Enable Seamless Integrated Communications for Power Automation

- IEC 61850-3 and IEEE 1613 for Ethernet switches
- Rugged industrial design, proven standards
- High integration between serial, LANs, and WLANs
- Maximum network reliability and availability
- Flexible configuration of fiber ports, long-haul support
- 20-year industry expertise and 5-year warranty

MOXA
Industry Trends and Needs for Power Automation

Requirements for Network Reliability and Availability

Extensive and complete coverage for power grids has become important for the economic development in modern countries. The escalating demand for electricity has driven the rapid growth in constructing or upgrading the power automation systems that involve intelligent, inter-active power distribution and transmission networks to achieve higher operating efficiency, without sacrificing the reliability of electrical protection.

The main role of power utilities is to offer uninterrupted and reliable electric power to the public under harsh environmental conditions. Introducing integrated communications into automation systems is required for managing the power automation process. For power automation, interoperability, reliability, and environmental suitability have to be considered as key factors that power utilities must deal with.

Integration and interoperability in communications

A major challenge of developing power automation systems is to coordinate the vast array of standard and proprietary protocols for device and system communication. Control devices used in power automation systems, such as protective relays, controllers, switchgears, and RTUs, still adopt different legacy protocols. For better integration between automation systems, new networks must be prepared to interconnect all devices with different protocols. A standard substation communication protocol, called IEC 61850, is thus defined to satisfy all aspects of device communications for the extensibility and interoperability based on Ethernet technology.

Reliable communications for non-stop operation

The second challenge faced by system integrators is to create a reliable and non-stop communication network for power automation, as well as to optimize and prioritize the data communications between systems. In recent years, network redundancy technology is deployed as the main communication structure to guarantee the substation network availability. In addition, Ethernet protocols such as QoS, TOS/DiffServ, VLAN, IGMP, and GMRP are also widely adopted to ensure that networks are deterministic.

Suitability for harsh substation environments

Harsh environmental conditions can cause a threat to the non-stop operation for power automation. Substations that are required to distribute electric power over a vast territory are often located outdoors under extreme temperature conditions. Besides, high-voltage substation always entails high EMI interference that could weaken the stability of data communications.
Moxa’s Integrated Communications for Power Automation

As a leading, world-class manufacturer of industrial-grade device networking, Moxa offers complete communication network solutions that well satisfy the strict, many-folded requirements for power automation. For ultimate reliability and interoperability in substation communications, Moxa has introduced IEC 61850-3 and IEEE 1613 compliant Ethernet switches, industrial embedded computers as IEC 61850 protocol conversion gateways, and secure terminal servers for connecting legacy devices. The core competences of Moxa’s substation communication solutions include:

**IEC 61850-3 & IEEE 1613 compliance**
Both IEC 61850-3 and IEEE 1613 defined the highest standard of EMI immunity and error free communication requirements for network equipments used in substations. Moxa's substation Ethernet switches comply with IEC 61850-3 and IEEE 1613 that are capable of protecting against various environmental threats.

**Better integration with legacy protocols**
In order to seamlessly integrate existing devices that run with proprietary protocols, Moxa provide substation gateway with IEC 61850 compliant software, which can handle complicated protocol conversions to reduce cost and improve efficiency. Additional solution includes secure terminal server with redundant dual fiber LAN capability to connect legacy devices for power automation.

**Advanced redundancy**
To maximize network availability, Moxa’s Ethernet switches and serial device servers support the fastest ring redundancy within 20 milliseconds and integrated dual redundant VAC/VDA power inputs.

**Enhanced determinism for data transmission**
In response to massive amount of data transmitted over utility-wide networks, High-performance fiber-optic gigabit Ethernet has become known as a future-proof solution for broad bandwidth and real-time communications. Together with high-performance gigabit features, enhanced traffic management protocols, such as QoS, TOS/DiffServ, IGMP snooping, and GMRP, make data transmissions more deterministic.

