



Reti di Calcolatori I

Esercitazione su routing IP con OSPF

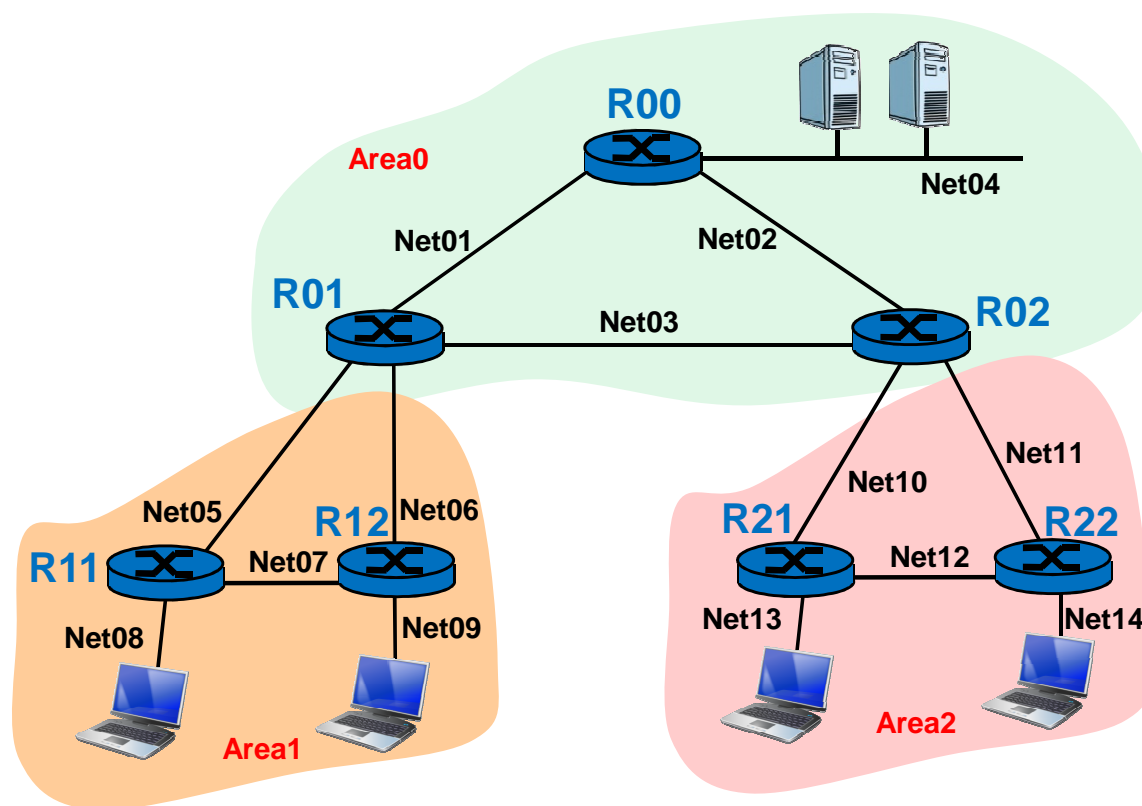
Prof. Roberto Canonico

Dipartimento di Ingegneria Elettrica e delle Tecnologie dell'Informazione

Corso di Laurea in Ingegneria delle Telecomunicazioni

Corso di Laurea in Ingegneria dell'Automazione

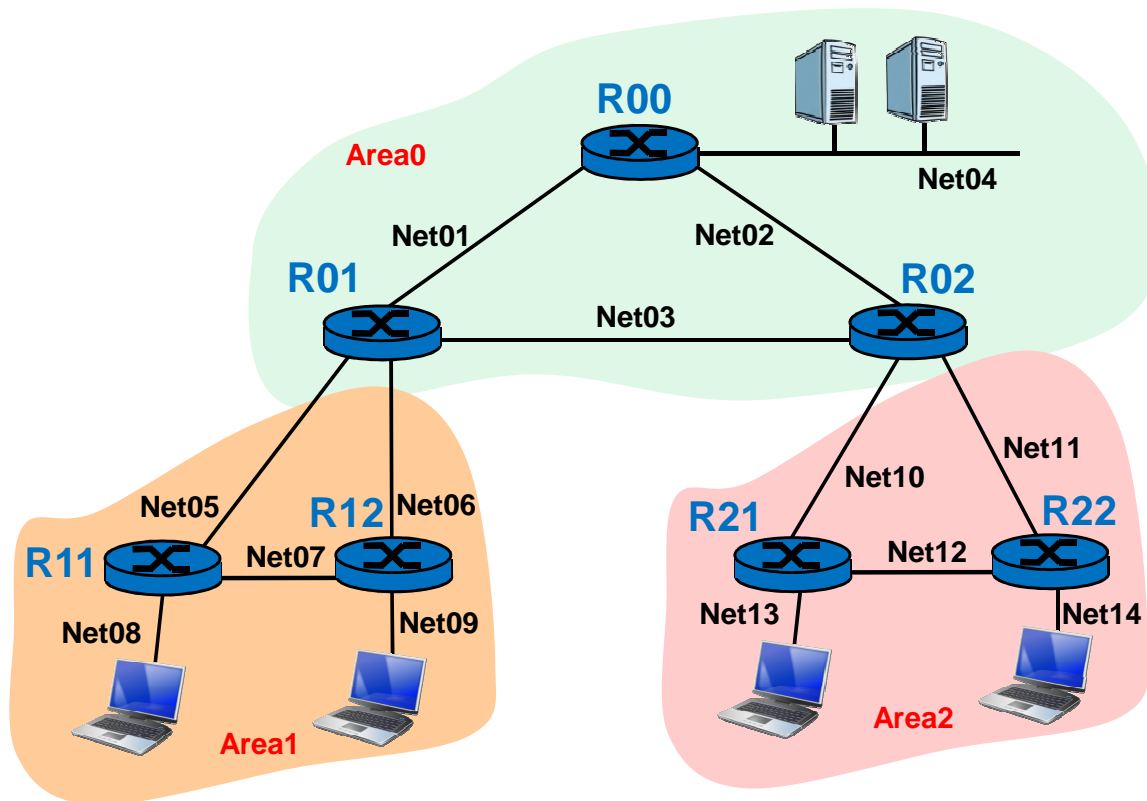
A.A. 2017-2018



- Si riprodurrà tramite emulazione una rete formata da 7 router IP e 6 end-system
- Sia i router che gli end-system sono realizzati da Linux Container LXC eseguiti in una VM Linux
- Per l'indirizzamento, si ha a disposizione il blocco di 128 indirizzi 192.168.24.0/25
- La topologia della rete richiede 14 subnet: Net01, Net02, ..., Net14
- La configurazione dei container (es. le NIC virtuali) è definita in un file di testo:


```
/var/lib/lxc/NOME_CONTAINER/config
```
- I collegamenti tra le NIC virtuali dei container sono realizzati mediante Linux Bridge
 - Un Linux Bridge per ciascuna subnet
 - Ciascun Linux Bridge è identificato dal nome **lxcbrID** dove ID = 1, 2, ..., 14
 - Il bridge lxcbr0 è usato per collegare il router R00 all'host che ospita i container

