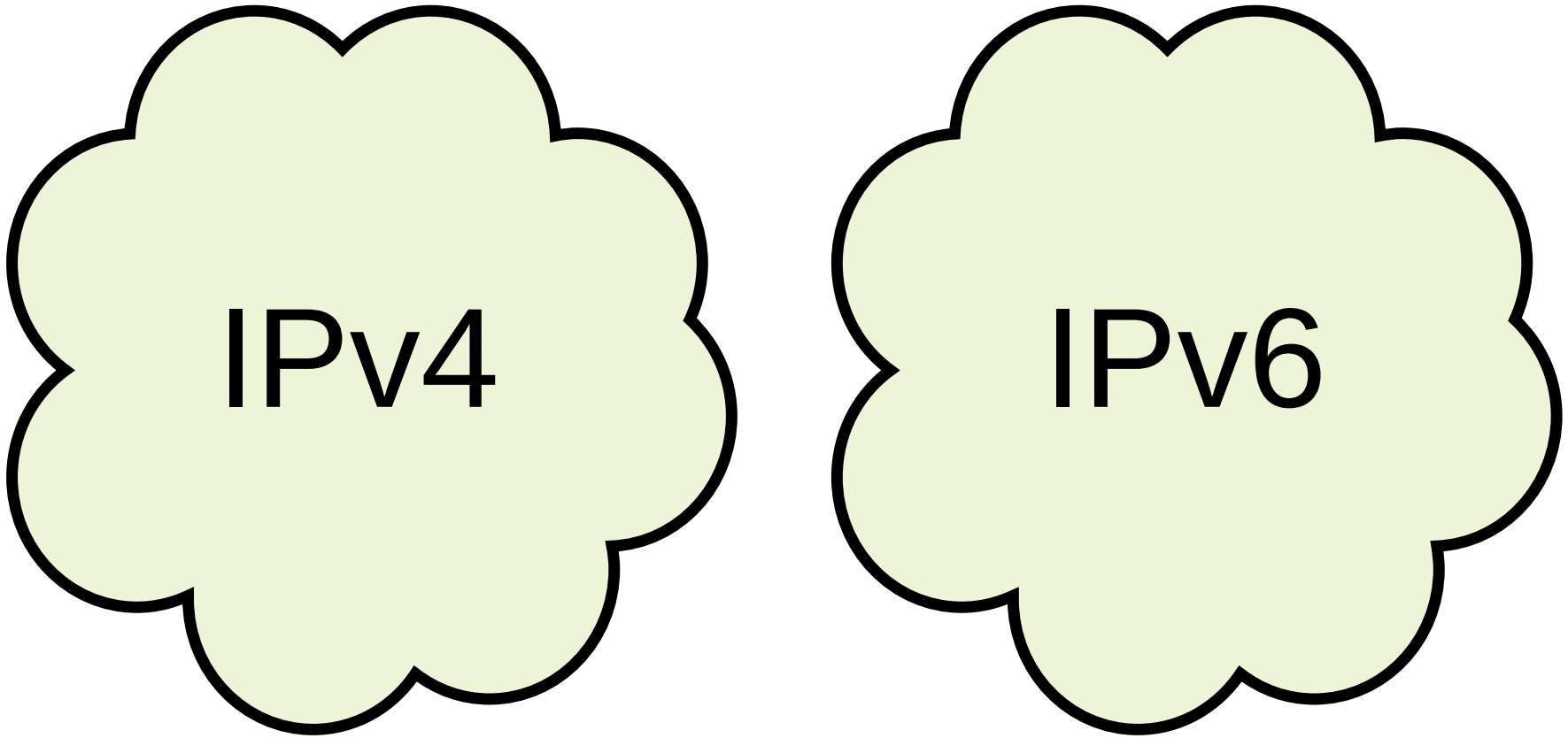
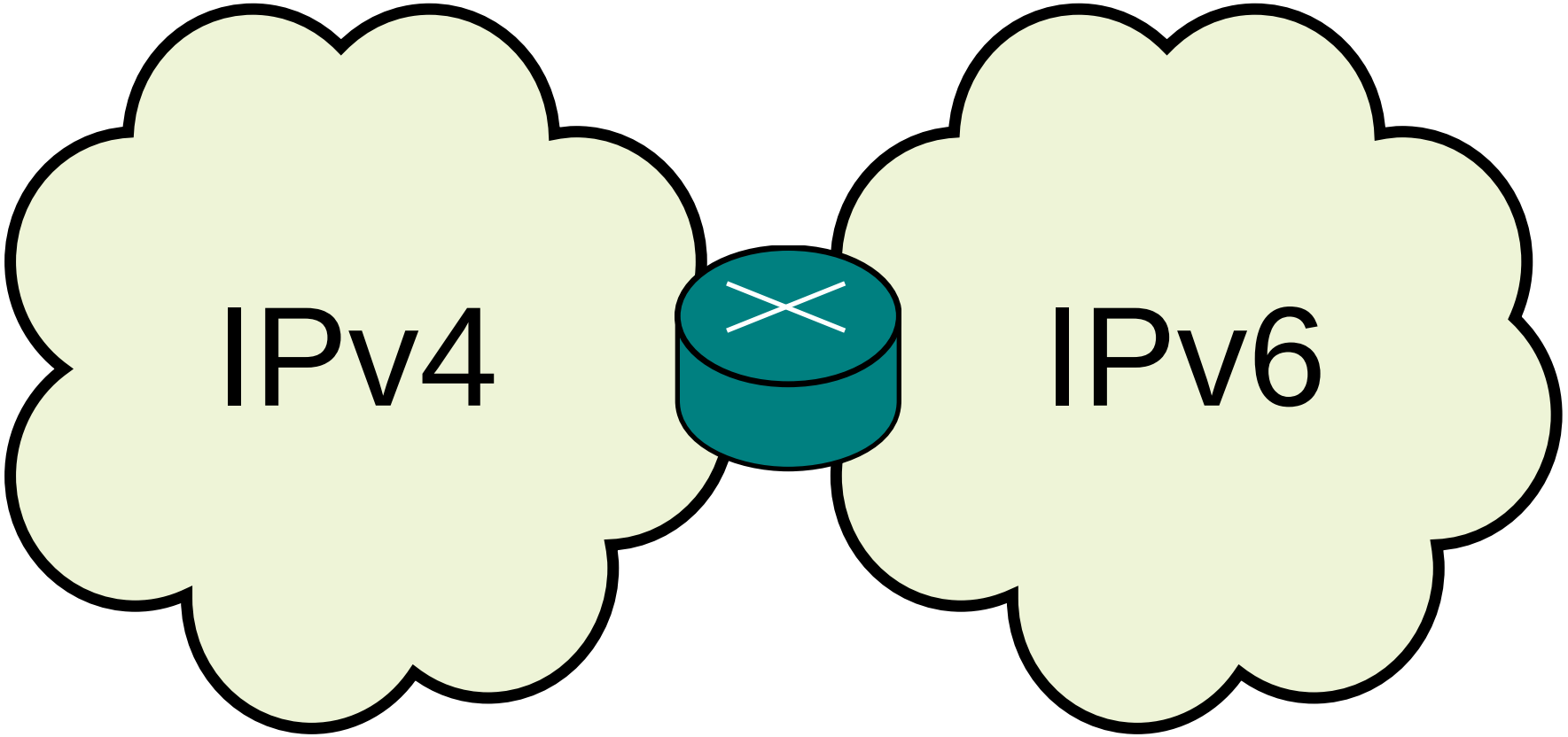
Jool

SIIT & NAT64

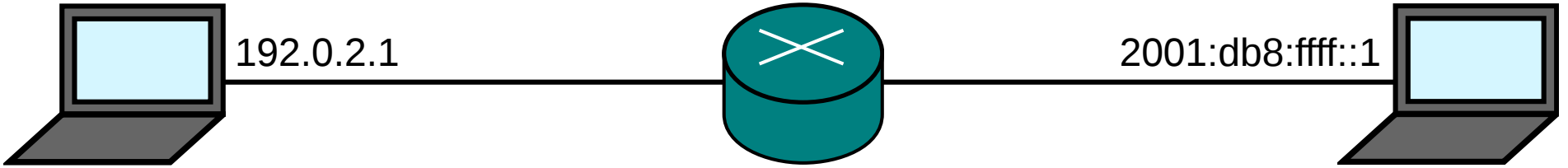
Problemática



Traducción IP



Traducción IP



MAC	01:01:01:01:01:01 02:02:02:02:02:02	03:03:03:03:03:03 04:04:04:04:04:04
IP	192.0.2.1 10.0.0.4	2001:db8:aaaa::1 2001:db8:ffff::1
PORT	6123 80	6123 80
DATA	Hola	Hola

Traducción IP/ICMP

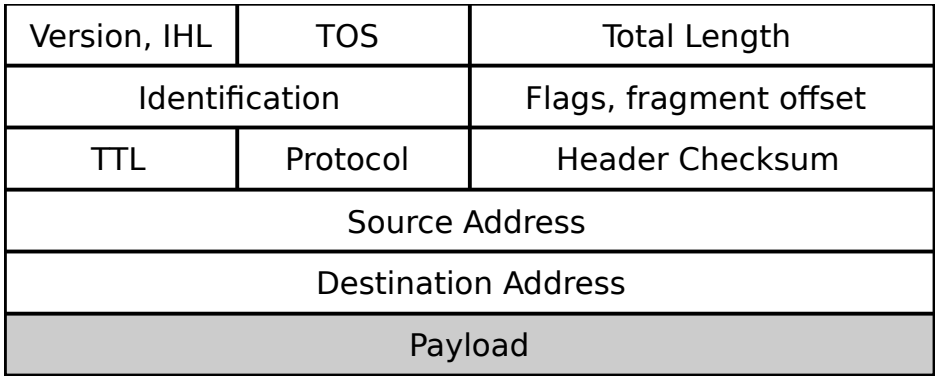
- Traducción de headers:
  - RFC 7915
- Traducción de direcciones:
  - RFC 6052 (Prefijo simple - tradicional)
  - RFC 6146 (Stateful NAT64)
  - RFC 7757 (Explicit Address Mappings)
  - RFC 6791 (Hack para ICMP errors)
  - RFC 7599 (MAP-T)

Traducción IP

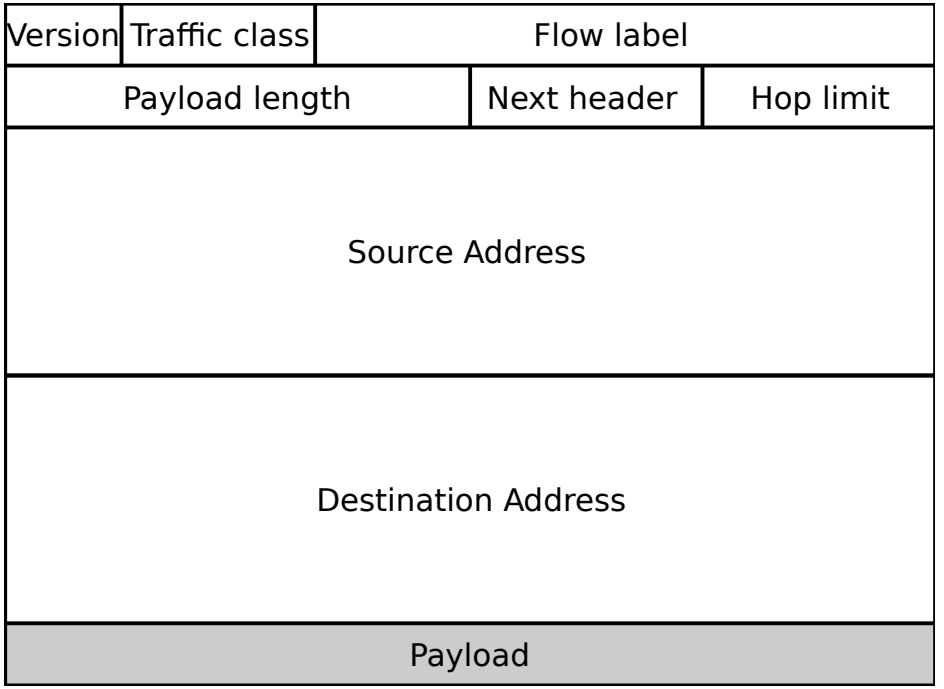
- SIIT
  - “Stateless NAT64”
  - Traductor de capa 3
- “NAT64”
  - Stateful NAT64
  - Traductor de capas 3 y 4