**Well-suited for harsh environments**
Moxa’s device network products provide superior EMI/RFI shielding and fiber-optic cable to minimize harmful interferences in a high-voltage environment and fulfill long run transmission needs for substations. Extended temperature operation is offered to withstand temperature-varied condition in substations.
Deliver Versatile, Reliable, and Robust Communication Networks

### Power Plant

1. **EDS-728** DCS System Ethernet Switch
   - 24+4G-port Modular Gigabit Managed Switch
   - Various media modules offered: RJ45, fiber, SFP ports
   - Gigabit Turbo Ring and RSTP/STP (IEEE802.1W/D) for Ethernet redundancy
   - Advanced management and security features

2. **ThinkCore V481** x86 Embedded Computers
   - x86 Ready-to-Run Embedded Computer
   - 8 software-selectable RS-232/422/485 serial ports
   - 10/100 and 10/100/1000 Mbps LAN ports for network redundancy
   - Fanless design, wide temperature model available

3. **NPort IAS150/5250** DCS System Device Server
   - 2- or 1-port Industrial Device Server
   - Versatile socket operating modes, including TCP Server, TCP Client, UDP, and Real Com driver
   - 2- or 4-wire RS-485 with patented Automatic Data Direction Control
   - 10/100BaseT(X) (RJ45) or 100BaseFX

4. **VPort 351** Video Surveillance
   - Full Motion, 1-channel MPEG4/MJPEG Industrial Video Encoder
   - Video stream up to 30 frames/sec at full D1 (720 x 480) resolution
   - Pre/post-alarm recording function, 2-way (1 in/1 out) audio supported
   - -40 to 75°C operating temperature model available

### Substation Automation

5. **PT-7828** IEC 61850-3 Layer 3 Ethernet Switch
6. **PT-7728** IEC 61850-3 Layer 2 Ethernet Switch
   - 24+4G-port Gigabit Modular Managed Ethernet Switch
   - Fan-less operation at extended temperature range of -40 to 85°C
   - Integrated, dual redundant power supplies of 24/48 VDC or 110/220 VDC/VAC
   - Turbo Ring and RSTP/STP for Ethernet redundancy
   - Various media modules offered: RJ45, fiber or SFP ports

7. **ThinkCore DA-662** Solution for IEC 61850 Gateway
   - Ready-to-Run, RISC-based Embedded Computer
   - Ready-to-run embedded Linux or Windows CE 5.0
   - 19-inch 1U rackmount design, 100 to 240V AC/DC power input
   - Fanless, low power consumption

8. **NPort 6450** Secure Terminal Server
   - Dual Fiber Optical LAN, Redundant Terminal Server
   - Dual redundant LAN ports with fiber optic support
   - Support RSTP redundant data communication protocol
   - Secure Ethernet data mode for TCP server, TCP Client, Pair Connection, and Real COM driver
   - Easy-to-use LCM (Liquid Crystal Module) interface for IP address configuration

9. **CN2650** Dual LAN Terminal Server
   - 16- or 8-port Dual-LAN RS-232/422/485 Terminal Server
   - LCD control panel for easy on-site management
   - Dual LAN with 2 IP addresses and 2 MAC addresses
   - Redundant COM with 2 active network connections
   - Dual host redundancy

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**Integrated Solution for EMS/DMS, Fault Recording and AMR**

**EMS/DMS**

- **IEC 61850-3 Ethernet Switch PT-7828/7728**

- **Data Acquisition Server NPort 6450**
Integrated Solution for Substation Automation

Fault Recording

11 PT-7324 IEC 61850-3 Smart Ethernet Switch
- 22+2G-port IEC 61850-3 and IEEE 1613 Certified Modular Ethernet Switch
  - Fan-less operation at extended temperature range of -40 to 85°C
  - Port-based, IEEE802.10 VLAN for enhanced security, 802.1p priority queues, port-based QoS
  - Integrated, dual redundant power supplies of 24/48 VDC or 110/220 VDC/VAC

Fault Recording

12 ThinkCore DA-662 Data Acquisition Server

Fault Recording

13 ThinkCore W325 Wireless Embedded Computer
- Mini RISC-based Ready-to-Run Wireless Embedded Computer with GSM/GPRS
  - Quad band GSM/GPRS 850/900/1800/1900 MHz cellular communication
  - GPRS Class 10, Coding Scheme From CS1 to CS4 supported
  - Robust, fanless design
  - 10/100Mbps Ethernet support

