



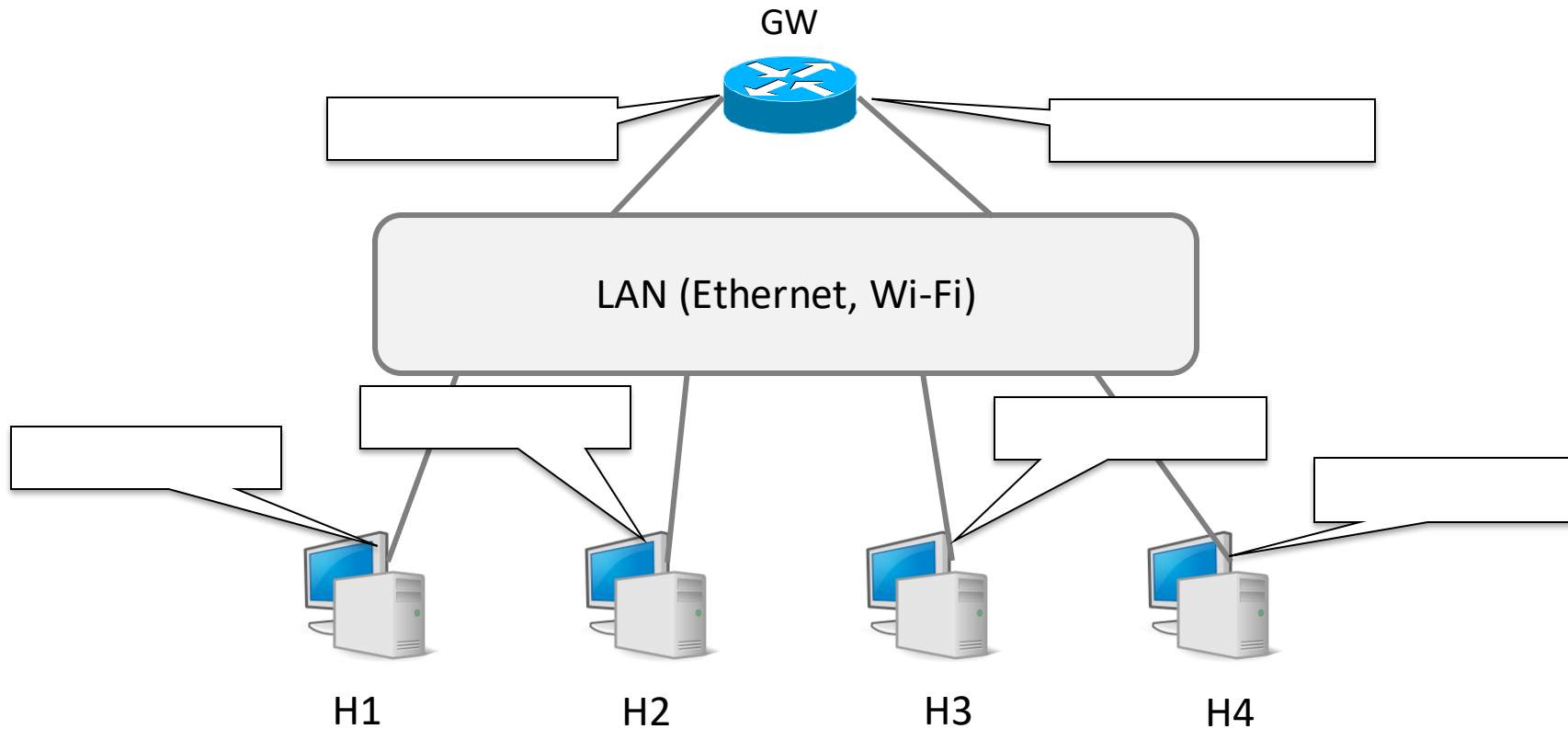
ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA

