

Campus Network Design Workshop

Migrating a Campus Network: Flat to Routed



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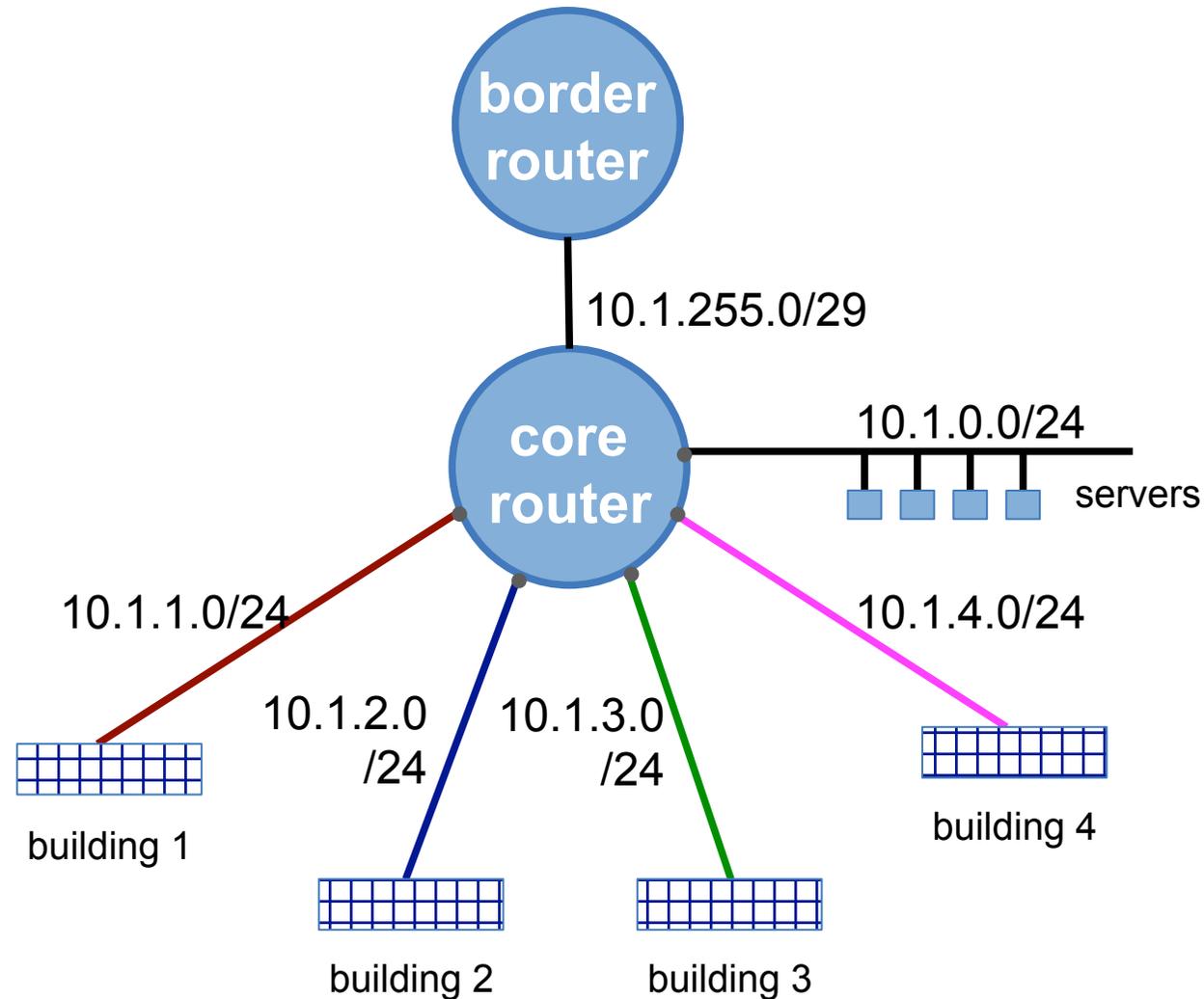


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Last updated 19th October 2016



Ideal routed campus network



Changing from flat network implies:

- Nearly everything needs renumbering!
 - Well, you can keep one subnet on its old addresses
 - What's hardest to renumber – servers perhaps?
- So, first get as much as possible onto DHCP
- This lets you renumber centrally



Quick refresher: DHCP (RFC2131)

- A DHCP exchange is 4 UDP messages:
 - Client sends “Discover” (broadcast)
 - One or more servers replies with “Offer”
 - Client picks one offer and sends “Request”
 - Server responds with “Ack” to confirm
- Address is granted for a finite “lease time”
 - When this is nearly over, client must request again to continue using the address



Lease time

- It's a good idea to reduce the lease time in advance of renumbering
 - e.g. say current lease time is 24 hours
 - Reduce this to 10 minutes then wait 24 hours
 - By this time you'll know every device is refreshing its address every 10 minutes
 - Minimises time for new addresses to be picked up
- Put back up after change tested and successful



DHCP options (RFC2132)

- DHCP response can also contain other settings to configure the client
 - Netmask, default gateway
 - DNS servers, default domain
 - SIP server (IP phones)
 - TFTP boot server (PXEboot / diskless clients)
- Centralises all client network configuration



Managing Devices

- Highly recommended to use DHCP to configure even devices with “static” IP addresses like printers, phones, admin workstations
 - DHCP servers can be configured with a mapping of MAC address to fixed IP address
- DHCP logs are a useful source of address pool availability information



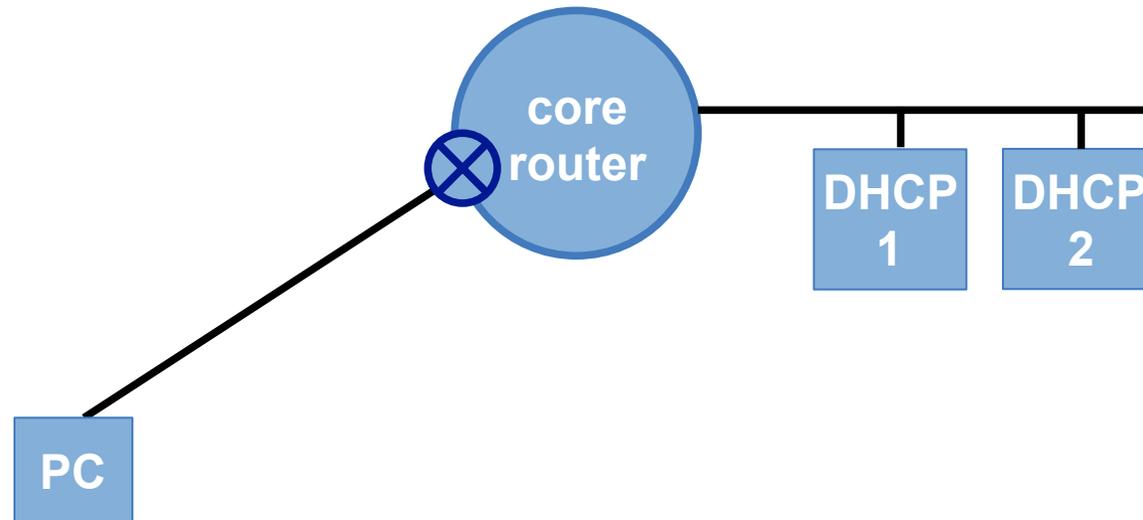
DHCP Broadcasts

- You need to respond to the DHCP Discover broadcasts on every subnet
- Option 1: run DHCP service on the router itself
 - Can be awkward to manage if you have a lot of custom options or static MAC address mappings
- Option 2: use a feature on the router called “DHCP relay” or “DHCP helper”
 - Relays requests to one or more DHCP servers