Fault Recording

14 ThinkCore IA241/IA261 Embedded Computer
- RISC-based Industrial Ready-to-Run Embedded Computer
  - Reliable and industrial-grade design to meet IP30 demand
  - -40 to 75°C wide temperature models available
  - 4 Serial Ports, 4 DI Channels, 4 DO Channels
  - Dual Ethernet, PCMCIA, SD, and USB Host

AMR

15 OnCell G2150I GSM/GPRS Modem
- Isolated Quad-Band Industrial GSM/GPRS Modem
  - Quad-band 900/1800, 850/1900 MHz GSM/GPRS
  - GPRS class10
  - Circuit-switch data mode up to 14,400 bps
  - Separate RS-232 and RS-422/485 (2w/4w) connectivity

AMR

16 ThinkCore W325 See  features

AMR

17 ThinkCore IA-241/IA261 See  features

AMR

18 ThinkCore DA-662 See  features
Why Substations Need Ruggedized Ethernet Networks

Utilities are beginning to replace many legacy and expensive proprietary technologies with the flexibility and cost effectiveness of Ethernet for mission-critical substation LANs. Since substation environments tend to be extremely varied, making Ethernet networks reliable and rugged is essential to achieve higher reliability, availability, and uptime of substation communications.

**Strong electromagnetic interferences**

The EMI stress in high voltage substations may cause errors or equipment damage in electronic communications. The general immunity standards for industrial environments are insufficient for substations. IEC 61850-3 specifies environmental and EMI immunity requirements for network equipment used in substations. IEEE 1613 is another industry standard that offers error-free device operation for challenging substation environments.

**Long-haul transmission and EMI Threats**

Fiber optic transmission offers the benefits of greater EMI shielding, long-haul transmission, higher bandwidth and avoidance of ground loops, making it suitable for extending Ethernet into power utility substations. Normally, optical fiber is ideal for networking RTUs, relays, and IEDs in a substation because it is compatible with both serial and Ethernet connections, and is especially easy to deploy for remote transmission throughout the large substation area. Copper cabling is usually used for short-run Ethernet interconnection and easily installed for both 10 Mbps and 100 Mbps speeds. Therefore, most substations use a mixture of fiber and copper cabling to construct a flexible and cost-effective Ethernet network.

**Extreme temperature-variations**

Since the temperature boundary conditions found in substations can be extremely varied, substation LANs must be capable of operating reliably across a wide temperature range. The use of cooling fans is unacceptable under vibration conditions, since they downgrade the total reliability of the devices.

**Challenges to maintaining high network availability**

A substation Ethernet LAN is an integral part of a mission critical protection and control systems that must perform extremely reliably and continue to operate under challenging situations, accidental network disruptions, and equipment failure. To ensure high network availability, network redundancy must be implemented and respond in milliseconds. In addition, redundant power for equipment is necessary for the backup source.

**Strict Requirements for Substation Ethernet Switches**

- Compliant with IEC 61850-3 for a high level of immunity to electromagnetic interference (EMI)
- Compliant with IEEE 1613 standards for error free communications performance under EMI stress
- Rapid network fault recovery and dual redundant power supplies for higher network availability
- Fan-less design enhances the overall reliability of devices
- Extended temperature tolerance is required to withstand climate extremes
- Optical fiber is preferred for immune connectivity and remote transmission
Suitable for Retrofit and Upgrade Projects

Due to the long life span of substation systems, substations are on the lookout for the most reliable components. In response to specific requirements for substations, Moxa has made substation EMI conditions and high network availability two of the main requirements for the design of its line of substation Ethernet switches.

Meeting IEC 61850-3 and IEEE 1613 standards for excellent RFI/EMI shielding

Moxa’s PowerTrans series of substation Ethernet switches comply with IEC 61850-3 and IEEE 1613, and are capable of protecting against electrical surges, EMI, and other environmental threats. These proven Ethernet switches also meet NEMA TS2 for traffic control equipment, in addition to EN50155 and EN 50121-4 standards for railway applications.

Tolerant of temperature extremes

To perform flawlessly in climate-uncontrolled utility substations and industrial environments, these rackmount Ethernet switches are designed for completely fan-less operation in a wide temperature range of -40 to +85°C.

