IP Routing

An Administrator's Survival Guide

Overview

- IP routing is very simple, that's why is works so well
- The "I" in IP stands for Internet
  - The key here is **inter**, this implies a way of connecting a number of networks
  - Each IP address is made up of two parts: **Network** and **Node**
  - Subnet masks are used to define the split between the Network and Node portions
- This guide will only use IP-v4 examples (not IP-v6)

Network – Node Split

- IP-v4 address consists of 32 bits
- The first <n> bits are the network portion
- The remainder are the node portion
- These 32 bits are usually written as 4 octets

  (e.g. 10.1.1.2)

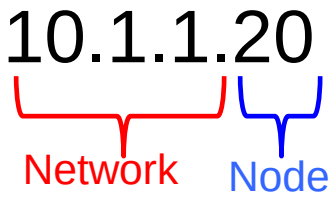
Network – Node Split (cont.)

- The ‘split’ point is defined by the network mask
- If no netmask is given, it is assumed based on address class *(for this guide we will always declare a netmask)*

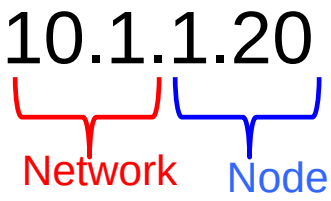
Netmask examples

Consider s01's IP address: 10.1.1.20/24

- The ***/24*** sets the netmask at 24 bits, or 255.255.255.0



If we change the netmask to 16 (255.255.0.0)…



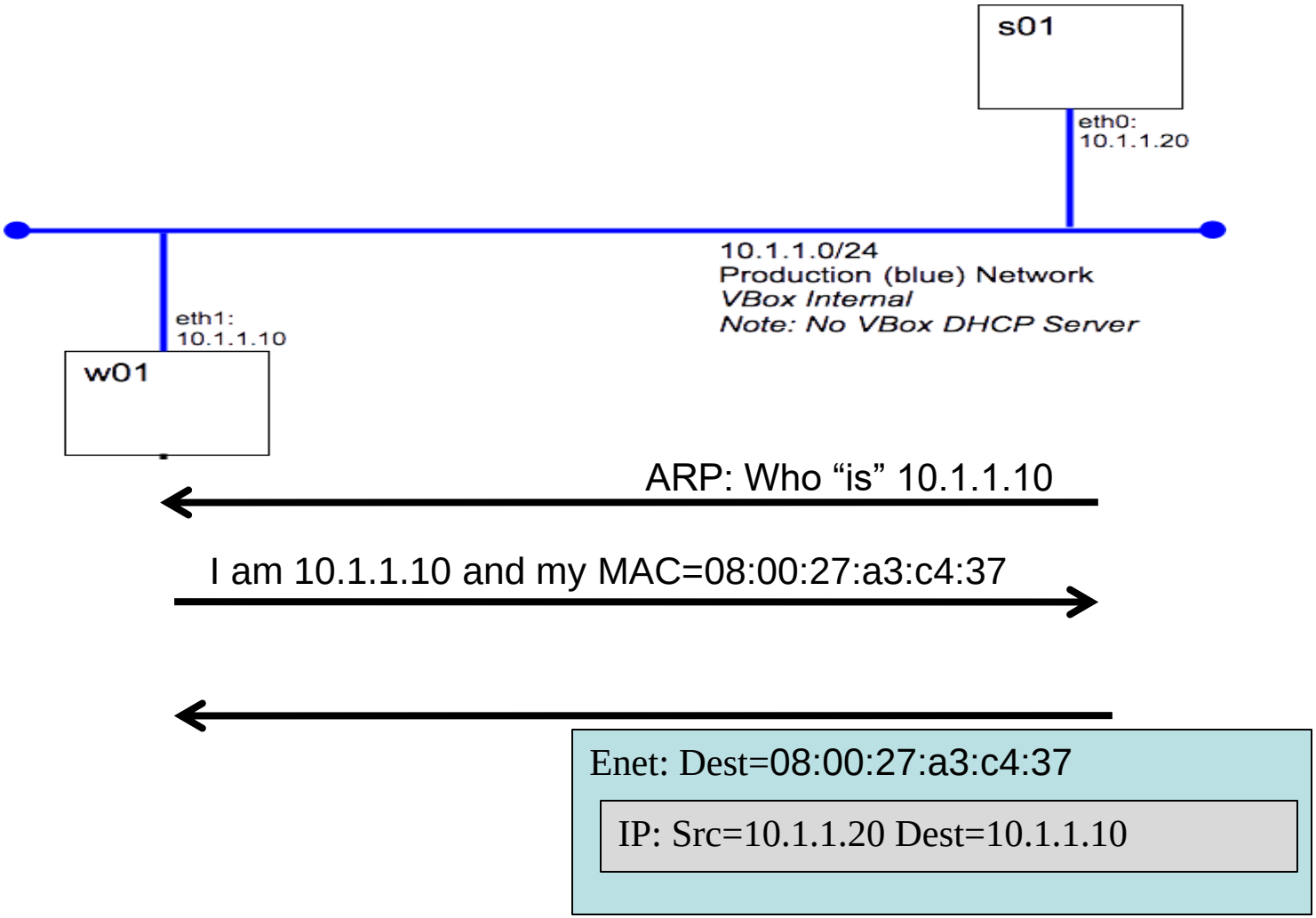
Netmasks' Implications For Routing

Every time a node has a packet to send it must decide whether to send the packet directly to the destination node or to send it through a router.

