



Networking Basis

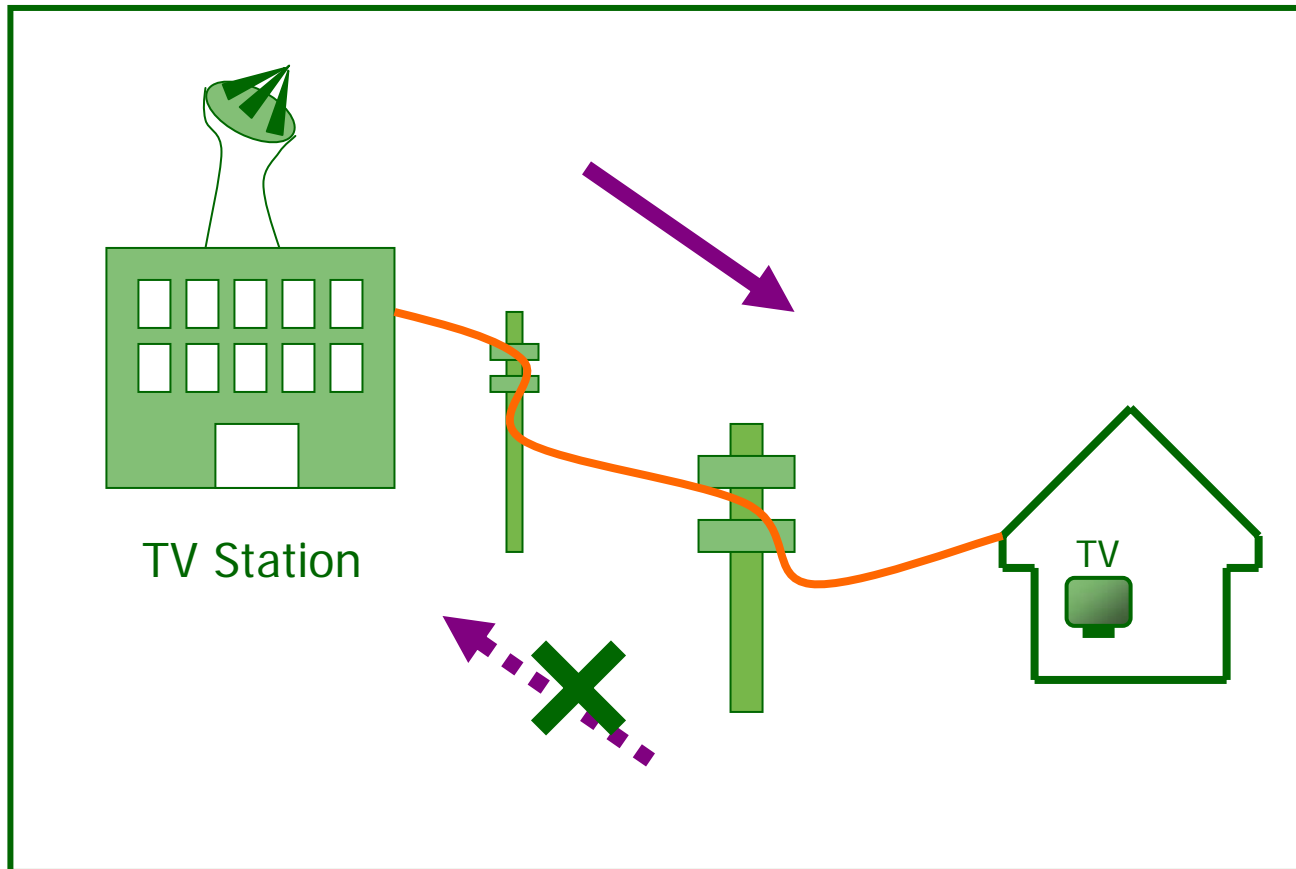
Information Transfer and Communication Protocol



Modes of Information Transfer

- ❑ There are three modes of information transfer: *Uni-directional*, *Half-Duplex* and *Full-Duplex*.
- ❑ Uni-directional means information can only be transferred in one direction. The transmitter and receiver should be pre-defined, and the receiver never give any responses.
- ❑ TV broadcasting is an example of uni-directional information transfer.

Modes of Information Transfer



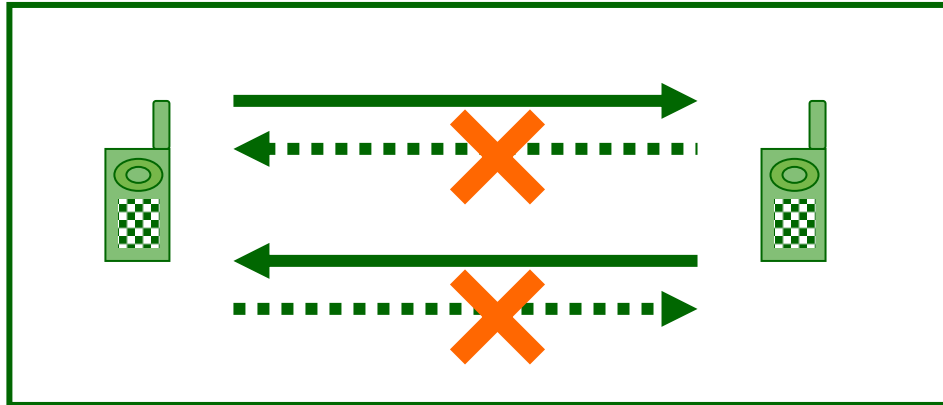
Uni-directional



Modes of Information Transfer

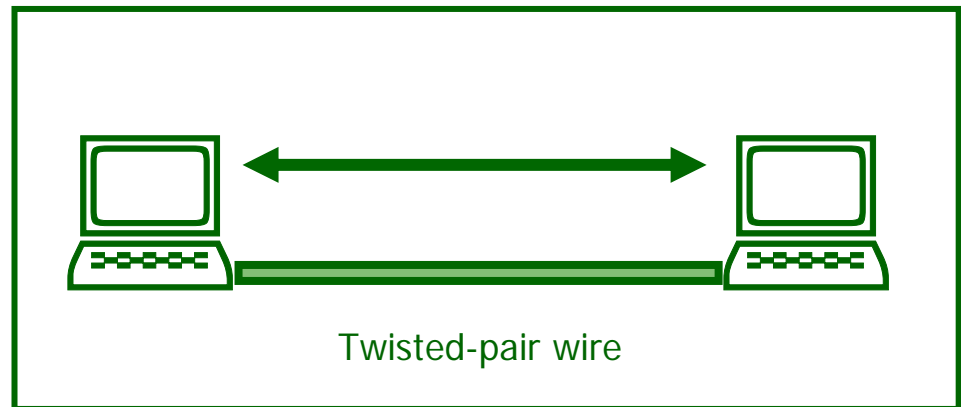
- ❑ Half-Duplex and Full-Duplex mean information can be transferred in both directions. In half-duplex, information can only be transferred in one direction at a time, while, in full-duplex, both receive and transmission can happen at the same time.
- ❑ Walkie-Talkie is an example of half-duplex communication.
- ❑ Telephone, Internet and LAN are examples of full-duplex communication.

Modes of Information Transfer



Half-Duplex

Full-Duplex



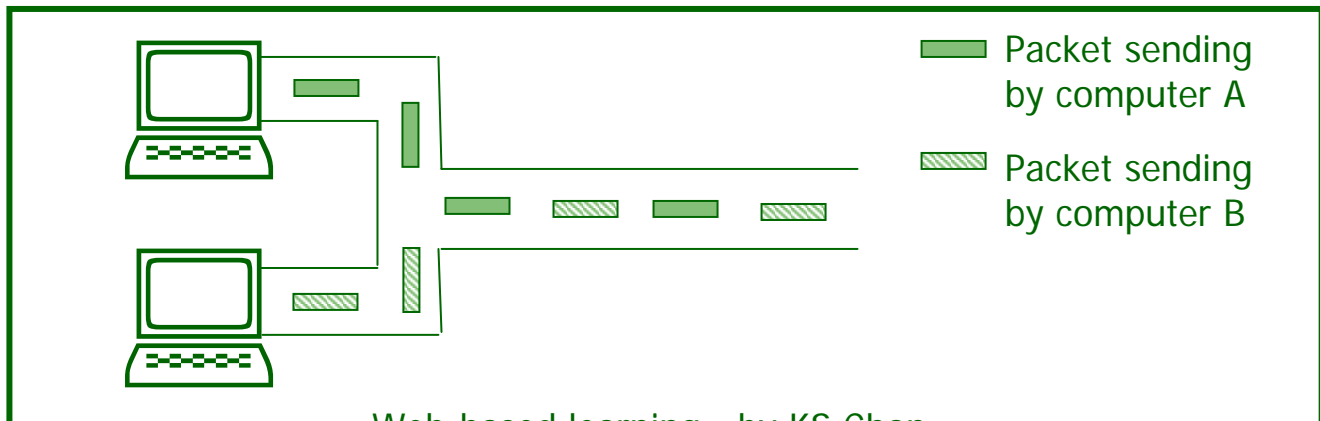


Packet Switching

- ❑ To prevent occupying the cable throughout the transmission process, Ethernet divides the whole transmitting data into several small units called *packets*.
- ❑ The packets are then sent to the cable one by one. Thus, there are spaces in-between each packet.
- ❑ Other terminals can also send their packets to the cable occupying those spaces.

