



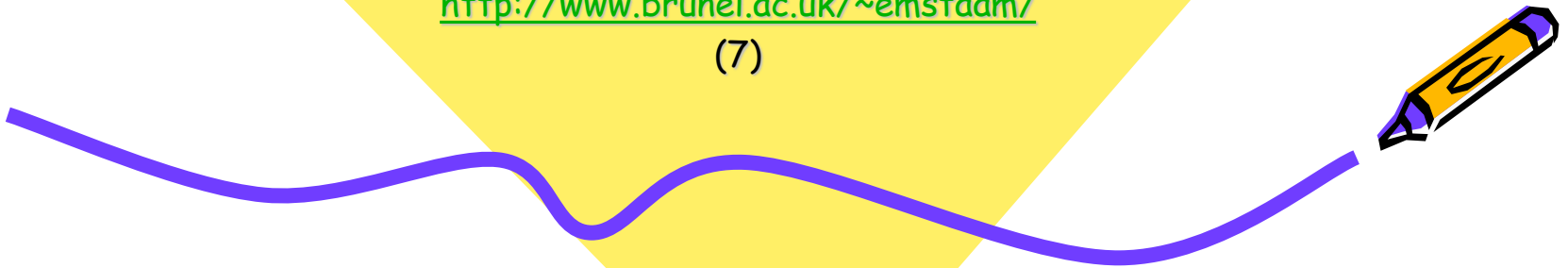
Electronic Business Systems

School of Engineering & Design

Alireza Mousavi

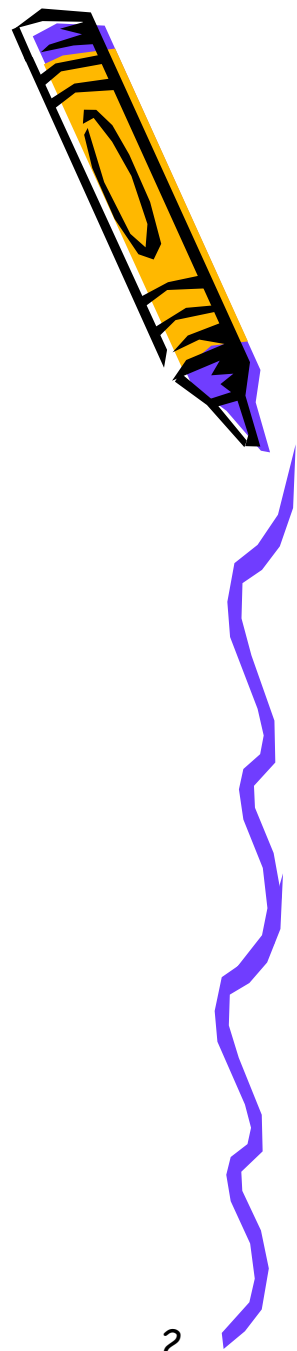
<http://www.brunel.ac.uk/~emstaam/>

(7)



Topics

- Networking and Communications
- Mobile & Wireless Networks
- Network Architectures in Industry





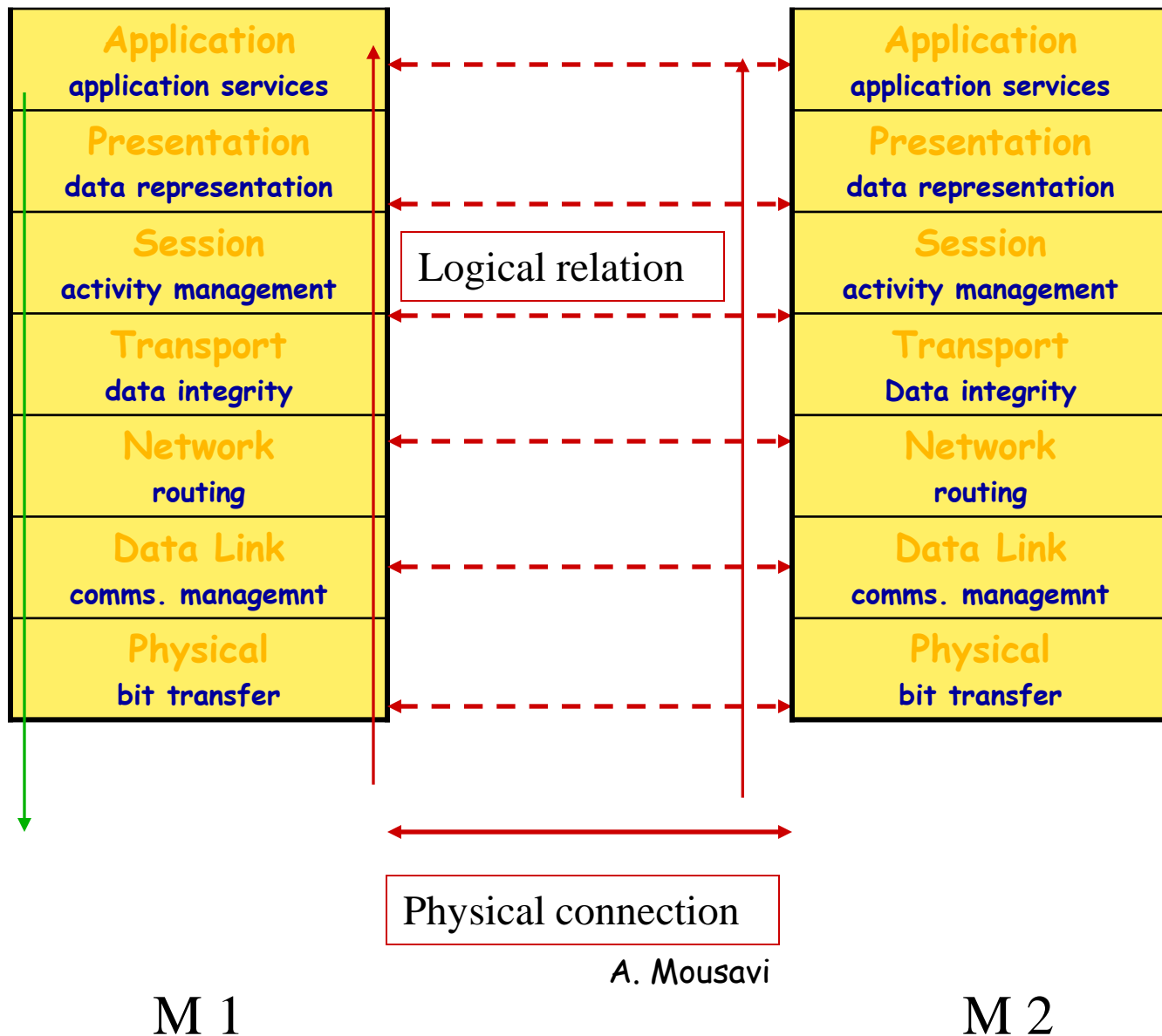
Networking and communication in e-enabled systems

- Communication Standards:

Companies have agreed to make public the details of their communication standards and protocols so others can adopt them and produce compatible systems. The standards allow:

- Equipment to communicate with each other
- Control data flow
- Error free communication.