# Esempio IP forwarding

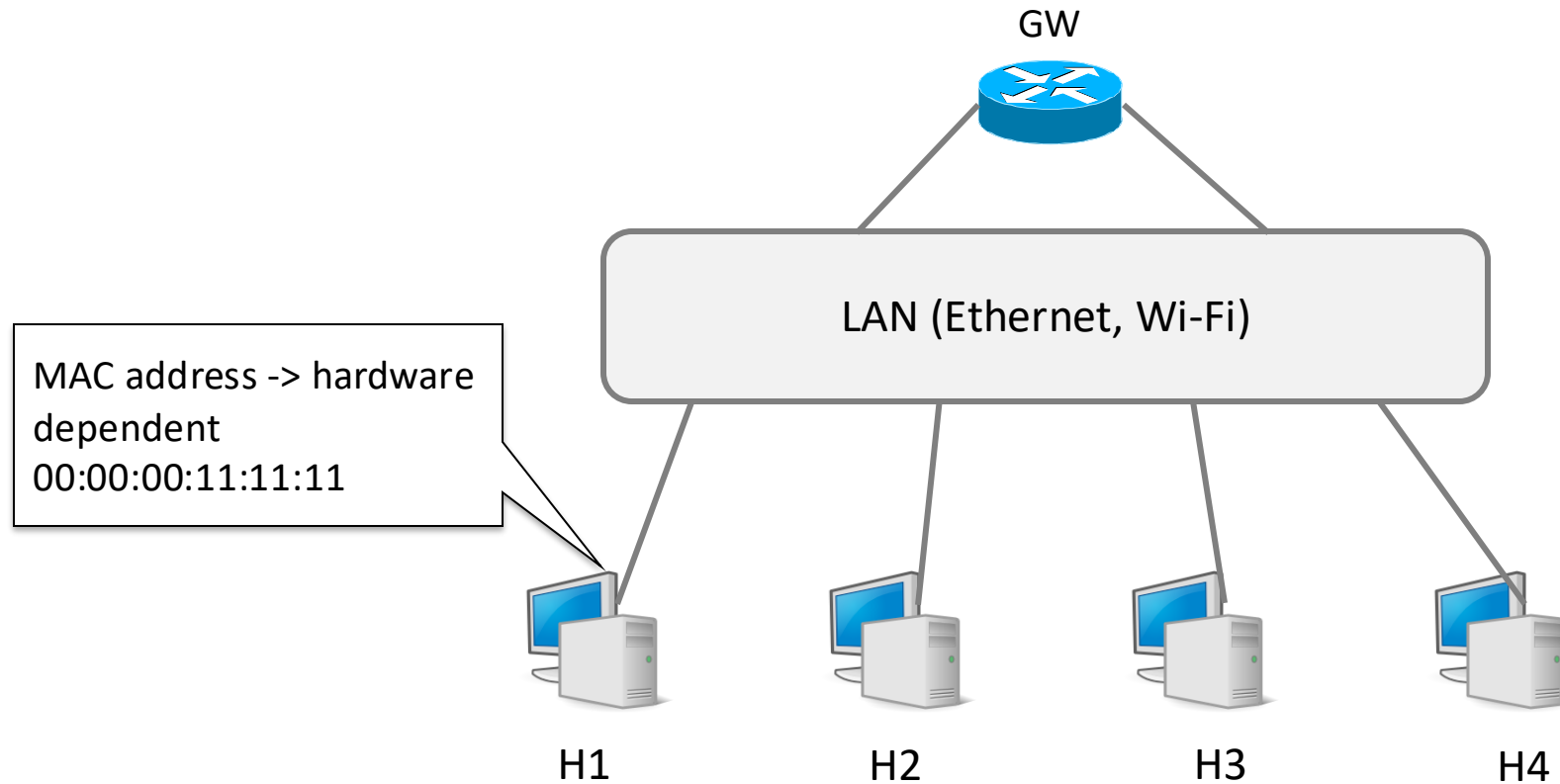
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