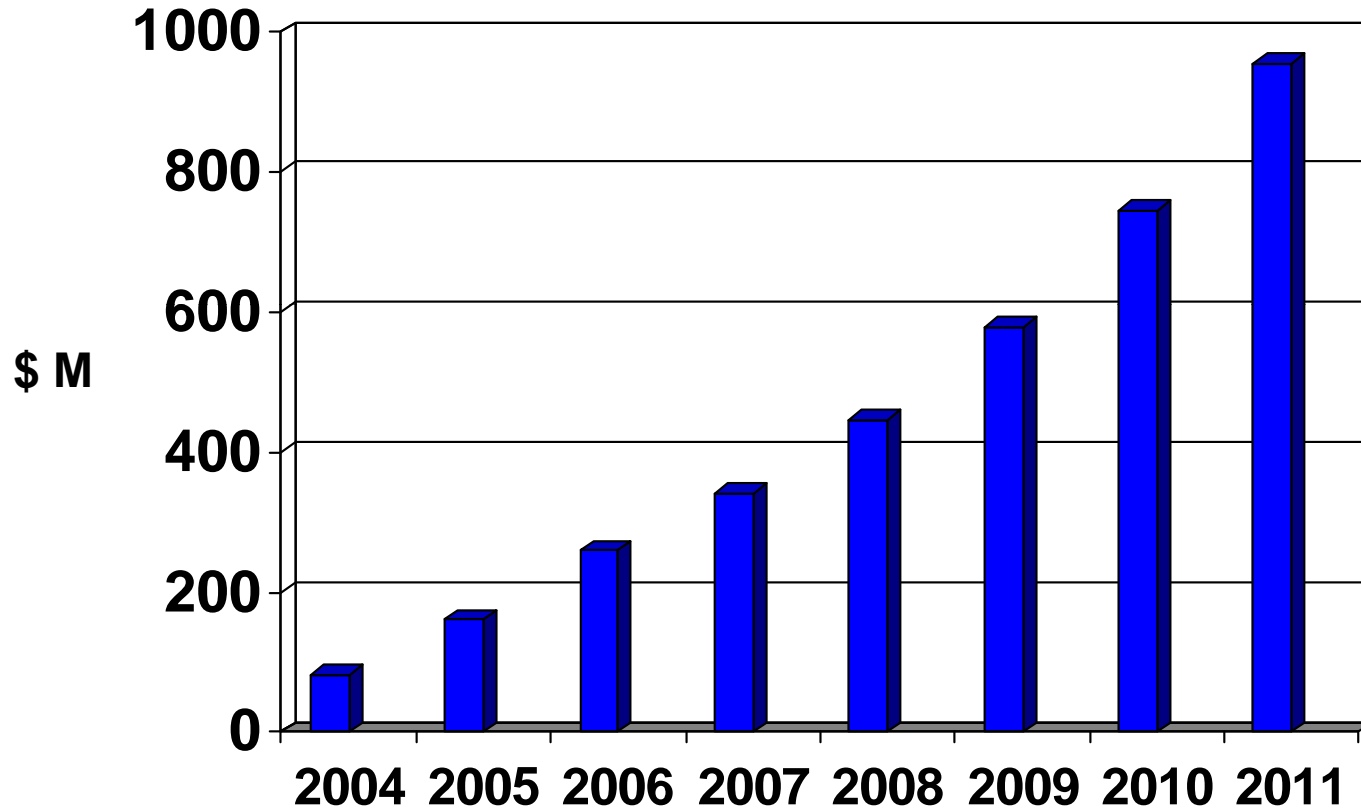


N-Tron Corporation

Creating Reliable
Ethernet Topologies for
Wind and Solar Energy

Growth of the Industrial Ethernet Market



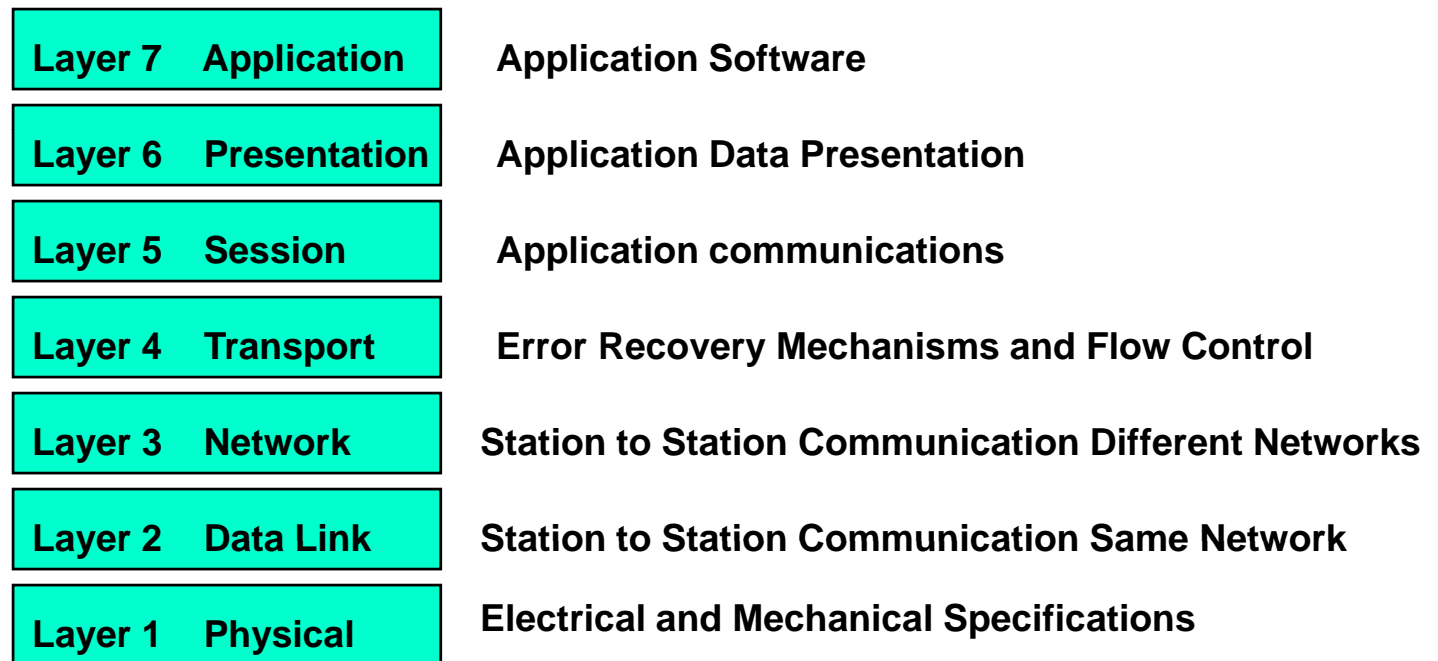
Source: ARC Advisory Group

Ethernet Energy System Control Applications

- **Gas Turbine**
- **Steam Turbine**
 - **Convectional**
 - **Nuclear**
 - **Solar**
- **Hydro Turbine**
- **Wind Turbine**
- **Solar Array**

International Organization for Standardization (ISO)

Open Systems Interconnection (OSI) Reference Model



LAYER 6/7

APPLICATION SOFTWARE
(PLC/DRIVE/CONTROLLER/OIT)

LAYER 5

APPLICATION PROTOCOLS
ETHERNET/IP, MODBUS/TCP, PROFINET

LAYER 4

USER DATAGRAM
PROTOCOL
(UDP)

TRANSMISSION
CONTROL PROTOCOL
(TCP)

LAYER 3

INTERNET PROTOCOL (IP)

LAYER 2

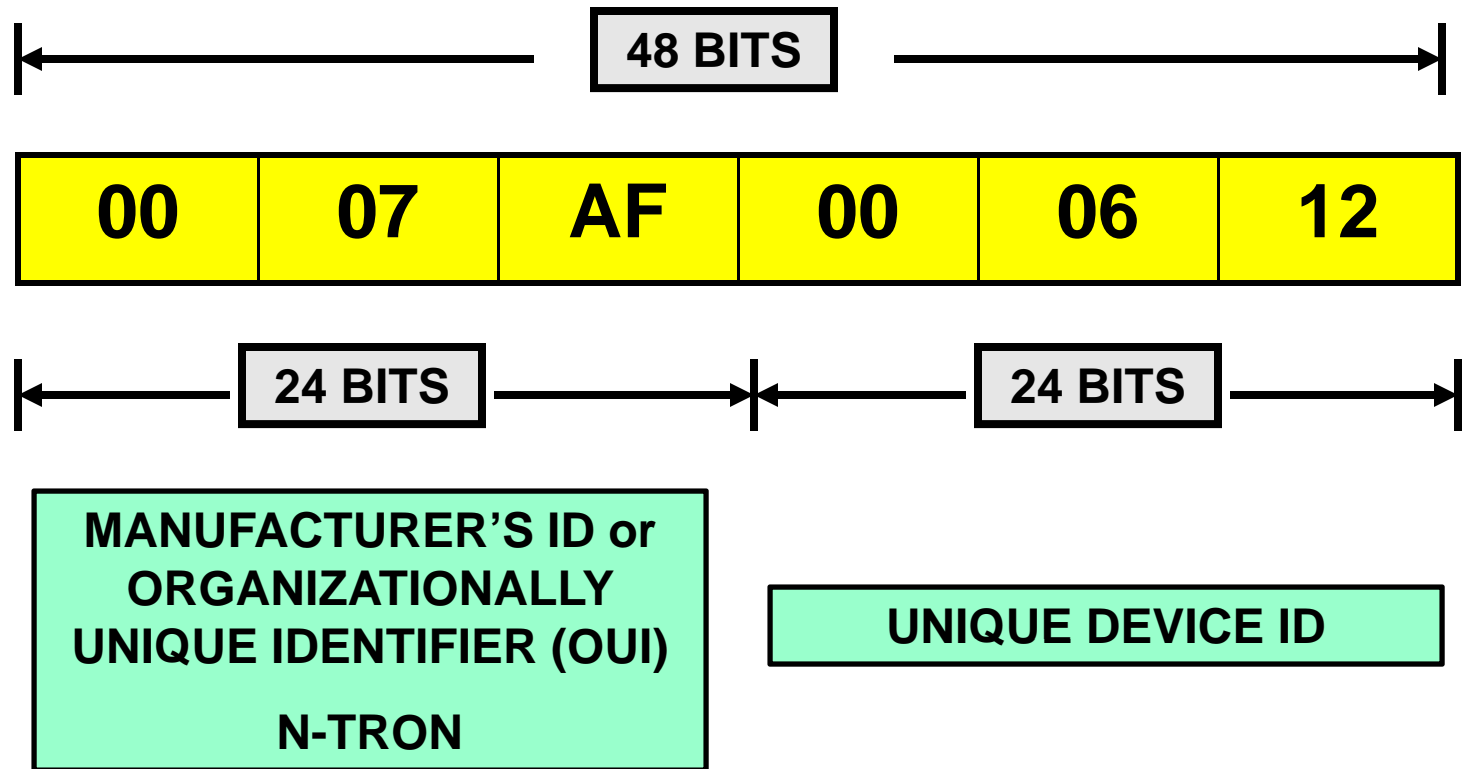
ETHERNET DRIVER

LAYER 1

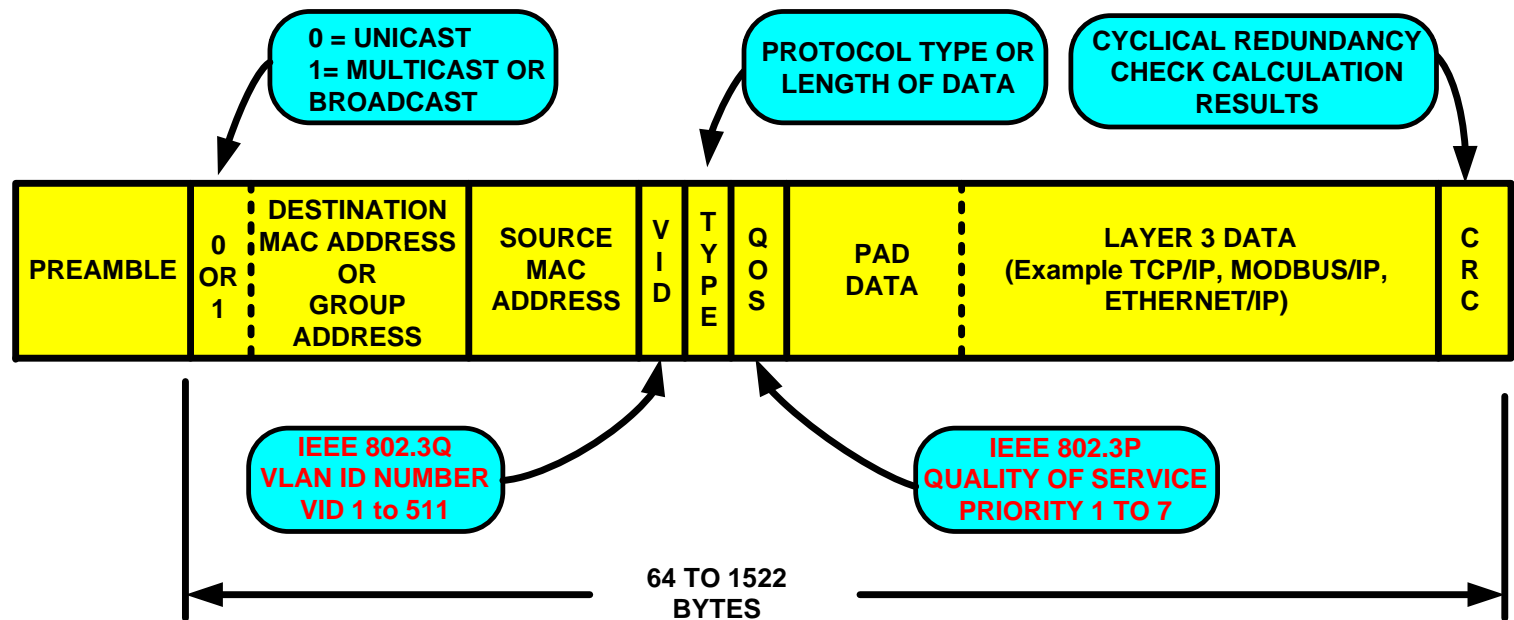
HARDWARE ETHERNET INTERFACE

NETWORK SWITCH

Media Access Control MAC Address

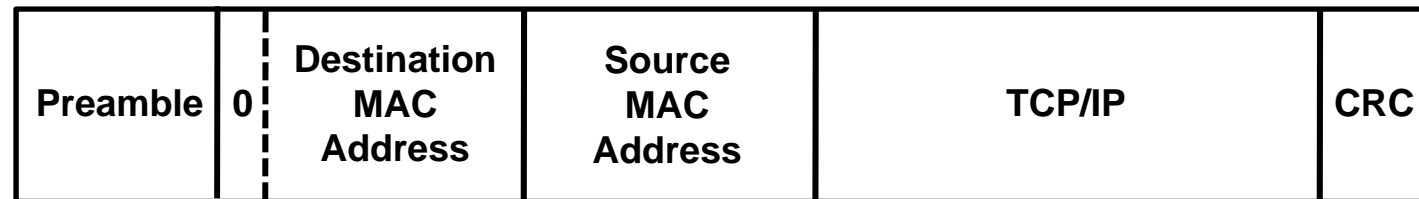


LAYER 2 IEEE 802.3 ETHERNET FRAME OR PACKET

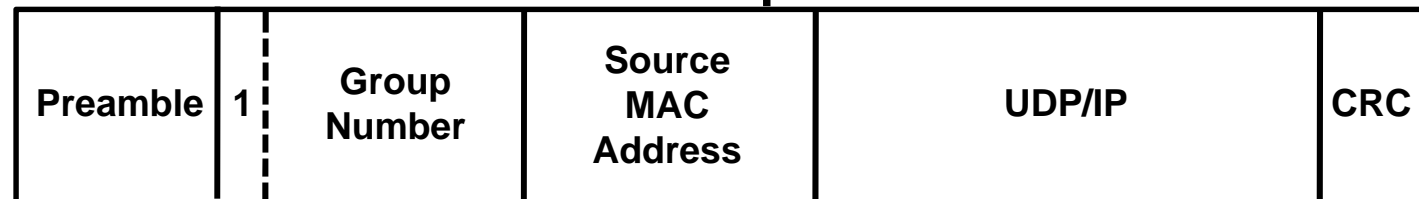


Ethernet Packet Types

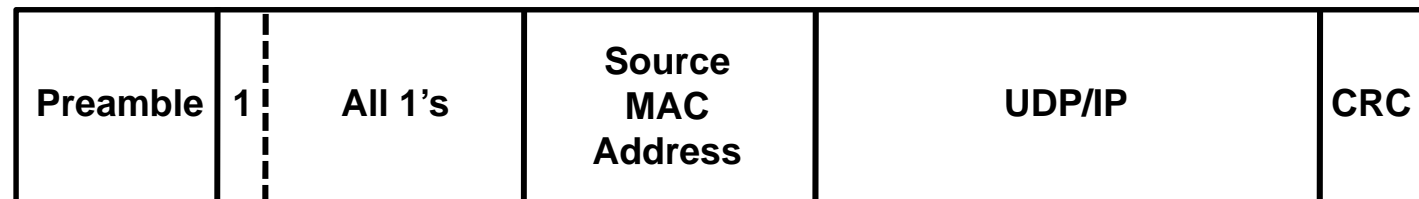
Ethernet Unicast



Ethernet Group Multicast



Ethernet Broadcast Multicast



Ethernet Collision and Network Domains

Network Domain

- Switching Hubs (Switches)

- Port and Switch Bandwidth (Hub vs Switches)

- Switch Packet Processing

 - MAC Address Mapping (MAC Address Table)