Open Standard Interconnection (OSI)



Communication media and bandwidth



"Communication involves the transmission of information through conducting medium" [Westland 2000]

Bandwidth is the amount or capacity used in transmission medium.

The amount of data transferred through a bandwidth reflects its efficiency.

The bandwidth is measured in terms of bit per second (bps)

Communication services



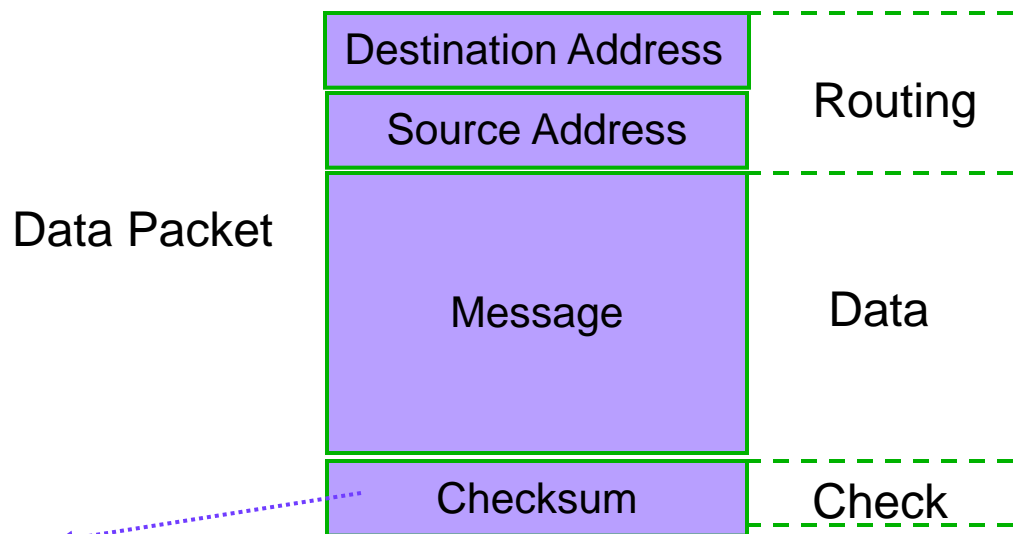
- *Integrated Services Digital Network (ISDN)*: ISDN transmits information digitally through the telephone networks without any conversion to analog along the line.
- *Asymmetric Digital Subscriber Line (ADSL)*: twisted copper pair cable with analog to digital conversion at the subscriber with advanced transmission capability.
- *Broadband*: using wireless technology to transfer data at a higher rate.

Synchronous and asynchronous transmission



Transmission of information can be synchronous (simultaneous) or asynchronous. Voice traffic is normally synchronous, voice mail is asynchronous.

Data can be transmitted quickly with a fixed number of characters grouped together for transmission as a single block of data (packet) without breaks in between.



16 bit checksum

A. Mousavi

Computer Networks



"A Computer network can be described as the result of any permanent or semi permanent linkage between two or more computer systems" [Westland 2000]

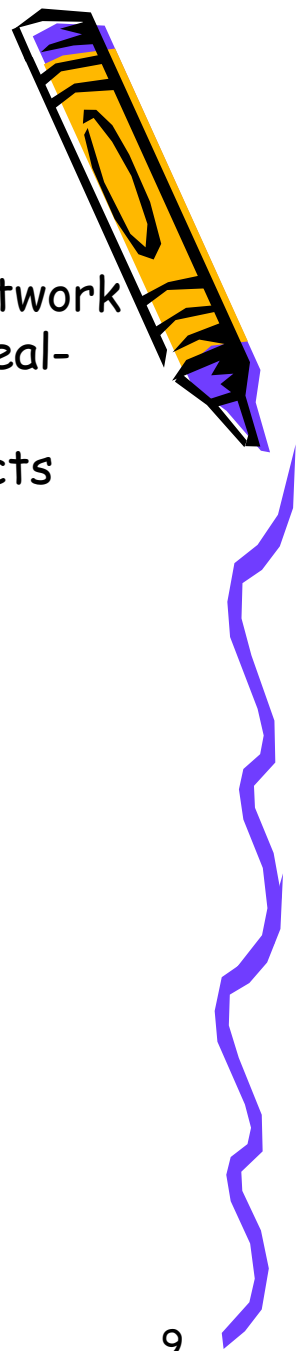
Networks can be used to:

- share resources i.e. data storage,
- share programs i.e. departmental software,
- share data files i.e. student records shared between finance/registry/department administration.

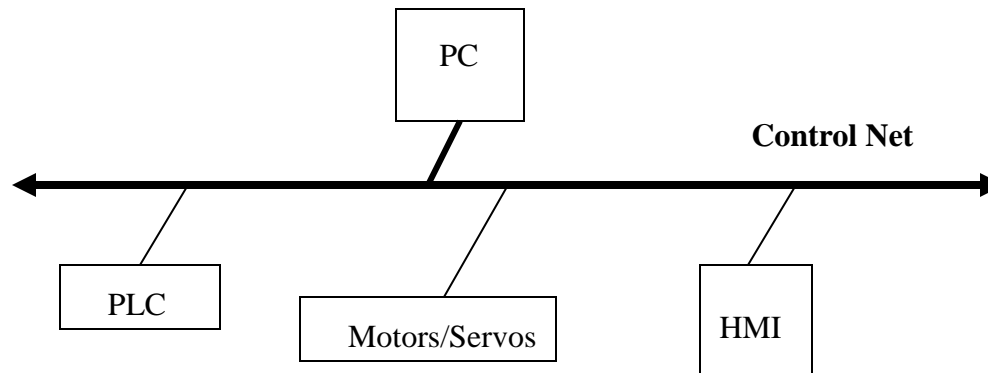
Networks also provide access to

- specialised data processing applications,
- integrating and coordinating organisational information, and
- management of IT resources.

