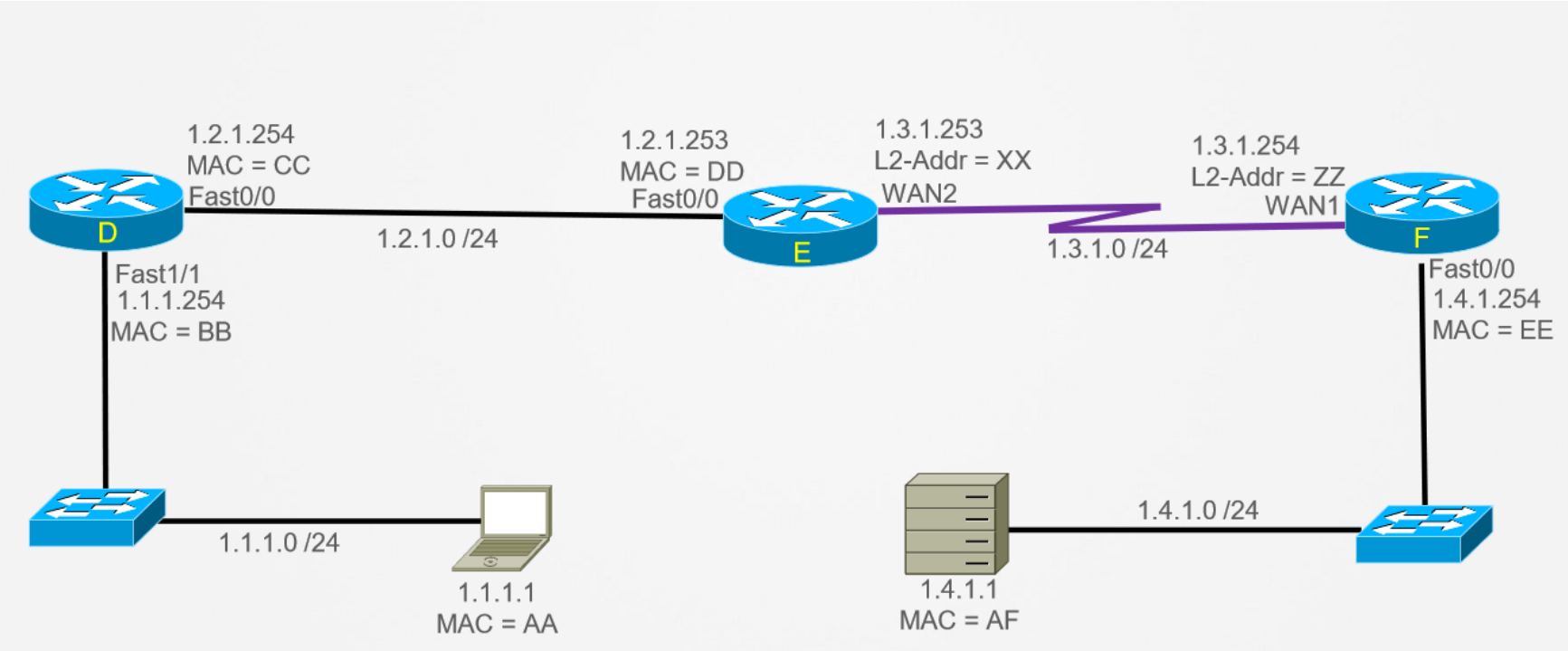
IP Routing (What IS Routing?)

