Advances in Communications & Reliability of Power Systems

Presented by
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Are you frustrated?

- Ever had problems getting on the network?
- Ever had problems getting on the web?
- How can a person with an Apple Computer send me an email when I use Microsoft Outlook?
- Why can’t I talk to these relays?

2

- All these questions will hopefully be answered and more because:

This is all part of Communications!

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Overview of Topics to be covered

- Basics
- Ethernet
- Protocols
- HMI

Basics

- Introduction
- Parallel
- Serial
- Parity Error
- Network
- Open verses Closed
- Standards
- OSI Model

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Introduction

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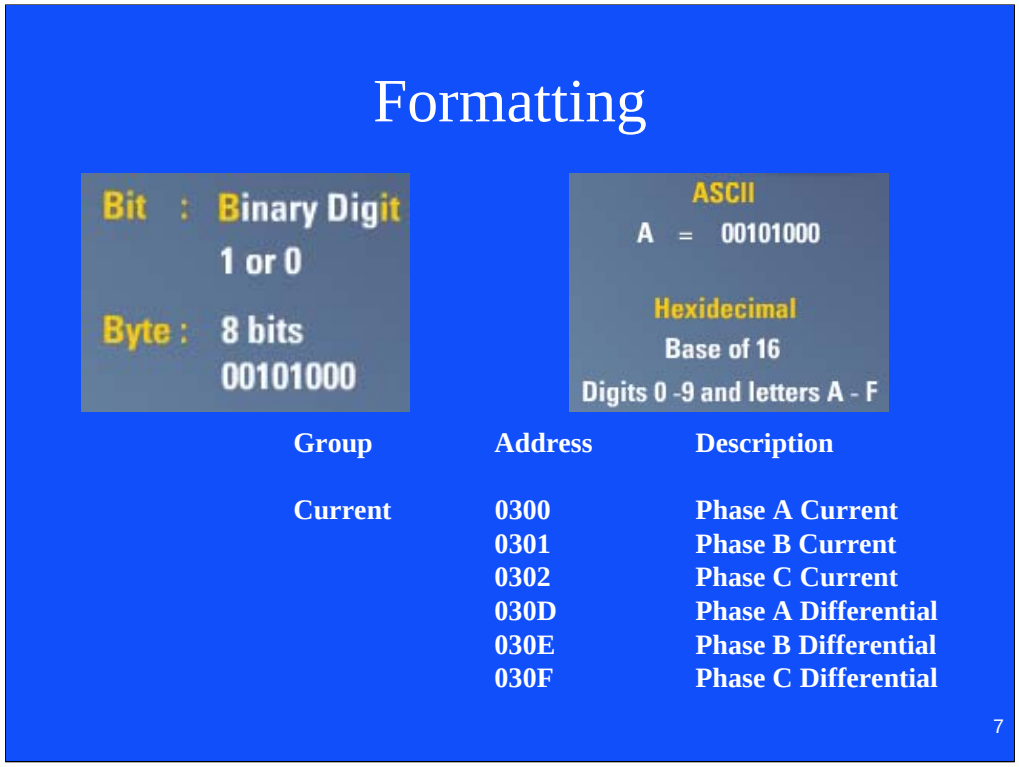
Simplex – One direction only

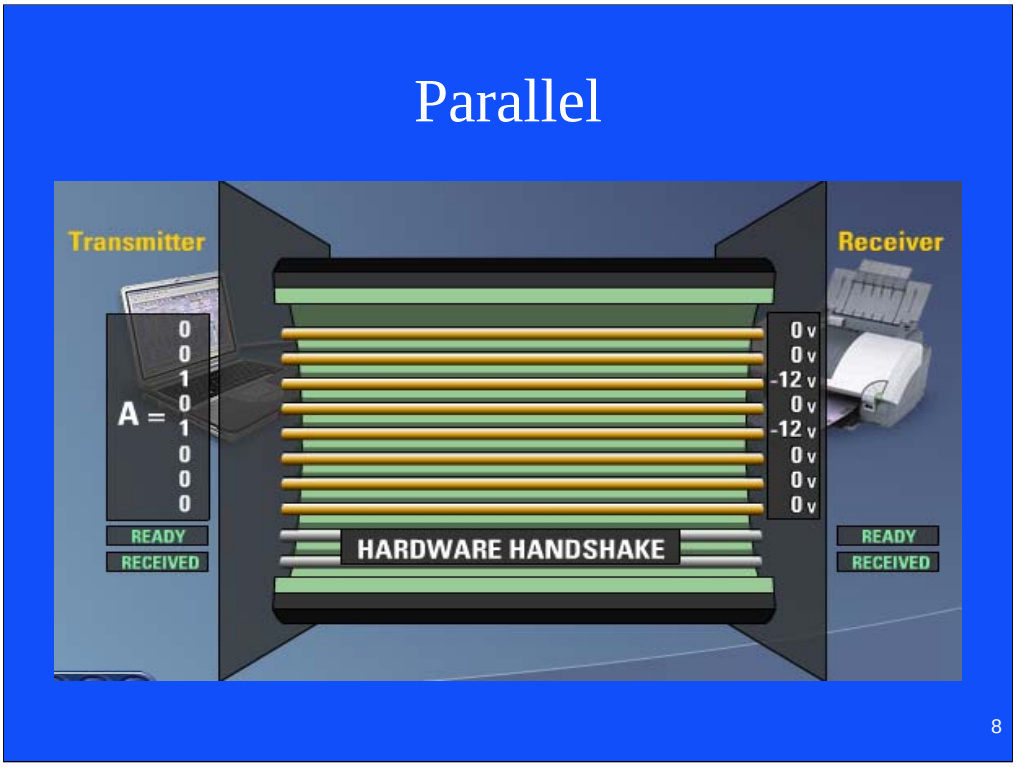
½ Duplex – either direction but only one at a time

Full Duplex – both directions at the same time



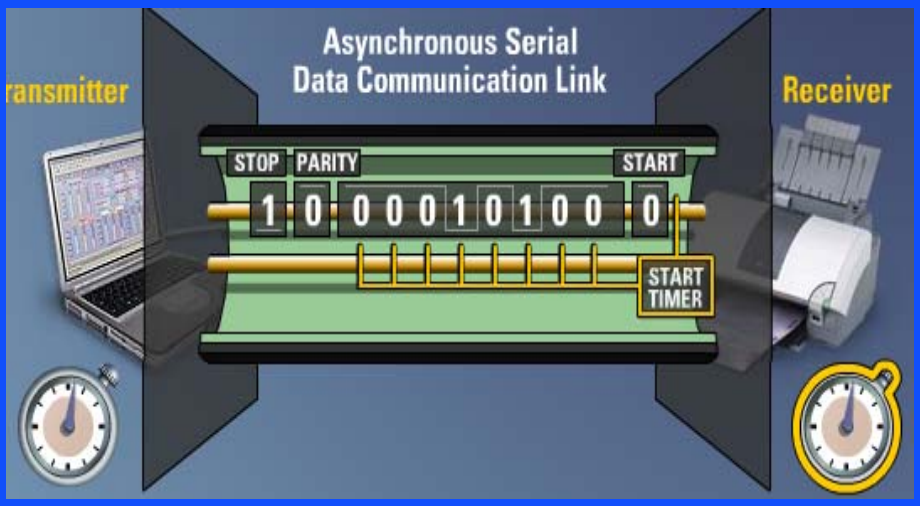
ASCII (***A****merican* ***S****tandard* ***C****ode for* ***I****nformation* ***I****nterchange*), is a character encoding based on the English alphabet. ASCII codes represent text in computers, communications equipment, and other devices that work with text. Most modern character encodings—which support many more characters—have a historical basis in ASCII.

ASCII was first published as a standard in 1967 and was last updated in 1986. It currently defines codes for 128 characters. 33 are non-printing, mostly obsolete control characters that affect how text is processed, and the other 95 printable characters are as follows (starting with the space character):



Printer port LPT1 is an example of this.

Serial



Baud Rate – A measure of how fast serial data is moving between devices per second. 2 common levels are 19,200 BPS and 9,600 BPS

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Asynchronous uses a start bit and a timer and measures the time to the center of each pulse. The Parity bit is used to check and make sure the data is correct and the stop bit is use to tell you the end of byte. You also have a Master and Slaves

Serial Communications

- Physical Layer
  - RS 232
  - RS 485
  - USB

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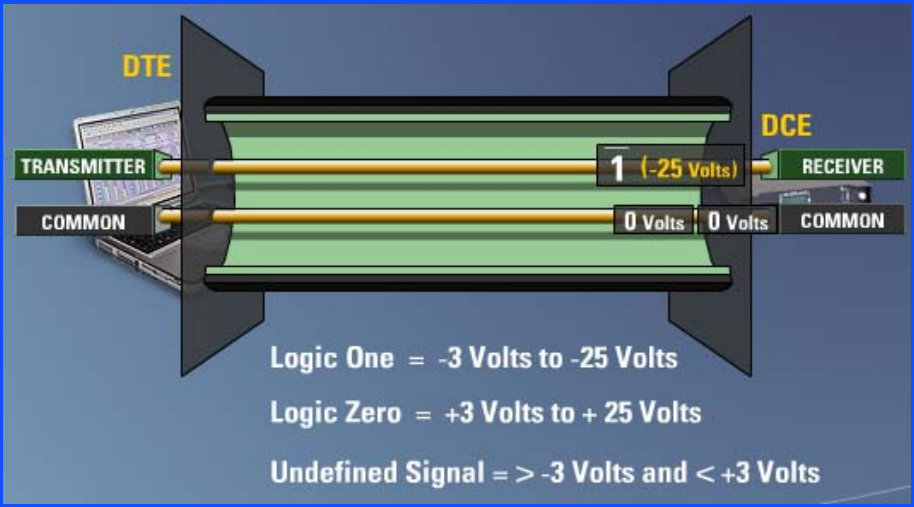
RS 232

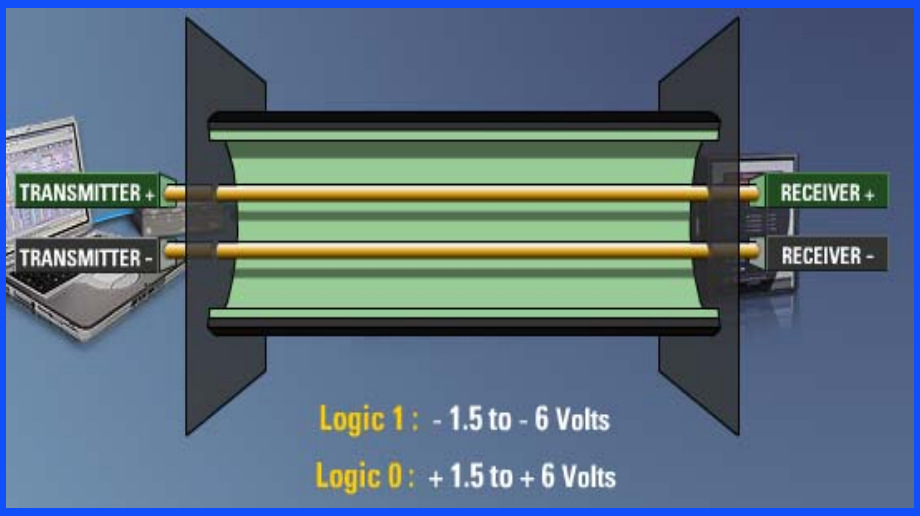


Slew Rate – Speed we can go from -25 V to 25 V, limits baud rate DTE Data Terminal Equipment DCE Data Communication Equipment 11

DTE Data Terminal Equipment DCE Data Communication Equipment

15 meters or less, baud rate of 19,200 or less

RS 485



conductors are electrically floating

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Up to 32 Devices, up to 4000 feet or 1200 meters, conductors are electrically floating which is why you can get the longer distances, only looking at difference so one may be at 100 V and the other at 106 volts, have a master and slaves

Universal Serial Bus (USB) Port

- Up to **127 devices** can connect to the host, either directly or by way of USB hubs.
- Individual USB cables can run as long as 5 meters; with hubs, devices can be up to 30 meters away from the host.
- With USB 2.,the bus has a maximum data rate of **480 megabits per second**.
- A USB cable has two wires for power (+5 volts and ground) and a twisted pair of wires to carry the data.
- On the power wires, the computer can supply up to 500 milliamps of power at 5 volts.