Packet Switching

- ❑ As a result, the cable is not absolutely occupied by one transmission process.
- ❑ This transmission method is called *Packet Switching*.

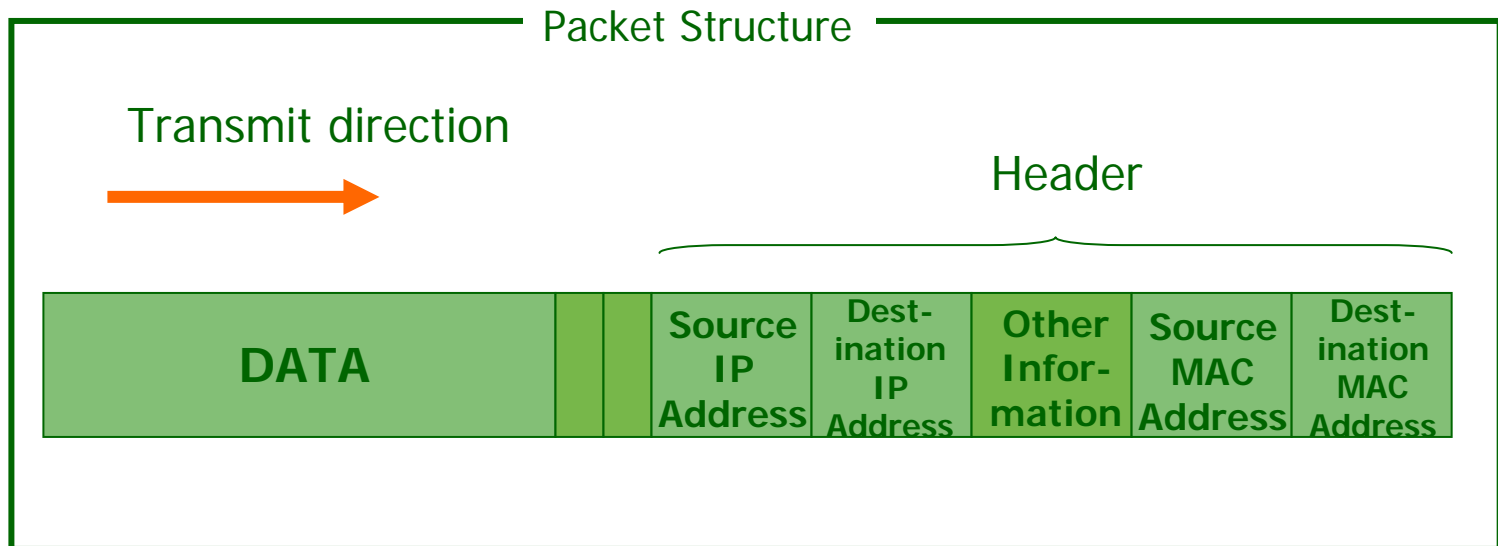




Packet Switching

- ❑ Each packet consists of “*data*” and “*header*”.
- ❑ Header is used to identify the destination to which the data is sent. Besides, it also shows the address of the sender.
- ❑ Every packet is attached with a header, thus, even though the whole data is split into several packets, they will not get loss.

Packet Switching





Line Switching

- ❑ It is another data transmission method which only allow one-to-one communication.
- ❑ It works like telephone communication or fax. Once the line is occupied by two persons, the third person cannot enter.
- ❑ In this method, a line should be connected before data is sent.



Communication Protocol

- ❑ Using the same communication protocol, computers within a LAN or Internet can communicate with each other.
- ❑ Generally speaking, communication protocol is a set of rules that should be followed by the networked computers in order to transfer data or communication.
- ❑ However, there are many different kinds of LAN and thus, there exist different communication rules.

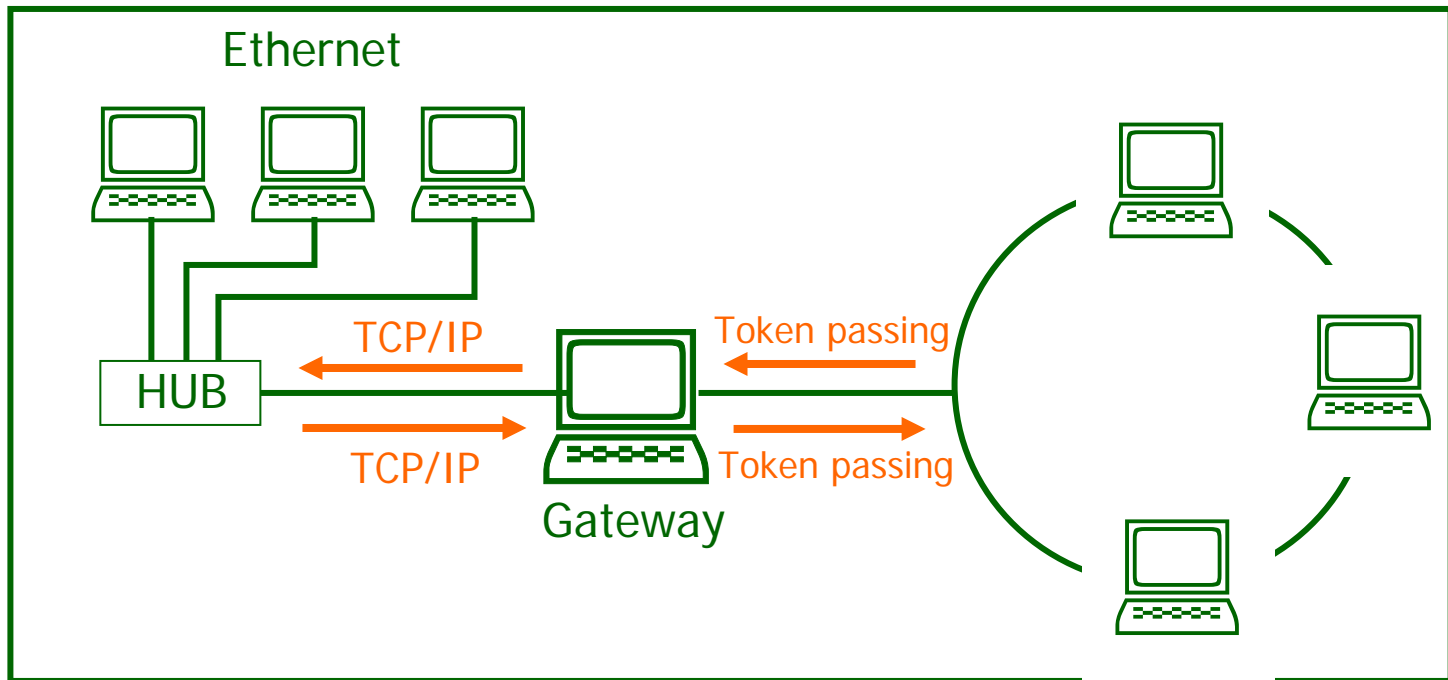


Communication Protocol

- ❑ If it is needed to transfer data from one kind of LAN to another, it should be:
 - ① translated to the language that can be understood by the other LAN, or
 - ② using the same language.

- ❑ To do translation, a *Gateway* is needed. A gateway can translate the language that is understood by the source network to the language that can be understood by the destination network.

