



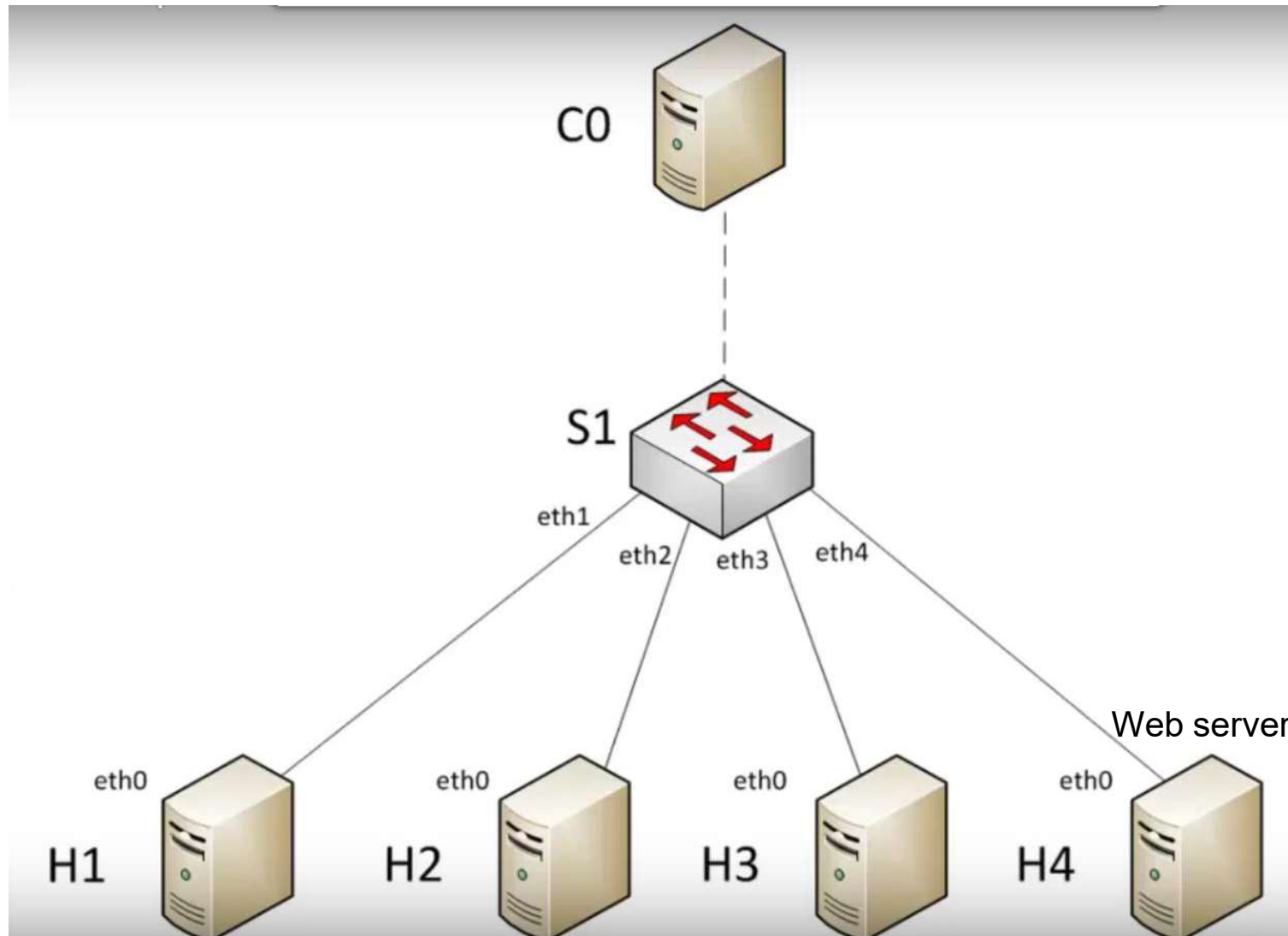
# Softvérovo definované siete (*OpenFlow prepínač*)