Maximum availability of ruggedized Ethernet switches for substations

High availability of rugged substation Ethernet switches is required to offer the Ethernet network backbone that all networked IEDs connect to. The PowerTrans Ethernet switches feature the highest level of reliability by offering Gigabit Turbo Ring and RSTP/STP (IEEE802.1W/D) technology) with faster network fault recovery (under 20 milliseconds). Maximum uptime is enhanced by the use of integrated dual redundant power supplies for 24/48 VDC, or 110/220 VDC/VAC, offering maximum assurance and flexibility.

Support for the highest fiber optic port densities

Designed to be flexible and expandable, Moxa’s modular PowerTrans series with multiple fiber options (up to 22 fiber ports per switch) is ideal for connecting devices that need to communicate and acquire data from distributed relays, RTUs, PLCs, and IEDs to the central control area. Fiber is available in both single mode and multi mode with multiple connector types (SC, ST, and LC).

Up to 4 gigabit ports and modular flexibility

Moxa’s PowerTrans Ethernet switches support up to 24 fast Ethernet ports and four Gigabit Ethernet ports. Two different gigabit modules that can be used to build a fiber optic gigabit backbone are available for copper or fiber connectors, redundant ring, or redundant gigabit uplinks. The modular design gives users a flexible media configuration to fit their specific application, and makes it easier to implement future plant upgrades and expansions.

Moxa’s IEC 61850-3 Ethernet Switches

<table>
<thead>
<tr>
<th>Model</th>
<th>Port Interface</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT-7828</td>
<td>28 4 24</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
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<tr>
<td>PT-7728</td>
<td>28 4 24</td>
<td>✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔</td>
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<tr>
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<tr>
<td>PT-7324</td>
<td>24 2 22</td>
<td>☑ ✔</td>
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</table>
Ready to Run Industrial Embedded Computer

Meets the unique requirements of Substation Protocol Gateway

Power automation requires a complicated and sophisticated architecture that forces system integrators and software programmers to develop optimal solutions that can withstand tough conditions. The solutions require many powerful controllers that offer multiple serial ports for legacy device connection and that can perform well for front-end tasks, such as data acquisition, numerical computing, data distribution, and remote device monitoring and management. System network redundancy is essential to ensure the continuous system operation of power automation applications. In addition, extreme temperature changes must be conquered to maintain system stability.

Special-purpose software is preferred for combining communication protocols such as Modbus and IEC 61850 with open communication standards in substation automation. Front-end communication computers with EMC Level 4 certification can be used to establish a reliable solution for substation automation. In addition, various industrial-grade form factors and wireless solutions are required to maximize installation flexibility and simplicity for any complex situation.

Interoperability, reliability, and versatility

Moxa’s embedded computers have a fan-less cooling design and operate in a wide temperature range, coupled with industrial rugged features to satisfy the harsh requirements of the power utility market. With up to 16 serial ports, Moxa’s embedded computers can connect many remote devices to perform front-end tasks extremely efficiently. With their multi-LAN design, Moxa’s products guarantee non-stop data communication and maximum uptime.

Moxa’s embedded computers can be managed easily with the Moxa Protocol Converter (MPC) software tool, which can handle complicated protocol communications, significantly reducing the cost and time required for software development and system integration. In addition, Moxa’s embedded computers support different mounting options and wireless connection to make installation easy in any industrial environment. The ThinkCore DA-662 can help establish the IEC 61850 gateway platform that standardizes all aspects of communication protocols in substations.

Moxa Embedded Computers

<table>
<thead>
<tr>
<th>Model</th>
<th>ThinkCore DA-662</th>
<th>ThinkCore W325</th>
<th>ThinkCore IA241</th>
<th>ThinkCore IA261</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>RISC-based Rackmount Embedded Computer</td>
<td>RISC-based Embedded Computer</td>
<td>RISC-based Embedded Computer</td>
<td>RISC-based Embedded Computer</td>
</tr>
<tr>
<td>Mounting</td>
<td>Rackmount</td>
<td>DIN-Rail</td>
<td>DIN-Rail</td>
<td>DIN-Rail</td>
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<tr>
<td></td>
<td>Wall-mount</td>
<td>Wall-mount</td>
<td>Wall-mount</td>
<td>Wall-mount</td>
</tr>
<tr>
<td>Serial</td>
<td>16 Serial Ports</td>
<td>2 Serial Ports</td>
<td>4 Serial Ports/DIO</td>
<td>4 Serial Ports/DIO</td>
</tr>
<tr>
<td>LAN</td>
<td>4 LANs</td>
<td>1 LAN</td>
<td>Dual Redundant LANs</td>
<td>Dual Redundant LANs</td>
</tr>
<tr>
<td>Wireless</td>
<td>x</td>
<td>GSM/GPRS</td>
<td>via PCMCIA</td>
<td>x</td>
</tr>
</tbody>
</table>