Let's look at what happens when the node sends the packet directly…

1. Source node sends an ARP request **broadcast** to all other nodes on the same network.
2. Destination node replies with its MAC address
3. Source node builds an IP packet with the MAC address it just received

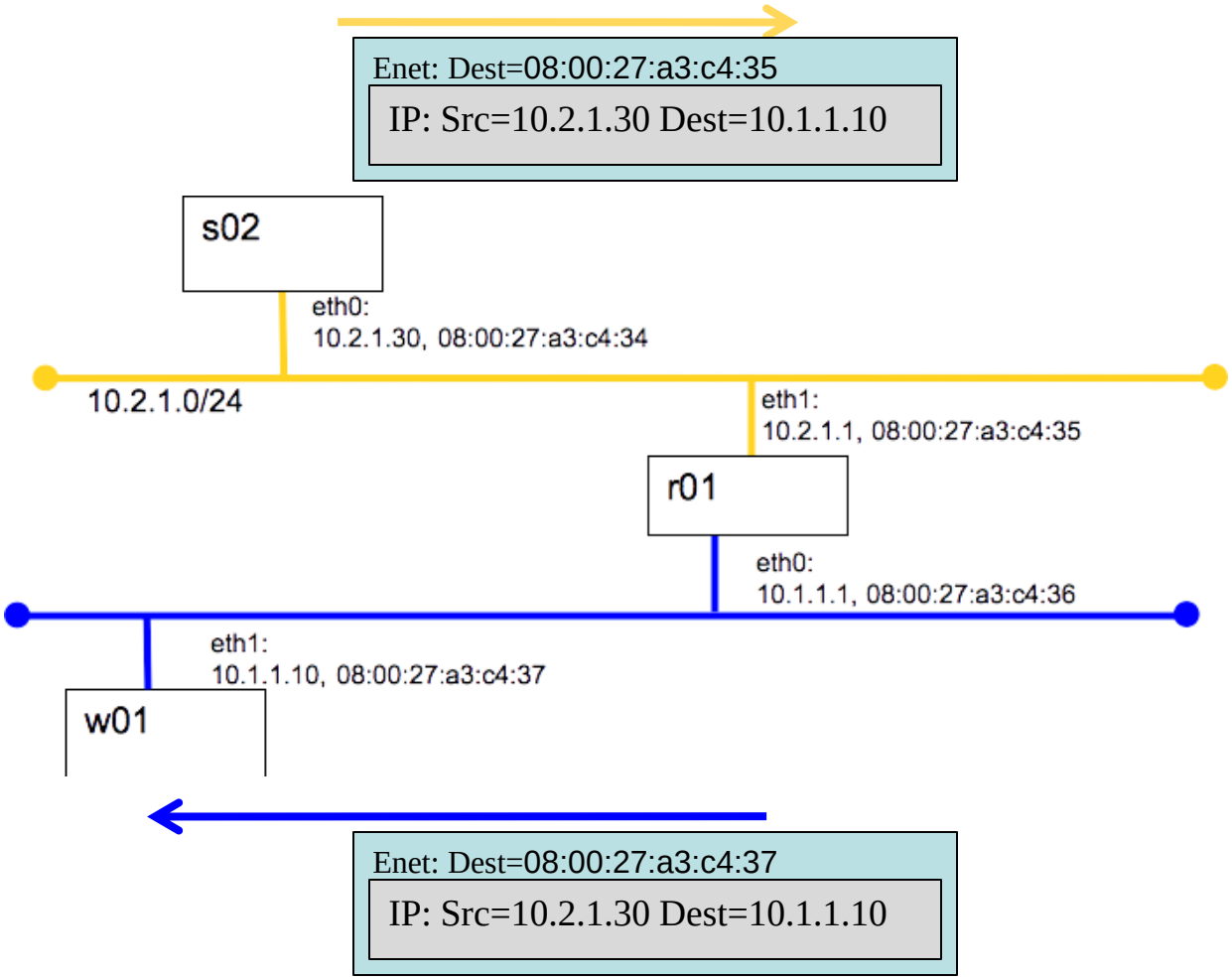
Destination on same network



Destination on different network

When the destination node is on different network we **must** send the packet to a router.

Lets look at what happens when there is router between s01 and w01, like in the routing lab.



1) s02 sends IP packet with w01 IP **but r01 MAC**
2) r01 builds now IP (note change to MAC)
3) r01 sends IP packet to w01

How does s02 know to send the packet to r01?

Routing Tables

Every node has a routing table.
When packets are to be sent, the node ‘walks’ the table and sends the packet via the first match.

s02

Destination	Route
10.2.1.0/24	eth0
Default	10.2.1.1

r01

Destination	Route
10.2.1.0/24	eth1
10.1.1.0/24	eth0

w01

Destination	Route
10.1.1.0/24	eth1
10.2.1.0/24	10.1.1.1

Routing Tables

Consider:

a) s02 sends a packet to w01
b) W01 send a response packet

s02

Destination	Route
10.2.1.0/24	eth0
Default	10.2.1.1

w01

Destination	Route
10.1.1.0/24	eth1
10.2.1.0/24	10.1.1.1

r01

Destination	Route
10.2.1.0/24	eth1
10.1.1.0/24	eth0

Routing Table - Destination

The destination column contains a list of Networks.

Two possible options:

a) A Network

b) Default

Routing Table - Route

The route column tells the node where to send the packet.

Two possible options:

a) Network interface (for networks to which the node is directly connected)

b) IP Address of a router

What makes a Linux/Unix system a router?

If IP-forwarding is turned off, the node does not process packets that have a destination IP address other then their own.

If IP-forwarding is enabled, the node will try to forward packets not addressed to it.

Magic of the ‘default’ route

- Each node may have at most one default route.
- The default route usually points toward the open Internet.
- Most nodes have only ‘local’ routes and a default router.

Exercise: Produce the routing tables for each node in the graded lab