Communication Protocol



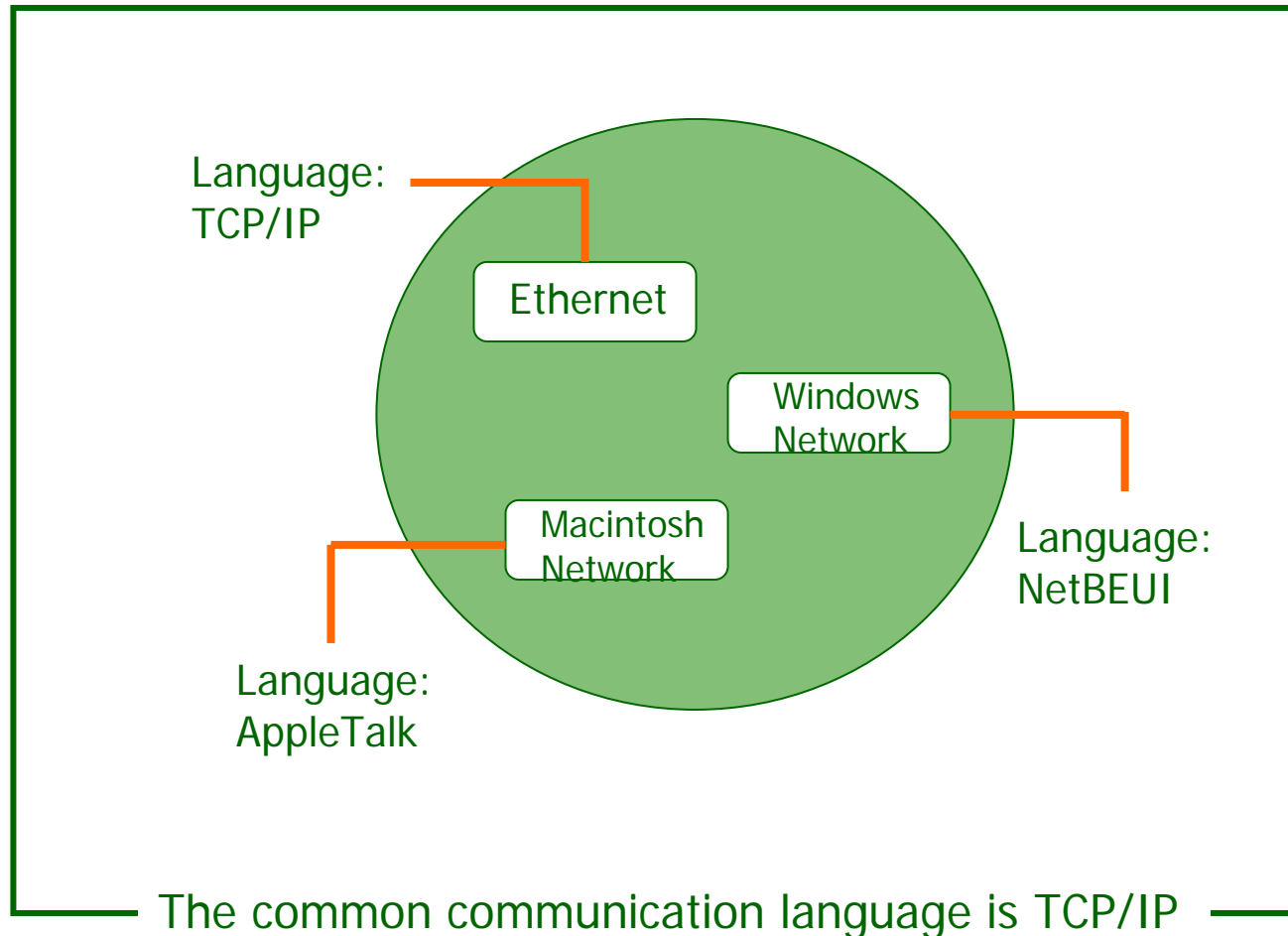
- ❑ However, there is no gateway that can translate every communication protocol.



Communication Protocol

- ❑ TCP/IP is the common communication protocol used by different LANs to communicate with each others.
- ❑ It is also the protocol used to access the worldwide Internet.

Communication Protocol





Levels of Communication Protocols

- ❑ “Communication Protocol” is an important term in networking study. In fact, there exist many different protocols like *TCP/IP*, *NetBEUI*, *HTTP*, *FTP*....
- ❑ These communication protocols can be divided into three levels: High Level, Medium Level and Low Level.



Levels of Communication Protocols

- ❑ High Level Protocols are used in application software such as web browser or FTP programs etc..
- ❑ Medium Level Protocols are used in internal processing of OS, such as Windows, MacOS, UNIX etc..
- ❑ Low Level Protocols are used in network related hardware such as network interface card, hubs etc..



Levels of Communication Protocols

Levels	Communication Protocol		
High	HTTP, FTP, NFS (Network File System)	SMB (Server Message Block)	AFP (Apple Filling Protocol)
Medium	TCP/IP	NetBEUI/NetBIOS	AppleTalk/EtherTalk
Low	Ethernet (CSMA/CD)		



TCP/IP 、 NetBEUI 、 AppleTalk 、 SPX/IPX

- ❑ Generally speaking, when we are talk communication protocols, it means the medium level protocols.
- ❑ TCP/IP is, so far, the most commonly used communication protocol. Both Ethernet Network or Internet are using this type of protocol. With the commonness of Internet, TCP/IP can be said to be the global standard of communication protocol.



TCP/IP 、 NetBEUI 、 AppleTalk 、 SPX/IPX

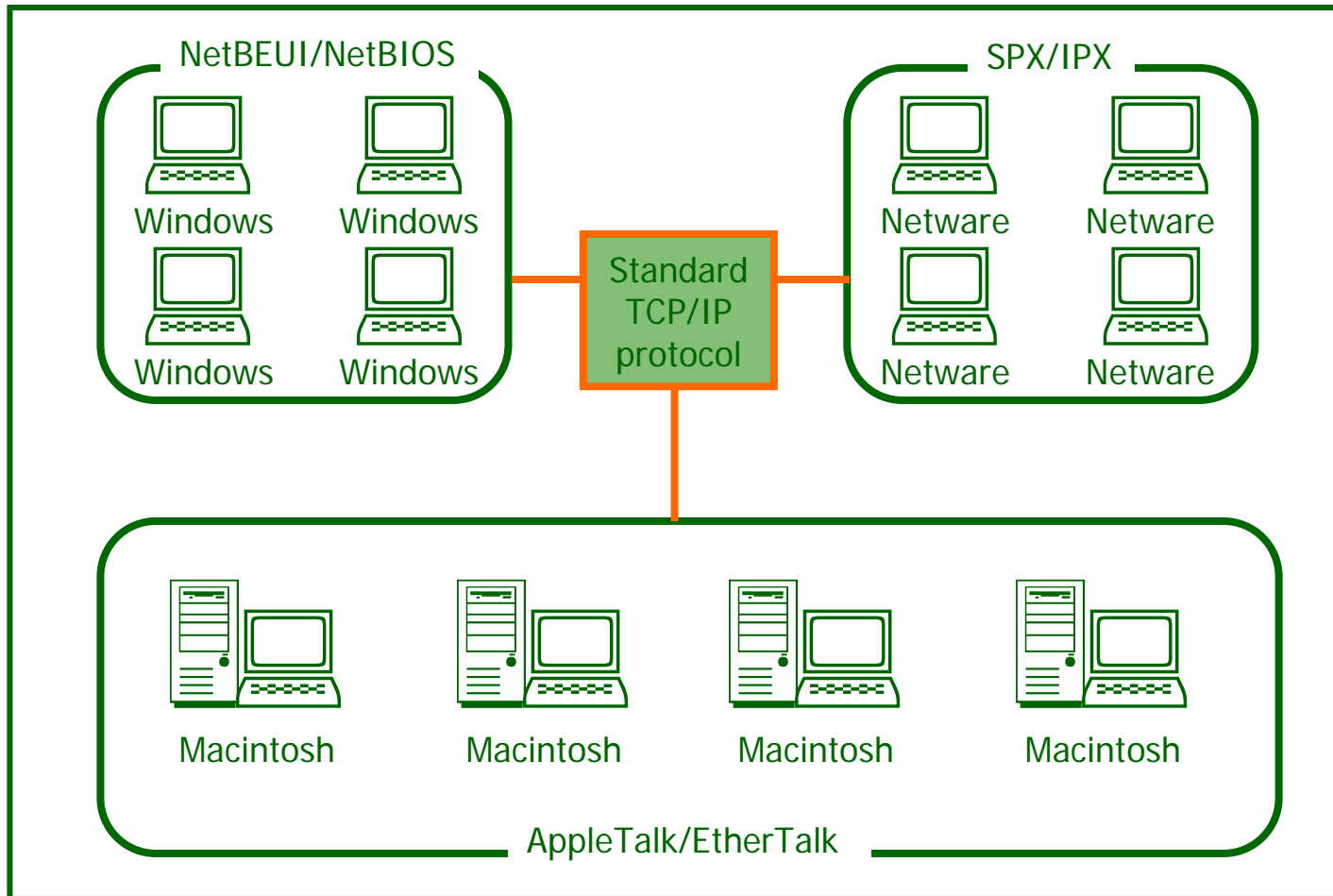
- ❑ NetBEUI and NetBIOS are the protocols used for file sharing in Windows network. It is a built-in communication protocol in all Windows OS. Almost all Windows PC use this protocol to communicate with each other.
- ❑ AppleTalk and EtherTalk are the protocols used in Macintosh network. It is also a built-in communication protocol in all MacOS.