* Model with Isolation function-ThinkCore DA-662-I is coming soon.
Networking Serial Devices for Power Automation

**The evolution of substation communications**
Trends in the field of substation communications are beginning to migrate to Ethernet connections. Even today, many devices in power substations use a serial interface to communicate with remote SCADA systems. Due to the huge investment of substation communication systems and the necessity for system reliability, how to migrate the system from traditional serial to Ethernet is an issue for this market. Terminal servers with the ability to connect serial devices directly to Ethernet are the best solution for responding to current trends and evolving requirement.

**20-year experience in Serial Connectivity**
With 20 years of experience with serial-enabling technology, Moxa continues to provide the best solution for EMS, DMS, and other systems in the electric power utility market. Customers include industry leaders such as ABB, Siemens, Areva, Schneider, and Nari.

**Secure terminal server**
To avoid EMI noise interference in substation environments, most system integrators use fiber optic cable to replace Cat. 5 cable. The NPort 6000 series provides 2 fiber optic Ethernet ports for EMI noise immunity. In addition, the NPort 6000 series supports 802.3w RSTP (rapid spanning tree protocol) to connect two Ethernet ports to different Ethernet switches. One Ethernet port can be configured as a primary path and the other as a back-up path. Once the primary path is damaged, the NPort 6000 will activate the back-up connection immediately to ensure no-data-loss communication.

**Advanced modbus gateway**
Modbus is the standard interface used for communicating between many industrial devices, such as PLCs, HMIs, meters, and drivers. The MGate MB3000 is specially designed to integrate Modbus TCP and Modbus RTU/ASCII networks, with one Ethernet connection and up to four serial ports. Once the system requires the Modbus RTU/ASCII devices to connect to Ethernet and connect to HMI/SCADA, the MGate MB3000 can help customers easily migrate to a new system.

**Moxa Serial to Ethernet Servers**

<table>
<thead>
<tr>
<th>CN2650</th>
<th>NPort 6000 Series</th>
<th>MGate MB3170/3270</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS-232/422/485 Terminal Server with Dual LAN Redundancy</td>
<td>Secure Terminal Server with Dual Redundant Fiber Optic LAN</td>
<td>1- or 2-port Advanced Modbus Gateway</td>
</tr>
</tbody>
</table>
IEC 61850-3 Compliant Communication Networks for Substation Automation

A reliable and intelligent network is a key success factor for modern substation automation. Substations that transmit and distribute electric power over expansive territories are often located out of doors in areas subjected to high electromagnetic interference and extreme temperature conditions. The substation infrastructure must be capable of providing EMI protection, network redundancy, great reliability, and flexible deployment options for future upgrades.

In addition to reliability, coordination between the many standards and proprietary protocols used in substations is also a major requirement in developing power automation systems. To build standard communication protocols between different intelligent electronic devices (IEDs), the IEC 61850 communication standards must be deployed based on Ethernet technology for better extensibility and interoperability.

**Network Requirements:**
- Network devices that comply with IEC 61850-3 or IEEE 1613 standards for best EMI shielding and error free communications.
- A redundant Ethernet infrastructure with secure data communication
- Fiber optic cabling for noise immunity, long-distance transmission, and scalable bandwidth for future upgrades
- Layer 3 routing capability to secure remote monitoring and control

**Why Moxa?**
- IEC 61850-3 and IEEE 1613 compliant for PowerTrans series substation Ethernet switches.
- Turbo Ring media redundancy with faster ring recovery (20 ms at 250 switches)
- Redundant power inputs at 24/48 VDC or 110/220 VDC/VAC
- Industrial grade solution with -40 to 85°C operating temperatures and 19-inch rackmount installation
- Flexible modular interface configuration with up to 22 fiber ports (18+4G ports) for long-haul transmission and scalable gigabit bandwidth
- L3 Ethernet switch supporting IP routing protocols for complex T&D automation networks