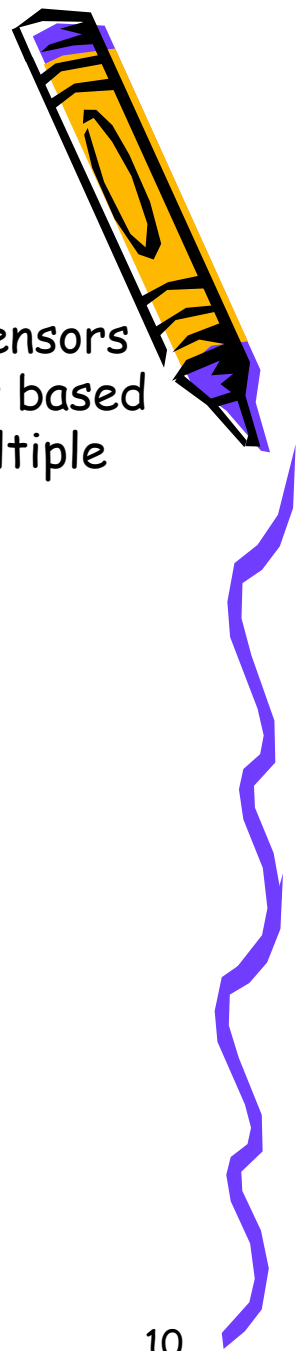
Industrial Networks (1)



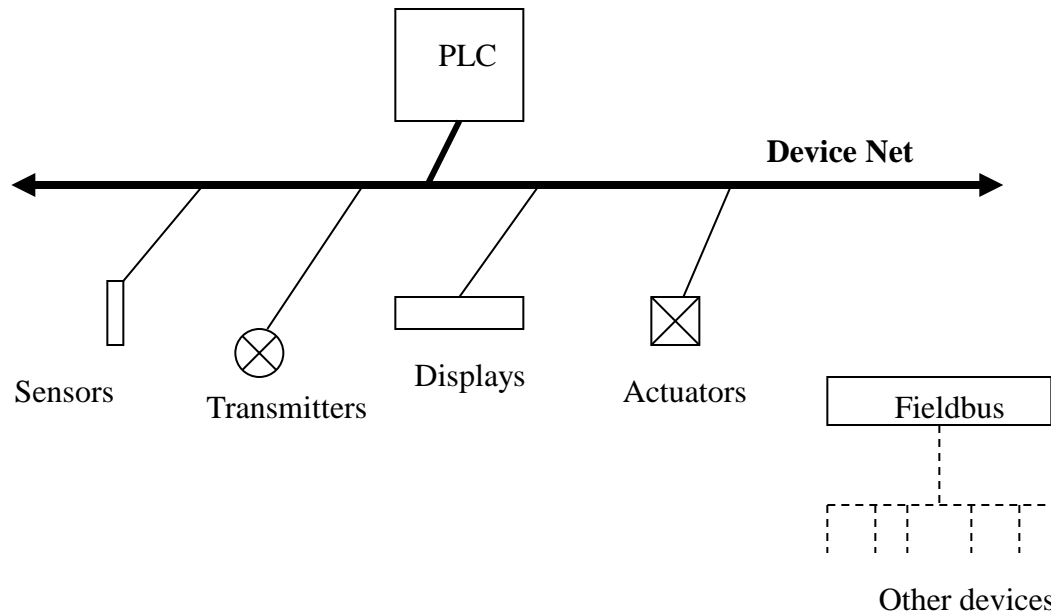
- **Control Networks:** an open, high speed, and deterministic network used for transmitting time critical information. It provides real-time control and messaging services for peer-to-peer communication. It is more used in industrial plants and connects PLCs, PCs, HMI devices (panels), drivers, motors and servos. [Rockwell Automation Structure]



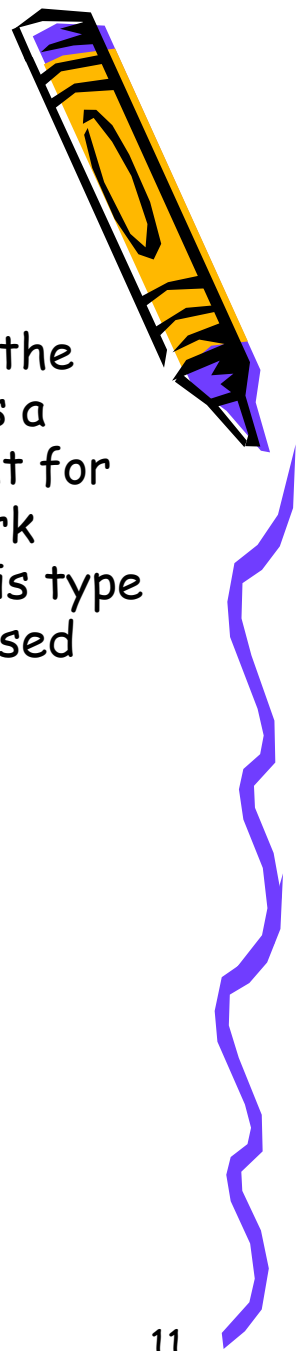
Industrial Networks (2)



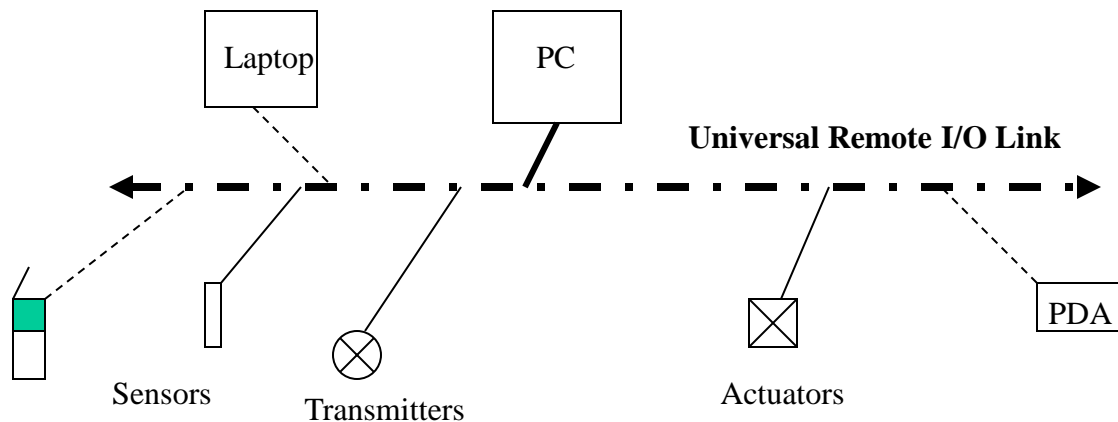
- **Device Network:** an open, low-level communication link that provides the connection between industrial devices such as sensors and actuators and high-level devices such as controllers. It is based on Controller Area Network (CAN) technology that allows multiple vendor devices to work together.