TCP/IP 、 NetBEUI 、 AppleTalk 、 SPX/IPX

- ❑ SPX/IPX6 is the protocol used for file sharing in NetWare OS. It is mainly used in the LAN of a large scale company or campus.
- ❑ TCP/IP is used as the standard communication protocol, so that networked computers with different OS can communicate with others.

TCP/IP、NetBEUI、AppleTalk、SPX/IPX



Other Communication Protocols

OSI Model		TCP/IP Group	
Layer 7	Application Layer	SMTP, HTTP, TELNET, SNMP, DNS, NNTP, POP, FTP	
Layer 6	Presentation Layer		
Layer 5	Session Layer		
Layer 4	Transport Layer	TCP	UDP
Layer 3	Network Layer	IP, RIP, OSPF	
Layer 2	Data Link Layer	Ethernet, Token Ring, FDDI	PPP
Layer 1	Physical Layer		



Other Communication Protocols

TCP/IP Group	Function
FTP	Transferring Files
HTTP	Transferring HTML Files
SMTP	Transferring E-mail
POP	Receiving E-mail
TELNET	Remote computer operation
NNTP	Transferring Network News
SNMP	Managing Network
DNS	Managing Network and IP Address



Connecting Windows LAN and MacOS LAN

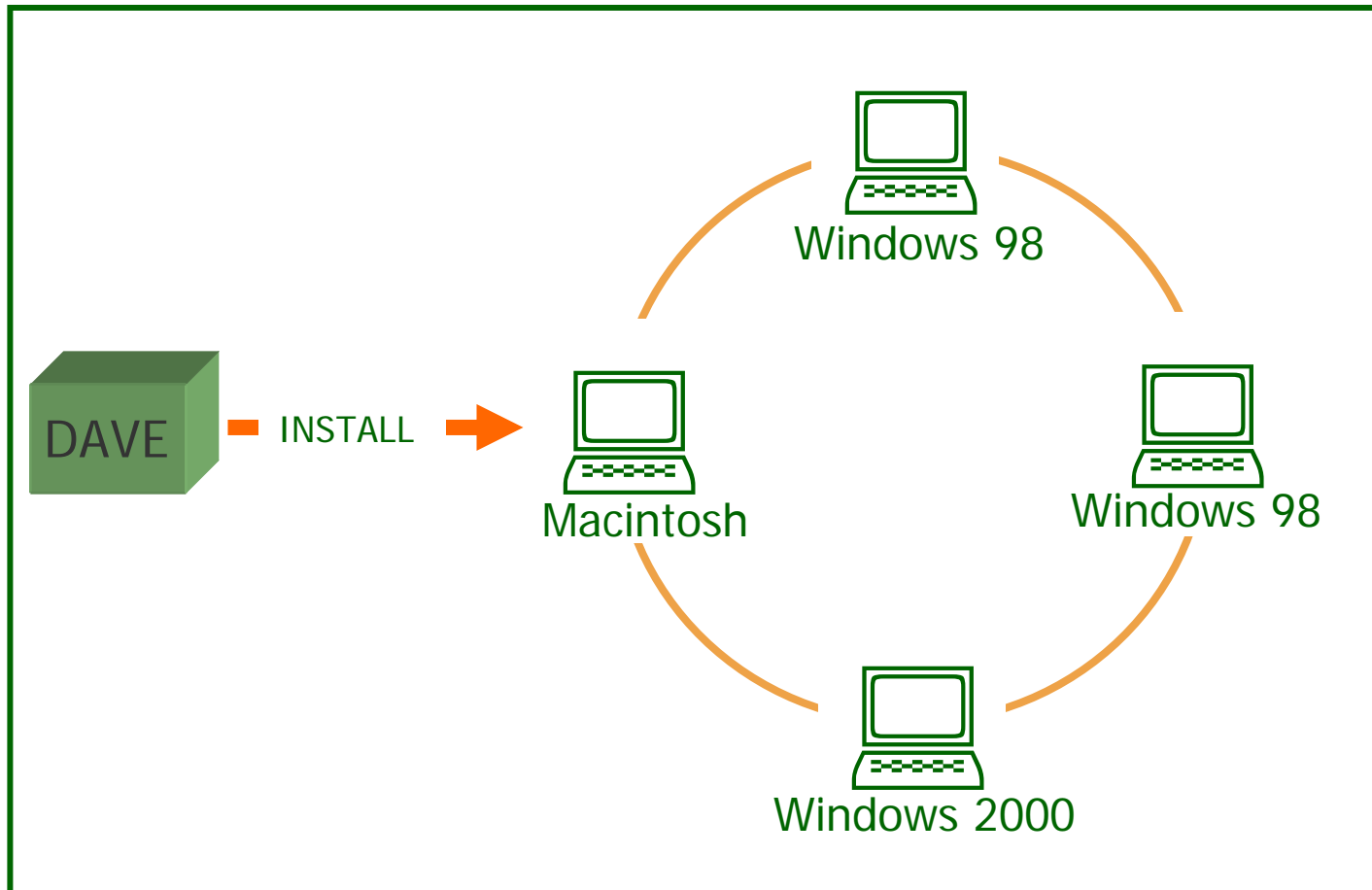
- ❑ The communication protocol used in Windows LAN is NetBEUI(NetBios), while the communication protocol used in MacOS is AppleTalk(EtherTalk).
- ❑ Besides using TCP/IP as the common communication protocol between the two LANs, we need other software installed to the system so as to share files, share printers and communicate between the two LANs.



Connecting Windows LAN and MacOS LAN

- ❑ In this case, we can either install a software named *Dave for Macintosh* in MacOS, or install the software *PC-MACLAN for Windows95/98 or WIN-MOUNTER* in Windows OS.