Martin Medvecký

*[martin.medvecky@adlerka.sk](mailto:martin.medvecky@adlerka.sk)*

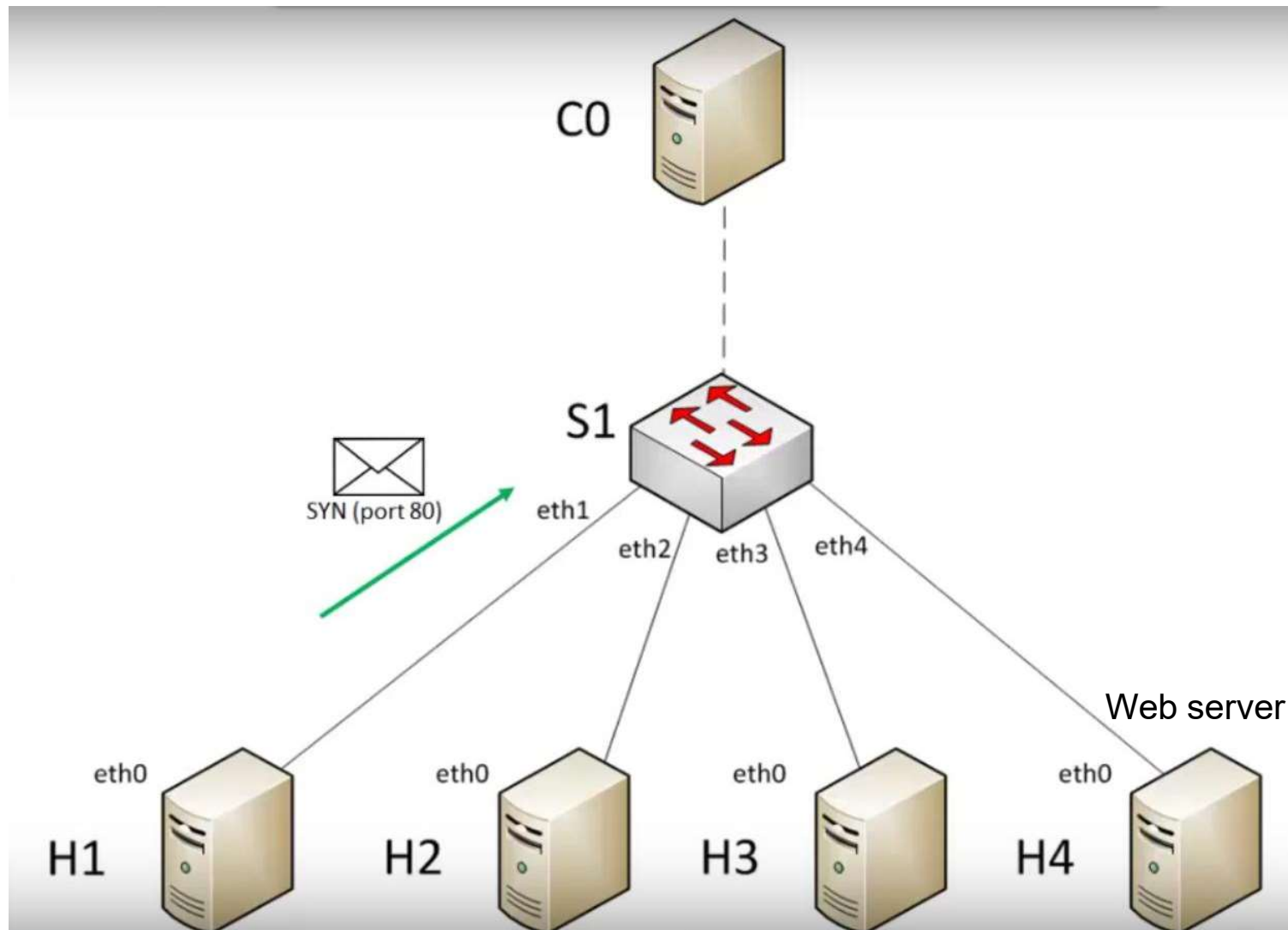


## Príklad (1/14)



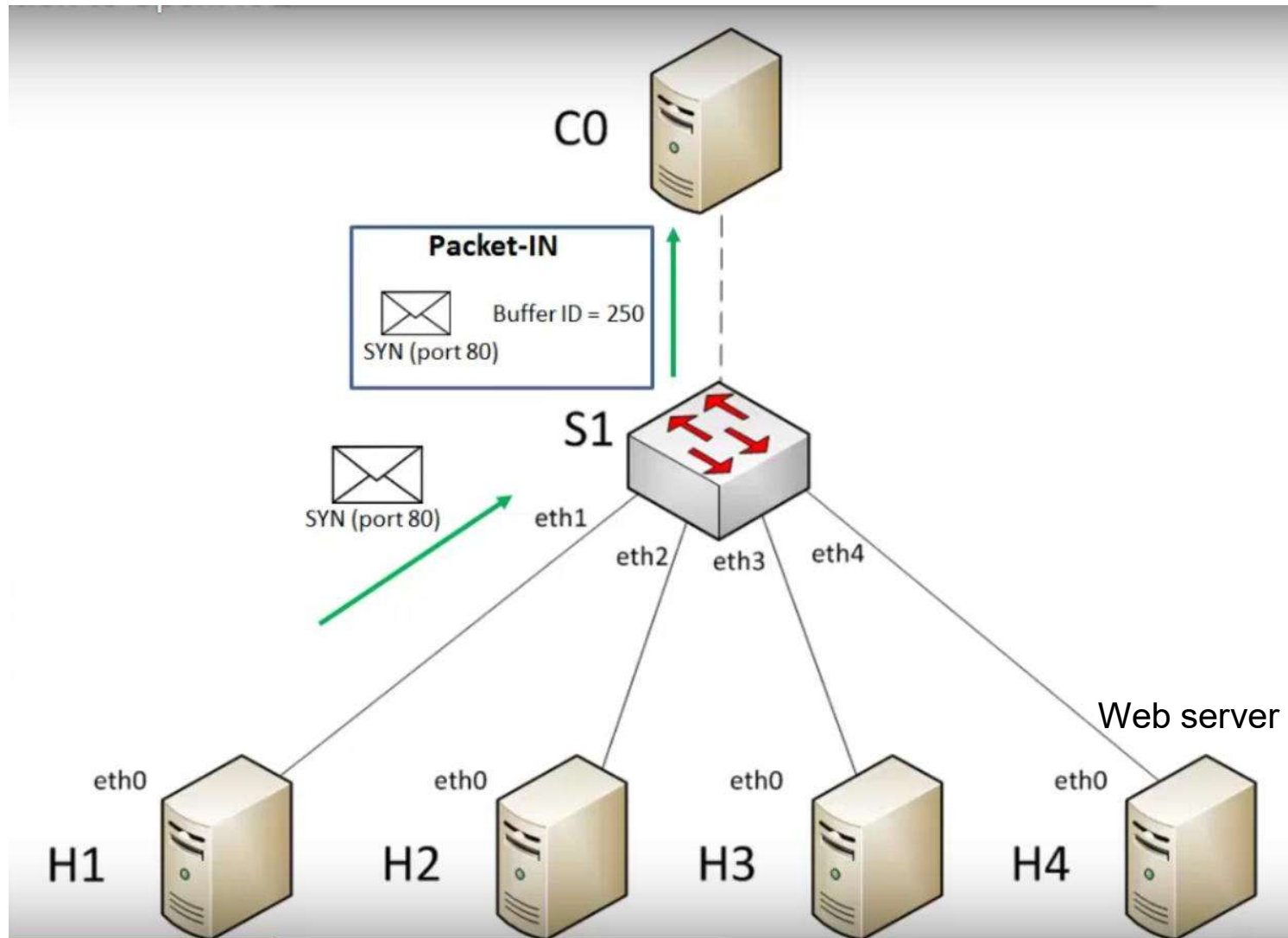


## Príklad (2/14)





## Príklad (3/14)





## Ukážka správy Packet-in - OpenFlow 1.0

No.	Time	Source	Destination	Protocol	Length	Info
29489	7.811809841	10.0.0.1	10.0.0.2	ICMP	100	Echo (ping) request id=0x3469, seq=1/256, ttl=64 (...)
29490	7.814228669	10.0.0.1	10.0.0.2	OpenFlow	184	Type: OFPT_PACKET_IN
29503	7.817852660	10.0.0.1	10.0.0.2	OpenFlow	190	Type: OFPT_PACKET_OUT
29507	7.818184772	10.0.0.1	10.0.0.2	ICMP	100	Echo (ping) request id=0x3469, seq=1/256, ttl=64 (...)
29508	7.818247928	10.0.0.2	10.0.0.1	ICMP	100	Echo (ping) reply id=0x3469, seq=1/256, ttl=64 (...)
29509	7.818634656	10.0.0.2	10.0.0.1	OpenFlow	184	Type: OFPT_PACKET_IN
29513	7.819248846	10.0.0.2	10.0.0.1	OpenFlow	190	Type: OFPT_PACKET_OUT
29519	7.819834615	10.0.0.2	10.0.0.1	ICMP	100	Echo (ping) reply id=0x3469, seq=1/256, ttl=64 (...)
33239	8.798126977	10.0.0.1	10.0.0.2	ICMP	100	Echo (ping) request id=0x3469, seq=2/512, ttl=64 (...)

- ▶ Frame 29490: 184 bytes on wire (1472 bits), 184 bytes captured (1472 bits) on interface 0
- ▶ Linux cooked capture
- ▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
- ▶ Transmission Control Protocol, Src Port: 33584, Dst Port: 6653, Seq: 246, Ack: 764, Len: 116
- ▼ OpenFlow 1.0

.000 0001 = Version: 1.0 (0x01)  
Type: OFPT\_PACKET\_IN (10)  
Length: 116  
Transaction ID: 0  
Buffer Id: 0xffffffff  
Total length: 98  
In port: 1

Reason: No matching flow (table-miss flow entry) (0)

Pad: 00

- ▶ Ethernet II, Src: 76:f7:fb:d5:03:19 (76:f7:fb:d5:03:19), Dst: 92:c7:ff:42:52:7b (92:c7:ff:42:52:7b)
- ▶ Internet Protocol Version 4, Src: 10.0.0.1, Dst: 10.0.0.2

### ▼ Internet Control Message Protocol

Type: 8 (Echo (ping) request)  
Code: 0  
Checksum: 0xee5b [correct]  
[Checksum Status: Good]  
Identifier (BE): 13417 (0x3469)  
Identifier (LE): 26932 (0x6934)  
Sequence number (BE): 1 (0x0001)  
Sequence number (LE): 256 (0x0100)