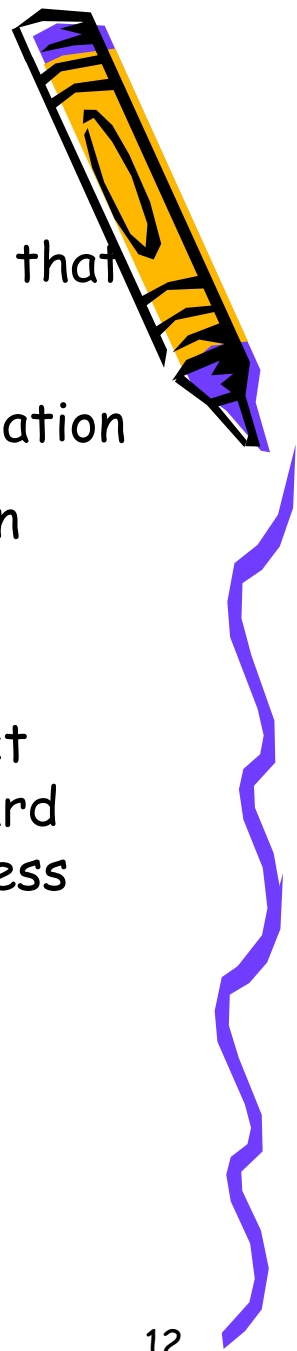
Industrial Networks (3)



- **Universal Remote I/O Link:** is similar to devicenet with the advantage of the breadth of products it supports. Bluetooth the latest technology developed and currently being perfected, is a short-range radio frequency link intended to be a replacement for cables between portable devices and may fall into this network type. In addition to field devices that can be connected in this type of network PDAs, mobile phones and laptops can be synchronised and communicate with devices in the network.



OLE for Process Control (OPC)

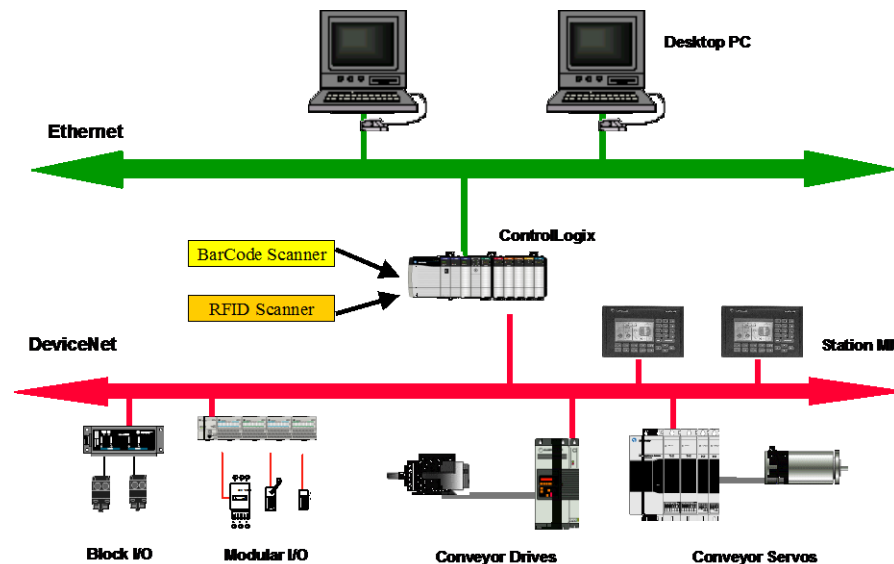


- Set of network protocols, standards and specifications that facilitate interoperability of multiple devices.
- The specifications are now called Data Access Specification
- Result of collaboration between a number of automation suppliers working in cooperation with Microsoft.
- Originally based on Microsoft's OLE COM (component object model) and DCOM (distributed component object model) technologies, the specification defined a standard set of objects, interfaces and methods for use in process control and manufacturing automation applications to facilitate interoperability. (Also see OPC official site)
- Link to OPC Architecture

http://www.opcfoundation.org/01_about/April19_OPC-DISPLAY%20LAYOUT.pdf

Industrial Networks (4)

- **Ethernet network:** Using standard Internet protocols (TCP/IP), Ethernet network is a local area network (LAN) designed for high-speed exchange of information between computers and related devices. With a bandwidth of 10 mbps, Ethernet networks allow many computers, controllers, and other devices to communicate onto a shared transmission cable or bus over a vast distance.



Rockwell Automation
Network Architecture

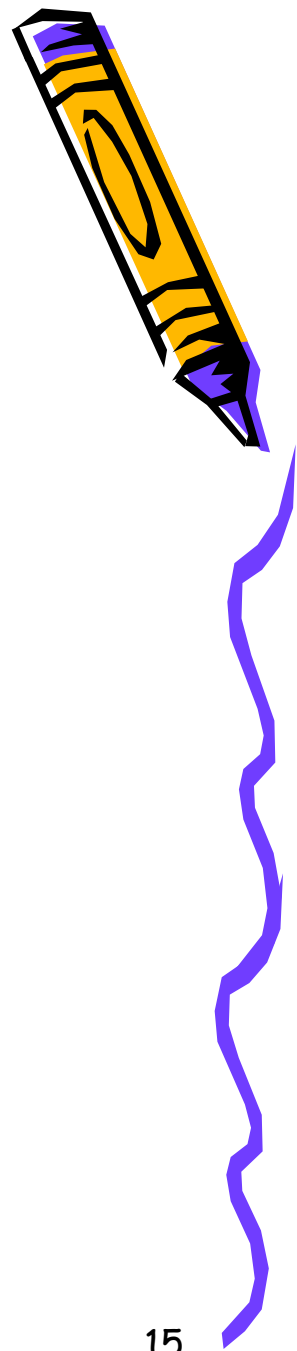
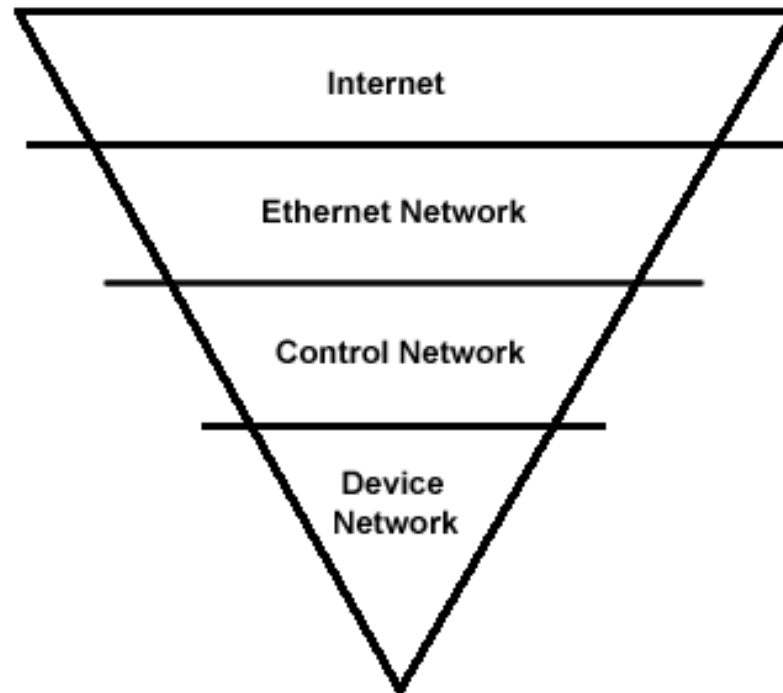
Industrial Networks (5)