Connecting Windows LAN and MacOS LAN

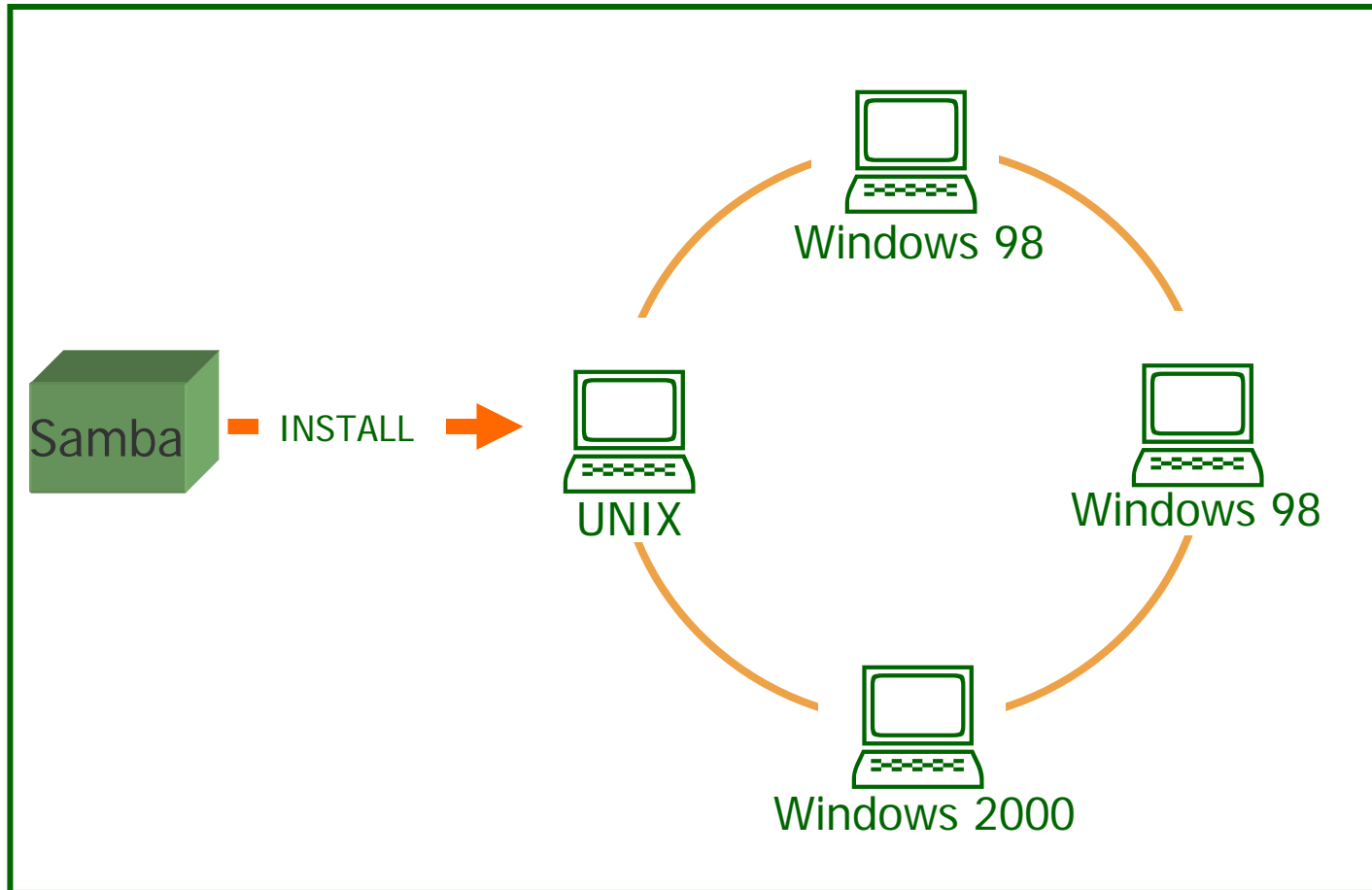




Connecting Windows LAN and UNIX LAN

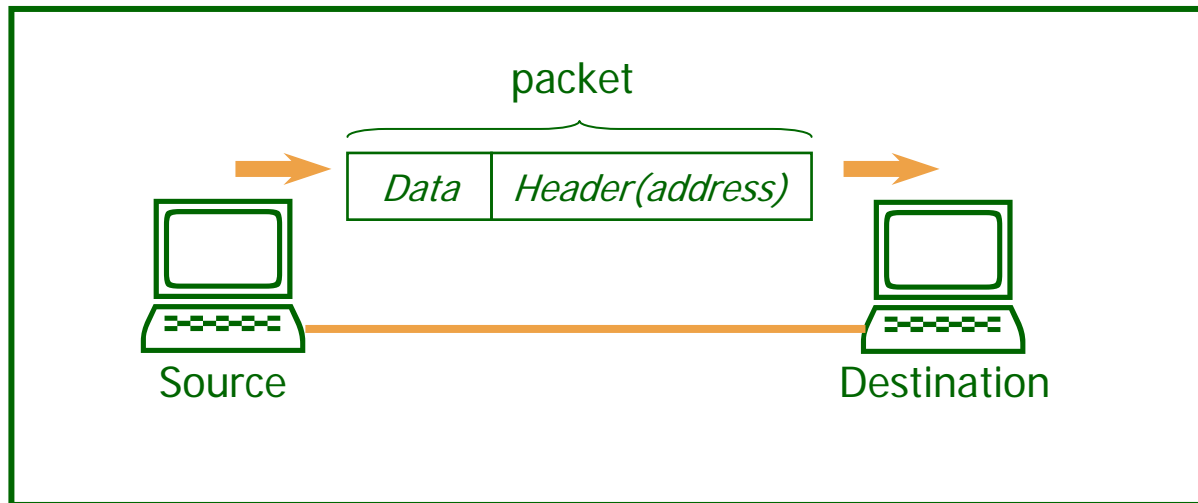
- ❑ In case of Windows LAN and UNIX LAN, we can install a software named *Samba* in UNIX, so that the two networks can be linked together.
- ❑ Samba is a freeware that you can download from the Internet.

Connecting Windows LAN and MacOS LAN



Use of Address

- ❑ To send data from one location to another through the network, an address should be attached to every transmitting packets.



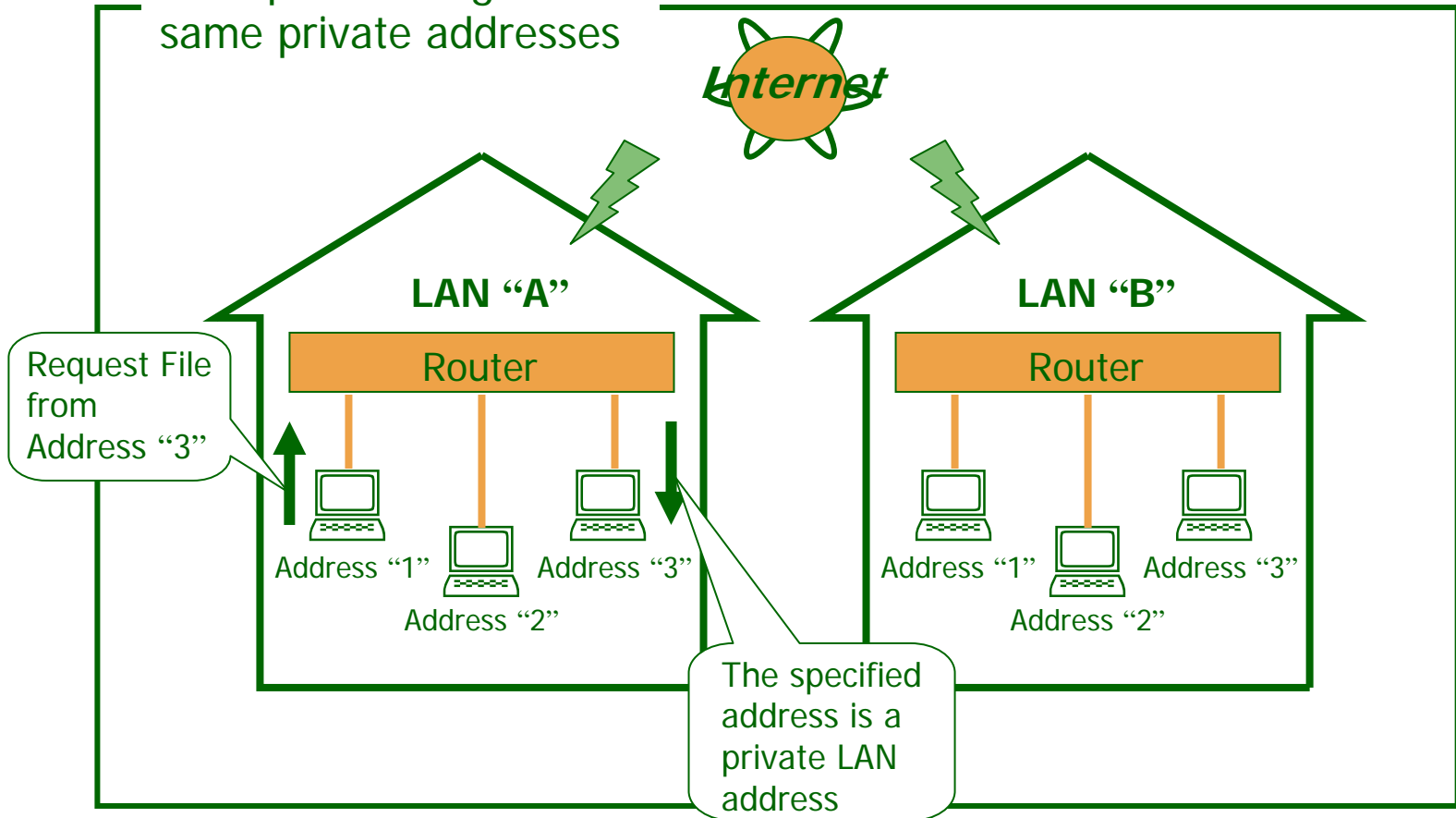


Use of Address

- ❑ There are two types of address, *Private Address* and *Global Address*.
- ❑ A private address is used to address a computer within a LAN. Thus, the same private addresses can be used in two separate LANs.
- ❑ A global address is used to address a computer in the Internet. This address should be unique.