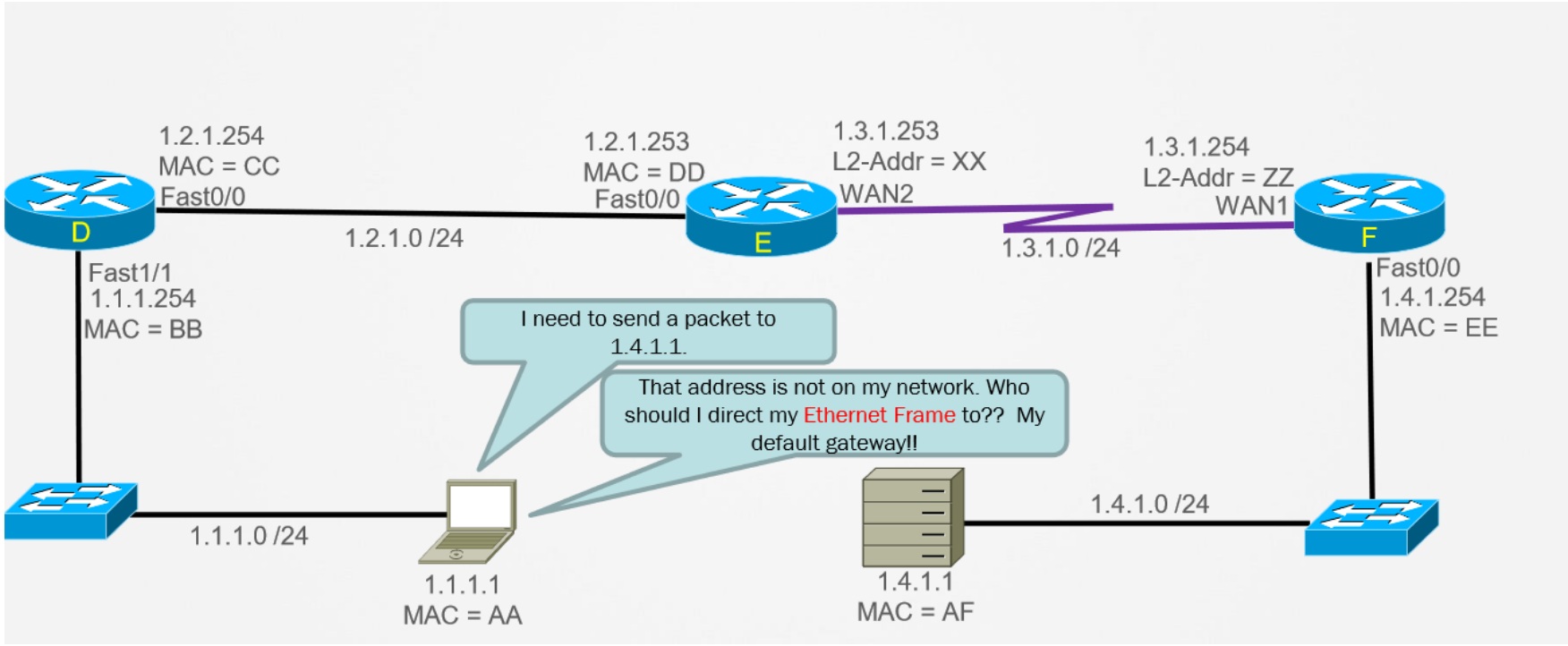
What is “Routing”?

- » Process of forwarding packets between networks. » Basic components needed to route:
- • Routable Packet (IPv4, IPv6, etc)
- • Network address
- • Subnet mask
- • Next Hop
- • Metric

