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Internet Protocol

IPv4

Internet Protocol version 4

IP v4 Stack

Application level(HTTP, FTP, PING, etc.)

Higher level Protocol(TCP, UDP)

Internet Protocol(IP)

Network Interface(Hardware)

IP header(v4)

Version(4)	Header length(4)	Type of Service(8)	Total length(16)	
Identification(16)			Flag(3)	Fragment Offset(13)
Time to live(8)		Protocol(8)	Header Checksum(16)	
Source IP address(32)				
Destination IP address(32)				
Options+Padding(variable)				
Data				

Total bits : 192 bit

IP Class

A Class (0x)	1.0.0.0 ~ 126.255.255.254
B Class (10x)	128.1.0.1 ~ 191.255.255.254
C Class (110x)	192.0.1.1 ~ 223.255.254.254
D Class (1110x)	224.0.0.0 ~ 239.255.255.255
E Class (1110x)	240.0.0.0 ~ 254.255.255.254

IP property

- Unstability
 - Packet loss, Duplicated packets
- Non-connectivity
 - Inversion of packet order
 - Do not form a certain connection

Reserved IP address

- Loop back address
 - 127.0.0.1
 - Points the host itself
- Subnet Mask
 - Pointing the entire network

Subnet Mask

- 255.255.255.255, 255.255.255.0, 255.255.0.0, 255.0.0.0
- 255.255.255.0 : 192.168.123.x
- 255.255.0.0 : 192.168.x.x
- If the result of AND bit operation between two addresses and a subnet mask, those two address belongs to same network

MTU(Maximum Transfer Unit)

- The size of packet that a router can transfer at one time
- When transferring larger packet than MTU, router uses fragment flags
- Normally 1500, MIN 68, MAX 65535

*Big Endian, Little Endian

- Big endian
 - Higher byte-> Starting memory address
 - Ex) sparcs.net, gura@sparcs.net
- Little endian
 - Lower byte-> Starting memory address
 - Ex) net.sparcs, net.sparcs@gura
 - NOT ten.scraps@arug