Traducción de encabezados

IPv4

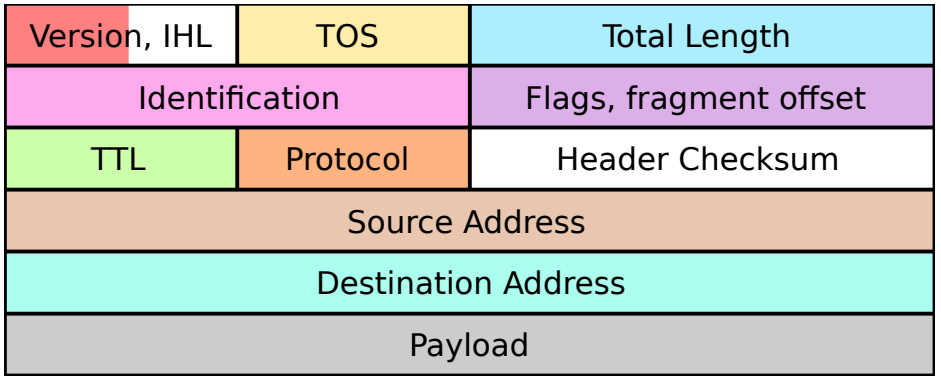


IPv6

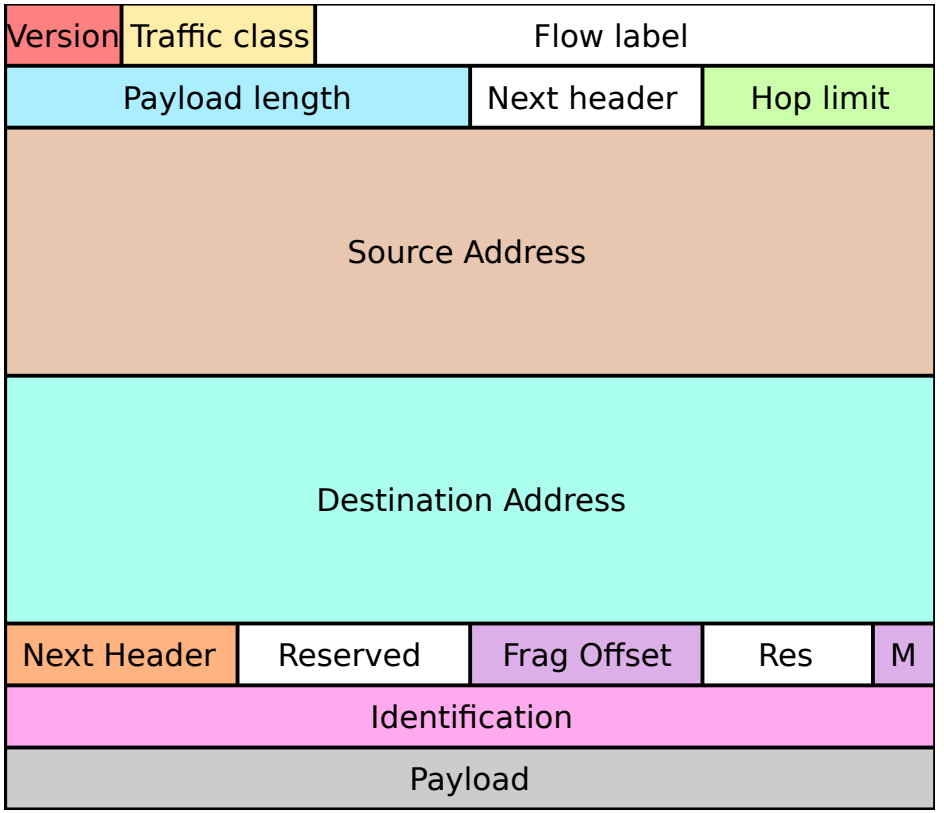


Traducción de encabezados

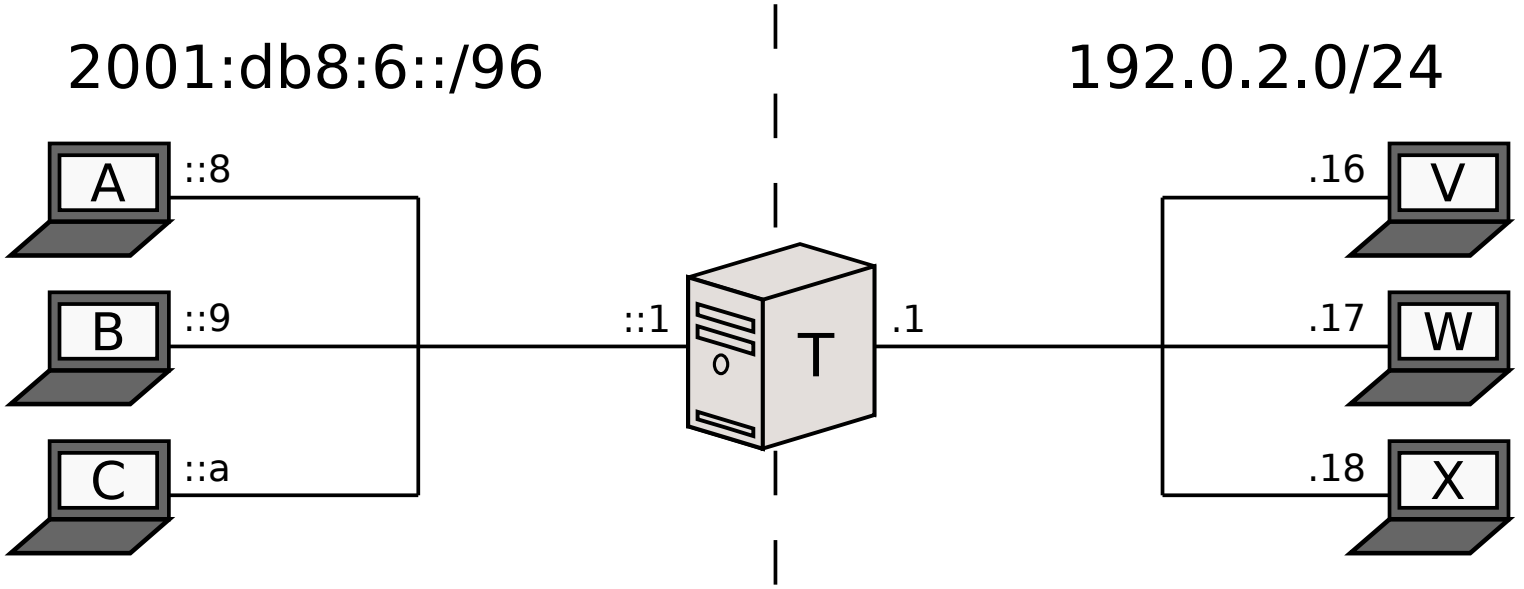
IPv4



IPv6



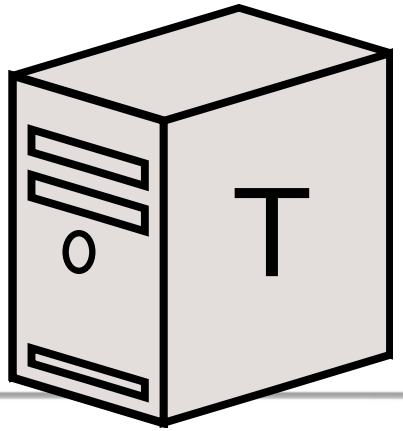
SIIT-EAM



SIIT-EAM

Voy a engañar a los nodos IPv4.
Ellos van a creer que los nodos
2001:db8:6::/120 se llaman 10.0.0.0/24.

También voy a engañar a los nodos de IPv6.
Ellos van a creer que los nodos
192.0.2.0/24 se llaman 2001:db8:4::/120.



2001:db8:6::/120 ↔ 10.0.0.0/24

- /120 y /24 indican prefijo.
- 10.0.0.0/24 → 10.0.0.0
- 2001:db8:6::/120 → 2001:0db8:0006:0000:0000:0000:0000:0000
- La idea de EAM es reemplazar prefijos.
- Por ejemplo, la dirección 10.0.0.5:
  - Quitamos prefijo de IPv4: .5
  - Agregamos prefijo de IPv6: 2001:db8:6::5
  - Done.

2001:db8:6::/120 ↔ 10.0.0.0/24

2001:db8:6::1 ↔ 10.0.0.1

2001:db8:6::2 ↔ 10.0.0.2

2001:db8:6::3 ↔ 10.0.0.3

...

2001:db8:6::9 ↔ 10.0.0.9

2001:db8:6::a ↔ 10.0.0.10

2001:db8:6::b ↔ 10.0.0.11

...

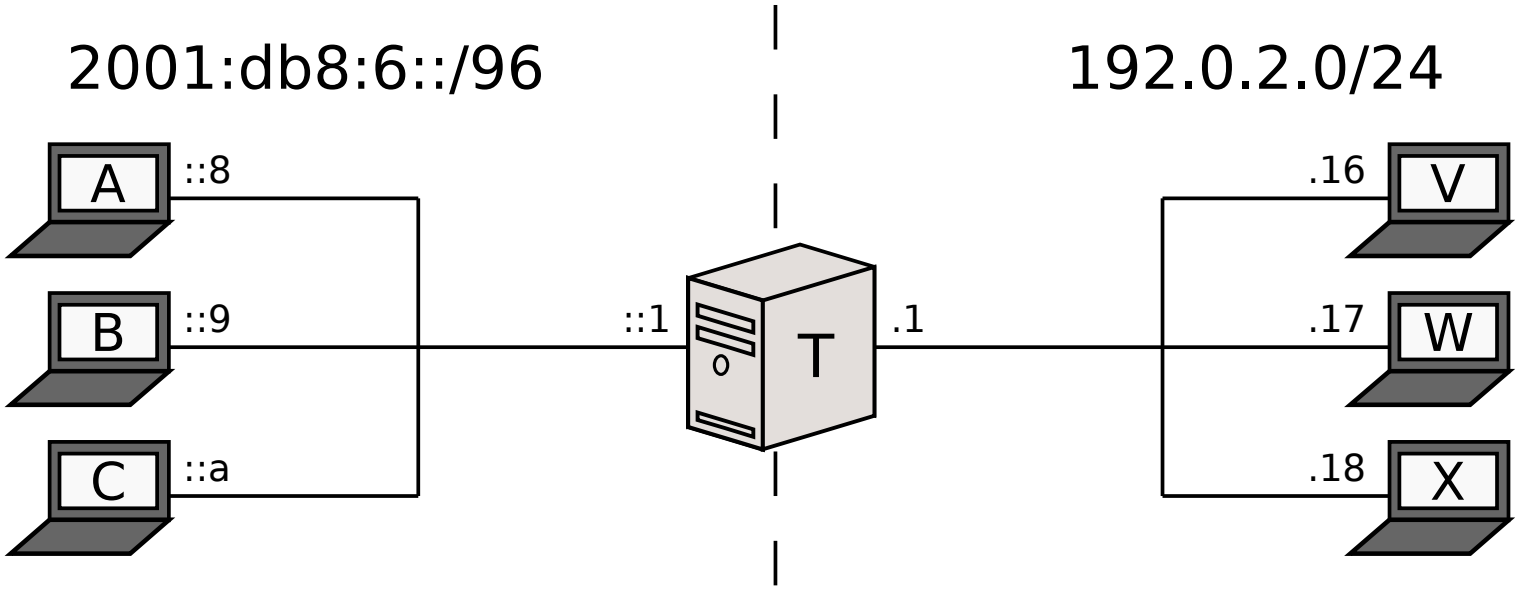
2001:db8:6::ef ↔ 10.0.0.254

2001:db8:6::ff ↔ 10.0.0.255

Tabla EAM

IPv6	IPv4
2001:db8:6::/120	10.0.0.0/24
2001:db8:4::/120	192.0.2.0/24

SIIT-EAM

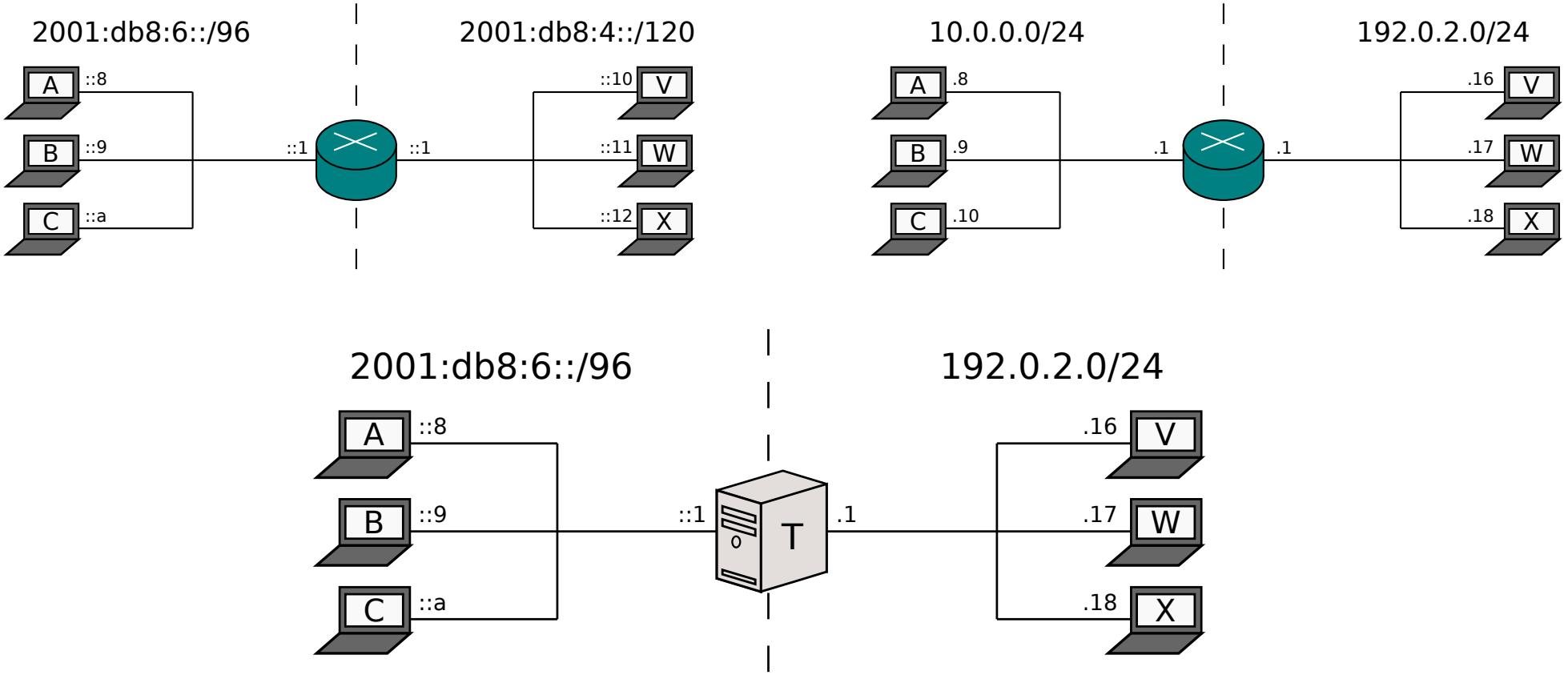


2001:db8:6::8
2001:db8:4::11

10.0.0.8
192.0.2.17

IPv6	IPv4
2001:db8:6::/120	10.0.0.0/24
2001:db8:4::/120	192.0.2.0/24

SIIT-EAM



IPv6	IPv4
2001:db8:6::/120	10.0.0.0/24
2001:db8:4::/120	192.0.0.0/24

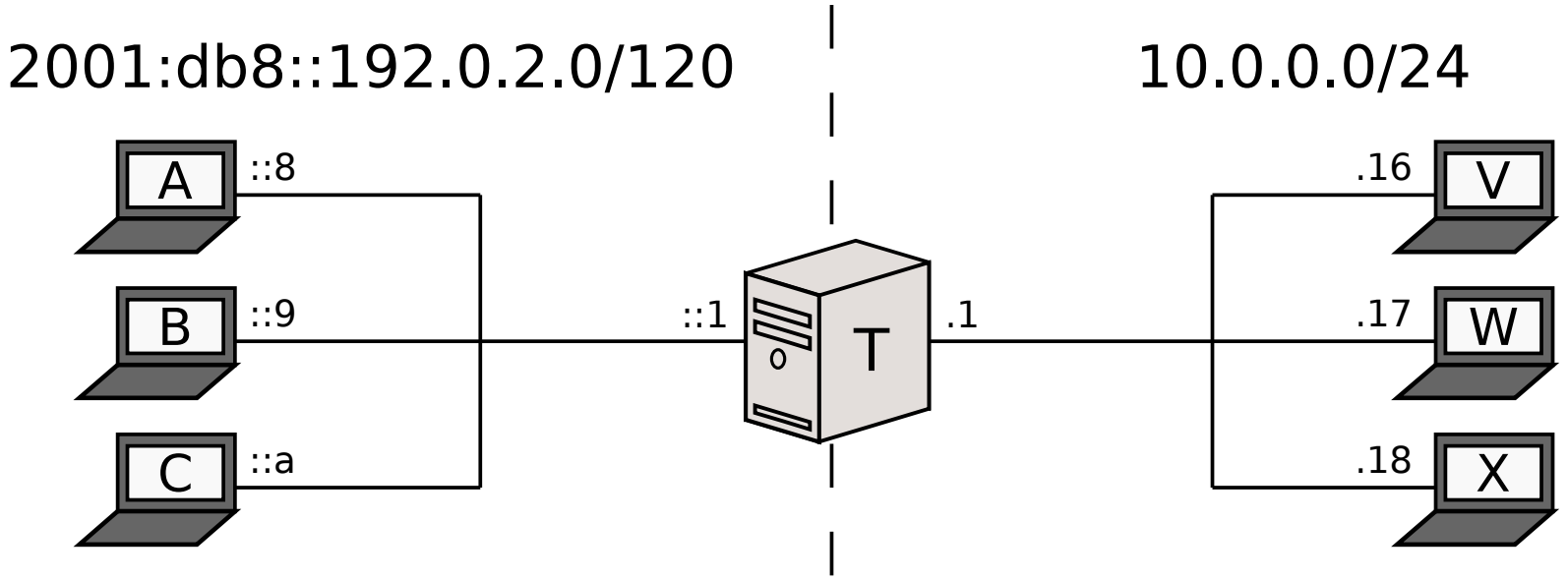
Tabla EAM (simplificada)

IPv6	IPv4
2001:db8:6::1/128	10.0.0.6/32
2001:db8:4::d5/128	192.0.2.10/32
2001:db8:aaaa:bbbb::cccc/128	198.51.100.55/32
1234:5678::abcd:ef/128	10.0.0.254/32

SIIT-tradicional

- SIIT-EAM reemplaza prefijos de ambos protocolos (IPv6/4).
  - Se basa en una tabla, por lo que podemos tener cualquier número de prefijos.
- En contraste, SIIT-tradicional solamente agrega y quita **un** prefijo de IPv6.
  - Es más restrictivo.