Si ha a disposizione il blocco di 128 indirizzi 192.168.24.0/25

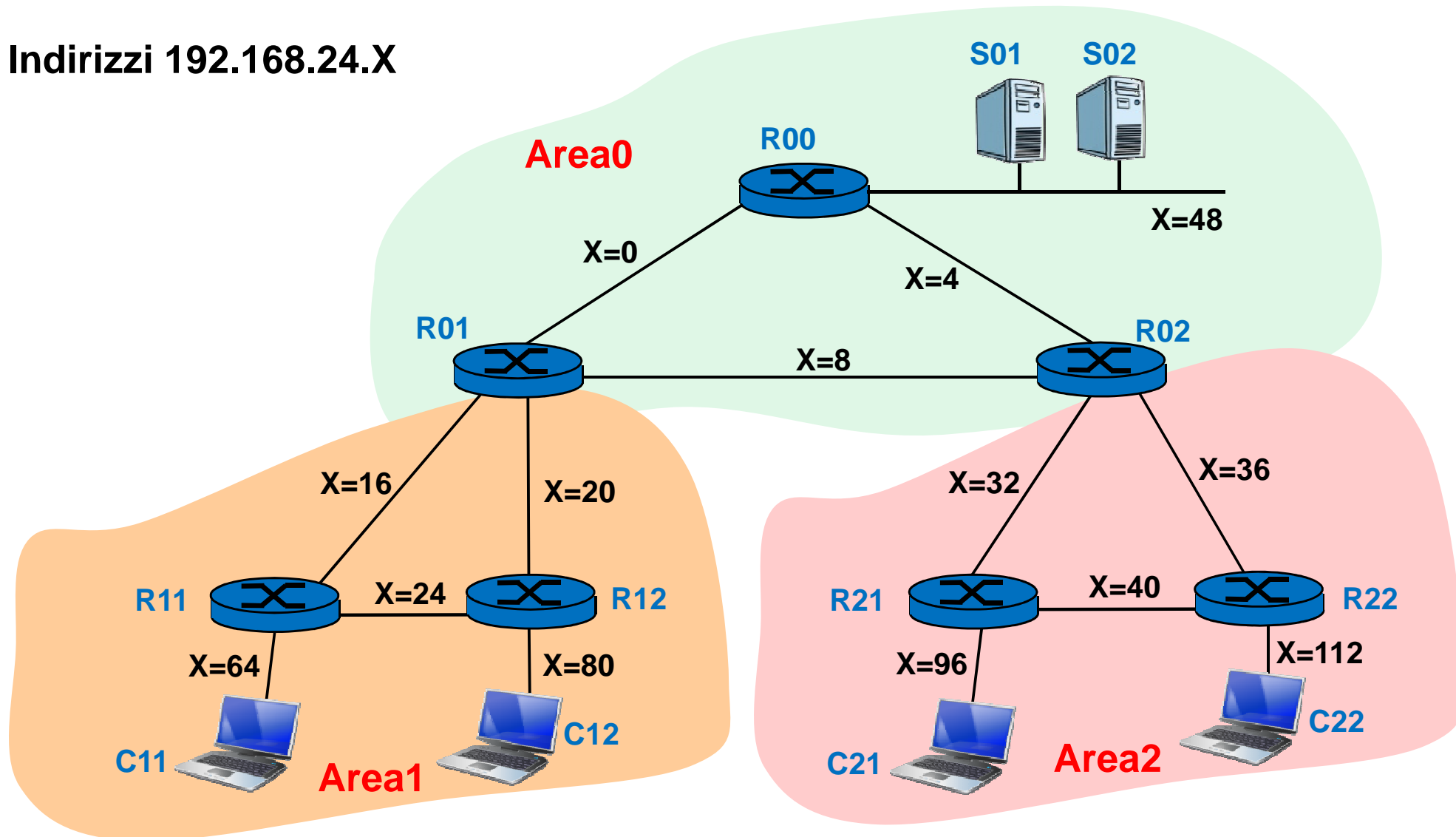


Nome	Indirizzo subnet	Range indirizzi 192.168.24.x	Numero indirizzi
Net01	192.168.24.0 /30	x in 0 ÷ 3	4
Net02	192.168.24.4 /30	x in 4 ÷ 7	4
Net03	192.168.24.8 /30	x in 8 ÷ 11	4
	192.168.24.12 /30	x in 12 ÷ 15	4
Net05	192.168.24.16 /30	x in 16 ÷ 19	4
Net06	192.168.24.20 /30	x in 20 ÷ 23	4
Net07	192.168.24.24 /30	x in 24 ÷ 27	4
	192.168.24.28 /30	x in 28 ÷ 31	4
Net10	192.168.24.32 /30	x in 32 ÷ 35	4
Net11	192.168.24.36 /30	x in 36 ÷ 39	4
Net12	192.168.24.40 /30	x in 40 ÷ 43	4
	192.168.24.44 /30	x in 44 ÷ 47	4
Net04	192.168.24.48 /28	x in 48 ÷ 63	16
Net08	192.168.24.64 /28	x in 64 ÷ 79	16
Net09	192.168.24.80 /28	x in 80 ÷ 95	16
Net13	192.168.24.96 /28	x in 96 ÷ 111	16
Net14	192.168.24.112 /28	x in 112 ÷ 127	16
		Totale:	128