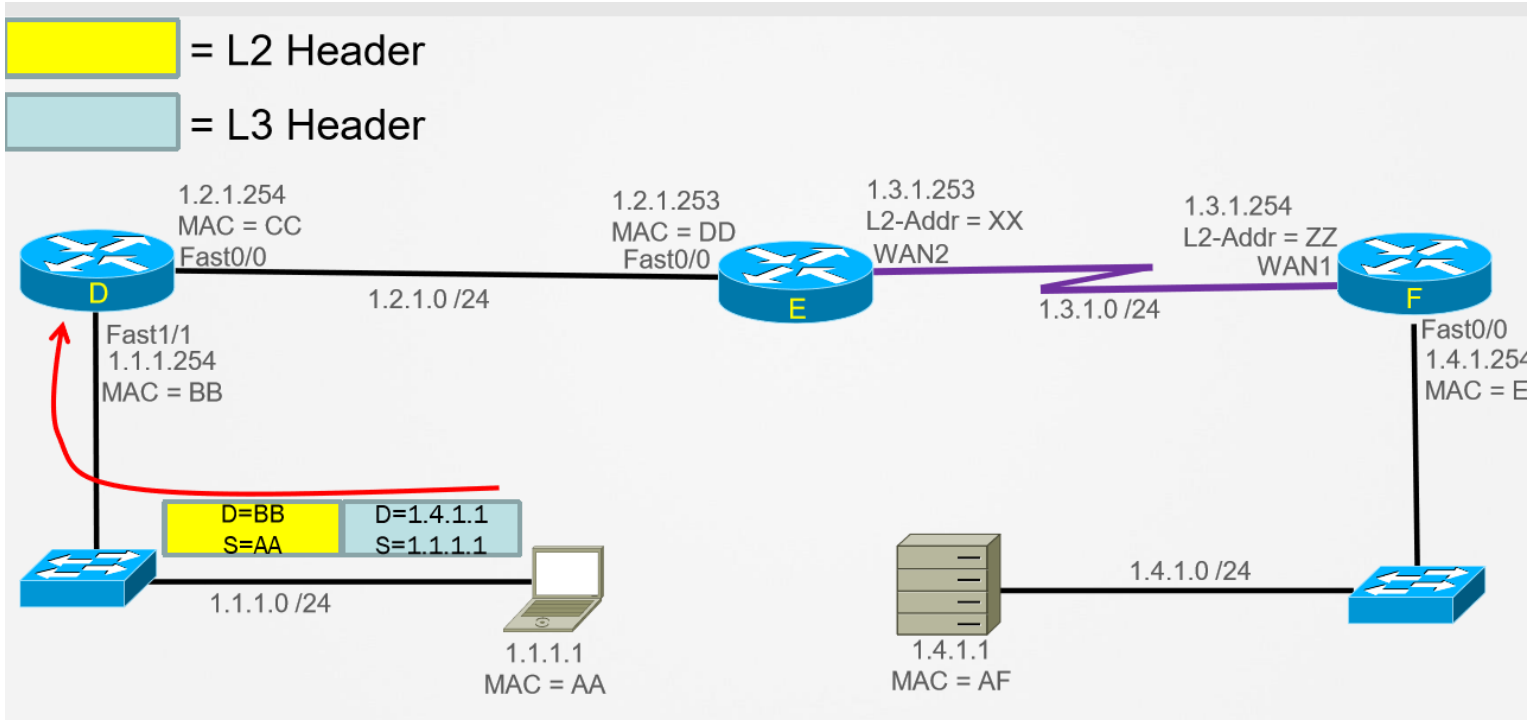
Routing: What Happens to the Packet (1)



