Campus Network Best Practices: Core and Edge Networks

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Campus Network Challenges

- Many are not structured properly and can't effectively utilize high bandwidth REN connections
- Many make heavy use of NAT and firewalls that limit performance
- Many are built with unmanaged network equipment that provide no ability for monitoring or tuning the network

How to Best Support R & E

- Research and Education needs flexible and open networks
- Things to consider
  - NAT makes some things hard (H.323 video conferencing)
  - Filtering makes it hard for researchers, teachers, and students to do interesting things
  - Your campus network must not be the bottleneck
- Make a plan for improvement – without a plan, how will you get there.

Campus Network Rules

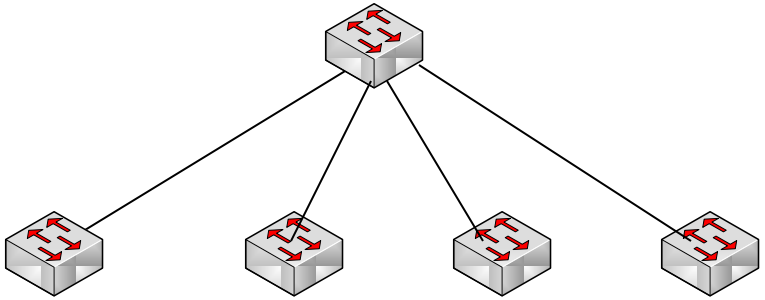
- Minimize number of network devices in any path
- Use standard solutions for common situations
- Build Separate Core and Edge Networks
- Provide services near the core
- Separate border routers from core
- Provide opportunities to firewall and shape network traffic

Core versus Edge

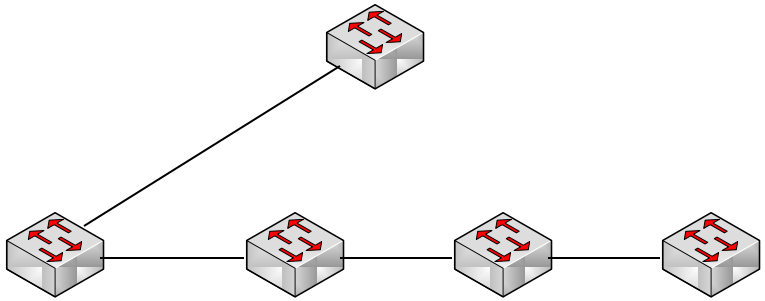
- Core network is the “core” of your network
  - Needs to have reliable power and air conditioning
  - May have multiple cores
  - Always route in the core
- Edge is toward the edges of your network
  - Provide service inside of individual buildings to individual computers
  - Always switch at the edge