DHCP Relay

 DHCP relay agent

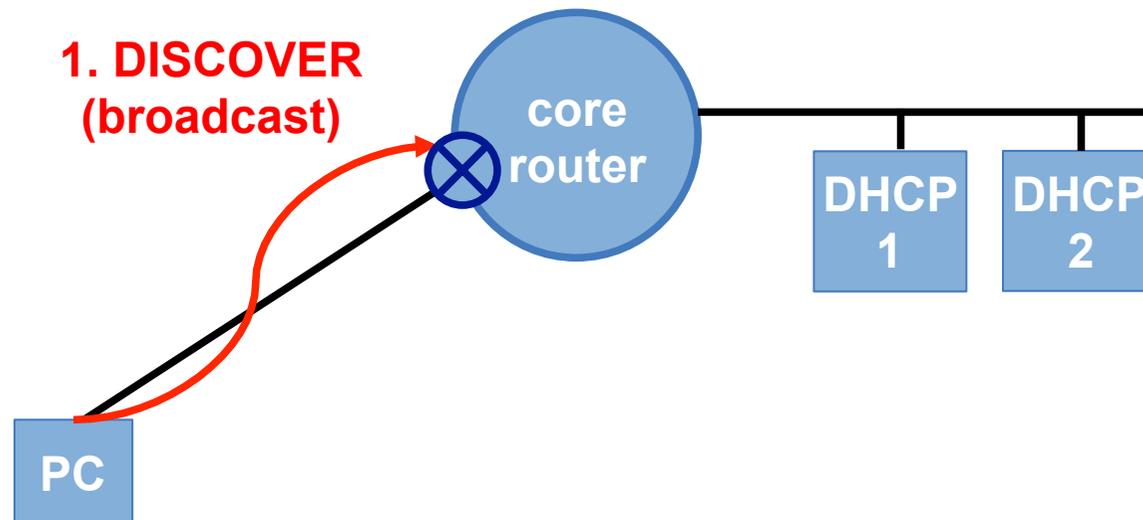


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DHCP Relay

 DHCP relay agent



* Client can request broadcast response using the B flag

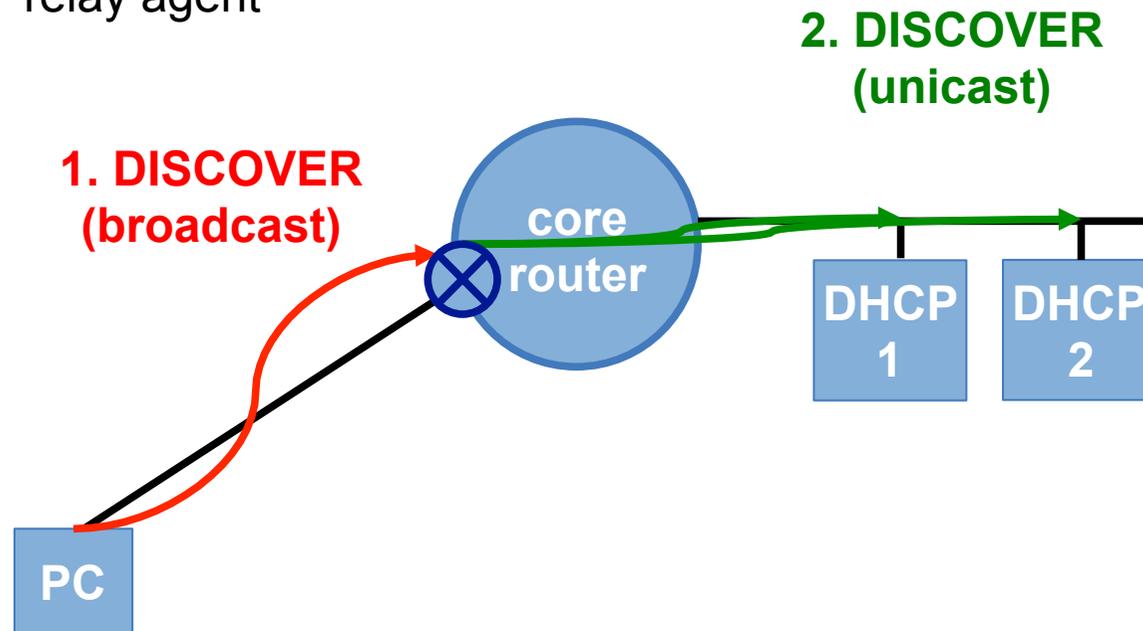


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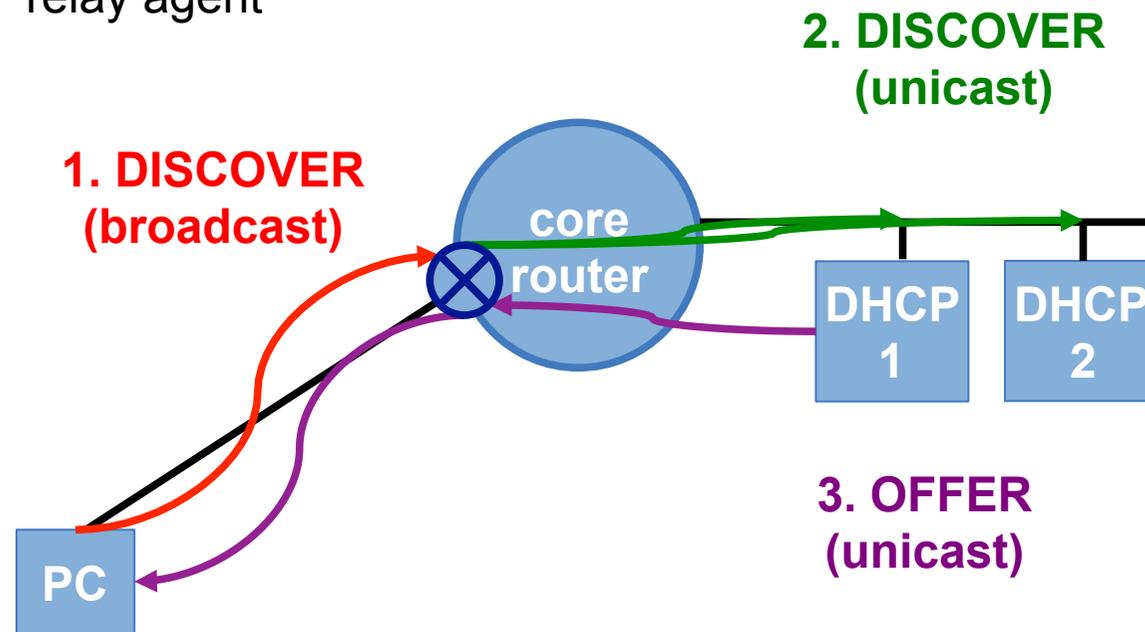


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DHCP Relay

 DHCP relay agent



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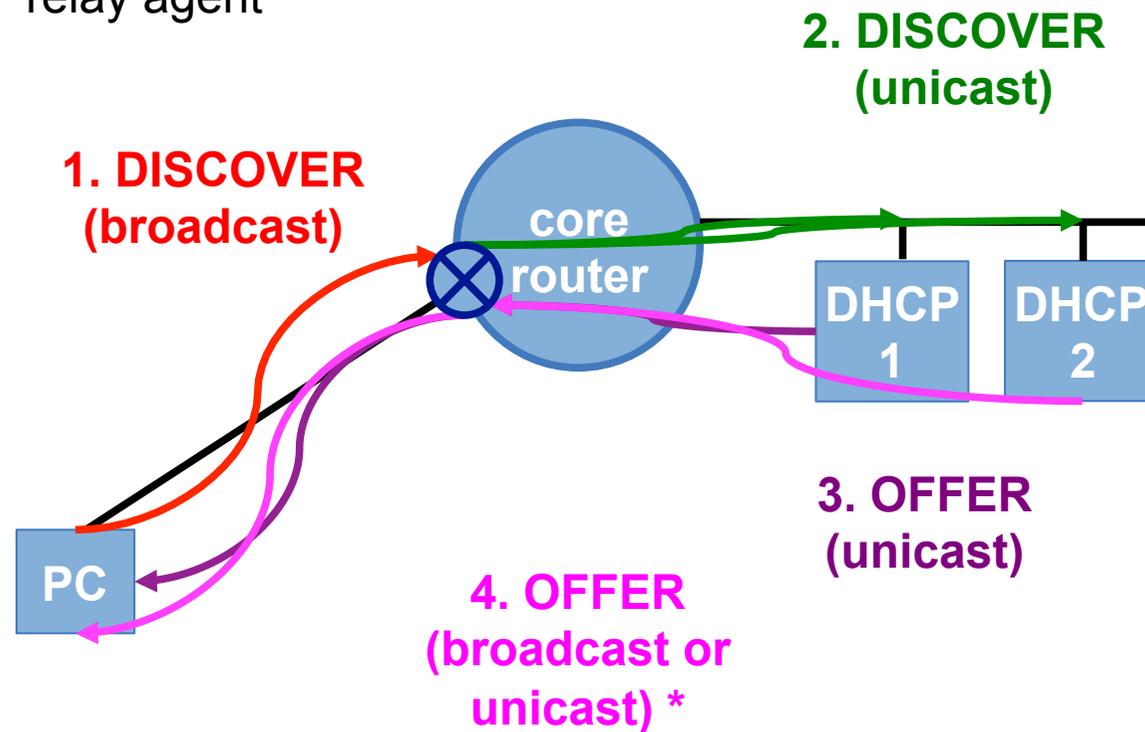