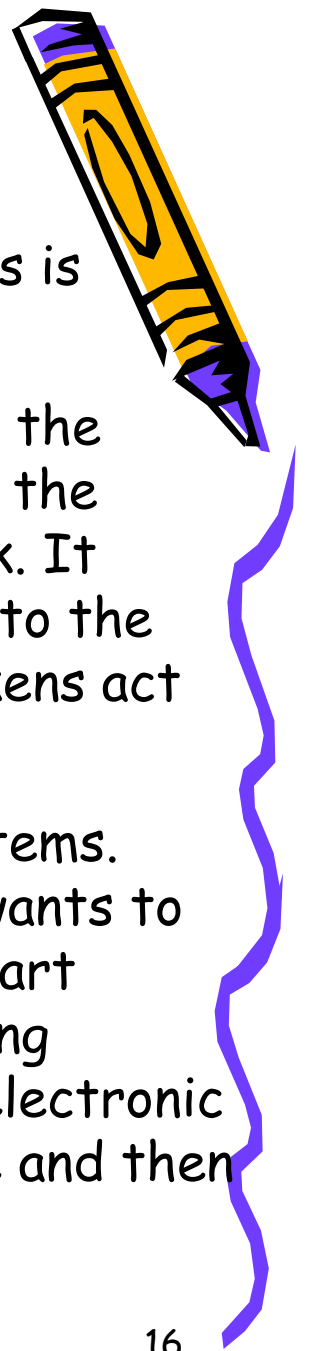
- **Internet:** The Internet is itself the network of networks connecting computers servers using TCP/IP communication protocols. In order to enable systems to communicate with each other, it is important that common standards are developed and products that are produced meet the standards.

"The Internet is therefore, less a physical entity than a set of standards that different firms agree to follow for connecting their physical telecommunications capacity to enable global sharing of information across these interconnected networks", [Westland & Clark, 2000].

Network types capacity and level of data communication



Connection Protocols



- Master/Slave protocol: In this protocol one of the systems is considered to be Master and the others are Slaves.
- Token protocol: Here a token is passed from one system to the other. Each system (origin) directly transmits the token to the destination system which is another element in the network. It checks the address and then transmits the packet of data to the destination node via the network. In other words these tokens act as carriers of data to destinations.
- Random Access protocol: Proposed by Xerox Ethernet Systems. Imagine a group of people are talking in a meeting. If one wants to talk he/she waits until everybody else is quiet then they start talking. If they realise that someone else has started talking simultaneously (collision detect) they all stop talking. The electronic system exactly works the same it waits until the line is idle and then transmits the data.

Networking concepts



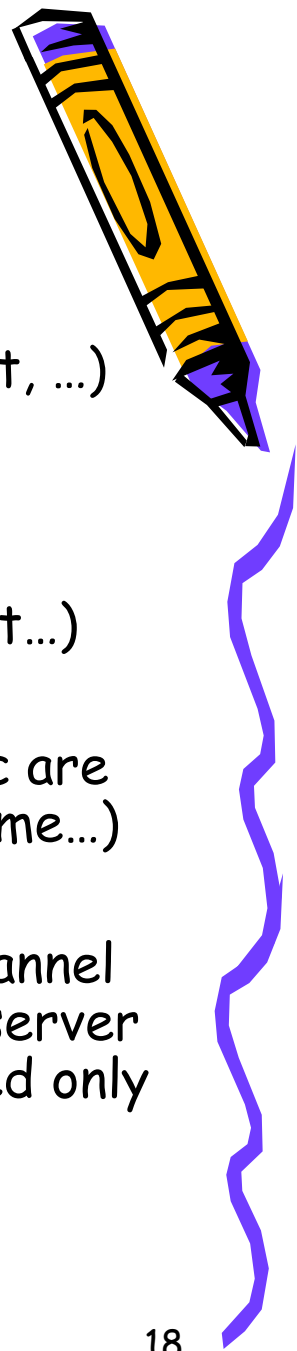
- **Dynamic Data Exchange (DDE)**

An interprocess communications specification that is built into the Microsoft Windows Operating System. It allows Windows programs that support DDE to communicate with each other within the Windows environment.

- **Transmission Control Protocol / Internet Protocol**

Suite of protocols that can be used to route information. The suite of protocols can provide addressing in LAN and WAN which can provide connectivity to a variety of hosts.

Dynamic Data Exchange (DDE)

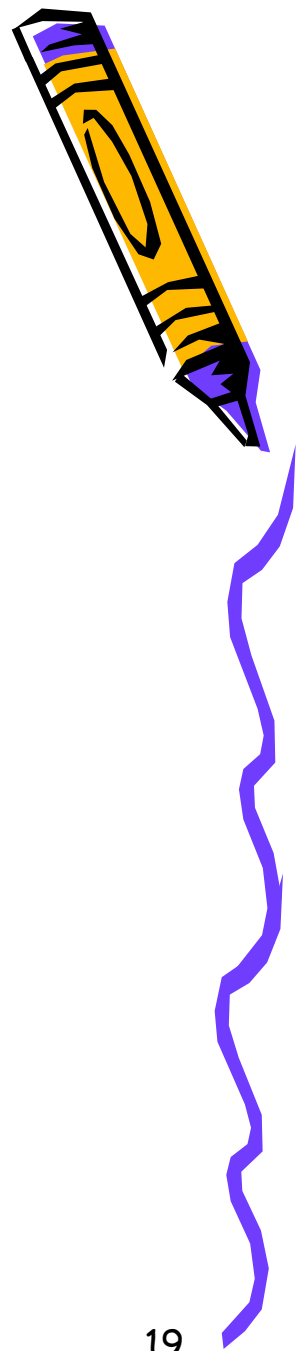


DDE questions consist of:

- Who am I talking to? (**Application** e.g. Excel, Powerpoint, ...)
- What is the subject of the talk? (**Topic** contains the necessary information to get us communicating with a specific device for example Book1.xls, Presentation1.ppt...)
- What Data do I need? (**Item**, once application and topic are known what specific data is required i.e. ID number, name...)
- Is it a **Hot Link** or a **Cold link**? A **Hot Link** is a DDE channel that remains open, though it is only updated when the server detects a data change. **Cold Link** applications are opened only on command.

