

Y2010 Power T&D & IEEE 1588 Solution

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Moxa's Industrial Networking Solutions in Smart-Substations

Direct Access For Ethernet Networking



Traditional Communication Protocols In Substation Automation





The Issues of Traditional Substation

Higher Integration Cost

• Different protocols increase the integration cost of communication

Higher Installation Cost

 Several blocks of Process layer in substation require 300~500 specific cables

Lower Flexibility and Reliability

- Complicated structure
- Non-real-time monitor and control





One Standardized Method of Communication in Substation Automation





Power Communication Trends in The World



IEC 61850 Ethernet-based Substation Automation System



The Benefits of Smart-Substation

Lower Integration Cost

• IEC 61850 protocols reduce the integration cost of communication

Lower Installation Cost

 Several blocks of Process layer in substation require 30~60 Ethernet cables (decrease 80% cabling)

Higher Flexibility and Reliability

- Simpler structure
- IEC 61850-3 for higher hardware requirement
- Real-time monitor and control





Moxa Offerings in Smart-Substations Generation ansm KV~500KV Under 110KV 400KV~220 **All PT series Fulfill Substation of** Power T & D by IEC 61850 **PT-7728-PTP** PT-7828 PT-7710 PT-7728 istribution **PT-508** PT-G7509

IEC 61850 Test In KEMA

Founded in 1927, KEMA is the most famous IEC 61850 technical consultant company



Moxa's full line of PowerTrans series Ethernet switches has passed IEC 61850 and IEEE 1613 performance tests conducted by KEMA lab



Two Different Category Tests in KEMA

Svotom Apposto	Abstract Comm. Services		
System Aspects	Mapping to real Comm. Networks (SCSM)		
Part 1: Introduction and Overview	<u>Part 8-1</u> : Mapping to MMS		
Part 2: Glossarv	GOOSE Message		
Part 3: General Requirements	Basic Communication Structure for		
	Substations and Feeder Equipment		
FMS and Environment	Part 7-4: Compatible Logical Node Classes and Data		
	Classes		
Part 5: Comm. Requirements for	Part 7-3: Common Data Clastes		
Hardware Requirement	Performance Requirement		
<u>Haranare Requirement</u>			
Comgaration	link		
Part 6: Configuration Language	Part 9-2: Mapping on a IEEE 802.3 based Process Bus		
for electrical Substation IED's			
	Part 10: Conformance Testing		



GOOSE Message Test In KEMA



IEC 61850-3 EMS Test In KEMA

	Test	Commercial	PT
	Items	Rackmount	Series
ESD	Enclosure, contact	+/- 4 KV	+/- 8 KV
	Enclosure, air	+/- 8 KV	+/- 15 K X 2
Radiated RFI (RS)	Signal ports	3 V/m	35 V/m X 10
Surge	Signal ports D.C power A.C power	n/a 0.5 KV 2 KV	+/- 2 KV CM +/- 4 KV +/- 4 KV X 2
EFT	Signal ports	0.5 KV	+/- 4 KV CM
	D.C power	0.5 KV	+/- 4 KV X 8
	A.C power	2 KV	+/- 4 KV CM



IEC 61850-3 Environmental Test In KEMA

Test Items	Commercial	PT	
	Rackmount	Series	
Low air temperature	0°C from datasheet	-40°C for 24 hrs and 96 hrs cycling test	
High air temperature	40°C from datasheet	+85°C, for 24 hrs, 96 hrs cycling test	
Stationary vibration	n/a	2-9 Hz 7mm / 9-200 Hz 2g / 200- 500 Hz 1.5g	
Shock	n/a	Peak acceleration: X/Y/Z axis - 330 m/s ²	
Warranty	1-2 yrs	5 yrs	



Design Requirements in Smart Substations

- Wide Operation Temperature -40°C to 85°C
- Zero-Packet-Loss for GOOES Message
- 19" Rackmount Installing
- Modular Design
 - Fiber port
 - Giga port
- Redundancy for both Power and Data
- Compliant with IEC 61850 & IEEE 1613
- Support IEEE 1588 Precision Time Protocol