- La topologia della rete richiede 14 subnet
- Si effettua un subnetting con netmask a lunghezza variabile
- Si usano subnet con netmask /30 per i 9 collegamenti punto-punto tra i router
- Si usano subnet con netmask /28 per le 5 reti LAN che ospitano gli end-system

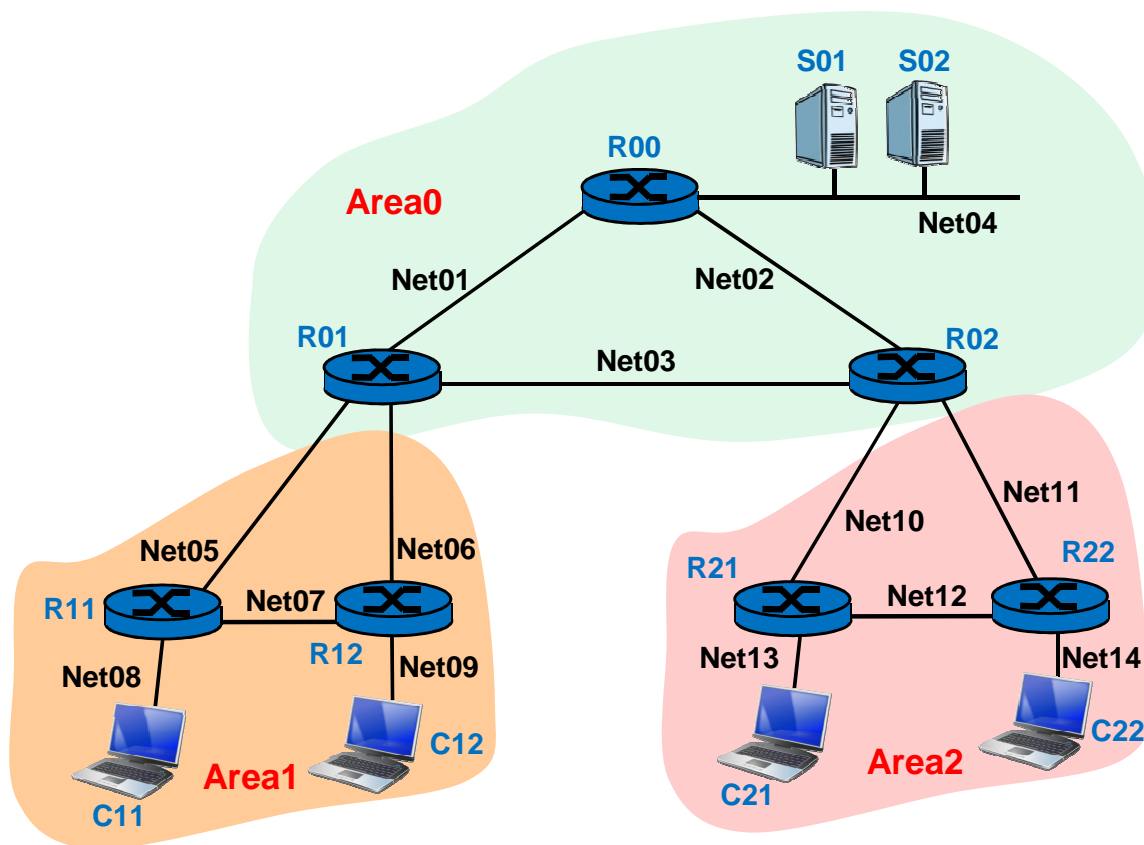
Indirizzi IP delle 14 subnet

Indirizzi 192.168.24.X



I collegamenti tra le i container LXC che realizzano i 7 router ed i 6 end-system sono realizzati mediante Linux Bridge identificati come **lxcbrID** con ID = 1, 2, 3, ..., 14

