The Basics of Ethernet and Internet Data Communication

Honeywell

Ethernet History

Honeywell

- 33rd Birthday 2006
- May 22, 1973 Bob Metcalfe Xerox (PARC)
- Hundreds of Millions Sold
- Most Popular Network sold
- Replaced the Big Mainframes ($$)

Ethernet History

Honeywell

- The Aloha Network
- University Of Hawaii 1960
- Norman Abramson and Colleagues Developed a Radio Network
- The Protocol - Transmit and Wait for Reply
- No Response Collision Assumed
- Station Would Back Off and Retransmit

Ethernet History

Honeywell

- Abramson Won The IEEE Koji Kobayashi Computer and Communications Award
- This Led to the Development of LANs
- Metcalfe Improved on this system
- Detected when Collisions Occurred (CD)
- Included Listen Before Talk (CS)

Ethernet History

Honeywell

- Supported Access to a Shared Channel by Multiple Stations (MA)
- Ethernet Channel Access Protocol is Called CSMA/CD Carrier Sense Multiple Access with Collision detection
- Metcalfe also Included a Back Off Algorithm (100%)

IEEE Wiring Identifiers

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- 10Base5 Thick Coaxial
  - 10 Mbps, Baseband, 500 Meters (1640ft)
- 10Base2 Thin Coaxial
  - 10 Mbps, Baseband, 185 Meters (606.8ft)
- 10Base-T Twisted Pair Cat 3 or Better
  - 10 Mbps, Baseband, 100 Meters (328ft)

Bus Topology

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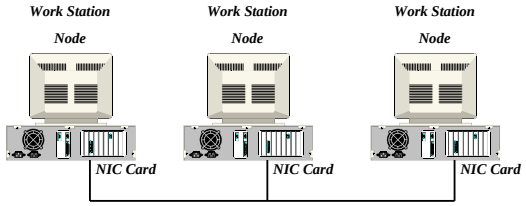

Ethernet Frames Travel The Bus

10Base5 and ***10Base2***

Star Topology

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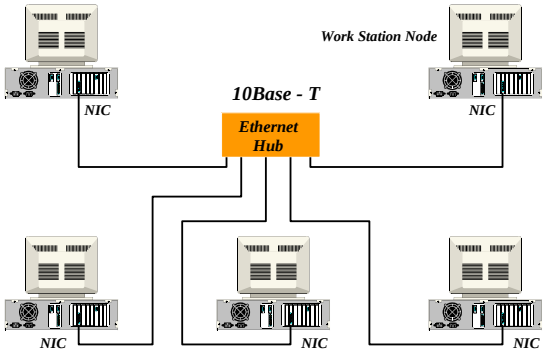

Ethernet Basic Rule

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Nodes Only Talk To Nodes On The Same Segment Of Wire

Bus Topology

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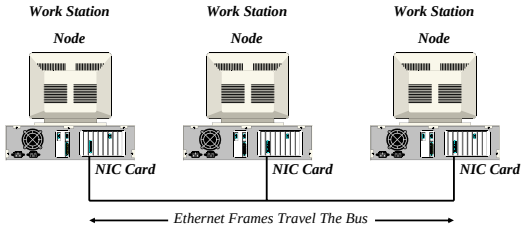
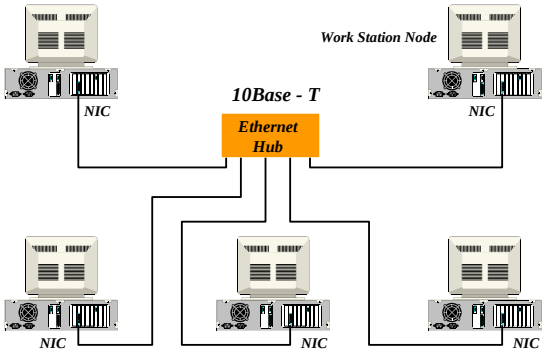