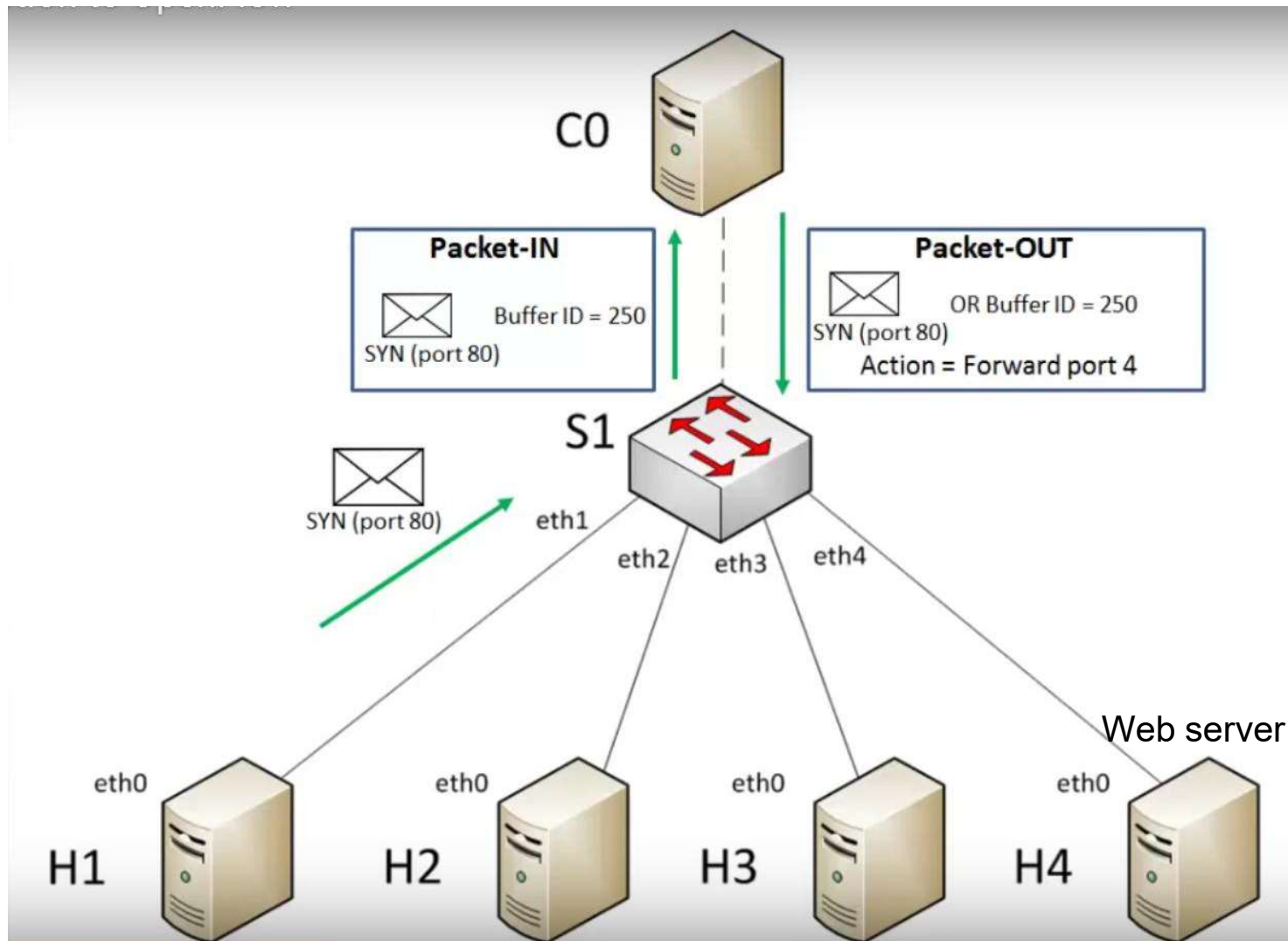
### ▶ [No response seen]

Timestamp from icmp data: Sep 28, 2022 22:01:31.000000000 CEST  
[Timestamp from icmp data (relative): 0.892605344 seconds]

- ▶ Data (48 bytes)



## Príklad (4/14)







# Ukážka správy Packet-out - OpenFlow 1.0

No.	Time	Source	Destination	Protocol	Length	Info
29489	7.811809841	10.0.0.1	10.0.0.2	ICMP	100	Echo (ping) request id=0x3469, seq=1/256, ttl=64 (...)
29490	7.814228669	10.0.0.1	10.0.0.2	OpenFlow	184	Type: OFPT_PACKET_IN
→ 29503	7.817852660	10.0.0.1	10.0.0.2	OpenFlow	190	Type: OFPT_PACKET_OUT
29507	7.818184772	10.0.0.1	10.0.0.2	ICMP	100	Echo (ping) request id=0x3469, seq=1/256, ttl=64 (...)
29508	7.818247928	10.0.0.2	10.0.0.1	ICMP	100	Echo (ping) reply id=0x3469, seq=1/256, ttl=64 (...)
← 29509	7.818634656	10.0.0.2	10.0.0.1	OpenFlow	184	Type: OFPT_PACKET_IN
29513	7.819248846	10.0.0.2	10.0.0.1	OpenFlow	190	Type: OFPT_PACKET_OUT
29519	7.819834615	10.0.0.2	10.0.0.1	ICMP	100	Echo (ping) reply id=0x3469, seq=1/256, ttl=64
33239	8.798126977	10.0.0.1	10.0.0.2	ICMP	100	Echo (ping) request id=0x3469, seq=2/512, ttl=64 (...)

▶ Frame 29503: 190 bytes on wire (1520 bits), 190 bytes captured (1520 bits) on interface 0

▶ Linux cooked capture

▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1

▶ Transmission Control Protocol, Src Port: 6653, Dst Port: 33584, Seq: 844, Ack: 362, Len: 122

▼ OpenFlow 1.0

- .000 0001 = Version: 1.0 (0x01)
- Type: OFPT\_PACKET\_OUT (13)
- Length: 122
- Transaction ID: 289329
- Buffer Id: 0xffffffff
- In port: 1
- Actions length: 8
- Actions type: Output to switch port (0)
- Action length: 8

**Output port: 2**

Max length: 65535

▶ Ethernet II, Src: 76:f7:fb:d5:03:19 (76:f7:fb:d5:03:19), Dst: 92:c7:ff:42:52:7b (92:c7:ff:42:52:7b)