 - CRC Check

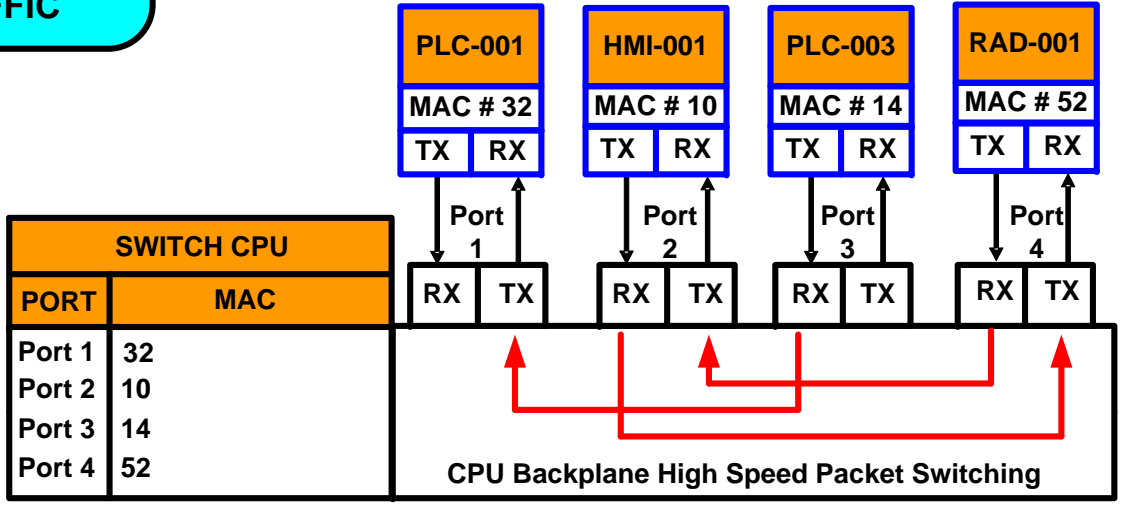
 - Store and Forward or Cut Through

 - MAC Aging

- MAC Memory

SWITCH UNICAST PACKET TRAFFIC

IEEE 802.3 NETWORK DOMAIN



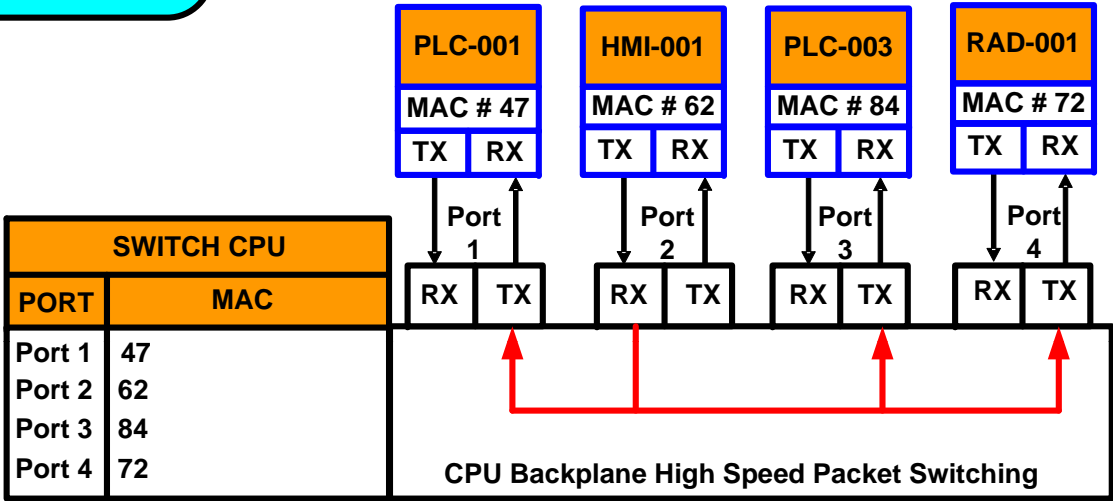
DESTINATION MAC ADDRESS

SOURCE MAC ADDRESS

Preamble	0	10	52	LAYER 3 DATA	CRC
Preamble	0	32	14	LAYER 3 DATA	CRC
Preamble	0	52	10	LAYER 3 DATA	CRC

SWITCH BROADCAST PACKET TRAFFIC

IEEE 802.3 NETWORK DOMAIN



**DESTINATION
MAC
ADDRESS**

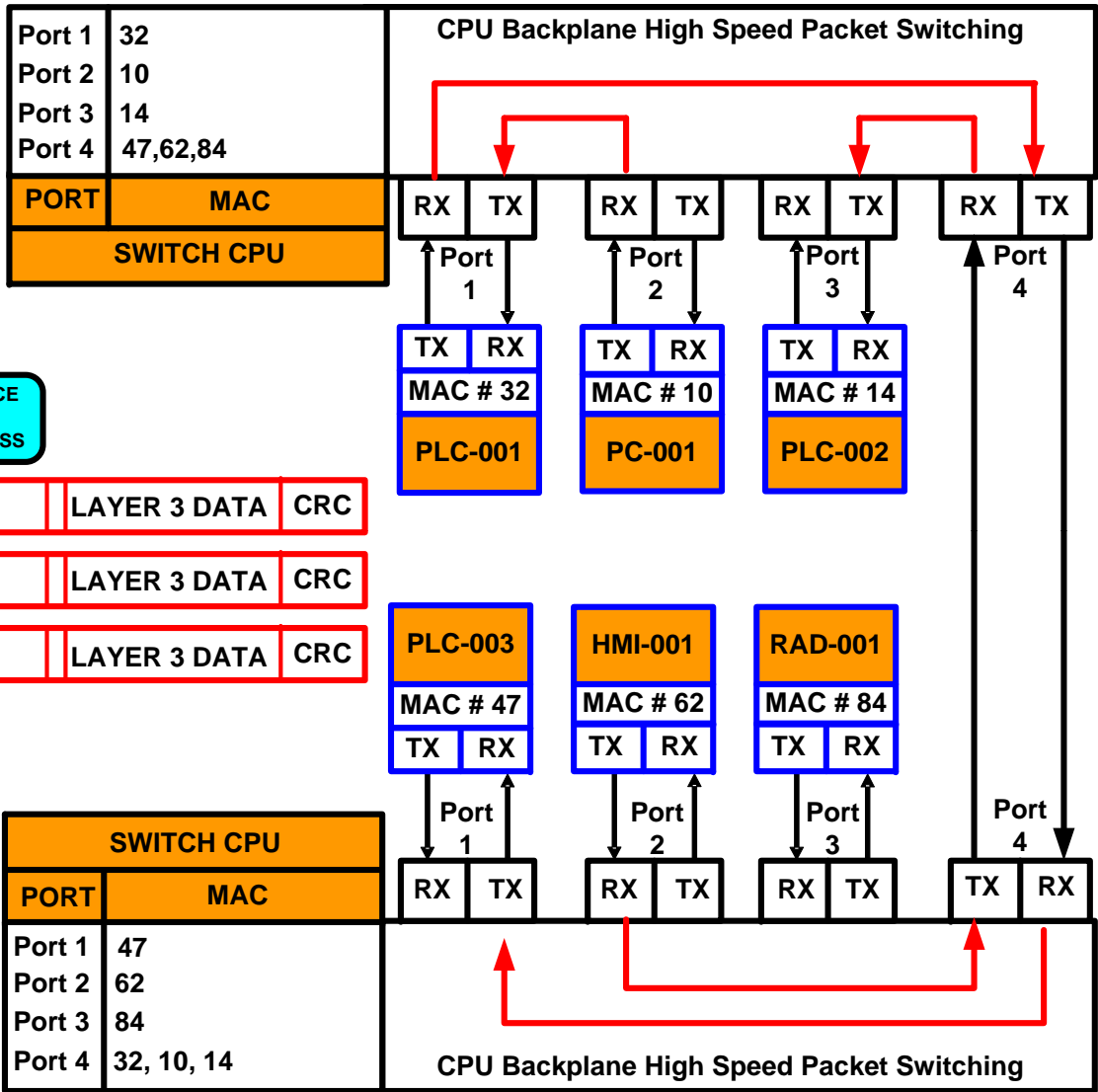
**SOURCE
MAC
ADDRESS**



**UNICAST TRAFFIC
TWO SWITCHES
LINKED WITH
AUTO PORT
CONFIGURATION
(MDIX)**

**DESTINATION
MAC
ADDRESS** **SOURCE
MAC
ADDRESS**

Preamble	0	47	32	LAYER 3 DATA	CRC
Preamble	0	32	10	LAYER 3 DATA	CRC
Preamble	0	14	62	LAYER 3 DATA	CRC