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DHCP Relay

 DHCP relay agent

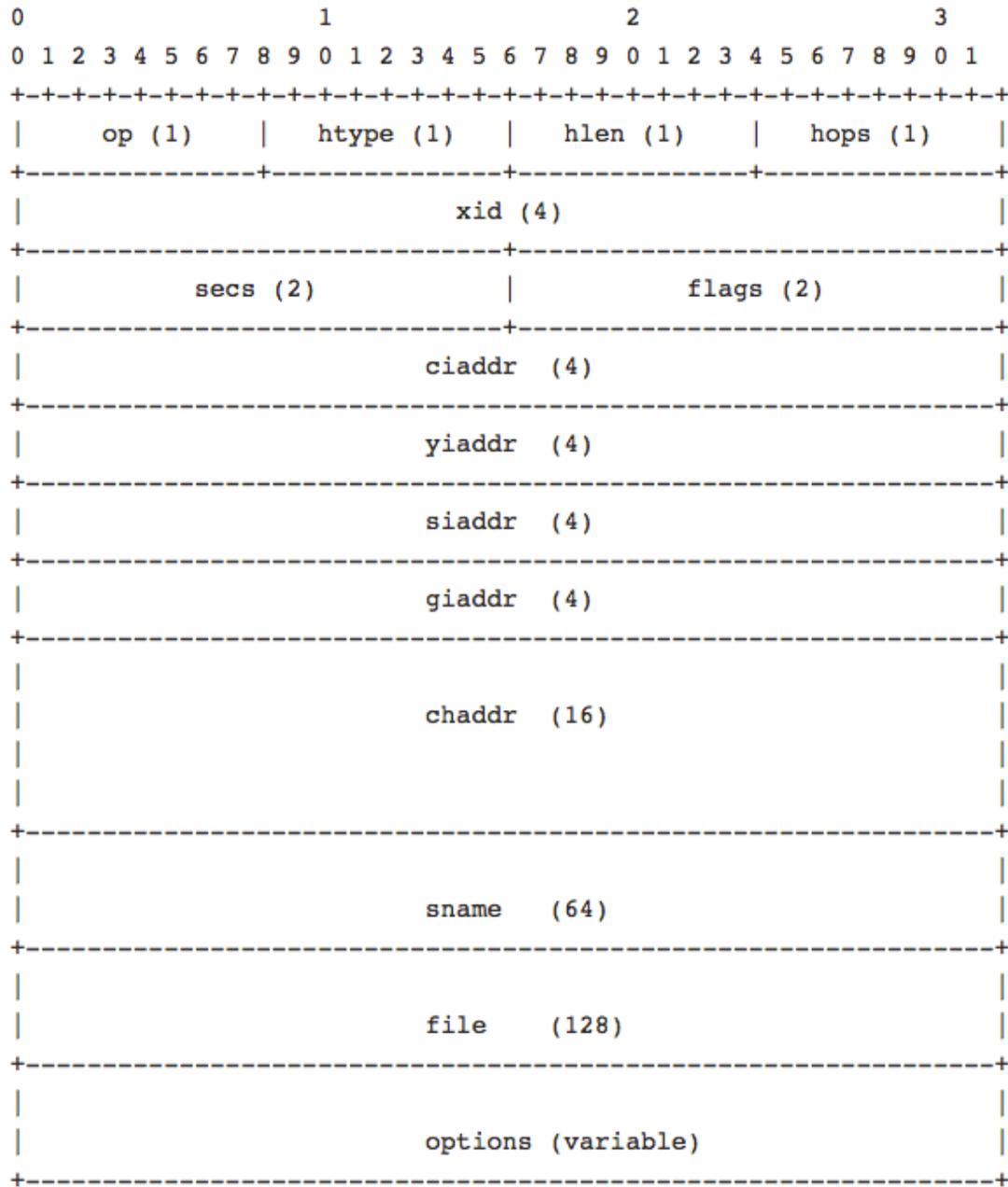


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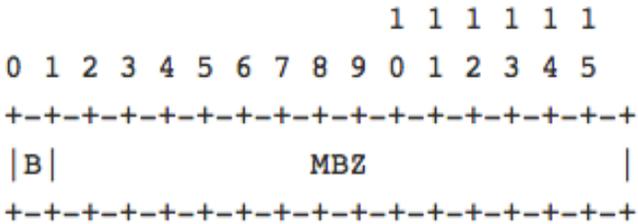


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DHCP Messages



B: BROADCAST flag

Source: RFC2131

DHCP relay configuration

- Repeat for every interface where DHCP service is required

```
interface Vlan100
  ip address 10.1.1.1 255.255.255.0
  ip helper-address 10.1.0.4
  ip helper-address 10.1.0.5
```



DHCP server configuration

- Define each subnet where service is required
 - (Windows DHCP server: "DHCP scope")

```
subnet 10.1.1.0 netmask 255.255.255.0 {  
    option routers 10.1.1.1;  
    option subnet-mask 255.255.255.0;  
    range 10.1.1.100 10.1.1.199;  
}
```



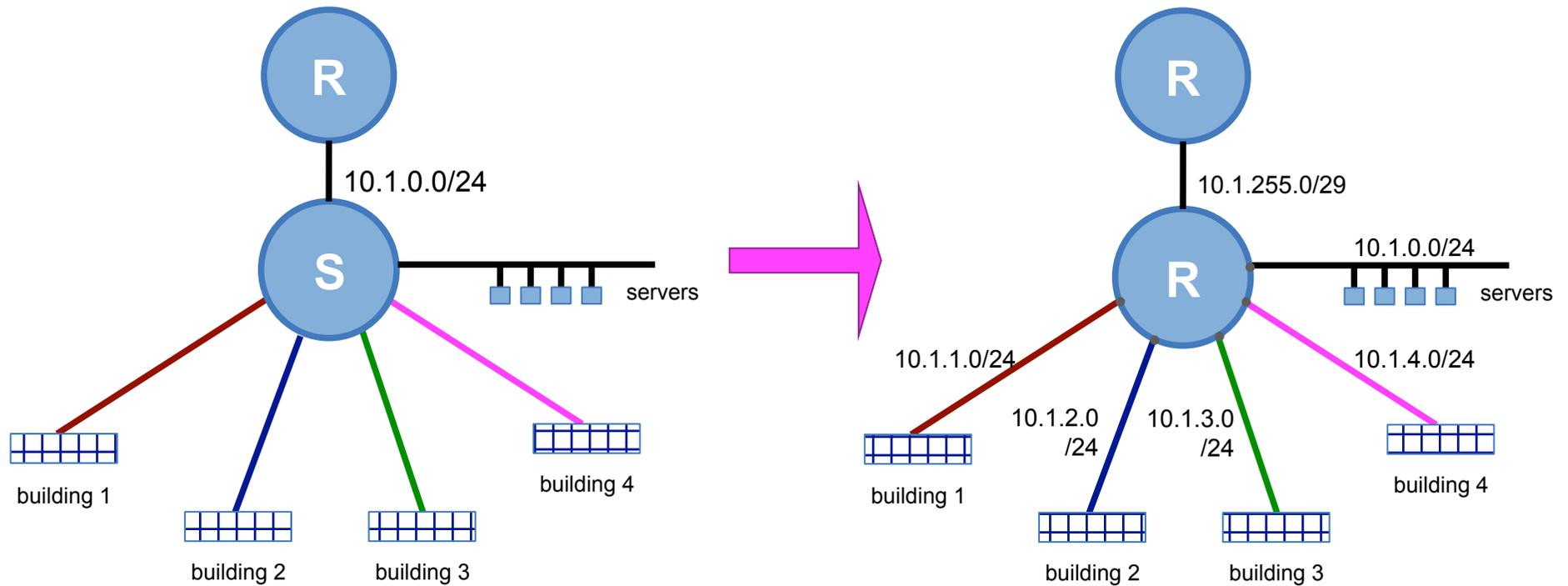
Questions?



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Planning Migration



General Principles

- No "big bang"!
- Series of small, incremental changes
- Test at each stage
- Plan to rollback at each stage
 - You will discover things that break
 - Understand the problem, correct and try again
- Localize outages and give advance warning



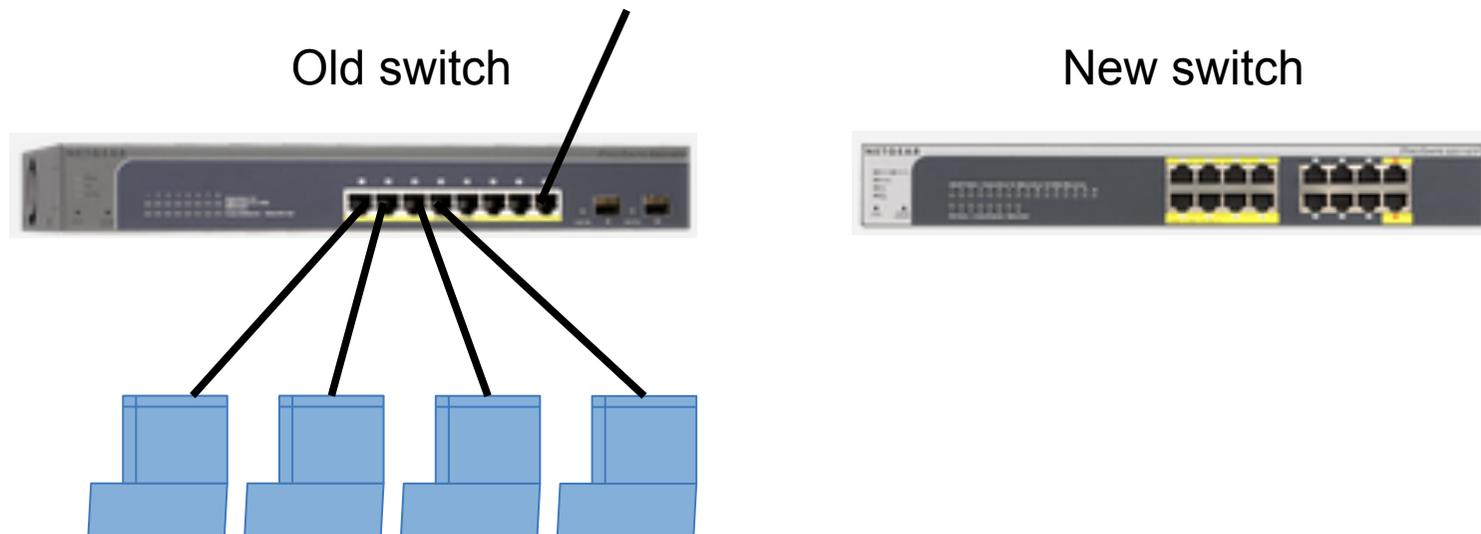
Managing Complexity

- Incremental steps means you will be running parts of old and new configuration in parallel
- Remember to strip out old configuration when it is no longer needed
 - So it's understandable
 - So you are not left with any configuration which might be important but actually isn't
- It all gets easier with experience



Quick Example

- You want to replace an old switch with a new one
 - How would you go about it?



For discussion!