▶ Internet Protocol Version 4, Src: 10.0.0.1, Dst: 10.0.0.2

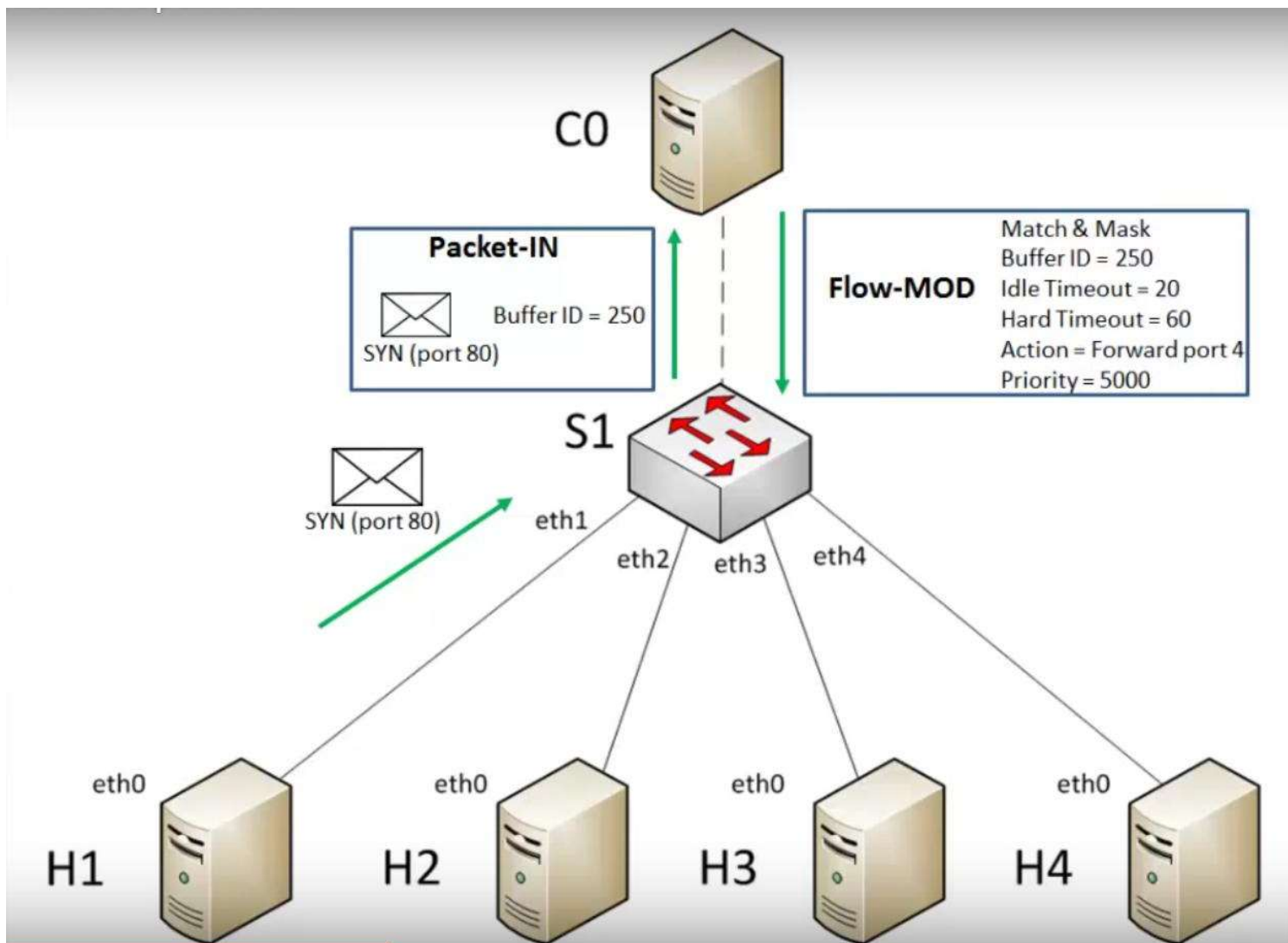
▼ Internet Control Message Protocol

- Type: 8 (Echo (ping) request)
- Code: 0
- Checksum: 0xee5b [correct]
- [Checksum Status: Good]
- Identifier (BE): 13417 (0x3469)
- Identifier (LE): 26932 (0x6934)
- Sequence number (BE): 1 (0x0001)
- Sequence number (LE): 256 (0x0100)
- [Response frame: 29509]
- Timestamp from icmp data: Sep 28, 2022 22:01:31.000000000 CEST
- [Timestamp from icmp data (relative): 0.896229335 seconds]

▶ Data (48 bytes)



## Príklad (5/14)







## Ukážka správy Flow Mod - OpenFlow 1.0

	Time	Source	Destination	Protocol	Length	Info
.	29490	7.814228669	10.0.0.1	10.0.0.2	OpenFlow	184 Type: OFPT_PACKET_IN
	29500	7.817781113	127.0.0.1	127.0.0.1	OpenFlow	148 Type: OFPT_FLOW_MOD
	29503	7.817852660	10.0.0.1	10.0.0.2	OpenFlow	190 Type: OFPT_PACKET_OUT
	29509	7.818634656	10.0.0.2	10.0.0.1	OpenFlow	184 Type: OFPT_PACKET_IN
	29510	7.819197868	127.0.0.1	127.0.0.1	OpenFlow	148 Type: OFPT_FLOW_MOD
	29513	7.819248846	10.0.0.2	10.0.0.1	OpenFlow	190 Type: OFPT_PACKET_OUT
	37079	9.801168544	127.0.0.1	127.0.0.1	OpenFlow	76 Type: OFPT_ECHO_REQUEST
	37081	9.801389989	127.0.0.1	127.0.0.1	OpenFlow	76 Type: OFPT_ECHO_REPLY
	37140	9.810330307	127.0.0.1	127.0.0.1	OpenFlow	76 Type: OFPT_ECHO_REQUEST

Frame 29500: 148 bytes on wire (1184 bits), 148 bytes captured (1184 bits) on interface 0

Linux cooked capture

Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1

Transmission Control Protocol, Src Port: 6653, Dst Port: 33584, Seq: 764, Ack: 362, Len: 80

OpenFlow 1.0

.000 0001 = Version: 1.0 (0x01)

Type: OFPT\_FLOW\_MOD (14)

Length: 80

Transaction ID: 289328

Wildcards: 3145954

In port: 1

Ethernet source address: 76:f7:fb:d5:03:19 (76:f7:fb:d5:03:19)

Ethernet destination address: 92:c7:ff:42:52:7b (92:c7:ff:42:52:7b)

Input VLAN id: 0

Input VLAN priority: 0

Pad: 00

DI type: 2048

IP ToS: 0

IP protocol: 0

Pad: 0000

Source Address: 10.0.0.1

Destination Address: 10.0.0.2

Source Port: 0

Destination Port: 0

Cookie: 0x0020000020000000

Command: New flow (0)