Ethernet Unmanaged Topologies

Star

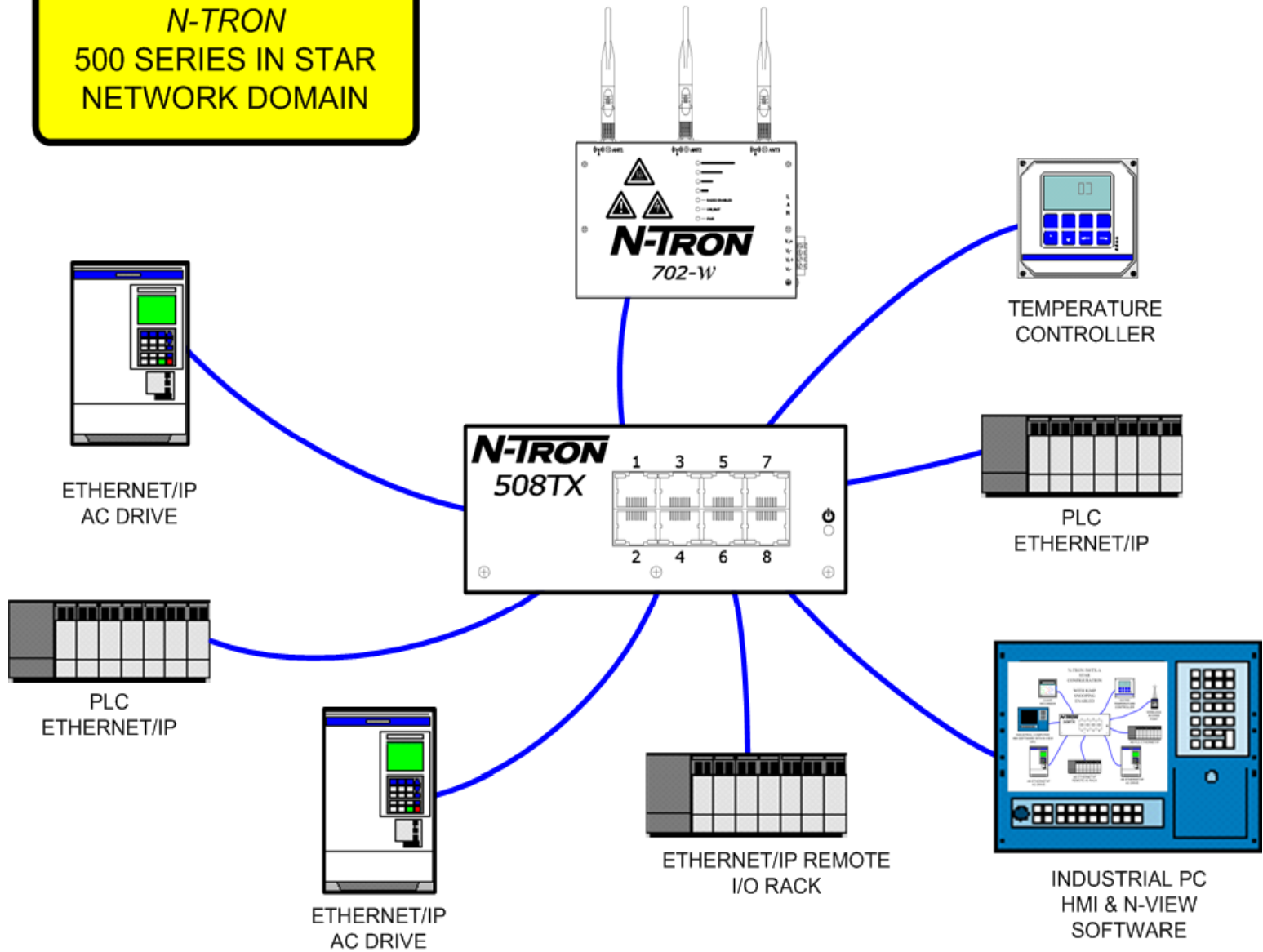
Tree

Daisy Chain

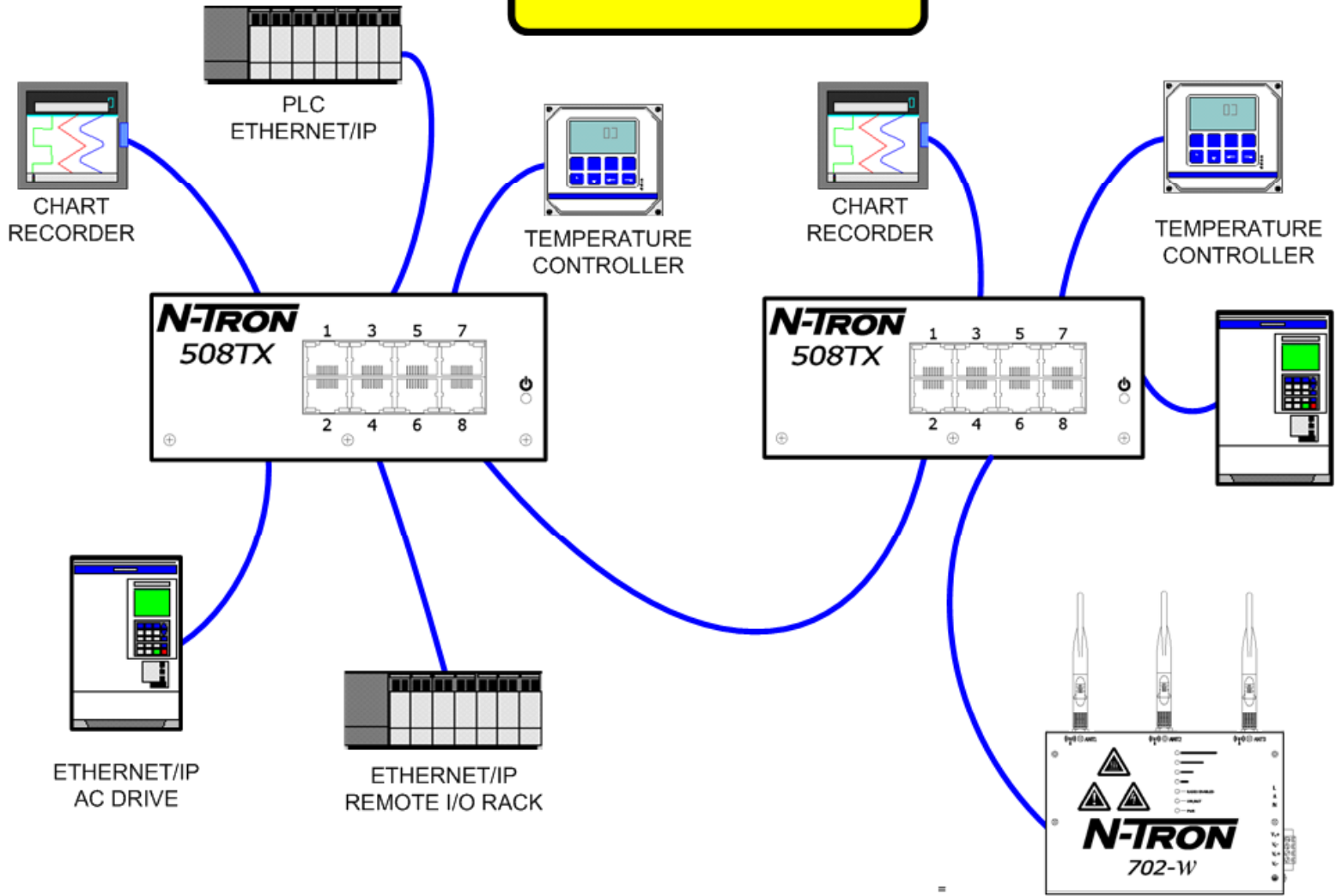
Redundant Star

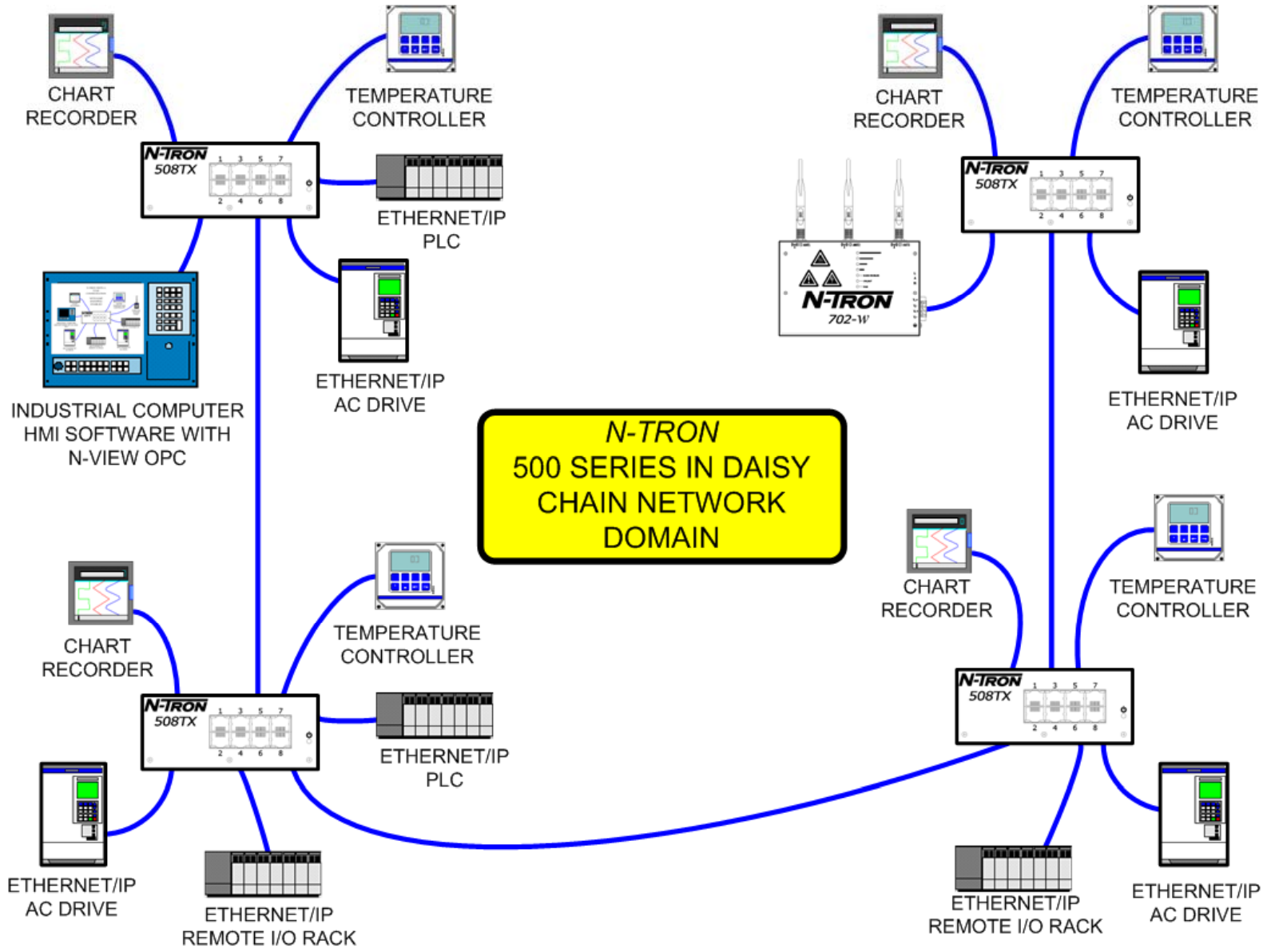
Redundant Daisy Chain

**N-TRON
500 SERIES IN STAR
NETWORK DOMAIN**

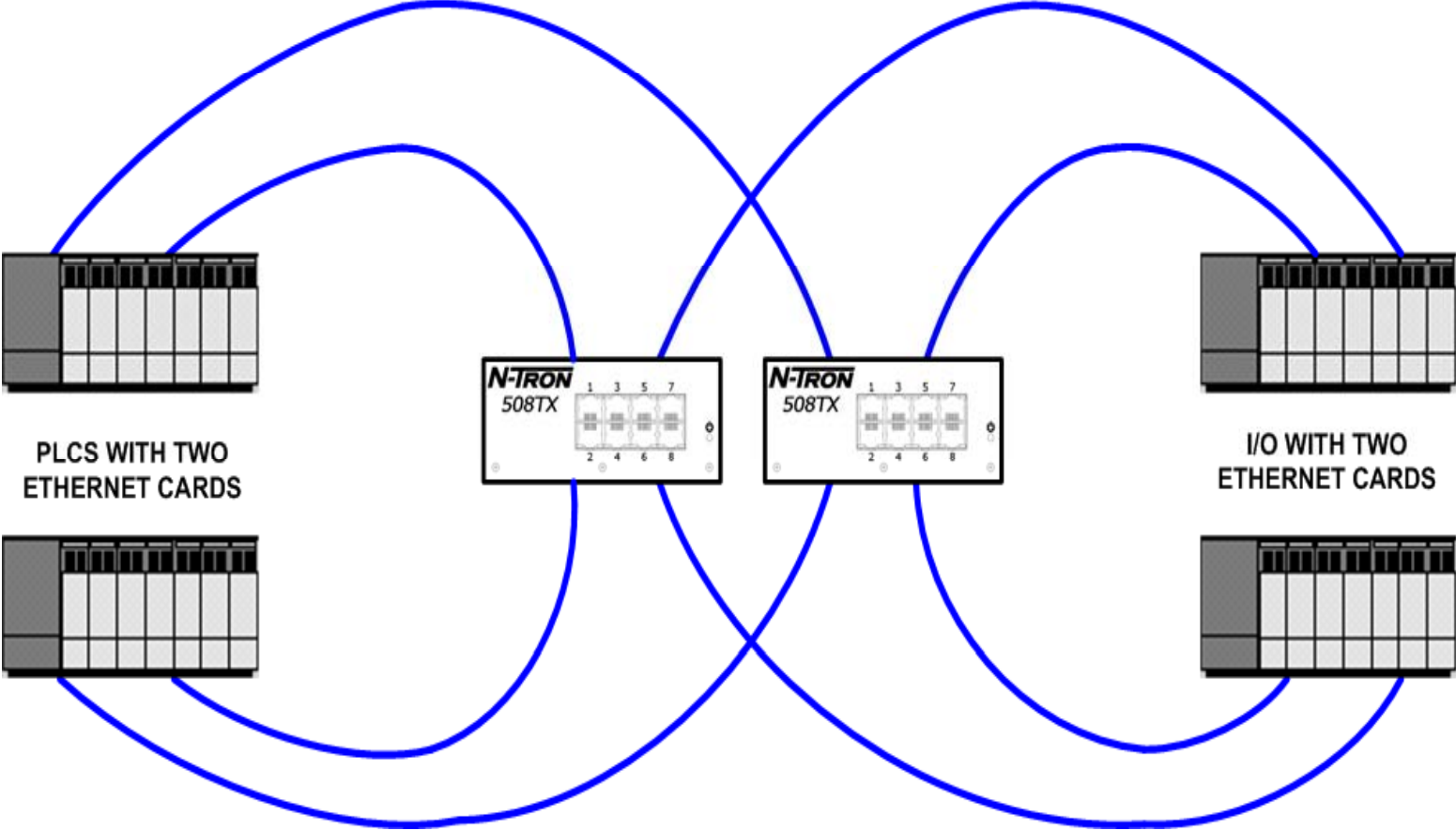


**N-TRON
500 SERIES IN TREE
NETWORK DOMAIN**



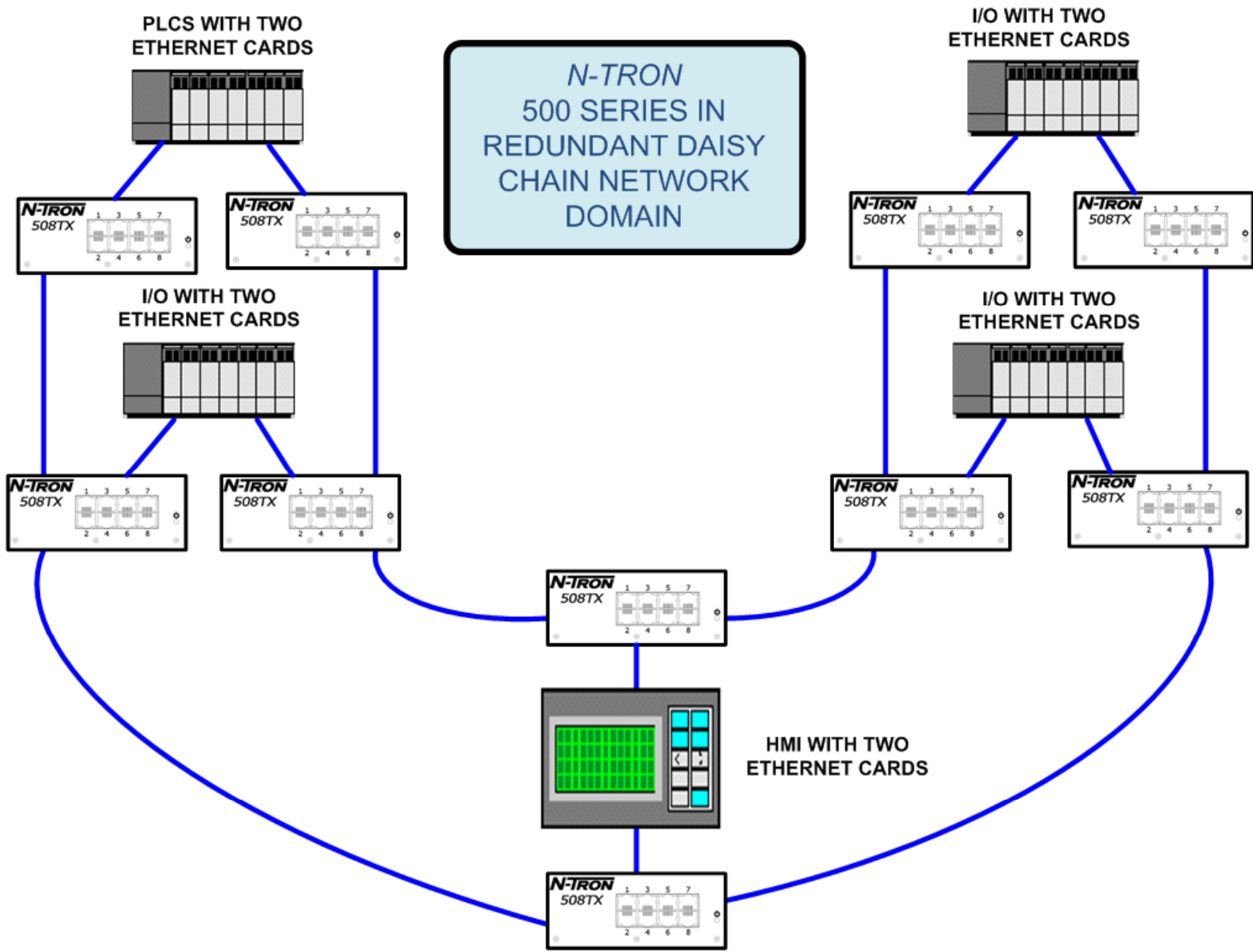


N-TRON
500 SERIES REDUDANT
STAR NETWORK



PLCS WITH TWO
ETHERNET CARDS

I/O WITH TWO
ETHERNET CARDS



Using Ethernet for Process Control Applications

Hardened Components

- ESD & RF Protection

- High G Force Construction

- High Temperature Range Performance

- High MTBF Performance (**Last Man Standing**)

OPC Reporting

- OPC vs SNMP

- OPC Heart Beat

 - Managed and **Unmanaged** Switches

- N-View OPC Setup and Monitoring

- HMI OPC Ready

Specifications	Typical Commercial Switch with Fan Cooling	Typical Industrial Switch and Field Devices	N-Tron Critical Control Switch
MTBF Hours	25K	200K	1-2M
Vibration	0G to 1G	5G	50G
ESD Protection	2KV	4KV to 6KV	16KV
RF Rejection	3 Volts/Meter	3 Volts/Meter	15 Volts/Meter
Operation Temp	0° to 45°	-20° to 60°	-40° to 70°

N-View OPC Monitoring

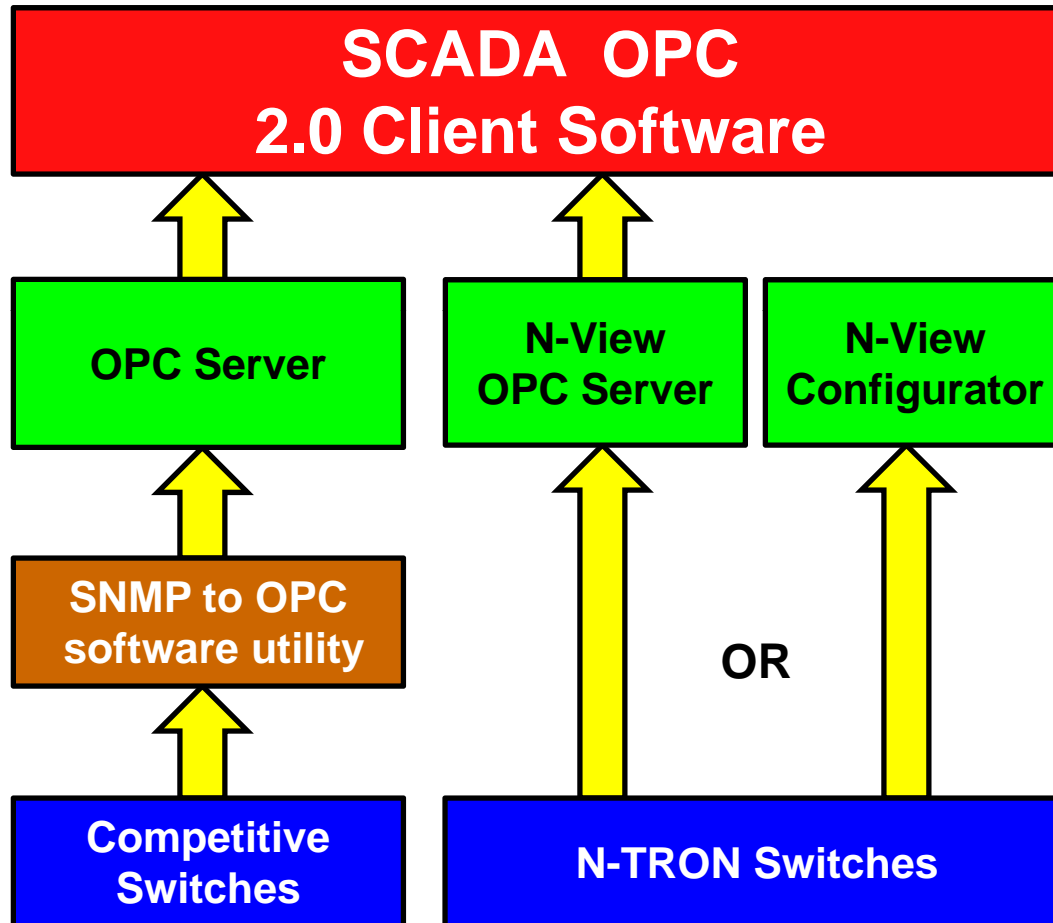
REV 090519 21

N-TRON Confidential

N-TRON
THE INDUSTRIAL NETWORK COMPANY

N-View OPC Software

OPC (Object Linking & Embedding for Process Control)



N-View OPC can be used with most leading Supervisory Control & Data Acquisition (SCADA) systems

RSView 32
WinCC
Wonderware
Citect
Intellution
Cimplicity
Iconics

N-ViewOPC

Selected Network Card (Adapter)
 Intel® Pro/100 VE Network Connection ▼ Import Export Save & Close Close, Don't Save

Current Switches

Each switch that is not shown in the right side list must be mapped to a switch model in the box below

00.07.AF.00.06.09
 00.07.AF.00.06.10
 00.07.AF.00.06.11
 00.07.AF.00.06.12
 00.07.AF.00.06.13
 00.07.AF.00.06.14
 00.07.AF.00.06.15
 00.07.AF.00.06.0A

516TX ▼ Map

To Change the switch alias select the switch in the right side list type in the new alias name in the box below and press '>>'.
 STA # 023 >>

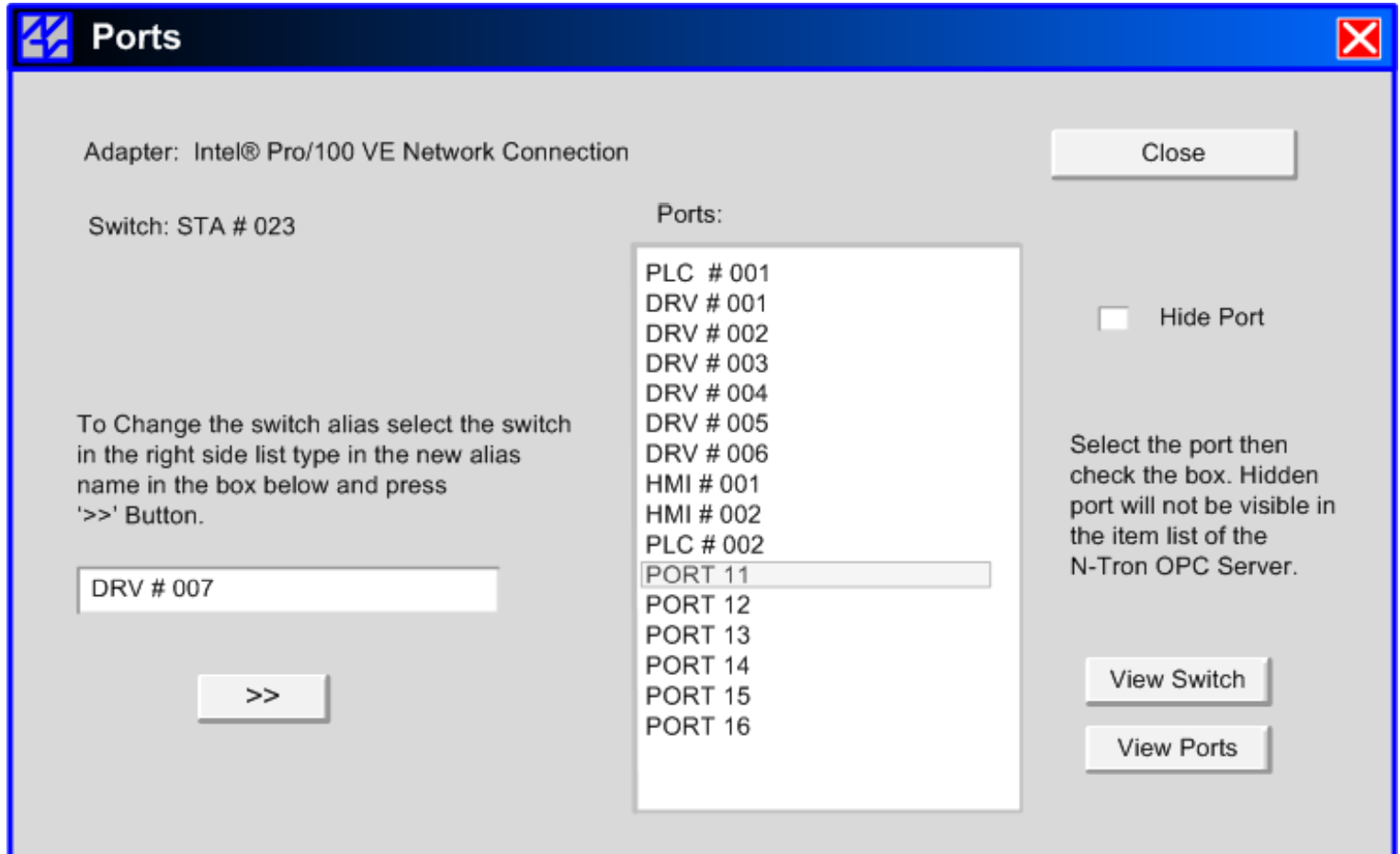
To delete a switch highlight it and press '<<'. <<

Switch - Alias Name

00.07.AF.00.06.09	MCC # 001
00.07.AF.00.06.10	MCC # 002
00.07.AF.00.06.11	MCC # 003
00.07.AF.00.06.12	MCC # 004
00.07.AF.00.06.13	BLG # 001
00.07.AF.00.06.14	BLG # 004
00.07.AF.00.06.15	BLG # 037
00.07.AF.00.06.0A	STA # 023

Switch Details

Data Format
 String
 Integer





Switch Details



Switch: STA # 023

IP Address: 192.168.1.61

N-Ring Version: 1

N-Ring Member: No

N-Ring Manager: Yes

N-Ring State: Ok

Close

Ports:

Links:

Speed:

Duplex:

PLC # 001	UP	100	FULL
DRV # 001	DOWN	NA	NA
DRV # 002	UP	100	FULL
DRV # 003	UP	100	FULL
DRV # 004	UP	100	FULL
DRV # 005	UP	100	FULL
DRV # 006	DOWN	NA	NA
HMI # 001	UP	10	HALF
HMI # 002	UP	10	HALF
PLC # 002	UP	100	FULL
I/O # 001	UP	100	FULL
I/O # 002	DOWN	NA	NA
DRV # 007	UP	100	FULL
DRV # 008	UP	100	FULL
I/O #003	UP	100	FULL
CAM # 003	UP	10	HALF



Port Counters



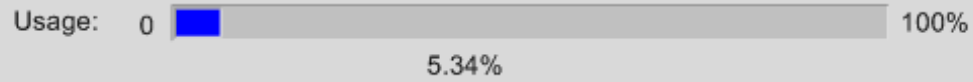
Switch: STA # 023
 IP Address: 192.168.1.61
 Port: CAM # 003
 Speed: 100
 Duplex: Full

Link: Up
 Enable: Yes

N-Ring Version: 1
 N-Ring Manager: Yes

N-Ring Member: No
 N-Ring State: Ok

Close

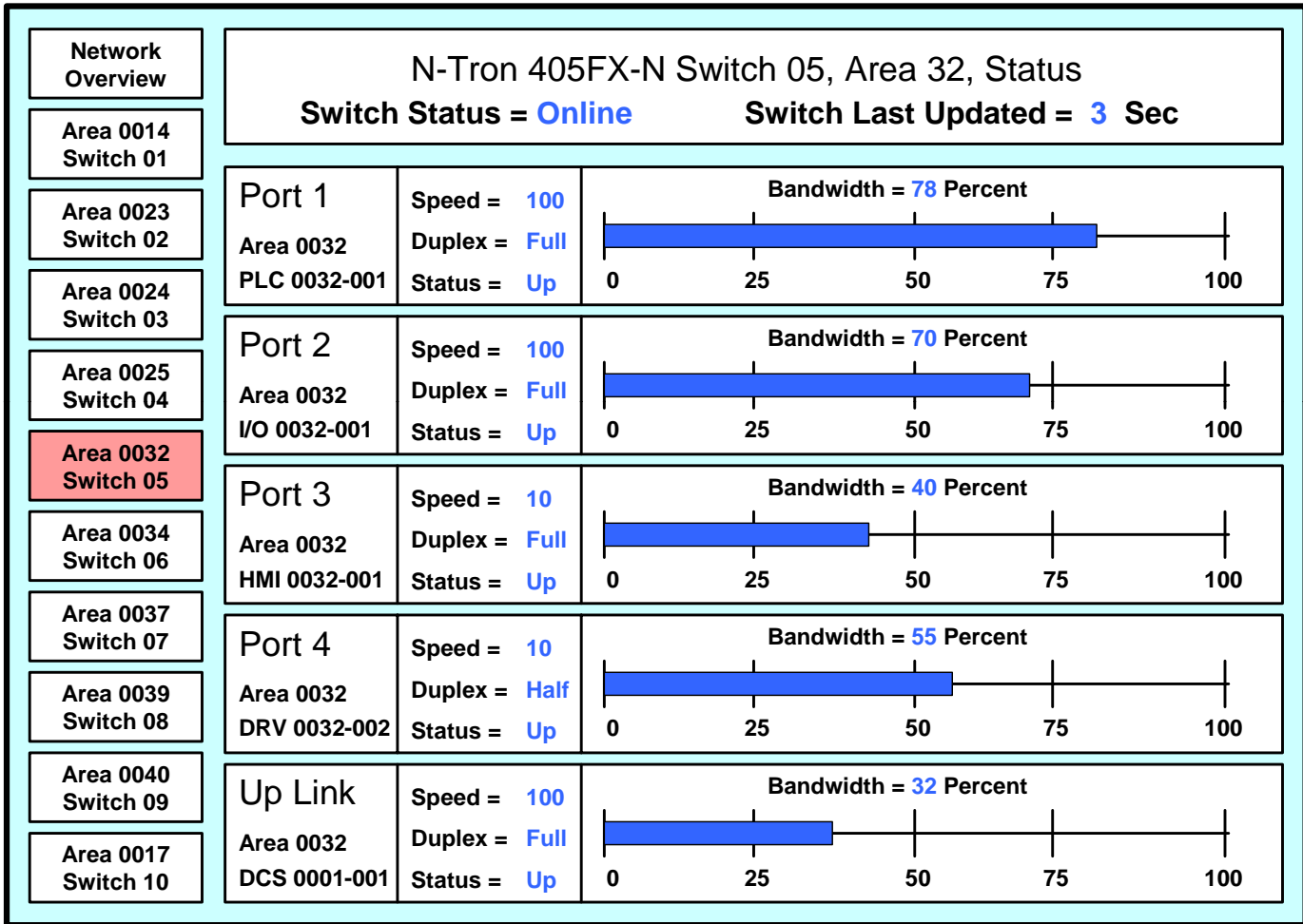


Select the port from the list below:

Tx Octets 4052024
 Tx Dropped Packets 0
 Tx Broadcast Packets 568
 Tx Multicast Packets 14346
 Tx Unicast Packets 2992
 Tx Collisions 0
 Tx Single Collision 0
 Tx Multiple Collision 0
 Tx Deferred 0
 Tx Late Collision 0
 Tx Excessive 0
 Tx Frame In Disc 0
 Tx Pause Packets 0
 64 Packets 264937
 65 to 127 Packets 2545888
 128 to 255 Packets 10160661
 256 to 511 Packets 1442929
 512 to 1023 Packets 3740131

Rx Octets 39844501556
 Rx Dropped Packets 0
 Rx Broadcast Packets 0
 Rx Multicast Packets 9
 Rx Unicast Packets 17890849
 Rx Undersize Packets 0
 Rx Oversize Packets 0
 Rx Jabbers 0
 Rx Alignment Errors 0
 Rx Good Octets 3984501780
 Rx SA Changes 0
 Rx FCS Errors 0
 Rx Pause Packets 0
 Rx Fragments 0
 RX Excessive Disc Size 101606610
 Rx Symbol Errors 0
 1024 to 1522 Packets 0

- PLC # 001
 - DRV # 001
 - DRV # 002
 - DRV # 003
 - DRV # 004
 - DRV # 005
 - DRV # 006
 - HMI # 001
 - HMI # 002
 - PLC # 002
 - I/O # 001
 - I/O # 002
 - DRV # 007
 - DRV # 008
 - I/O #003
-





Main Menu

Alarms

N-Tron Network Status

4/20/2009

10:29:28 AM



BW SYSTEMS, INC.
 www.BWSystems-inc.com
 346 Chester St.
 St. Paul, MN 55107
 (651) 665 - 9060

Switch Variables

Switch Alias	Switch 5
Switch Status	Online
Switch Last Update	1
Switch MAC Address	00.07.AF.01.3D.CE
Switch Total Ports	16

N-Ring Details

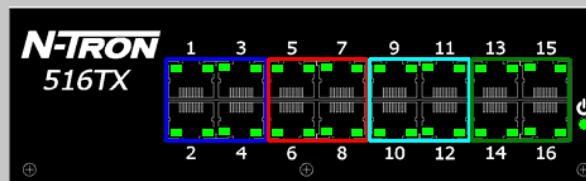
Manager	N/A
Member	N/A
State	N/A
Version	0

	Port 1	Port 2	Port 3	Port 4
Port Alias	Port1	Port2	Port3	Port4
Port Duplex	Full	Full	Full	Full
Port Link Status	Up	Up	Up	Up
Prot PortId	1	2	3	4
Port Speed	100	100	100	100
Port Usage	0.63	0.00	0.47	0.41
Port Enable/Disable	1	1	1	1

Variables Port 1 - 4

	Port 5	Port 6	Port 7	Port 8
Port Alias	Port5	Port6	Port7	Port8
Port Duplex	Full	N/A	Full	N/A
Port Link Status	Up	Down	Up	Down
Port PortId	5	6	7	8
Port Speed	100	N/A	100	N/A
Port Usage	0.32	0.00	0.93	0.00
Port Enable/Disable	1	1	1	1

Variables Port 5 - 8



	Port 9	Port 10	Port 11	Port 12
Port Alias	Port9	Port10	Port11	Port12
Port Duplex	Full	Full	Full	N/A
Port Link Status	Up	Up	Up	Down
Prot PortId	9	10	11	12
Port Speed	100	100	100	N/A
Port Usage	0.27	0.00	0.19	0.00
Port Enable/Disable	1	1	1	1

Variables Port 9 - 12

	Port 13	Port 14	Port 15	Port 16
Port Alias	Port13	Port14	Port15	Port16
Port Duplex	N/A	N/A	Full	N/A
Port Link Status	Down	Down	Up	Down
Port PortId	13	14	15	16
Port Speed	N/A	N/A	100	N/A
Port Usage	0.00	0.00	1.01	0.00
Port Enable/Disable	1	1	1	1

Variables Port 13 - 16

[Main Menu](#)[Alarms](#)**Ports 1 - 4 Status Variables**

	Port 1	Port 2	Port 3	Port 4
Port Alias	Port1	Port2	Port3	Port4
Port Duplex	Full	Full	Full	Full
Port Link Status	Up	Up	Up	Up
Port PordId	1	2	3	4
Port Speed	100	100	100	100
Port Usage	0.63	0.00	0.47	0.41
Port Enable/Disable	1	1	1	1

Ports 1 - 4 Error Variables

	Port 1	Port 2	Port 3	Port 4
Rx Alignment Errors	0	0	0	0
Rx Dropped Packets	26896	12	22505	24427
Rx FCS Errors	0	0	0	0
Rx Fragments	0	0	0	0
Rx Jabbers	0	0	0	0
Rx Over Size Packets	0	0	0	0
Rx SA Changes	1	1	1	1
Rx Symbol Errors	0	0	0	0
Rx Undersized Packets	0	0	0	0
Tx Deferred	0	0	0	0
Tx Dropped Packets	0	0	0	0
Tx Excessive Collision	0	0	0	0
Tx Frame in Disc	0	0	0	0
Tx Late Collision	0	0	0	0

Ports 1 - 4 Traffic Variables

	Port 1	Port 2	Port 3	Port 4
64 Packets	954886	2013	1071963	1244005
65 - 127 Packets	635261627	5079812	423624549	486003913
128 255 Pakcets	137983652	1271849	353282364	251858
256 - 511 Packets	0	0	0	0
512 - 1023 Packets	0	0	0	0
1024 - 1522 Packets	0	0	0	0
Rx Octets	1075104790	965874603	3097764742	2655430138
Rx Good Octets	1075104790	965874603	3097764742	2655430138
Rx Broadcast Packets	26896	12	22505	24427
Rx Multicast Packets	252448708	0	364957118	40810134
Rx Unicast Packets	521724561	6969279	425410363	446665215
Rx Pause Packets	0	0	0	0
Tx Octets	1141335070	2603744245	1151796678	294130216
Tx Collisions	0	0	0	0
Tx Multiple Collision	0	0	0	0
Tx Single Collision	0	0	0	0
Tx Broadcast Packets	178842	204967	183234	181110
Tx Multicast Packets	1061389137	7539002	781368904	985906172
Tx Unicast Packets	567824279	8035931	423012149	13909892
Tx Pause Packets	0	0	0	0

**BW**SYSTEMS, INC.

www.BWSystems-inc.com
 346 Chester St.
 St. Paul, MN 55107
 (651) 665 - 9060

[Overview](#)[Ports 5 - 8](#)[Ports 9 - 12](#)[Ports 13 - 16](#)

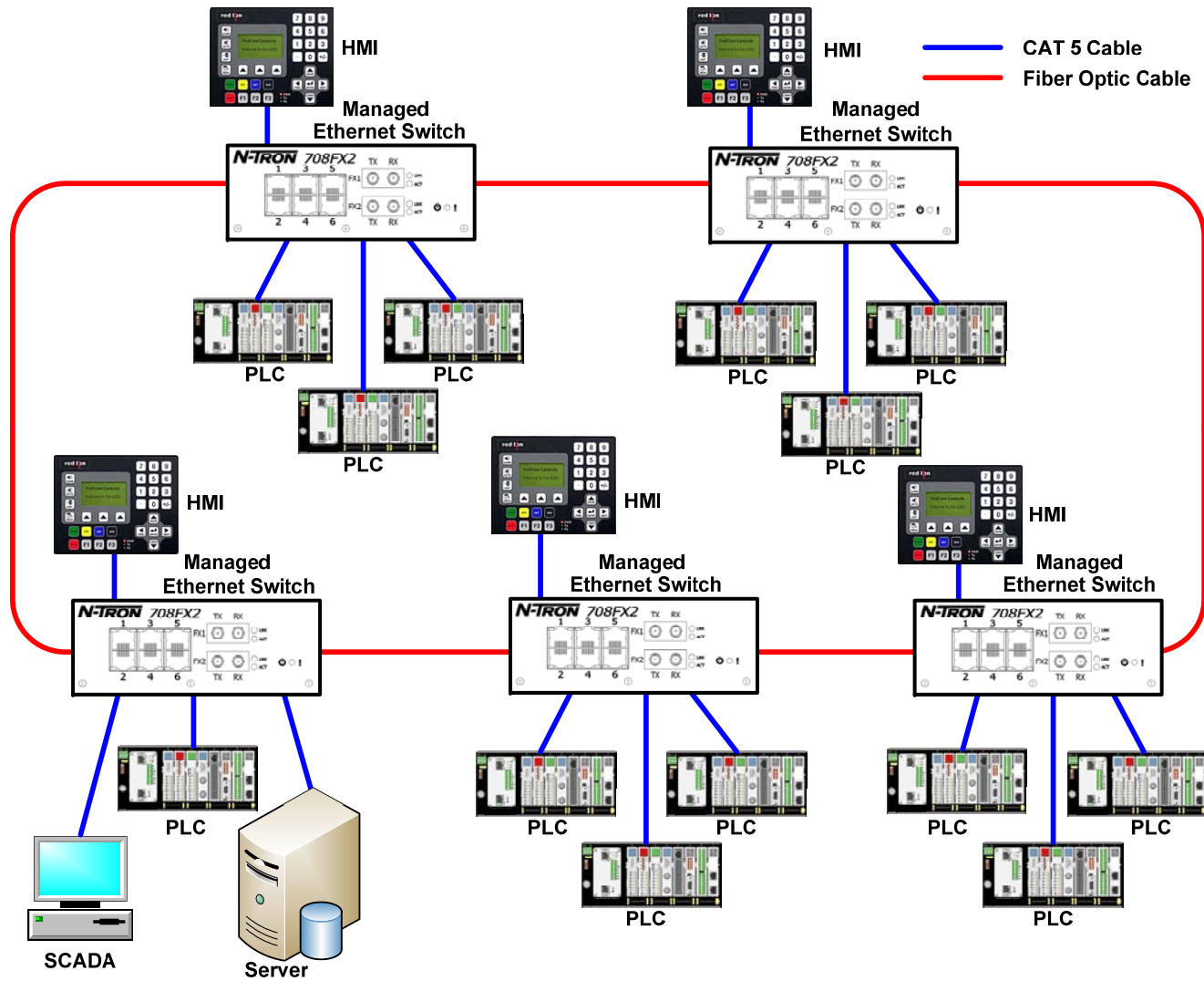
Key Managed Switch Protocols

- Simple Network Management Protocol.
- Internet Group Management Protocol (IGMP)
- Quality of Service (QoS)
- Virtual Local Area Network (VLAN)
- Dynamic Host Configuration Protocol (DHCP)
- Rapid Spanning Tree (RSTP)
- High Speed Ring Manager (N-Ring)

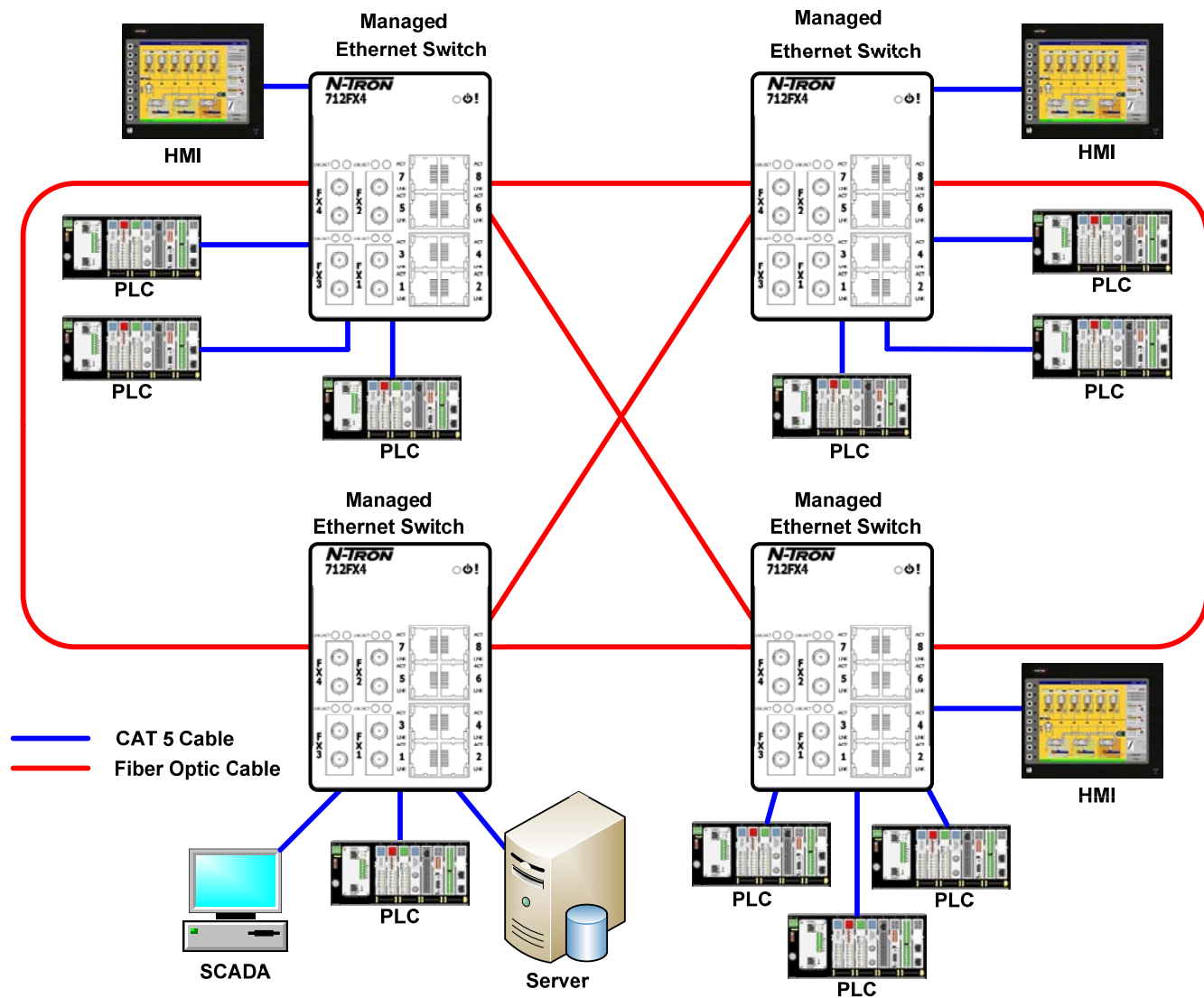
Ethernet Managed Topologies

- Spanning Tree (IEEE)
- Rapid Spanning Tree (IEEE)
- Proprietary High Speed Ring
- Multi Ring

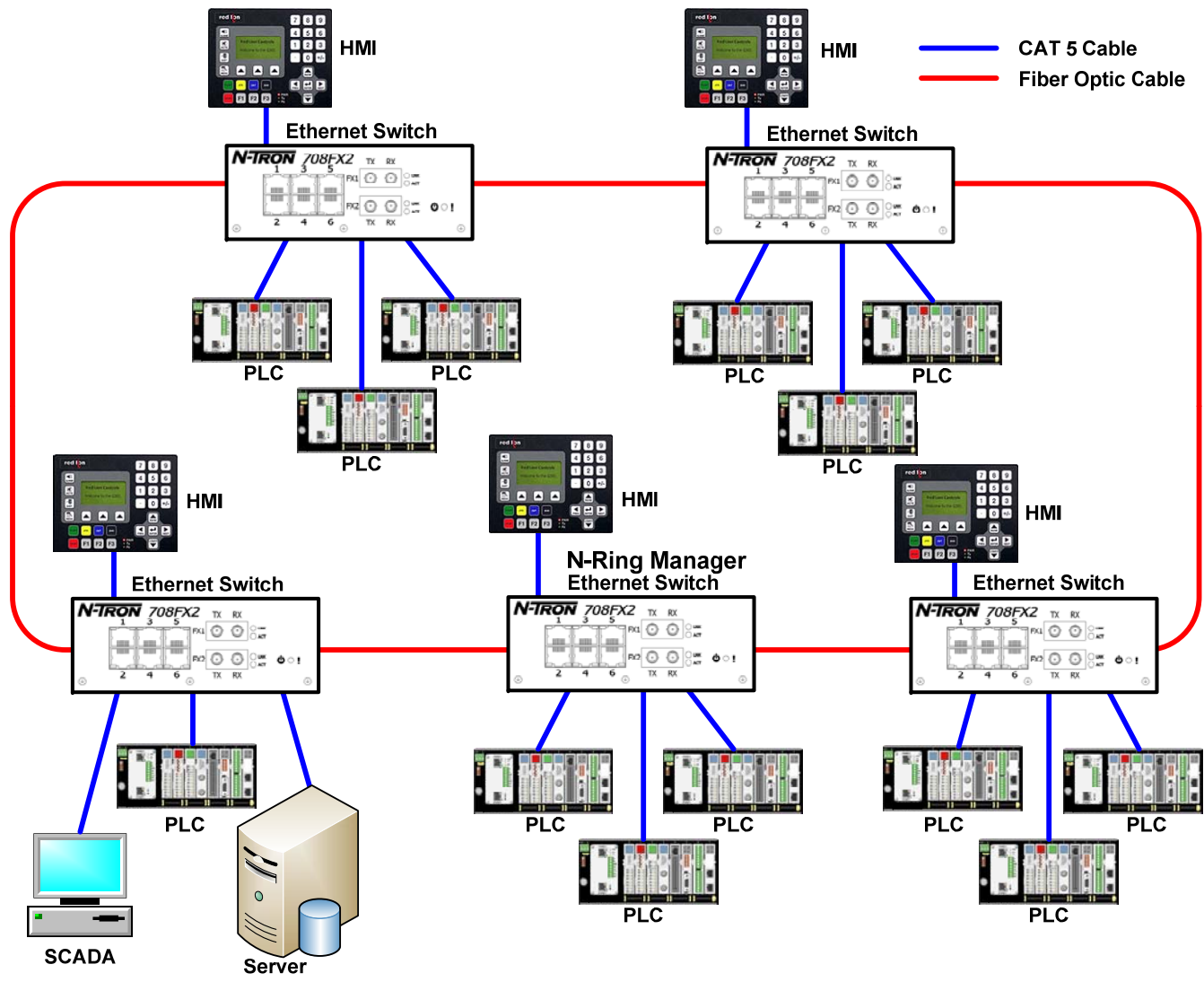
RSTP Ring Topology



RSTP Mesh Topology



N-Ring Topology



N-Ring VS RSTP

Ring Management Comparison	N-Ring	RSTP	STP
Ring Break Detect Time	~30 ms	~1-3sec	>30 sec
Ring Heal Time	~10 ms	~1-3sec	>30 sec
Fault Reporting	Yes	No	No
Proprietary	Yes	No	No
Sufficient for Automated Control	Yes	No	No