TCP/IP networking

- TCP / IP address
- TCP / IP address format
- Network and node address
- Network Class:
- Subnet Mask



TCP/IP



TCP / IP:

A set of communication protocols for data transfer.

Some protocols:

- TCP (Transmission Control Protocol)

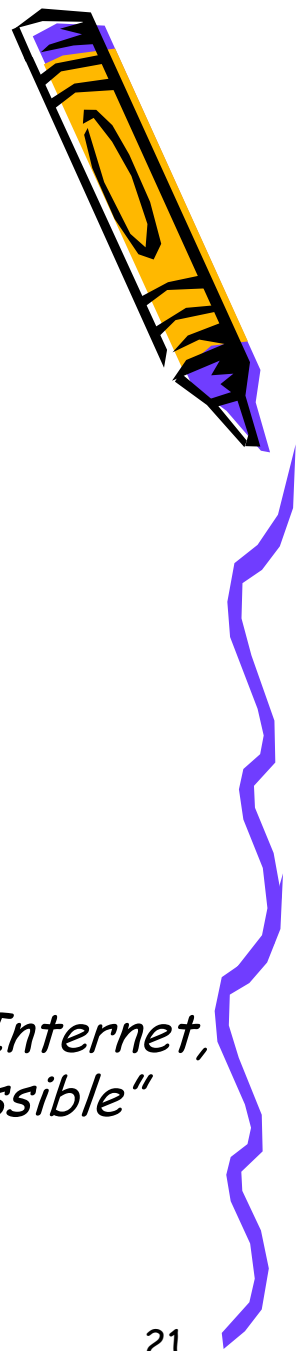
- UDP (User Datagram Protocol)

- IP (Internet Protocol)

- File Transfer Protocol (FTP)

- HTTP (Hypertext Transfer Protocol)

IP addressing & Domain Names

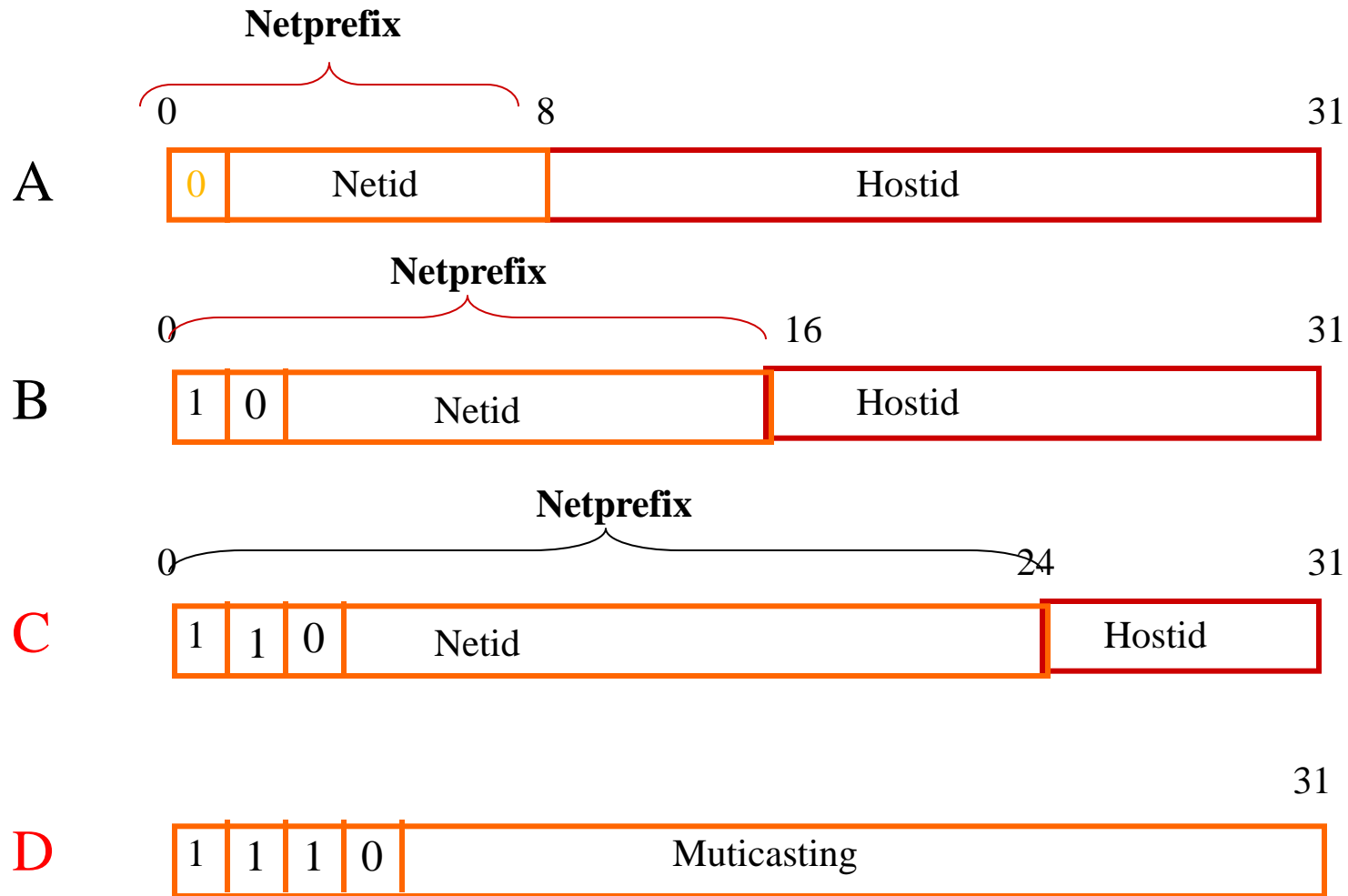
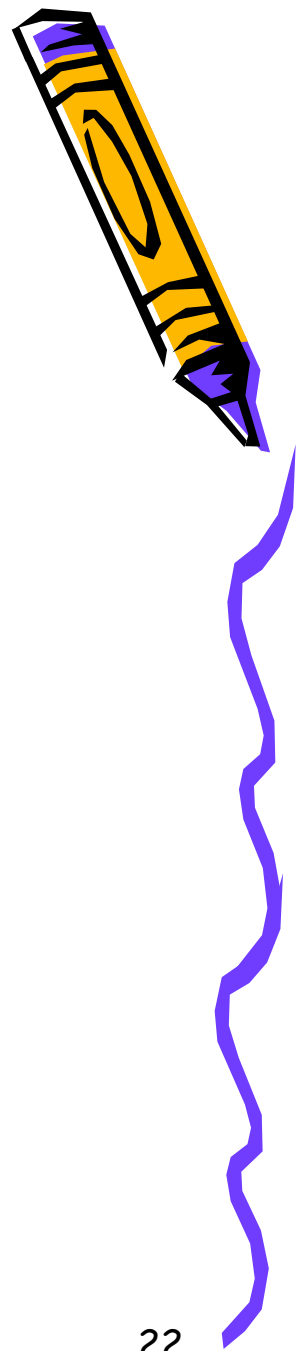