Configurazione delle interfacce dei router



Net01=192.168.24.0/30

Net04=192.168.24.48/28

Net07=192.168.24.24/30

Net10=192.168.24.32/30

Net13=192.168.24.96/28

Net02=192.168.24.4/30

Net05=192.168.24.16/30

Net08=192.168.24.64/28

Net11=192.168.24.36/30

Net14=192.168.24.112/28

Net03=192.168.24.8/30

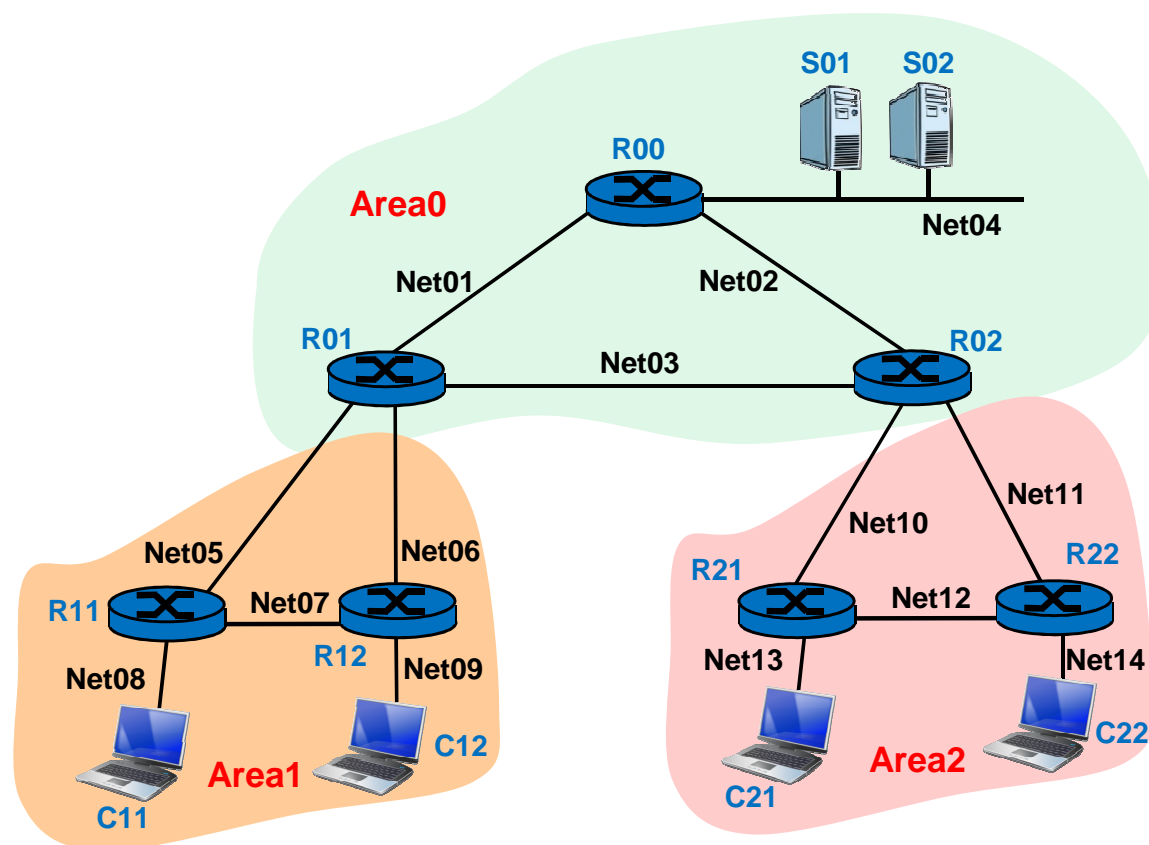
Net06=192.168.24.20/30

Net09=192.168.24.80/28

Net12=192.168.24.40/30

	Dev	Indirizzo /netmask	Netmask	Bridge
R00	eth1	192.168.24.1	/30	lxcbr1
R00	eth2	192.168.24.5	/30	lxcbr2
R00	eth3	192.168.24.49	/28	lxcbr4
R01	eth0	192.168.24.2	/30	lxcbr1
R01	eth1	192.168.24.9	/30	lxcbr3
R01	eth2	192.168.24.17	/30	lxcbr5
R01	eth3	192.168.24.21	/30	lxcbr6
R02	eth0	192.168.24.6	/30	lxcbr2
R02	eth1	192.168.24.10	/30	lxcbr3
R02	eth2	192.168.24.33	/30	lxcbr10