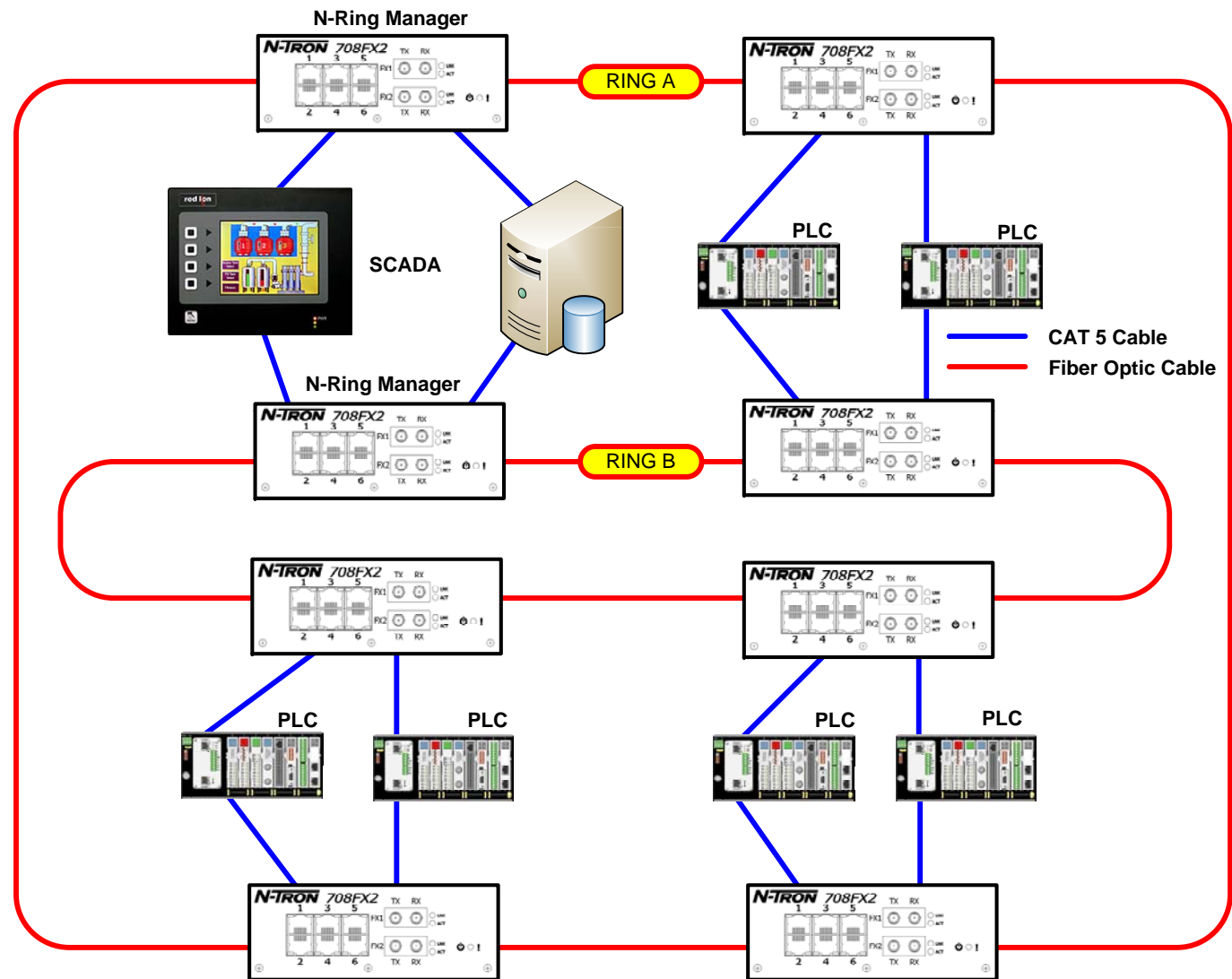
N-Ring Status Monitoring

N-Ring OK!!					
N-Ring Status View					
Switch is an N-Ring Manager.					
Switch No	MAC Address	IP Address	Subnet Mask	Name	Ports
RM	00:07:af:ff:f6:e0	192.168.1.136	255.255.255.0	N-TRON Switch	A2
					A1
1	00:07:af:ff:f6:40	192.168.1.131	255.255.255.0	N-TRON Switch	A1
					A2
2	00:07:af:ff:f6:60	192.168.1.132	255.255.255.0	N-TRON Switch	A2
					A1
3	00:07:af:ff:f6:80	192.168.1.133	255.255.255.0	N-TRON Switch	A1
					A2
4	00:07:af:ff:f6:a0	192.168.1.134	255.255.255.0	N-TRON Switch	A2
					A1
5	00:07:af:ff:f6:c0	192.168.1.135	255.255.255.0	N-TRON Switch	A1
					A2

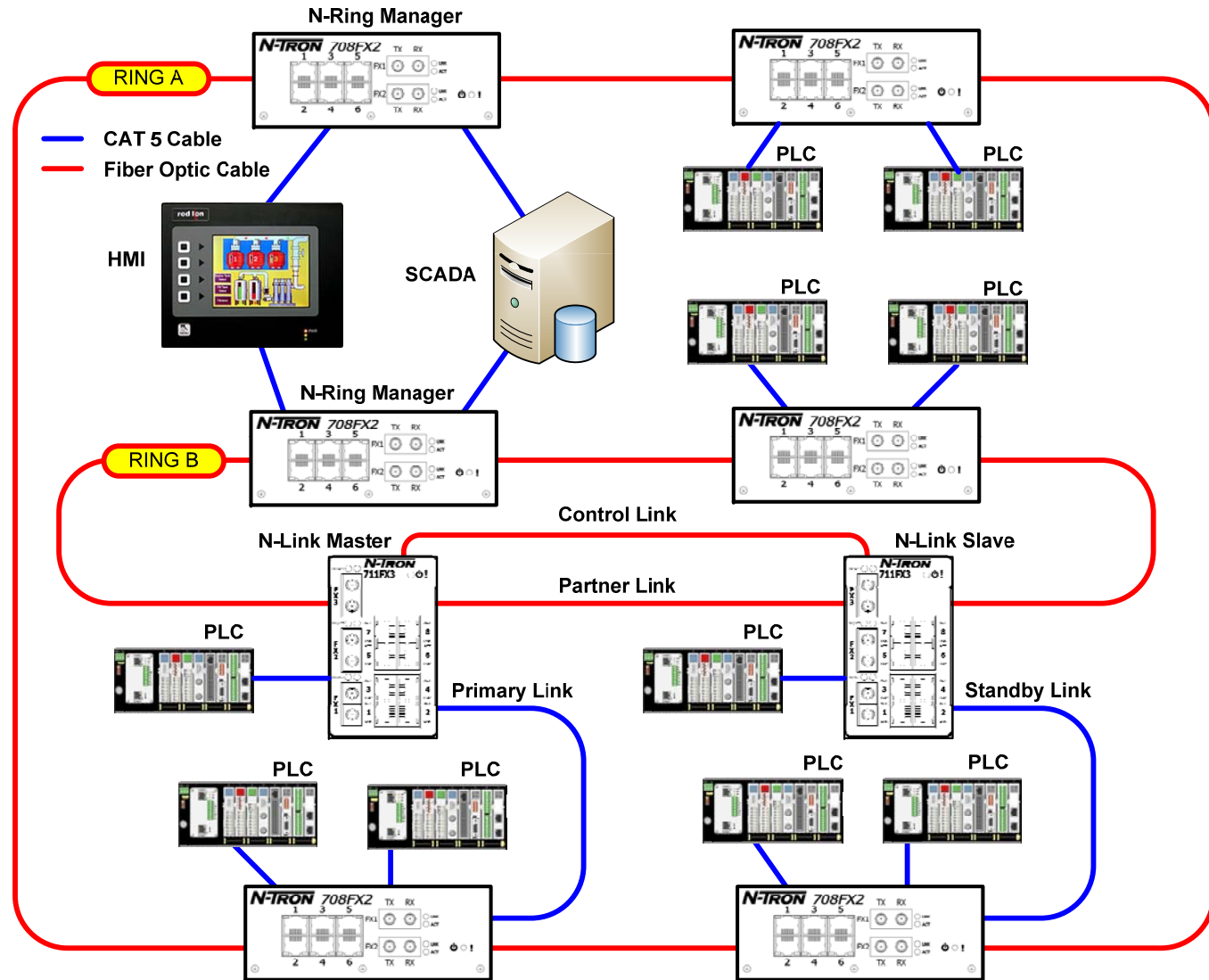
N-Ring Status Monitoring

N-Ring Fault!!					
N-Ring Status View					
Switch is an N-Ring Manager.					
Switch No	MAC Address	IP Address	Subnet Mask	Name	Ports
RM	00:07:af:ff:f6:e0	192.168.1.136	255.255.255.0	N-TRON Switch	A2 A1
1	00:07:af:ff:f6:40	192.168.1.131	255.255.255.0	N-TRON Switch	A1 A2
2	00:07:af:ff:f6:60	192.168.1.132	255.255.255.0	N-TRON Switch	A2 A1
3	00:07:af:ff:f6:80	192.168.1.133	255.255.255.0	N-TRON Switch	A1 A2
4	00:07:af:ff:f6:a0	192.168.1.134	255.255.255.0	N-TRON Switch	A2 A1
5	00:07:af:ff:f6:c0	192.168.1.135	255.255.255.0	N-TRON Switch	A1 A2

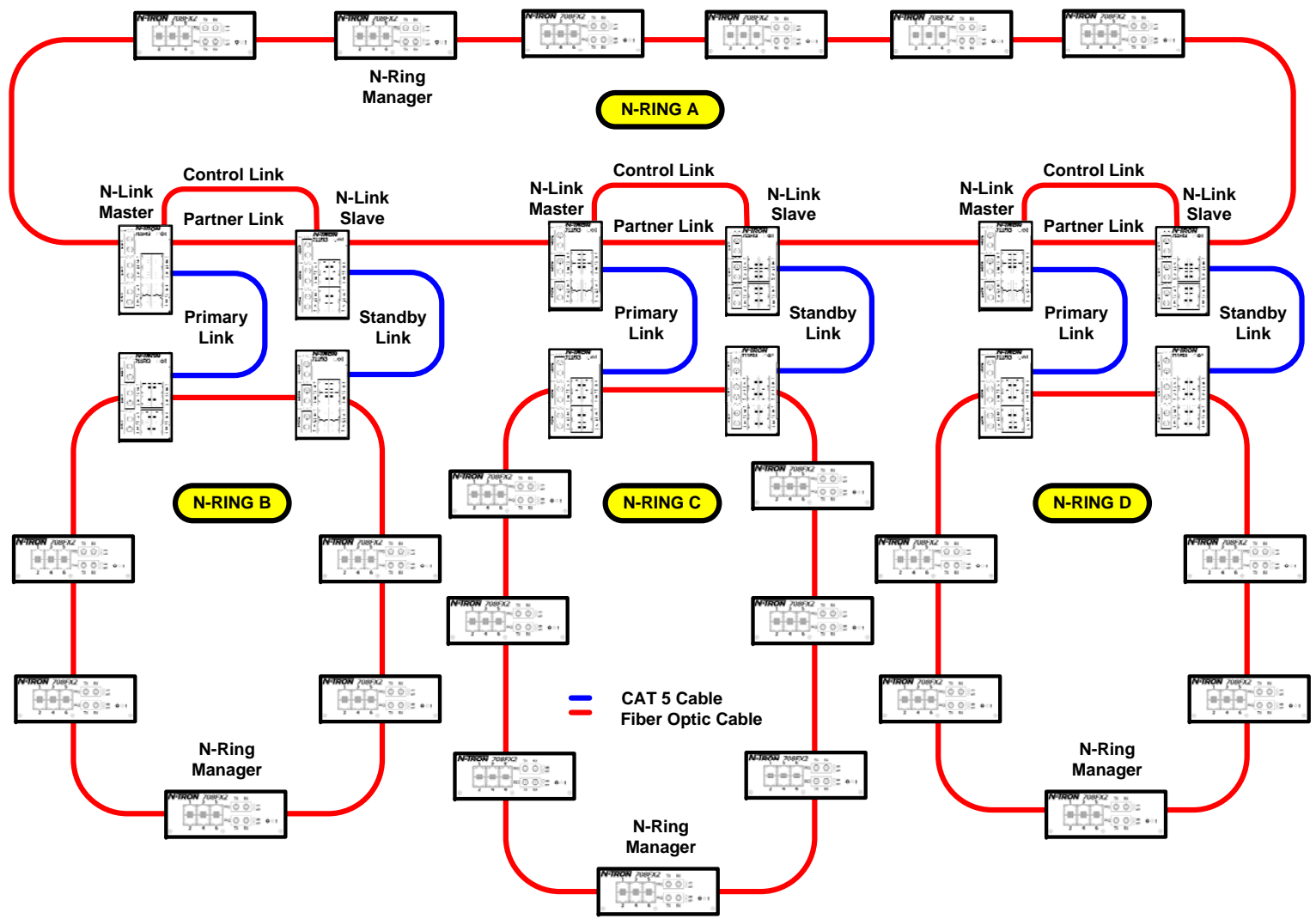
Double Ring



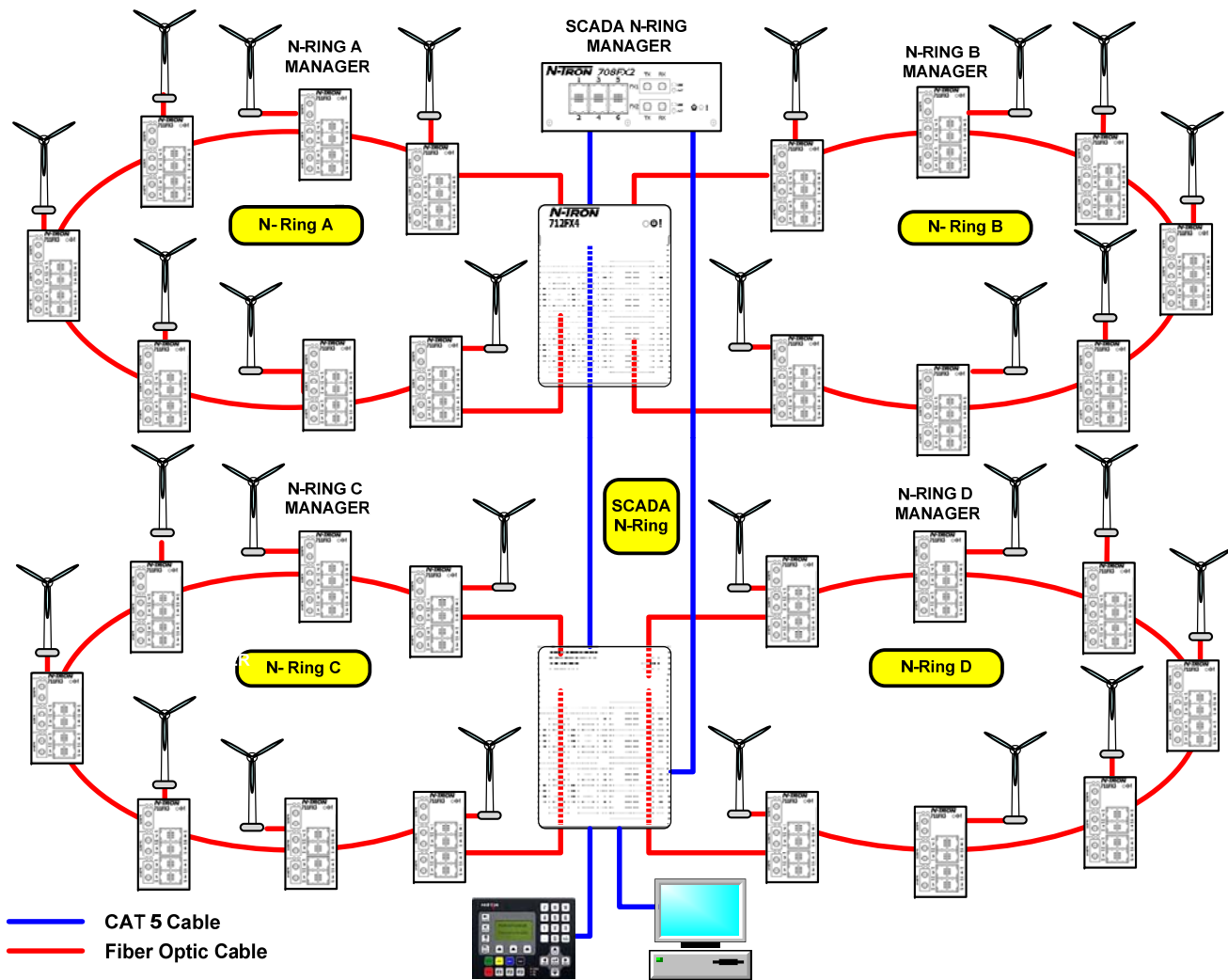
N-Link



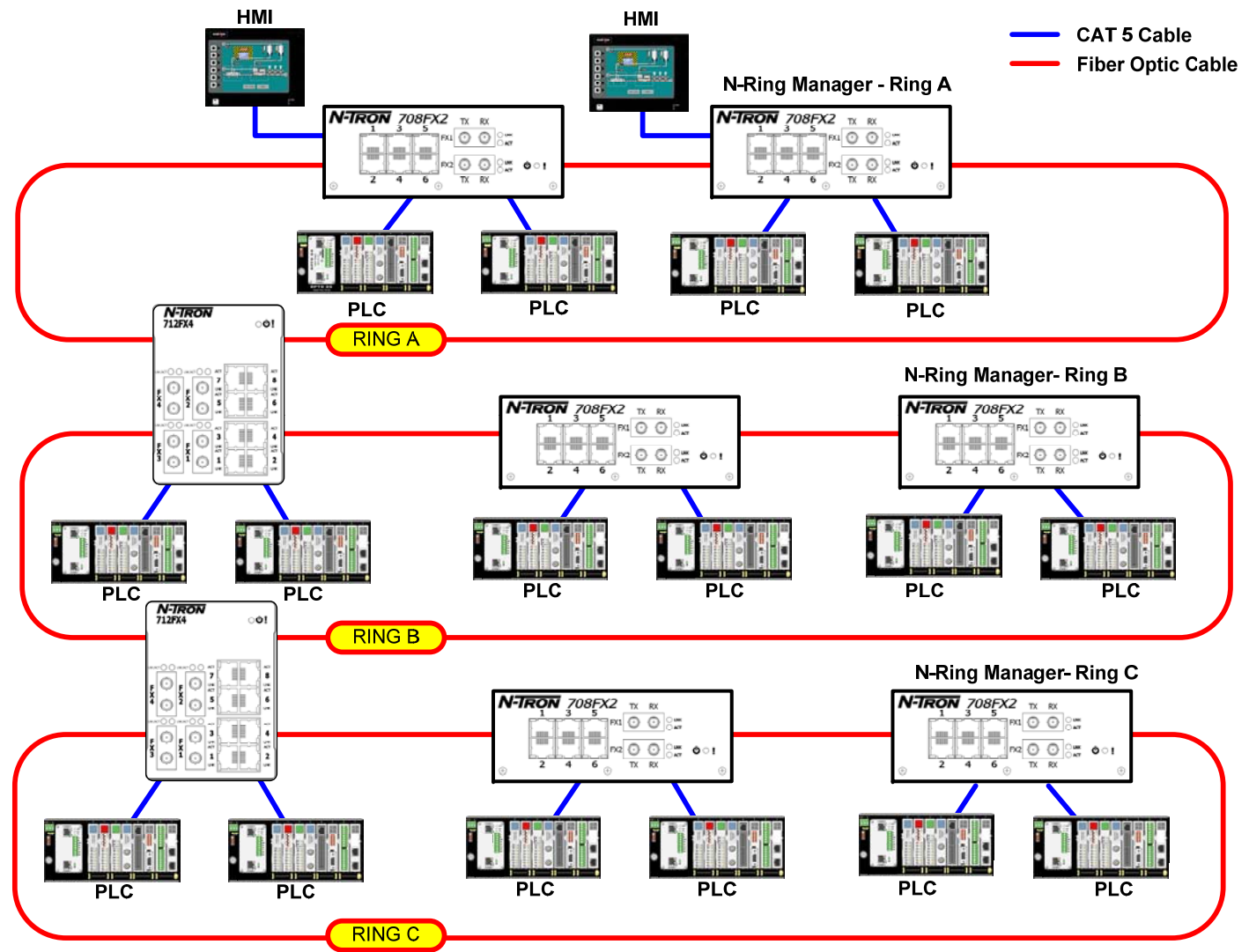
N-Linked Rings



Multiple N-Ring



Daisy Chained N-Rings



IEEE 802.11 Wireless Local Area Network Standards

Protocol	Release Date	Operating Frequency	Throughput Typical	Data Rate Maximum	Modulation Technique
802.11a	1999	5.X GHz	23 Mbit/s	54 Mbit/s	OFDM
802.11b	1999	2.4 GHz	4.3 Mbit/s	11 Mbit/s	DSSS
802.11g	2003	2.4 GHz	19 Mbit/s	54 Mbit/s	OFDM
802.11n Draft	2009	2.4 GHz 5.X GHz	74 Mbit/s	300 Mbit/s	MIMO SDM