Idle time-out: 5

hard time-out: 0

Priority: 1

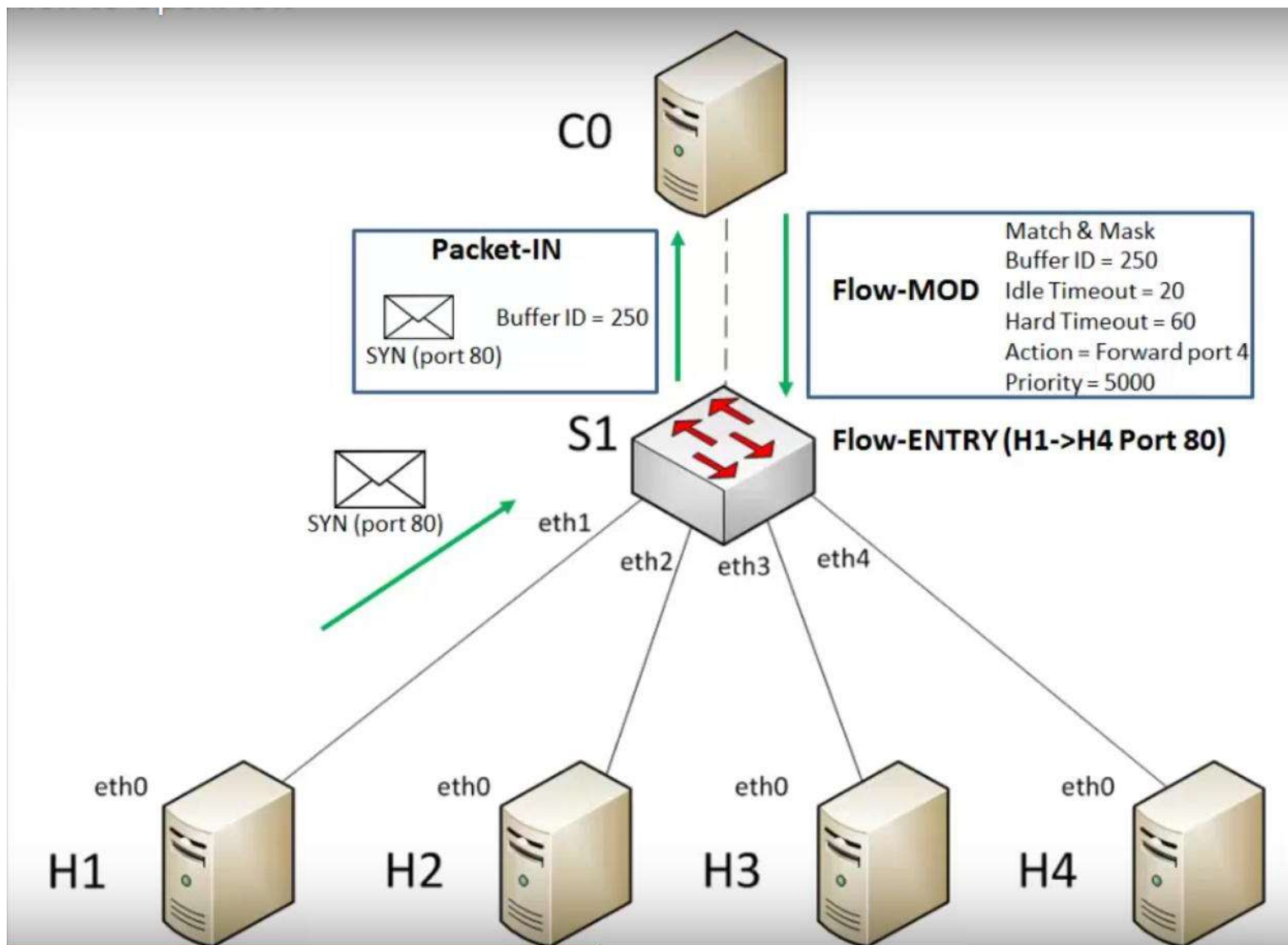
Buffer Id: 0xffffffff

Out port: 2

Flags: 0