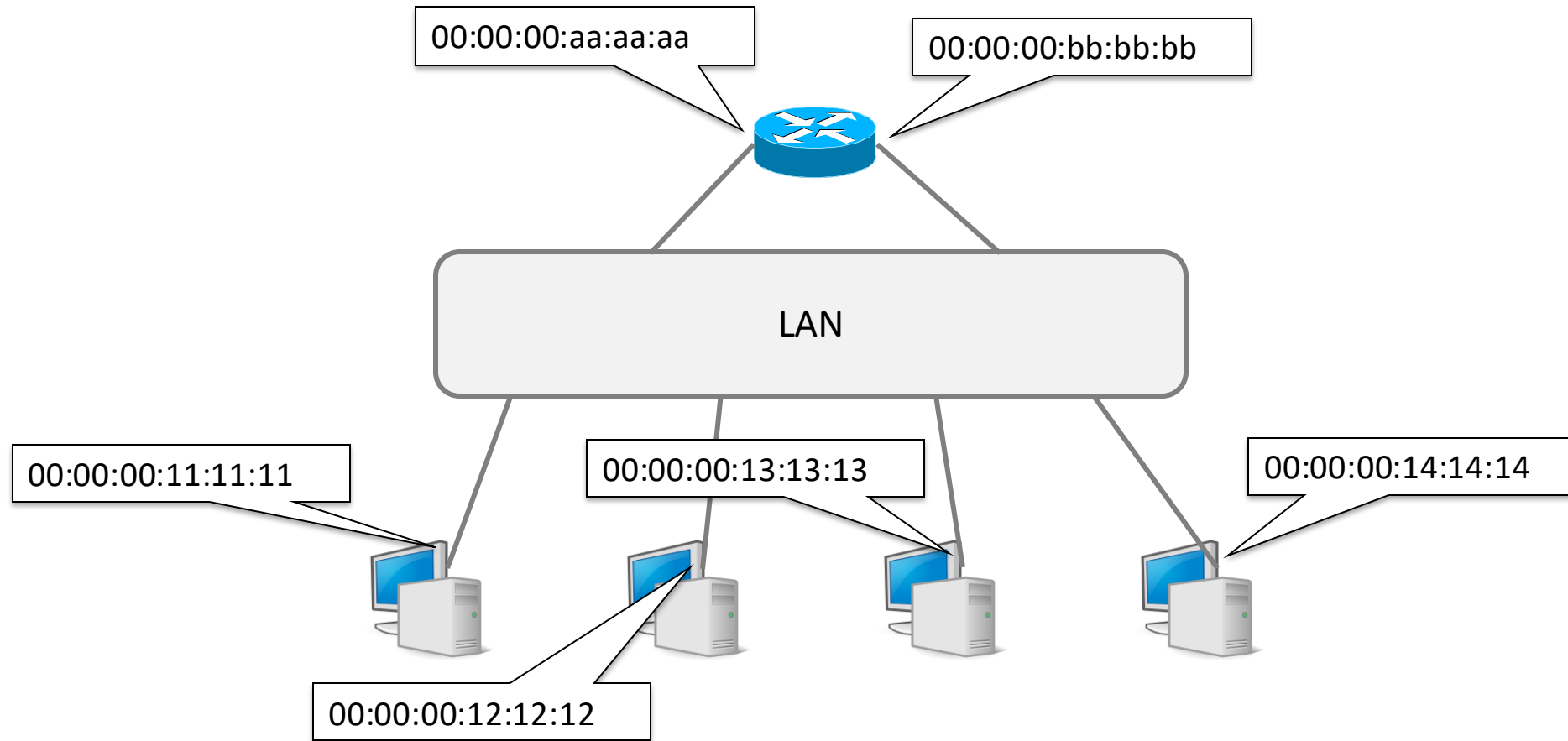
# Topologia: le interfacce non sono configurate



