Computer Science CSCI 251

Systems and Networks

Dr. Peter Walsh
Department of Computer Science
Vancouver Island University
peter.walsh@viu.ca

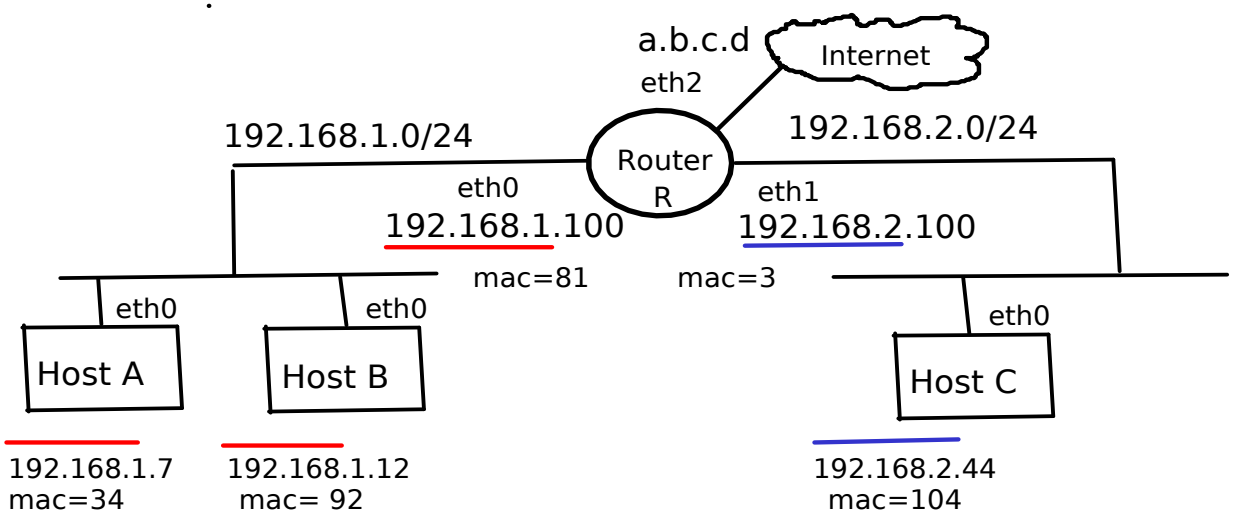
Internet Communication

Host to Host communication over the internet can be modelled using the 4-tuple: source ip address (`SRC IP`), source mac address (`SRC MAC`), destination ip address (`DEST IP`) and destination mac address (`DEST MAC`).

For Host X to communicate with Host Y, Host X must know:

- X's `SRC IP`
- X's `SRC MAC`
- Y's `DEST IP`

Host X to Host Y Communication



Host A's Routing Table

Network	Gateway	Interface
192.168.1.7	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
0.0.0.0	192.168.1.100	eth0

Router R's Routing Table

Network	Gateway	Interface
192.168.1.100	0.0.0.0	lo
192.168.2.100	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
192.168.2	0.0.0.0	eth1
0.0.0.0	a.b.c.d	eth2