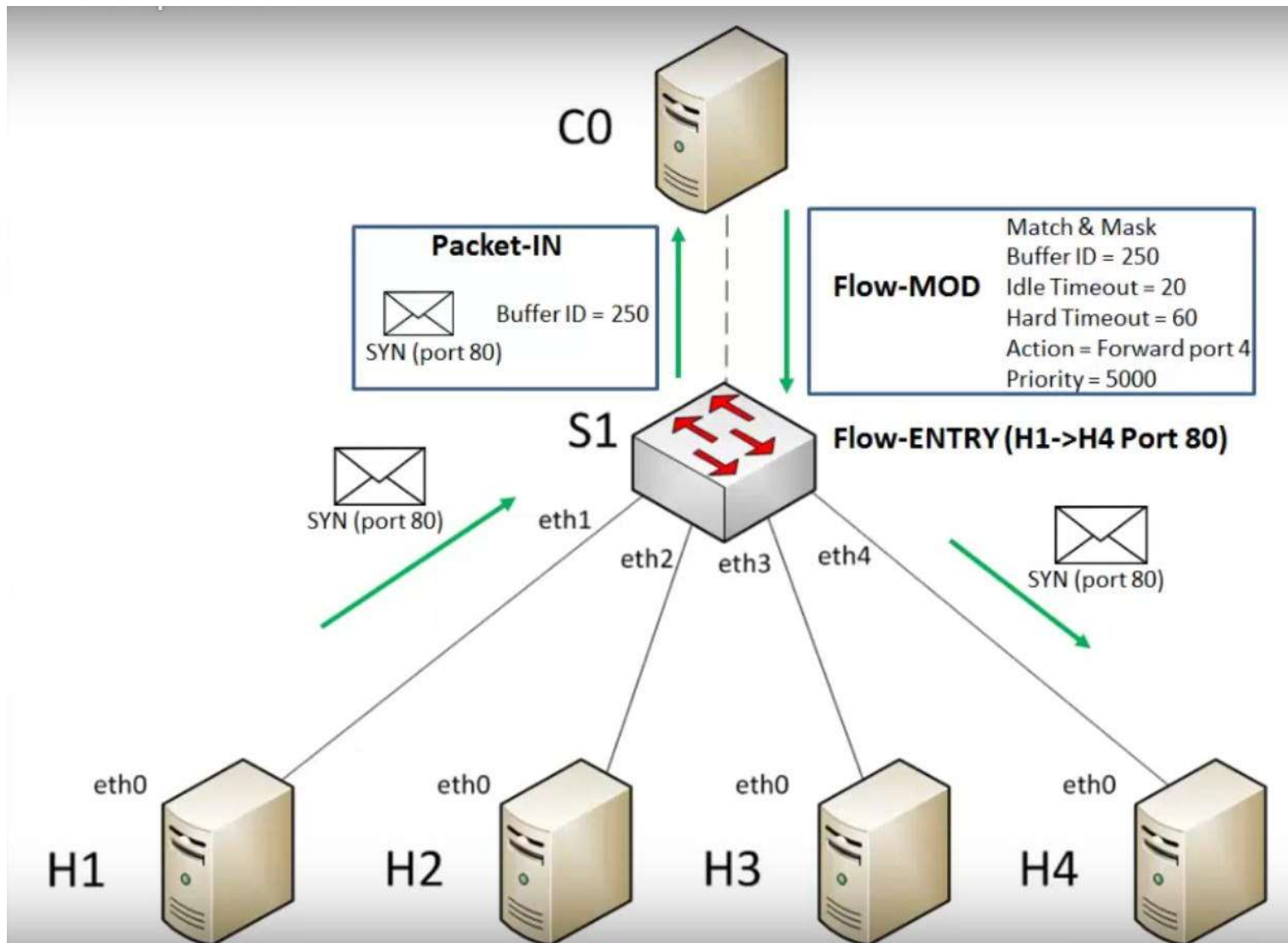


## Príklad (6/14)



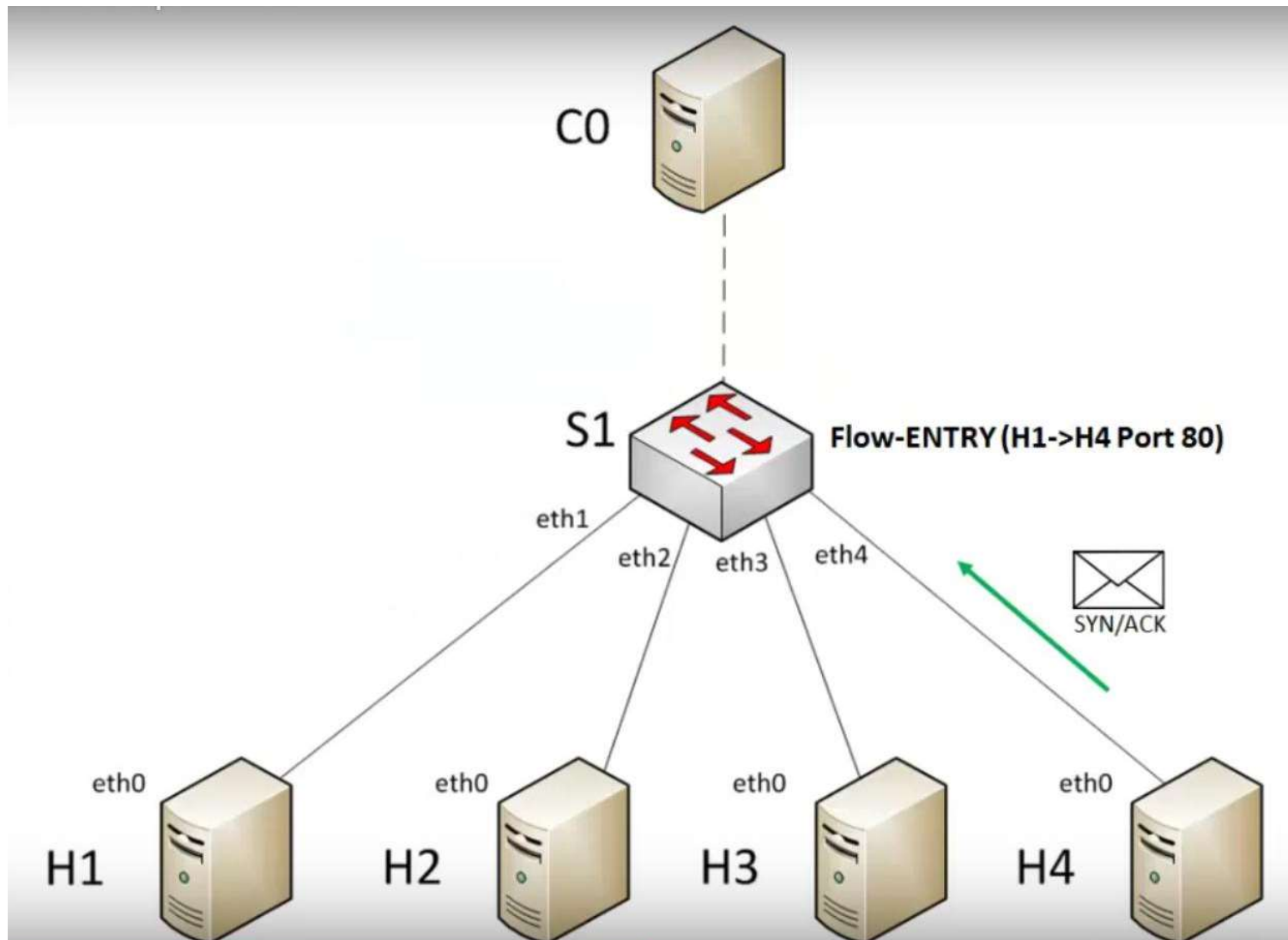