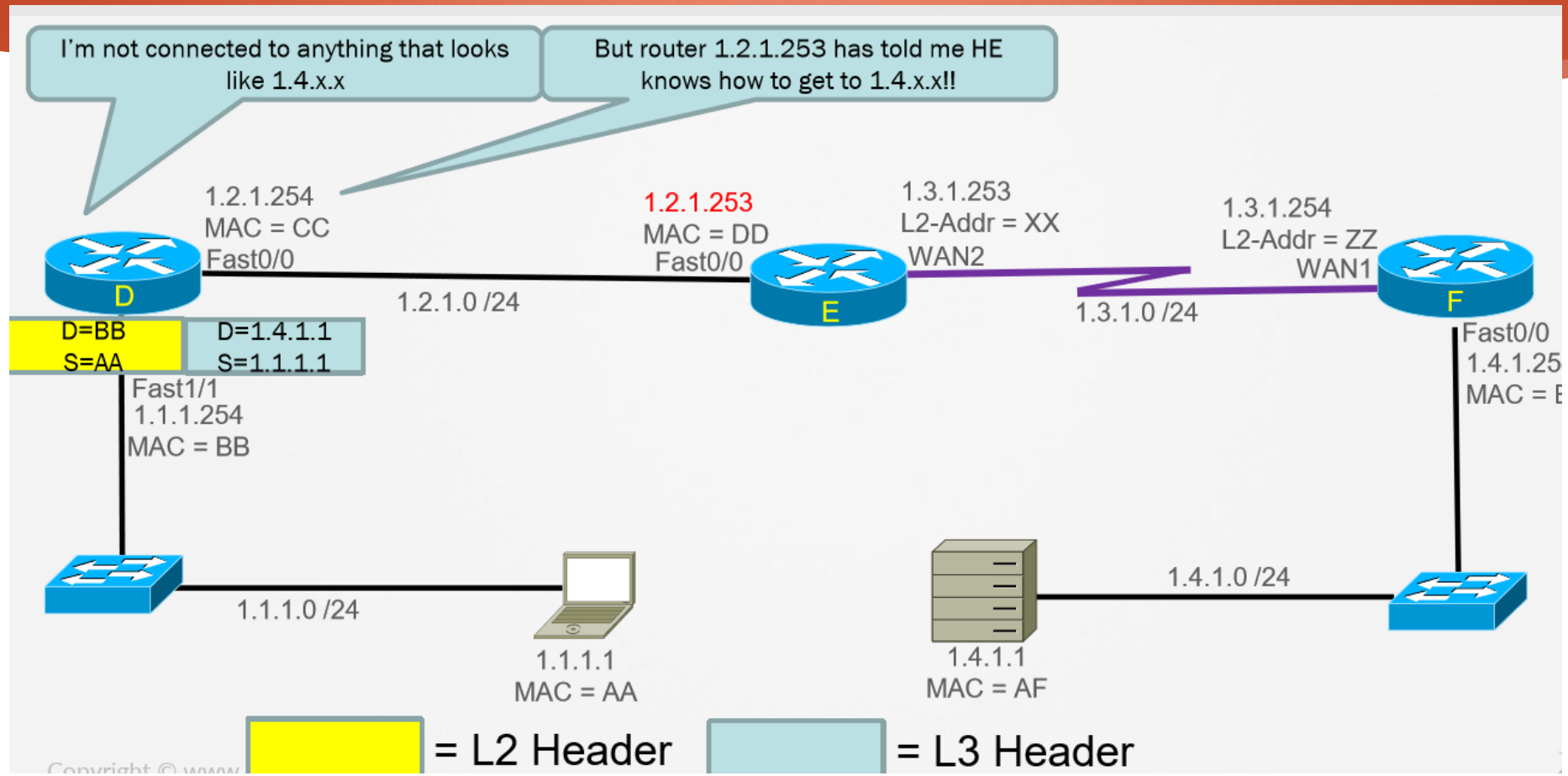
Routing: What Happens to the Packet (2)



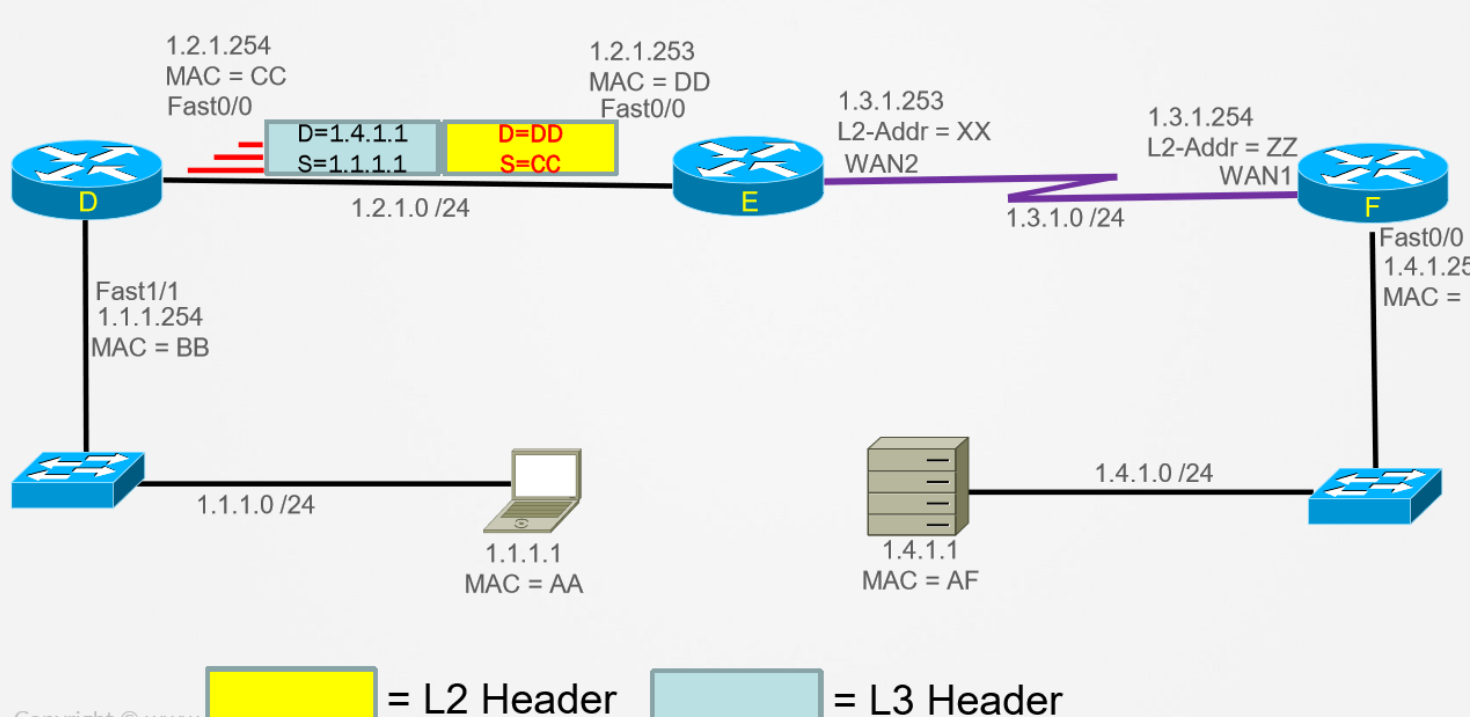
Routing: What Happens to the Packet (3)