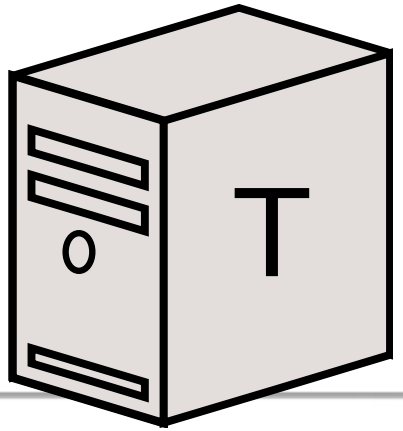
SIIT-tradicional



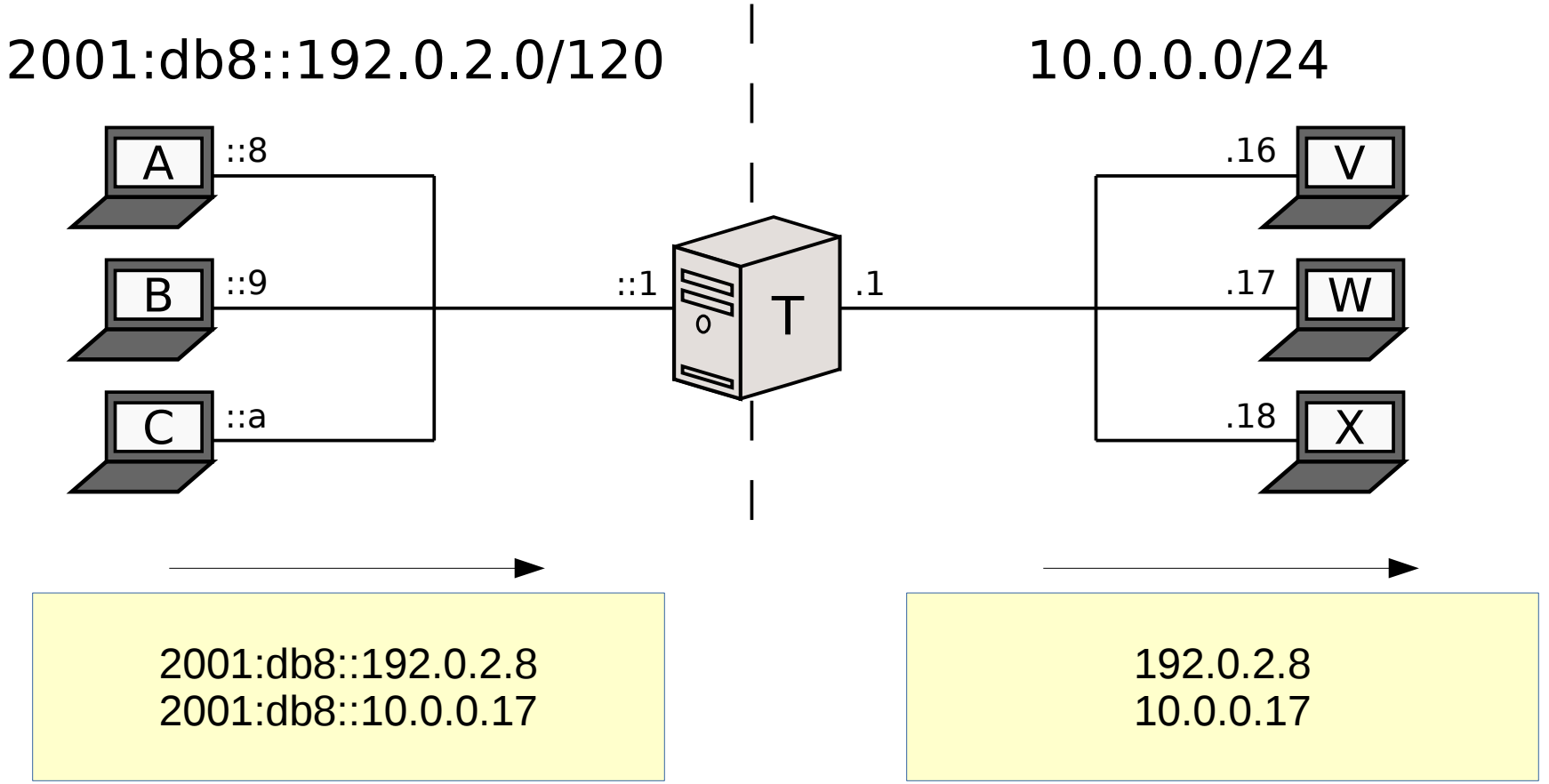
SIIT-tradicional

Cuando me toque traducir un paquete de 4 a 6,
voy a agregar el prefijo 2001:db8::/96.

Cuando me toque traducir de 6 a 4,
voy a quitar el prefijo 2001:db8::/96.

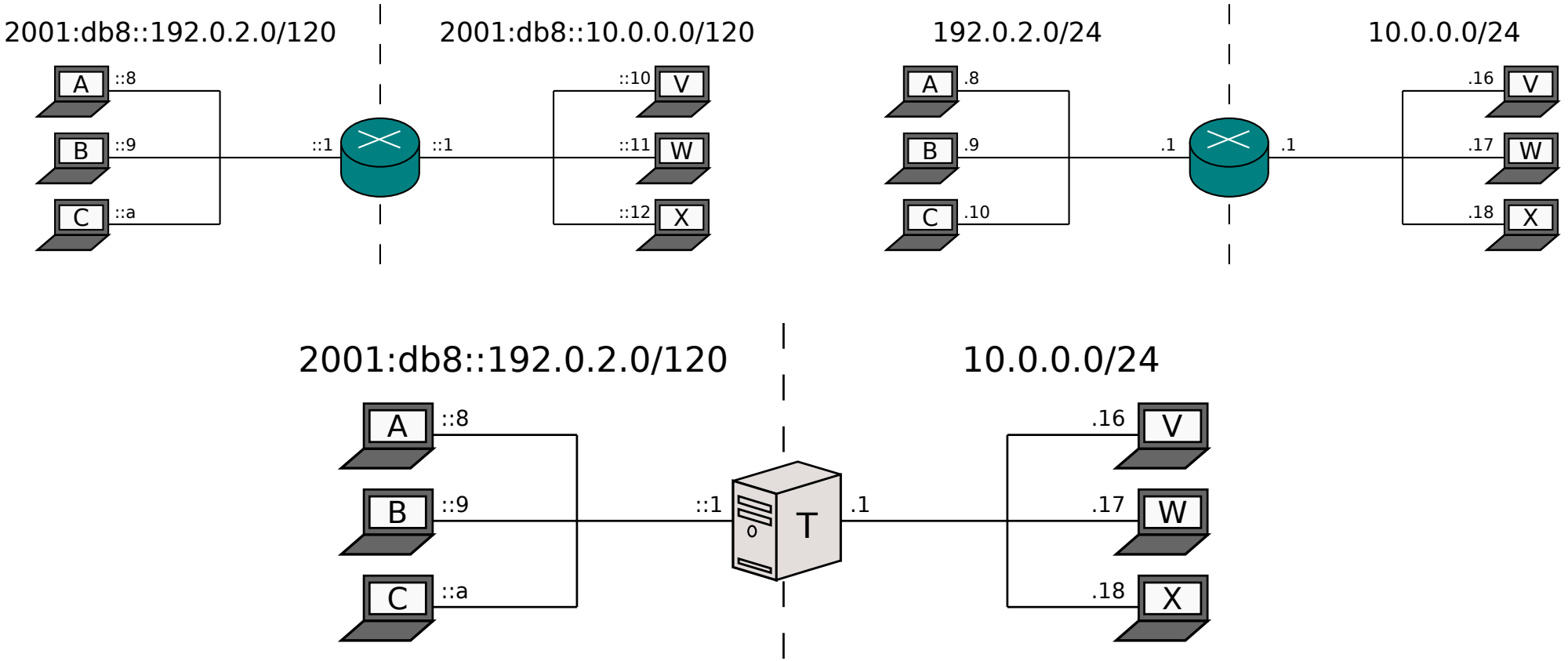


SIIT-tradicional



- Toda la dirección de IPv4 sobrevive.
- Todos los nodos de IPv6 que quieran hablar con IPv4 necesitan el prefijo y una dirección IPv4 válida dentro.

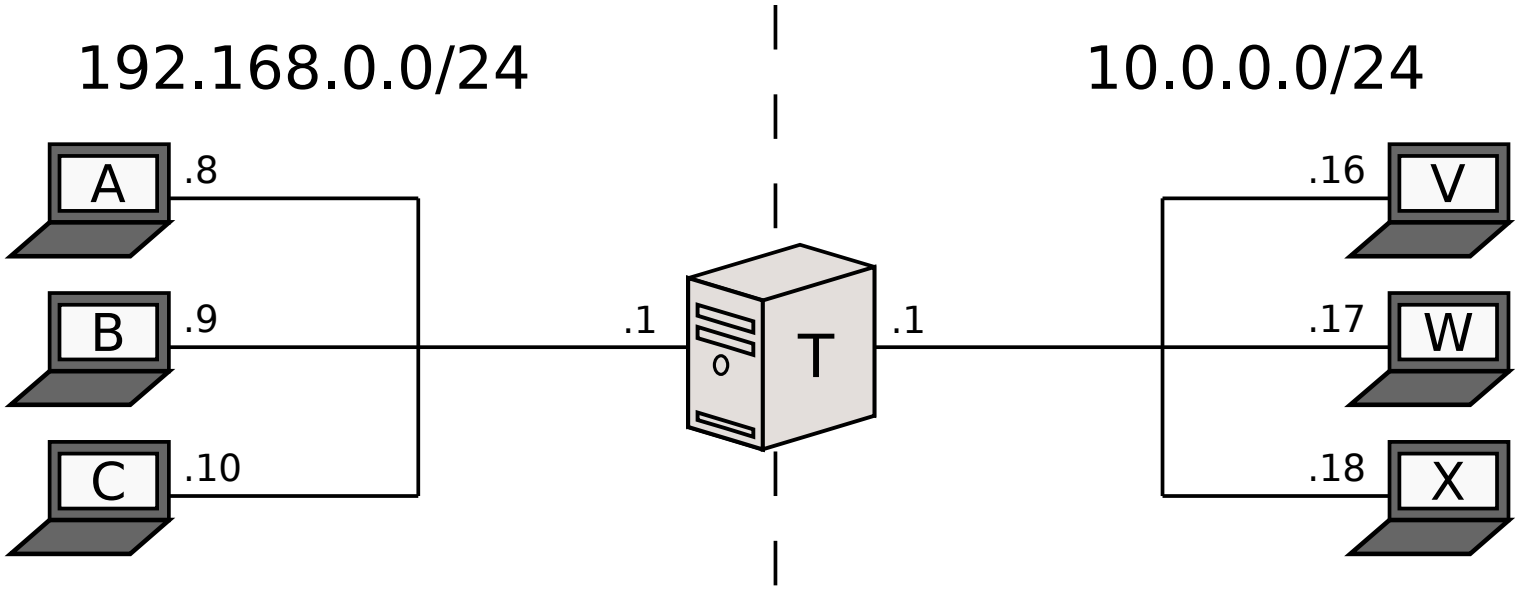
SIIT-tradicional



NAT64

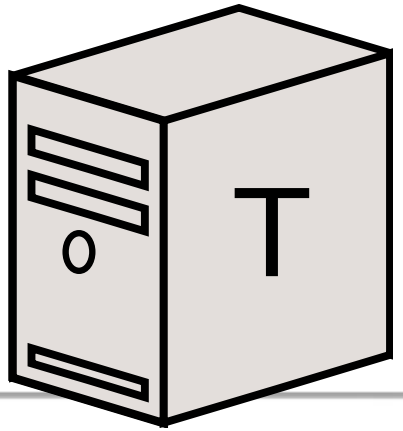
- SIIT es solo un mecanismo para permitir que IPv6 e IPv4 coexistan; no soluciona el problema del agotamiento de direcciones de IPv4 porque el mapeo de direcciones es 1 a 1.
- NAT64 combina SIIT y NAT para lograr que *n* direcciones de IPv6 puedan mapearse a *unas cuantas* direcciones de IPv4.

