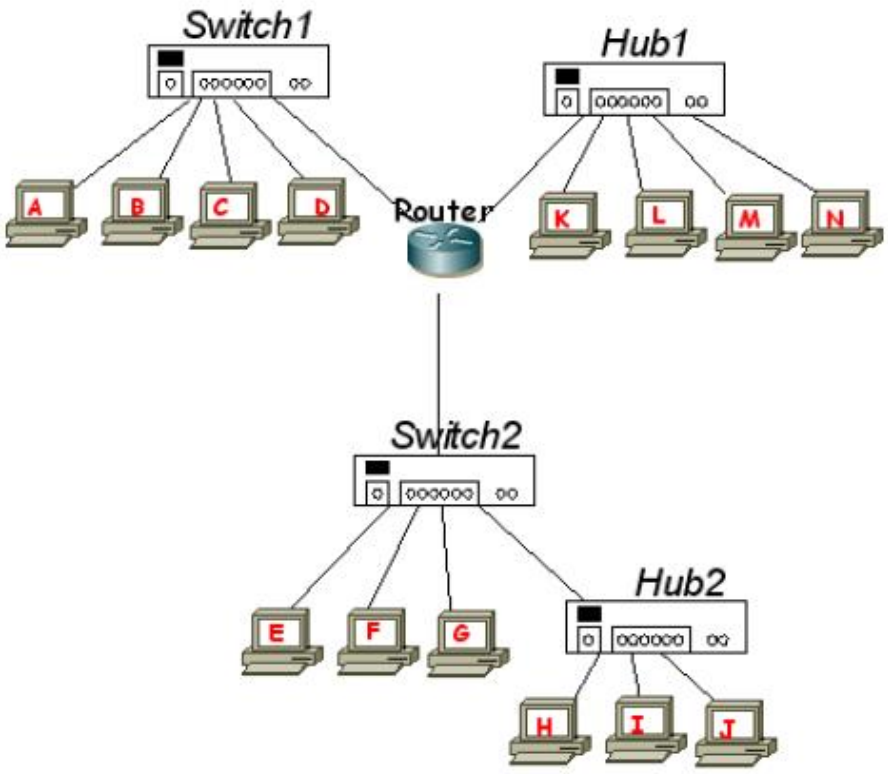
1. Suppose nodes A and B are on the same 10 Mbps Ethernet segment, and the propagation delay between the two nodes is 225 bit times. Suppose node A begins transmitting a frame, and before it finishes, node B begins transmitting a frame. Can node A finish transmitting before it detects that node B has transmitted?

2. We have a 10 MBit/s CSMA/CD LAN with a length of 50 m. The speed of the signal within the transmission medium is $2 \cdot 10^8$ m/s.
   a.) What is the maximum time till a sending station observes a collision?
   b.) What is the minimal frame length necessary for this LAN

3. Given the topology shown in the figure:



All network adapters used are Ethernet based. We assume that the router is properly configured and working; we also suppose that the switches know the location of all machines.
Answer the following questions:

a) How many broadcast domains are there? Show them on the figure.

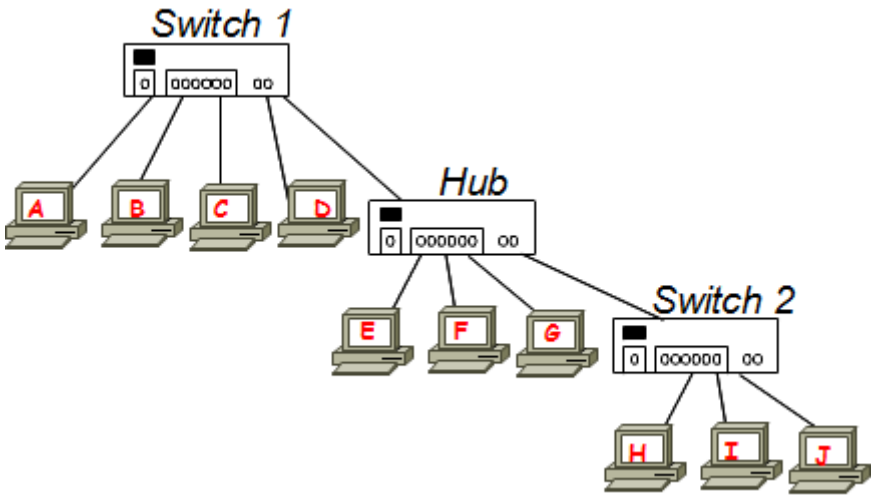
b) If J performs a broadcast, which hosts will receive a copy of the frame?