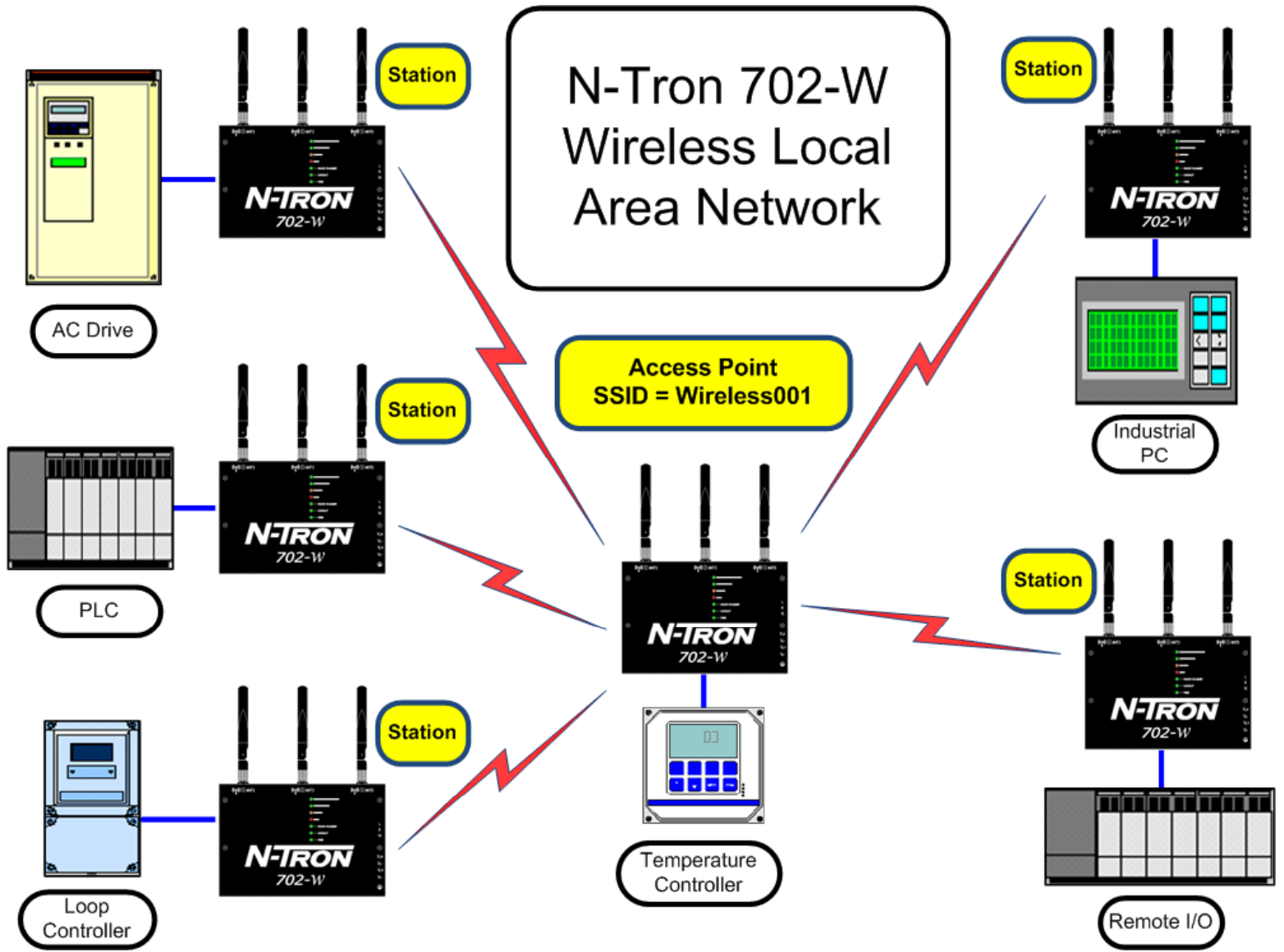
OFDM = Orthogonal Frequency-Division Multiplexing

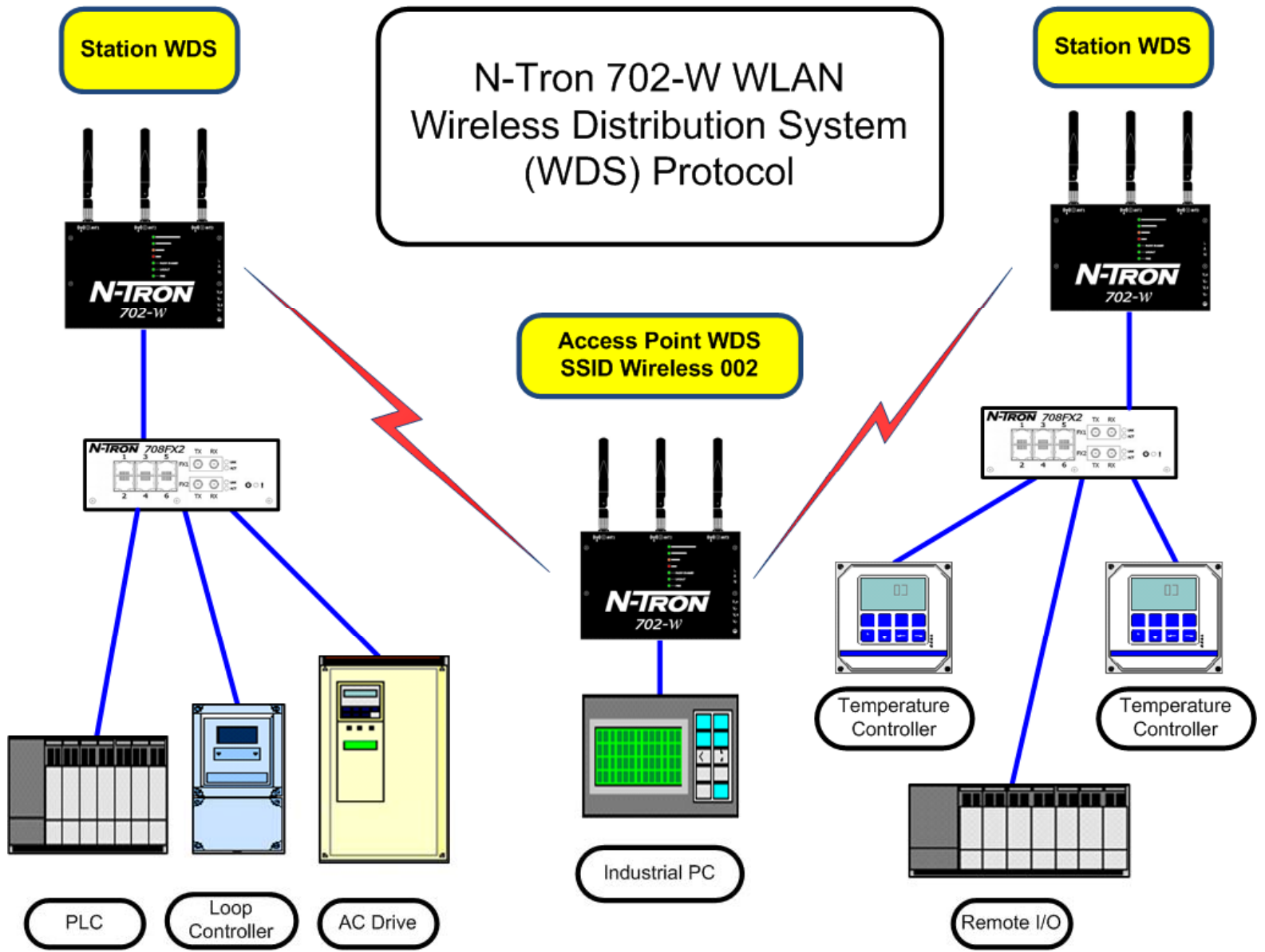
DSSS = Direct-Sequence Spread Spectrum Multiplexing

MIMO/SDM = Multiple-Input Multiple-Output / Spatial Division Multiplexing

Note 1 - 802.11g is backward compatible with 802.11b

Note 2 – 802.11n is backward compatible with 802.11a,b,g

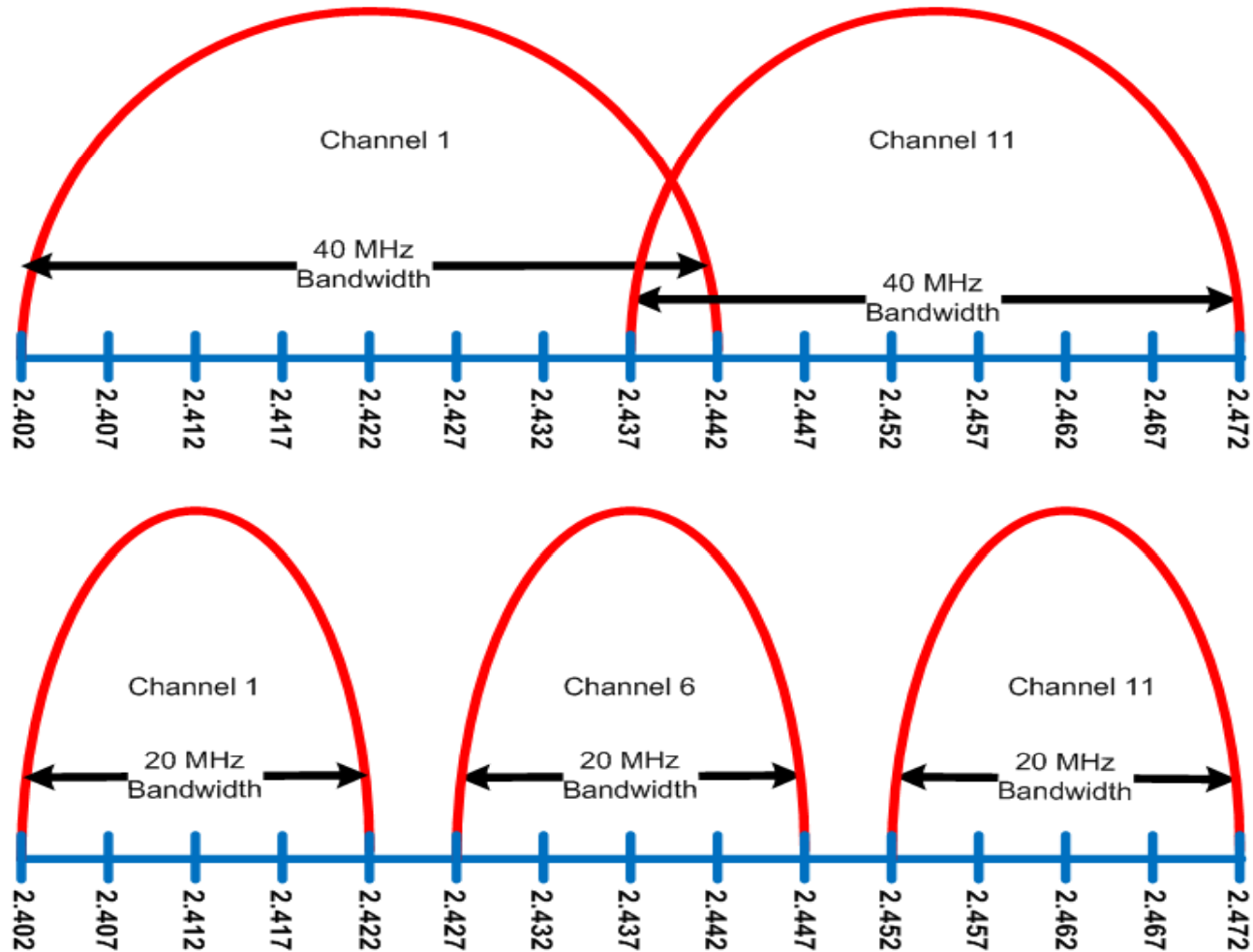




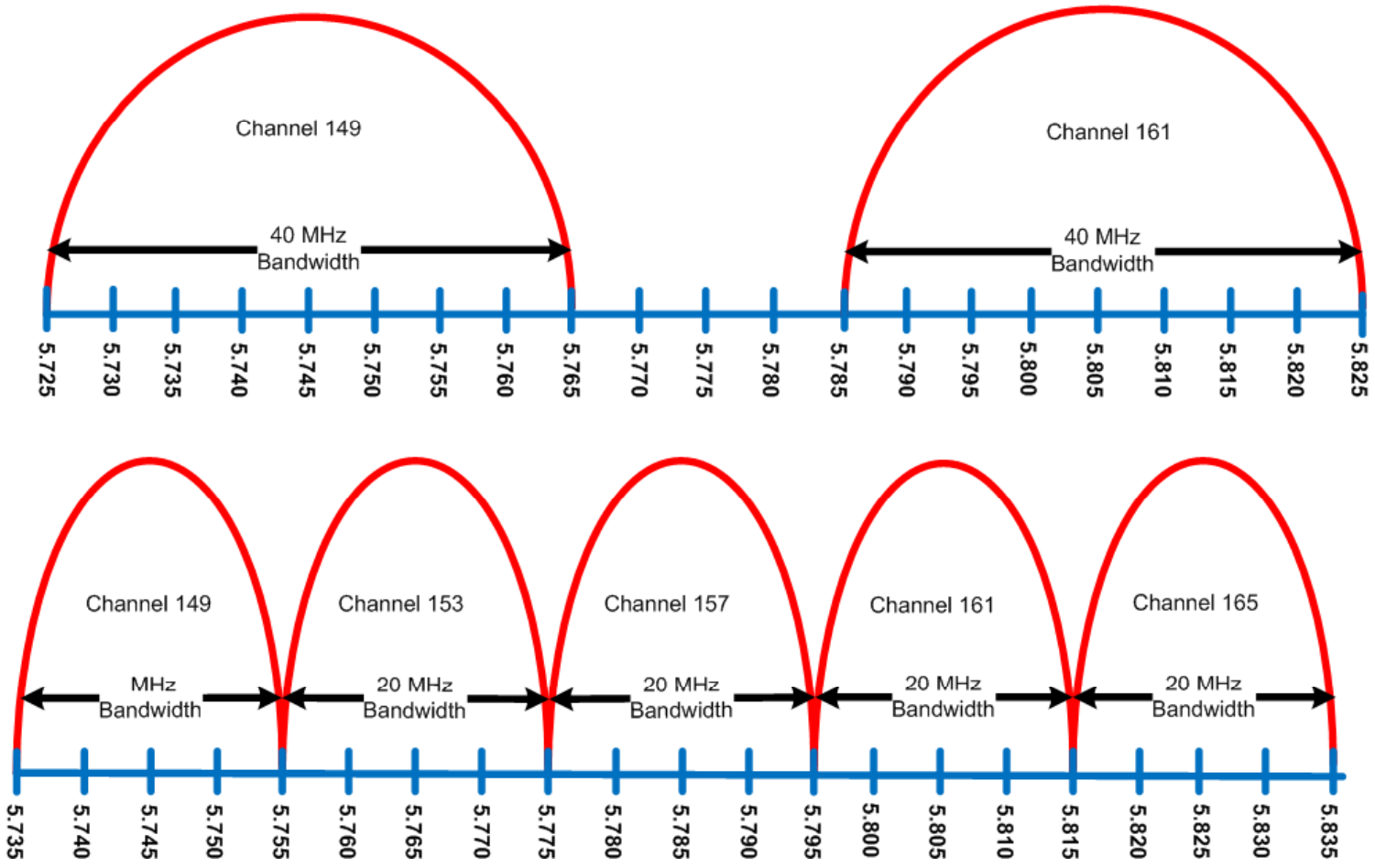
N-Tron 702-W Frequency Comparison 2.4GHz or 5.0GHz

Compare	2.4GHz	5.0GHz
Interference	Many devices use these frequencies.	Fewer devices use these frequencies
	Frequency spread between channels is small which leads to interference	Wider frequency spread between channels causes less interference
Maximum Radius Open Room, Standard Antennas, 20Mhz Bandwidth at 100 Mbps	~100Meters	~75 Meters
Maximum Radius Outdoors, Standard Antennas, 20Mhz Bandwidth at 100 Mbps	~400 Meters	~280 Meters