USB type A and B

IEEE 1394 Interface

- The **IEEE 1394** interface is a serial bus interface standard for high-speed communications and isochronous real-time data transfer, frequently used in a personal computer (and digital audio and digital video). The interface is also known by the brand names of **FireWire** (Apple Inc.), **i.LINK** (Sony), and **Lynx** (Texas Instruments). Though not as widely used, the 1394 standard also defines a backplane interface.
- Firewire 400-Speeds from 100, 200 or 400 Mbits/s half-duplex
- Firewire S3200-Speeds up to 3200 Mbits/s half-duplex

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S3200 is a 9 pin connector or now can use Cat 5e Cable, isochronous (iso means same, chronous is time),

Network


LAN
Local Area Network
Allows a number of independent devices to communicate directly with each other

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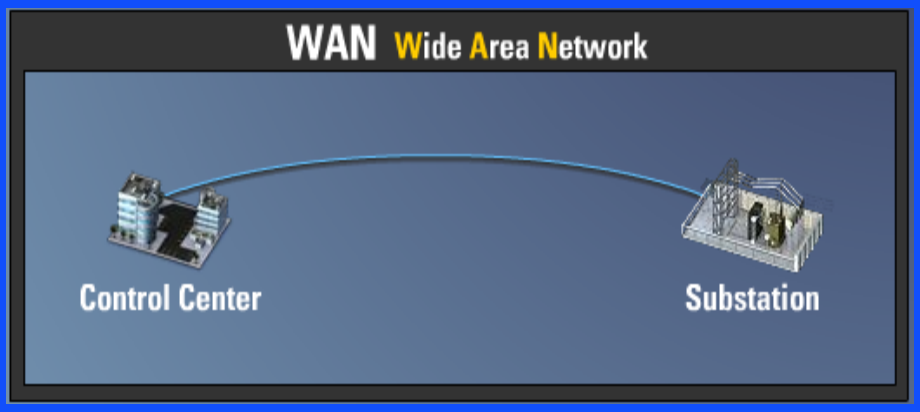
Network



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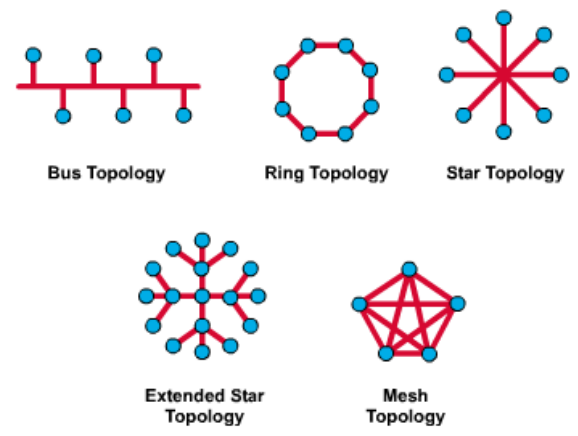
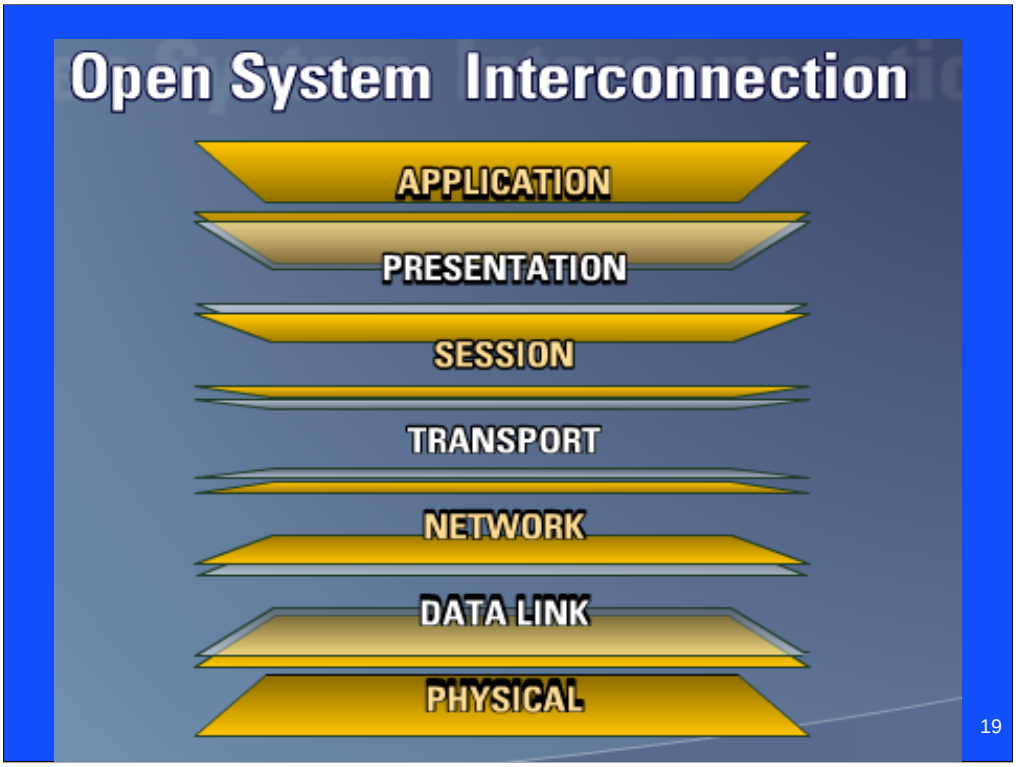
Network Topologies



- The network topology defines the way in which computers, printers, IEDs and other devices are connected
- A network topology describes the layout of the wire and devices as well as the paths used by data transmissions.
- Commonly, referred to as a linear bus, all the devices on a bus topology are connected by one single cable.

Standards

ANSI: The American National Standards Institute
CCITT: Comite Consultatif International Telegraphique et Telephonique
EIA: Electronic Industries Association
IEC: International Electrotechnical Commission
IEEE: Institute of Electrical and Electronic Engineers
ISO: International Organization for Standards and
TIA: Telecommunication Industries Association



Developed in 1978, the Open System Interconnection has 7 layers each performing part of the communications.

1) the physical level controls the physical connections between devices, network topology, voltage levels to define 0's and 1's.RS232 and RS485 are 2 examples
2) Data link level provides framing
3) network determines optima routing
4) transport level guarantees delivery and is error free -TCP / IP (Transport Control Protocol / Internet Protocol) is at transport level
5) session mechanism for the establishment of a communications session between applications
6) presentation – correct translation of data
7) application – provides the facilities or interface to allow the application protocols or drivers such as Modbus or DNP

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2) Data link level provides framing
3) Network determines optima routing – IP of TCP/IP is based on this
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Ethernet

- Introduction
- 10/100 Base T
- Hubs and Switches
- Fiber

Introduction

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Relays are now available with Ethernet connectors and IP addresses built in.

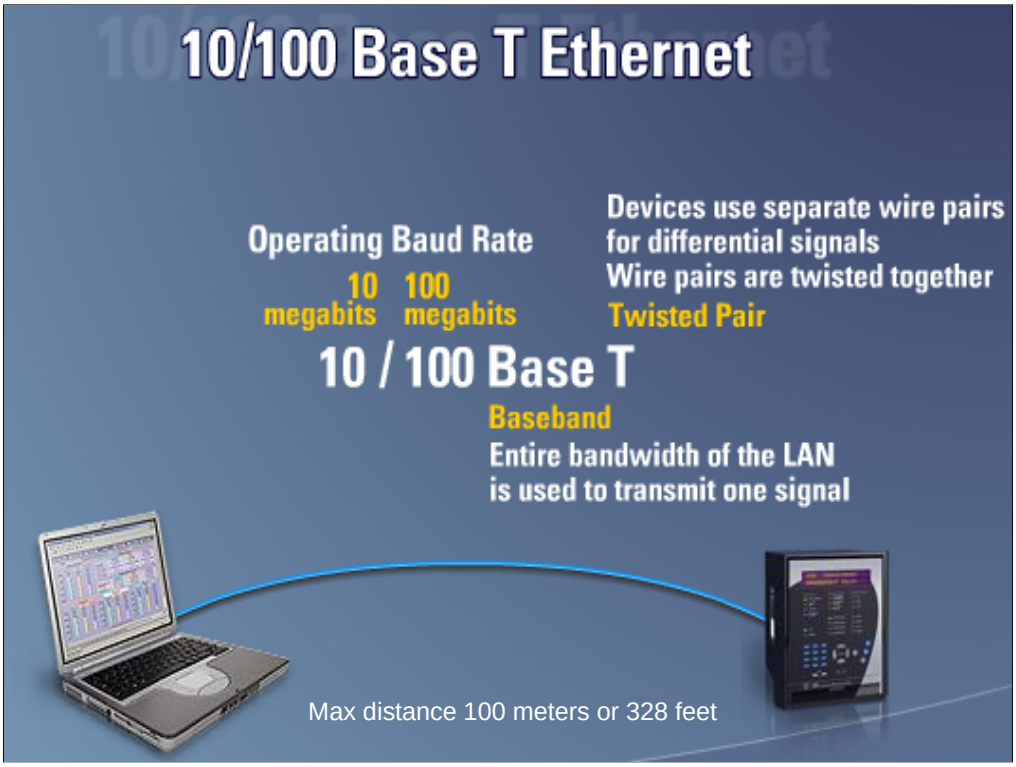
Ethernet in Devices

PATH: SETPOINTS ▷ S1 469 SETUP ▷▽ COMMUNICATIONS

■ COMMUNICATIONS [▷]	SLAVE ADDRESS: 254	*Range: 1 to 254 in steps of 1*
MESSAGE	COMPUTER RS485 BAUD RATE: 9600	*Range: 300, 1200, 2400, 4800, 9600, 19200*
MESSAGE	COMPUTER RS485 PARITY: None	*Range: None, Odd, Even*
MESSAGE	FRONT PORT RS232 BAUD RATE: 19200	*Range: 300, 1200, 2400, 4800, 9600, 19200*
MESSAGE	IP ADDRESS: 0.0.0.0	*Range: standard IP address format*
MESSAGE	SUBNET IP MASK: 255.255.255.000	*Range: standard IP address format*
MESSAGE	GATEWAY IP ADDRESS: 0.0.0.0	*Range: standard IP address format*

The IP addresses are used with the Modbus protocol. Enter the dedicated IP, subnet IP, and gateway IP addresses provided by the network administrator.