c) If K sends a datagram to J, which network card will receive a copy of the frame containing the datagram?

d) The computer E starts sending frames to H. Moments later, J initiates sending to I; is there a possibility of a collision occurring? Explain why.

e) Is it possible to have simultaneously a transfer from A to B, one from C to J and another from E to F? Explain why.

4. Given the topology shown in the figure:



All network adapters used are Ethernet based. We assume the switches know the location of all machines.

a) If A performs a broadcast, which hosts will receive a copy of the frame?

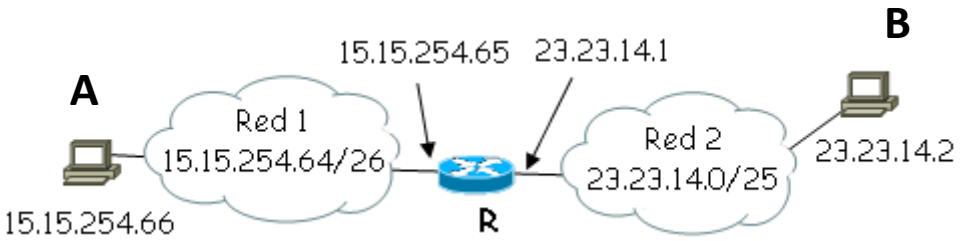
b) If A sends a datagram to J, which network card will receive a copy of the frame containing the datagram?

c) The computer B starts sending frames to E. Moments later G initiates sending to H; is there a possibility of a collision occurring? Explain why.

d) The computer B starts sending frames to E. Moments later C initiates sending to J; is there a possibility of a collision occurring? Explain why.

e) Is it possible to have simultaneously a transfer from A to B, one from D to G and another from I to J? Explain why.

5. Consider the configuration in the following Figure:



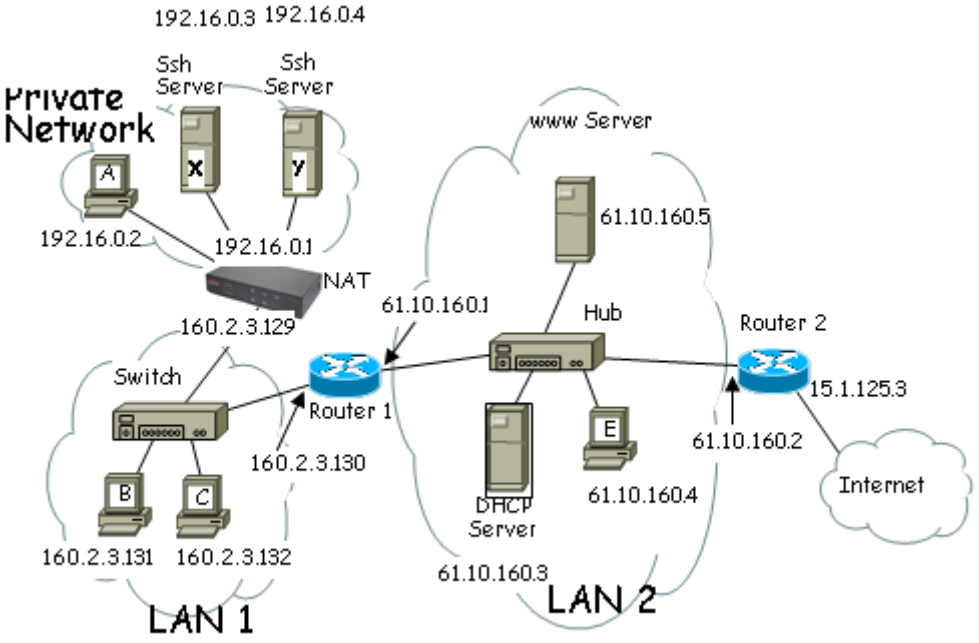
a) In the table below, write the header fields of each frame generated in LAN 1 and 2 when **A** sends an IP datagram to **B**. **A** only knows **B** IP address (but not **B** MAC address). All ARP caches are empty.