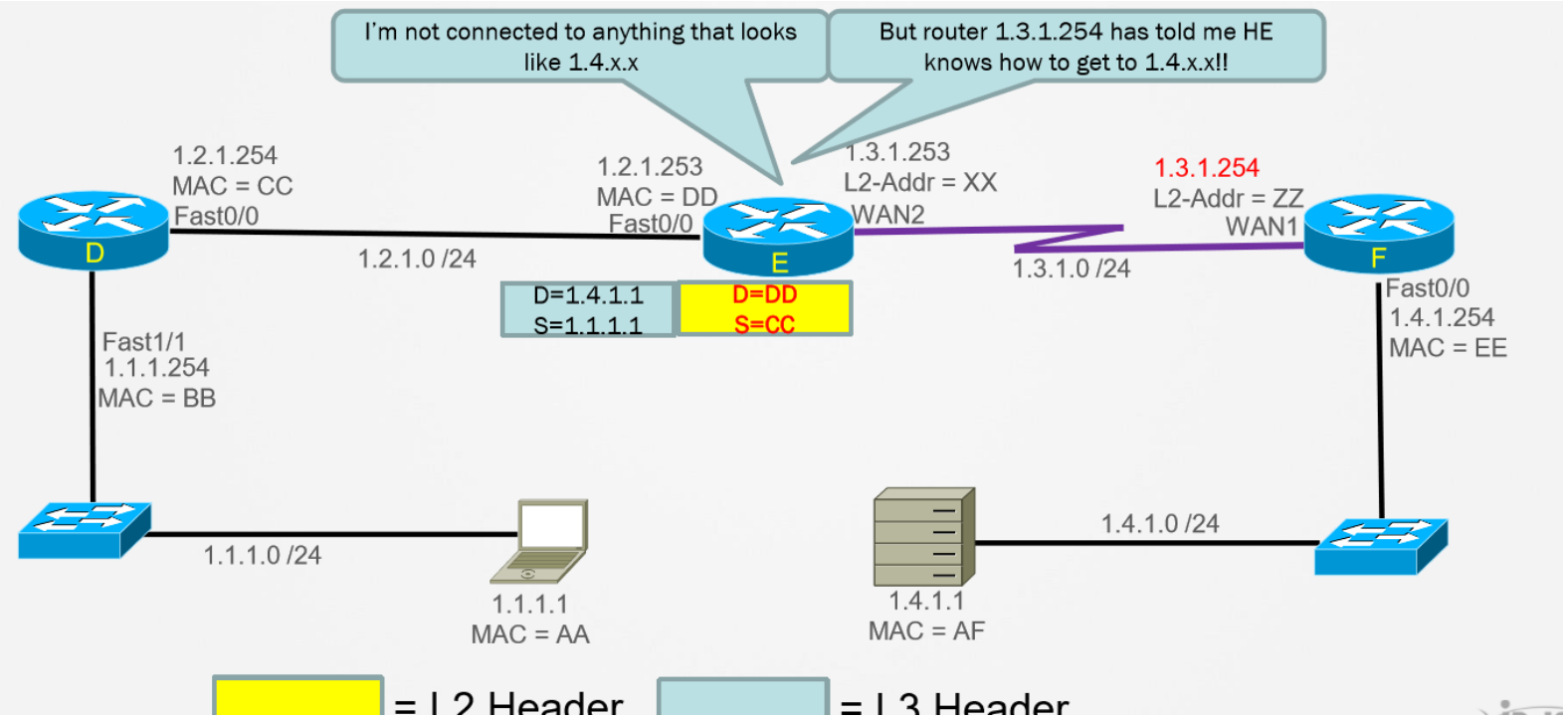
Routing: What Happens to the Packet (4)