R02	eth3	192.168.24.37	/30	lxcbr11
R11	eth0	192.168.24.18	/30	lxcbr5
R11	eth1	192.168.24.25	/30	lxcbr7
R11	eth2	192.168.24.65	/28	lxcbr8
R12	eth0	192.168.24.22	/30	lxcbr6
R12	eth1	192.168.24.26	/30	lxcbr7
R12	eth2	192.168.24.81	/28	lxcbr9
R21	eth0	192.168.24.34	/30	lxcbr10
R21	eth1	192.168.24.41	/30	lxcbr12
R21	eth2	192.168.24.97	/28	lxcbr13
R22	eth0	192.168.24.38	/30	lxcbr11
R22	eth1	192.168.24.42	/30	lxcbr12
R22	eth2	192.168.24.113	/28	lxcbr14

Configurazione delle interfacce degli end-system



Indirizzi IP assegnati agli end-system

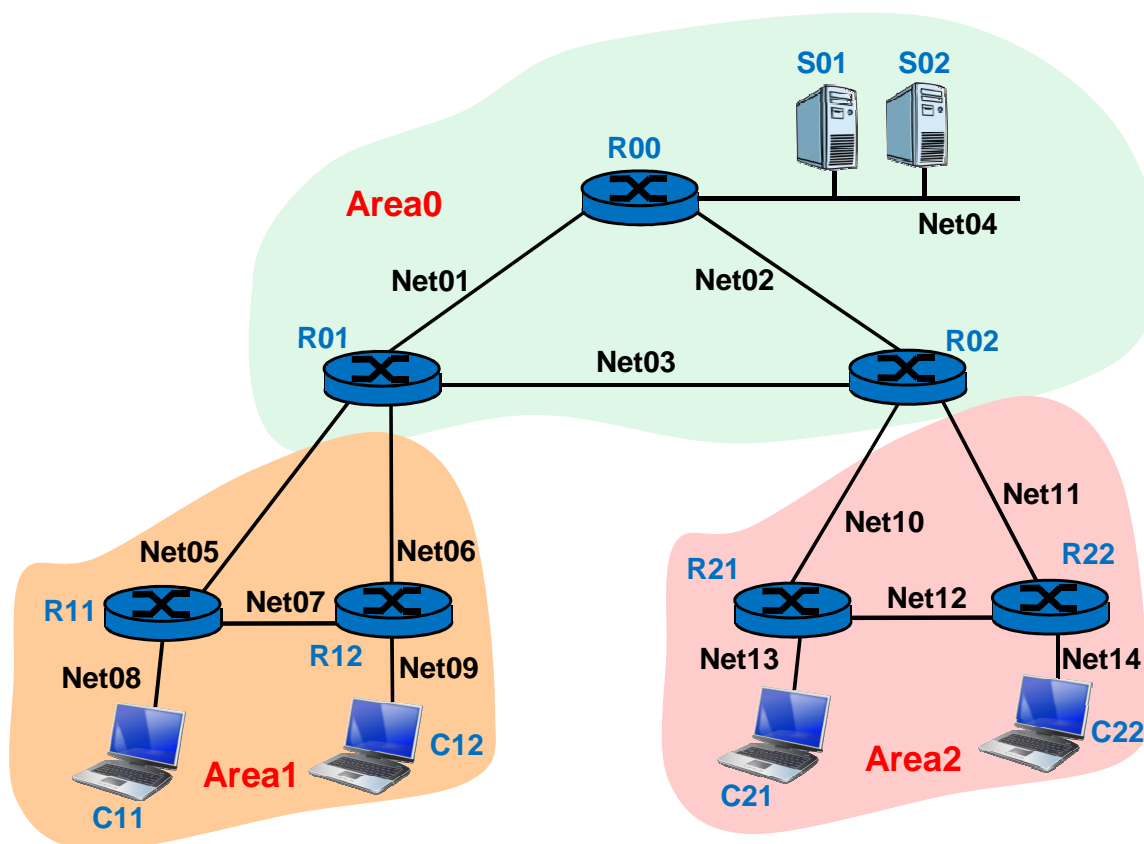
	Dev	Indirizzo /netmask	Bridge
S01	eth0	192.168.24.50/28	lxcbr4
S02	eth0	192.168.24.51/28	lxcbr4
C11	eth0	192.168.24.66/28	lxcbr8
C12	eth0	192.168.24.82/28	lxcbr9
C21	eth0	192.168.24.98/28	lxcbr13
C22	eth0	192.168.24.114/28	lxcbr14