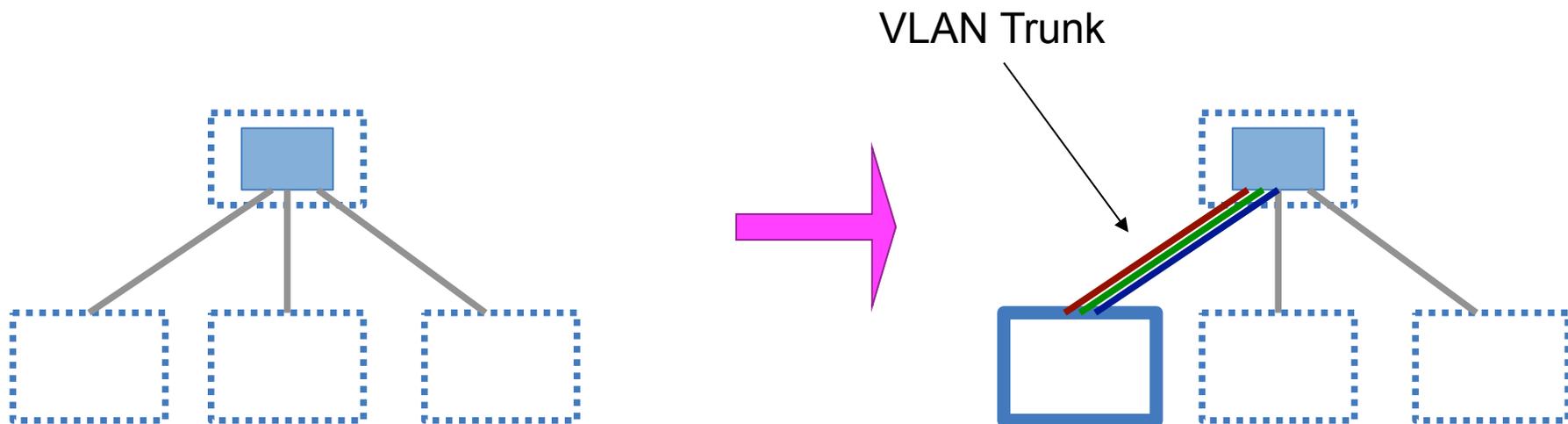


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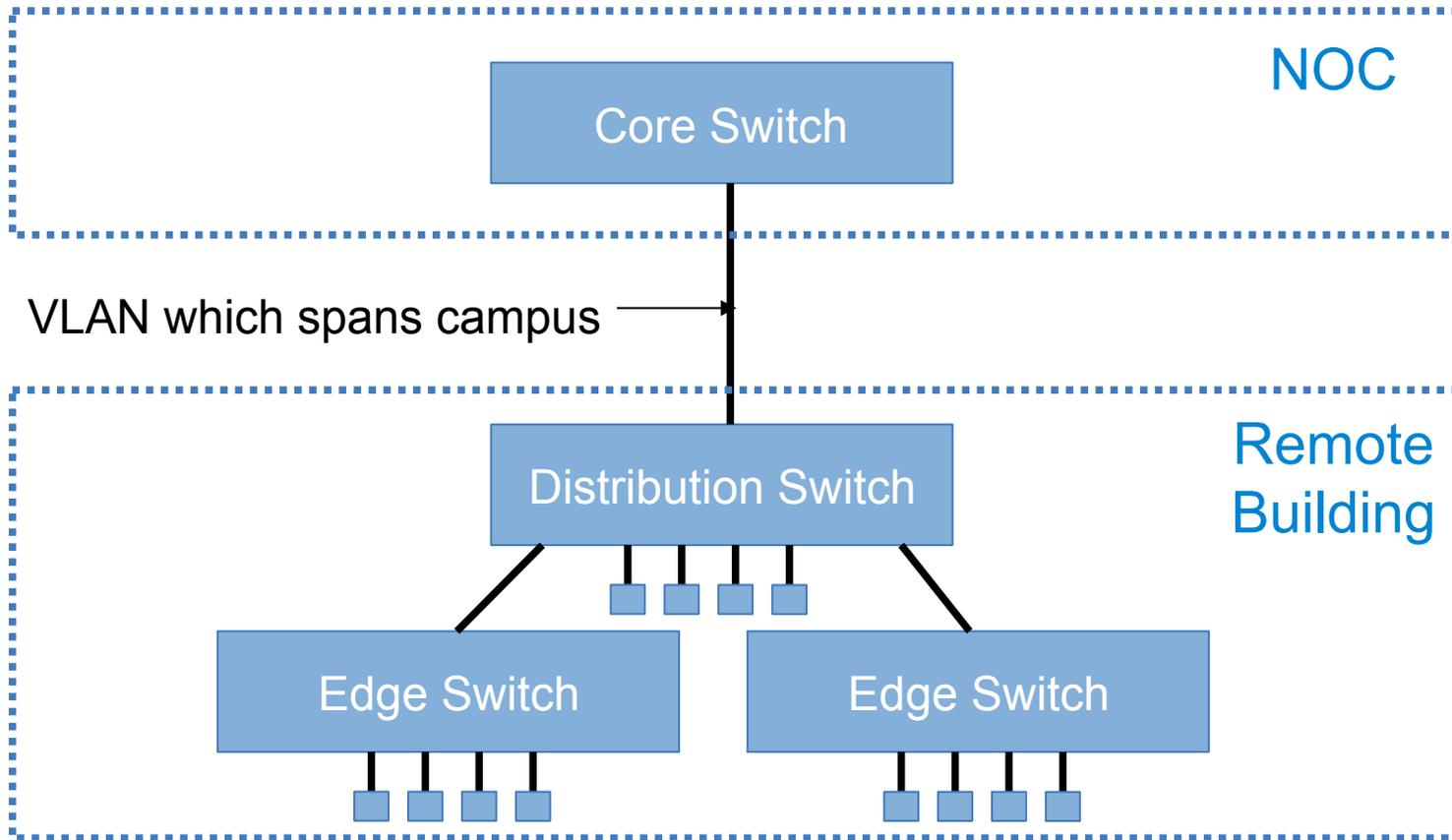


Longer Example

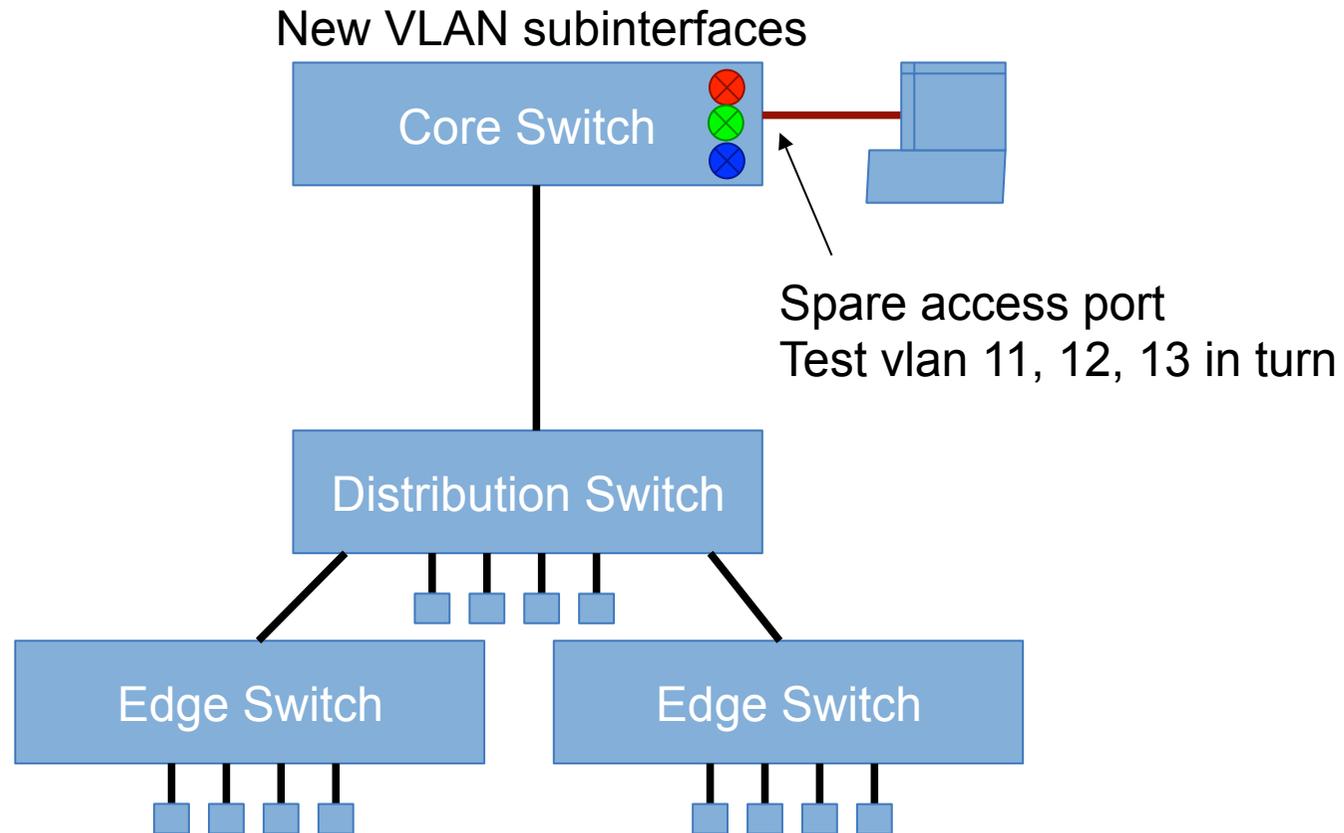
- Migrate one building from the flat network onto three new subnets (*e.g. wired, wireless, guest*)



Before (detail)