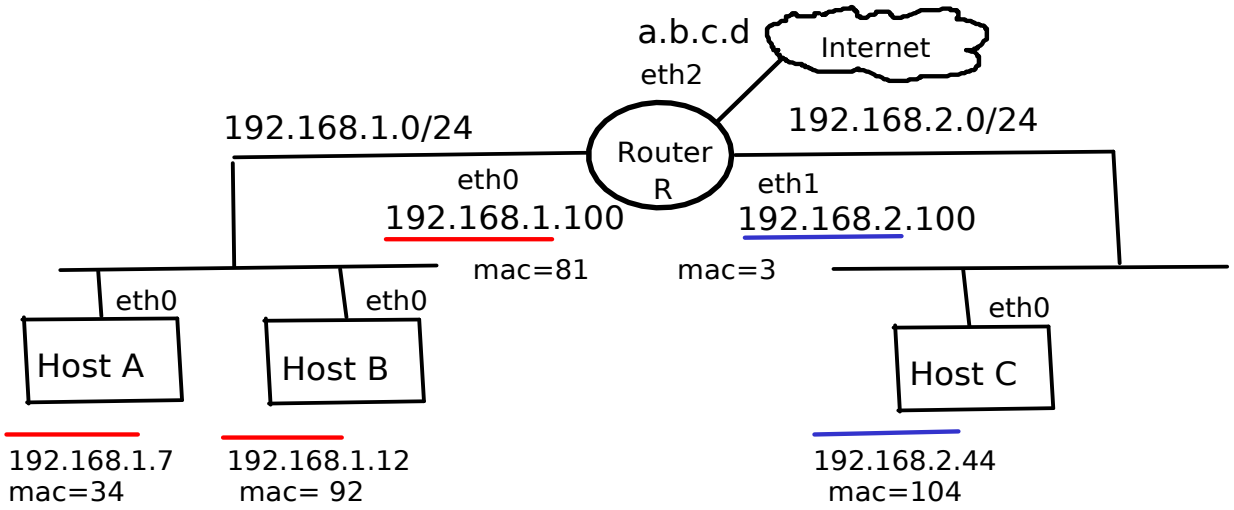
ARP

Address Resolution Protocol (ARP) is a procedure for mapping an ip address to a mac address on a LAN. Use ARP to "request" a `DEST MAC` as necessary. `DEST MAC` is determined as follows:

```
if X and Y have the same network prefix (sub-net) then
   DEST MAC <-  Y's mac address
else
   DEST MAC <- gateway mac address
```

IP address can be resolved using ARP. Once an ip address is resolved, the resulting ip-address/mac-address pair can be (dynamically) stored in an ARP cache for future reference.

Host A to Host B Communication



Host A's Routing Table

Network	Gateway	Interface
192.168.1.7	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
0.0.0.0	192.168.1.100	eth0

Router R's Routing Table

Network	Gateway	Interface
192.168.1.100	0.0.0.0	lo
192.168.2.100	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
192.168.2	0.0.0.0	eth1
0.0.0.0	a.b.c.d	eth2

Host A to Host B Communication cont.

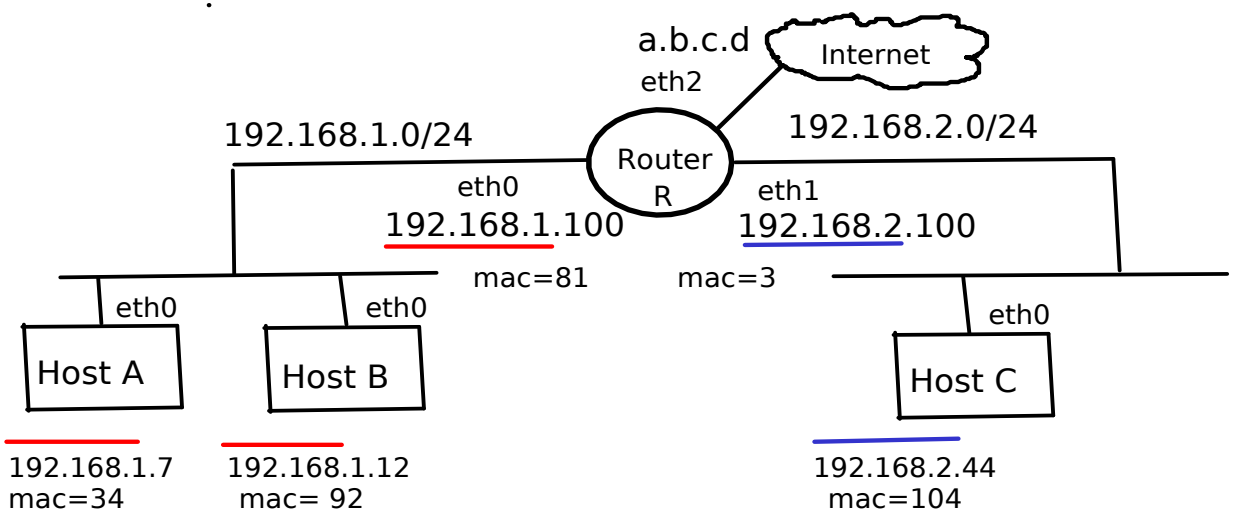
- transmit 1 udp packet from A to B
- assume ARP caches are initially cleared