NAT

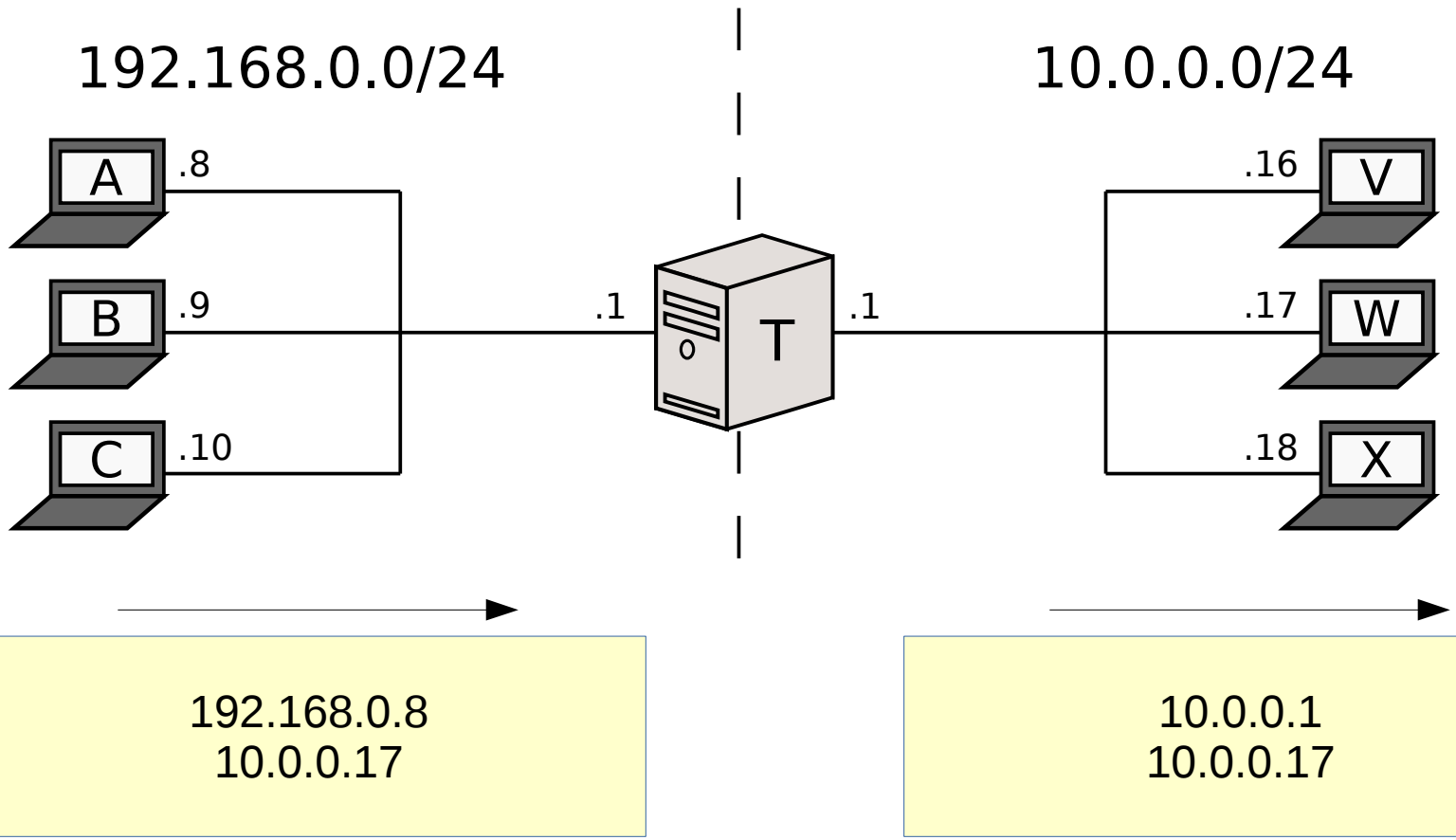


NAT

Voy a enmascarar a los nodos
de la red 192.168.0.0/24
Con mi propia dirección de IPv4.

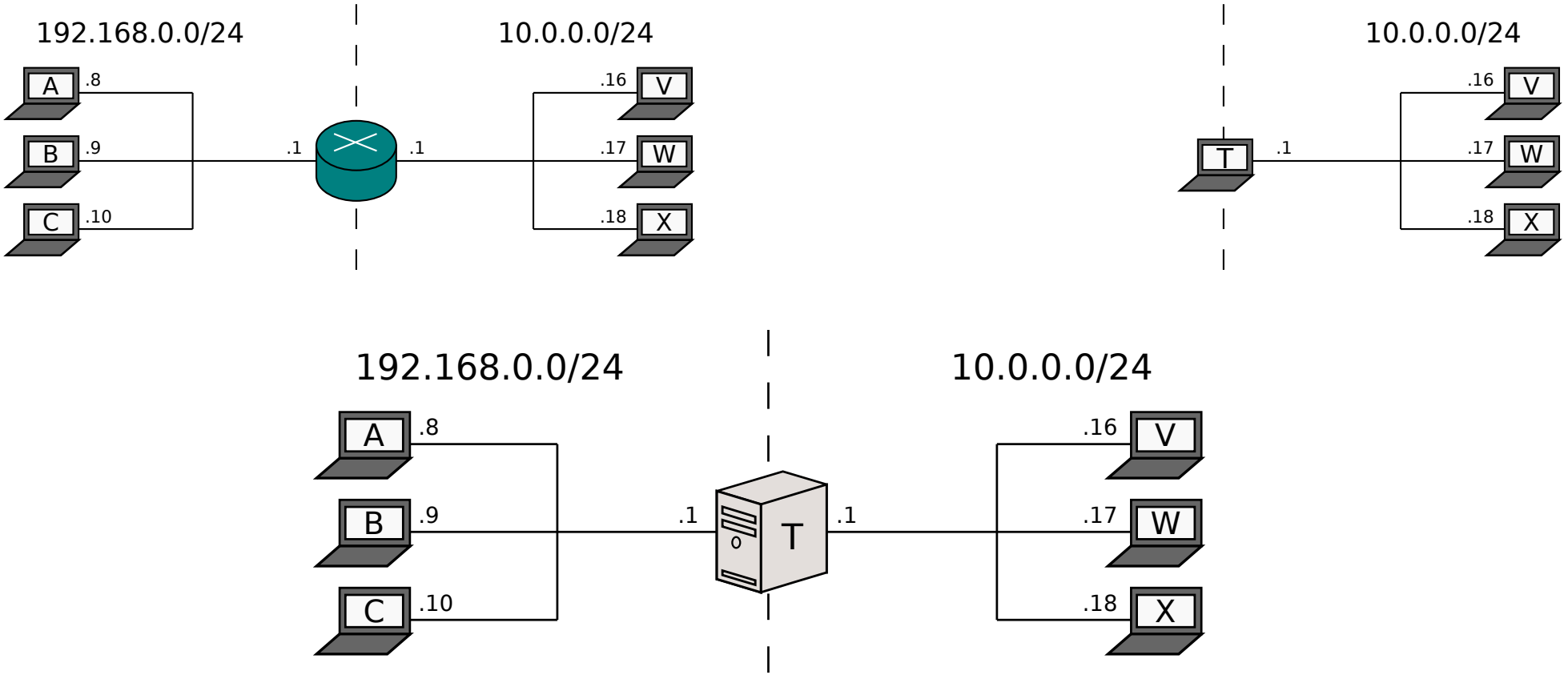


NAT

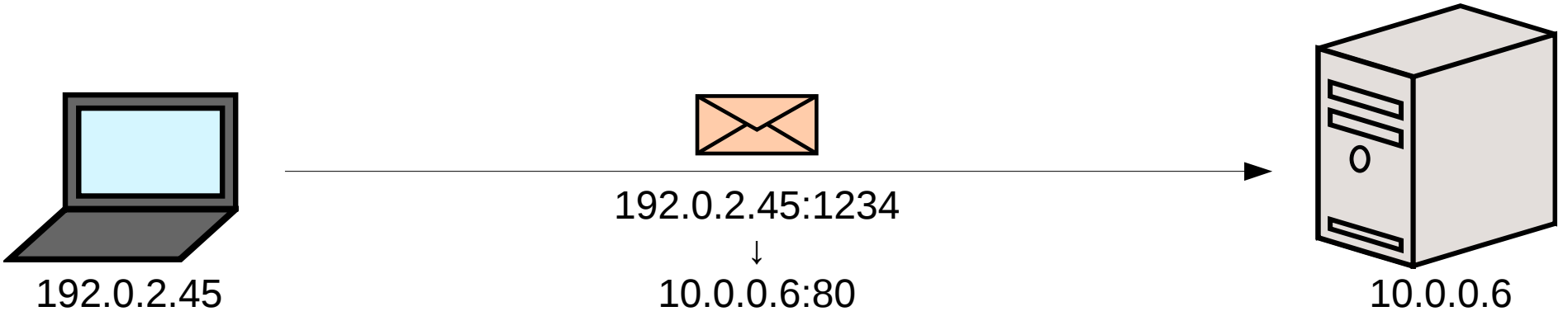


Soluciona el problema de agotamiento de direcciones porque hace que A, B, C y T tengan la misma dirección a los ojos de cualquier otra red.

NAT

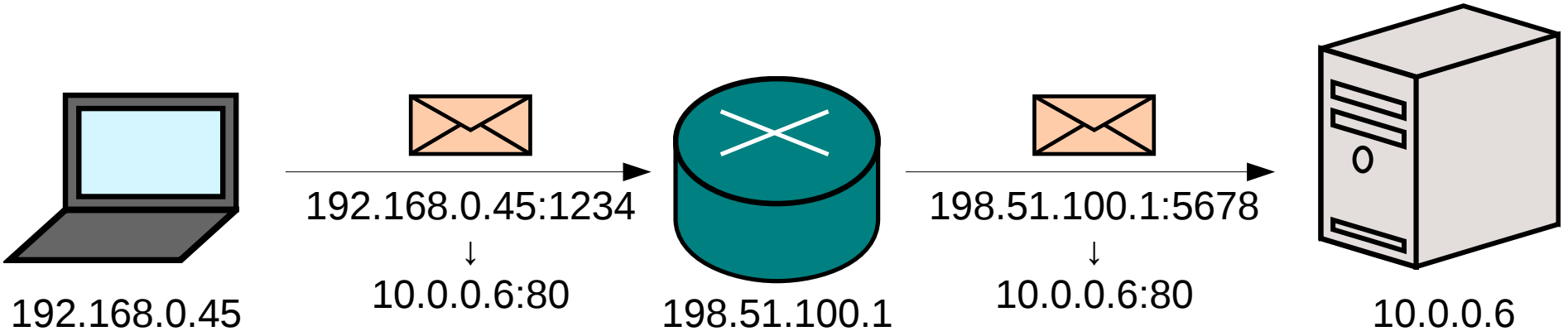

192.168.0.0/24
10.0.0.0/24
A
.8
B
.9
C
.10
.1
.1
.16
V
.17
W
.18
X
10.0.0.0/24
T
.1
.16
V
.17
W
.18
X
192.168.0.0/24
10.0.0.0/24
A
.8
B
.9
C
.10
.1
T
.1
.16
V
.17
W
.18
X

Sockets



Socket	Cliente	Servidor
Dirección	192.0.2.45	10.0.0.6
Puerto	1234	80

Sockets, NAT

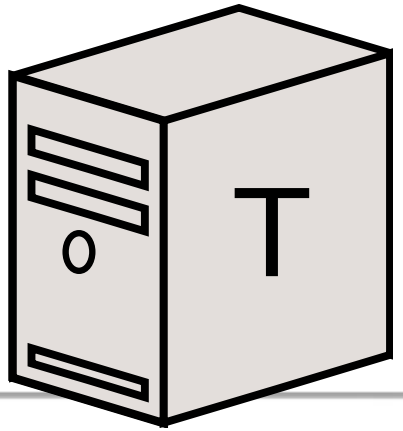


Socket	Cliente	Servidor
Dirección	192.168.0.45	10.0.0.6
Puerto	1234	80

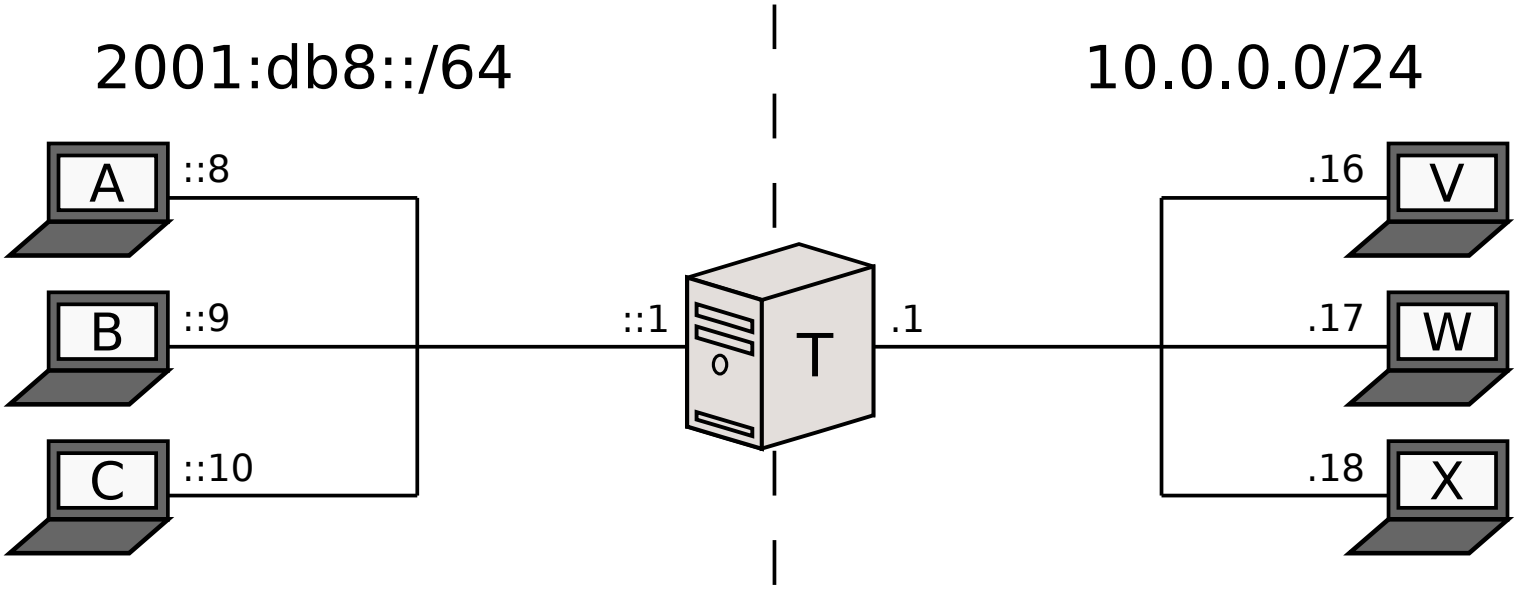
Socket	Cliente	Servidor
Dirección	198.51.100.1	10.0.0.6
Puerto	5678	80

NAT64

Voy a enmascarar a los nodos de IPv6
Con mi propia dirección de IPv4.