1. Create new vLANs in core



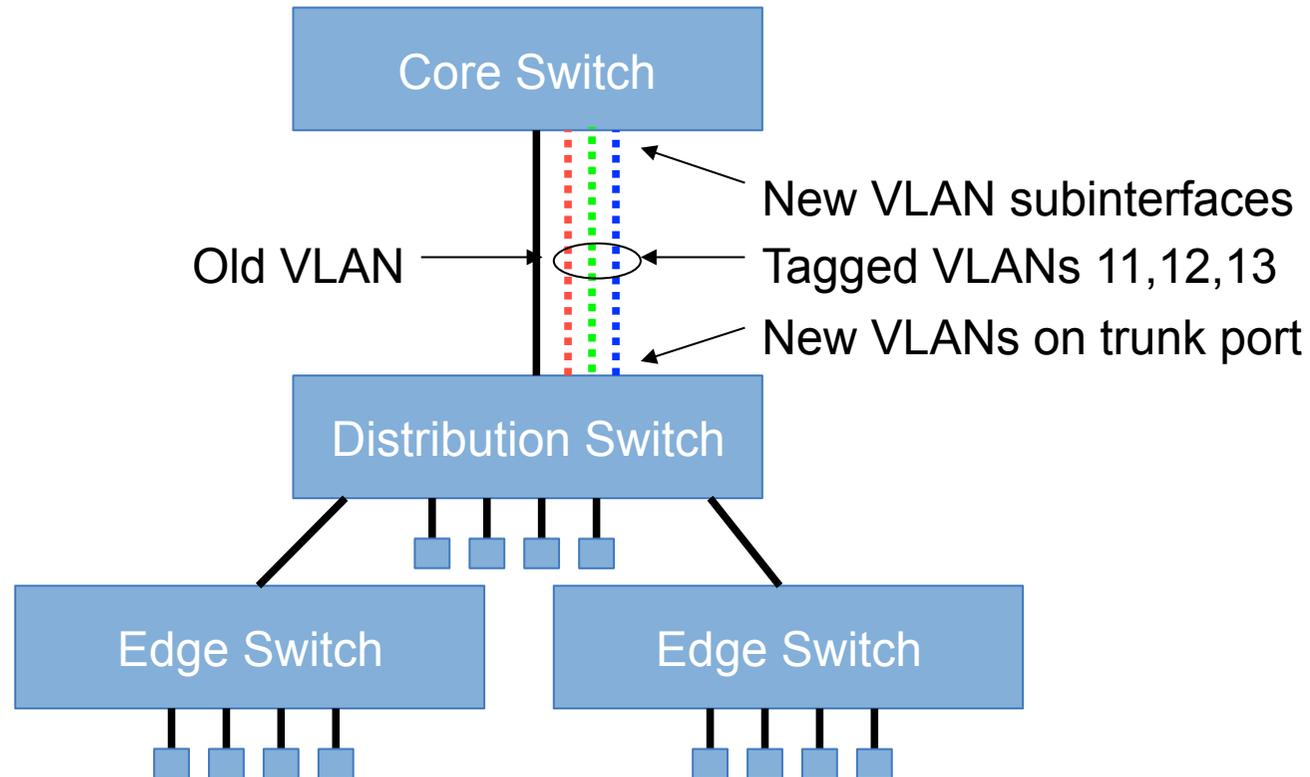
Test all client functionality, e.g. DHCP, routing



Rollback plan

- Undo changes to core switch
- Take a copy of the configuration before you start making any changes, so you have a reliable reference

2. Add new vLANs to trunk



Should not break anything! (But check anyway)

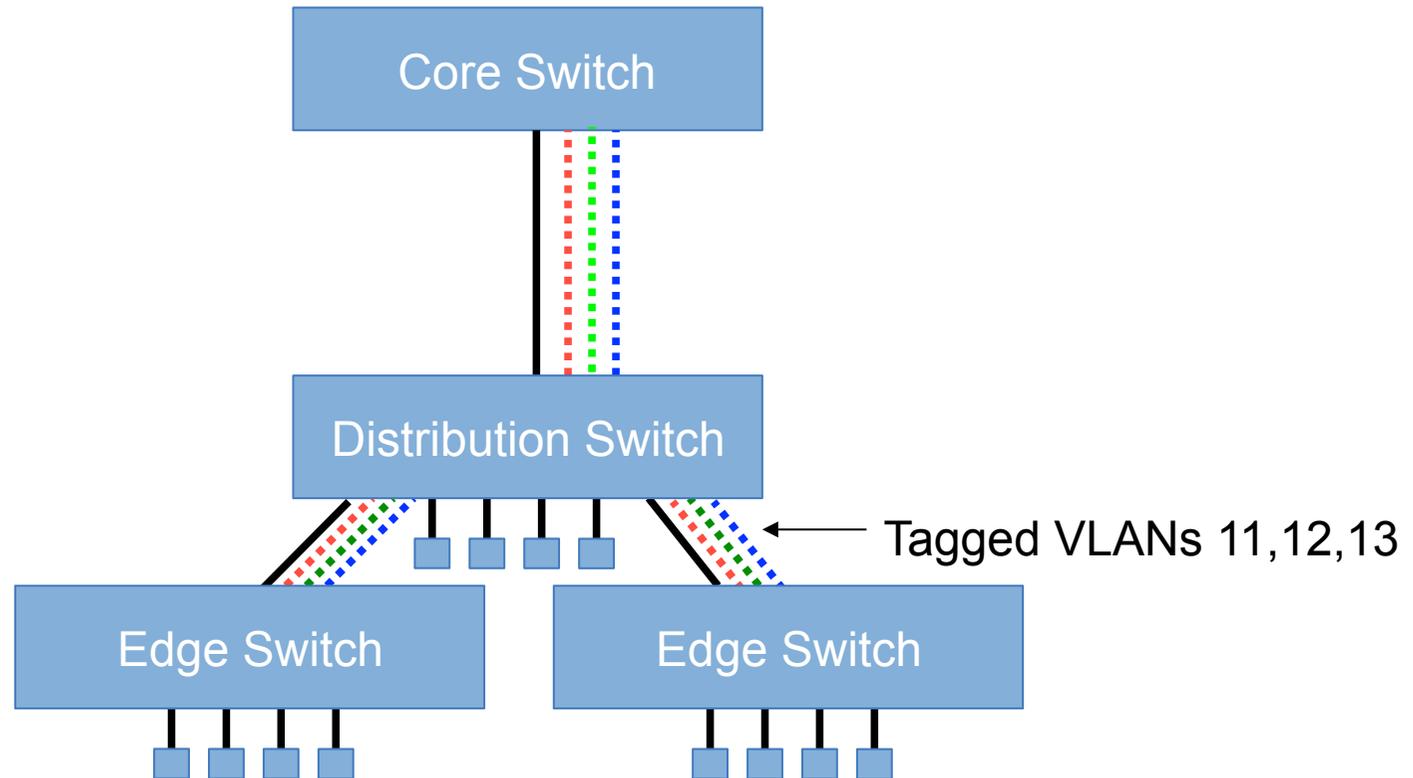


Choice to make

- Run the old VLAN untagged, together with the new VLANs tagged; OR
- Change the old VLAN to tagged at both ends
 - Bigger change, but may be easier to understand
- Whichever you are most comfortable with
- No clients should be affected yet
- Rollback plan: revert these small config changes