Minimize Number of Network Devices in the Path

- Build star networks



- Not daisy chained networks

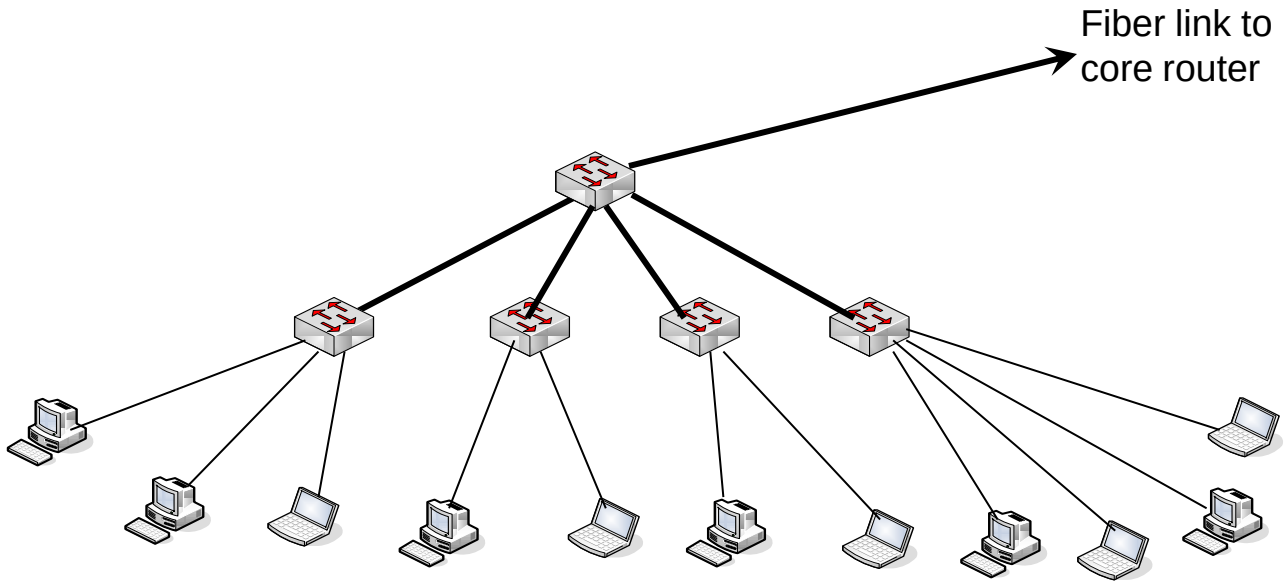


Edge Networks (Layer 2 LANs)

- Provides Service to end users
- Each of these networks will be an IP subnet
- Plan for no more than 250 Computers at maximum
- Should be one of these for every reasonable sized building
- This network should only be switched
- Always buy switches that are managed – no unmanaged switches!

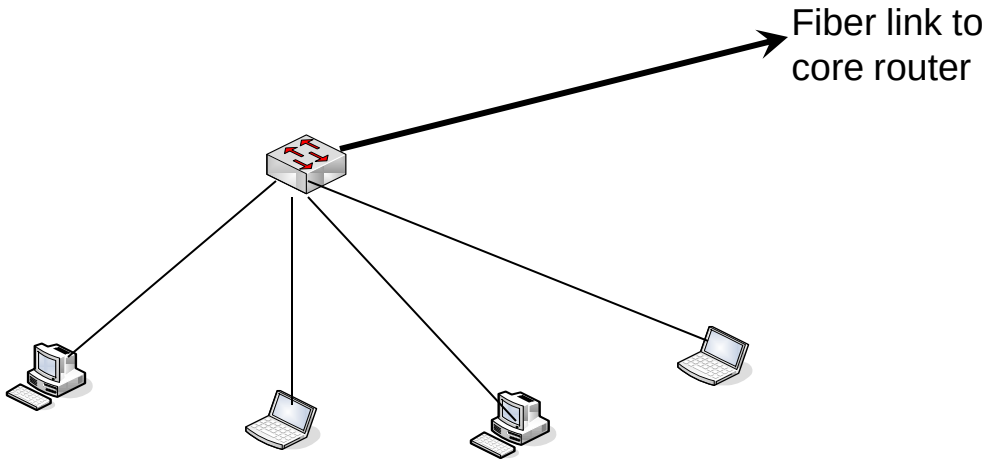
Edge Networks

- Make every network look like this:



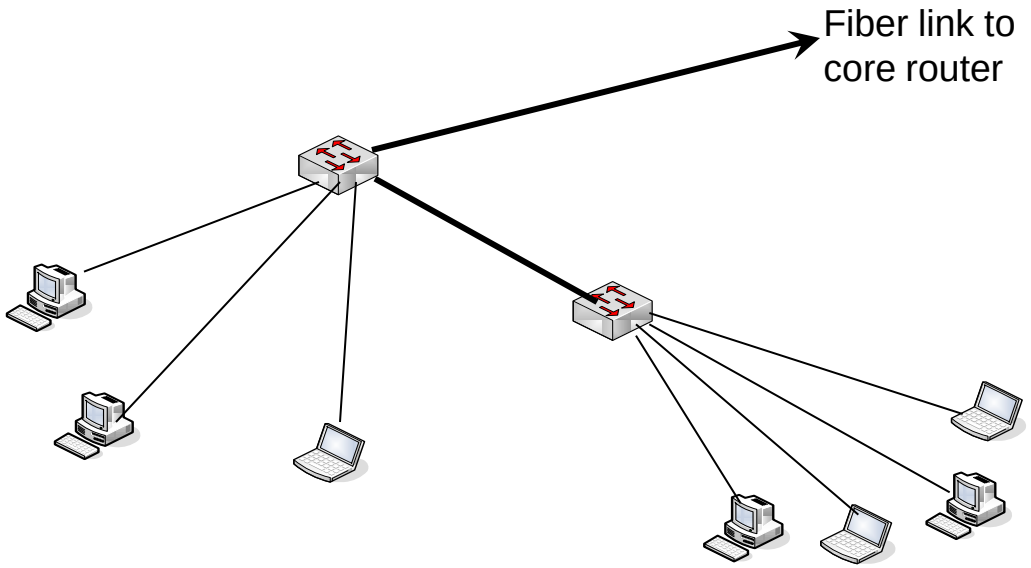
Edge Networks Continued

- Build Edge network incrementally as you have demand and money
- Start Small:



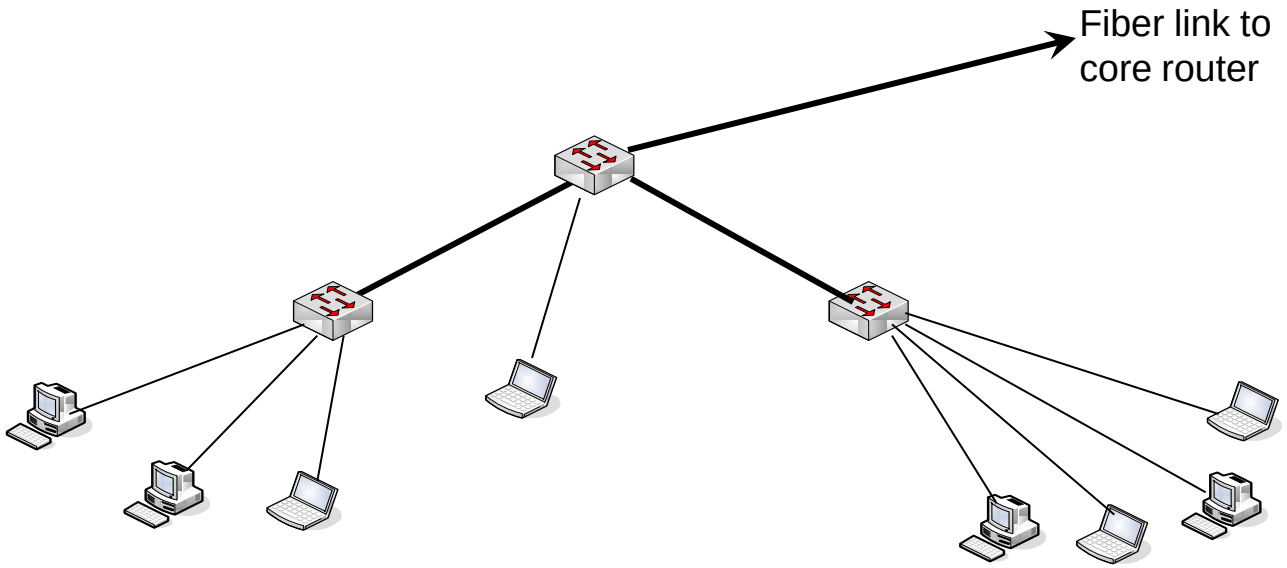
Edge Networks Continued

- Then as you need to add machines to the network, add a switch to get this:



Edge Networks Continued

- And keep adding switches to get to the final configuration



Edge Networks Continued

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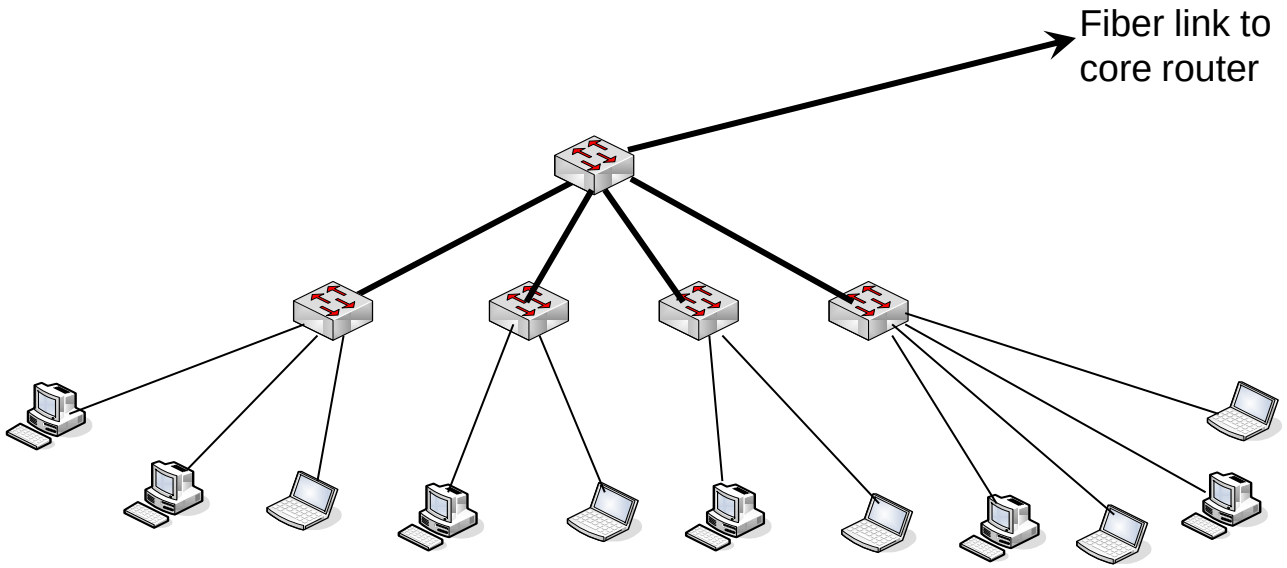
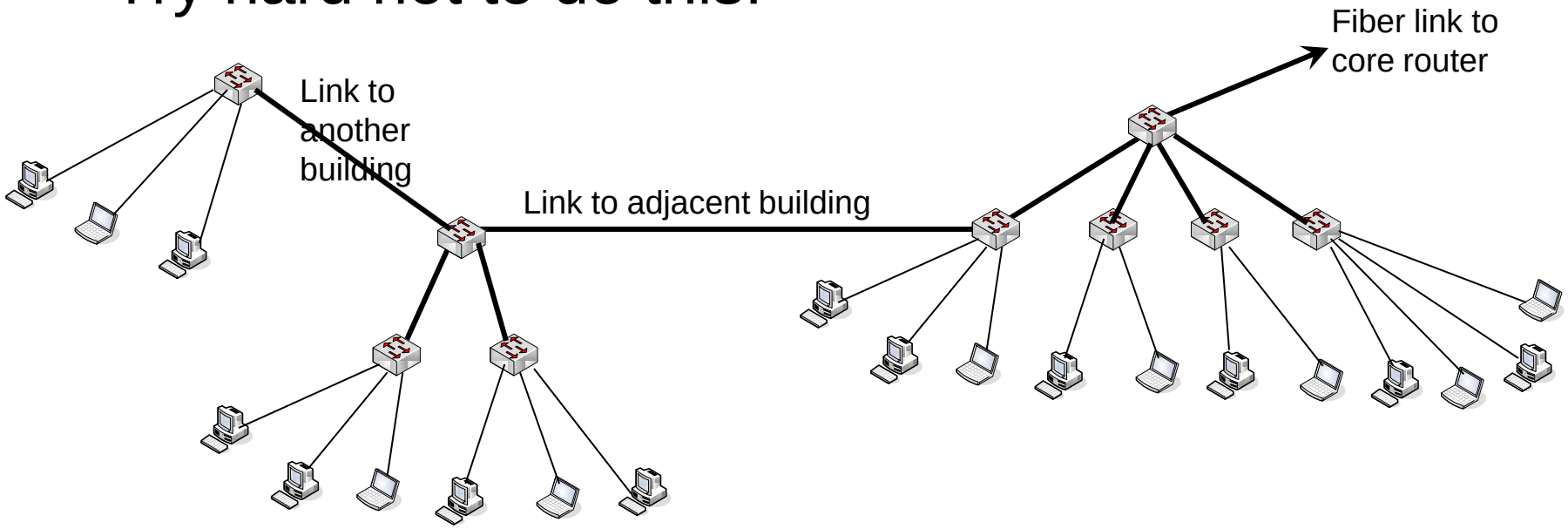