10Base5 and ***10Base2***

STAR Topology

Honeywell



Ethernet Nodes Talk On Same Segement

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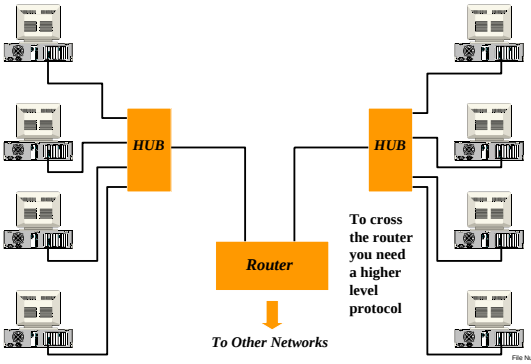

International Standards Organization

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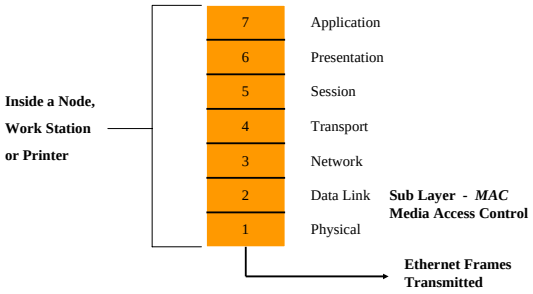
OSI Structure



ISO – OSI Structure

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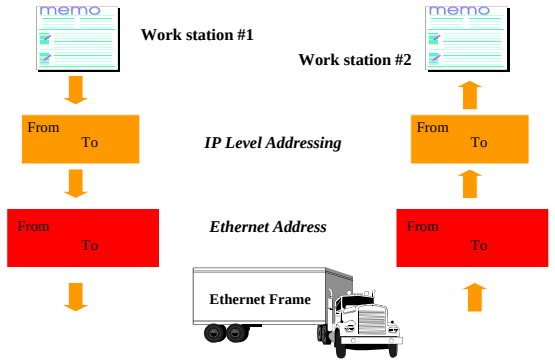

MAC Address

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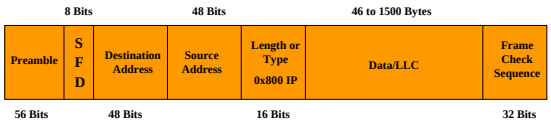
- Fixed Address Installed By Vendor
- Also called the Ethernet Address
- 48 BIT HEX Address
- First 24 Bits Vendor ID
- Last 24 Bits Vendors unique ID
- A New NIC Card Will Broadcast It's MAC Address

The Ethernet Frame IEEE 802.3

Honeywell



Preamble 56 Bits

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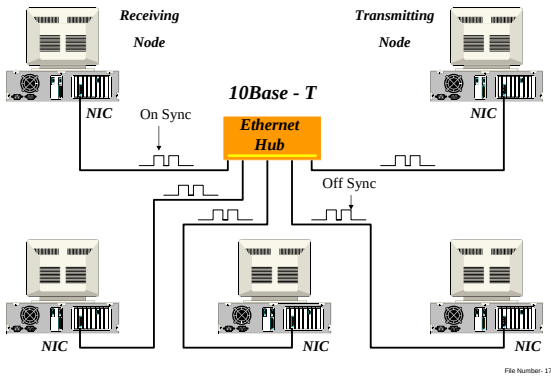