2.4 GHz Channel Allocation at 20MHz and 40 MHz Bandwidth



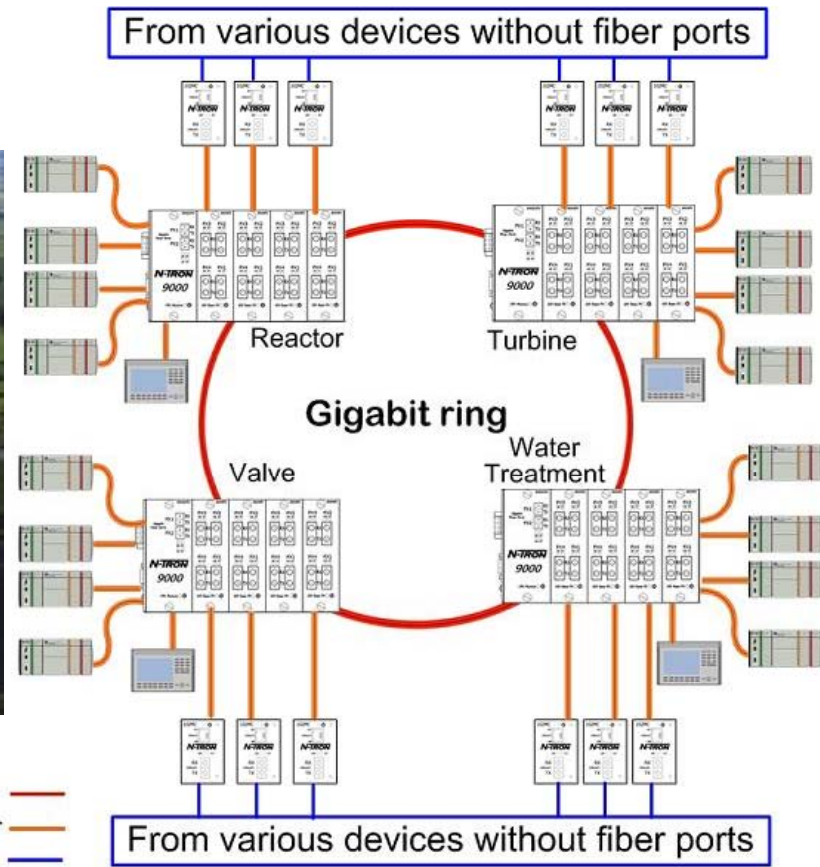
5.0 GHz Channel Allocation at 20MHz and 40 MHz Bandwidth



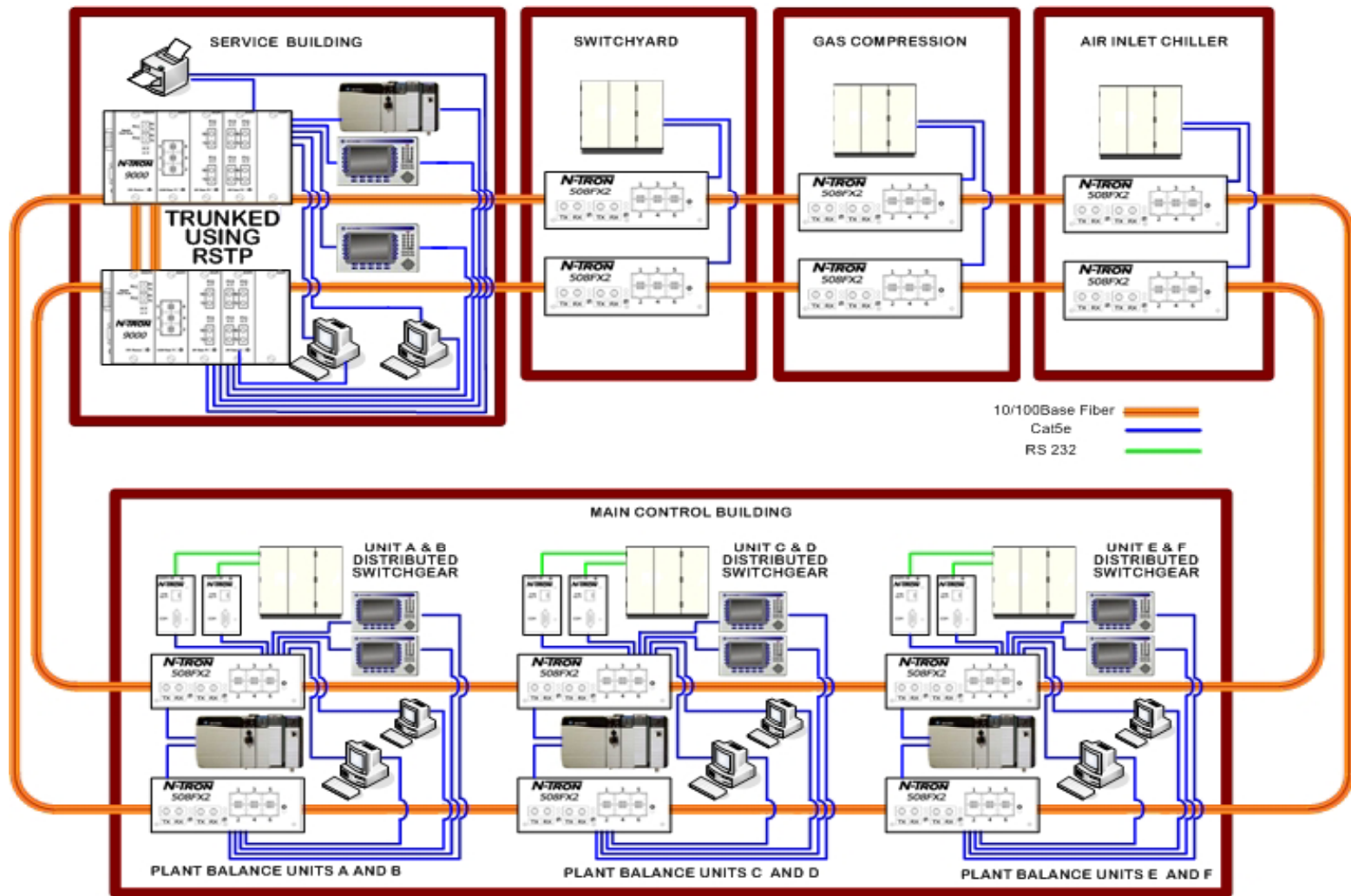
Energy Topologies

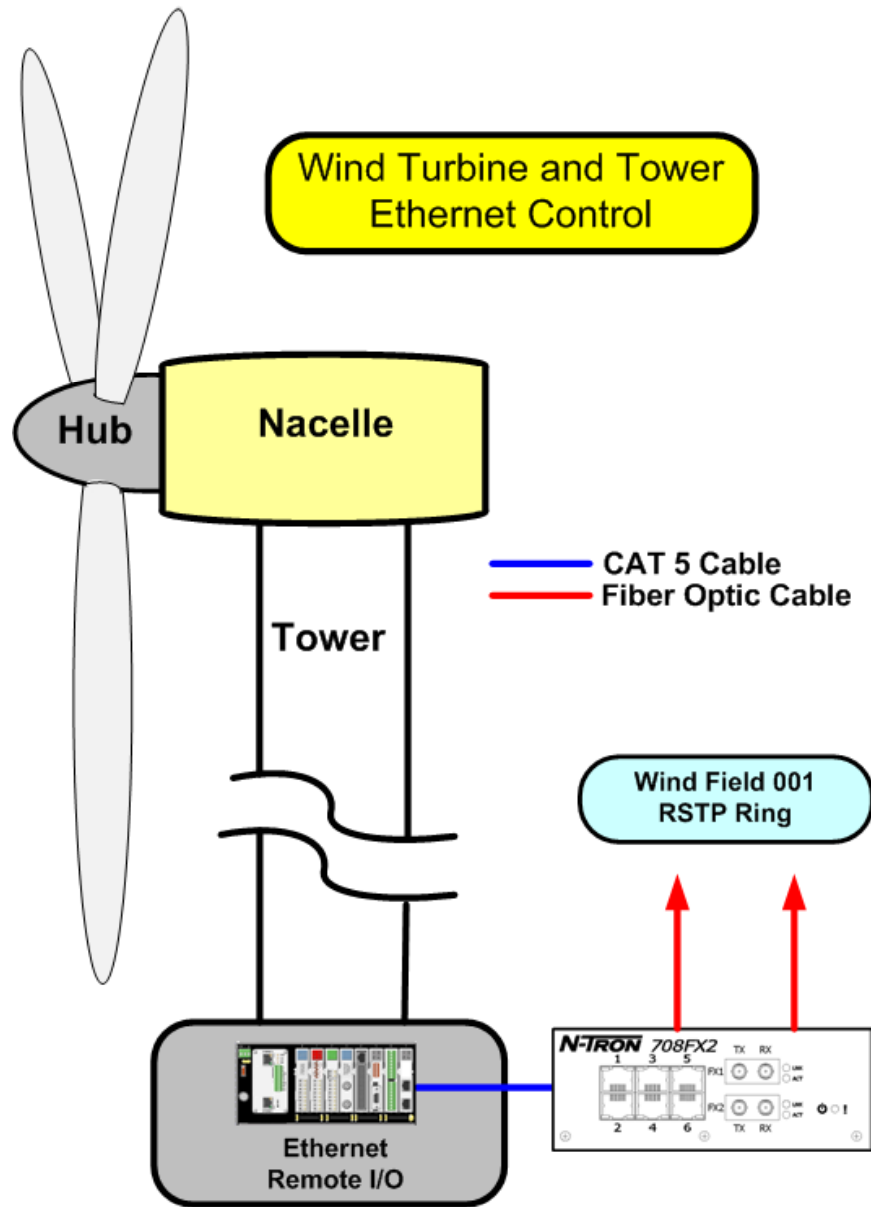


Nuclear Power Plant

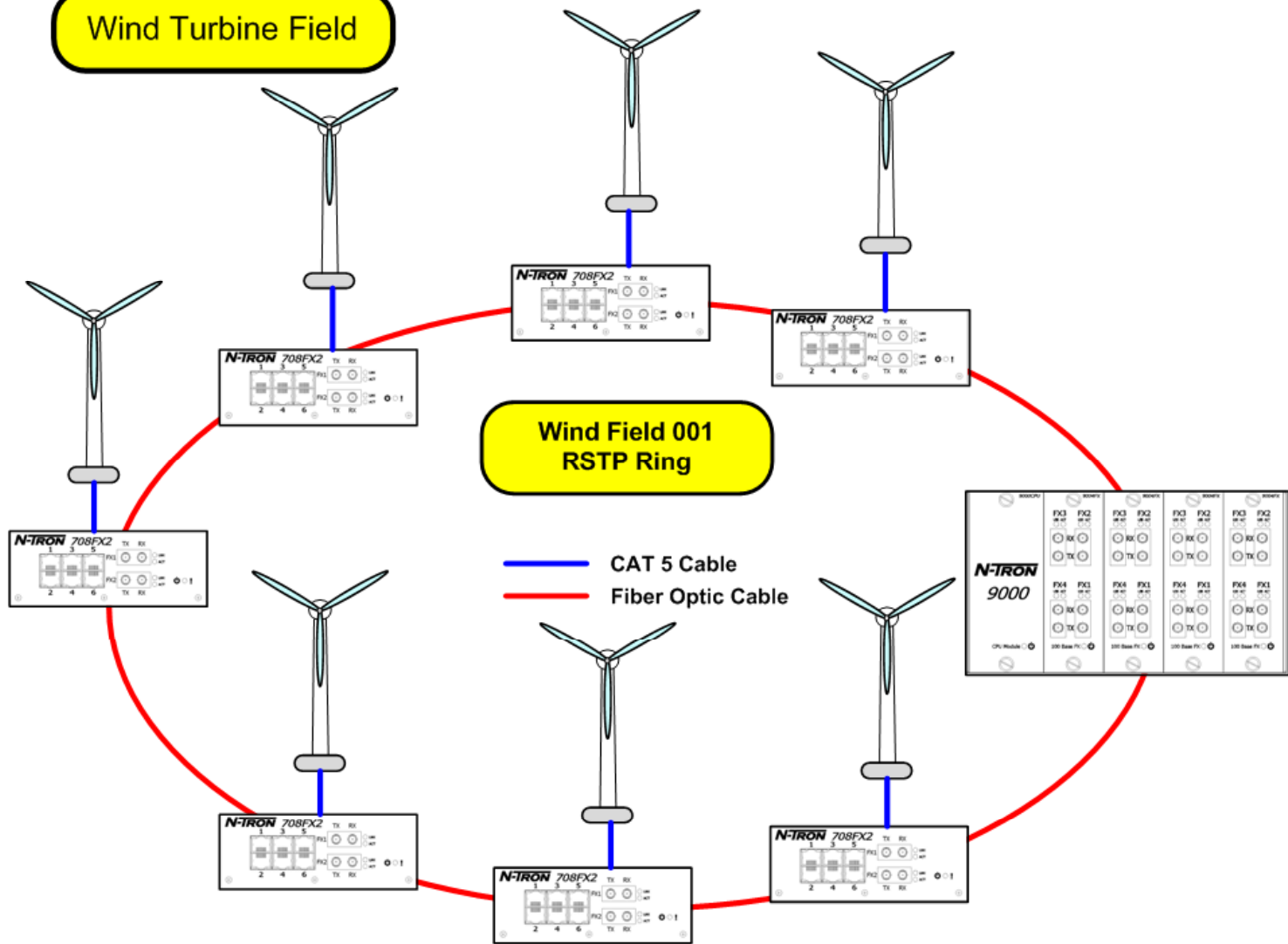


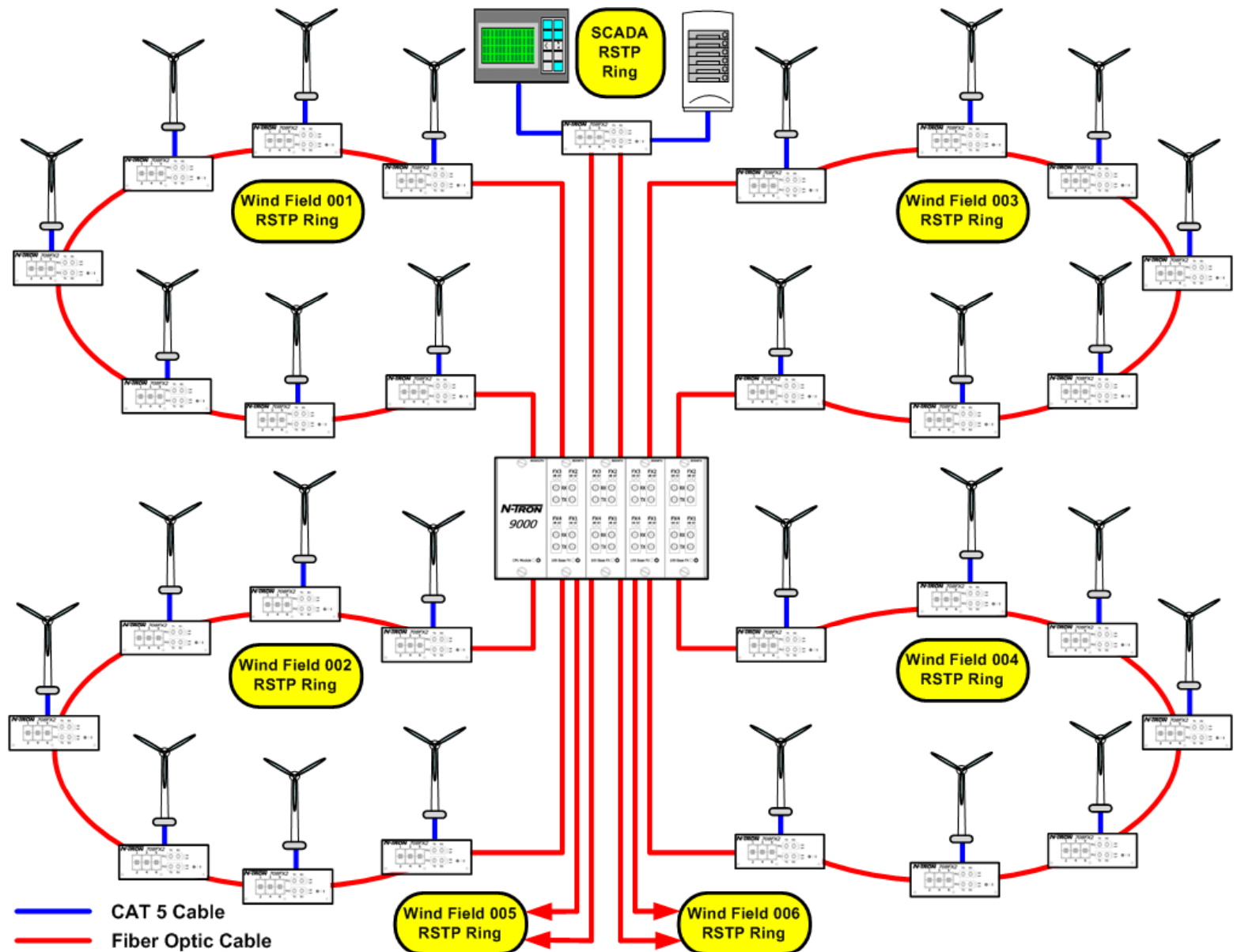
Topology for Electric Power Generation Plant