**Key products**

**PT-7828**
L3 24+4G-port Rackmount Gigabit Modular Ethernet Switch

**PT-7728**
24+4G-port Rackmount Gigabit Modular Ethernet Switch

**PT-7710**
8+2G-port Rackmount Gigabit Modular Ethernet Switch

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Optic Fiber
Reliable Unmanned Substation Automation with Embedded Computers

Power substations require many types of devices to construct a system that transmits and distributes power. A power substation handles many tasks simultaneously. Traditionally, engineers were employed to monitor the performance of the devices, but this solution is costly and unreliable due to the unpredictable failures that might arise from any part of the automation system. Effective substation automation uses synchronized management to integrate communications between a variety of devices. Under such conditions, power substations have migrated to unmanned, automated monitoring systems.

**Application Requirements:**
- Design that ensures a longer MTBF to enhance system reliability
- Front-end communication computer used for data processing and protocol conversion
- Create an environment that can handle multiple devices using different protocols for data communication
- Rack-mountable embedded computers and Ethernet switches for easy installation
- Support for 110/220 VAC and VDC power inputs
- Quick system response is a must
- Defense against higher EMI/EMS fields onsite
- Multiple built-in Ethernet ports for establishing network redundancy to ensure system reliability and continuous operation

**Why Moxa?**
- Fanless, no hard-drive, low-power consumption design offers a reliable solution for substation automation
- Ready-to-run platform for flexible systems that provide multi-level open data interfaces and stability for easy integration with third-party devices.
- Moxa’s DA-662 computer uses software to provide ready and effective protocol conversion that facilitates data communication with various protocols from legacy devices
- Rack-mountable design for easy installation and system management
- Wide range of power input voltages from 100 to 240 VAC/DC
- Real time Linux platform for quick system response
- Compliant with EMC Level 4 certification
- Quad Ethernet ports offer network redundancy and continuous operation for substation automation
- 5-year warranty ensures system reliability for long-term operation

**Key products**

**ThinkCore DA-662**
RISC-based Rackmount Embedded Computer

**PT-7728**
24+4G-port Rackmount Gigabit Modular Ethernet Switch
Redundant Serial to Ethernet Communications in Power Substations

Power substations use sophisticated networks for data acquisition and access control. The industry relies on automation systems to increase efficiency and redundant solutions to ensure reliability. The use of substation automation solutions that apply dual-LAN architecture to help ensure the reliability is becoming more and more common in the power automation market.

Until recently, in addition to purchasing serial device servers, users needed to invest in the creation of software to control system redundancy. Various devices used in power automation systems, such as protection relays, controllers, switchgears, and RTUs, are still using RS-232 and RS-485 serial protocols. To accommodate the integration of serial devices into automation systems, such systems now use armies of serial device servers to transmit RS-232, RS-422, and RS-485 signals over an Ethernet LAN to PC hosts.

**Key products**

**CN2650**
RS-232/422/485 terminal server with dual LAN redundancy

**Network Requirements:**
- Connect RS-232 and RS-485 legacy serial devices to Ethernet for advanced management and synchronization from local and remote control sites
- Redundancy is preferred to ensure exceptional stability and reliability for data acquisition and access control
- Network devices with rugged design and rackmount installation for the application needs in substation automation

**Why Moxa?**
- Dual LAN ports allow the establishment of redundant networks to access dual hosts for data acquisition, which help ensure continuous operation in the event of connection problems
- Meters, RTUs, and other RS-232/422/485 serial devices are easy to attach and can be used by custom applications for network integration with unlimited synchronization and management options
- Easy-to-configure and ready-to-use Real COM/TTY drivers for Windows and Linux
- “Redundant COM” (patent pending) operation mode for setting up a redundant LAN
Offering a Full Spectrum of Industrial Device Networking Solutions for Power Automation