Start Frame Delimiter 8 Bits

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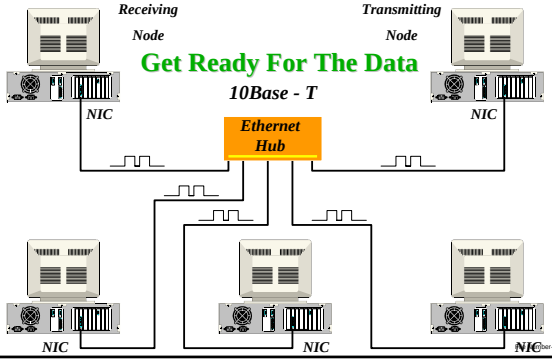
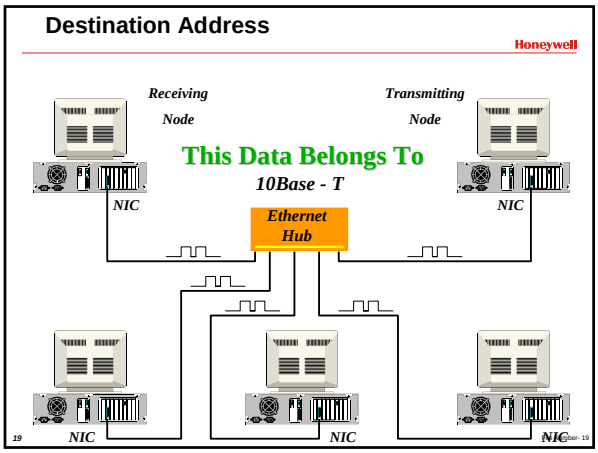
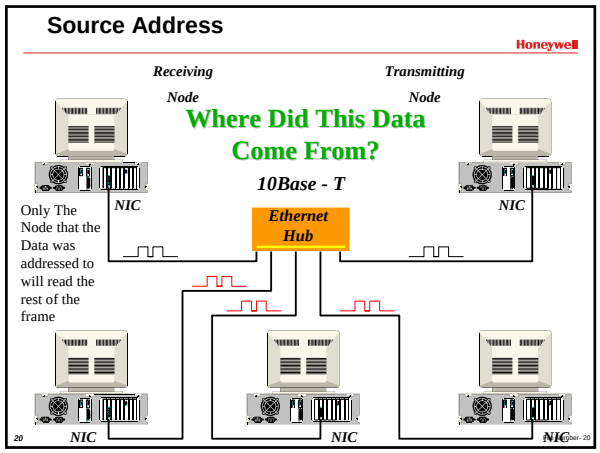