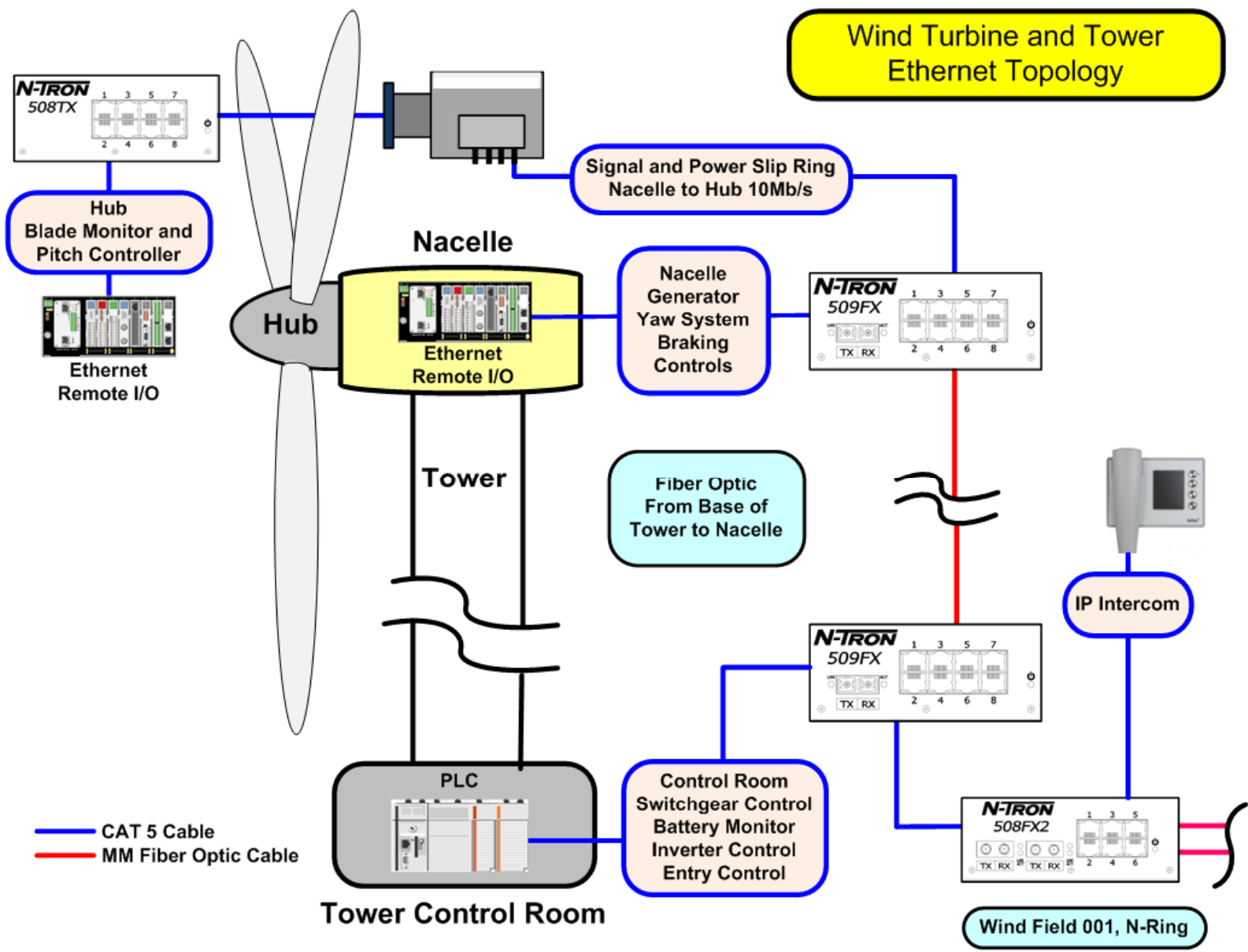




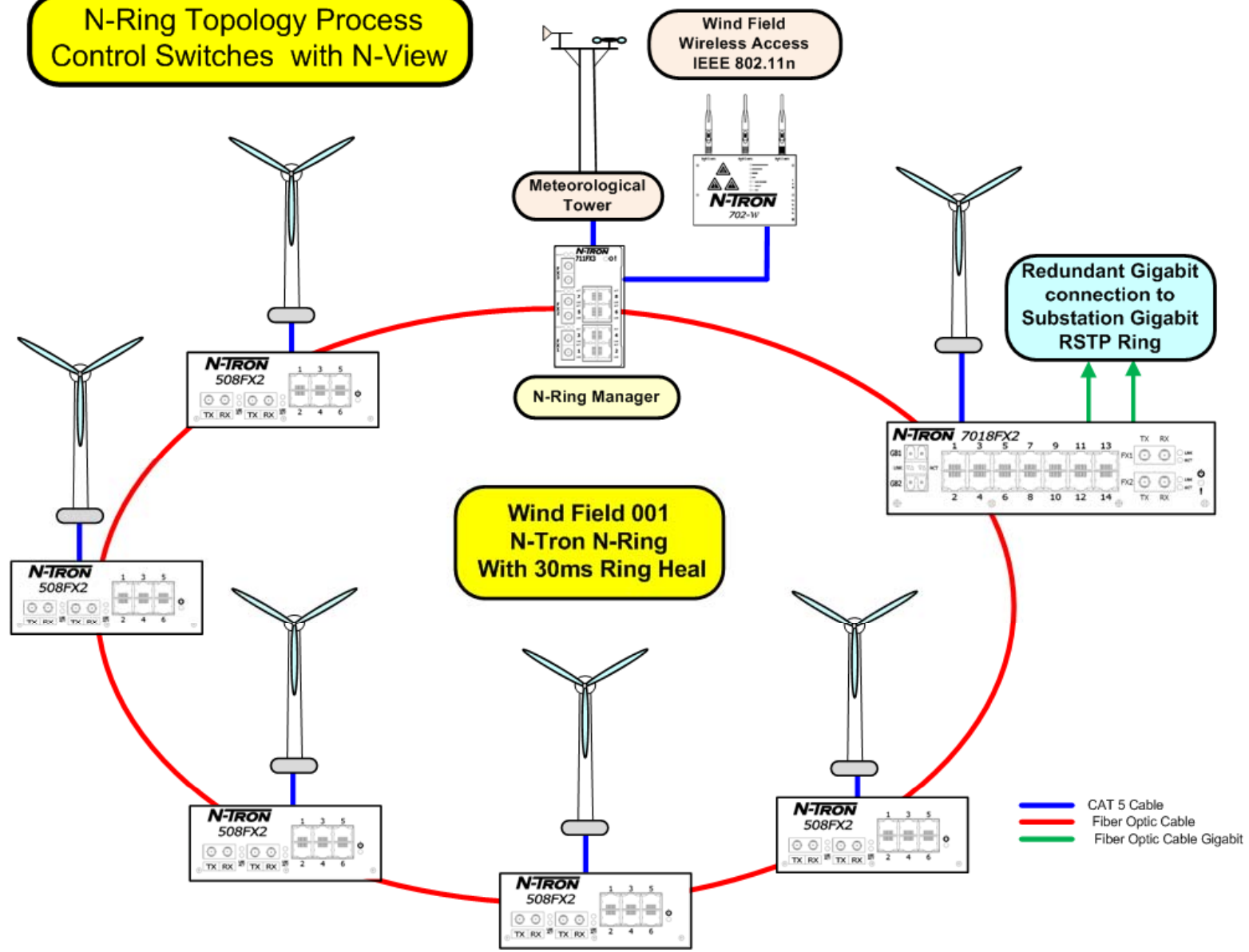
Wind Turbine Field

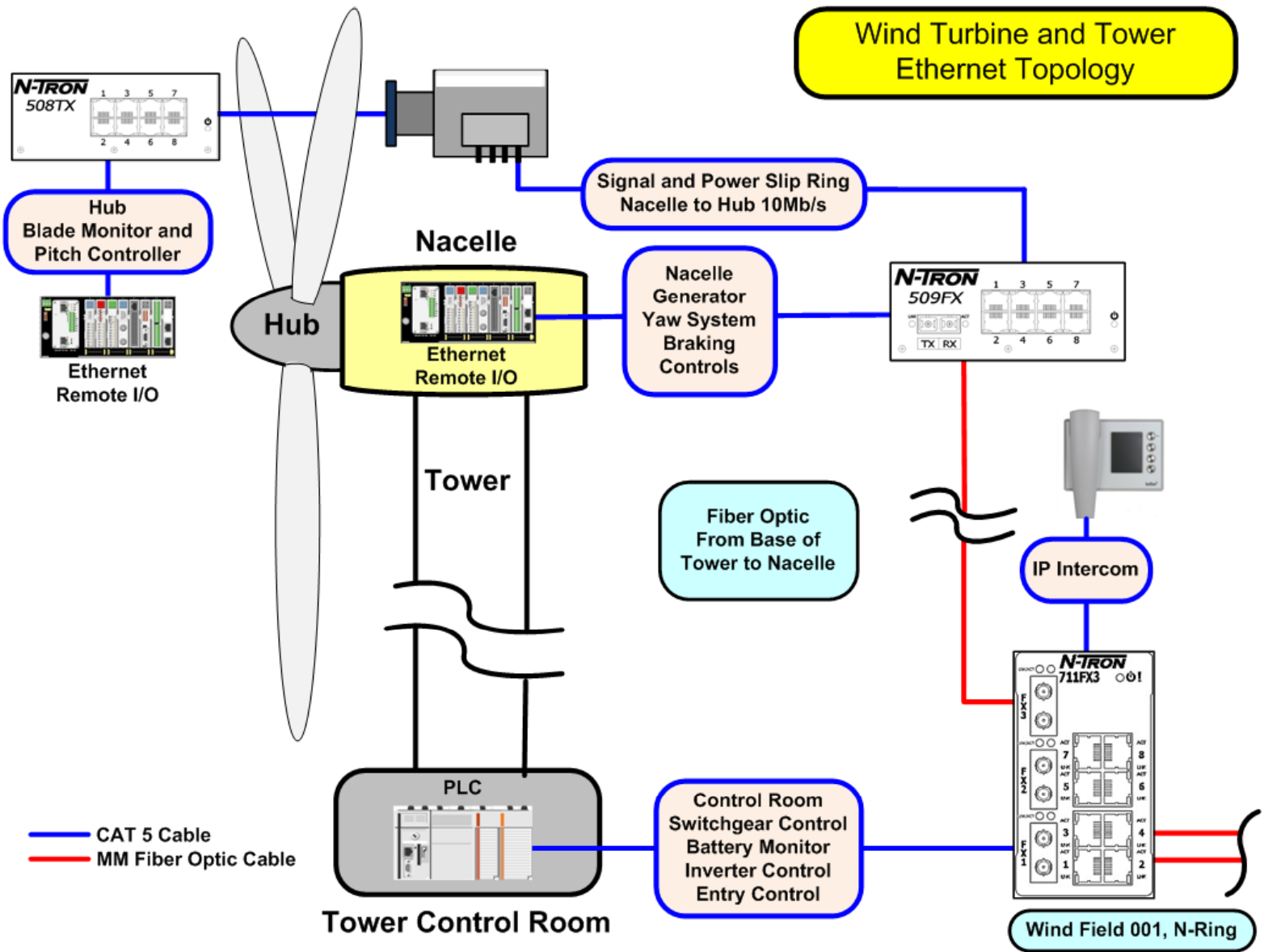


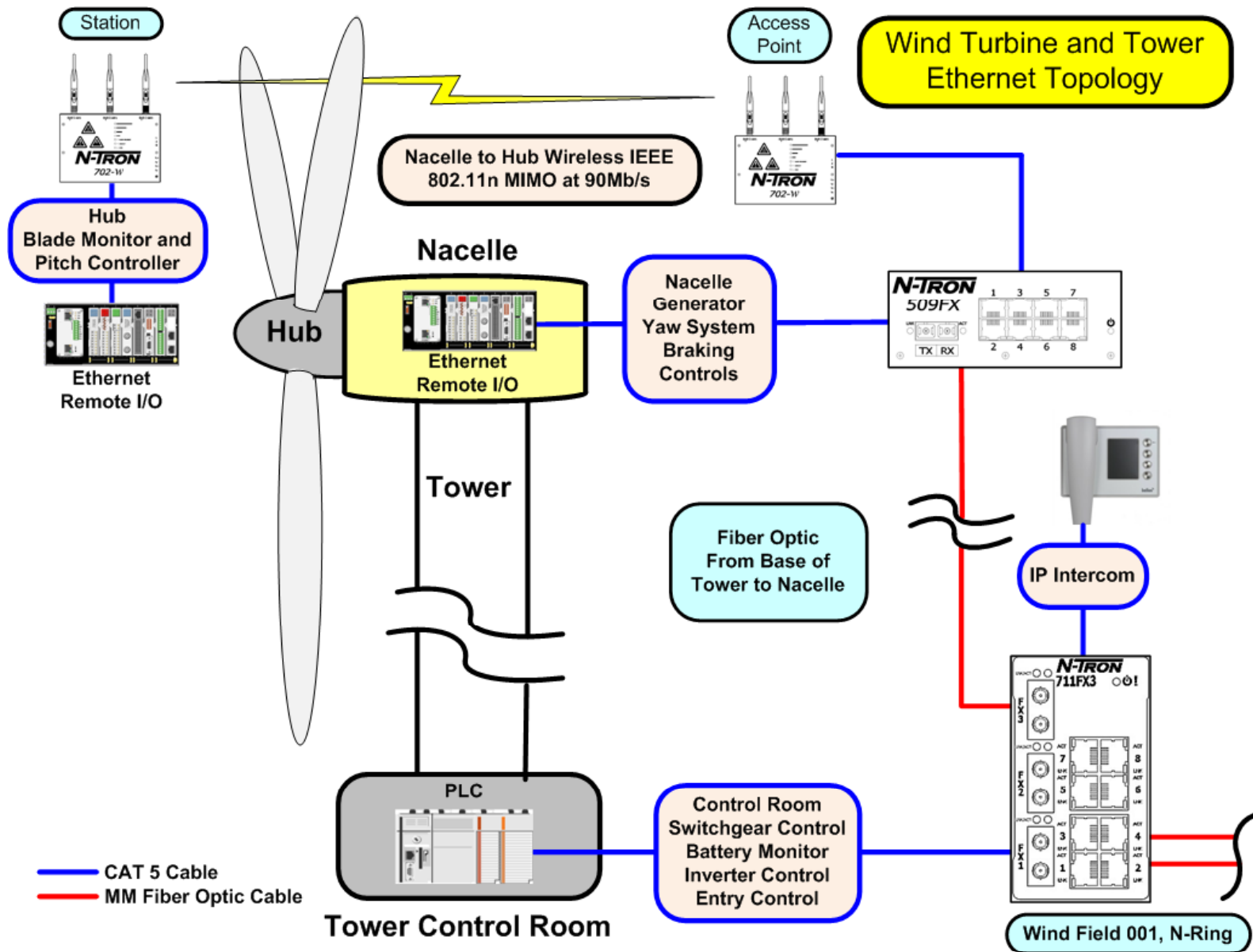




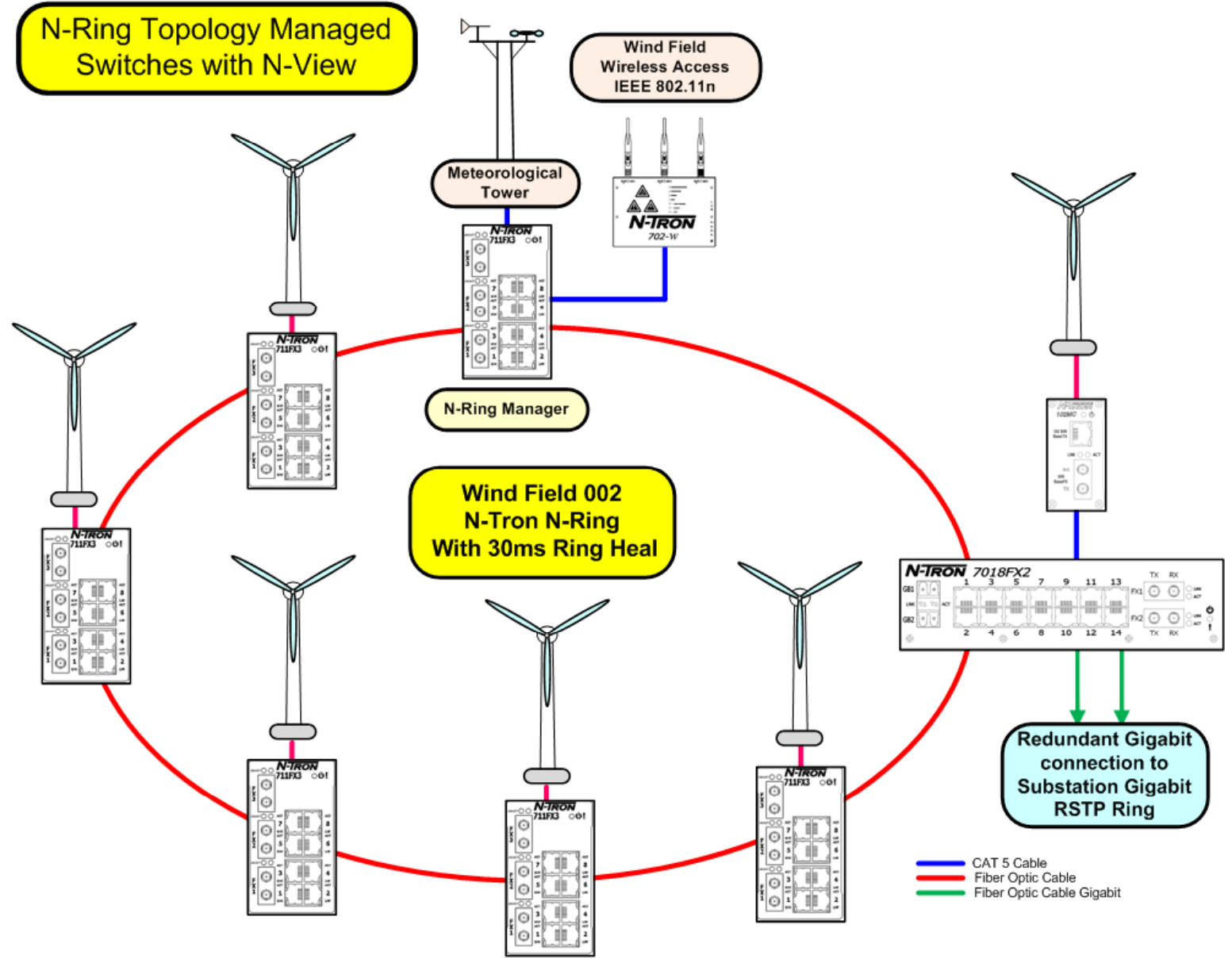
N-Ring Topology Process Control Switches with N-View

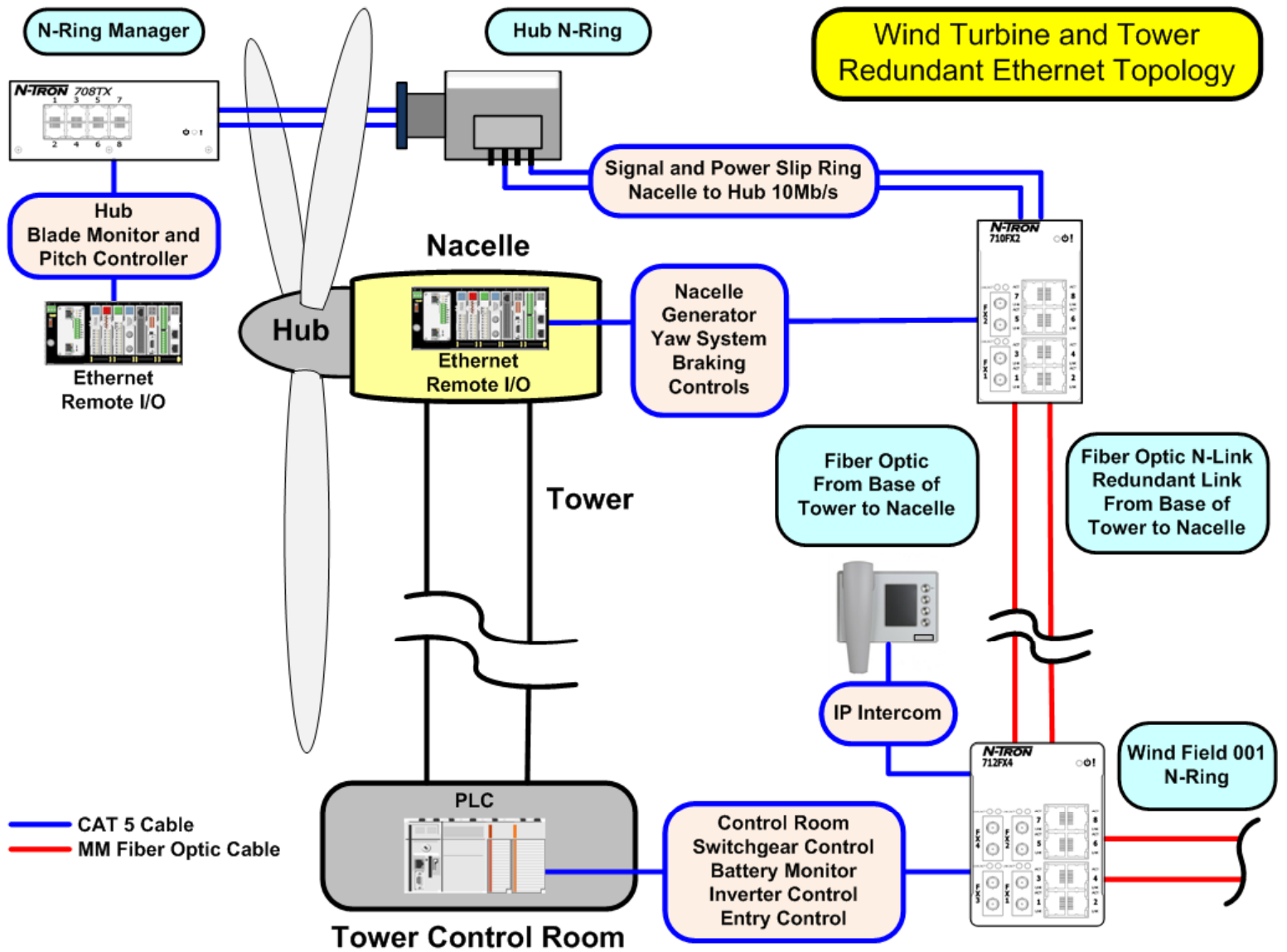






N-Ring Topology Managed Switches with N-View





Ring Topology Managed Switches with N-Ring and N-View

