Managing Cisco Networks via Infrastructure as Code

MASTERING NETWORK FUNDAMENTALS

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Agenda

The OSI model

Different kinds of network devices

Encapsulation and addressing

Demos!

- Ethernet switching
- IP routing

Prerequisite Courses

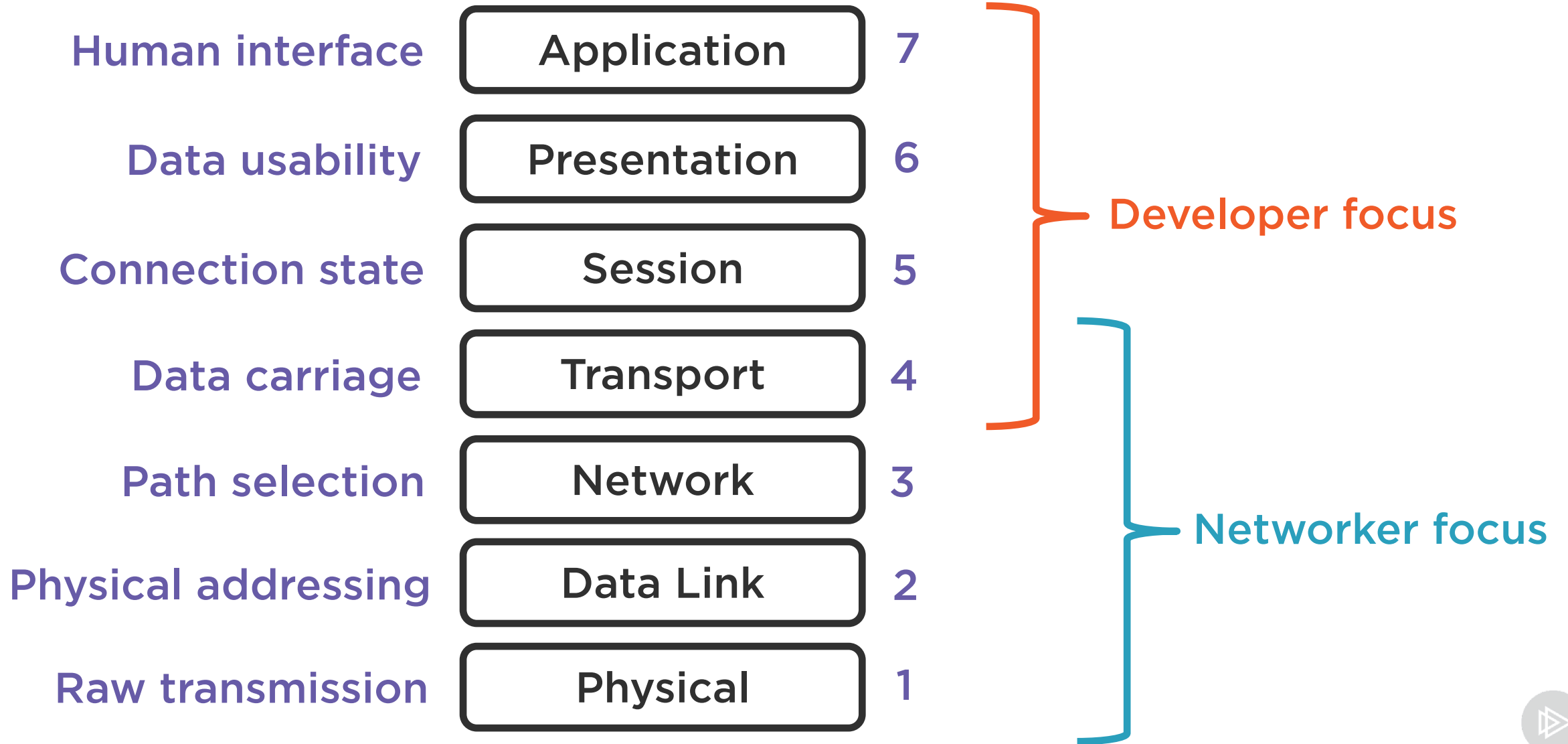**Getting Started with Software Development using Cisco DevNet**