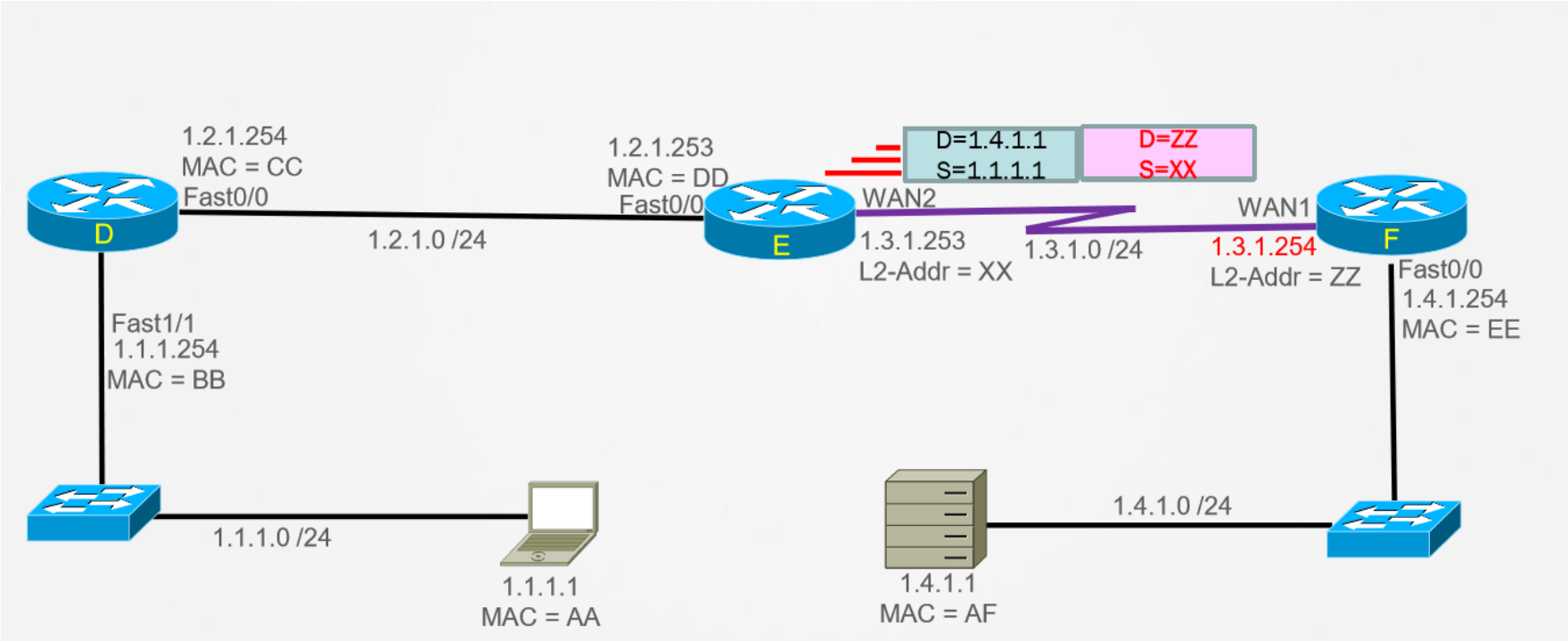
Routing: What Happens to the Packet (5)