### Power Plant

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDS-728</td>
<td>Modular Managed Ethernet Switch with 6 slots for 4-port 100 Mbps modules, and 2 slots for 2-port Gbps modules, for a total of 24+4G ports, 24 VDC power input</td>
</tr>
<tr>
<td>VPort 351</td>
<td>1-channel MPEG4/MJPEG Industrial Video Encoder, 24 VDC power input</td>
</tr>
<tr>
<td>NPort IA5150/5250</td>
<td>1- or 2-port RS-232/422/485 serial device server, 2 x 10/100BaseT(X) (RJ45, single IP)</td>
</tr>
<tr>
<td>ThinkCore V481</td>
<td>x86 Ready-to-Run Embedded Computer with VGA, Dual LANs, 8 Serial Ports, CompactFlash, USB, Audio, WinCE 5.0</td>
</tr>
</tbody>
</table>

### Substation Automation

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<th>Device</th>
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<tbody>
<tr>
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<td>Layer 3 Modular Rackmount Ethernet Switch with 3 slots for 100 Mbps modules and 1 slot for Gbps modules, for a total of up to 24+4G ports, 24/48 VDC or 110/220 VDC/VAC power input</td>
</tr>
<tr>
<td>PT-7728</td>
<td>Modular Rackmount Ethernet Switch with 3 slots for 100 Mbps modules and 1 slot for Gbps modules, for a total of up to 24+4G ports, 24/48 VDC or 110/220 VDC/VAC power input</td>
</tr>
<tr>
<td>PT-7710</td>
<td>Modular Rackmount Ethernet Switch with 1 slot for 100 Mbps modules and 1 slot for Gbps modules, for a total of up to 8+2G ports, 24/48 VDC or 110/220 VDC/VAC power input</td>
</tr>
<tr>
<td>CN2650</td>
<td>8- or 16-port, RS-232/422/485 terminal server with dual-LAN ports, 100 to 240 VAC power input</td>
</tr>
<tr>
<td>NPort 6450</td>
<td>4-port RS-232/422/485 to Ethernet Secure Device Server, 110 VAC power input</td>
</tr>
<tr>
<td>MGate MB3170/3270</td>
<td>1- or 2-port advanced Modbus gateway</td>
</tr>
<tr>
<td>ThinkCore DA-662</td>
<td>RISC-based 19-inch Rackmount Data Acquisition Embedded Computer with 16 Serial Ports, Quad LANs, PCMCIA, CompactFlash, USB, Linux or WinCE 5.0 OS</td>
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<td>Modular Rackmount Ethernet Switch with 1 slot for 100 Mbps modules and 1 slot for Gbps modules, for a total of up to 8+2G ports, 24/48 VDC or 110/220 VDC/VAC power input</td>
</tr>
<tr>
<td>NPort 6450</td>
<td>4-port RS-232/422/485 to Ethernet Secure Device Server, 110 VAC power input</td>
</tr>
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</table>

### EMS/DMS

<table>
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<tr>
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<tbody>
<tr>
<td>ThinkCore DA-662</td>
<td>RISC-based 19-inch Rackmount Data Acquisition Embedded Computer with 16 Serial Ports, Quad LANs, PCMCIA, CompactFlash, USB, Linux or WinCE 5.0 OS</td>
</tr>
<tr>
<td>PT-7324</td>
<td>Smart Rackmount Ethernet Switch with 22 10/100BaseT(X) ports and 1 slot for Gbps or 100 Mbps modules, for a total of up to 22+2G ports, 24/48 VDC or 110/220 VDC/VAC power input</td>
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### Fault Recording

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### Automated Meter Reading

<table>
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</thead>
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<tr>
<td>OnCell G2150I</td>
<td>Industrial RS-232/422/485 Isolated GSM/GPRS Modem with 2.5 KV isolation</td>
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About Moxa

Industrial Device Networking Solutions
Used in Mission-Critical Applications around the World

Moxa brings together the entire spectrum of industrial device networking products that enable integrated communications to connect any device to a network. With deep industry experience, Moxa products emphasize industry-proven standards, extended temperature tolerance, superior EMI and environmental protection and network redundancy, which stand up to the most challenging industrial environments.

Moxa’s Core Competence

20 Years of Experience in Industrial Communication Solutions
Moxa has 20 years of experience and know-how in providing world-class industrial communication products and networking infrastructure solutions for harsh, industrial applications such as power automation, traffic control, process automation, factory automation, building automation, and more.