A – B

	SRC IP	SRC MAC	DEST IP	DEST MAC
ARP Request	192.168.1.7	34	192.168.1.12	bc
ARP Reply	192.168.1.12	92	192.168.1.7	34
Message	192.168.1.7	34	192.168.1.12	92

bc = mac broadcast

Host A to Host C Communication cont.



Host A's Routing Table

Network	Gateway	Interface
192.168.1.7	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
0.0.0.0	192.168.1.100	eth0

Router R's Routing Table

Network	Gateway	Interface
192.168.1.100	0.0.0.0	lo
192.168.2.100	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
192.168.2	0.0.0.0	eth1
0.0.0.0	a.b.c.d	eth2

Host A to Host C Communication cont.

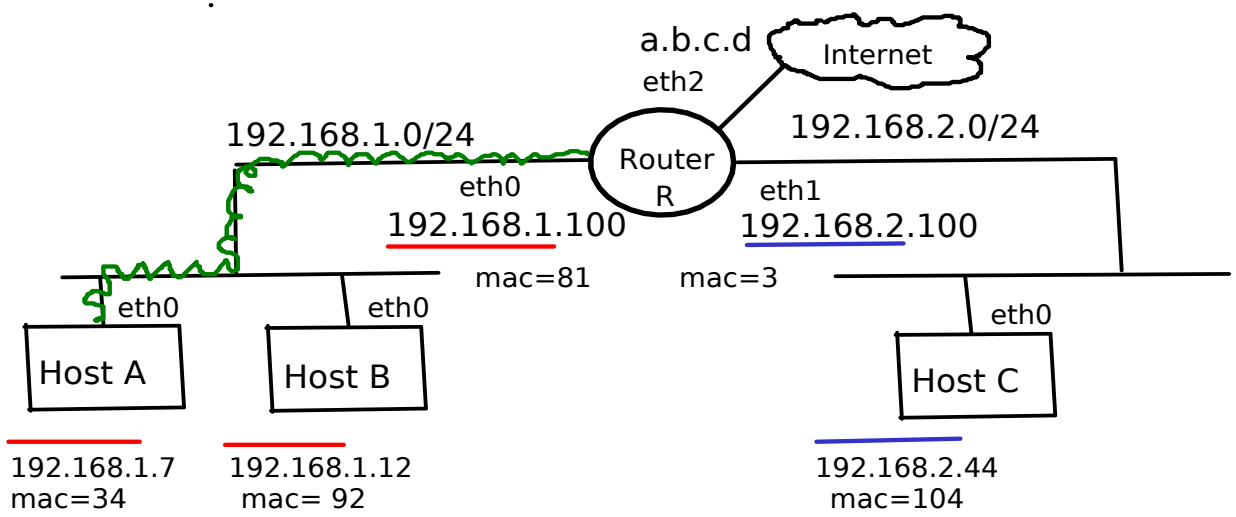
- transmit 1 udp packet from A to C
- assume ARP caches are initially cleared

A – R

	SRC IP	SRC MAC	DEST IP	DEST MAC
ARP Request	192.168.1.7	34	192.168.1.100	bc
ARP Reply	192.168.1.100	81	192.168.1.7	34
Message	192.168.1.7	34	192.168.2.44	81

bc = mac broadcast

Host A to Host C Communication cont.



Host A's Routing Table

Network	Gateway	Interface
192.168.1.7	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
0.0.0.0	192.168.1.100	eth0

Router R's Routing Table

Network	Gateway	Interface
192.168.1.100	0.0.0.0	lo
192.168.2.100	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
192.168.2	0.0.0.0	eth1
0.0.0.0	a.b.c.d	eth2

Host A to Host C Communication cont.