When devices come with an Ethernet port, you assign a fixed IP address in the Relay.



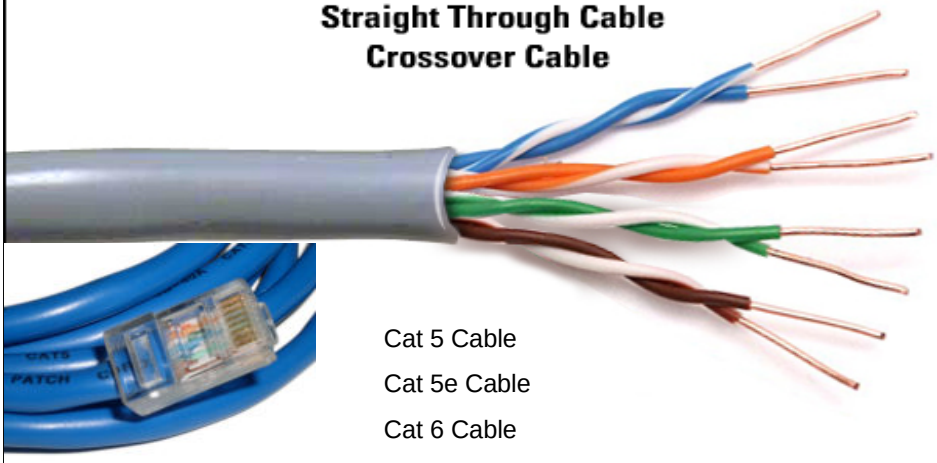
Max distance is 100 meters or 328 feet.

10/100 Base T

Cable pin connections can be one of two configurations

Straight Through Cable

Crossover Cable

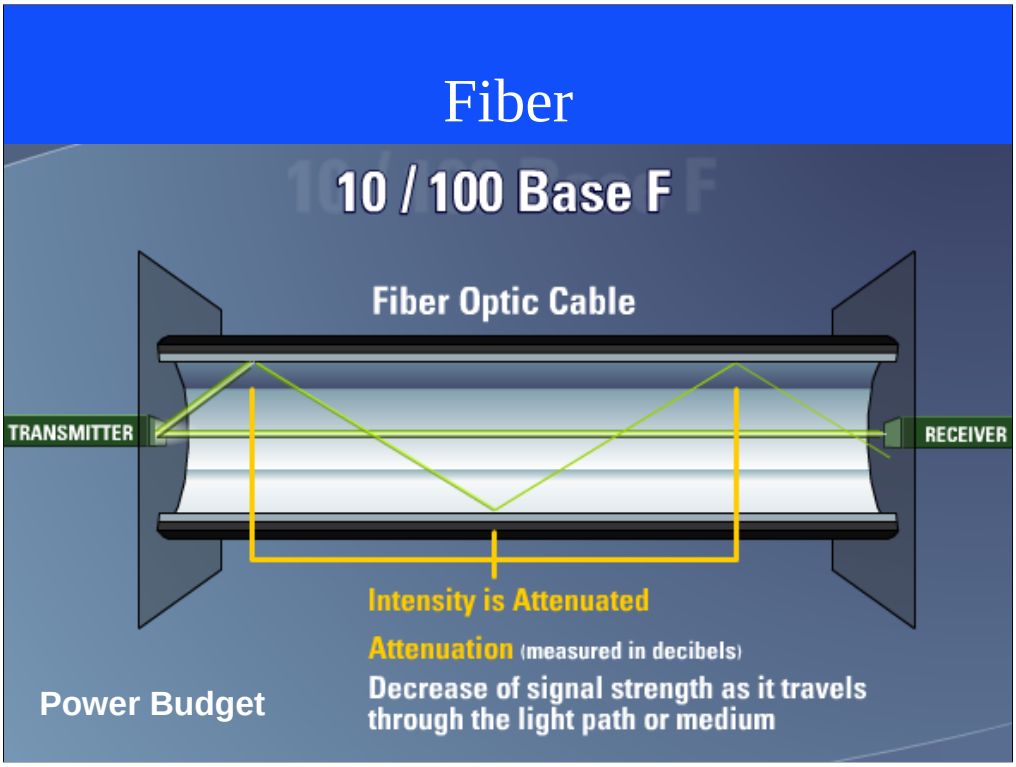


Cat 5 Cable

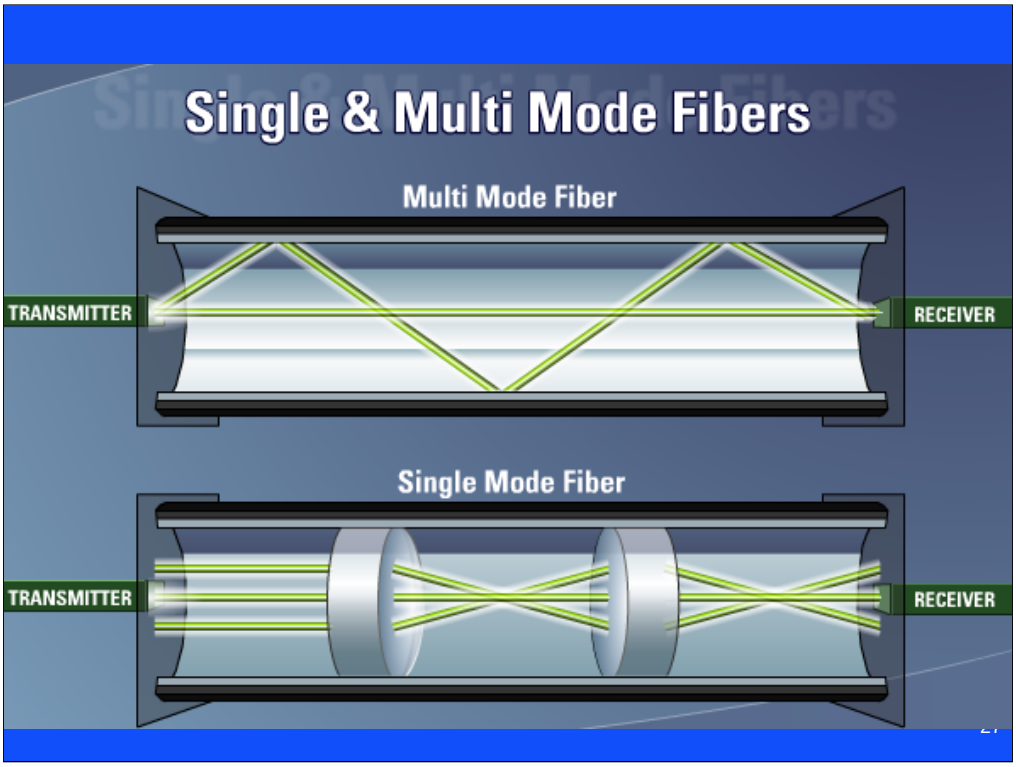
Cat 5e Cable

Cat 6 Cable

If you have a computer talking directly to another computer or device you need a cross over cable.

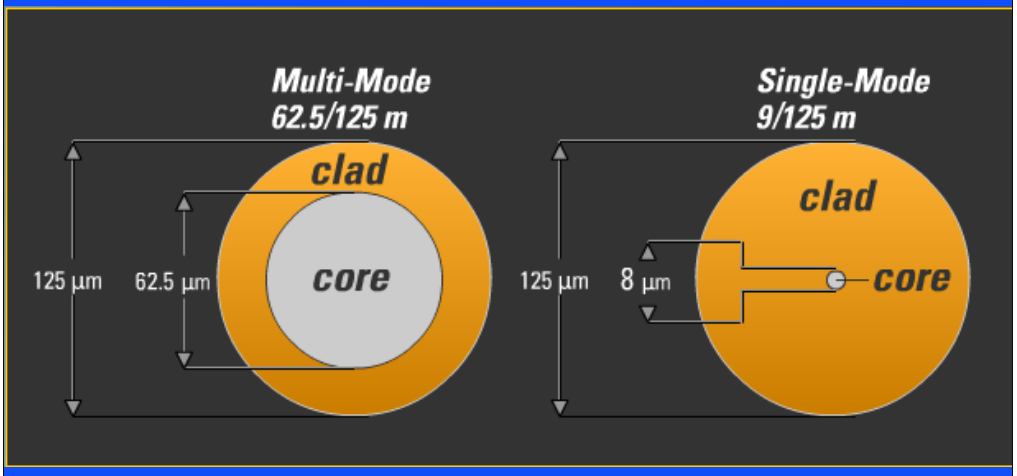


Power budget is the signal transmitter rated power minus the attenuation (cable, connections, splices, and cable aging) and the receiver's sensitivity



Multi mode has a shinny mirrored surface. Single mode keeps redirecting the light to the center, The center of multi mode is “doped” to slow down the signal so the reflected light gets there at the same time as what goes through the center.

Single and Multi Mode Fiber



62.5 micrometers

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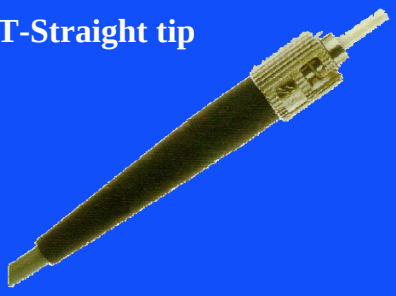
125 micrometers

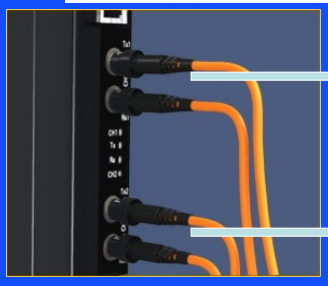
Common Fiber Connectors

ST-Straight tip



SC-Subscriber Connector

LC-Lucent Connector



Primary Ethernet Port

Secondary Ethernet Port

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GE Multilin uses the ST as standard

NOTES:

Hard Fiber Eliminating Complexity

Eliminates 33% of breaker terminations

40% less cabling with no terminations required

Eliminate 90% of control building terminations

1,000's of wires replaced with few communication cables

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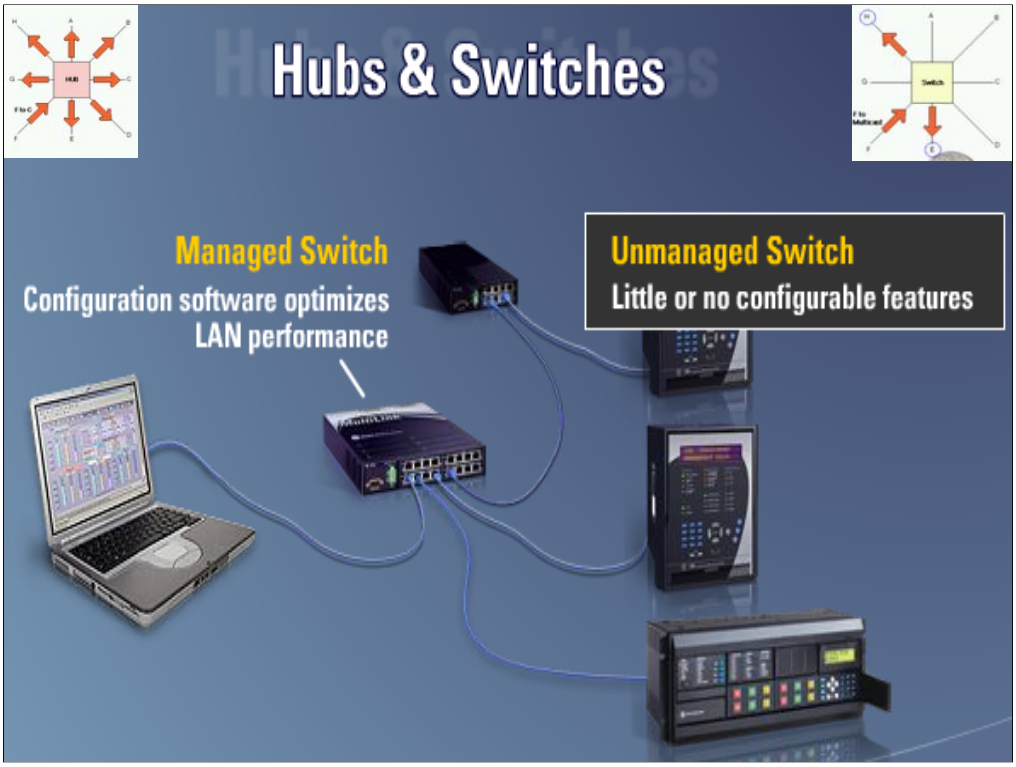

Switches can buffer the message so there are no collisions like a hub. Ours are Utility hardened, have output contact and dual power supply, can use on a ring topology.

Managed Switches

- **Simple Network Management Protocol (SNMP):** a set of protocols for managing network performance, finding and solving network problems, and planning for network growth
- **Internet Group Management Protocol (IGMP):** configures broadcast message behavior
- **Virtual LAN (VLAN):** a network of computers that behave as if they are connected to the same wire even though they may actually be physically located on different segments of a LAN
- **Quality of service (QoS):** Allows prioritization of packets to occur or improve performance for key channels
- **Spanning Tree Protocol (STP):** algorithm to prevent wiring topology mistakes or create redundancy in a network

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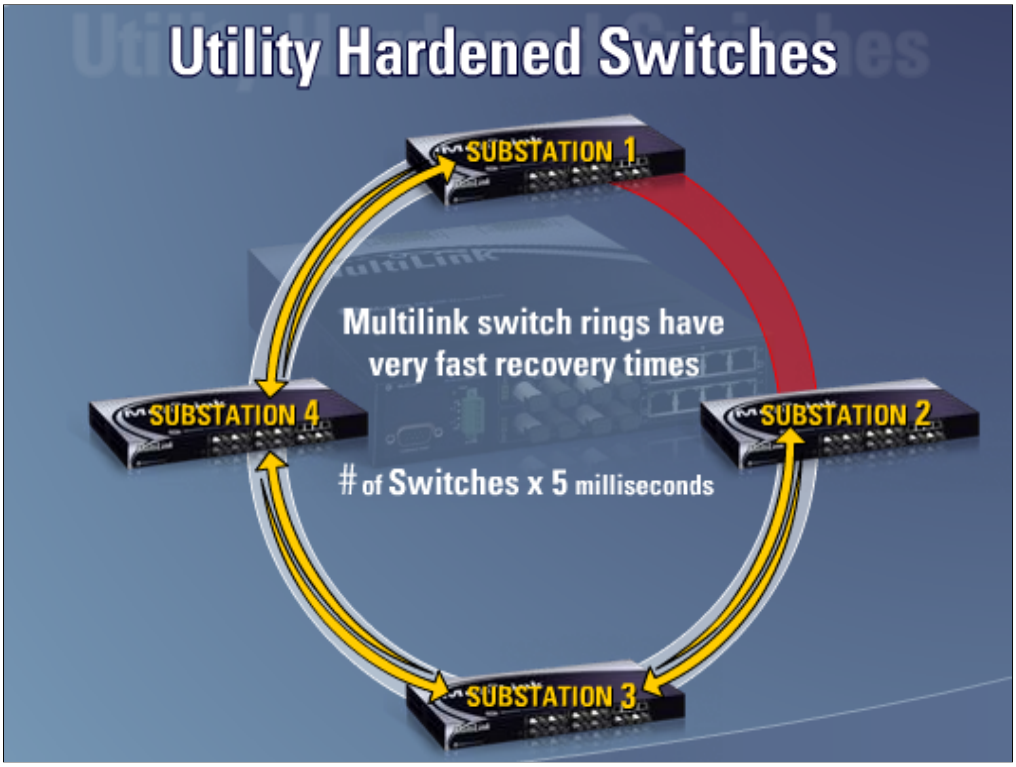
Key features of a managed switch, There is a buffer in a switch. The QoS can bypass the buffer.



Has Normal and alternate port, managed and unmanaged, operating temperature of -40º C to +80º C

Wireless

- This is where the future is. Products are now being designed with Wireless build into the device.
- Regulated and unregulated frequencies
- Different speeds depending on the application
- Security & Encryption

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Wireless Product Portfolio

- Licensed & Unlicensed Transparent
- NDS x710 Platform 9.6 kbps
- MDS TransNET 115 kbps
- 5 Watt Tx Power

- NETio Platform
  - 115 kbps FHSS
  - ISM 900MHz & 2.4 Ghz
  - Support for IEEE802.15.4

- Unlicensed Broadband
- Data Speeds to 8 Mbps
- Mobile and Fixed
- Network Enabled

- MDS iNET and INET II
- Up to 1 Mbps
- Mobile and Fixed
- Network Enabled

- LEDR PTP Radio
  - 4 / 16 / 32 QAM Radio
  - Data Rates to 8 Mbps
  - T1 / E1 / Fractional Rates

- MDS eNET
- 115 kbps FHSS
- 900 and 2.4 GHz FHSS
- Network enabled

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Router

- Definition from Wikipedia - A **router** is a computer networking device that forwards data packets across a network toward their destinations, through a process known as routing. Routing occurs at Layer 3 (the network layer i.e. Internet Protocol (IP) of the OSI seven-layer protocol stack.

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Side note – Wikipedia and Linux are written collaboratively by volunteers and are “open source” and free.

Other Computer Networking Devices

- Gateway: device sitting at a network node for interfacing with another network that uses different protocols. Works on OSI layers 4 to 7.
- Bridge: a device that connects multiple network segments along the data link layer. Works on OSI layer 2.
- Repeater: device to amplify or regenerate digital signals received while setting them from one part of a network into another. Works on OSI layer 1.

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Proxy, Firewall, and Port

- Proxy: computer network service which allows clients to make indirect network connections to other network services
- Firewall: a piece of hardware or software put on the network to prevent some communications forbidden by the network policy
- Computer port (hardware) - a physical interface between a computer and other computers or devices
- Computer port (software) - a virtual data connection between computer programs possibly through a computer network

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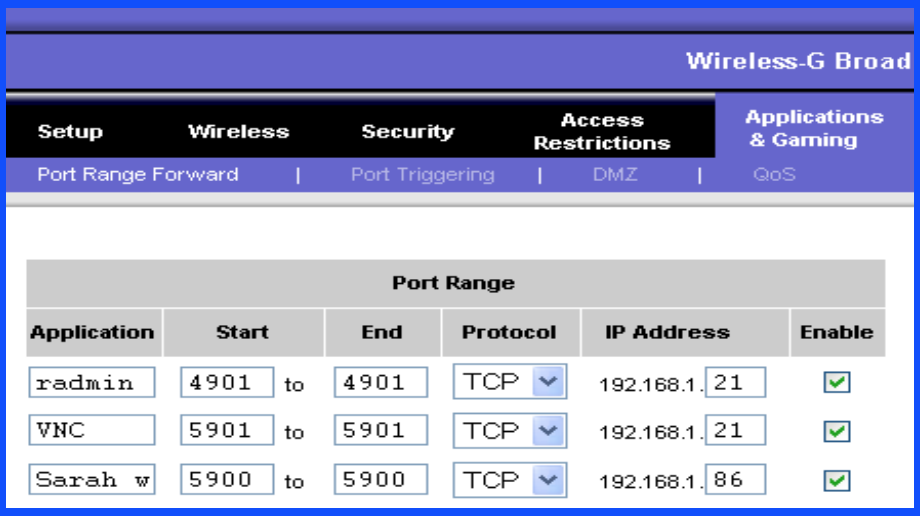
A **proxy server** is a computer that offers a computer network service to allow clients to make indirect network connections to other network services. A client connects to the proxy server, then requests a connection, file, or other resource available on a different server. The proxy provides the resource either by connecting to the specified server or by serving it from a cache. In some cases, the proxy may alter the client's request or the server's response for various purposes.

Firewalls



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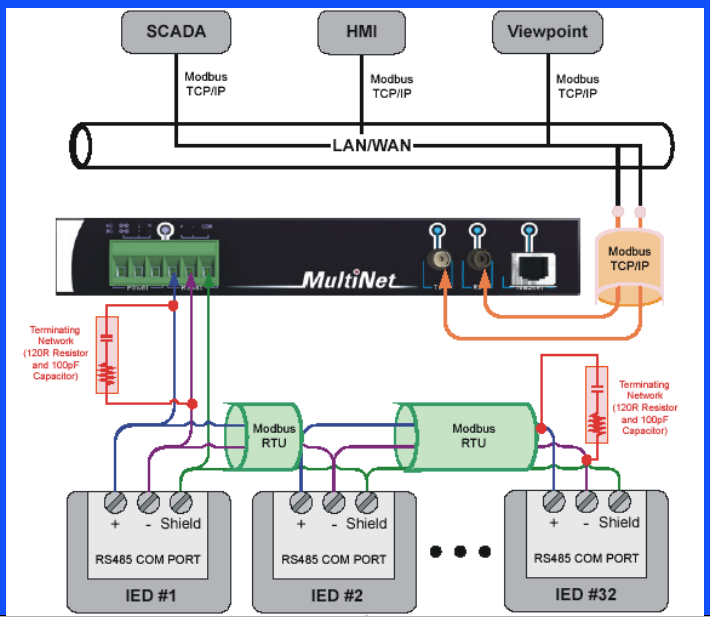
Relays at L-3

Remote I.P	Firewall Port	Technology	Destination IP	Destination Port	Slave Address	Device	Current Status
74.92.196.201	502	Relays	192.168.1.240	502	254	F60	Connected
74.92.196.201	503	Relays	192.168.1.241	502		Multinet	Connected
74.92.196.201	503	Relays	Uses Multinet	502	89	489	Connected
74.92.196.201	504	Relays	192.168.1.242	502	242	469	Connected
74.92.196.201	505	Relays	192.168.1.243	502	243	760	Connected
74.92.196.201	506	Relays	192.168.1.244	502	244	MM300	Connected
74.92.196.201	507	Relays	192.168.1.245	502	13	T60	Connected

Serial to Ethernet Converters



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Converter may just change from serial to Ethernet or may also be a gateway and change from one protocol to another. You assign an IP address to the converter.