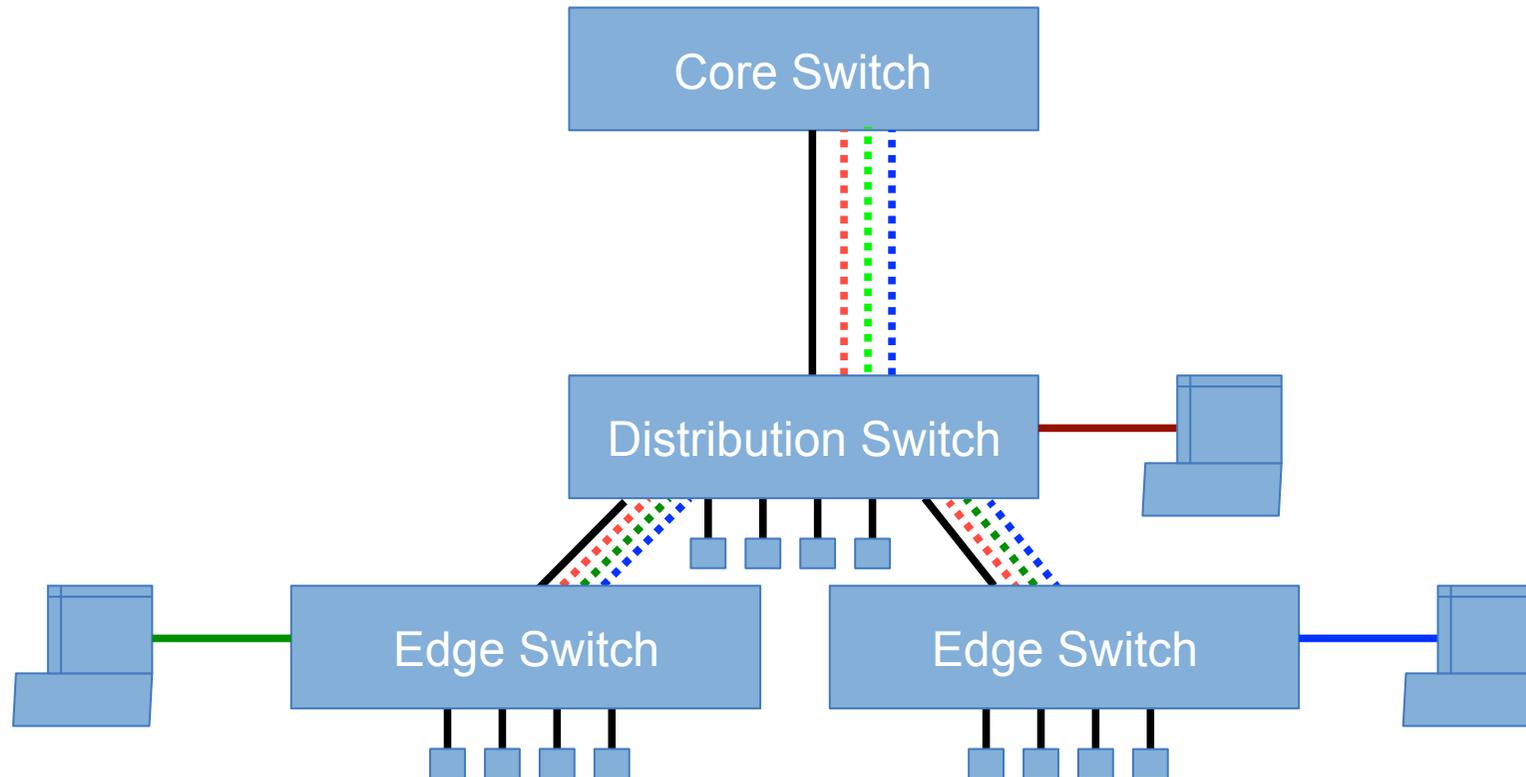
3. Extend vLANs to edge



Again, nothing should break



4. Test with spare access ports



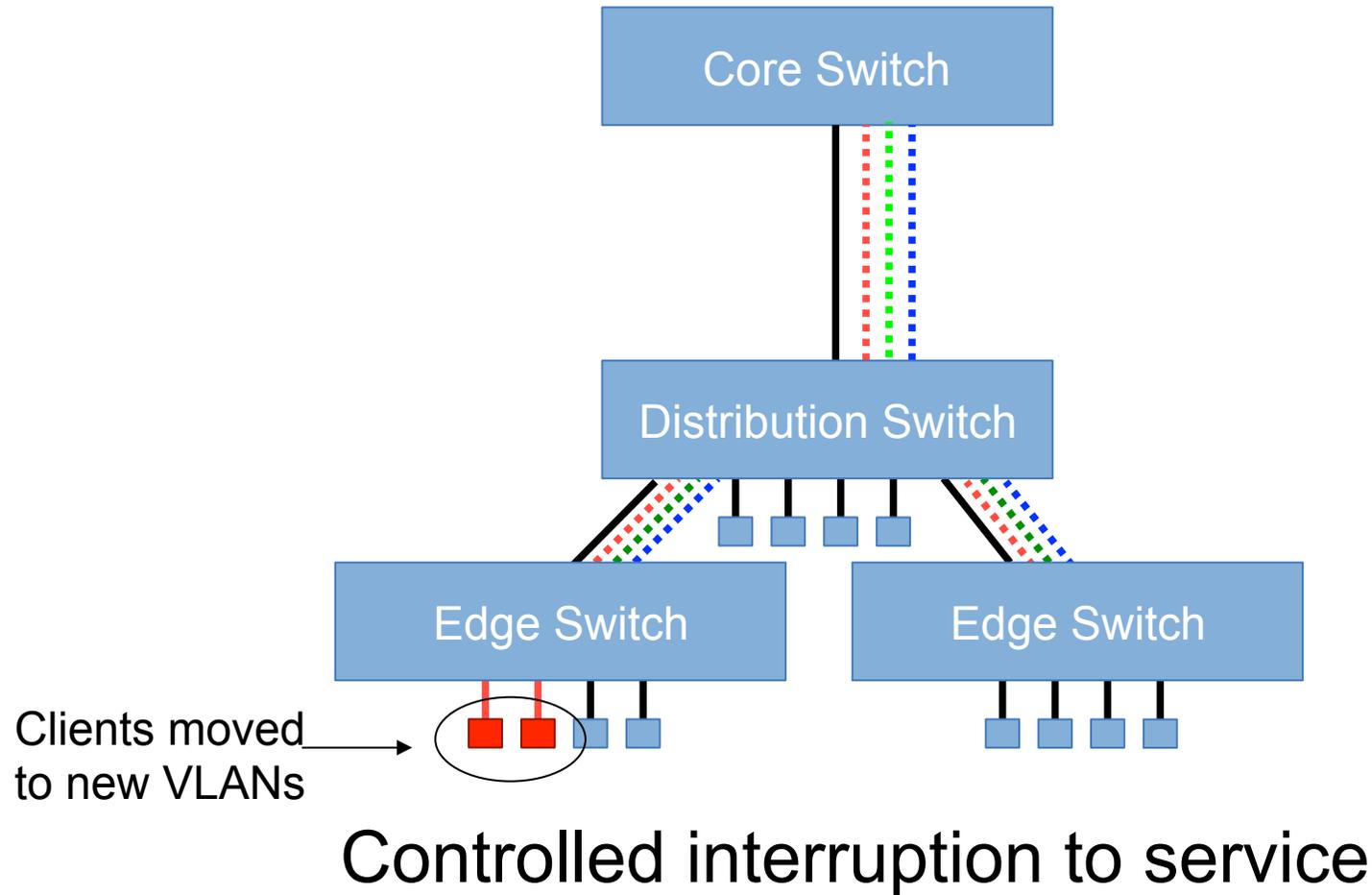
Re-test all client functionality, DHCP, routing



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5. Re-assign edge ports individually



6. Move all the remaining clients

- Hint: a 5-second shutdown on the port can help force clients to re-DHCP

```
interface GigabitEthernet 0/3
 shutdown
no shutdown
```

- Problematic clients can be rolled back to the old vLAN while you work out how to fix them
- For important devices, check in DHCP logs that they have come back



7. Renumber the switches

- Give the switches new management IP addresses on the appropriate new VLAN
 - Remember the default gateway will change
 - Try not to lock yourself out!
 - Serial console is safest way to do this
- Might choose to do this earlier (before moving clients)



8. Check nothing on old VLAN IPs

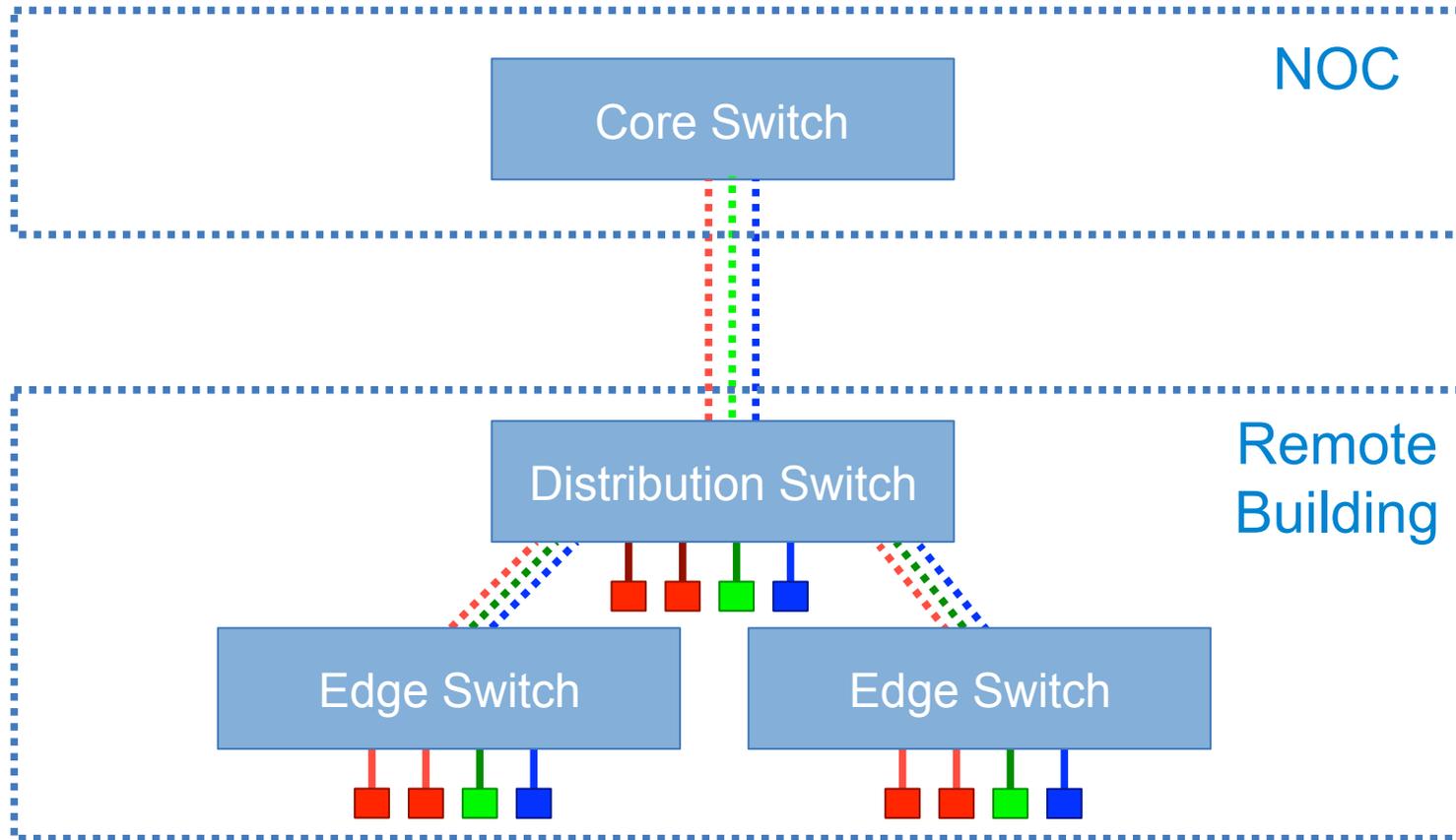
- wireshark / nmap / angry IP scanner are useful tools for this
 - Connect a laptop to each new VLAN, but configured statically with an IP address on the old VLAN range

```
nmap -sP -n x.x.x.x/x # old range
```

- You will discover any devices which are still statically configured with old IP addresses
- Find them and correct them



9. Strip out the old vLAN



Final test to sign-off



Summary

- Lots of steps, but each one is easy to rollback
- Plan in advance what the final configuration will look like, and the steps to get there
- Make sure you know how to rollback any step
- Test before and after each change
 - Monitoring key devices with e.g. LibreNMS can give you extra confidence nothing has broken



Plan within your constraints

- Some of your switches are dumb?
- Some parts of your network must be in service at particular times?
- Make a plan which best fits your situation



Other hints and tips

- If your core switch has only SFP ports, a copper gigabit SFP is useful for testing
- If you move an IP address from one device to another, other devices may have the old MAC address cached in their ARP table for a while
 - Cisco routers are worst: 4 hour ARP timeout!
 - “clear arp-cache” may be required
- “write memory” as each change completed and tested