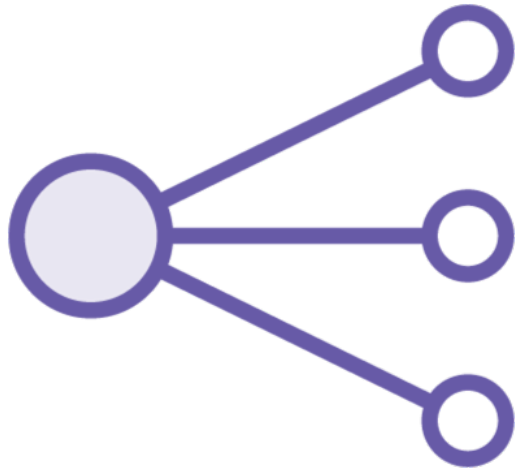**Consuming Cisco APIs and Understanding Application DevOps**
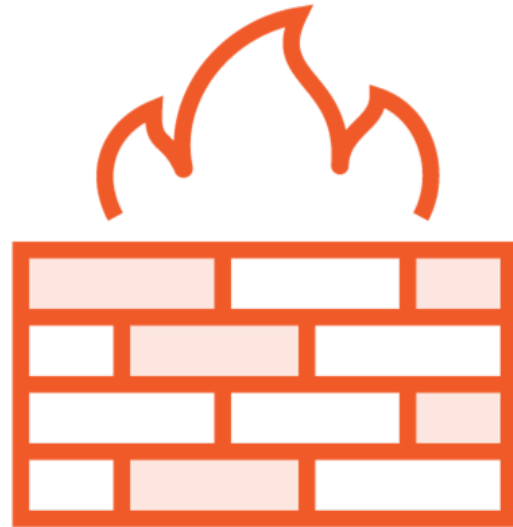
Your Role at Globomantics

Open Systems Interconnection (OSI) Model

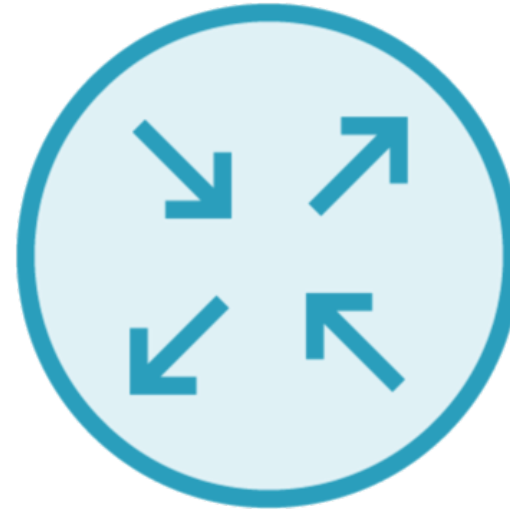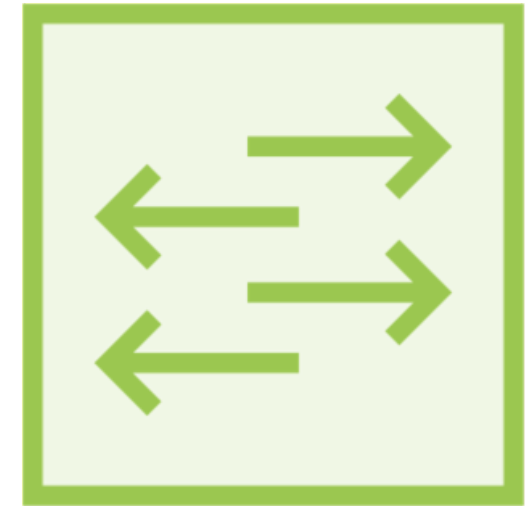| Description	Layer	#	Focus
Human interface	Application	7	Developer focus
Data usability	Presentation	6	Developer focus
Connection state	Session	5	Developer focus
Data carriage	Transport	4	Developer focus
Path selection	Network	3	Networker focus
Physical addressing	Data Link	2	Networker focus
Raw transmission	Physical	1	Networker focus