- IP addressing
 - 32-bit that uniquely addresses each host and network as four Octet 0 to 255
 - Network Classes A, B, C, D, E define the size of the network (see next slide)

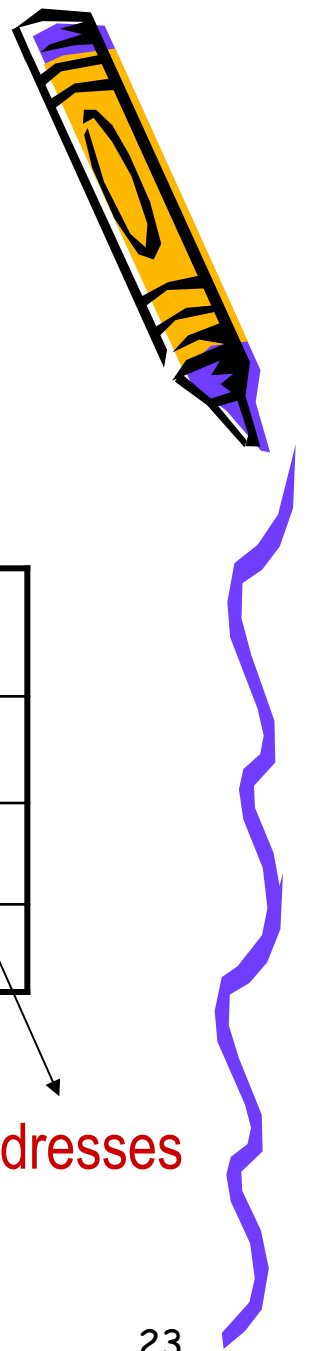
- Domain Names System (DNS)

"Is hierarchical database that is distributed across the Internet, with information being distributed to the lowest level possible"
(Whittaker 2002)

Internet Address Classes



Network Classes by Size



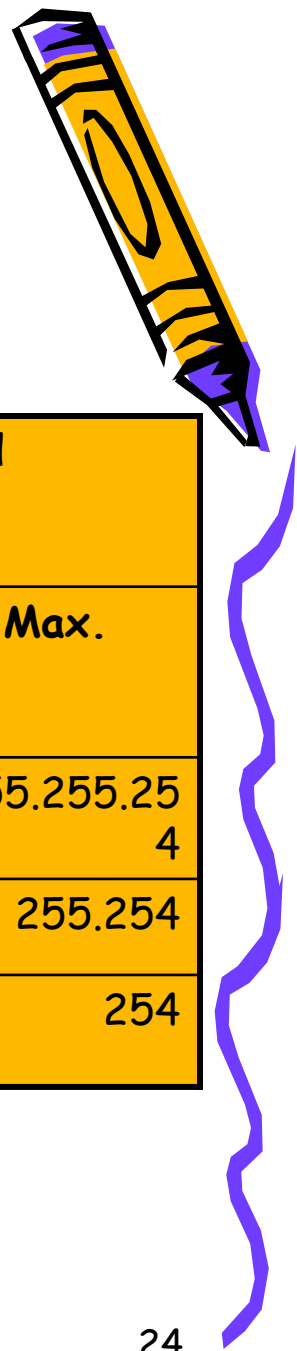
16 million addresses

	Many Hosts	Some Hosts	Few Hosts
Few Networks	Class A		
Some Networks		Class B	
Many Networks			Class C