Serial to Ethernet Converters

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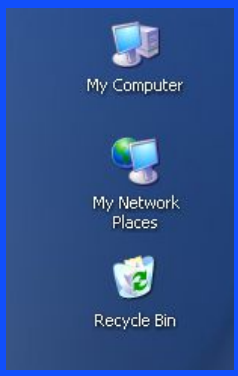
Multinet acts as a master for the 485 slave relays

Adding Devices to a Network

- Static IP address 3.94.244.1 for devices
- Subnet 255.255.255.0 for network



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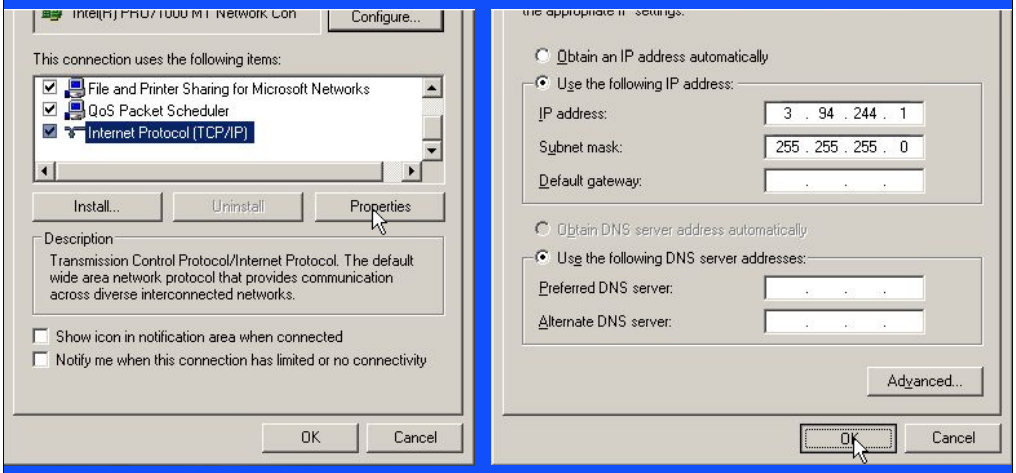
Adding Devices to a Network



DNS - Domain Name System, Internet system to translate names into IP addresses

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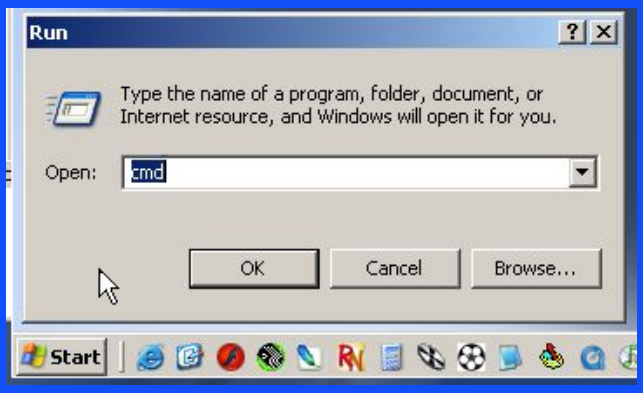
If you are going wireless you will want to leave it as obtain an IP address automatically.

Checking IP Address



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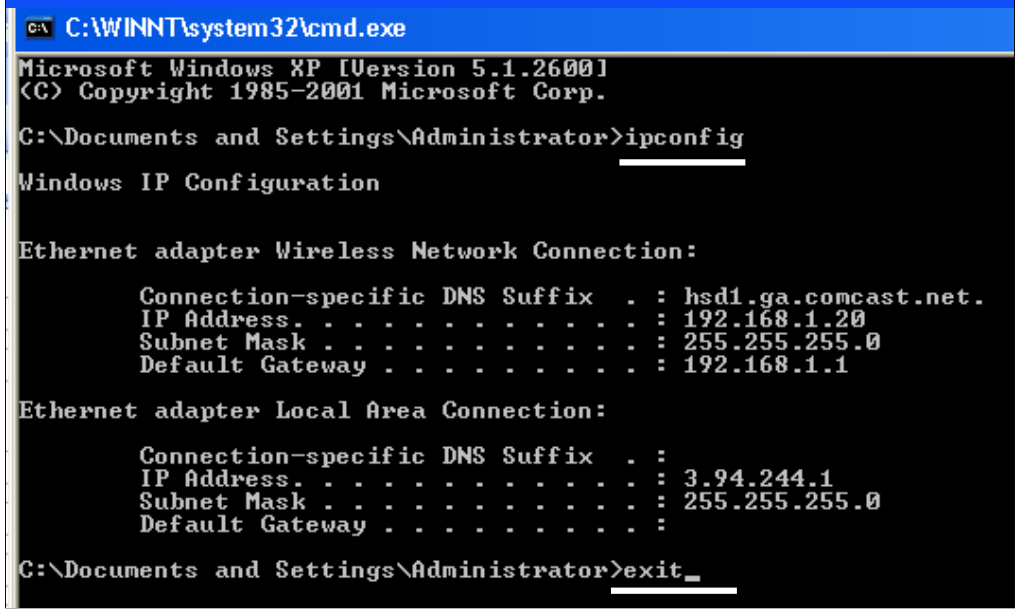
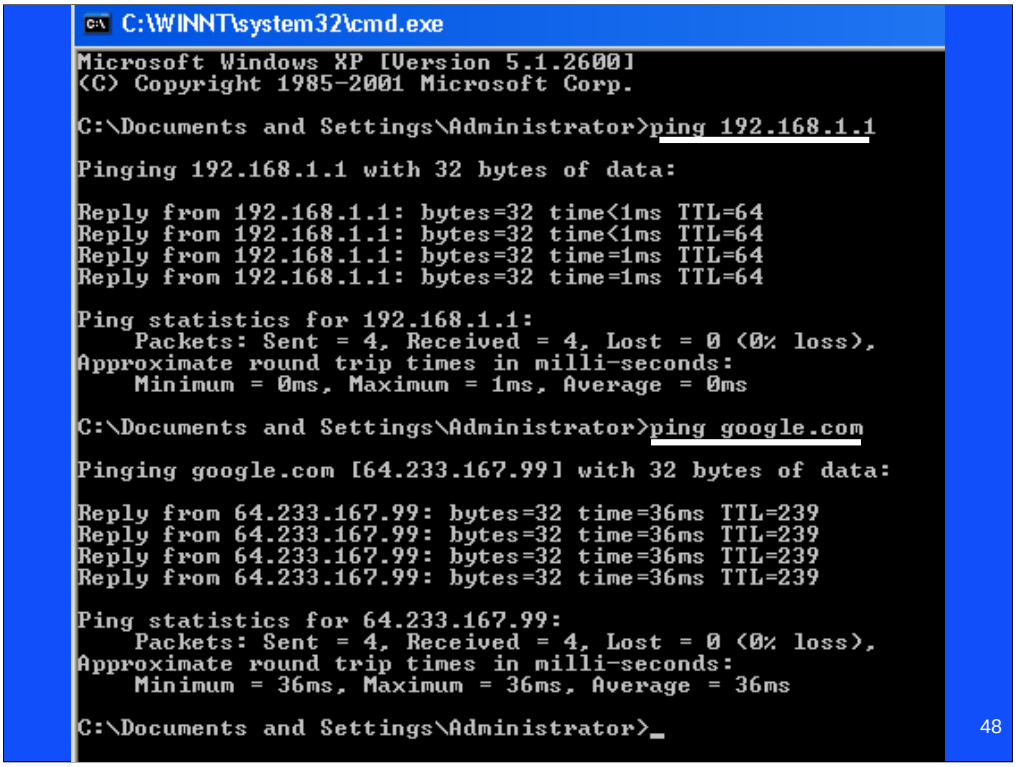
cmd will bring up the dos prompt

Checking IP Address



Other useful Dos Command

- ipconfig /release
- ipconfig /renew
- ipconfig /all (gives you IP and MAC address)
- ping -t
- tracert
- exit
- You can hit F3 to go to the previous dos command
- Or you can hit the up arrow to go back to previous dos commands



Disconnect relay and check ping to make sure 2 devices do not have the same IP address. TTL stands for time to live

tracert

```
C:\Documents and Settings\Administrator>tracert google.com

Tracing route to google.com [64.233.167.99]
over a maximum of 30 hops:

  1     7 ms     1 ms     1 ms  192.168.1.1
  2    14 ms     9 ms     7 ms  73.61.160.1
  3     9 ms     7 ms     7 ms  GE-2-1-ur01.B3marietta.ga.atlanta.comcast.net [68.86.108.12
  4    14 ms    10 ms     8 ms  te-9-4-ur02.b0atlanta.ga.atlanta.comcast.net [68.86.106.125
  5    10 ms     8 ms     7 ms  te-9-4-ur01.b0atlanta.ga.atlanta.comcast.net [68.86.106.13]
  6    14 ms     8 ms     8 ms  te-9-2-ar01.b0atlanta.ga.atlanta.comcast.net [68.86.106.9]
  7    14 ms     9 ms     9 ms  12.116.167.5
  8    15 ms     8 ms    10 ms  tbr2012001.attga.ip.att.net [12.123.20.238]
  9    14 ms     9 ms    10 ms  ggr2-ge90.attga.ip.att.net [12.123.20.205]
 10    14 ms    12 ms     9 ms  192.205.33.90
 11    10 ms     9 ms     9 ms  atl-core-01.inet.qwest.net [205.171.21.105]
 12    36 ms    29 ms    30 ms  cer-core-02.inet.qwest.net [67.14.8.18]
 13    29 ms    28 ms    29 ms  chx-edge-01.inet.qwest.net [205.171.139.166]
 14    44 ms    29 ms    30 ms  63.144.64.134
 15    34 ms    29 ms    30 ms  216.239.46.5
 16    35 ms    32 ms    31 ms  72.14.232.57
 17     *        *        *     Request timed out.
 18    34 ms    30 ms    30 ms  64.233.167.99
```

- Black list and White list

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If you hit a request time out before the trace is compete it may be due to a black list.

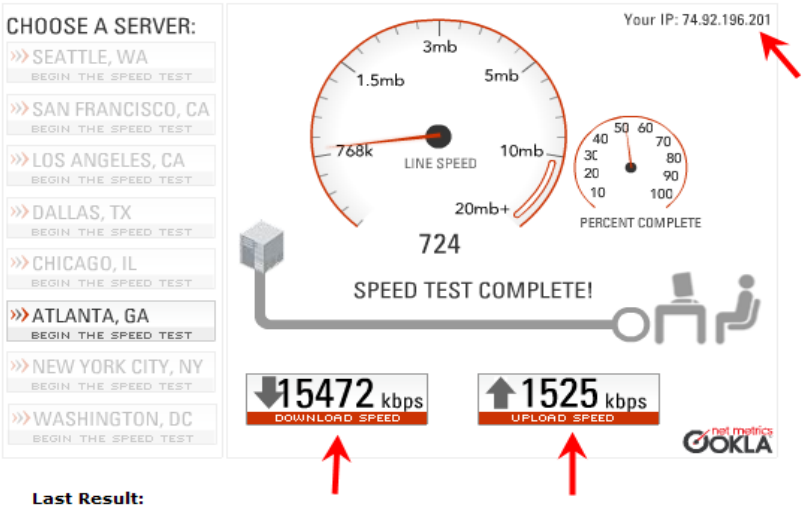
Useful Internet Sites

- www.Dnsstuff.com - can use to find if a web site is getting blocked or who owns it.
- www.Speakeasy.net/speedtest/ - Can use for a speed test
- www.Spinrite.com – Can use to check for leaks in your firewall
- http://www.kloth.net/services/nslookup.php get the IP address for a I.P. name.
- www.whatismyip.com – your WAN IP

Speakeasy — Speed Test

Test your internet connection speed!