TCP

Transmission Control Protocol

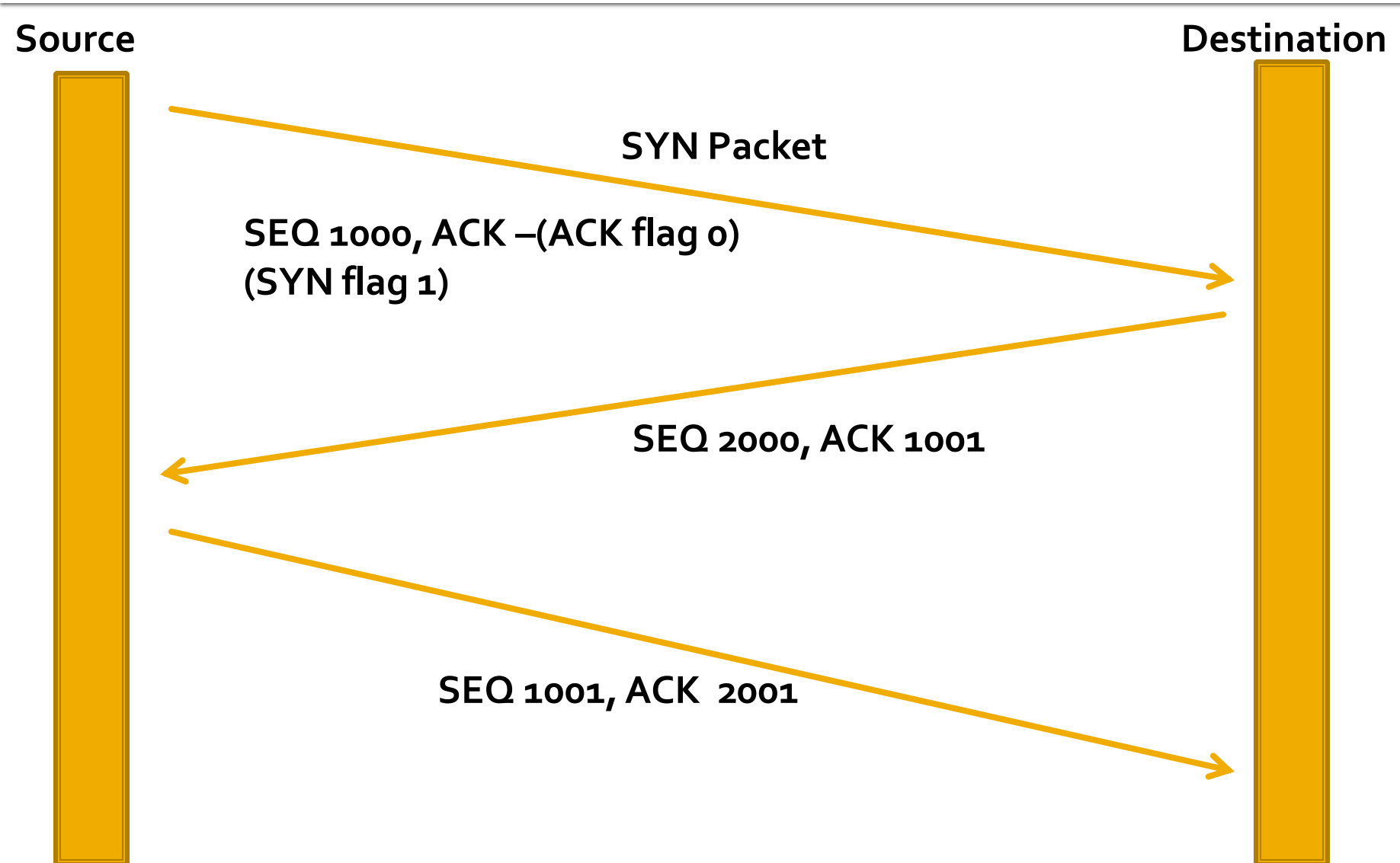
TCP Header

0~3	4~9	10	11	12	13	14	15	16~31
Source Port								Destination Port
SEQ								
ACK								
Header Length	Reserved	Urgent	ACK	Push	Reset	Synchronize	FIN	Window Size
Checksum								Urgent Point
Option(variable)								
Data Field								