Innovative Force for More Intelligent Solutions
Moxa’s “Turbo Ring,” which provides faster Ethernet fault recovery speed of under 20 ms at a full load of 250 Ethernet switches, helps end-users minimize downtime caused by network failures. Redundancy is the most critical demand in the industrial world, and system integrators are always on the lookout for intelligent solutions that can help users minimize loss. Moxa’s R&D force is committed to developing an array of innovative solutions that answers this need, and help users optimize their communication systems.

Expert at Developing Solutions for a Diversity of Industrial Applications
Moxa offers a broad range of industrial communication solutions that are well-suited for the demands and conditions of a diverse number of applications. Specific needs required for applications such as environments subjected to strong electromagnetic fields, a corrosive atmosphere, or explosion hazards, can be easily fulfilled with Moxa’s products. One aspect of Moxa’s expertise is application-specific products such as IEC 61850-3/IEEE1613 solutions for substation automation, NEMA TS2 for traffic control systems, EN50121-4 for railway applications, DNV/GL solutions for marine and offshore applications, Class 1, Div 2/Zone 2 for hazardous locations, and more.

Globally Available, Local Services
To let our customers enjoy zero lag time for service, Moxa formed a network of professional distributors in more than 56 countries around the world. Moxa believes the best service is to deliver customers with immediate response and timely problem solving, so we can stay “plug-in” to all your application needs, whenever and wherever you need them.

5-year Warranty and Proven Quality
As an ISO 9001:2000 and ISO 14001 certified company, Moxa adheres to strict quality control standards applied to design, production, and shipment processes, and Moxa prides itself on providing a solid 5-year warranty on most products.
Complete Solutions for Industrial Communications

Moxa provides a comprehensive array of solutions that include:

**Industrial Ethernet Switches**
As the key components for network infrastructure, industrial Ethernet switches interconnect key sites, devices, and facilities for automation applications. Moxa provides IEC 61850-3 rackmount Ethernet switches, modular switches, managed switches, and unmanaged switches to make network planning easier.

**Embedded Computers**
Embedded computers are all-in-one programmable devices designed for special purpose computing tasks, and serve as protocol gateways for consumer and industrial applications. Moxa's embedded computing solutions come with wireless embedded PCs, rackmount embedded PCs, DIN-Rail embedded PCs, box computers, and embedded modules for a variety of applications.

**Serial-to-Ethernet Products**
Serial to Ethernet device servers translate data bi-directionally between the serial and Ethernet formats, allowing legacy devices to communicate over Ethernet networks. Moxa offers the perfect device server solutions that include external and embedded device servers, terminal servers, and modbus gateways for integrating existing serial devices with Ethernet.

**Active Ethernet I/O Servers**
Active Ethernet I/O is a new concept for PC-based data acquisition and control that introduces proactive, condition-based reporting and control of I/O devices. Users can choose from Moxa’s active Ethernet I/O, modular I/O, peer-to-peer I/O, and serial I/O for control applications.

**Industrial Wireless Products**
Wireless solutions provide the kind of connection flexibility needed to connect mobile devices with a stationary central control center. Moxa provides wireless AP/bridge/AP clients, industrial GSM/GPRS modems, and wireless device servers.

**Multiport Serial Boards**
Serial communication involves transmitting digital data one bit at a time without collision, and is known as one of the most reliable media used in industrial fields. Moxa supplies PCI express boards, universal PCI boards, PCI boards, ISA boards, and PC/104 boards for expanding serial connections.

**Industrial Media Converters**
Industrial media converters extend communication possibilities by converting between two different protocols or interfaces. Moxa’s media conversion products include serial to fiber converters, Ethernet copper to fiber converters, RS-232 to RS-422/485 converters, and USB-to-serial converters.

**Industrial Video Servers**
Industrial video networking solutions digitize CCTV surveillance systems for transmitting images over an IP-based platform. Moxa’s MPEG4/MJPEG industrial video encoders and decoders are designed with advanced video compression technologies and rugged protection for use in demanding industrial environments.
Moxa Integrated Communication Solutions

Moxa’s total solution of industrial device networking products meet the strict requirements needed for power automation and other industrial applications. With 20 years of industry experience, Moxa’s solutions include industrial Ethernet products, serial device servers, wireless communication devices, remote I/O servers, embedded computers, and industrial video networking products. Moxa’s products highlight redundant features, adherence to industry standards, and industrial ruggedness to help build reliable communication networks that connect legacy devices to modern power systems.

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