By measuring the download and upload rate from the following locations you are able to accurately measure your current line throughput or internet connection speed.



Last Result:
Download Speed: **15362** kbps (1920.3 KB/sec transfer rate)
Upload Speed: **1462** kbps (182.8 KB/sec transfer rate)

Protocols

- Modbus
- Modbus Plus
- DNP
- DeviceNet
- Profibus
- Direct I/O
- IEC 61850
- Protocol Converters

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Modbus

- Can be communicated via RS 232, RS485, 10/100 Base T, and 10/100 Base F
- Is half-duplex serial in all configurations
- Uses a master and slaves
- Data is stored in a register

Table 1: 469 MEMORY MAP (Sheet 7 of 61)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
LAST TRIP DATA ALARM continued	0235	Pre-trip temperature of hottest stator RTD	-50	250	1	°C	F4	0
	0236	Hottest bearing RTD during trip	0	12	1	--	F1	0
	0237	Pre-trip temperature of hottest bearing RTD	-50	250	1	°C	F4	0
	0238	Hottest other RTD during trip	0	12	1	--	F1	0
	0239	Pre-trip temperature of hottest other RTD	-50	250	1	°C	F4	0
	023A	Hottest ambient RTD during trip	0	12	1	--	F1	0
	023B	Pre-trip ambient RTD temperature	-50	250	1	°C	F4	0
	023C	Pre-trip voltage Vab	0	20000	1	V	F1	0
	023D	Pre-trip voltage Vbc	0	20000	1	V	F1	0
	023E	Pre-trip voltage Vca	0	20000	1	V	F1	0
	023F	Pre-trip voltage Van	0	20000	1	V	F1	0
	0240	Pre-trip voltage Vbn	0	20000	1	V	F1	0

Data is stored in a hex register. In order to get all the data with one read command we have a user map where we store the data we want consecutively.

Modbus Plus

- Proprietary protocol
- Can be communicated via RS485. Uses a peer-to-peer token exchange type network. Multi-Master.
- Global data can be sent with the token.
- 64 nodes per network, can Bridge networks.
- Speeds up to 1 MB
- Up to 1800 meters with repeaters

Distributed Network Protocol (DNP 3)

- Developed by GE Harris – can time stamp data
- Scalable
- Has Client (computer) and server (device)
- Can poll for change
- Can set up for Unsolicited messaging from server

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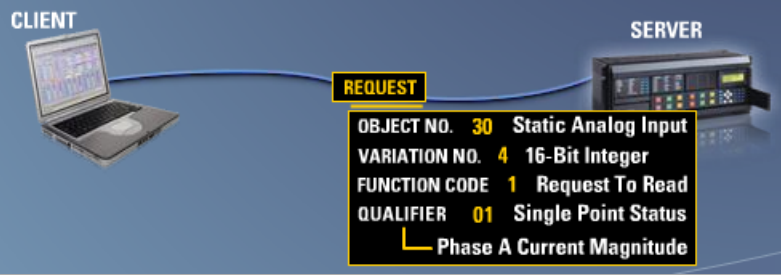
You can set it up to only give you values that have changed. If they have not changed then they are not resent.

Distributed Network Protocol (DNP 3)

Implementation

OBJECT NO.	VARIATION NO.	DESCRIPTION	FUNCTION CODES (DEC)	QUALIFIER CODES (HEX)	FUNCTION CODES (DEC)	QUALIFIER CODES (HEX)
30	4	16-Bit Analog Input (no Flag)	1	00, 01, 06	129	01



DeviceNet
EtherNet/IP (Ethernet Industrial Protocol)

- Based on the Controller Area Network protocol (CAN)
- Managed by the Open DeviceNet Vendors Association
- Bus Topology at 24 VDC
- Baud rates of 125, 250, and 500 Kbps
- Can have up to 64 nodes on a single local network
- DeviceNet uses abstract **OOT** (Object-Oriented Technique)
  - objects
  - class
  - instances
  - attributes

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Designed for control not data collection. Must be on smaller network.

DeviceNet

Overload Object, Class Code 0x2C, Instance 1:

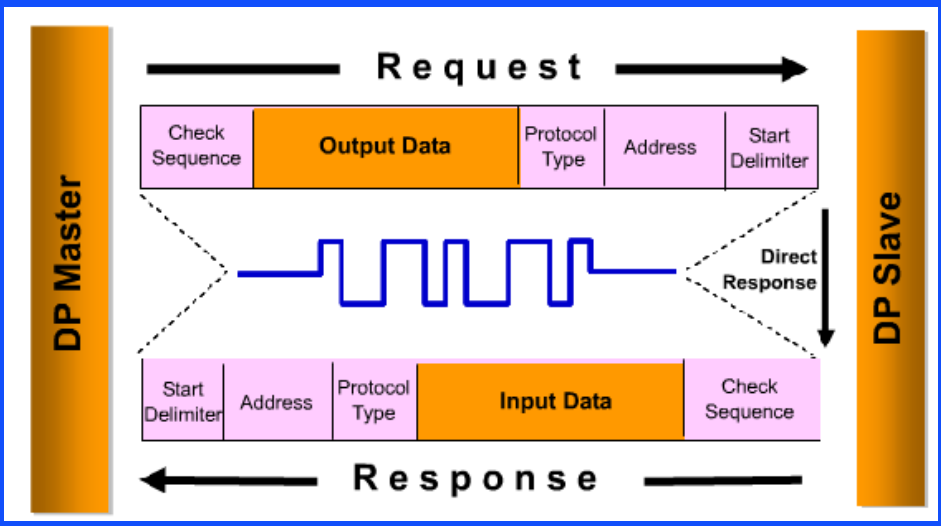
Attribute	Access	Name/description	Data Type	Value
3	Get	FLA	UINT	---
4	Get	Trip Class	UINT	---
5	Get	Average Current	UINT	---
6	Get	Phase Unbalance	UINT	---
8	Get	Current Phase A	UINT	---
9	Get	Current Phase B	UINT	---
10	Get	Current Phase C	UINT	---
11	Get	Ground Current	UINT	---
12	Get	Current Scale (fixed at 100 mA)	UINT	1

UINT = 16-bit unsigned integer

Profibus

- PROFIBUS (Process Field Bus)
- Profibus-DP (Decentralized Periphery)
- PROFIBUS-FMS (Fieldbus Message Specification)
- PROFIBUS-PA (Process Automation)
- Profinet – Ethernet based Fieldnetwork

Profibus


DP Master
Request
Check Sequence
Output Data
Protocol Type
Address
Start Delimiter
Direct Response
Start Delimiter
Address
Protocol Type
Input Data
Check Sequence
Response
DP Slave

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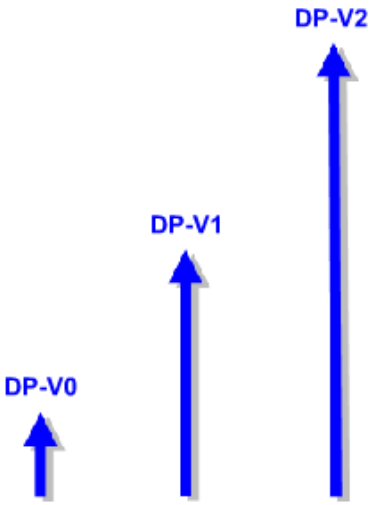
Profibus

PROFIBUS DP Protocol Services

Data Exchange Broadcast
- Isochronous Mode
- Clock Synchronization
- Time Stamp
- HART on DP
- Redundancy

Acyclic Data Exchange between PLC and Slaves
- Engineering (EDD, FDT)
- Fail-Safe Communication
- Alarms

Cyclic Data Exchange between PLC and Slaves
- GSD Configuration, Diagnosis



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Profibus

Table 9–1: PROFIBUS INPUT DATA (Sheet 3 of 3)

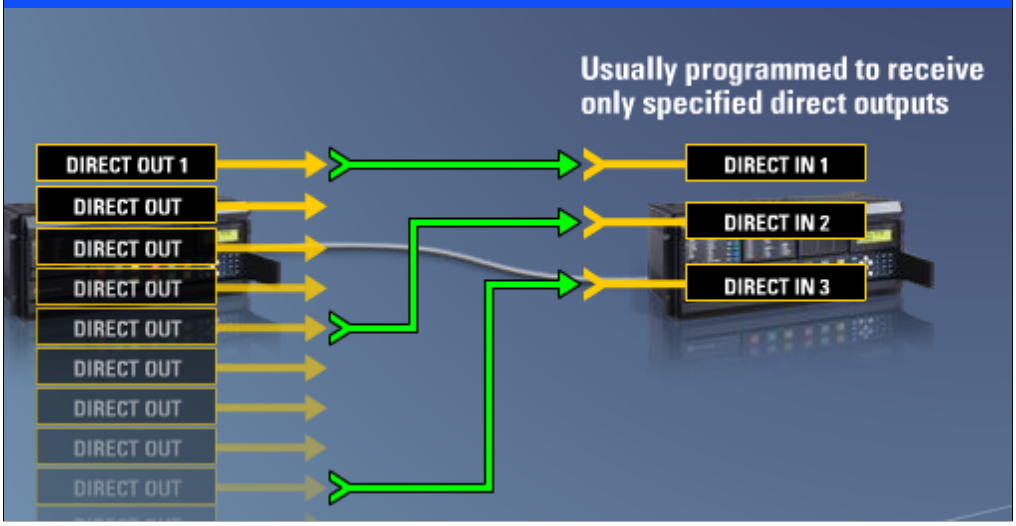
OFFSET	CYCLIC DATA (ACTUAL VALUES)	LENGTH (BYTES)	MINIMUM		MAXIMUM		STEP VALUE	UNITS	FORMAT CODE	DEFAULT
			VALUE	HEX	VALUE	HEX				
148	Learned StartingCapacity	2	0	0000	100	0064	1	%	F1	0
150	Learned RunningCoolTime Constant	2	0	0000	500	01F4	1	min	F1	0
152	LearnedStoppedCoolTime Constant	2	0	0000	500	01F4	1	min	F1	0
154	Last StartingCapacity	2	0	0000	100	0064	1	%	F1	0
156	Learned UnbalanceKfactor	2	0	0000	29	001D	1	–	F1	0
158	BSDState	2	0	0000	6	0006	1	–	F27	0
160	RawPredictionTimer	2	0	0000	50000	C350	1	s	F2	0
162	NumberOfStarts	2	0	0000	50000	C350	1	–	F1	0
164	NumberOfRestarts	2	0	0000	50000	C350	1	–	F1	0
166	DigitalCounter	2	0	0000	65535	FFFF	1	–	F1	0
168	MotorRunningHours	2	0	0000	65535	FFFF	1	hr	F1	0
170	RelayOperatingHours	2	0	0000	65535	FFFF	1	hr	F1	0
172	Last trip Cause	2	0	0000	169	00A9	1	–	F134	0
174	Last trip Date	4	N/A	N/A	N/A	N/A	N/A	N/A	F18	N/A
178	Last trip Time	4	N/A	N/A	N/A	N/A	N/A	N/A	F19	N/A
182	Last pre-trip Ia	2	0	0000	65535	FFFF	1	A	F1	0

Direct I/O

- 4 interface standards can be used
  - IEEE 37.94, Fiber, RS422, and G.703

Direct I/O

- Great for a Main – Tie – Main application



In the 750 relay you have to tie 11 of the 14 inputs to the other 2 relays. If one of the wires gets broken or miswired you probably will not know till it is too late. If the fiber get cut you will know in 8 msec or less. Can have redundant channels.