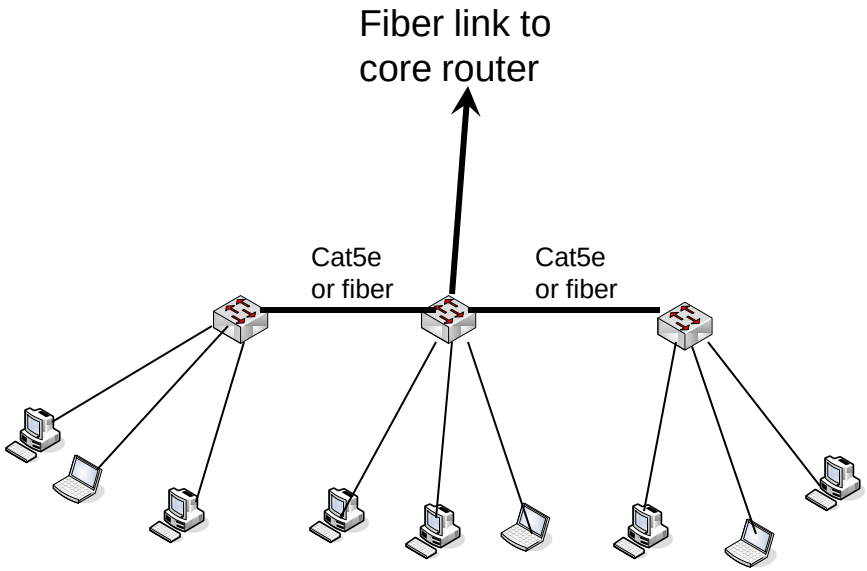
Edge Networks Continued

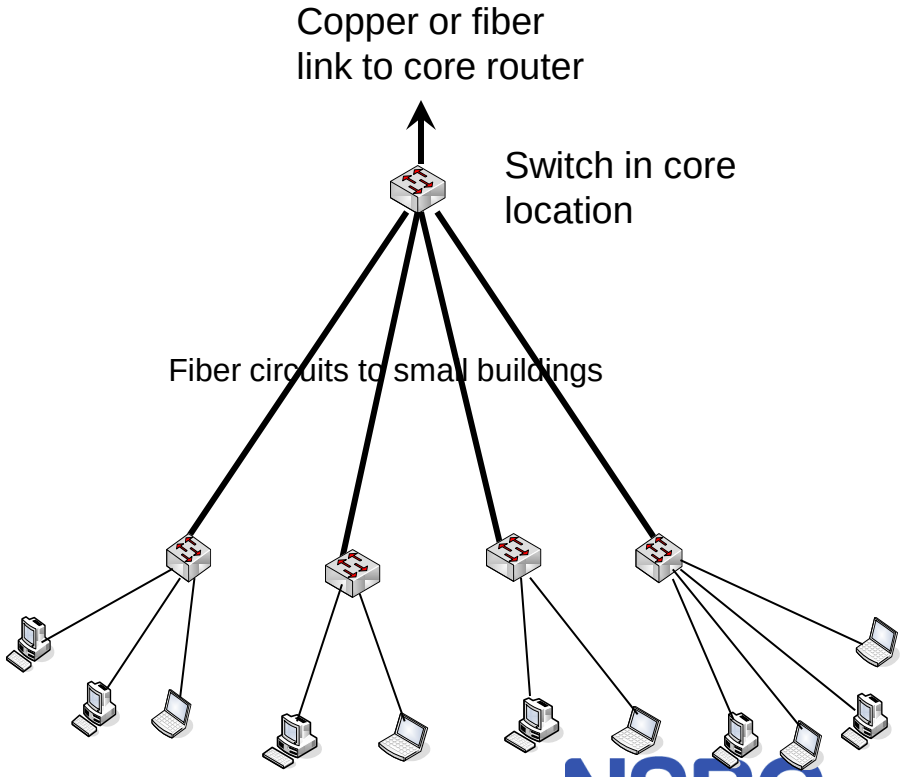
- Resist the urge to save money by breaking this model and daisy chaining networks or buildings together
- Try hard not to do this:



Edge Networks Continued

- There are cases where you can serve multiple small buildings with one subnet.
- Do it carefully.
- Two basic models:





Core Network

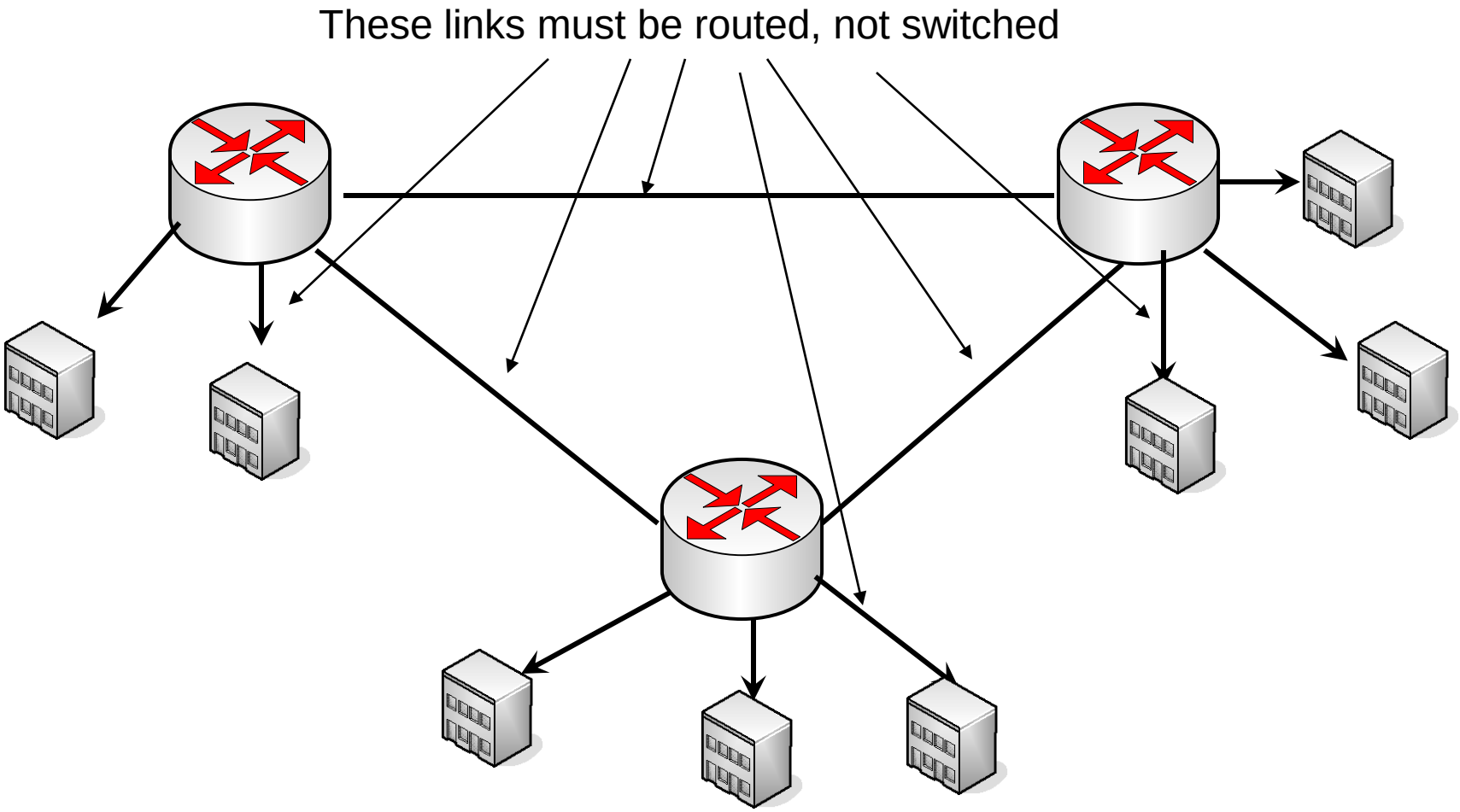
Routing versus Switching Layer 2 versus Layer 3