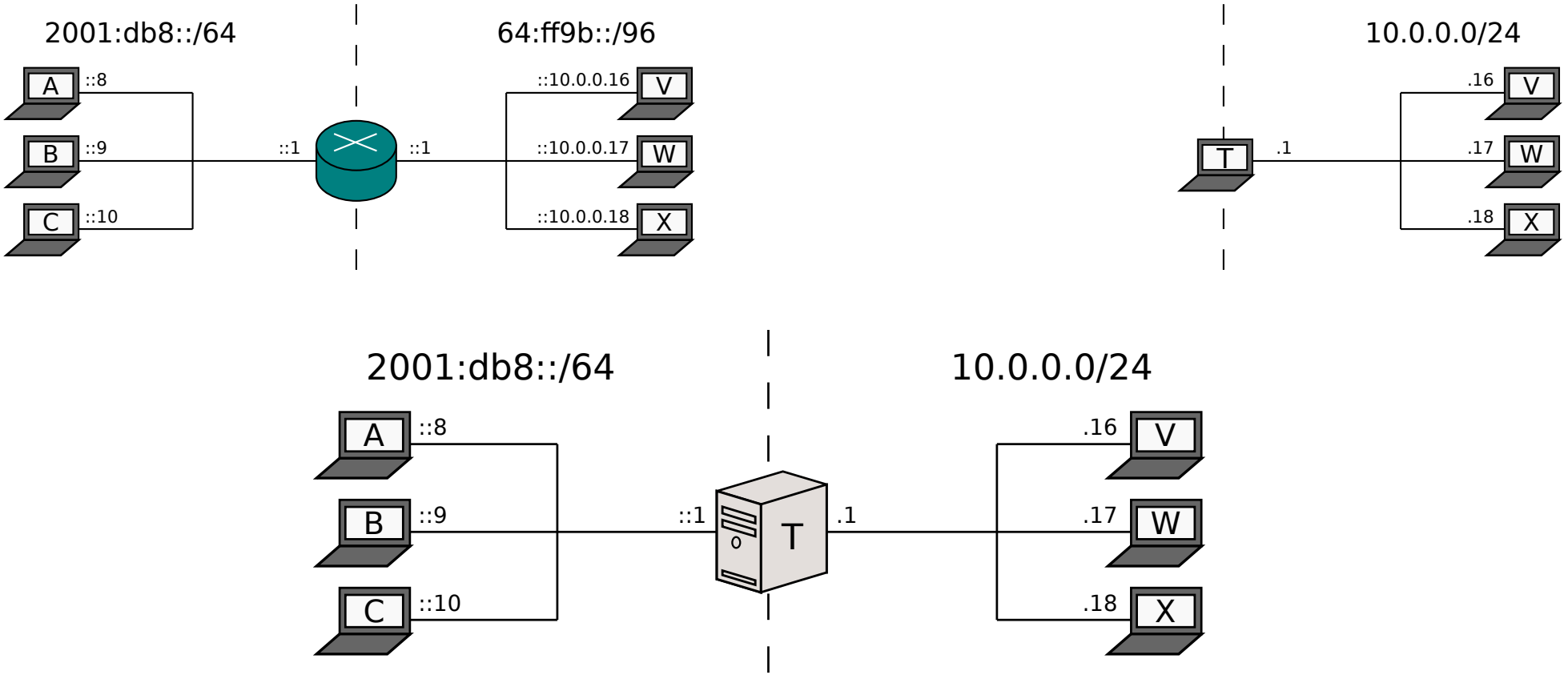
NAT64



2001:db8::8
64:ff9b::10.0.0.17

10.0.0.1
10.0.0.17

NAT64


2001:db8::/64
64:ff9b::/96
10.0.0.0/24
A
::8
B
::9
C
::10
::1
::1
::10.0.0.16
V
::10.0.0.17
W
::10.0.0.18
X
T
.1
.16
V
.17
W
.18
X
2001:db8::/64
10.0.0.0/24
A
::8
B
::9
C
::10
::1
T
.1
.16
V
.17
W
.18
X

NAT64

- Notar:
  - Soluciona el problema de agotamiento de direcciones porque hace que A, B, C y T tengan la misma dirección a los ojos de IPv4.
  - La dirección fuente se destruye completamente.
    - Esto implica que el NAT64 tiene que guardar una tabla que mapea los sockets.
  - La dirección destino se traduce mediante el mecanismo tradicional.

Jool

- SIIT y NAT64
- Linux (kernels 3.2 en adelante)
- Gratis y código abierto (C)
- https://jool.mx

Instalar Jool

- Módulos de Kernel
- Aplicaciones de configuración y control

Documentación completa y ejemplos en
https://www.jool.mx

Instalar Jool: Módulos del Kernel

1.Revisar versión del kernel

```
$ /bin/uname -r
3.5.0-45-generic
```

2. Build Essentials

```
# apt-get install build-essential
```

3. Kernel headers

```
# apt-get install linux-headers-$(uname -r)
```

4. DKMS / Kbuild

```
$ unzip Jool-<version>.zip
# dkms install Jool-<version>
```

```
$ unzip Jool-<version>.zip
$ cd Jool-<version>/mod
$ make
# make install
```

Instalar Jool: Aplicaciones

1.Build Essentials

```
# apt-get install gcc make pkg-config
```

2. libnl-genl-3

```
# apt-get install libnl-genl-3-dev
```

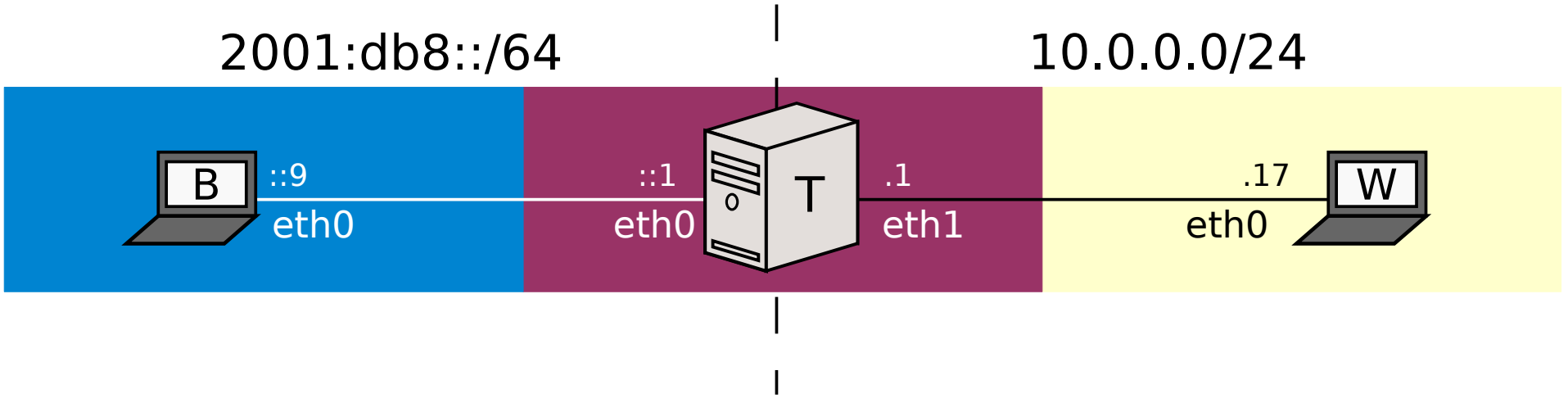
3. Autoconf

```
# apt-get install autoconf
```

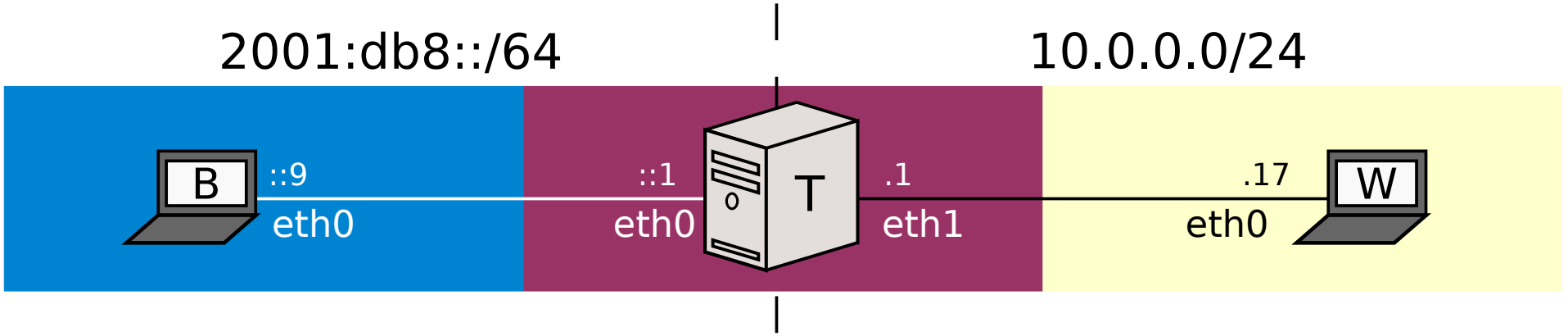
4. Compilar e Instalar

```
$ unzip Jool-<version>.zip
$ cd Jool-<version>/usr
$ ./configure
$ make
# make install
```

NAT64 (demo)

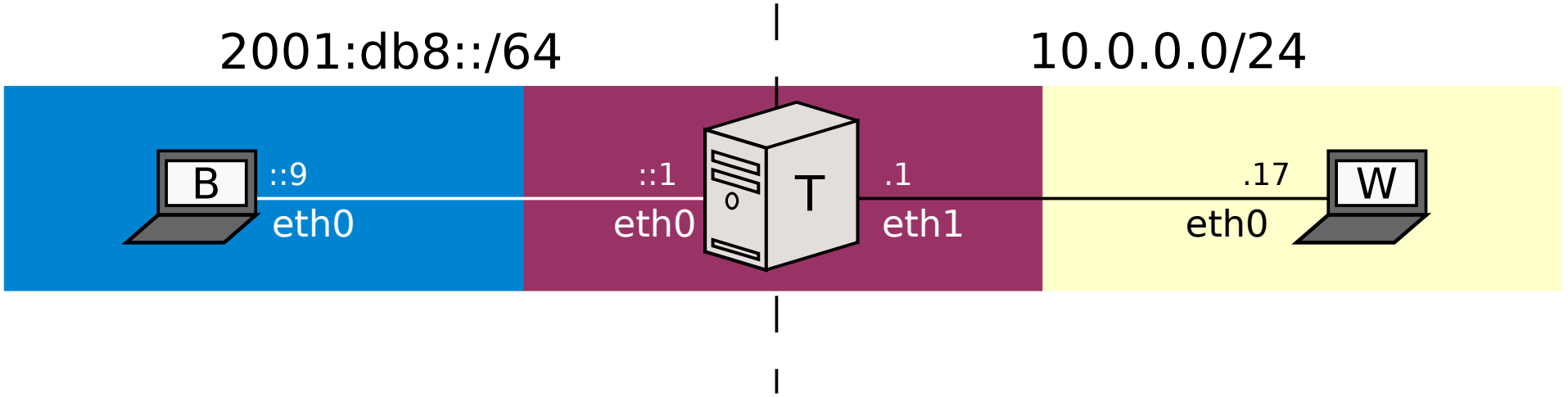


NAT64 (demo)



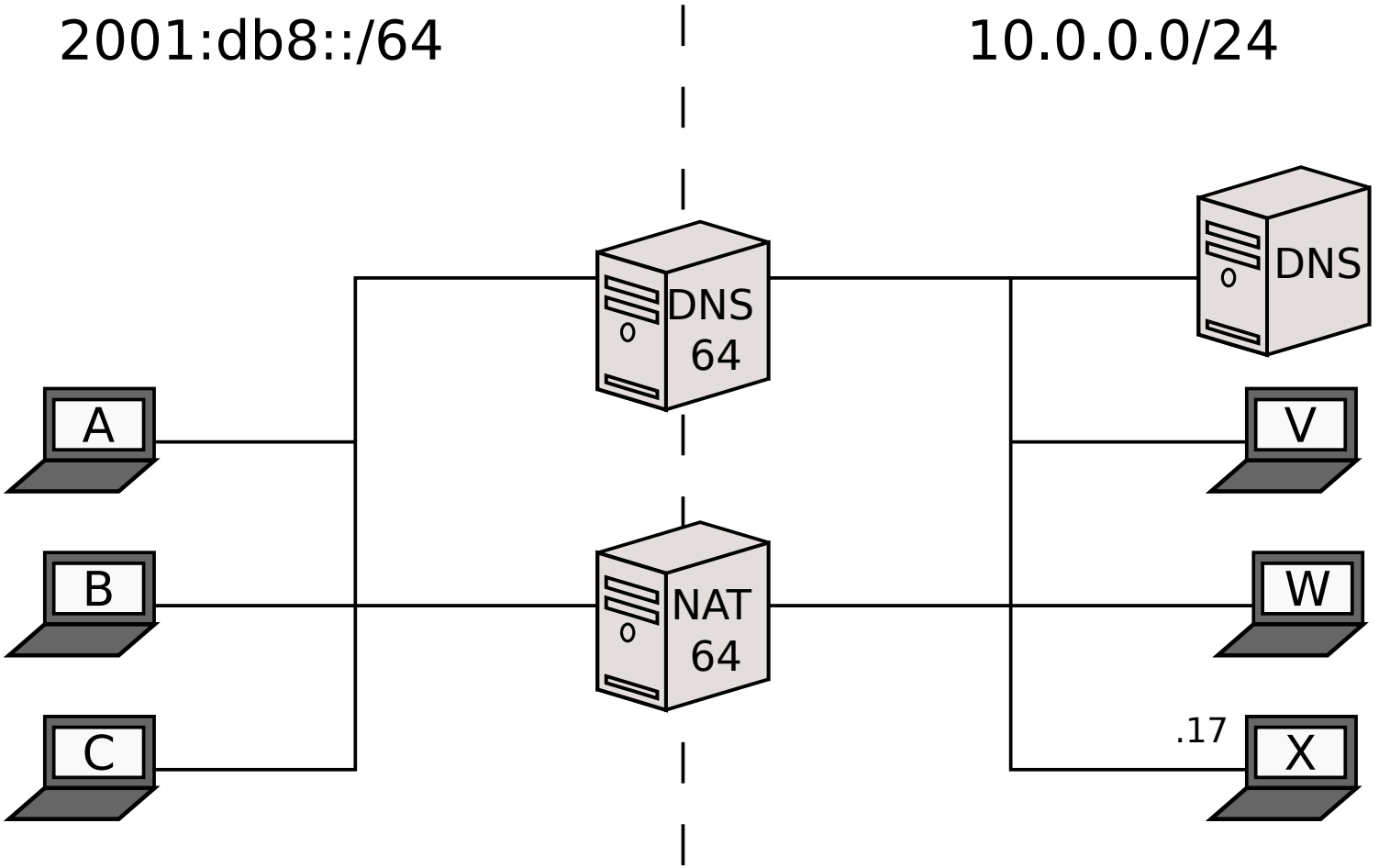

```
user@T:~# service network-manager stop
user@T:~#
user@T:~# /sbin/ip link set eth0 up
user@T:~# /sbin/ip address add 2001:db8::1/96 dev eth0
user@T:~#
user@T:~# /sbin/ip link set eth1 up
user@T:~# /sbin/ip address add 10.0.0.1/24 dev eth1
user@T:~#
user@T:~# sysctl -w net.ipv4.conf.all.forwarding=1
user@T:~# sysctl -w net.ipv6.conf.all.forwarding=1
user@T:~#
user@T:~# ethtool --offload eth0 gro off
user@T:~# ethtool --offload eth0 lro off
user@T:~# ethtool --offload eth1 gro off
user@T:~# ethtool --offload eth1 lro off
```

NAT64 (demo)