IEC 61850

- Designed as a universal plug and play between manufactures
- Uses descriptions instead of registers
- Generic Object Oriented Substation Event – Messaging (GOOSE Messaging)
- Ethernet is required as part of IEC 61850

The phrase "sixty-one-eight-fifty" (sĭksˈtē)(wŭn)(āt)(fĭfˈtē) has become a designator for the next generation substation secondary system with a higher degree of integration, reduced cost, greater flexibility, communication networks replacing hard-wired connections, plug-and-play functionality, reduced construction and commissioning time, and other advantages

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We have an example where we are sending a goose message from one relay to another relay that is 100 miles away and are making the second breaker trip within 8 ms.

IEC 61850 Applications

- **Breaker Failure Initiate to Other Breaker**
- **Broadcast a Trip Message to All Feeder Breakers**
- **High Speed Bus Transfer (M-T-M)**
- **Switching Set Groups**
- **Load Shedding**
- **Upstream Relay Tripping & Blocking**
- **Bus Protection**
- **Relay Voting**
- **Reclose Initiation**
- **Underfrequency Load Shedding**
- **Transfer Tripping**
- **Remote Start/Stop Commands**
- **Blocking Schemes**
- **?**

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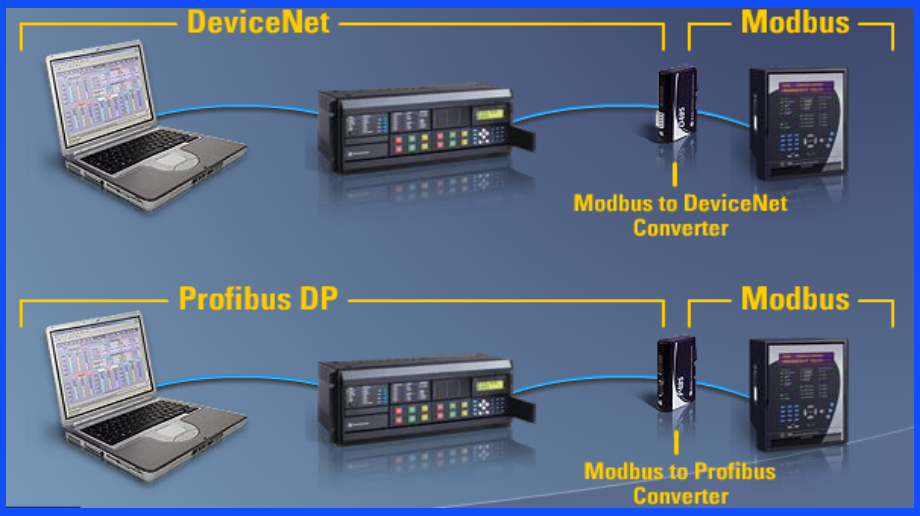
Protocol or Gateway Converters



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Human Machine Interface (HMI)

- Overview
- Plug and Play
- One-Line Viewer
- Annunciator
- OPC / DDE Server

HMI Overview

- SCADA – Supervisory Control And Data Acquisition
- RTU – Remote Terminal Unit
- It is now extremely easy and cost effective to view your devices without having to be in front of the relays.

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Plug and Play Viewpoint Monitoring

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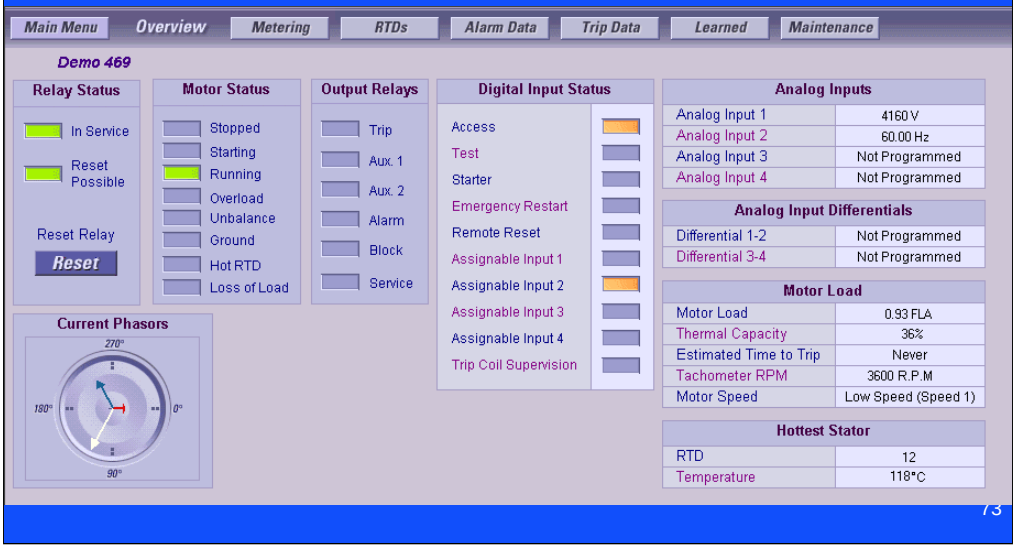
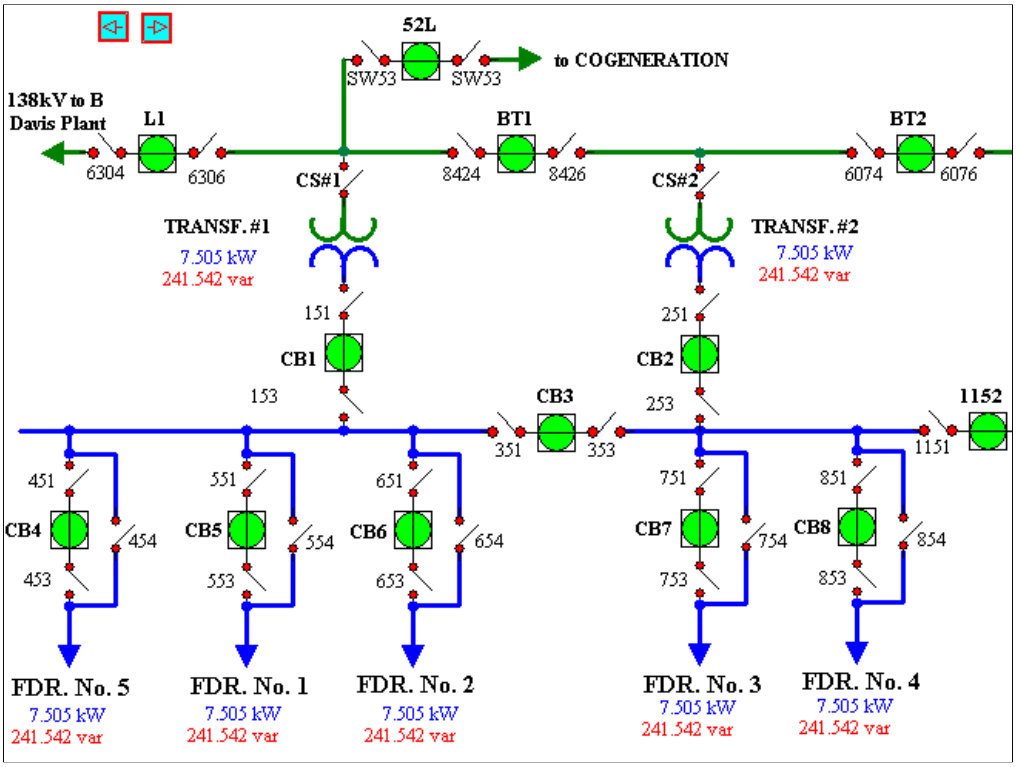
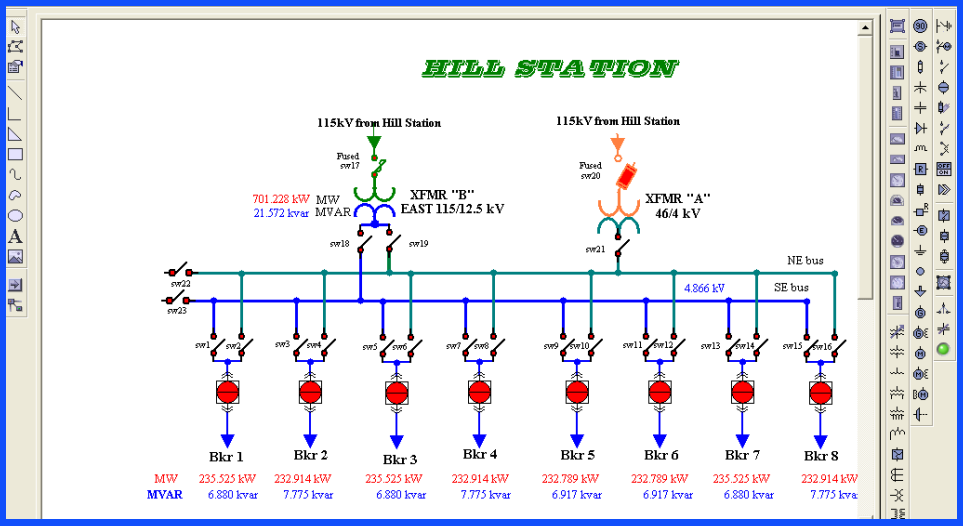
Can use to sync all the clocks.