65,000 addresses

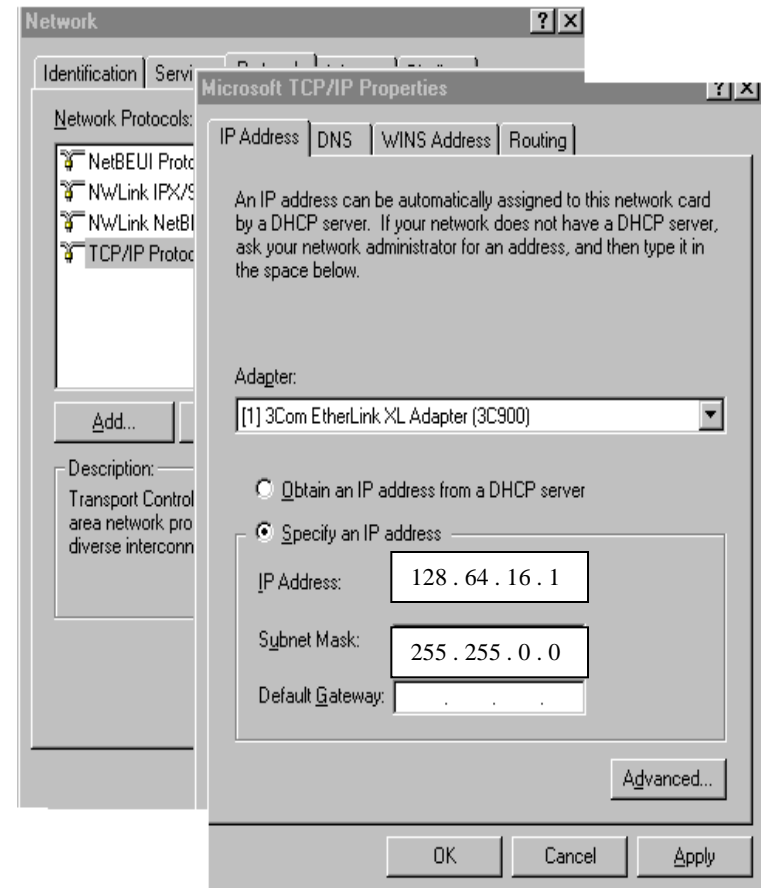
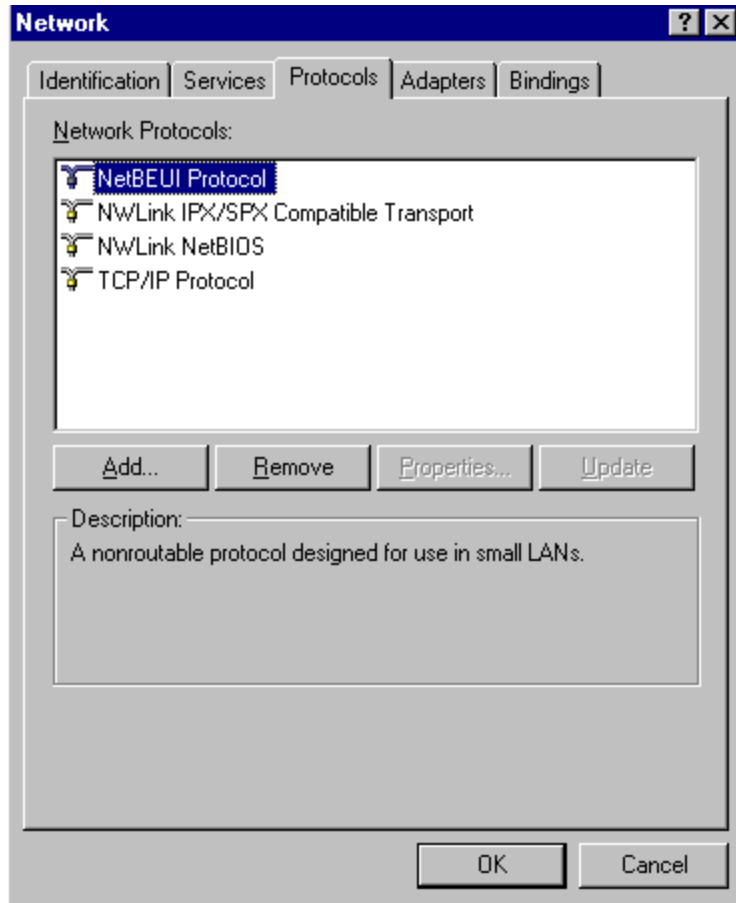
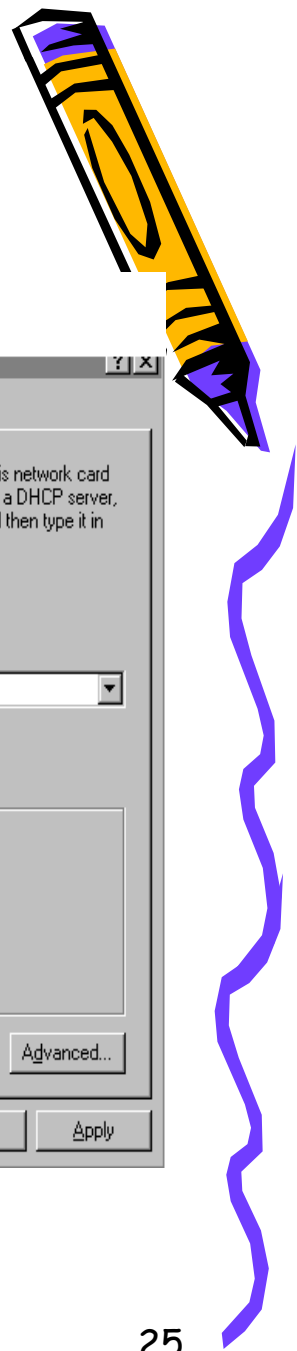
254 addresses

Range Permitted for Assigning Addresses

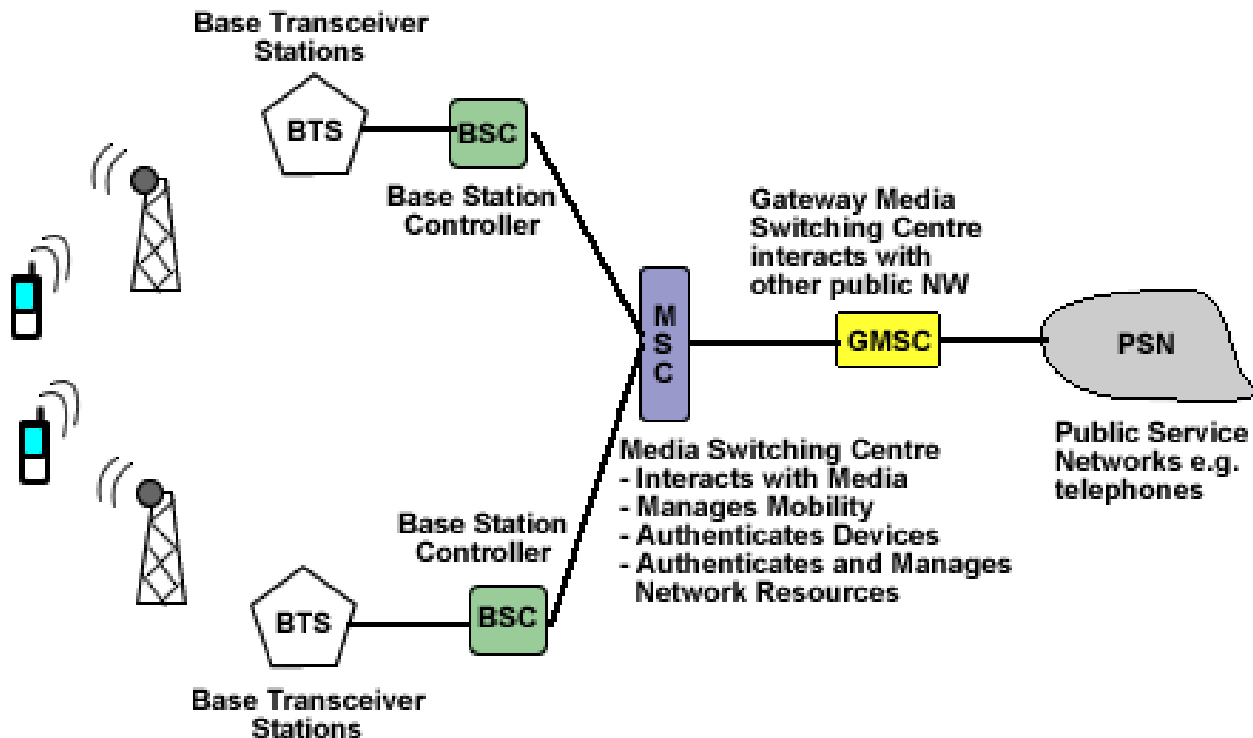


		Netid		Hostid	
Class	Netprefix (bits)	Min.	Max.	Min.	Max.
A	8	1.	126.	0.0.1	255.255.254
B	16	128.0.	191.255.	0.1.	255.254
C	24	192.0.0	223.255.255.	1.	254

IP Address example (Windows)



Current Mobile Systems Network



Current Wireless Network Structures

Source: Sun Micro Systems Educational Services