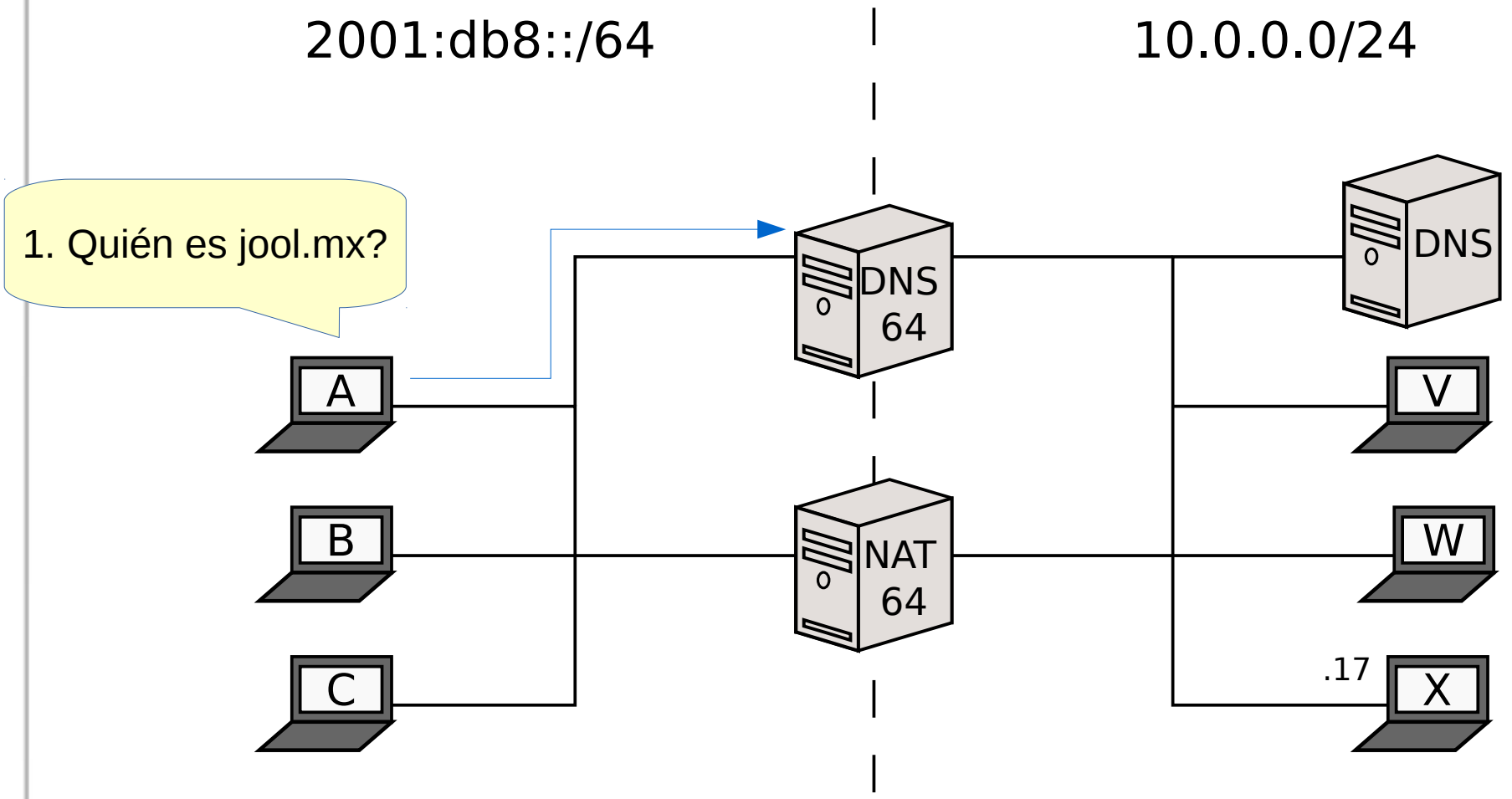



```
user@T:~# /sbin/modprobe jool pool6=64:ff9b::/96


user@B:~$ ping6 64:ff9b::10.0.0.17
PING 64:ff9b::10.0.0.17(64:ff9b::a00:11) 56 data bytes
64 bytes from 64:ff9b::a00:11: icmp_seq=1 ttl=63 time=1.13 ms
64 bytes from 64:ff9b::a00:11: icmp_seq=2 ttl=63 time=4.48 ms
64 bytes from 64:ff9b::a00:11: icmp_seq=3 ttl=63 time=15.6 ms
64 bytes from 64:ff9b::a00:11: icmp_seq=4 ttl=63 time=4.89 ms
^C
--- 64:ff9b::10.0.0.17 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 1.136/6.528/15.603/5.438 ms
```

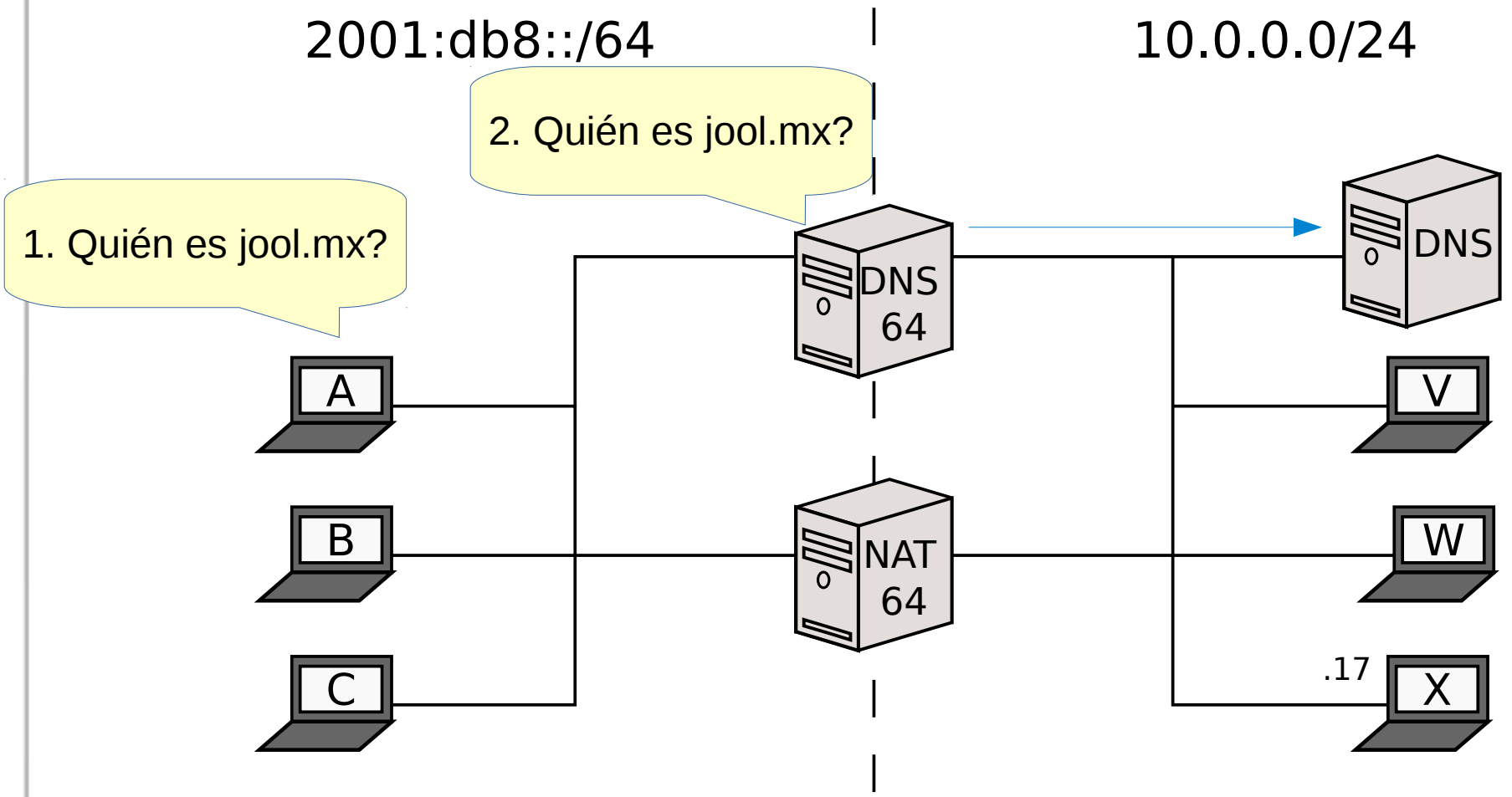
DNS64



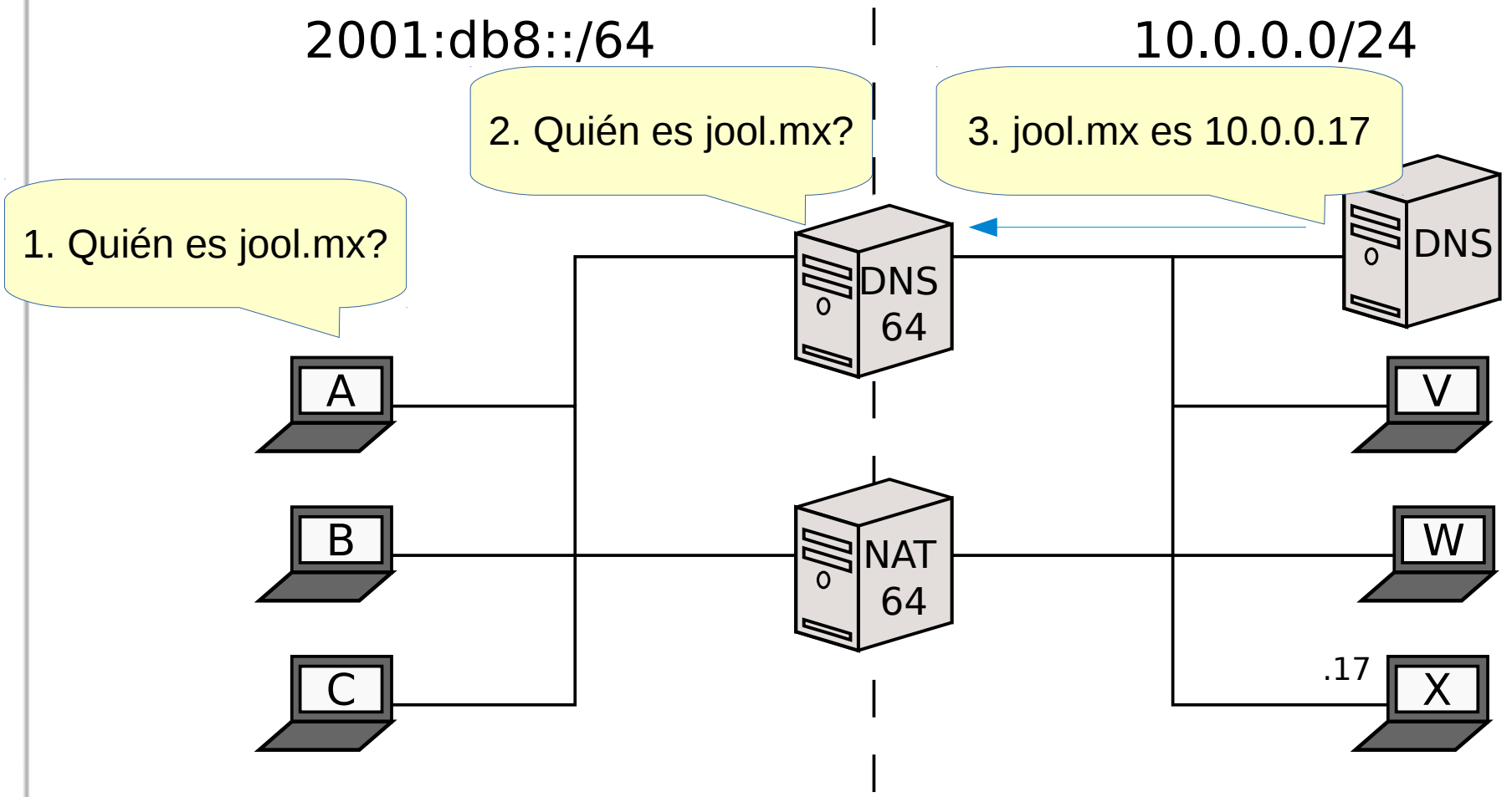
DNS64


2001:db8::/64
10.0.0.0/24
1. Quién es jool.mx?
A
B
C
DNS
64
NAT
64
DNS
V
W
.17
X

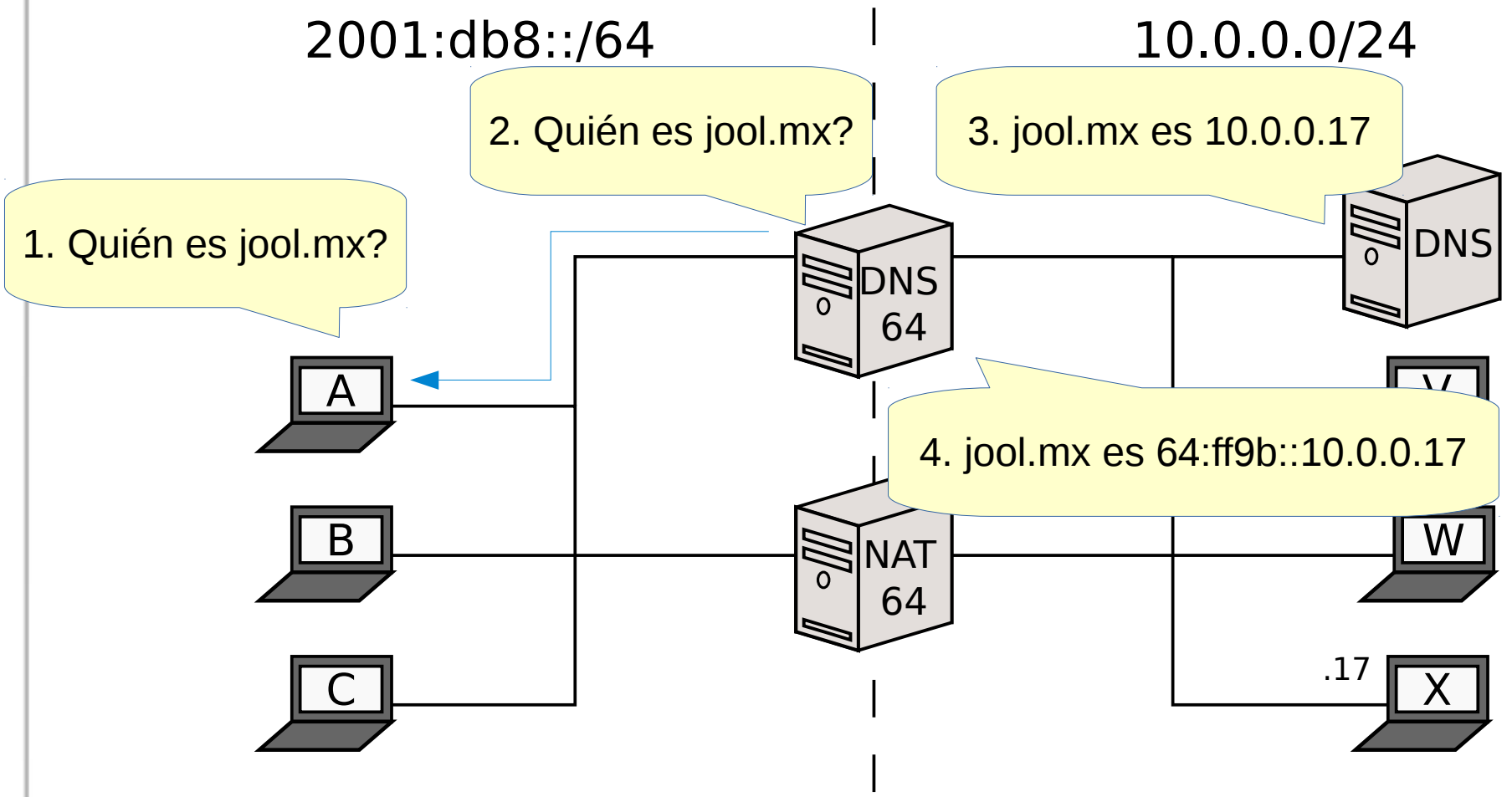
DNS64


2001:db8::/64
10.0.0.0/24
2. Quién es jool.mx?
1. Quién es jool.mx?
DNS
64
DNS
A
V
B
NAT
64
W
.17
X
C