Dashboard


Main Menu
Overview
Metering
RTDs
Alarm Data
Trip Data
Learned
Maintenance
Demo 469
Relay Status
In Service
Reset Possible
Reset Relay
Reset
Motor Status
Stopped
Starting
Running
Overload
Unbalance
Ground
Hot RTD
Loss of Load
Output Relays
Trip
Aux. 1
Aux. 2
Alarm
Block
Service
Digital Input Status
Access
Test
Starter
Emergency Restart
Remote Reset
Assignable Input 1
Assignable Input 2
Assignable Input 3
Assignable Input 4
Trip Coil Supervision
Analog Inputs
Analog Input 1 4160 V
Analog Input 2 60.00 Hz
Analog Input 3 Not Programmed
Analog Input 4 Not Programmed
Analog Input Differentials
Differential 1-2 Not Programmed
Differential 3-4 Not Programmed
Motor Load
Motor Load 0.93 FLA
Thermal Capacity 36%
Estimated Time to Trip Never
Tachometer RPM 3600 R.P.M
Motor Speed Low Speed (Speed 1)
Hottest Stator
RTD 12
Temperature 118°C
Current Phasors
270°
180°
0°
90°
73


52L
SW53
SW53
to COGENERATION
138kV to B
Davis Plant
L1
6304
6306
CS#1
BT1
8424
8426
CS#2
BT2
6074
6076
TRANSF. #1
7.505 kW
241.542 var
TRANSF. #2
7.505 kW
241.542 var
151
CB1
153
251
CB2
253
CB3
351
353
1152
1151
451
CB4
453
454
551
CB5
553
554
651
CB6
653
654
751
CB7
753
754
851
CB8
853
854
FDR. No. 5
7.505 kW
241.542 var
FDR. No. 1
7.505 kW
241.542 var
FDR. No. 2
7.505 kW
241.542 var
FDR. No. 3
7.505 kW
241.542 var
FDR. No. 4
7.505 kW
241.542 var

One-Line Editor



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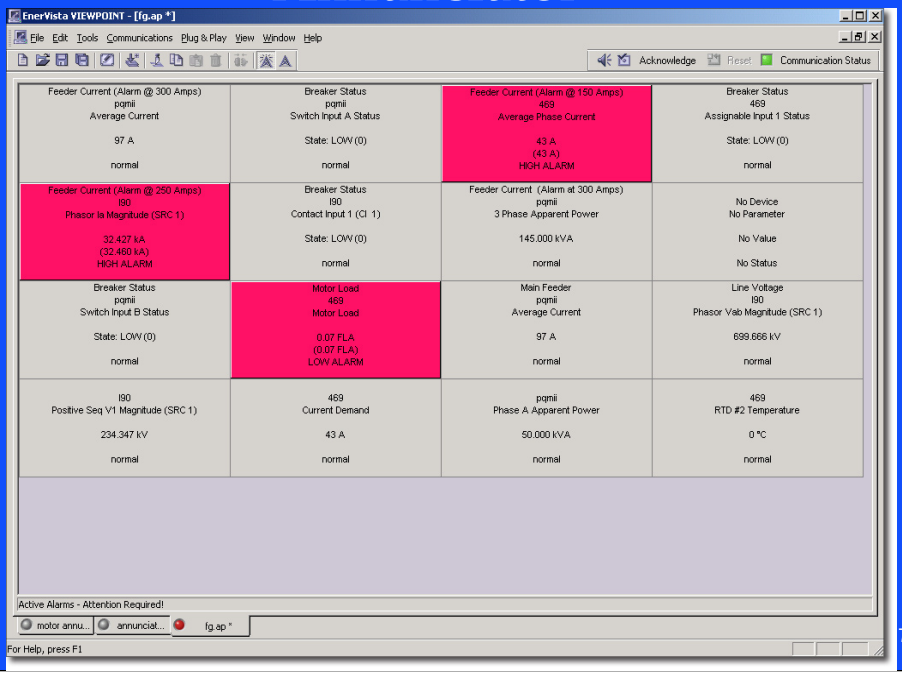
Annunciator



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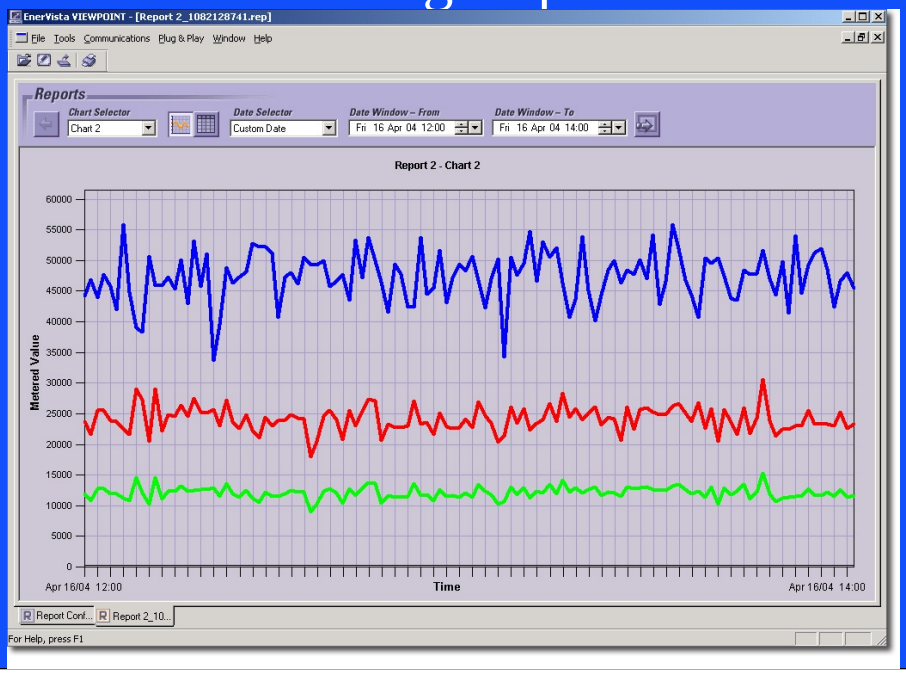
Automatic Event and Waveform Retrieval

Trending Reports



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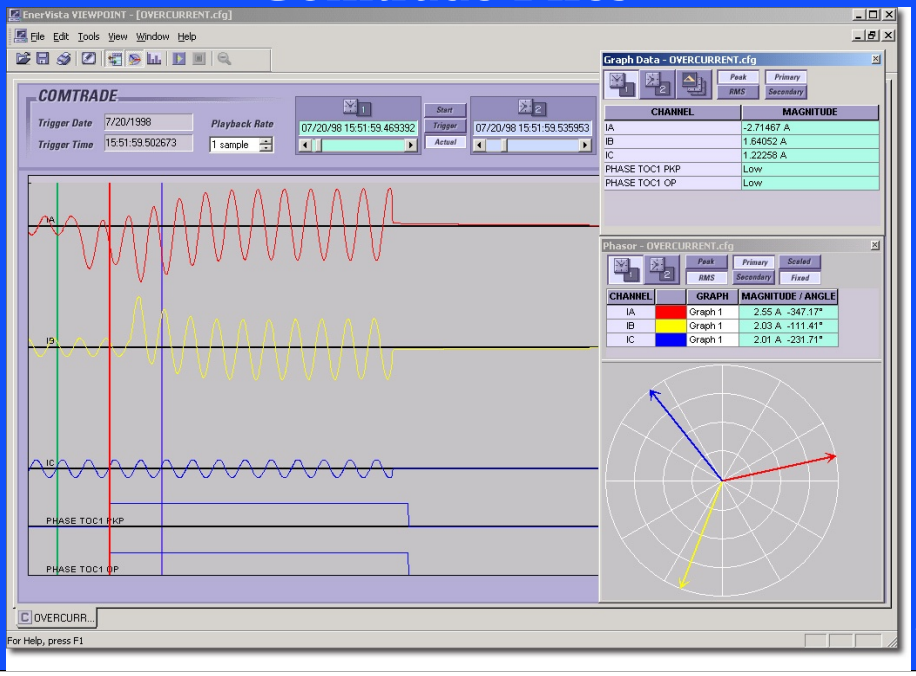
Comtrade Files



OPC

- The **OPC Foundation** is an industry consortium that creates and maintains standards for open connectivity of industrial automation devices and systems. The OPC standards specify the communication of industrial process data, alarms and events, historical data and batch process data between sensors, instruments, controllers, software systems and notification devices.

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The OPC Foundation started as a task force comprised of five industrial automation vendors with the purpose of creating a basic OLE for Process Control specification. OLE is a technology developed by Microsoft Corporation for the MS Windows operating system. The task force released the OPC standard in August 1996. The OPC Foundation was chartered to continue development of interoperability specifications and includes manufacturers and users of devices, instruments, controllers, software and enterprise systems.

OPC Standards and Specification Groups

OPC Data Access

> This group of standards provides specifications for communicating real-time data from data acquisition devices such as PLC's to display and interface devices like Human-Machine Interfaces (HMI). The specifications focus on the continuous communication of data

OPC Alarm and Events

> Standards for communicating alarm and event data on demand, as opposed to the continuous communications in the OPC Data Access group

OPC Batch

> Standards to address the needs of batch processes

OPC Data exchange

> This group of standards addresses server to server communications across industrial networks. The standards also address remote configuration, diagnostics, monitoring and management communications

OPC Historical Data Access

DDE

- **Dynamic Data Exchange** (**DDE**) is a technology for communication between multiple applications under Microsoft Windows and OS/2.
- Microsoft Excel has a DDE server – you can open a Microsoft Excel spreadsheet and fill it with data, by opening a DDE conversation with Excel and sending it DDE commands.

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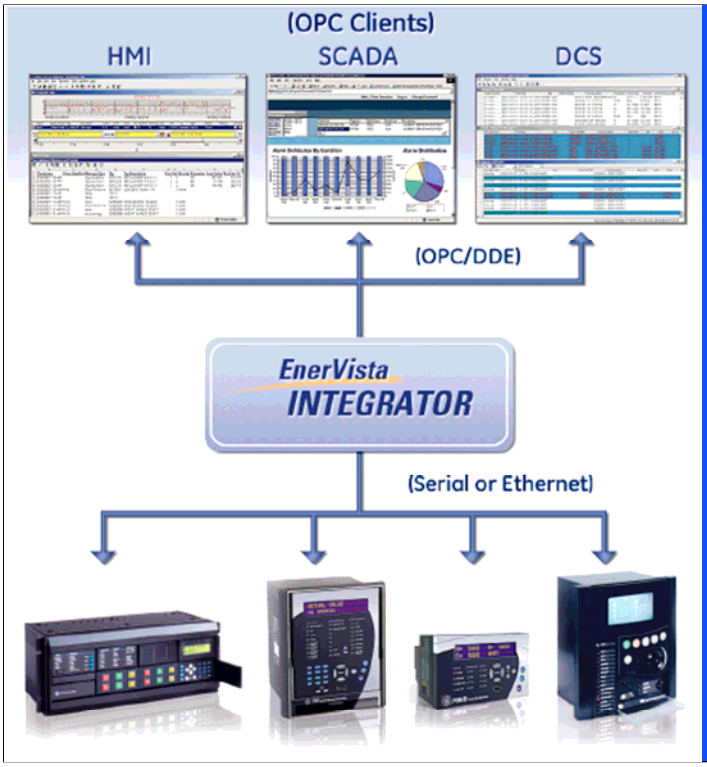
Dynamic Data Exchange was first introduced in 1987 with the release of Windows 2.0. Although still supported in even modern Windows versions, it has mostly been replaced by its much more powerful successors OLE, COM, and OLE Automation. However, it is still used in several places inside Windows, e.g. for Shell file associations.

DDE allows one application to open a session with another, send commands to the server application and receive responses. However, it does not enable the server application's graphical user interface to be incorporated into the client application's; it did not support incorporation of server application data into client application files (i.e. structured storage); and in order to use DDE, one has to know the DDE commands that the server supports, which were generally not standardized (although some standards do exist, e.g. the Spyglass specification for web browsers). Thus, in order to use DDE fully, special code must be added to each client application for each server application it wants to control, or the client application must provide a scripting language or macro facility.



OPC / DDE Server

Sources of Information

- GE Multilin Communications Training CD
- http://www.wikipedia.org/
- http://www.profibus.com/wbt/en/wbt1/
- http://www.odva.org/

Copy of Presentation

http://www.L-3.com/private/levine/ieee communications-2008.ppt

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Thank You

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