Use of Address

Example of using the same private addresses





MAC, NetBIOS, AppleTalk and IP address

- ❑ In the world of Ethernet and Internet, every node is assigned an address.

- ❑ However, the formats of the address are different according to the different communication protocols used. Following shows the four main address formats:
 1. MAC address
 2. NetBIOS name
 3. AppleTalk address
 4. IP address



MAC, NetBIOS, AppleTalk and IP address

- ❑ MAC address is the address used to identify a terminal in an Ethernet. MAC address is assigned to every network hardware by the manufacturer. This address must be unique, and can never be changed.

Example of MAC address

08:00:5a : 1b:22:ca

Manufacturer Code –
It is assigned to each
manufacturer by IEEE.

Hardware Code – It is
assigned to each
hardware by the
manufacturer.



MAC, NetBIOS, AppleTalk and IP address

- ❑ NetBIOS name is used to identify a terminal in the Windows Network. It can be freely defined or changed in the OS under Control Panel -> System -> Computer Description.
- ❑ AppleTalk address is used to identify a terminal in the Macintosh Network. It composes of network ID and node ID. Unlike NetBIOS name, the AppleTalk address is automatically assigned by the system and is not allowed to be changed freely.

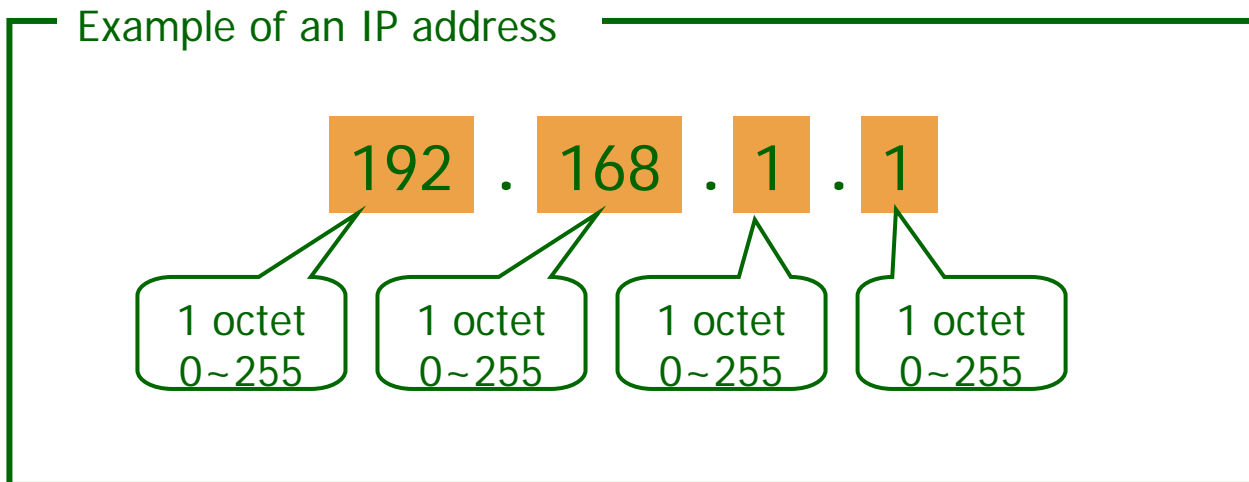


MAC, NetBIOS, AppleTalk and IP address

- ❑ IP address is used in Internet or WAN where TCP/IP communication protocol is used.
- ❑ An IP address must be assigned to a node/terminal so that files can be transferred through the network. And, this address must be unique.
- ❑ An IP address consists of 4 *octets* (each octet contains 8 bits), and each octet is separated by a dot “.”.

MAC, NetBIOS, AppleTalk and IP address

- Each octet, when represented in decimal number, is ranged from 0 to 255. Thus the smallest IP address is [0 . 0 . 0 . 0] and the largest IP address is [255 . 255 . 255 . 255].

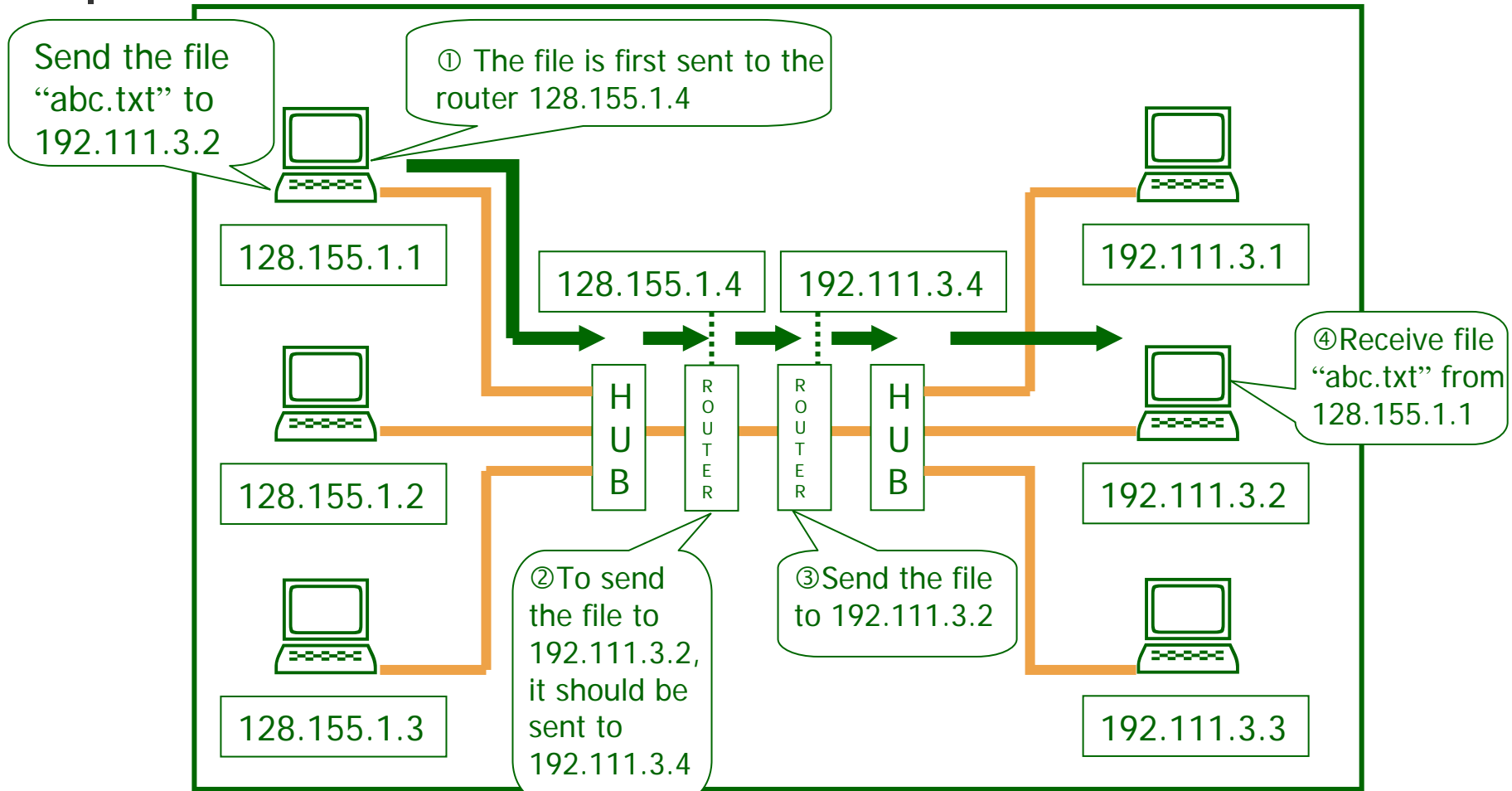




MAC, NetBIOS, AppleTalk and IP address

- ❑ IP address is divided into Private Address which can be freely assigned by user, and Global Address which cannot be freely assigned by user. The assignment of global address is restricted by *Network Information Center (NIC)*.
- ❑ Private addresses are usually used in LAN. In practice, the private IP address is assigned by network administrator.