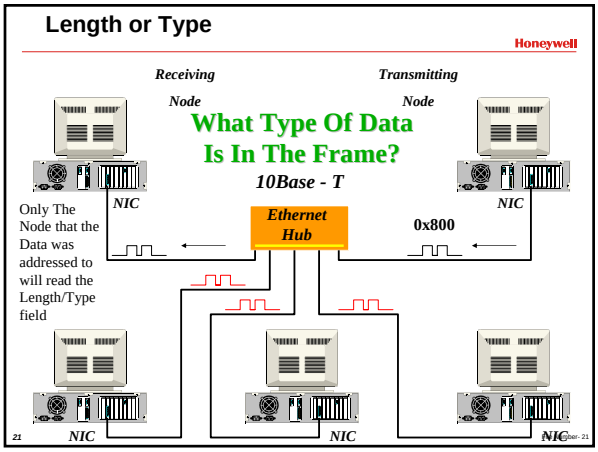
Destination Address



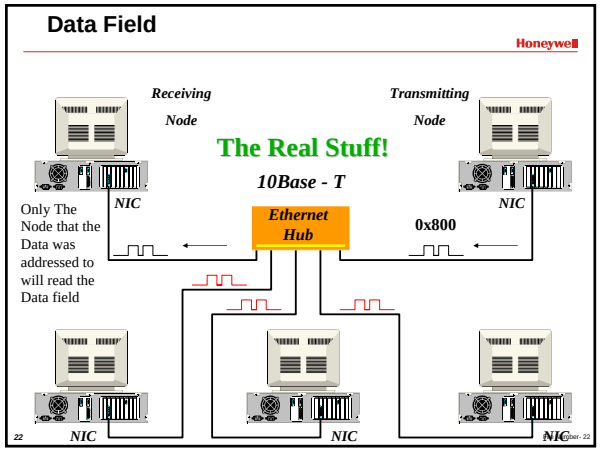
Source Address



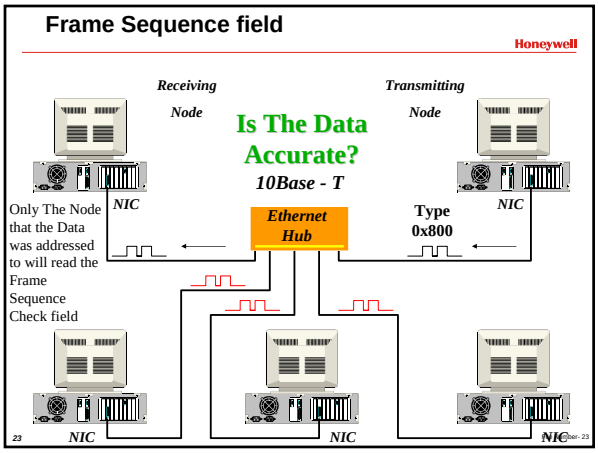
Length or Type



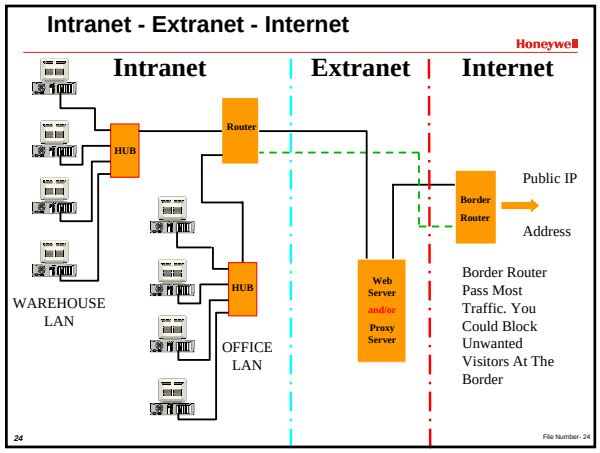
Data Field



Frame Sequence field



Intranet - Extranet - Internet



Internet communications

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Customer Expectations

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- Instantaneous signal transport
- Line Security – Always on connection, will know when there is a problem
- Alarm Industry is current with newer technology

Questions to Ask

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- Is the customer's network TCP/IP ready
- Is your network TCP/IP enabled
  - Are your devices connected via TCP/IP?
- Does your customer have a network diagram they are willing to share?
- Who are their network resources?
  - Internal?
  - Outsourced?

What Type of Network

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- Will you be using a private network connection?
  - Frame Relay?
- Public Internet connection?

Issues to Consider

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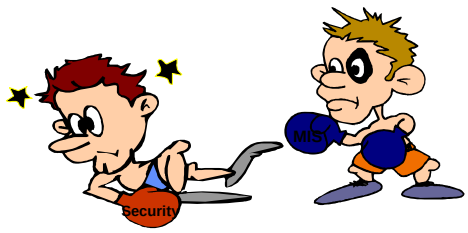
- Security vs. MIS
- Use caution not to become responsible for end users network
  - You will often be the first to know of a network outage



Uses for IP Communication

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- Central Station Monitoring
- Guard Station Monitoring
- Remote Control
  - Arm/Disarm
  - Add/Delete Codes
  - Control lights & Devices
  - View History
  - View Video

TCP / IP History

Honeywell

- DoD and Rand Corp's (Think Tank) started ARPA in the 1950s
- TCP/IP Launched in 1969
- Goal was to design a fault tolerant network
- No one point more critical than any other

TCP / IP History

Honeywell

- Redundant routes to any destination
- On the fly rerouting of data
- Ability to connect different types of computers over different types of networks
- Not controlled by a single corporation

TCP / IP History

Honeywell

- 1974 Vint Cerf and Bob Kahn published a Protocol for Packet Network
- TCP described host-to-host portion of communication
- Set of rules of when to send and receive data
- Administrators are forced to use TCP/IP

Protocol / Language

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- People speak the same language to communicate
- Computers work the same way
- TCP/IP are the languages of choice
- TCP/IP are a set of rules
- Popular because TCP/IP compatible with almost every computer in the world

TCP / IP Features

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- Support from vendors
  - Not tied to the efforts of a single vendor
- Interoperability
  - Installed and used on virtually every platform
- Flexibility
  - Assign IP addresses automatically or manually
  - Resolve names to numbers

TCP / IP Features

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- Routability
  - Route data from one segment of a network to another
  - Route data from one host on a network in one part of the world, to a host on another network in another part of the world