# Topologia: i MAC address sono legati all'hardware

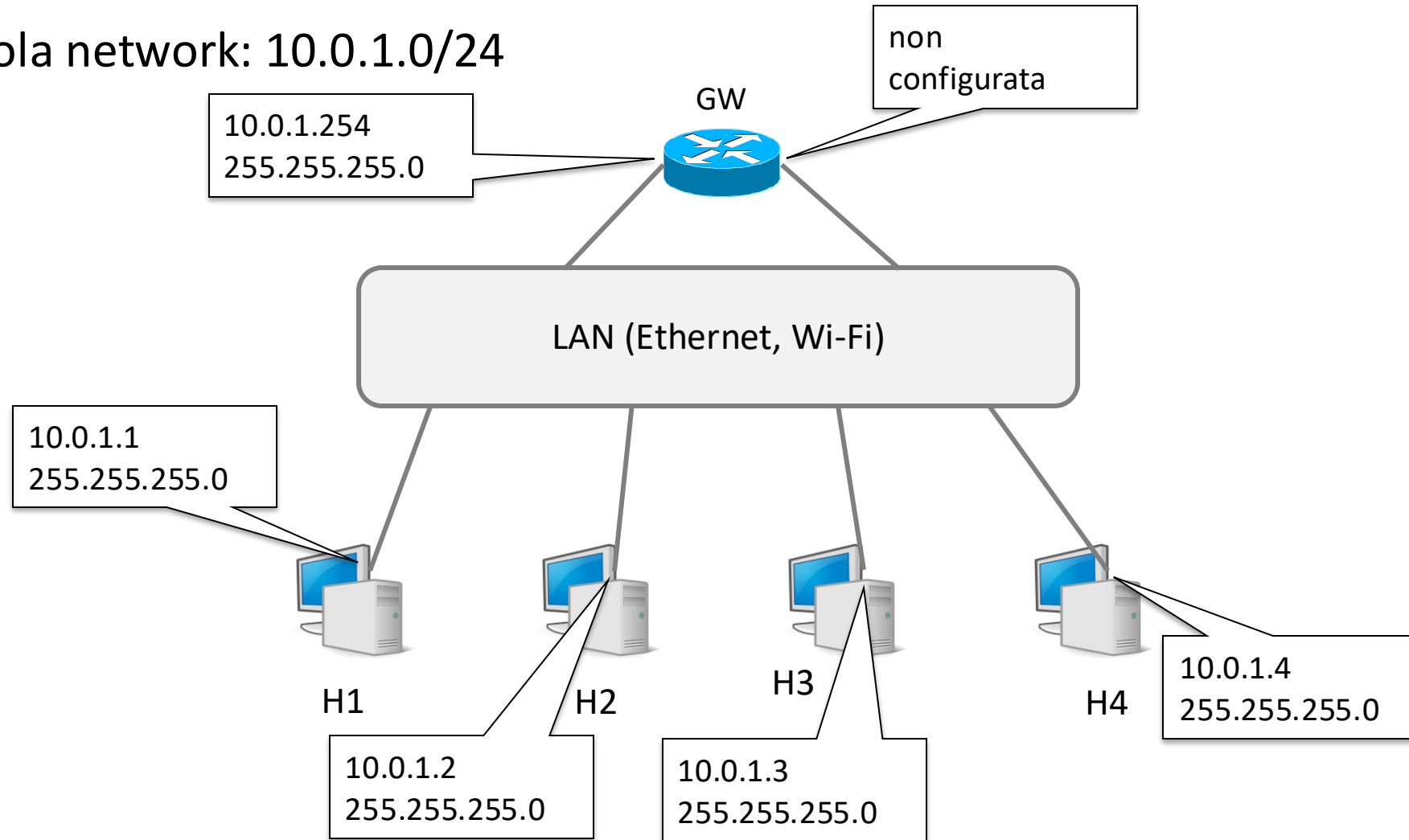


# MAC addresses



# Configurazione IP

Una sola network: 10.0.1.0/24



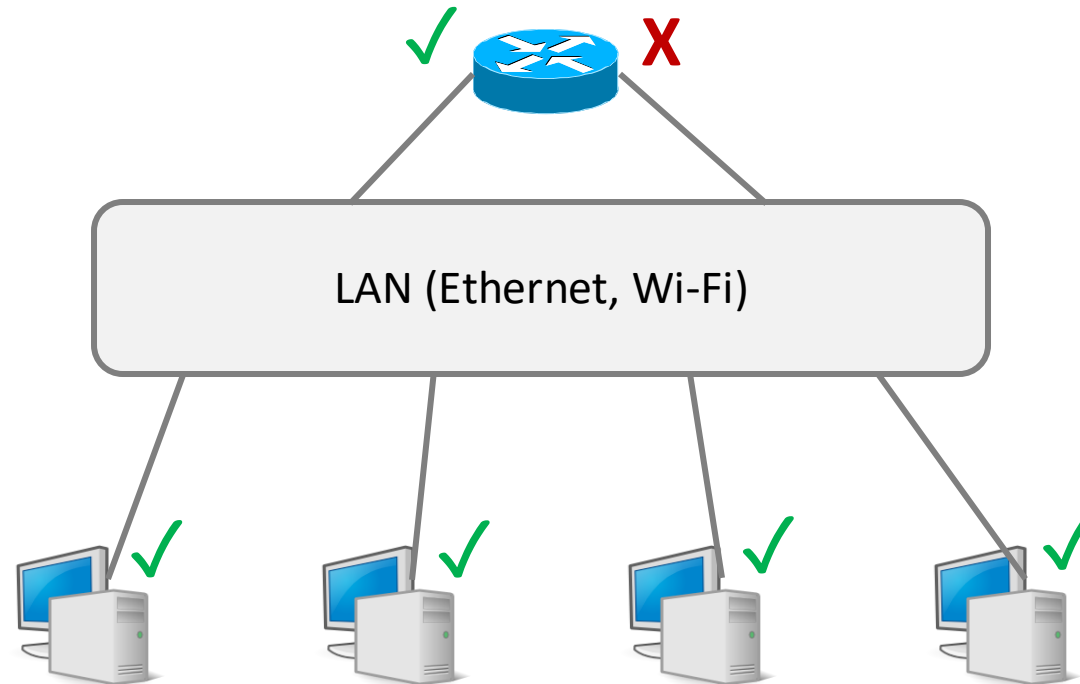
# Tabella di instradamento

- Uguale per tutti gli host
- Contiene informazioni solamente sulla network di appartenenza
- Viene compilata in modo automatico a partire dalla configurazione

Destination	Netmask	Gateway	Interface
10.0.1.0	255.255.255.0	on-link	eth0

# Raggiungibilità

Vedi ping\_H1\_H2.pcapng



Da H1 a H2

1. Da H1 arp request verso 10.0.1.2
2. H1 scopre così che il Mac address di 10.0.1.2 è 00:00:00:12:12:12
3. H1 invia un pacchetto data link al MAC address 00:00:00:12:12:12 con indirizzo di destinazione IP 10.0.1.2
4. H2 riceve il pacchetto dal data link e lo elabora a livello IP



# Raggiungibilità

## Configurazione interfaccia

```