MAC Header			IP Header		
Source MAC address	Destination MAC address	Protocol	Source IP address	Destination IP address	Packet function

b) If LAN 1 uses private IP addresses (10.0.0.0/26) and router R is a NAT router, write the header fields of each frame generated in LAN 1 and 2 when **A** sends an IP datagram to **B**. **A** only knows **B** IP address (but not **B** MAC address). All ARP caches are empty. The new address of A is 10.0.0.1

MAC Header			IP Header		
Source MAC address	Destination MAC address	Protocol	Source IP address	Destination IP address	Packet function

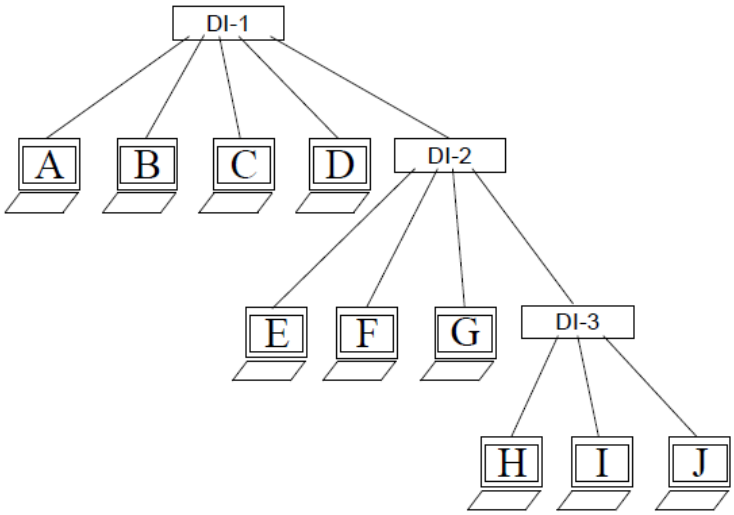
6. Consider the configuration in the following Figure:



a) Computer **A** wants to establish a TCP connection with the **Web Server**. In the table below, write the header fields of each frame that the network the interface of computer E receives as a consequence of this process the **Web Server** receives the TCP connection sent by **A**. **A** only knows **Web Server** IP address (but not **Web Server** MAC address). All ARP caches are empty.

MAC Header			IP Header		
Source MAC address	Destination MAC address	Protocol	Source IP address	Destination IP address	Packet function

7. In the following diagram, DI-1, DI-2, and DI-3 are interconnection devices (Router, Switch, and/or Hub). Indicate which interconnection device isD1-1, DI-2, and DI-3 in each of the following cases:



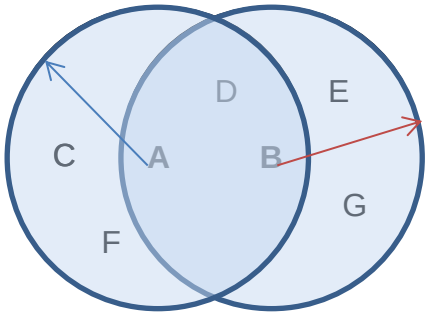
a) If A sends a frame to J, E, F, G and J will receive a copy of the frame

b) If A performs a broadcast, B, C, D, and DI-2 will receive a copy of the frame. Moments later, H sends a frame to A, and only A receives the frame

c) B starts sending a frame to I; at the same time, J starts sending a frame to B, in such a way that B is sending and receiving simultaneously. Both I and B receive a copy of the original frame without collisions.

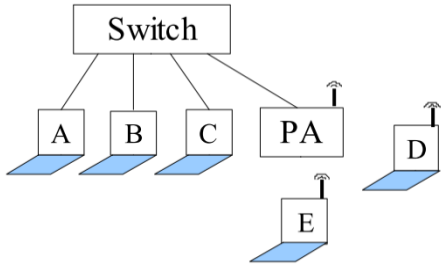
d) There is a transfer from A to B, and simultaneously one from D to G, and another from I to J. A collision occurs, and is received by hosts: E,F,G,H,I, and J.