Default router per gli end-system

	Indirizzo default router
S01	192.168.24.49
S02	192.168.24.49
C11	192.168.24.65
C12	192.168.24.81
C21	192.168.24.97
C22	192.168.24.113

Net01=192.168.24.0/30 **Net02**=192.168.24.4/30 **Net03**=192.168.24.8/30
Net04=192.168.24.48/28 **Net05**=192.168.24.16/30 **Net06**=192.168.24.20/30
Net07=192.168.24.24/30 **Net08**=192.168.24.64/28 **Net09**=192.168.24.80/28
Net10=192.168.24.32/30 **Net11**=192.168.24.36/30 **Net12**=192.168.24.40/30
Net13=192.168.24.96/28 **Net14**=192.168.24.112/28

Routing table in R11



- Nota: da R11 a Net06 ci sono due rotte: via R01 e via R12

Routing table in R11 subito dopo lo startup

```

C>* 127.0.0.0/8 is directly connected, lo
O 192.168.24.16/30 [110/10] is directly connected, eth0, 00:00:32
C>* 192.168.24.16/30 is directly connected, eth0
O 192.168.24.24/30 [110/10] is directly connected, eth1, 00:00:32
C>* 192.168.24.24/30 is directly connected, eth1
O 192.168.24.64/28 [110/10] is directly connected, eth2, 00:00:32
C>* 192.168.24.64/28 is directly connected, eth2
  
```

Routing table in R11 dopo lo scambio di LSP

```

C>* 127.0.0.0/8 is directly connected, lo
O>* 192.168.24.0/30 [110/20] via 192.168.24.17, eth0, 00:01:36
O>* 192.168.24.4/30 [110/30] via 192.168.24.17, eth0, 00:01:36
O>* 192.168.24.8/30 [110/20] via 192.168.24.17, eth0, 00:01:36
O 192.168.24.16/30 [110/10] is directly connected, eth0, 00:02:22
C>* 192.168.24.16/30 is directly connected, eth0
O>* 192.168.24.20/30 [110/20] via 192.168.24.17, eth0, 00:01:22
*
  via 192.168.24.26, eth1, 00:01:22
O 192.168.24.24/30 [110/10] is directly connected, eth1, 00:02:22
C>* 192.168.24.24/30 is directly connected, eth1
O>* 192.168.24.32/30 [110/30] via 192.168.24.17, eth0, 00:01:36
O>* 192.168.24.36/30 [110/30] via 192.168.24.17, eth0, 00:01:36
O>* 192.168.24.40/30 [110/40] via 192.168.24.17, eth0, 00:01:34
O>* 192.168.24.48/28 [110/30] via 192.168.24.17, eth0, 00:01:27
O 192.168.24.64/28 [110/10] is directly connected, eth2, 00:02:22
C>* 192.168.24.64/28 is directly connected, eth2
O>* 192.168.24.80/28 [110/20] via 192.168.24.26, eth1, 00:01:22
O>* 192.168.24.96/28 [110/40] via 192.168.24.17, eth0, 00:01:34
O>* 192.168.24.112/28 [110/40] via 192.168.24.17, eth0, 00:01:34
  
```