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN group default qlen 1000
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
18: veth0@if17: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
   link/ether 00:00:00:11:11:11 brd ff:ff:ff:ff:ff:ff link-netnsid 0
```

## Manca la configurazione IP quindi

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
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## Se aggiungo la configurazione IP (indirizzo e netmask)

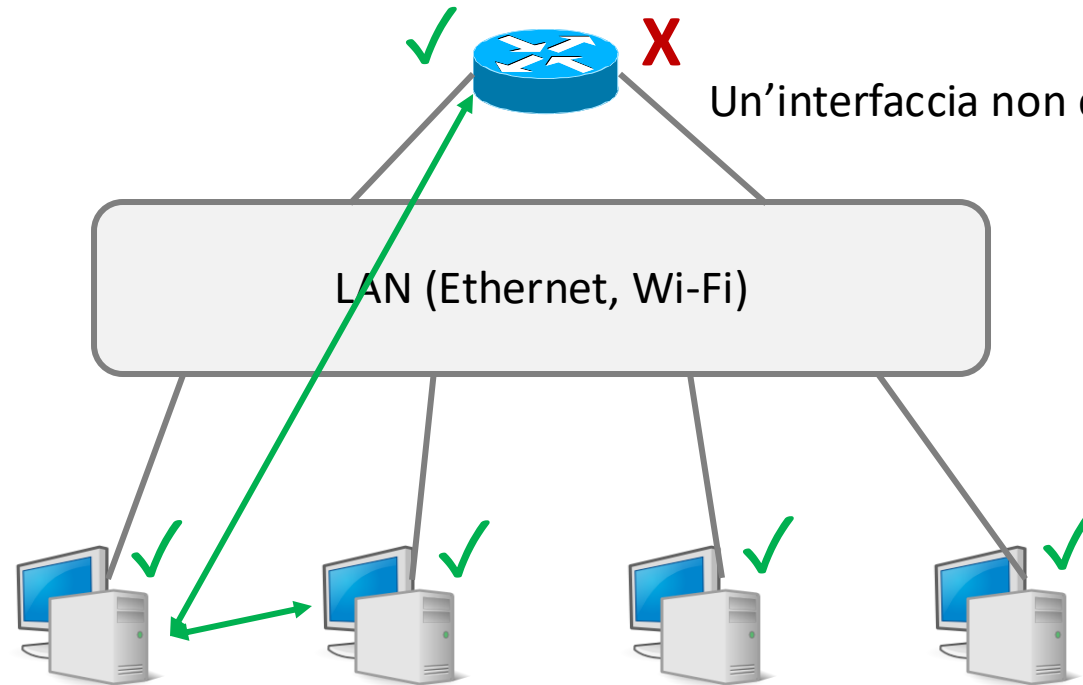
```
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN group default qlen 1000
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
32: veth0@if31: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
   link/ether 00:00:00:11:11:11 brd ff:ff:ff:ff:ff:ff link-netnsid 0
   inet 10.0.1.1/24 scope global veth0
       valid_lft forever preferred_lft forever
```