## Príklad (7/14)



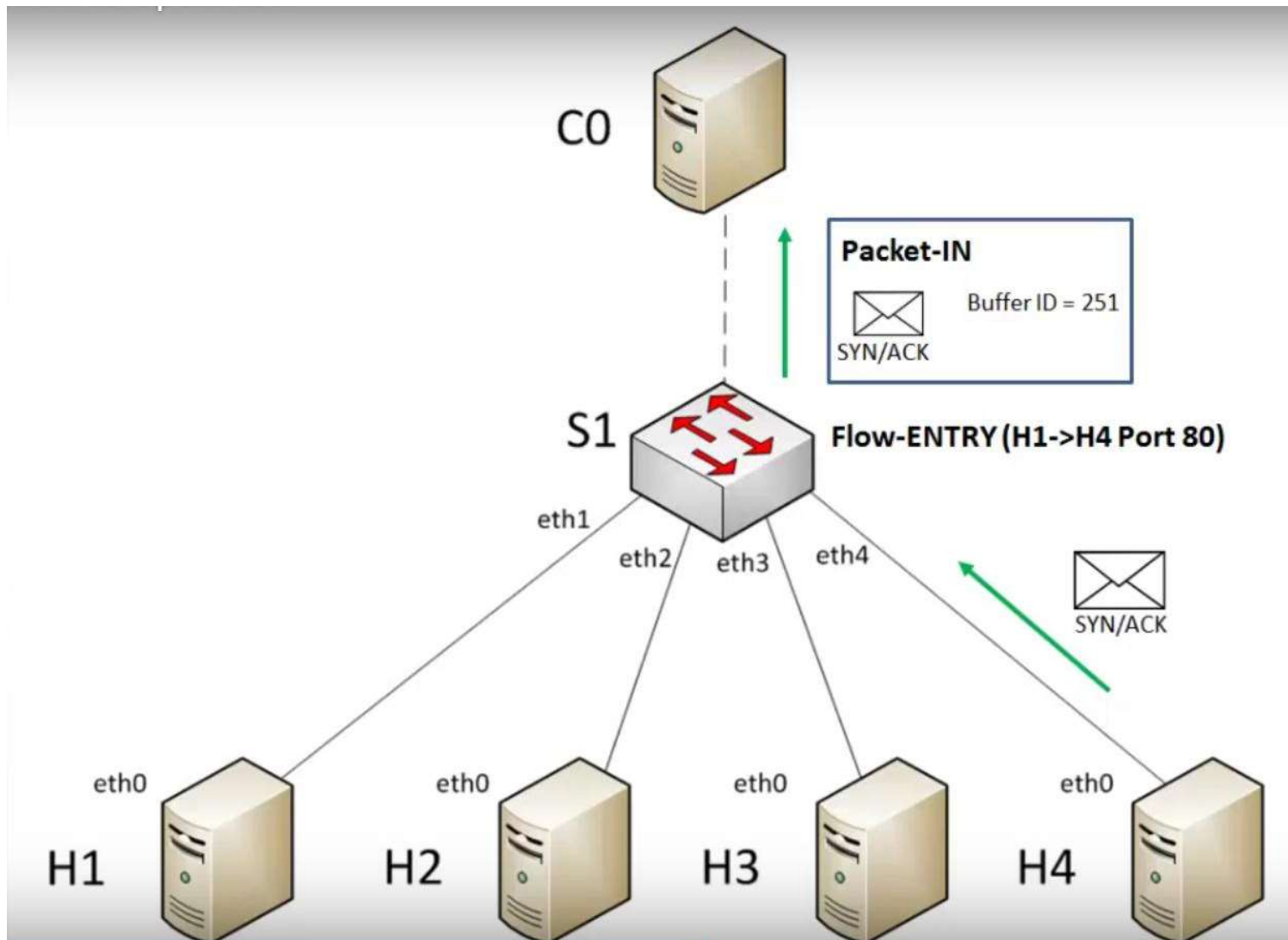


## Príklad (8/14)





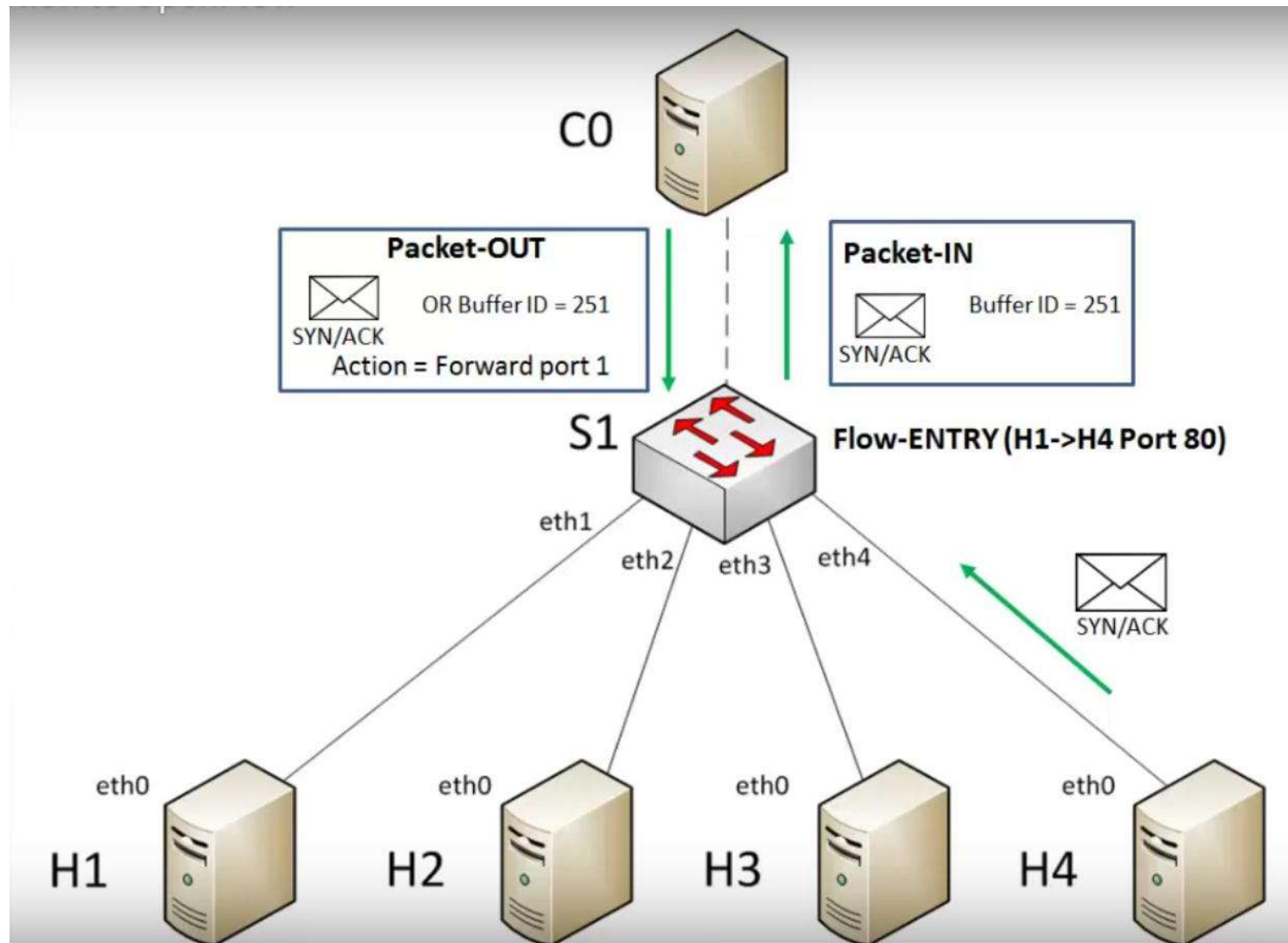
## Príklad (9/14)