Routers

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- Most common connectivity device
- If the source and destination are on the same segment the router will stop the transmission from passing on to another network
- Connects dissimilar physical networks (Ethernet / Token Ring). They replace Physical layer headers as they pass from one network to the next
- Filters traffic by logical address (Subnet Mask used)
- Routing protocols i.e., OSPF
  (Open Shortest Path First) Each router periodically broadcast information on itself and the status of its links with other routers to which it is directly connected

Open System Interconnect

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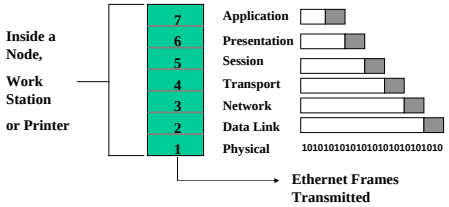
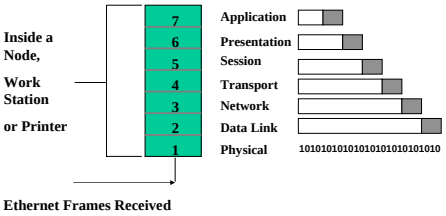


Open System Interconnect

Honeywell



TCP/IP Networking System

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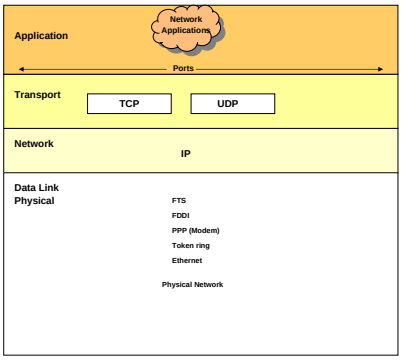

Entering IP Addresses

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- Configured as part of TCP/IP software
- Static Addresses **(manually entered)**
  - i.e., Routers, Printers, Servers
- Dynamic Addresses **(auto entered)**
  - i.e., DHCP Server, Client Computers

DHCP?

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- Dynamic Host Configuration Protocol
  - Assigns TCP/IP parameters to hosts
  - Parameters include IP Addresses and Subnet Masks
  - Commonly used on networks with many hosts

Four Steps in the DHCP Process

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- Discover
- Offer
- Request
- ACK

DHCP Discover

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- The Client (Host) sends a broadcast through UDP port 68. (Used by DHCP Servers)
- This broadcast is a request to any DHCP Server for configuration information

DHCP Offer

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- The receiving DHCP Server/s sends a return broadcast through UDP port 67
- This offer contains the offered IP address as well as the Subnet Mask

DHCP Request

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- The Client selects an offer and sends back a request datagram
- This request tells the DHCP server that its offer is accepted and to assign the configuration information
- The request also informs any other DHCP server that made an offer that it was refused

DHCP Ack

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- The DHCP Server now sends a packet back to the client (Host) with the final lease process
- This packet assigns the IP Address, Subnet Mask and may also include other optional information such as the Default Gateway

DHCP Time Field

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- IP Addresses are leased for a fixed period of time
- At 50% of the lease time the client attempts to renew the lease with the DHCP server
- If attempt fails, the client will try again at 75% of lease and again at 87.5%.
- If lease has still not been renewed, the client will send out a discover broadcast

Name Resolution

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- Humans find it easier to remember names i.e., honeywell.com
- TCP/IP cannot find or connect to another host with just words
- TCP/IP needs an IP address
- The name used must be resolved to an IP address

Resolving a Name

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- Some different places to resolve a name
  - Local Host
  - Host file
  - DNS
  - NetBIOS name cache
  - WINS

IP Addressing Modes

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- Public
  - Registered IP Address
  - Can connect directly to the Internet
- Private
  - Non Registered
  - Cannot connect directly to the Internet

IP Address Classes

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- Class A Addresses 1-127 (10 is private)
- Class B Addresses 128-191 (172 is private)
- Class C Addresses 192-223 (192 is private)
- Class D Addresses 224-239 (Multicast)
- Class E Addresses 240-255 (Experimental)

Where IP Addresses are Used

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- IP Address
  - Unique Device (Host) Address
- Subnet Mask
  - Identifies which portion of the address is network ID and which is the host ID
- Default Gateway
  - IP address of the router on the same physical segment

What is an IP Address?