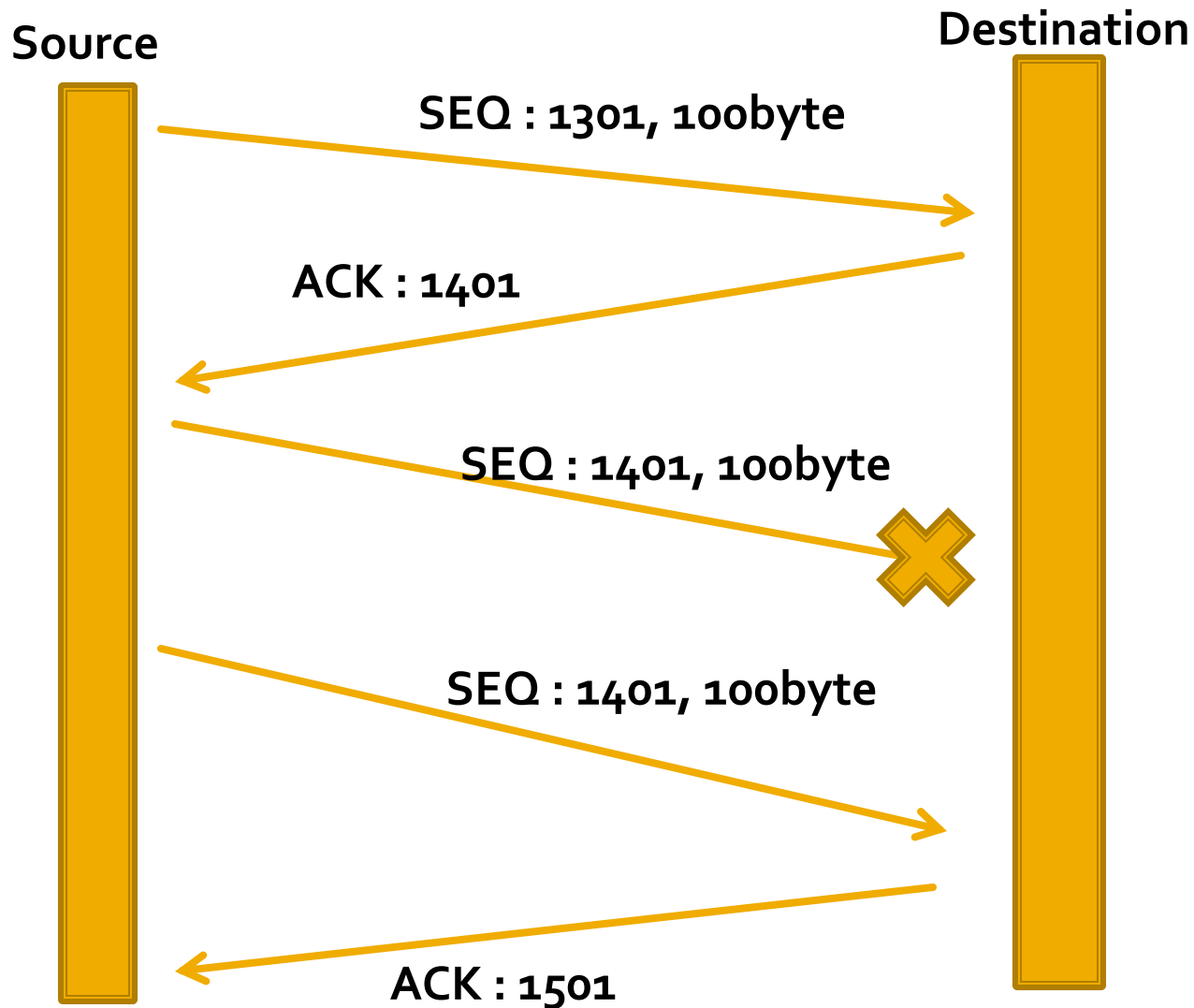
Port

- Distinguishes services of single host
- Packet is successfully delivered to certain process or services via ports
- Port is expressed by unsigned 2byte number
 - Range : 0~65535

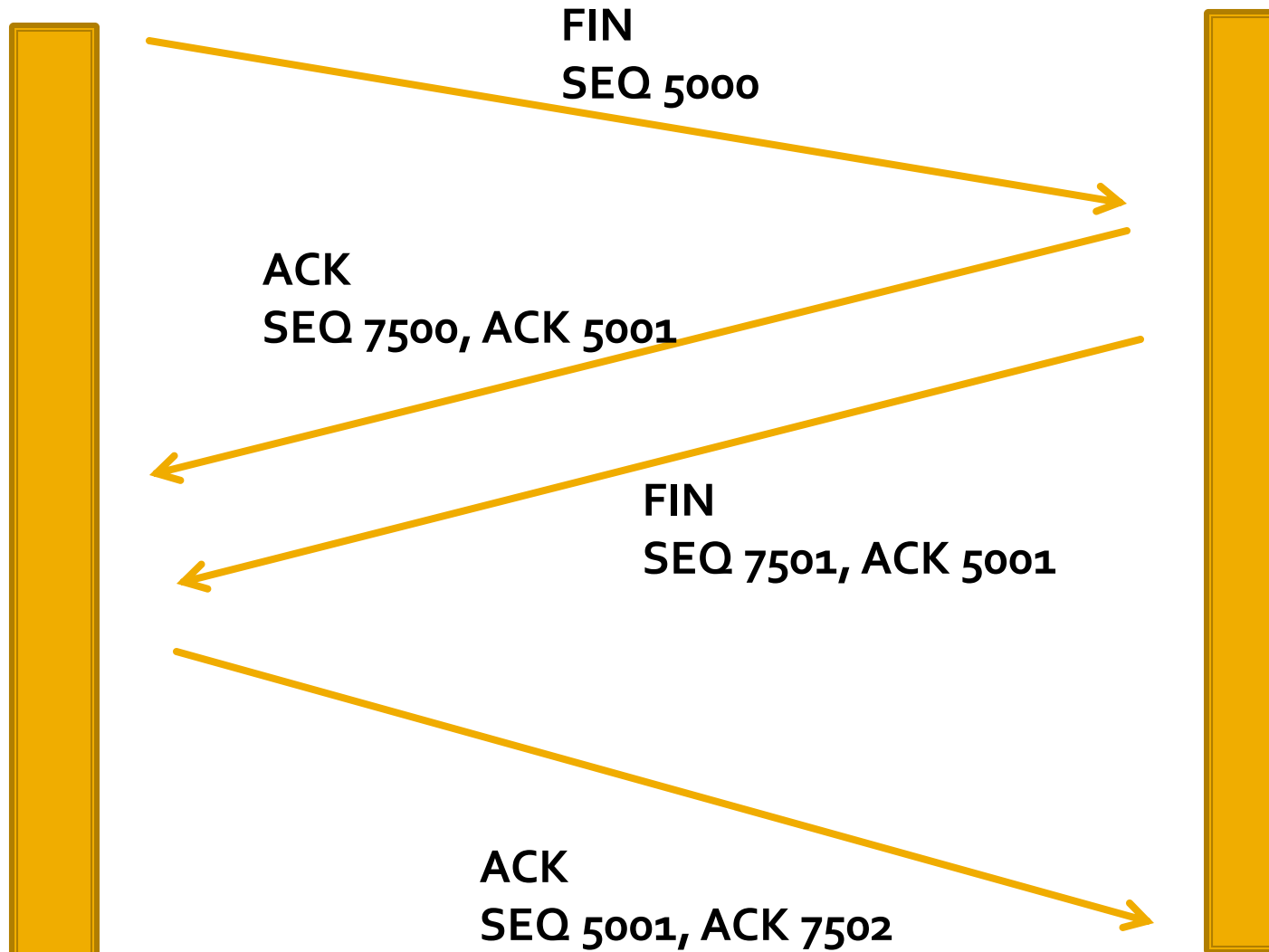
Connection Initialize(Sync)