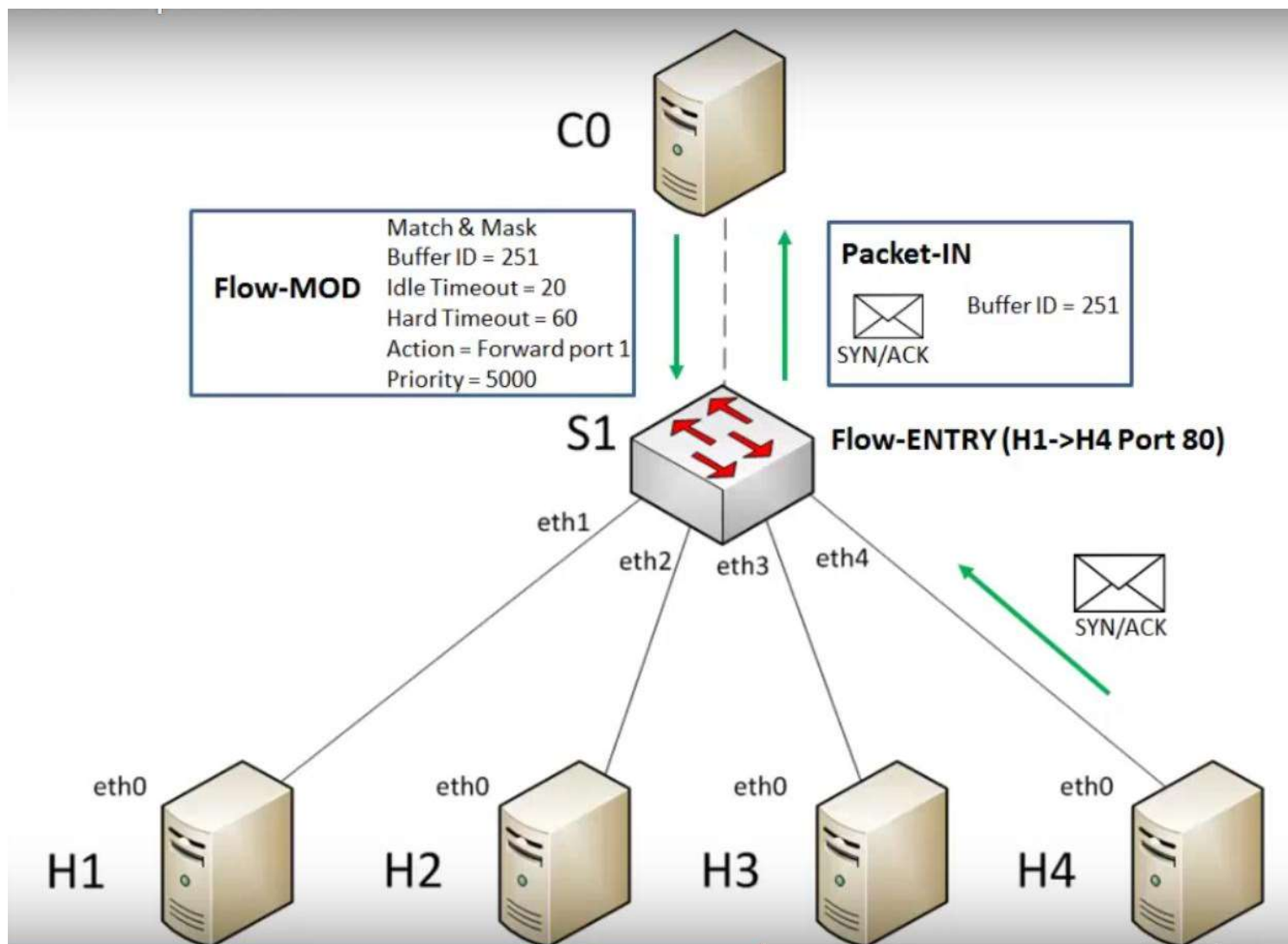


## Príklad (10/14)



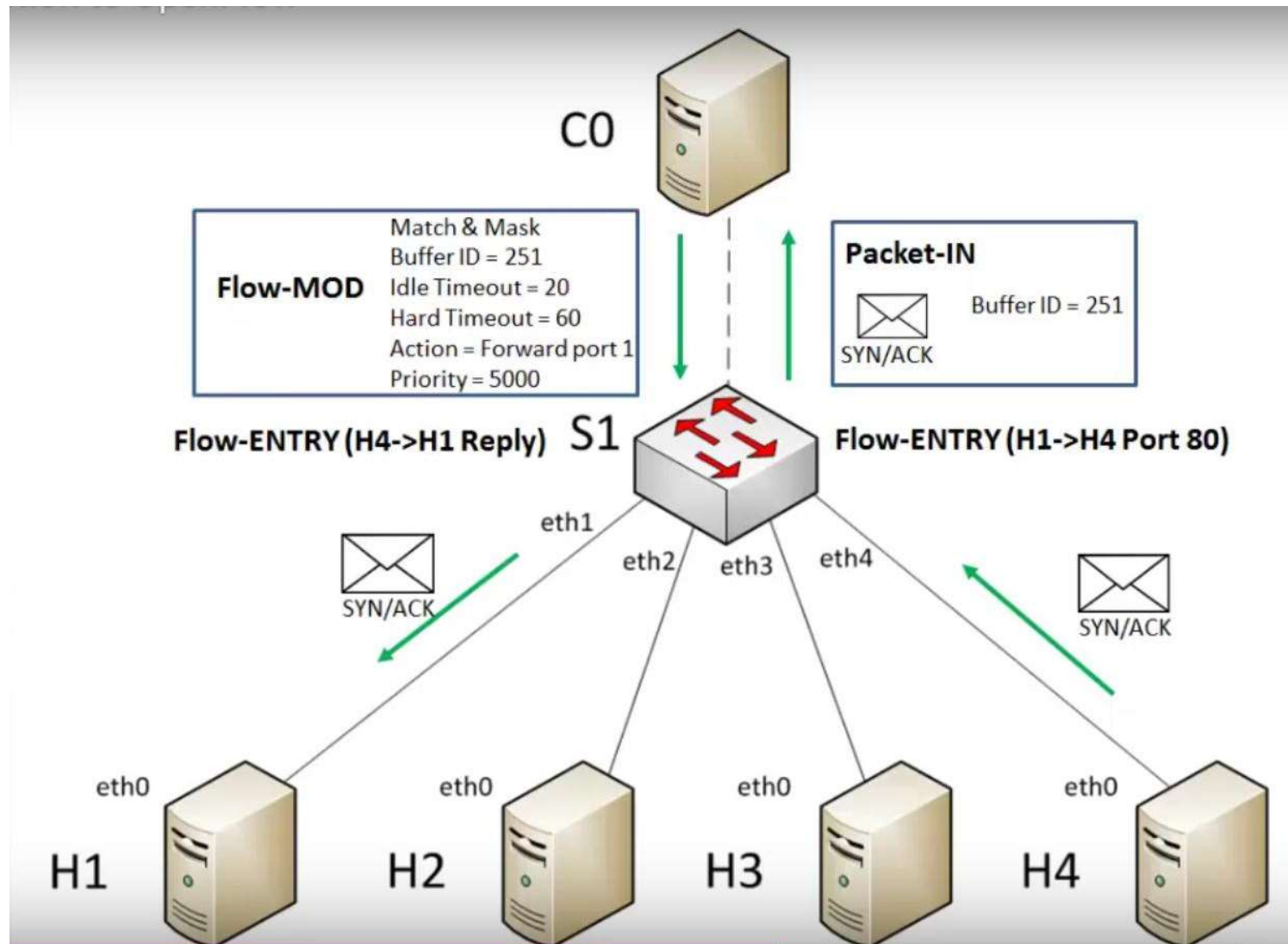


## Príklad (11/14)



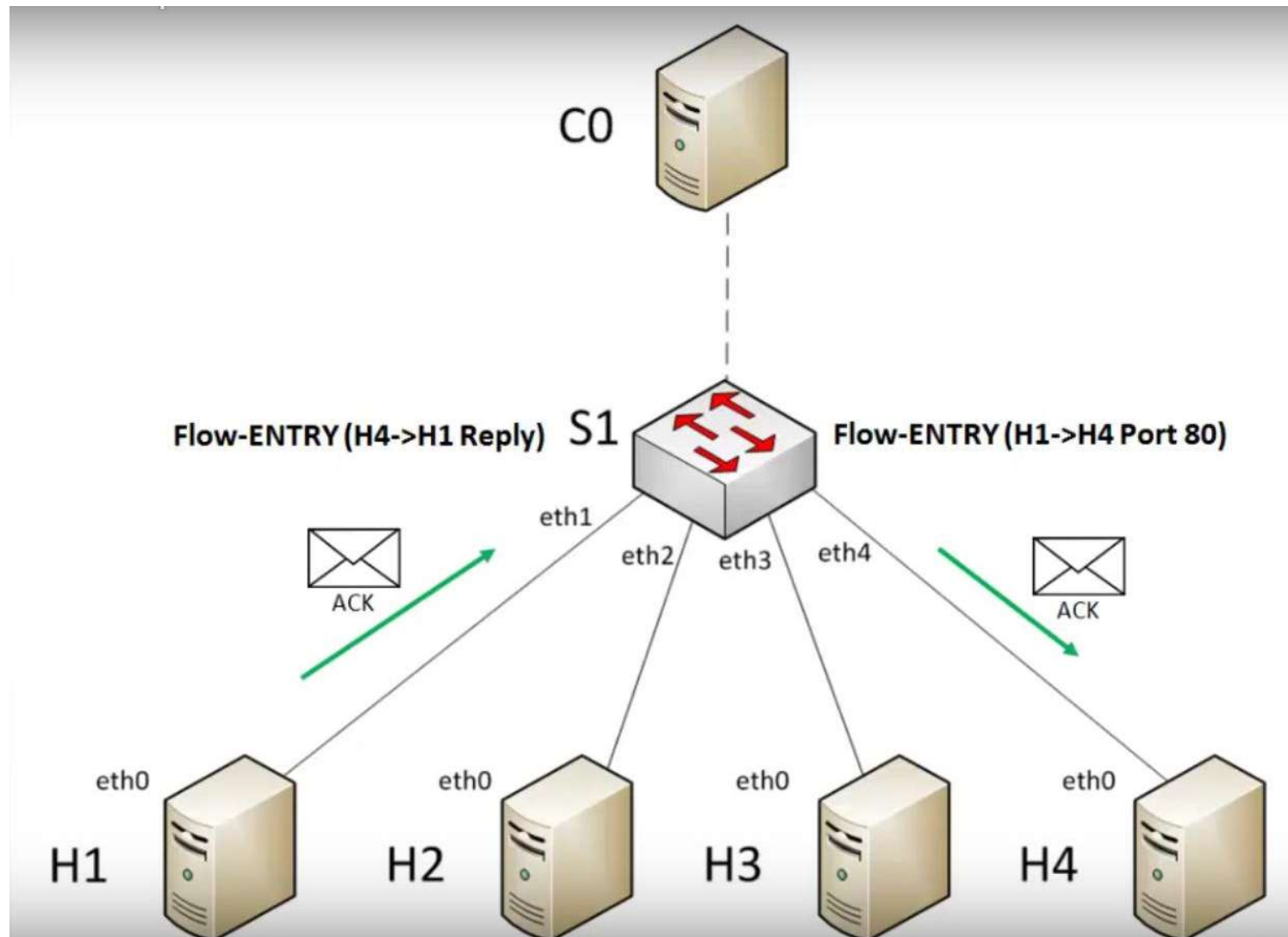


## Príklad (12/14)





## Príklad (13/14)





## Príklad (14/14)