8. The following figure shows the physical distribution of several wireless stations.



a) If A initiates a transfer to B, what stations can cause the problem of "hidden station"?
b) The RTS / CTS protocol solves this problem. Explain how the protocol operates, specifically indicating which stations receive the RTS and which the CTS frames.

9. The network in the figure below consists of an Ethernet switch that connects computers A, B, C, and the wireless access point PA. At this access point mobile stations D and E are associated. The switch knows the complete network configuration. ARP caches of all systems have the necessary information. Describe the frame or frames that are generated, in the following cases, until they reach the desired destination (to indicate the physical address of a device, use the name of that device: A, B, Switch, PA,…):



a) A sends a frame to B

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

b) A sends a frame to E

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

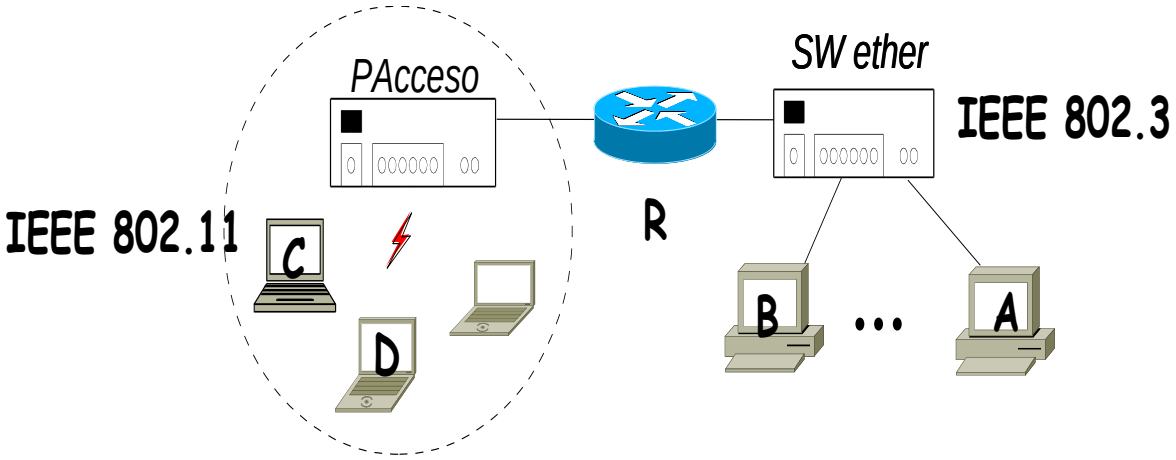
c) D sends a datagram to A

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

d) D sends a datagram to E

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

10. Consider the configuration in the following Figure:



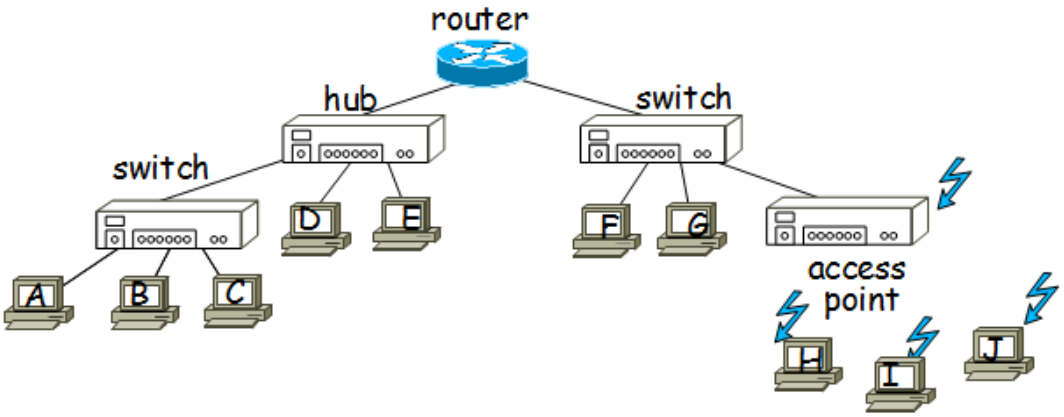
a) In the table below, write the indicated header fields of each frame when **A** sends an IP datagram to **D**. Only the ARP cache of **A** has all the necessary information for the transmission. ARP caches of other stations are empty. C and D are associated to the access point. Indicate the frames that arrive at the network interface of C.

