications	Packetcom. Modular, compact access and aggregation platform for operational communication networks
	Wavecom. Robust wireless routers designed to work under harsh conditions commonly found on substations and industrial applications
	MDS Orbit. Next generation wireless communications solution, supporting a diverse portfolio of radios to extend network coverage in various spectrum and geographic locations

A Worldwide Team of Experts

Skills and Resources Near to Your Business

Any significant transformation in the telecom operational network necessitates the convergence of multiple capabilities and skills ranging from technology assessment, architectural design, solution engineering and performance planning to legacy integration, commissioning, performance testing and general project management. GE encompasses all the know-how a power utility may require in its telecom transformation plan, including:

- A wide range of technical capabilities and project-related skills available in each delivery unit across the world
- Further technical and project support available at GE's center of telecom expertise, enabling shared knowledge management and technical support from other delivery centers

Moreover, because the success of any major transformation project is conditional to the build-up of internal skills for the operation and maintenance of the system, GE provides extensive training courses tailored to power utility needs either at utility premises or in one of several GE training centers.

Telecom Delivery Centers

- Europe and Africa delivery center - Paris, France
- Middle-East delivery centres - Dubai, Jeddah (KSA)
- Latin America Delivery Centre - Sao Paulo, Brazil
- South Asia delivery centre - Noida, India
- South East Asia delivery centre - Jakarta, Indonesia

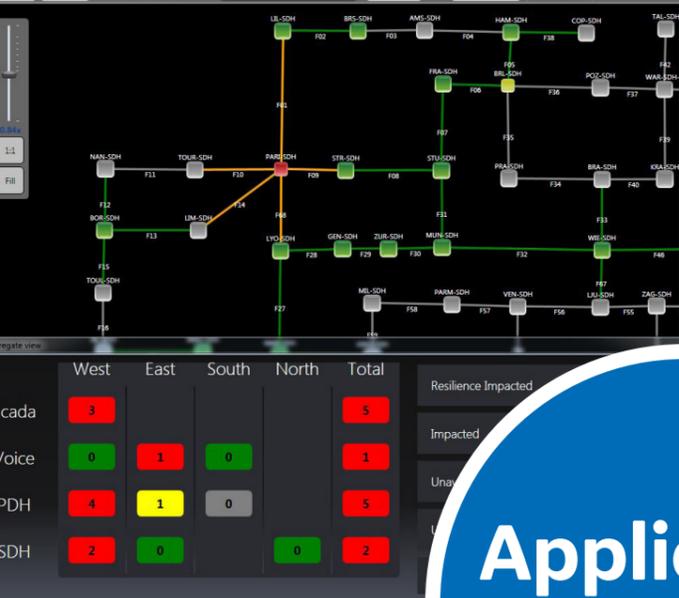
A Full Scope of Services and Capabilities

- Network design and engineering
- Performance coordination
- Project management and provisioning
- Cubicle integration and design
- Validation platforms
- Site engineering and installation
- Commissioning and testing
- Technical and project training
- Field intervention and maintenance
- Network consulting, equipment expertise and diagnostics

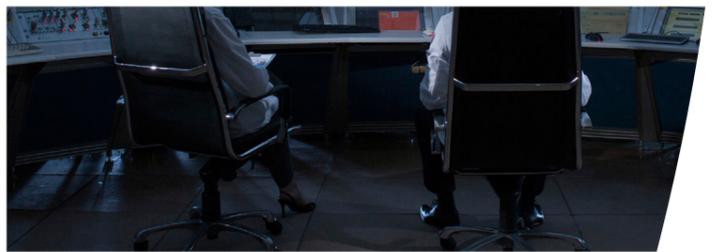
Local Resources with Worldwide Experience

Our team is global, with extensive knowledge shared between our experts and a continuous return of operational excellence on legacy and new technologies. GE has the most appropriate answers to share with your telecommunications team.





Application Examples



Project Scope

Italy

- Integration of Gridcom T390 High Voltage Power Line Carrier (HV PLC) with Terna's existing Remote Authentication Dial-In User Service (RADIUS)
- User authentication and rights authorization
- A Secure Shell (SSH) channel for communications between HV PLC hardware and remote users
- Increased hardware data processing capacity for RADIUS and SSH, while keeping original service performance

Benefits

- **RADIUS authentication ensures confidential communication for remote users**
- **Secure SSH channel guarantees data integrity**
- **Adapts to customer-defined centralized telecom user management system**
- **Improvement to existing HV PLC software and hardware platform by introducing enhanced cyber security management features**