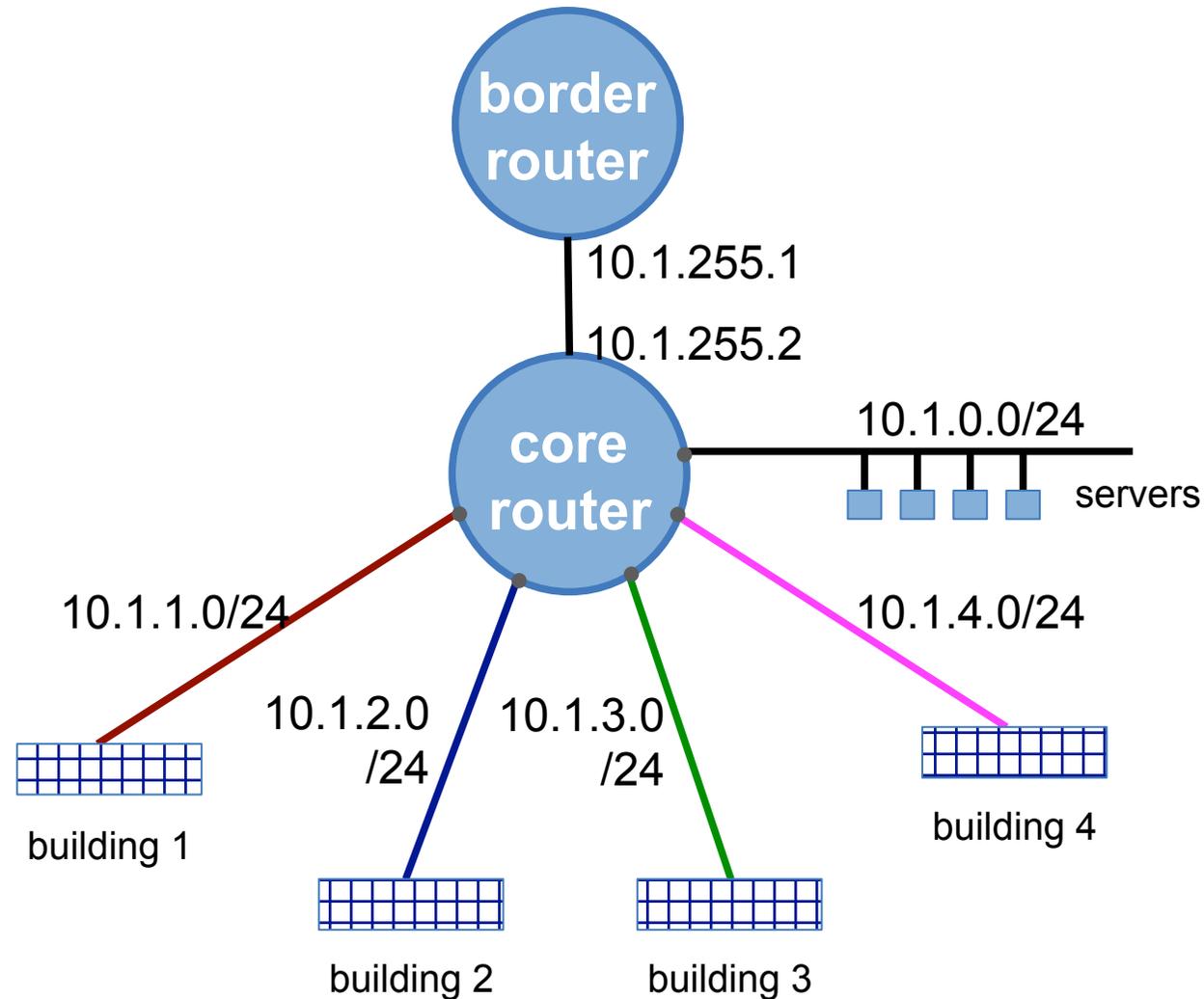


Renumbering servers

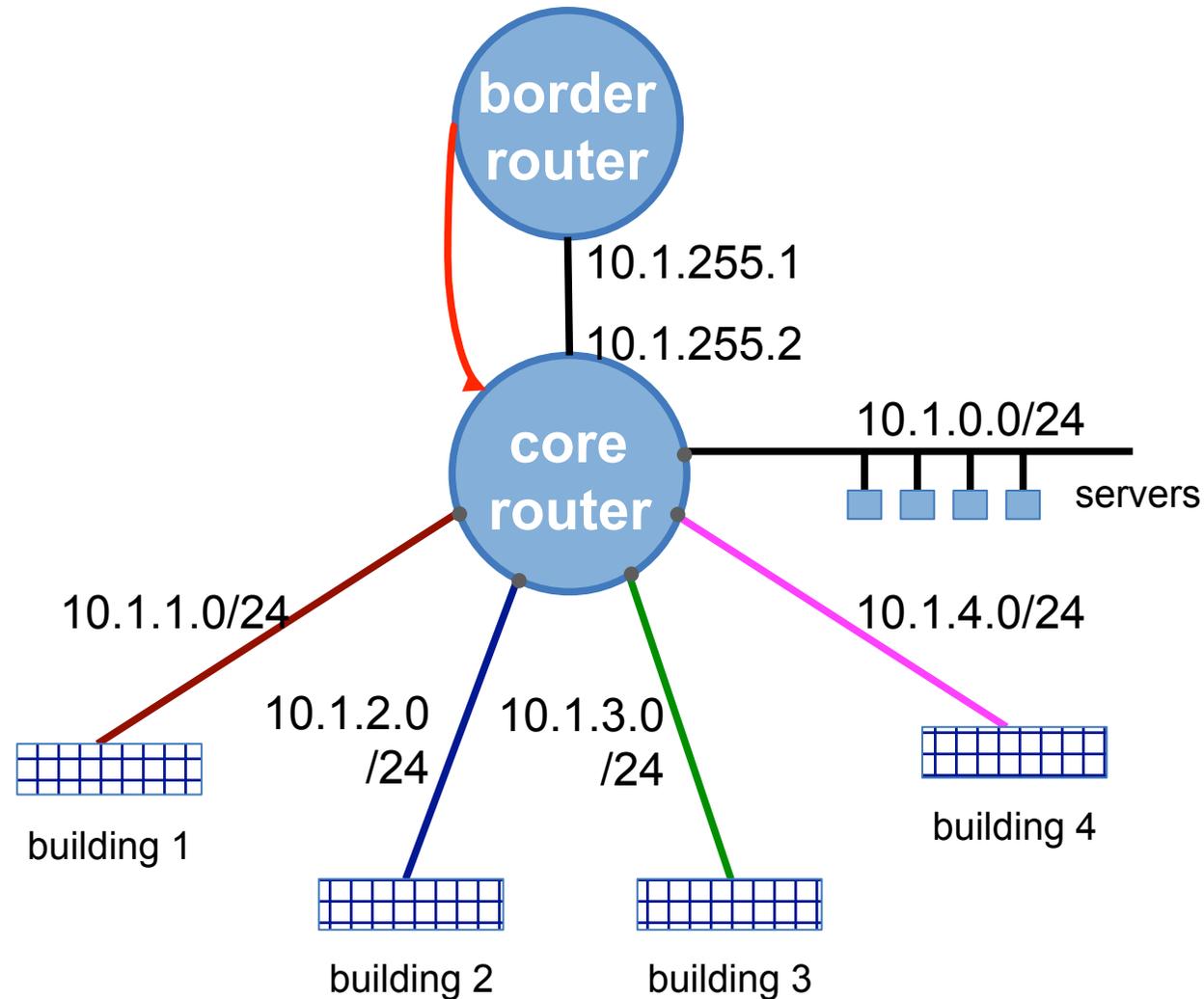
- If you are renumbering servers, remember to reduce the DNS TTL in advance of changes
 - Allow enough time for all caches to expire records with the old TTL
 - Put it back up afterwards
- “Secondary IP addresses” can be useful when renumbering servers on the same VLAN
 - Both old and new IP addresses are active at the same time