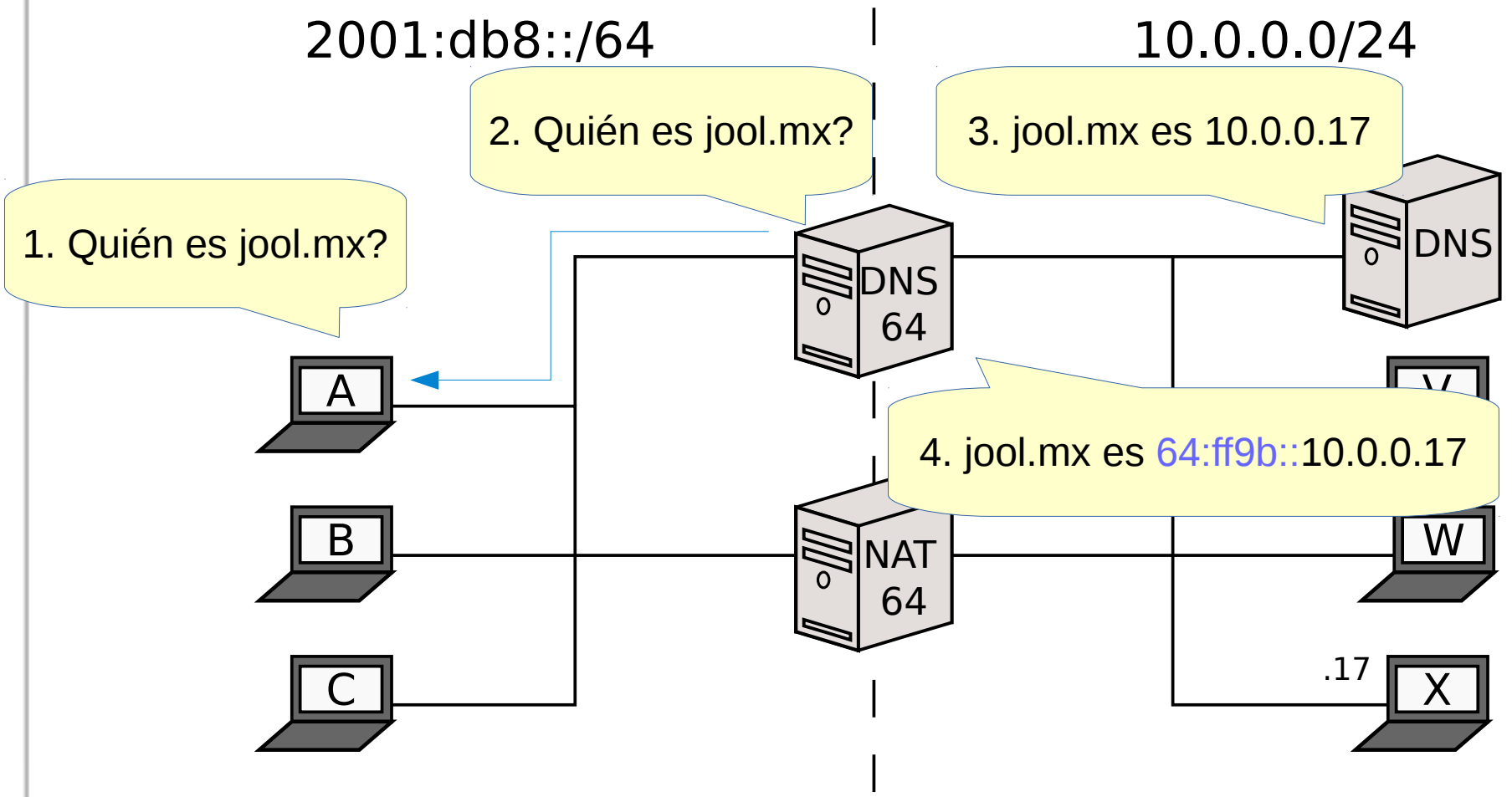
DNS64


2001:db8::/64
10.0.0.0/24
2. Quién es jool.mx?
3. jool.mx es 10.0.0.17
1. Quién es jool.mx?
DNS 64
DNS
A
B
C
NAT 64
V
W
.17
X

DNS64


2001:db8::/64
10.0.0.0/24
1. Quién es jool.mx?
2. Quién es jool.mx?
3. jool.mx es 10.0.0.17
4. jool.mx es 64:ff9b::10.0.0.17
DNS 64
DNS
NAT 64
A
B
C
W
.17
X

DNS64

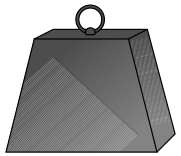

2001:db8::/64
10.0.0.0/24
1. Quién es jool.mx?
2. Quién es jool.mx?
3. jool.mx es 10.0.0.17
4. jool.mx es 64:ff9b::10.0.0.17
DNS 64
DNS
NAT 64
A
B
C
W
.17
X

DNS64 (BIND)

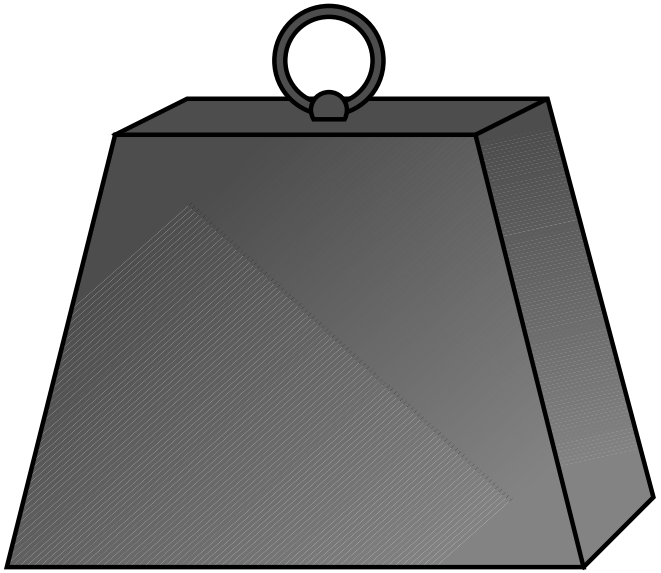
```
options {
        (...)

        # BIND no escucha en IPv6 por defecto.
        listen-on-v6 { any; };

        # Aquí se le indica a BIND el prefijo que
        # el NAT64 está agregando y quitando.
        dns64 64:ff9b::/96 {
                # Opciones
        };
};
```

SIIT vs NAT64

- SIIT
  - Stateless

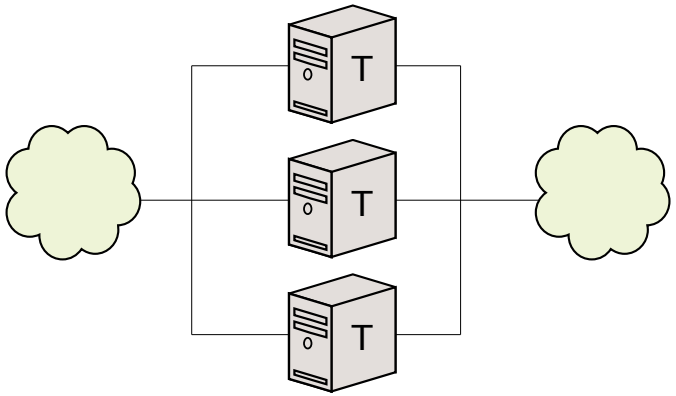


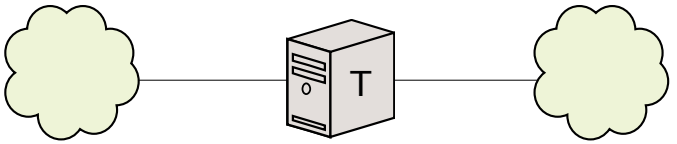
- NAT64
  - Stateful



SIIT vs NAT64

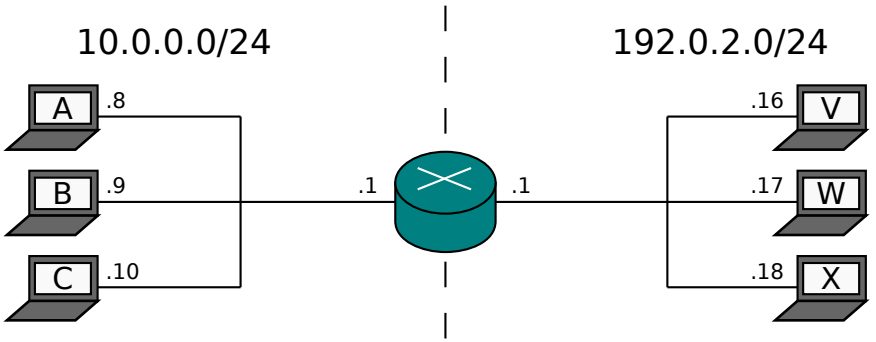
- SIIT
  - Stateless
- NAT64
  - Stateful

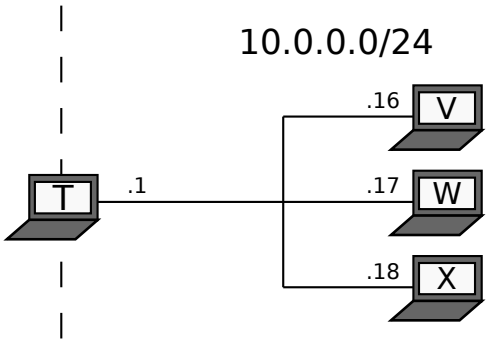




SIIT vs NAT64

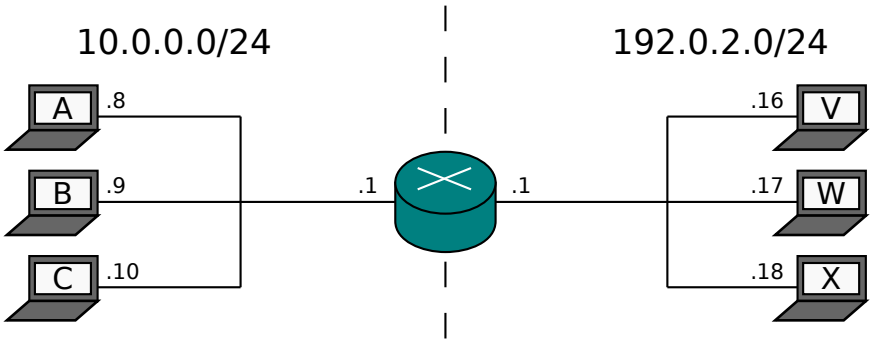
- SIIT
  - Transparente
- NAT64
  - No transparente