Common Network Devices

Load Balancer
(Presentation)

Firewall
(Transport)

Router
(Network)

Switch
(Data Link)

The Importance of Encapsulation

Common Transport Protocols

TCP	UDP
Transmission Control Protocol	User Datagram Protocol
Reliability and flow control	Fire and forget
Good for most data transport	Good for interactive/real-time traffic

Reference: Ports and Protocols

Protocol Name	Type	Port Number
DHCP	UDP	67 server / 68 client
DNS	UDP	53
FTP	TCP	20 active data / 21 control
HTTP	TCP	80
HTTPS	TCP	443
NETCONF	TCP	830
NTP	UDP	123
SNMP	UDP	161 poll / 162 trap
SSH	TCP	22
Telnet	TCP	23
TFTP	UDP	69 control
Windows RDP	TCP	3389

Layered Addressing

Transport ports	IP addresses	MAC addresses
0 – 65535	0.0.0.0 – 255.255.255.255	0000.0000.0000 – FFFF.FFFF.FFFF

Packet Analysis – TCP Ports

No.	Protocol	Info
4	HTTP	GET / HTTP/1.1
9	HTTP	HTTP/1.0 200 OK (text/html)
16	HTTP	POST / HTTP/1.1 (application/x-www-form-urlencoded)
21	HTTP	HTTP/1.0 200 OK (text/html)

▶ Frame 4: 400 bytes on wire (3200 bits), 400 bytes captured (3200 bits) on interface 0
▶ Ethernet II, Src: c8:e0:eb:13:de:6d, Dst: 48:5d:36:c9:c9:6b
▶ Internet Protocol Version 4, Src: 192.168.1.151, Dst: 52.45.123.182
▶ Transmission Control Protocol, Src Port: 53344 Dst Port: 5000 Seq: 1, Ack: 1, Len: 334
▼ Hypertext Transfer Protocol
   ▶ GET / HTTP/1.1\r\n
     Host: crm.njrusmc.net:5000\r\n
     User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.14; rv:67.0) Gecko/20100101 Firefox/67.0\r\n
     Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8\r\n
     Accept-Language: en-US,en;q=0.5\r\n
     Accept-Encoding: gzip, deflate\r\n
     Connection: keep-alive\r\n
     Upgrade-Insecure-Requests: 1\r\n
     \r\n
     [Full request URI: http://crm.njrusmc.net:5000/]
     [HTTP request 1/1]
     [Response in frame: 9]

Laptop random source port

Flask App fixed destination port

Packet Analysis – IP Addressing

No.	Protocol	Info
4	HTTP	GET / HTTP/1.1
9	HTTP	HTTP/1.0 200 OK (text/html)
16	HTTP	POST / HTTP/1.1 (application/x-www-form-urlencoded)
21	HTTP	HTTP/1.0 200 OK (text/html)