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- Bits n' Bytes
  - A Bit consist of one digit and has a value of zero (0) or one (1)
  - A Byte consist of 8 Bits and is called an Octet

Converting Binary to Decimal

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- Each combination of 8 bits (Octet) can be converted to a decimal number
- Each bit position has a decimal value assigned to it

Bits	0	0	0	0	0	0	0	0
Value	128	64	32	16	8	4	2	1

55 File Number- 55

Converting Binary to Decimal

Honeywell

- If the bit is zero – The bit value is zero
- If the bit is one – The bit value is equal to the decimal conversion. In this case, the total value is 46

Bits	0	0	1	0	1	1	1	0
Value	128	64	32	16	8	4	2	1

56 File Number- 56

Convert These Numbers to Decimal

Honeywell

Value	128	64	32	16	8	4	2	1	
	0	1	1	1	0	0	1	0	114
	1	1	0	0	0	0	0	1	193
	0	1	1	1	0	1	1	1	119
	1	1	1	1	1	1	1	1	255

57 File Number- 57

Dotted Decimal Notation

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- IP addresses are expressed in dotted decimal notation
  209.132.95.62
- TCP/IP see views 209.132.95.62 in binary numbers

11010001100001000101111100111110
1101 0001.1000 0100.0101 1111.0011 1110

58 File Number- 58

Subnet Mask

Honeywell

- Standard Subnet Masks
- Class A = 255.0.0.0
  NNNN NNNN. HHHH HHHH. HHHH HHHH. HHHH HHHH
- Class B = 255.255.0.0
  NNNN NNNN. NNNN NNNN. HHHH HHHH. HHHH HHHH
- Class C = 255.255.255.0
  NNNN NNNN. NNNN NNNN. NNNN NNNN. HHHH HHHH
- Class C 192.064.013.025
  255.255.255.000
  192.064.013.032

59 File Number- 59

Security and Authentication

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Data Security and Authentication

Should be the Requirements of Any Internet Based Service

60 File Number- 60

Security and Authentication

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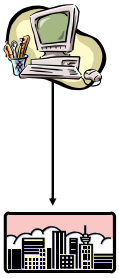


Authentication

A process whereby the sending or receiving party can test and confirm that the other person is who they claim to be.

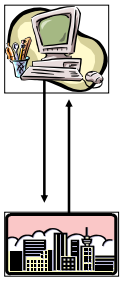
SSL

The weak aspect of SSL is in the fact that the authentication is ***one way***.

61 File Number- 61

Security and Authentication

Honeywell



It is important that the central station is who they claim to be and the protected premises is indeed who they say they are.

Neither can afford to be substituted

Two-Way authentication assures that both the protected premise and the central station are who they say they are.

62 File Number- 62

Security and Authentication

Honeywell

Data needs to be encrypted.

Alarm Zone 1 Front Door

4hfahyfindasnvjd k8avjk3ahjks7nvj kdsa0jahfjkavc1j kd274sbvdjksahfj dkap

Encryption

A technology that allows data to be altered in a way that both the sender and receiver can understand it, but if captured during transmission would not be meaningful to the intruder.

63 File Number- 63

Security and Authentication

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That it assumes an attacker has access to the algorithm that encrypts the data

It can withstand attacks by fast and powerful computers

That it be publicly available and scrutinized by professionals as being secured

Encryption

Encryption of data can be accomplished in many different ways. Approaches differ and there is no one right way to encrypt data. What is important in selecting a scheme for encryption is the three statement on the left.

64 File Number- 64

Security and Authentication

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Algorithm Flexibility

Communication modules should be capable of having their encryption scheme changes through flash memory.

The changes should have no impact on the security equipment or central station operations.

65 File Number- 65

Suggested Study Material

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Title	Author	Publisher
TCP/IP	Andrew G. Blank	Sybex
TCP/ IP	Joe Casad/Bob Willsey	Sams
TCP/IP	Matthew Naugle	Wiley
Windows Networking	Peter Kuo/John Pence	Sams
How the Internet Works	John Eddings	ZD Press

66 File Number- 66