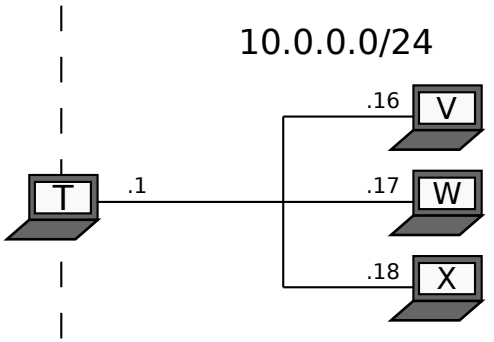




SIIT vs NAT64

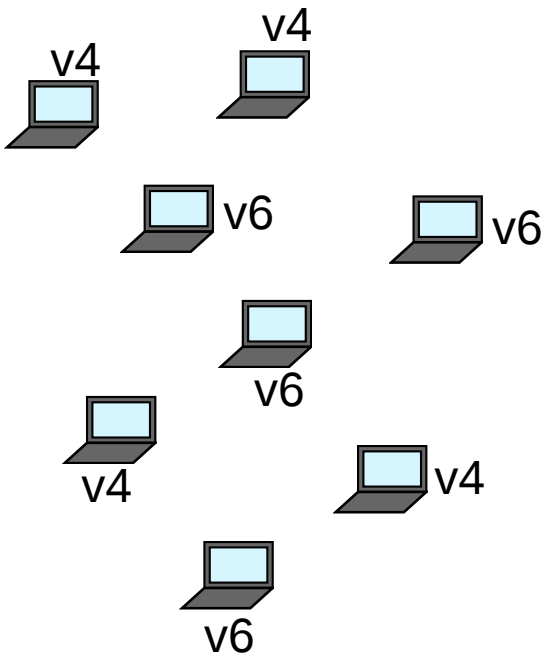
- SIIT
  - 1 a 1
- NAT64
  - 1 a N



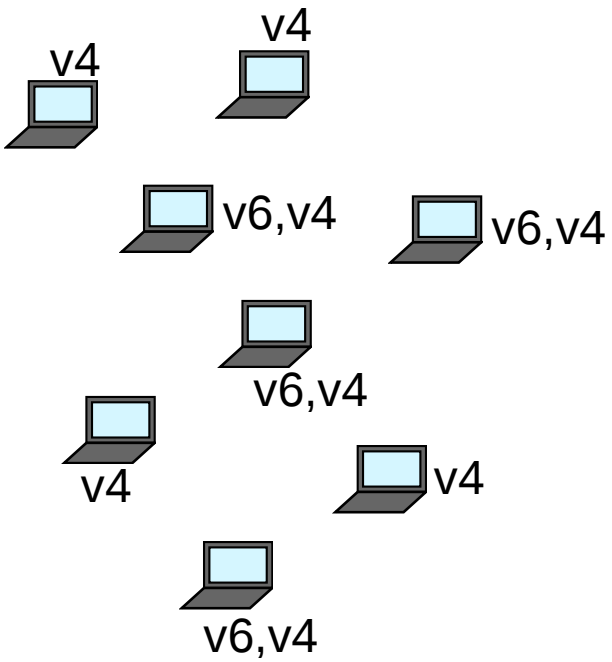


SIIT vs NAT64

- SIIT
  - Soluciona coexistencia

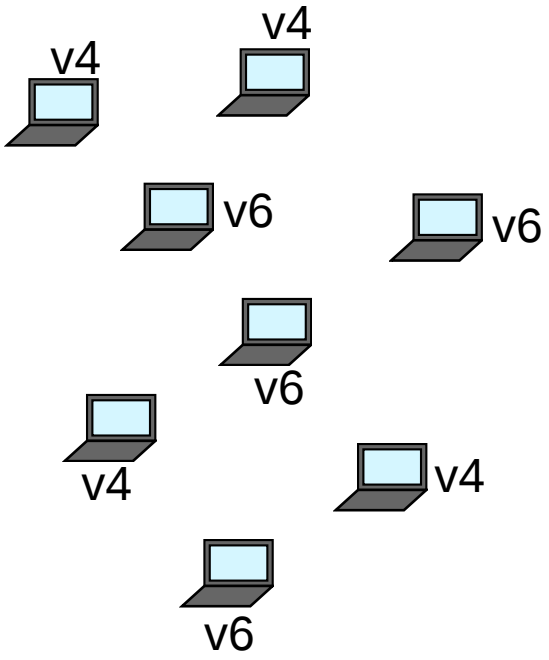


- NAT64
  - Soluciona coexistencia y agotamiento

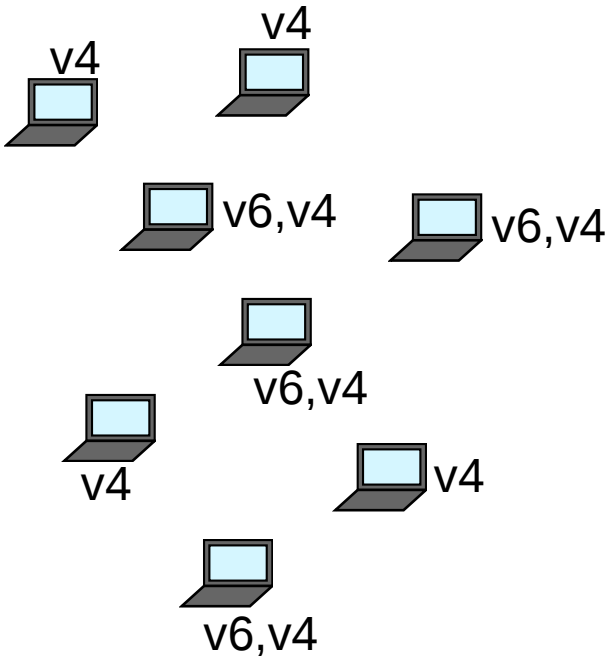


SIIT vs NAT64

- SIIT
  - Comunicación iniciable desde v4 y v6



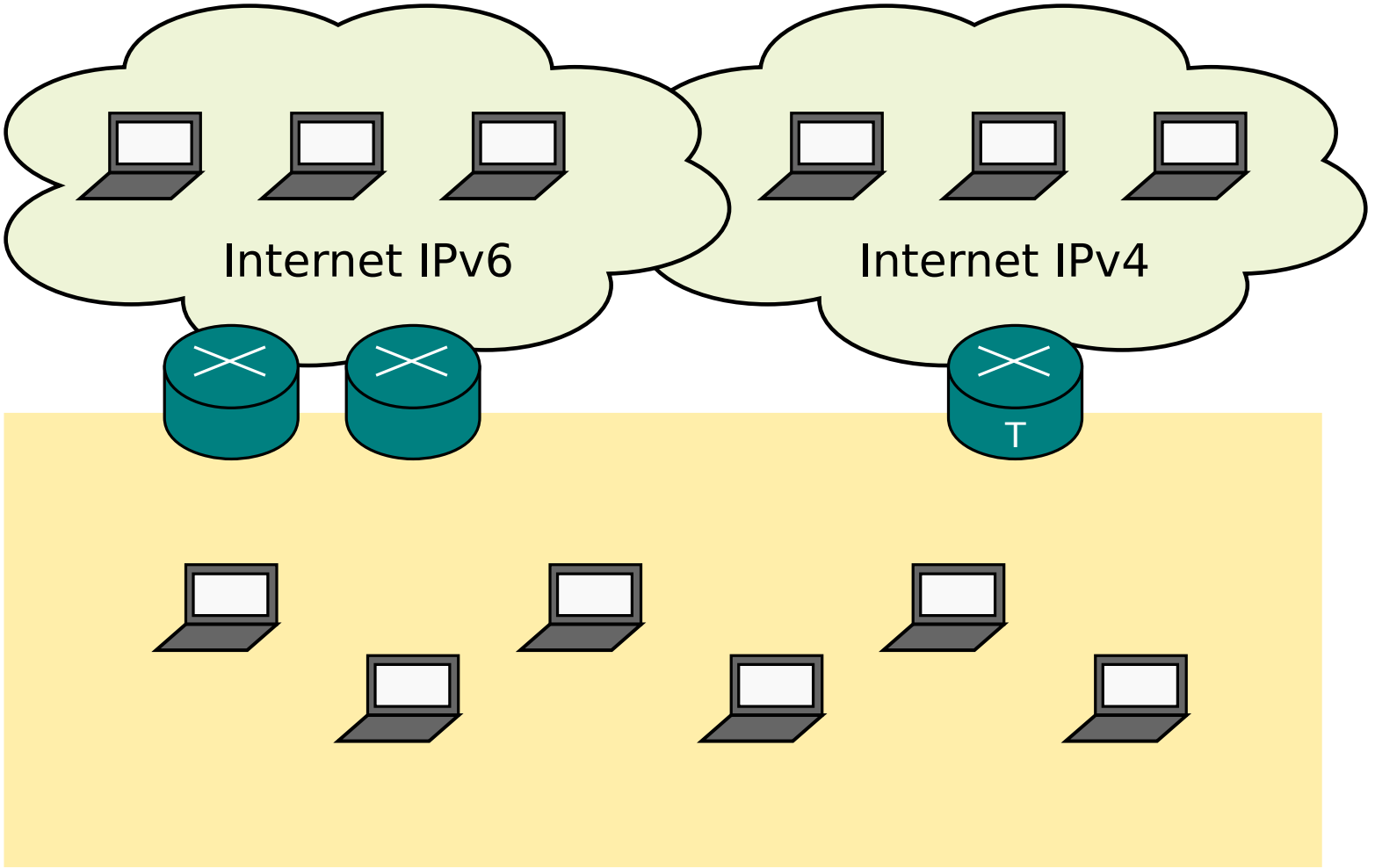
- NAT64
  - Requiere estado para iniciar desde v4



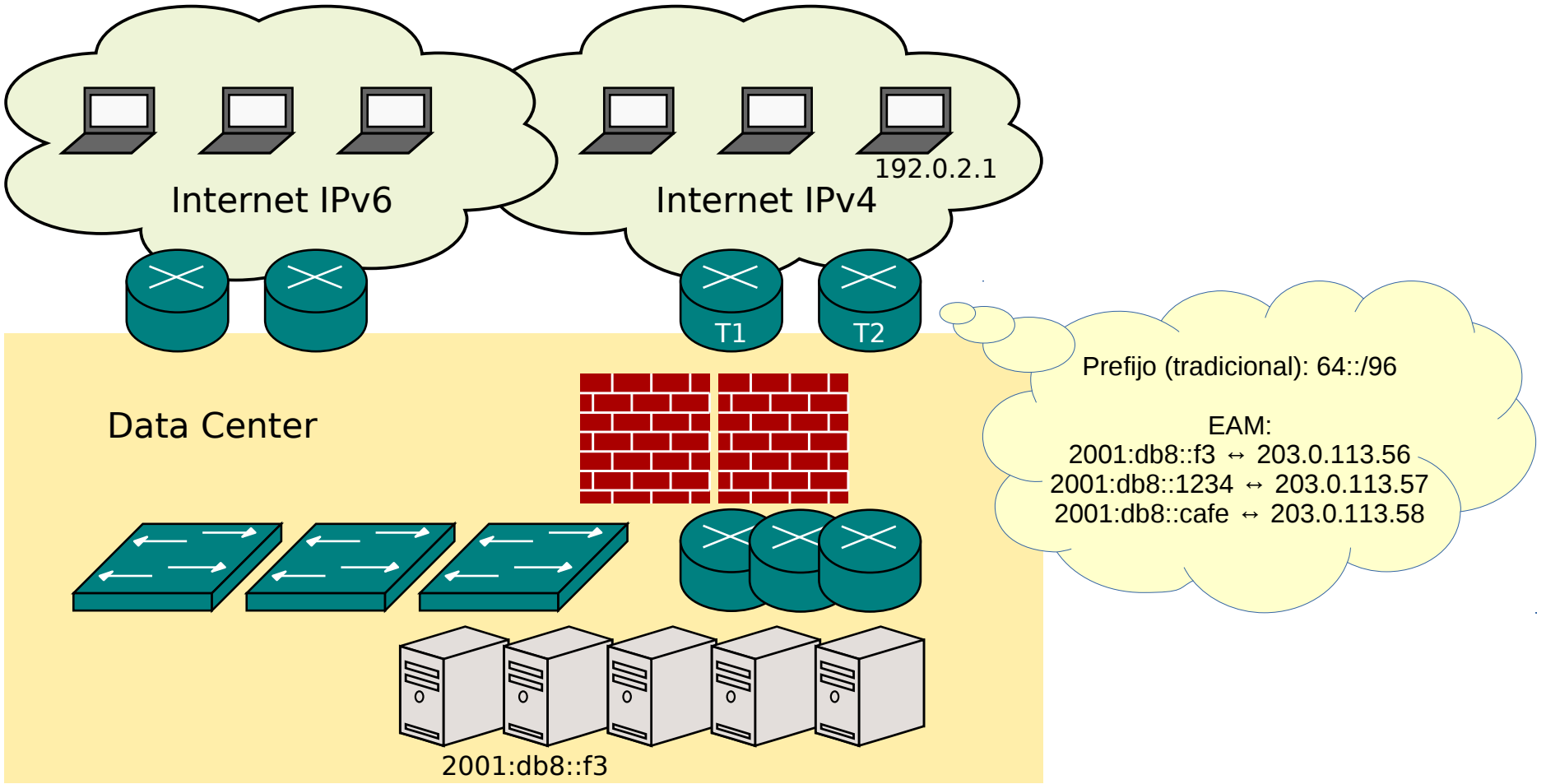
SIIT vs NAT64

- SIIT
  - TCP, UDP y otros
  - Capa 3 solamente
- NAT64
  - TCP y UDP
  - Capa 3 y 4

NAT64 (Vida real)



SIIT-DC


Internet IPv6
Internet IPv4
192.0.2.1
T1
T2
Data Center
2001:db8::f3
Prefijo (tradicional): 64::/96
EAM:
2001:db8::f3 ↔ 203.0.113.56
2001:db8::1234 ↔ 203.0.113.57
2001:db8::cafe ↔ 203.0.113.58

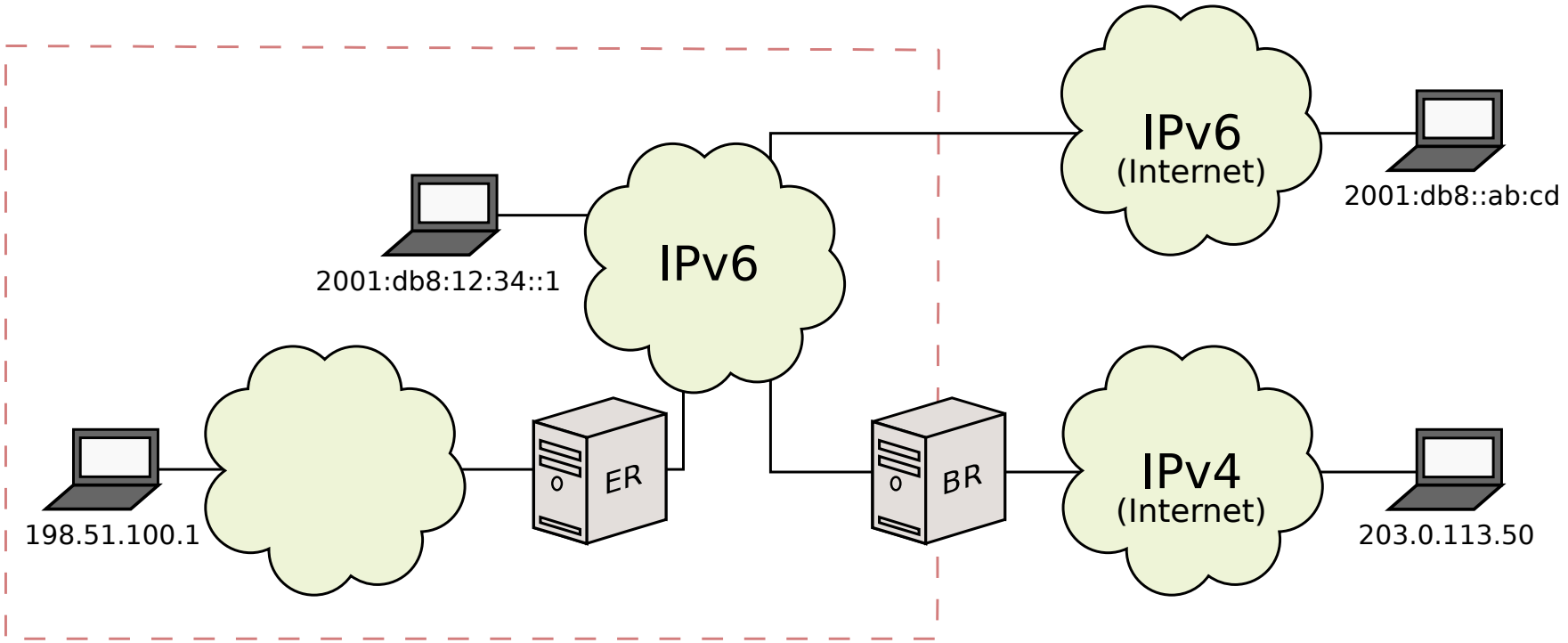
SIIT-DC

- Similar a NAT64,
  - Acceso a IPv4 se convierte en una especie de “servicio” proveído por la red
  - No requiere que las direcciones de IPv6 tengan direcciones de IPv4 embebidas
- A diferencia de NAT64,
  - No guarda estado.

Desventajas

- Literales
  - <a href=”http://192.0.2.1/index.html”>
- Algunas aplicaciones no son compatibles con IPv6

464XLAT y SIIT-DC Dual



Contacto

https://jool.mx	Página oficial
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jool-news@nic.mx	Noticias
jool@nic.mx	Discusión privada

Muchas gracias