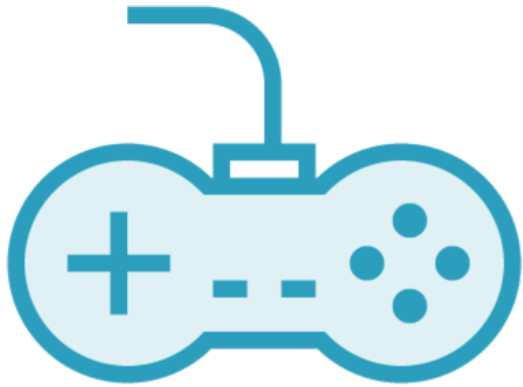▶ Frame 4: 400 bytes on wire (3200 bits), 400 bytes captured (3200 bits) on interface 0
▶ Ethernet II, Src: c8:e0:eb:13:de:6d, Dst: 48:5d:36:c9:c9:6b
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▼ Hypertext Transfer Protocol
   ▶ GET / HTTP/1.1\r\n
   Host: crm.njrusmc.net:5000\r\n
   User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.14; rv:67.0) Gecko/20100101 Firefox/67.0\r\n
   Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8\r\n
   Accept-Language: en-US,en;q=0.5\r\n
   Accept-Encoding: gzip, deflate\r\n
   Connection: keep-alive\r\n
   Upgrade-Insecure-Requests: 1\r\n
   \r\n
   [Full request URI: http://crm.njrusmc.net:5000/]
   [HTTP request 1/1]
   [Response in frame: 9]

Client IP

Flask App IP

Packet Analysis – MAC Addressing

No.	Protocol	Info
4	HTTP	GET / HTTP/1.1
9	HTTP	HTTP/1.0 200 OK (text/html)
16	HTTP	POST / HTTP/1.1 (application/x-www-form-urlencoded)
21	HTTP	HTTP/1.0 200 OK (text/html)

▶ Frame 4: 400 bytes on wire (3200 bits), 400 bytes captured (3200 bits) on interface 0
▶ Ethernet II, Src: c8:e0:eb:13:de:6d, Dst: 48:5d:36:c9:c9:6b
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▼ Hypertext Transfer Protocol
   ▶ GET / HTTP/1.1\r\n
   Host: crm.njrusmc.net:5000\r\n
   User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.14; rv:67.0) Gecko/20100101 Firefox/67.0\r\n
   Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8\r\n
   Accept-Language: en-US,en;q=0.5\r\n
   Accept-Encoding: gzip, deflate\r\n
   Connection: keep-alive\r\n
   Upgrade-Insecure-Requests: 1\r\n
   \r\n
   [Full request URI: http://crm.njrusmc.net:5000/]
   [HTTP request 1/1]
   [Response in frame: 9]