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
10.0.1.0	0.0.0.0	255.255.255.0	U	0	0	0	veth0



# Chi può parlare con chi



# Configuriamo anche la seconda interfaccia

Vedi ping\_G1.pcapng  
ping\_G1.pcapng

Utilizzo il numero IP 10.0.1.253

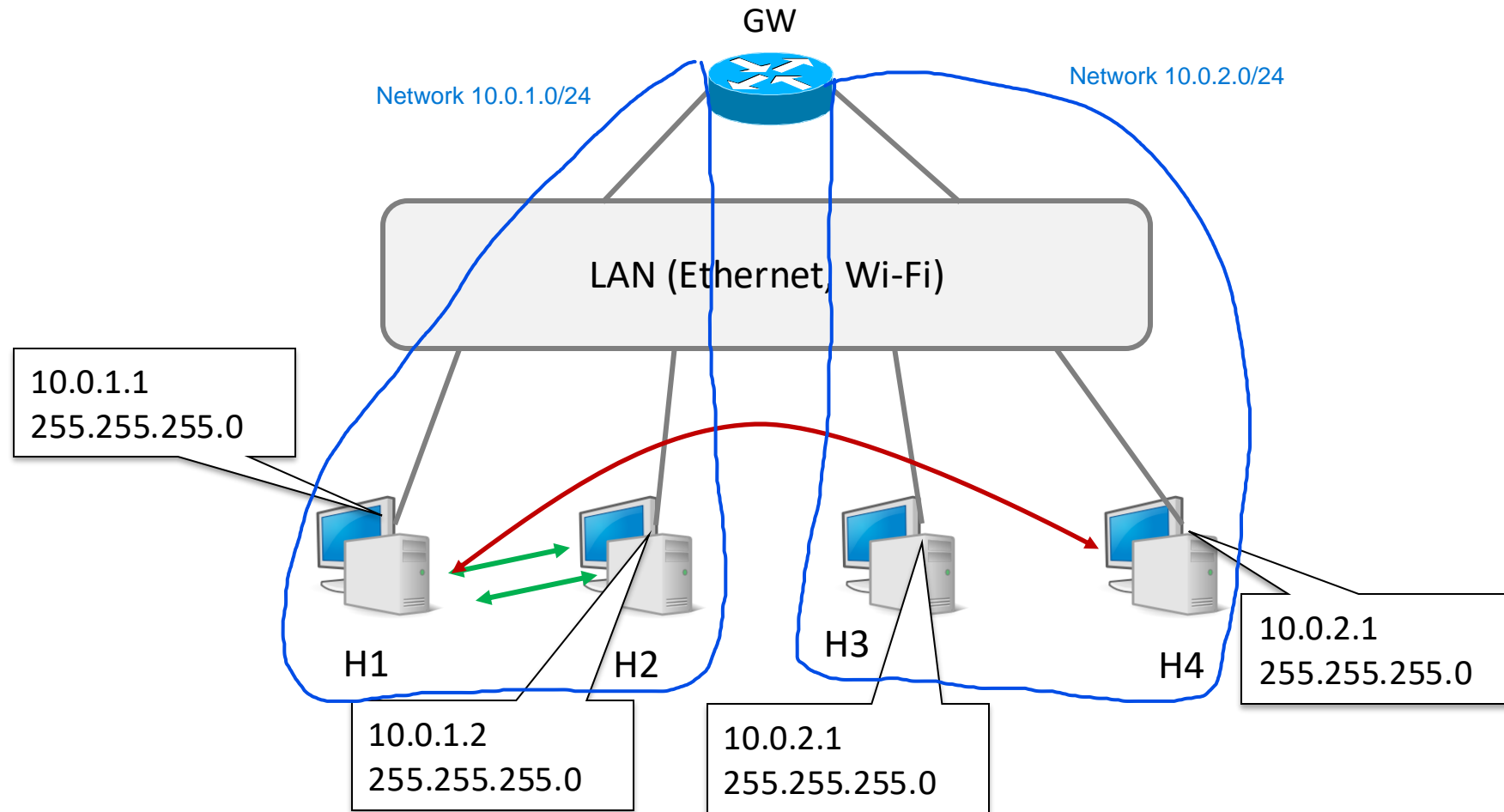
```
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
40: veth1@if39: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen
1000
    link/ether 00:00:00:aa:aa:aa brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.0.1.254/24 scope global veth1
        valid_lft forever preferred_lft forever
42: veth2@if41: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen
1000
    link/ether 00:00:00:bb:bb:bb brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.0.1.253/24 scope global veth2
        valid_lft forever preferred_lft forever
```