MAC, NetBIOS, AppleTalk and IP address



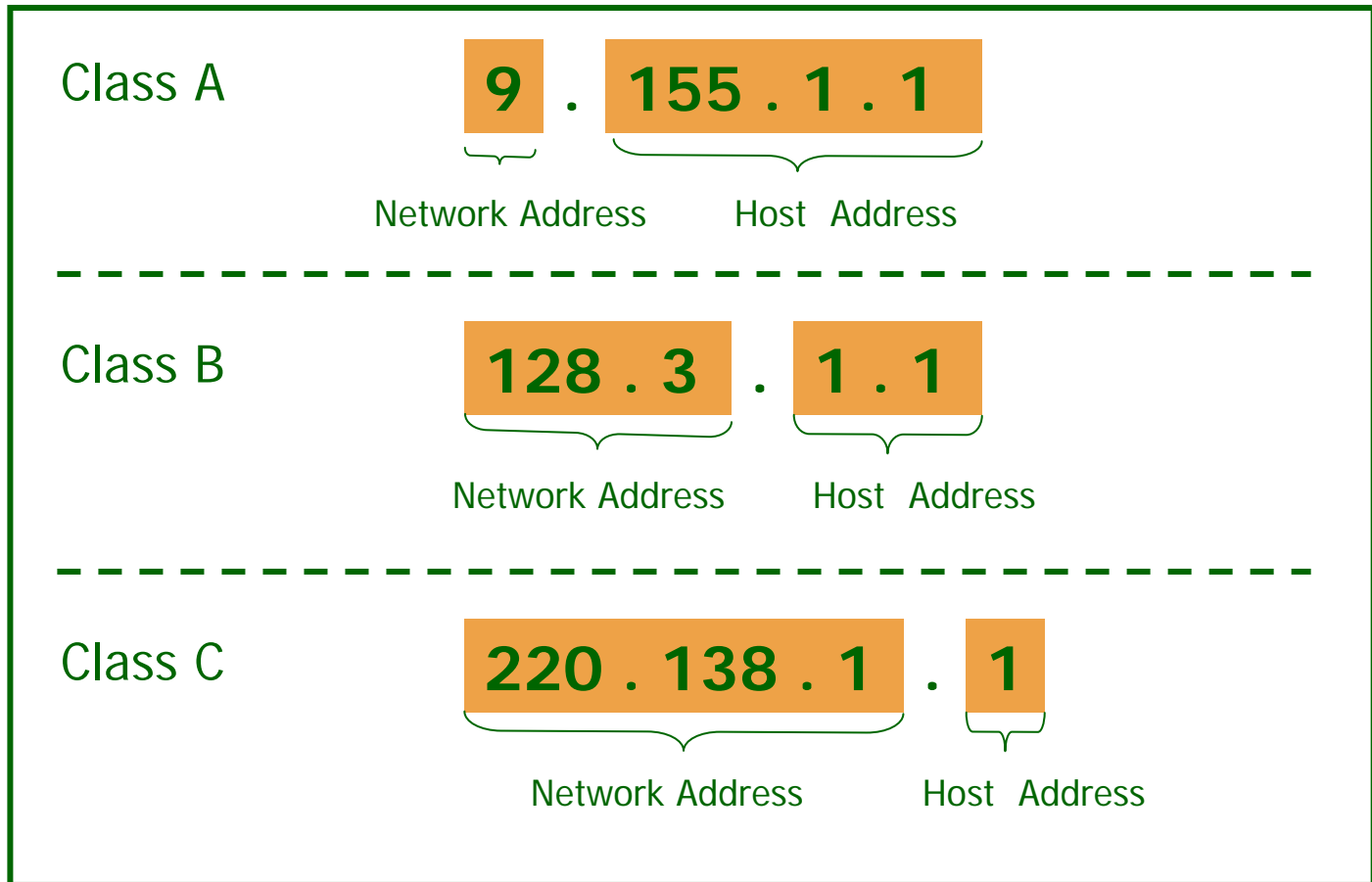


More about IP address

- ❑ Global IP addresses are divided into several classes, each class has different combination of *Network Address* and *Host Address*.
- ❑ The Network address is the fixed address which is issued to the company or organization by the NIC.
- ❑ The Host Address is the dynamic address which is assigned to the node by the company or organization.



More about IP address





More about IP address

- ❑ Class A IP addresses, with the first octet lies between 1 and 126, is assigned to all ISP or some global companies.
- ❑ Class B IP addresses, with the first octet lies between 128 and 191, are assigned to some large or medium scale companies or organizations.
- ❑ Class C IP addresses, with the first octet lies between 192 and 223, are assigned to some small scale companies or organization.



More about IP address

Class	Value of 1 st octet	Range of the IP address	Network address	No. of address allocation
A	1 ~ 126	1.0.0.0 ~ 126.0.0.0	First 1 octet	16,777,214
B	128 ~ 191	128.1.0.0 ~ 191.254.0.0	First 2 octets	65534
C	192 ~ 223	192.1.0.0 ~ 223.254.254.0	First 3 octets	254



More about IP address

- ❑ Each octet in the IP address can be a value between 0 and 255. But inside the host address, the values 0 and 255 are never used.
- ❑ The value 0 in the host address represents the network itself, while the value 255 in the host address represents the broadcast address.
- ❑ For example, NIC assigned a Class A IP address to IBM computers manufacturing company, and the first octet is given as 9, then no any other companies can use an IP address started with 9.



More about IP address

- ❑ In the above example, the addresses `9 . 0 . 0 . 0` and `9 . 255 . 255 . 255` are never used.
- ❑ No matter which class the address belongs to, or what value is assigned in each octet, every global IP address must be unique.
- ❑ Though private addresses are not unique, there are also some rules and classes in assigning private addresses in a LAN.