Client MAC

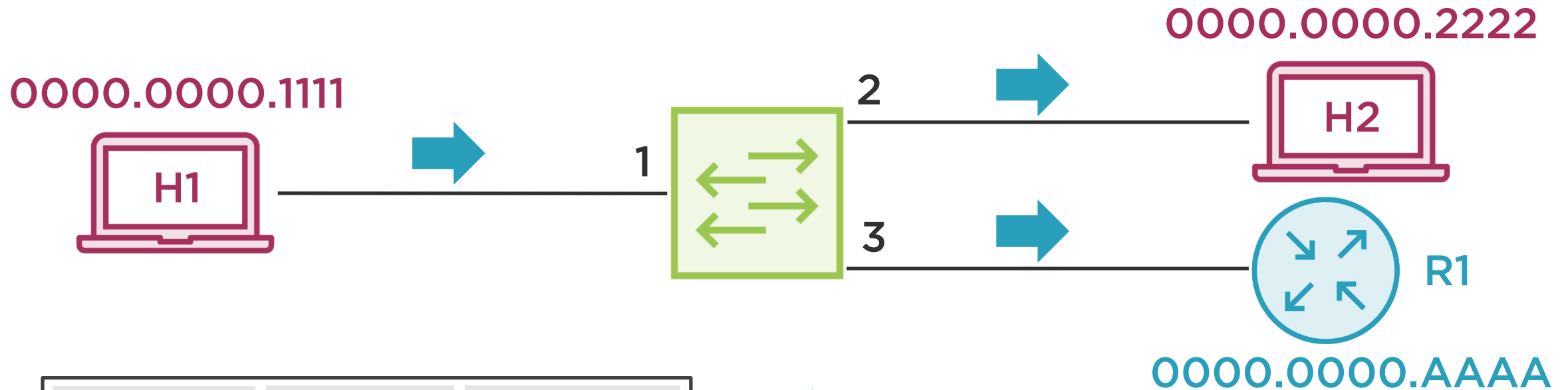**Local router MAC**

Planes of Operation

Control plane   **Data/forwarding plane**   **Management plane**
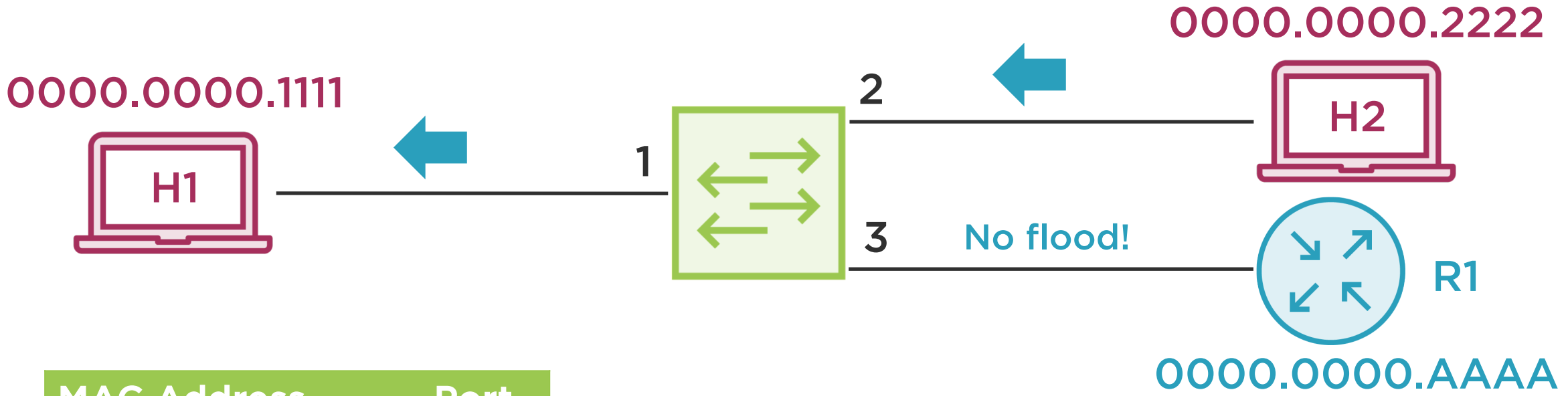
Switching Fundamentals – First Frame

0000.0000.1111

0000.0000.2222

H1

H2

1

2

3

R1

0000.0000.AAAA

IP packet payload	Src MAC .1111	Dest MAC .2222

MAC Address Table	Port
0000.0000.1111	1
FFFF.FFFF.FFFF	All
Unknown entry	All

Switching Fundamentals – Second Frame

0000.0000.1111

0000.0000.2222

H1

H2

1

2

3

No flood!

0000.0000.AAAA

R1

MAC Address Table	Port
0000.0000.1111	1
0000.0000.2222	2
FFFF.FFFF.FFFF	All
Unknown entry	All

Dest MAC .1111	Src MAC .2222	IP packet payload

Switching Fundamentals – Virtual LANs

VLAN 10: Users
VLAN 20: Voice
VLAN 30: Management

VLAN Trunking

| Dest MAC .AAAA | Src MAC .2222 | 802.1Q VLAN 10 | IP packet payload |

0000.0000.2222

R1

VLAN 10

H2

All VLANs

VLAN 20

P3

0000.0000.AAAA

0000.0000.3333

| Dest MAC .AAAA | Src MAC .3333 | 802.1Q VLAN 20 | IP packet payload |

Demo

Switching exploration

The Globomantics Network

Routing Fundamentals

IP Prefix	Next-hop
10.1.10.0/24	Connected
10.1.2.0/24	Connected
10.2.5.0/24	10.1.2.2