La tabella di instradamento contiene 2 righe identiche, dovute rispettivamente alla configurazione delle interfacce veth1 e veth2

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
10.0.1.0	0.0.0.0	255.255.255.0	U	0	0	0	veth1
10.0.1.0	0.0.0.0	255.255.255.0	U	0	0	0	veth2

# Due network



# Importanza del gateway

## Interfaccia

```
ping -c 3 10.0.2.1
ping: connect: Network is unreachable
```

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
10.0.1.0	0.0.0.0	255.255.255.0	U	0	0	0	veth0

Non ci sono indicazioni per 10.0.2.0 ?

Aggiungiamo un gateway di default

Vedi ping\_GW\_noroute.pcapng

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
<b>0.0.0.0</b>	<b>10.0.1.254</b>	<b>0.0.0.0</b>	<b>UG</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>veth0</b>
10.0.1.0	0.0.0.0	255.255.255.0	U	0	0	0	veth0

```
$ sudo ip netns exec H11 ping -c 3 10.0.2.1
PING 10.0.2.1 (10.0.2.1) 56(84) bytes of data.
From 10.0.1.254 icmp_seq=1 Destination Net Unreachable
From 10.0.1.254 icmp_seq=2 Destination Net Unreachable
From 10.0.1.254 icmp_seq=3 Destination Net Unreachable
```

```
--- 10.0.2.1 ping statistics ---
```

```
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2044ms
```

# Riconfigurazione del gateway

## Dopo

```
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN group default qlen 1000
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
40: veth1@if39: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
   link/ether 00:00:00:aa:aa:aa brd ff:ff:ff:ff:ff:ff link-netnsid 0
   inet 10.0.1.254/24 scope global veth1
       valid_lft forever preferred_lft forever
42: veth2@if41: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
   link/ether 00:00:00:bb:bb:bb brd ff:ff:ff:ff:ff:ff link-netnsid 0
   inet 10.0.2.254/24 scope global veth2
       valid_lft forever preferred_lft forever
```

## Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
10.0.1.0	0.0.0.0	255.255.255.0	U	0	0	0	veth1
<b>10.0.2.0</b>	<b>0.0.0.0</b>	<b>255.255.255.0</b>	<b>U</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>veth2</b>

# Raggiungibilità

Vedi ping\_GW\_oneway.pcapng

## H11

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
0.0.0.0	10.0.1.254	0.0.0.0	UG	0	0	0	veth0
10.0.1.0	0.0.0.0	255.255.255.0	U	0	0	0	veth0

## H13

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
10.0.2.0	0.0.0.0	255.255.255.0	U	0	0	0	veth0

PING 10.0.2.1 (10.0.2.1) 56(84) bytes of data.

--- 10.0.2.1 ping statistics ---

3 packets transmitted, 0 received, 100% packet loss, time 2050ms

C'è consapevolezza del percorso di andata, ma non di quello di ritorno

# Raggiungibilità

Vedi ping\_GW\_OK.pcapng

Configuro correttamente anche i calcolatori della network 10.0.2.0/24

Kernel IP routing table

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
0.0.0.0	10.0.2.254	0.0.0.0	UG	0	0	0	veth0
10.0.2.0	0.0.0.0	255.255.255.0	U	0	0	0	veth0

Ed ora finalmente c'è la raggiungibilità



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