PT-7828 Series

-IEC 61850-3 24+4G-port Layer 3 Gigabit modular managed rackmount Ethernet switches



- > Layer 3 routing interconnects multiple LAN segments
- > IEC 61850-3, IEEE 1613 (power substations), and EN50121-4 (railway applications) compliant
- > Turbo Ring, Turbo Chain, and IEEE 802.1D-2004 RSTP/STP for Ethernet Redundancy
- > IEEE 1588 PTP for precise time synchronization of networks
- > Isolated redundant power inputs with universal 24/48 VDC or 110/220 VDC/VAC power supply range
- > Modular design for various media options
- > -40 to 85°C operating temperature range



MOX



PT-G7509 Series

IEC 61850-3 9G-port full Gigabit managed rackmount

Ethernet switches



> 9 combo 10/100/1000BaseT(X) or 100/1000BaseSFP slot Gigabit ports

Full Gigabit Switch

- > IEC 61850-3, IEEE 1613 (power substations), and EN50155/ EN50121-4 (railway applications) compliant
- > IEEE 1588 PTP for precise time synchronization of networks
- > Turbo Ring, Turbo Chain, and IEEE 802.1D-2004 RSTP/STP for Ethernet Redundancy
- > Isolated redundant power inputs with universal 24/48 VDC or 110/220 VDC/VAC power supply range
- > -40 to 85°C operating temperature range





PT-7728 Series

– IEC 61850-3 24+4G-port Gigabit modular managed rackmount Ethernet switches



> IEC 61850-3, IEEE 1613 (power substations), NEMA TS2 (traffic control systems), and EN50121-4 (railway applications) compliant

High Port Density

- > IEEE 1588 PTP for precise time synchronization of networks
- > Turbo Ring, Turbo Chain, and IEEE 802.1D-2004 RSTP/STP for Ethernet Redundancy
- > Isolated redundant power inputs with universal 24/48 VDC or 110/220 VDC/VAC power supply range
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IEEE 1588 v2 in Substation Automation System

From ms to ns World



When the clocks in our lives get out of sync!?

Bad things happen...

- Late for solution day
- Miss the flight
- Forget favorite TV show
- Burn your roast chicken

Wouldn't it be helpful if clocks were always set to the correct time?



Station Level in Substation Automation



- Accurate Timing is required for Power Recorder on Station Bus:
 - Fault recording
 - Events recording
 - Any other application require precise time sync

The pre-fault, fault and post-fault events can be accurately analyzed



Process Level in Substation Automation



- **Gather information:**
 - Voltage
 - Current
 - Status information

- Accurate Time Sync < 1us for:
 - Merging Units
 - Control IED
 - Protection IED



Different time synchronization methods

synchronization Method	Time Accuracy	Dedicated Cabling	Provide Date & time Indication	Cost Saving	Fit large-distributed Substation
IEEE 1588 v2	1us		*	*	*
IEEE 1588 v1	1us		*	*	
NTP	1~10ms		*	*	
GPS	1us	*	*		
1PPS	1us	*			
IRIG-B	100us	*	*		





Time Sync. on the process bus

- Sync Sampled Measured Values between:
 - MU
 - Receiving IED

Station Level

Merging Units continuously measure multiple analog CT/VT values (Sampled Measured Values) from primary equipment and digitize them according to IEC 61850-9-2 standard



IEEE 1588 Working Scenario



Synchronization is achieved by <u>exchanging PTP</u> packets between master and slave (ordinary clock), and to adjust slave (ordinary clock) automatically.



IEEE 1588 v2 Precision Timing





PT-7728-PTP make "Process Bus" more cost-effective, efficient and easier to deploy a reliable and precise time synchronization over the substation Ethernet network



Advantages of Using MOXA IEEE 1588 Ethernet Switch

- Network clock synchronization accuracy in the nanosecond range
- Synchronization of clocks support for large & distributed substation networks
- Low-cost implementation in multicast messaging networks such as Ethernet
- Fast re-synchronization when system changes occur
- **Simple installation** and maintenance

MOXA