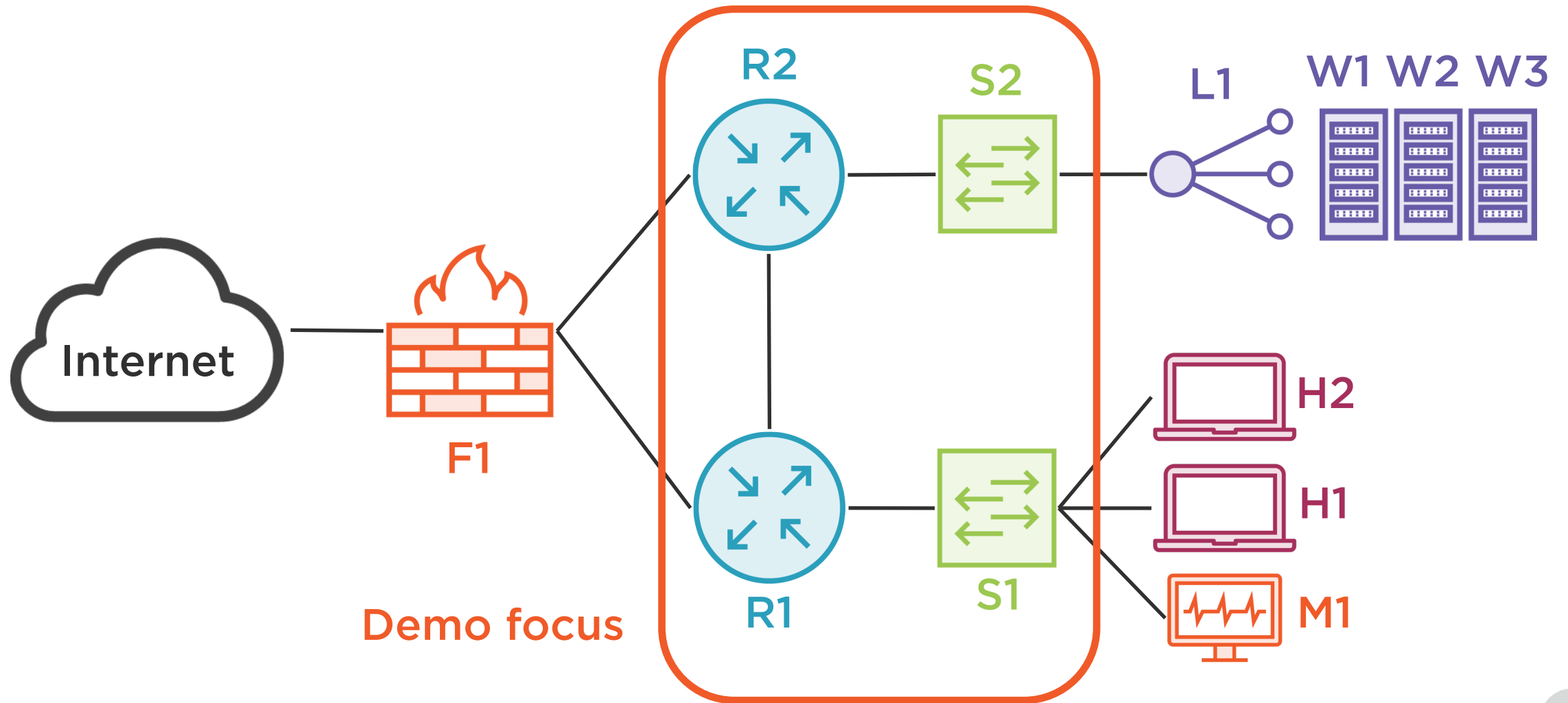| IP Prefix	Next-hop
10.1.10.0/24	10.1.2.1
10.1.2.0/24	Connected
10.2.5.0/24	Connected

Demo

IP routing exploration

The Globomantics Network

Summary

OSI model and encapsulation

Routing and switching

Ports and protocols