Don't forget (static) routes

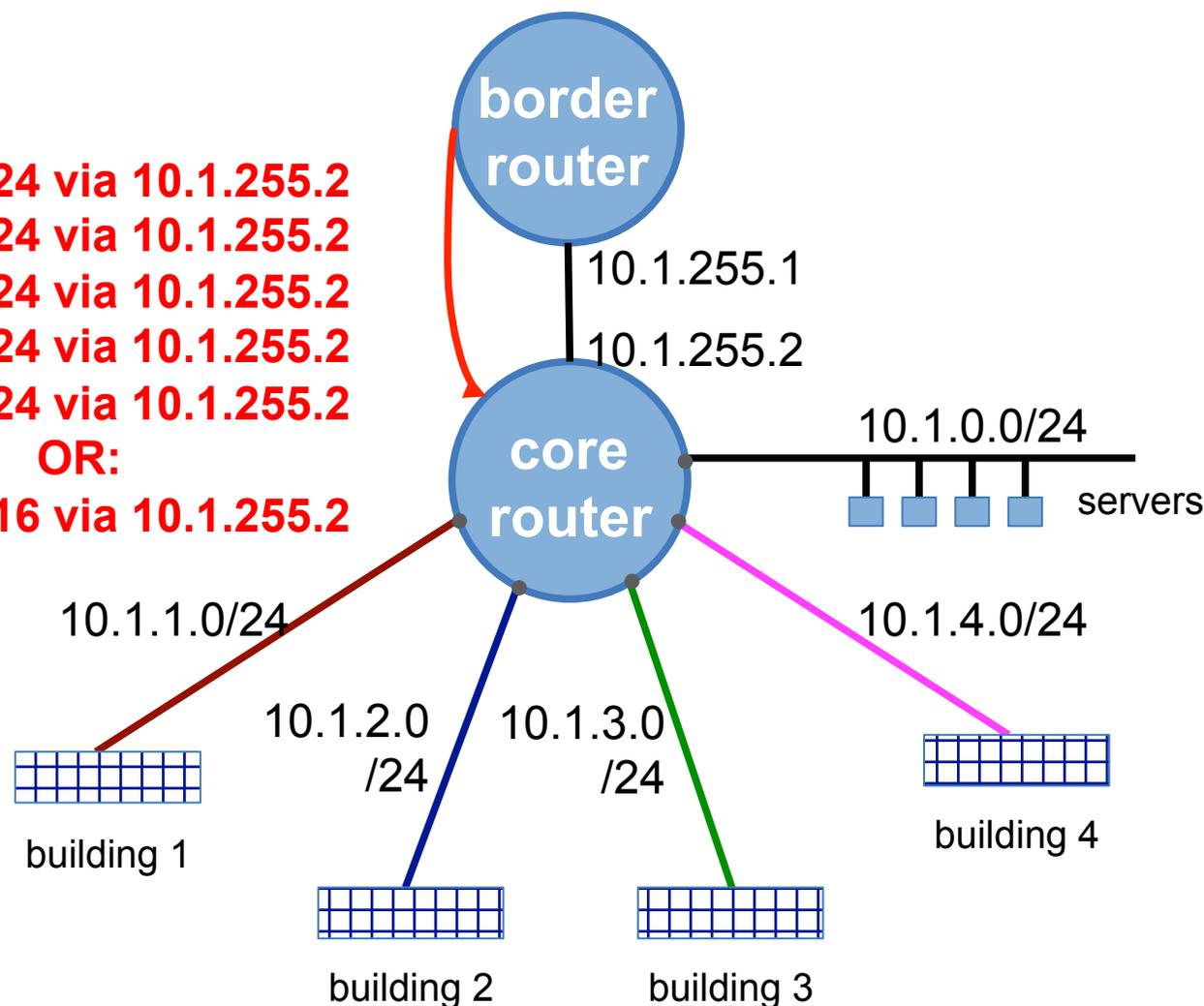


Don't forget (static) routes



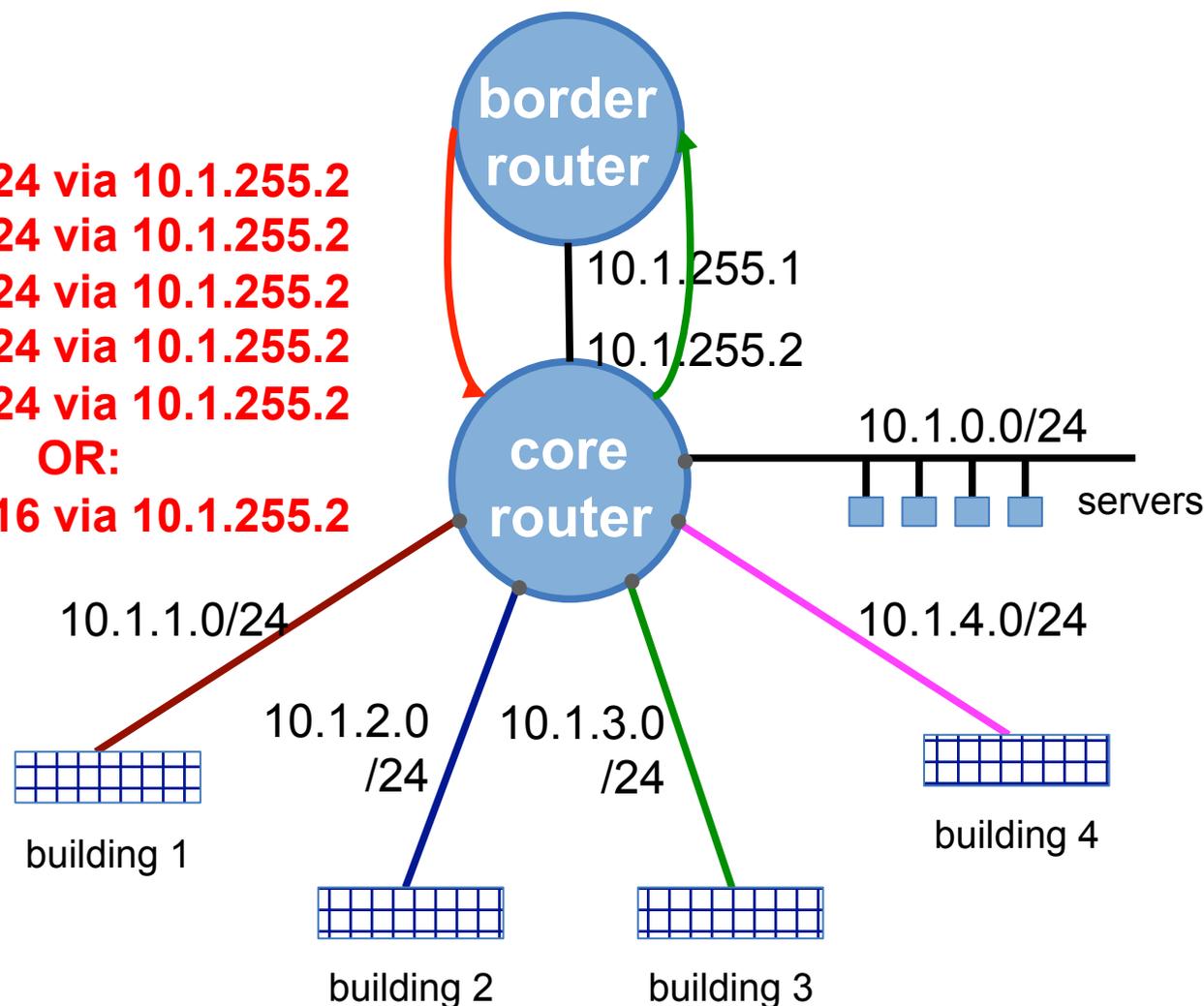
Don't forget (static) routes

10.1.0.0/24 via 10.1.255.2
10.1.1.0/24 via 10.1.255.2
10.1.2.0/24 via 10.1.255.2
10.1.3.0/24 via 10.1.255.2
10.1.4.0/24 via 10.1.255.2
OR:
10.1.0.0/16 via 10.1.255.2

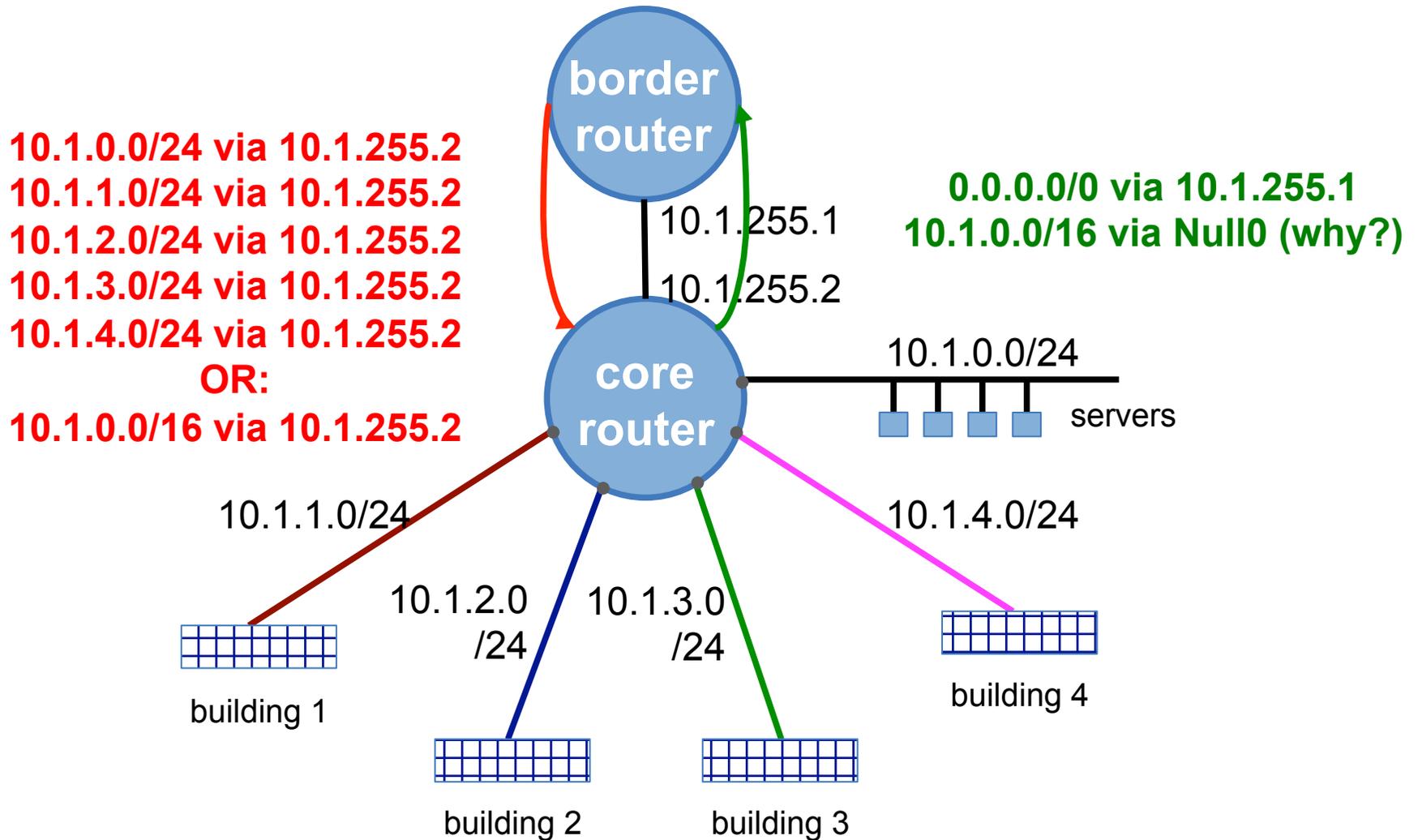


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10.1.4.0/24 via 10.1.255.2
OR:
10.1.0.0/16 via 10.1.255.2



Don't forget (static) routes



Questions?

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