- transmit 1 udp packet from A to C
- assume ARP caches are initially cleared

A-R

	SRC IP	SRC MAC	DEST IP	DEST MAC
ARP Request	192.168.1.7	34	192.168.1.100	bc
ARP Reply	192.168.1.100	81	192.168.1.7	34
Message	192.168.1.7	34	192.168.2.44	81

R-C

ARP Request	192.168.2.100	3	192.168.2.44	bc
ARP Reply	192.168.2.44	104	192.168.2.100	3
Message	192.168.1.7	3	192.168.2.44	104

bc = mac broadcast

Host A to Host C Communication cont.

- transmit 1 udp packet from A to C
- assume ARP caches are initially cleared

A-R

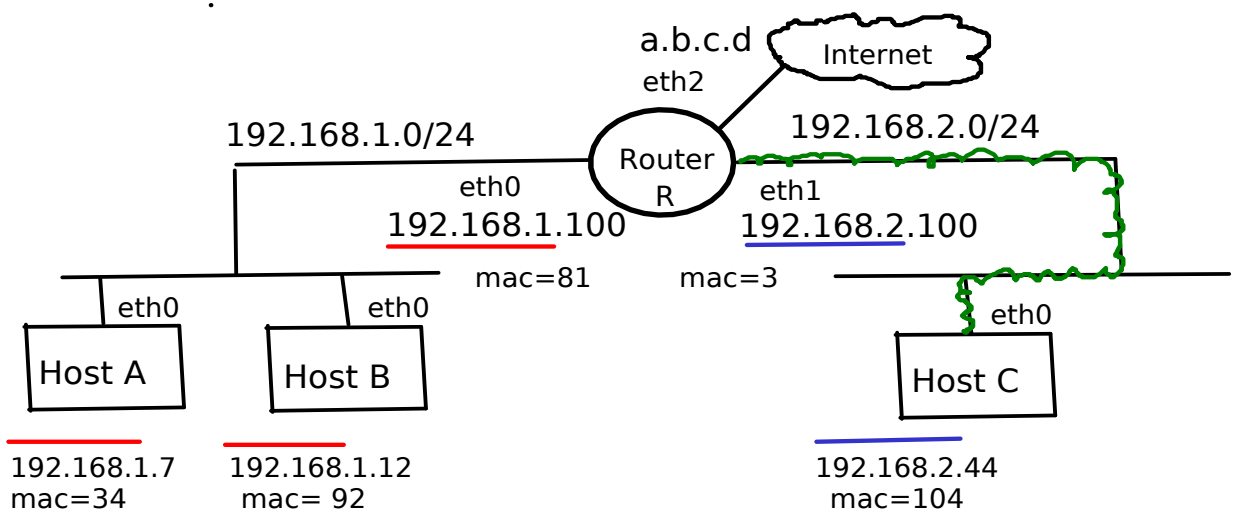
	SRC IP	SRC MAC	DEST IP	DEST MAC
ARP Request	192.168.1.7	34	192.168.1.100	bc
ARP Reply	192.168.1.100	81	192.168.1.7	34
Message	192.168.1.7	34	192.168.2.44	81

R-C

ARP Request	192.168.2.100	3	192.168.2.44	bc
ARP Reply	192.168.2.44	104	192.168.2.100	3
Message	192.168.1.7	3	192.168.2.44	104

bc = mac broadcast

Host A to Host C Communication cont.



Host A's Routing Table

Network	Gateway	Interface
192.168.1.7	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
0.0.0.0	192.168.1.100	eth0

Router R's Routing Table

Network	Gateway	Interface
192.168.1.100	0.0.0.0	lo
192.168.2.100	0.0.0.0	lo
192.168.1	0.0.0.0	eth0
192.168.2	0.0.0.0	eth1
0.0.0.0	a.b.c.d	eth2

Communication Data Structures

- Static
  - routing tables (as discussed in this lecture)
- Dynamic
  - switch data structures
  - arp caches
  - routing tables using RIP or OSPF