Nº	Address 1	Address 2	Address 3

b) Function of the frame and type of information in its data field.

c) Indicate if the network card (C) processes or discards the frame and the maximum level in the network architecture that analyzes the received information.

11. Given the topology shown in the figure:



At this access point mobile stations H, I and J are associated. The switch knows the complete network configuration. Only the ARP cache of **A** has all the necessary information for the transmission. ARP caches of other stations are empty.

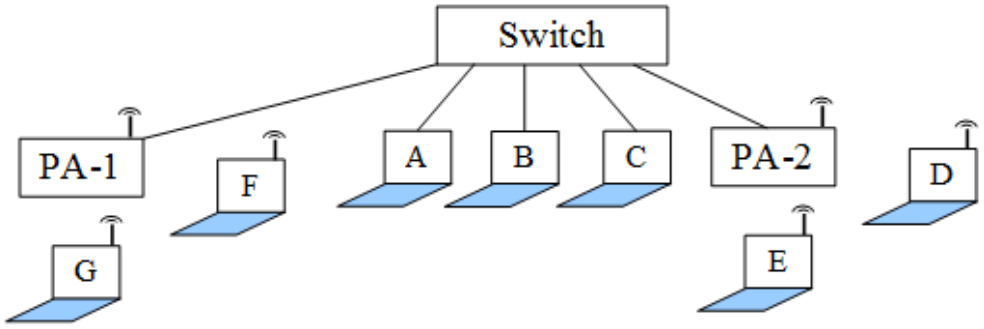
a) How many broadcast domains are there? Show them on the figure.

b) Computer A starts sending frames to D. Moments later C initiates sending to E; is there a possibility of a collision occurring? Explain why.

c) In the table below, write the indicated header fields of the frames that reach the network interface of D, when **A** sends an IP datagram to **J.** (to indicate the physical address of a device, use the name of that device: A, B, Switch, PA, ...)

Nº	Address 1	Address 2	Address 3

12. Given the topology shown in the figure:



At the access point 1 (PA-1) mobile stations G, and F are associated; they can sense Access Point 1 but cannot sense each other. At Access Point 2 (PA-2) mobile stations E, and D are associated; they can sense Access Point 2 but cannot sense each other. The switch knows the complete network configuration. ARP caches of all systems have the necessary information for the transmission.
Describe the frame or frames that are generated, in the following cases, until they reach the desired destination (to indicate the physical address of a device, use the name of that device: A, B, Switch, PA, ...):