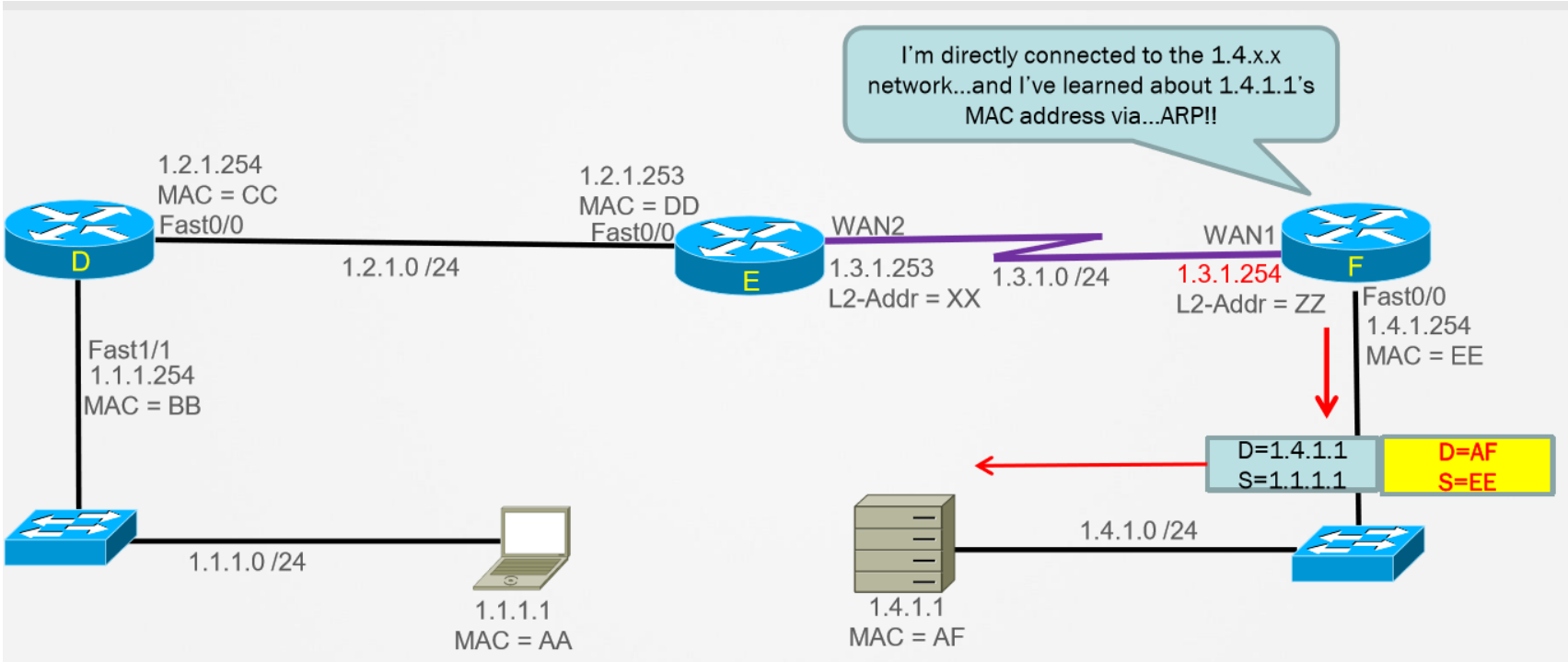
Routing: What Happens to the Packet (6)



Routing: What Happens to the Packet (7)



Routing: What Happens to the Packet (8)



IP Routing (What is the “best”?)