- Routers provide more isolation between devices (they stop broadcasts)
- Routing is more complicated, but also more sophisticated and can make more efficient use of the network, particularly if there are redundancy elements such as loops

Layer 3 Switches

- Many vendors use the term “Layer 3 Switch”.
- These are contradictory terms
  - Layer 3 = Routing
  - Switch = Layer 2
- What vendors mean is that it is a device that can be configured as a router or a switch or possibly both at the same time.

Switching versus Routing

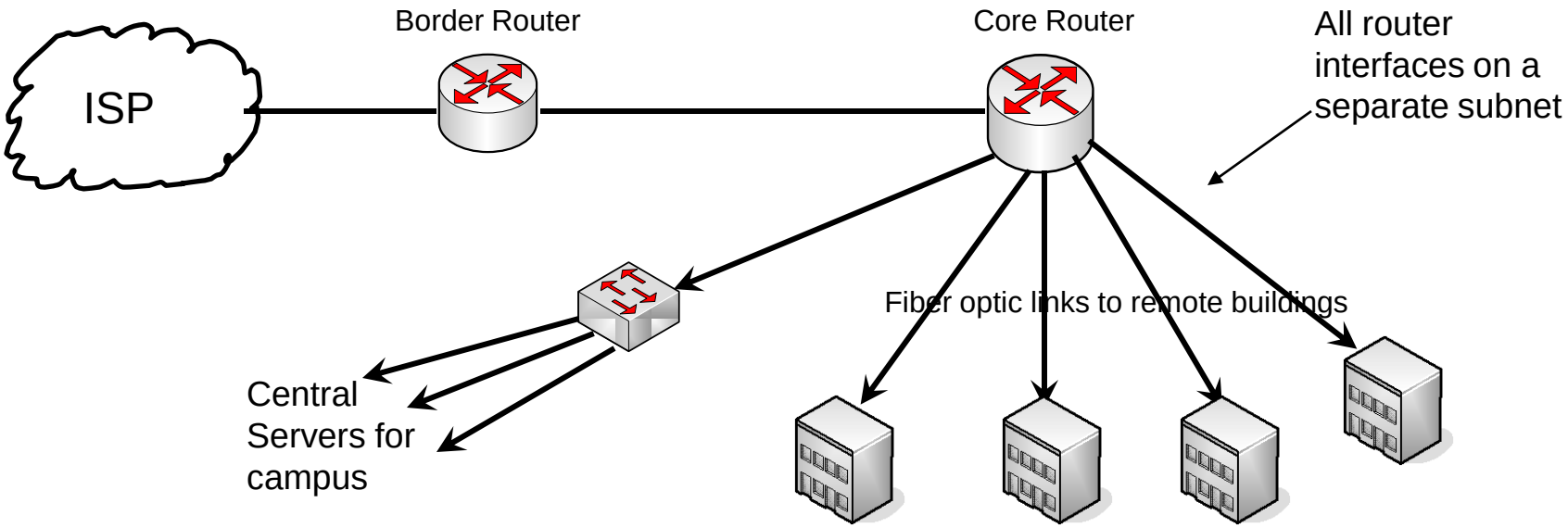