a) A sends a frame to B

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

b) A sends a frame to G

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

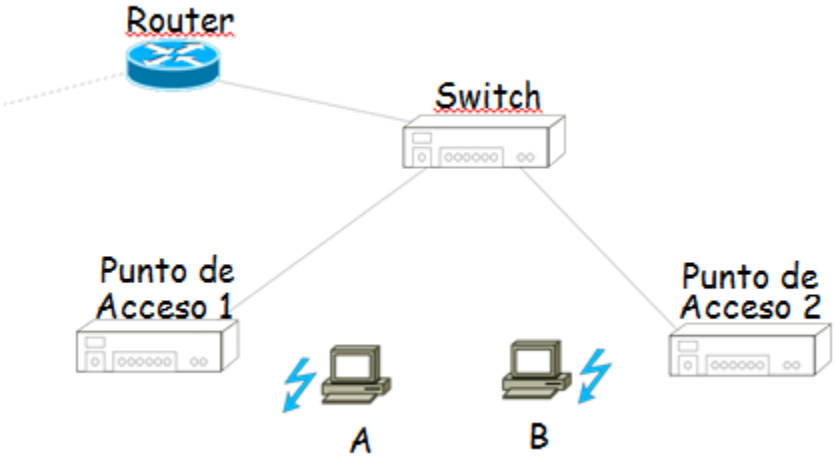
c) D sends a datagram to D

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

d) D sends a datagram to G

Nº	Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3

13. Given the topology shown in the figure:

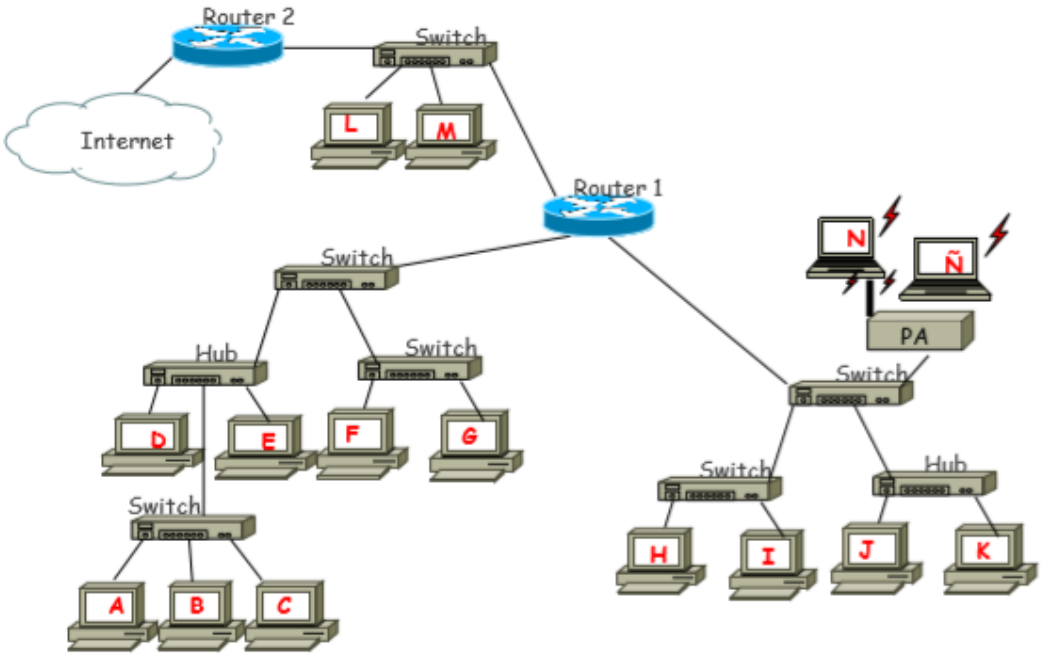


At access point 1 (PA-1) mobile station A is associated. At Access Point 2 (PA-2) mobile station B is associated. The switch knows the complete network configuration. ARP caches of all systems are empty.

In the table below, write the frame or frames that are generated, when computer A sends an ICMP message of echo request to computer B. To indicate the physical address of a device, use the name of that device: A, B, Switch, PA, ...

	MAC Header				Related IP Addresses			
Type of Frame (Ethernet or 802.11)	Dest. Ad. or Ad. 1	Source Ad. or Ad. 2	Ad. 3	Protocol	Source IP address	Destination IP address	Host that receives a copy of the frame	Packet function

14. Given the topology shown in the figure:



All network adapters used are Ethernet based. We assume that the router is properly configured and working; we also suppose that the switches know the location of all machines. At the access point PA are associated mobile stations N and Ñ, and they can not sense each other. ARP caches of all systems are empty.

Answer the following questions:

a) The computer L starts sending frames to J. Moments later M initiates sending to K; is there a possibility for a collision to occur? Explain why.
b) The computer N starts sending frames to H. Moments later Ñ initiates sending to G; is there a possibility for a collision to occur? Explain why.
c) How many broadcast domains are there? Show them on the figure.
d) If F performs a broadcast, which hosts will receive a copy of the frame?
e) In the table below, write the header fields of each frame generated when N sends a IP datagram to E.

MAC Header			IP Header		
Source MAC address	Destination MAC address	Protocol	Source IP address	Destination IP address	Packet function