Data Transmission



Finishing Connection



TCP Property

- Connectivity
 - Maintains connecting state between hosts
 - Guarantees packet order
- Stability
 - No loss or duplication of packets

UDP

User Datagram Protocol

UDP Header

Source Port(16)	Destination Port(16)
Length(16)	Checksum(16)
Data Field	

UDP Property

- Same as IP itself
- No fragmentation
- Supports Multicasting and Broadcasting

Broadcasting

- Destination address :
 - 255.255.255.255
- Any packet toward this address goes to EVERY hosts sharing same subnet mask

Multicasting

- Destination address : D class address
 - Some addresses are reserved for special use
- Any listener toward certain address can listen packets sent to certain multicast address

IPv6

Internet Protocol version 6

IPv6 Header

Version(4)	Traffic Class(8)	Flow Level(20)	
Payload Length(16)		Next Header(8)	Hop Limit(8)
Source Address(128)			
Destination Address(128)			
Extended headers			

IPv6 Extended Headers

- Hop-by-Hop Options
- Routing Header
- Fragment Header
- Destination Options Header
- Authentication Header
- Encapsulating Security Payload Header

IPv4 & IPv6

- IPv6 has more addresses
- IPv6 doesn't have a header checksum
 - In IPv4, header checksums should be recalculated while passing routers that changes TTL
- IPv6 doesn't support Broadcasting
- IPv6 multicast address
 - FFoo::/8
 - FFoo:0000:XXXX:XXXX:XXXX:XXXX:XXXX:XXXX
- IPv6 extension headers are not processed

IPv4 <-> IPv6 Transition Techs

Dual Stack

Application level(HTTP, FTP, PING, etc.)

Higher level Protocol(TCP, UDP)

IPv4 | IPv6

Network Interface(Hardware)

Tunneling

- Encapsulate IPv6 packet into IPv4 packet
- Encapsulated packet is delivered by IPv4 network
- Used when there exists IPv4 network between two IPv6 hosts

IPv4 mapping

- IPv4 address is mapped into ::FFFF:(IPv4 address)
 - Ex) ::FFFF:192.168.0.1 (as binary bits)
- Used when most network is IPv6 and few hosts use IPv4

Bibliography

- RFC 675
- RFC 793
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 - Port numbers and Assigned multicast addresses
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- RFC4291
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