- General Rules of Routing
- » Router will only use routes with reachable “next hops”
- » Routers will only use the “best” routes
- » Routes must be “believable” (how do I know this route is still good?)
- » Router will only accept routes that match its own, active protocols
- • No IPv6 routes accepted if router not an IPv6 host

Types of Routes

- » Connected
- » Static
- » Dynamic

Routing Components

- » Administrative Distance (AD)
- • Defines trustworthiness of a routing protocol
- • 8-bit numbering system
- • Ranges from 0 through 255

Administrative Distance Values

Protocols	AD Value
Connected	0
Static	1
EIGRP (Internal routes)	90
OSPF	110
IS-IS	115
RIP	120
EIGRP (External routes)	170
iBGP/eBGP	200/20
Unreachable	255

IP Routing (IGP and EGP)

- Dynamic Protocols: IGP or EGP?
- » Autonomous System;
- • Collection of networks all under one administrative authority.
- » IGP;
- • Interior Gateway Protocol
- • Designed to provide prefix reachability information within an Autonomous System
- » EGP;
- • Exterior Gateway Protocol
- • Designed to provide prefix reachability information between different Autonomous Systems.

IP Routing (Classifying Dynamic Routing Protocols)

- Protocol Characteristics (1)
- » RPs can be classified into one-of-four categories that broadly define operational characteristics;
- • Distance Vector (IGPs)
- • Link-State (IGPs)
- • Advanced Distance Vector (Hybrid) (IGPs)
- • Path Vector (EGP)

Protocol Characteristics (2)

- » Once categorized, assumptions about the protocol can be made about such things as:
- • Neighbor requirements
- • Route Maintenance (is this route still believable after some prolonged time?)
- • Visibility into network topology
- • Necessity of different data structures (tables, databases, etc)

Protocol Characteristics - Routing Updates

- » Incremental update
- • Only changes are sent in the routing update
- » Full update
- • All of the routing table is sent in the update
- » Periodic update
- • Sent in the specified time interval
- » Triggered update
- • Sent whenever change is detected

Distance Vector

- » Neighbor requirements;
- • No neighborships required
- » Route Maintenance (is this route still believable after some prolonged time?)
- • Resend routes after defined interval
- » Visibility into network topology
- • Knowledge of topology only extends to directly-connected routers.
- » Necessity of different data structures (tables, databases, etc)
- • Database of learned routes
- » Protocol Examples: • RIP (v1 and v2), IGRP (deprecated)

Link State (1)

- » Neighbor requirements;
- • Neighborships required
- » Route Maintenance (is this route still believable after some prolonged time?)
- • Periodic Hello's between neighbors
- • Regenerate LSAs after defined interval
- » Visibility into network topology
- • Complete visibility of entire topology for directly-connected areas.

Link State (2)

- » Necessity of different data structures (tables, databases, etc)
- • Database of learned LSAs (Link State Database)
- • Neighbor Table
- • SPF Tree
- » Protocol Examples:
- • OSPF, ISIS

Advanced Distance Vector / Hybrid (1)

- » Neighbor requirements;
- • Neighborships required (Link State characteristic)
- » Route Maintenance (is this route still believable after some prolonged time?)
- • Periodic Hello's between neighbors (Link State characteristic)
- » Visibility into network topology
- • Knowledge of topology only extends to directly-connected routers. (Distance Vector characteristic)

Advanced Distance Vector / Hybrid (2)

- » Data structures (tables, databases, etc)
- • Topology Table of learned routes (Link State characteristic)
- • Neighbor Table (Link State characteristic)
- » Protocol Examples:
- • EIGRP

Path Vector

- » Neighbor requirements;
- • Neighborships required
- » Route Maintenance (is this route still believable after some prolonged time?)
- • Periodic Hello's between neighbors
- » Visibility into network topology
- • No Knowledge of topology. Relies on IGP's for this.
- » Necessity of different data structures (tables, databases, etc)
- » Protocol Examples: • BGP

Routing Metric

- » Used for best path selection process
- » IGPs use metric for shortest path calculation
- » Lower value is preferred
- » Depends on the routing protocol architecture
- • EIGRP metric = composite formula utilizing link bandwidth + delay
- • RIP metric = hop count
- • OSPF metric = link bandwidth