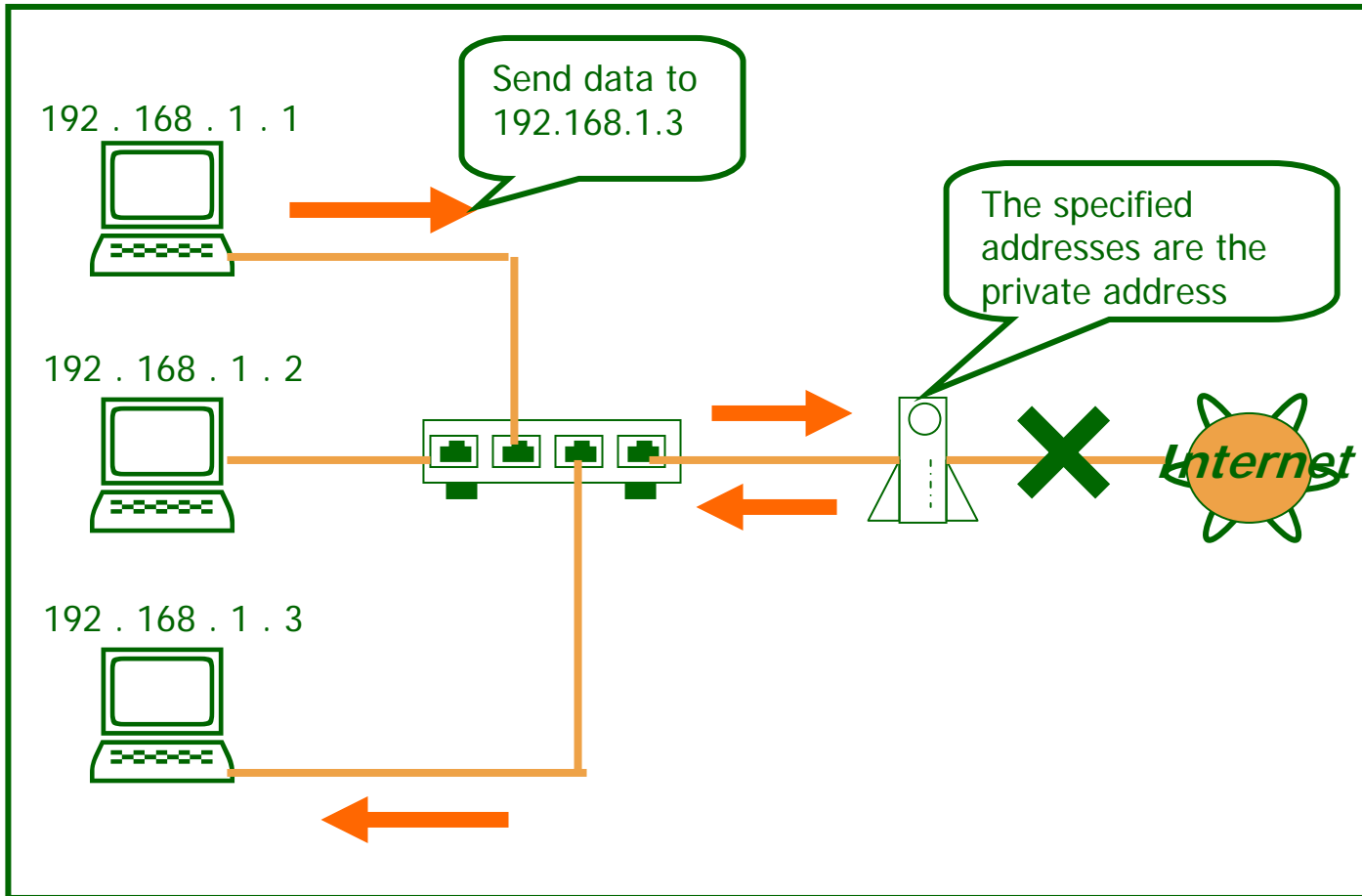


More about IP address

Class	IP address of the private address	Example
A	The first octet is “10”	10 . 1 . 1 . 1
B	The first two octet are “172 . 16” ~ “172 . 31”	172 . 16 . 1 . 1
C	The first three octet are “192 . 168 . 0” ~ “192 . 168 . 255”	192 . 168 . 1 . 1

- ❑ Private addresses can only be used within a LAN. Routers, dial up routers or repeaters have the power to distinguish a private address from a global address.

More about IP address



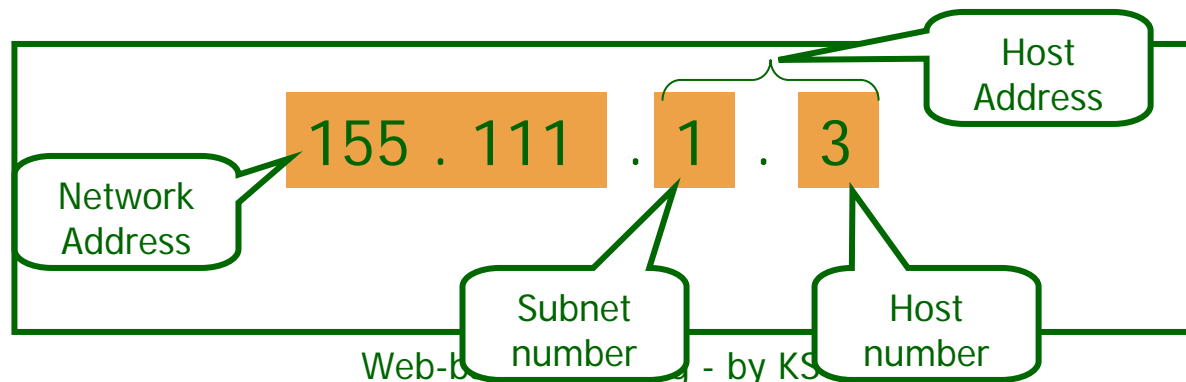


Subnetting

- ❑ When the number of terminals in a particular network is very large, e.g. 1000, then we can subdivide the whole LAN into several small LANs according to different departments, floors or rooms, so that the management is less difficult.
- ❑ Those small LANs are called *Subnets*. The subnets are connected together by routers.

Subnetting

- ❑ For example, if a company is given a class B IP address starting with “155 . 111”, then it can build three subnet with the first three octets set as “155 . 111 . 1”, “155 . 111 . 2” and “155 . 111 . 3”
- ❑ In this case, the third octet of the IP addresses, “1”, “2” and “3” are called subnet numbers.





NAT and IP Masquerade

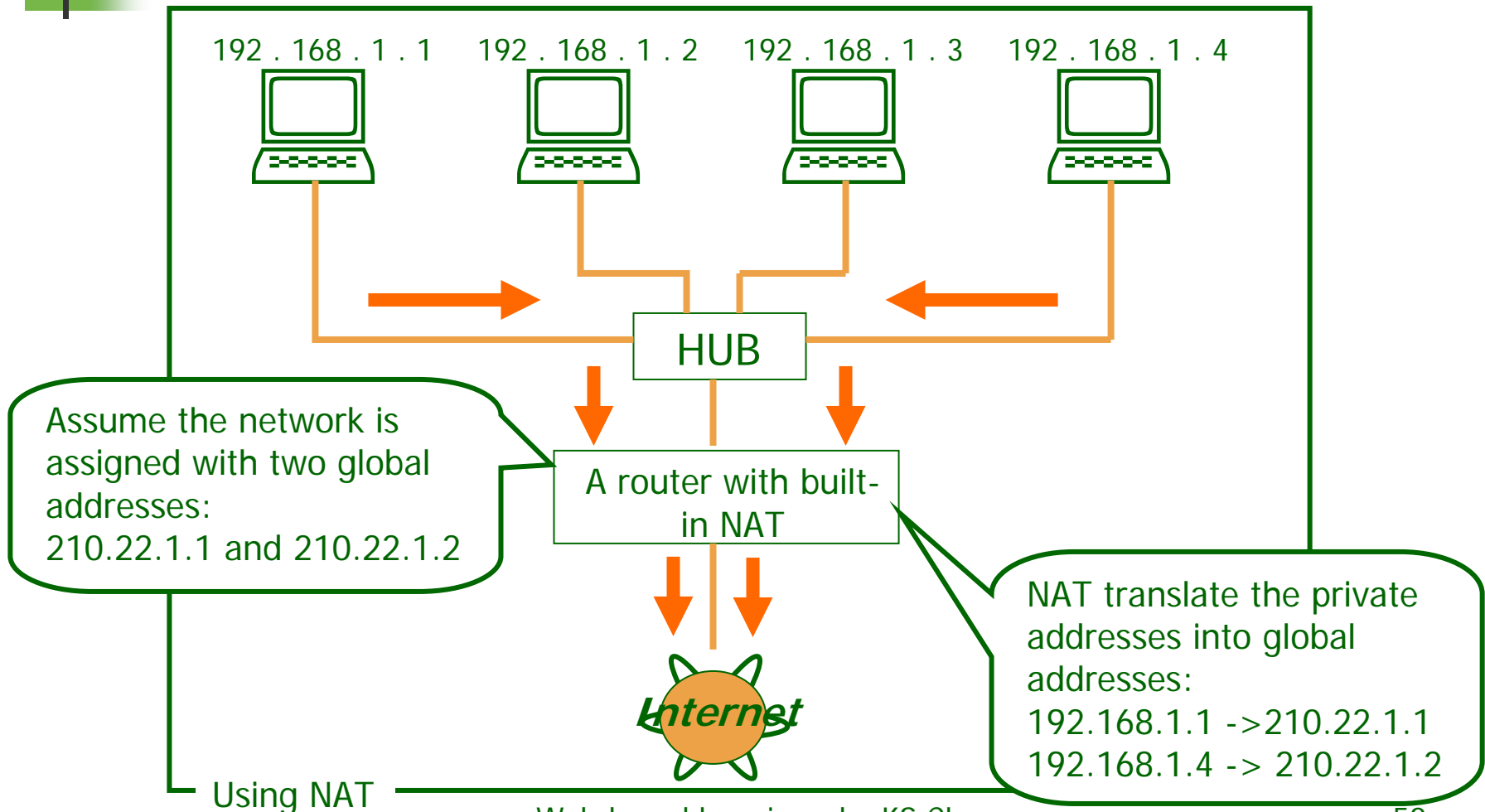
- ❑ NAT stands for Network Address Translator.
- ❑ It is a technique that allows switching a global address from one terminal to another.
- ❑ For example, if there are only two global addresses in a network, then NAT allows more than two terminals accessing the internet by switching the global address from one terminal to another.



NAT and IP Masquerade

- ❑ But, it should be noticed that the number of terminal accessing the internet at one time is still two.
- ❑ IP Masquerade is a technique that build-up a relationship between private addresses and global address.
- ❑ For example, if there are only two global addresses in a network, IP Masquerade allows more than two terminals accessing the internet at the same time.

NAT and IP Masquerade



NAT and IP Masquerade