Democratic Republic of Congo

Installation and commissioning of:

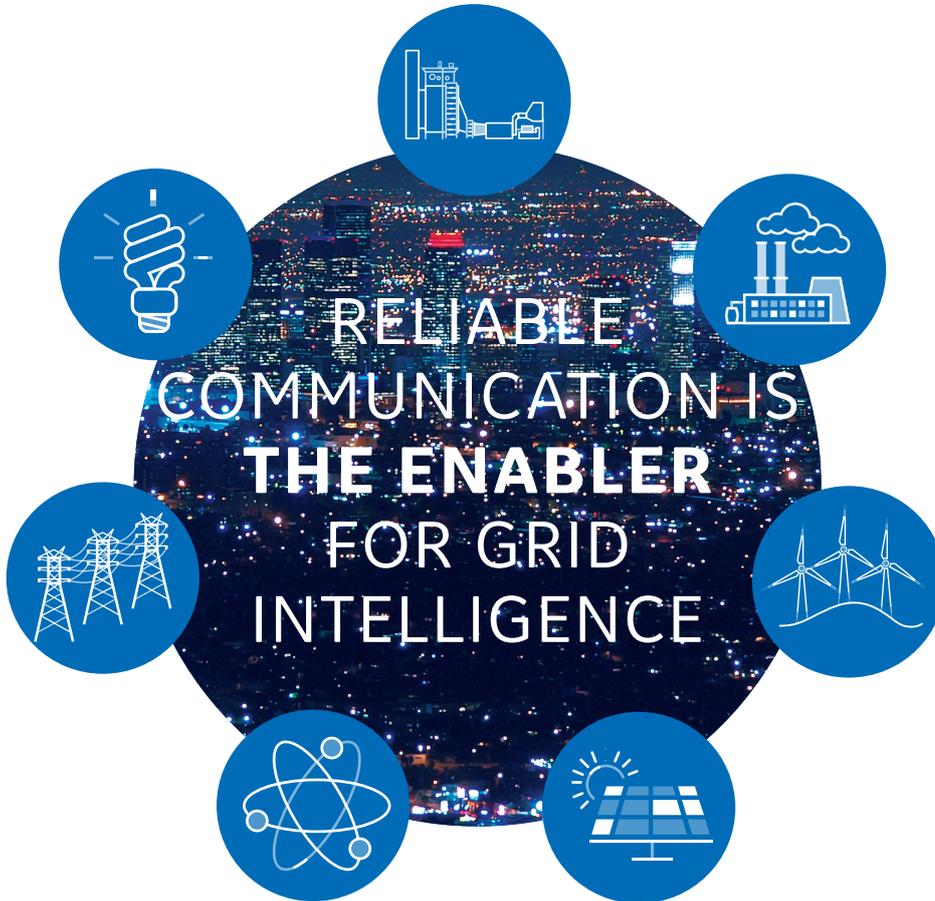
- Plesiochronous Digital Hierarchy (PDH), Synchronous Digital Hierarchy (SDH), Teleprotection (TP) and Private Automatic Branch Exchange (PABX) network with 30 telecom panels
- 29 telecom towers
- 7 solar shelters along 1500km of High Voltage Direct Current (HVDC) line
- High Frequency radio network for voice & data communications between two control centers situated 1500km apart
- CCTV system in remote shelter sites

- **Improved management of the electrical grid network**
- **Remote control of substations from both control centers, with greater protection of electrical lines**
- **Enhanced communications between operational teams**
- **Improvement of exchanges with Zambia and communications between Distribution Control Systems (DCS) located in HVDC and High Voltage Alternate Current (HVAC) substations**

Brazil

- Delivery of Dense Wavelength Division Multiplexing (DWDM), Optical Transport Network (OTN) and Synchronous Digital Hierarchy (SDH) devices
- Project documentation and drawings
- Integration of all devices and their systems
- Proof of concept and factory & site acceptance testing of OTN/DWDM, SDH and Network Management (NMS) Systems
- Local installation and supervision of OTN/DWDM, SDH and NMS system in Northwest region of Brazil
- Customer training on the new OTN/DWDM technology
- Trial operation with functional and systemic testing in a real environment
- 3-year system assurance

- **Accelerating telecommunications services by operating on fiber optics at a 10 gigabyte per second laser speed**
- **Optimization of network management in real-time, aligning operations and ensuring a continuous of energy at all times**



50+
Years Energy
Experience

Operational
in **56**
countries

Reliable **partner** for
critical power system
communication
networks

Seamless integration
of **New and Legacy
technologies** into a
Single Network

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