Core Network

- Reliability is the key
  - remember many users and possibly your whole network relies on the core
- May have one or more network core locations
- Core location must have reliable power
  - UPS battery backup (redundant UPS as your network evolves)
  - Generator
  - Grounding and bonding
- Core location must have reliable air conditioning

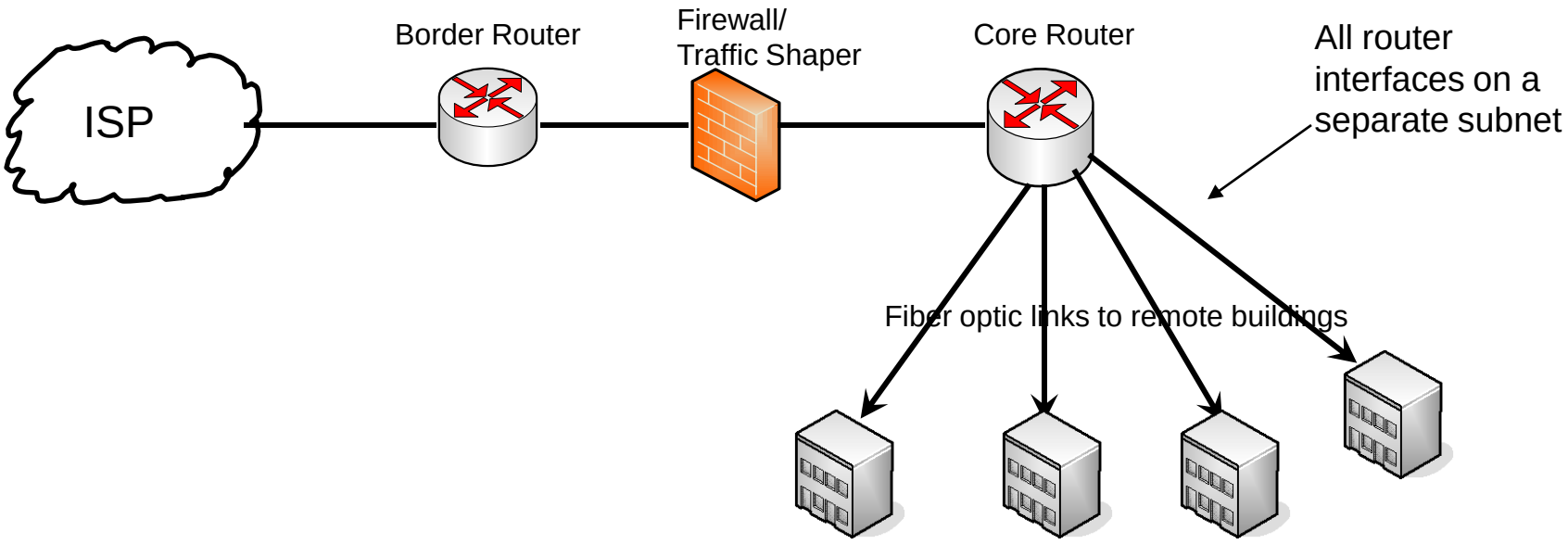
Core Network

- At the core of your network should be routers – you must route, not switch.
- Routers give isolation between subnets
- A simple core:



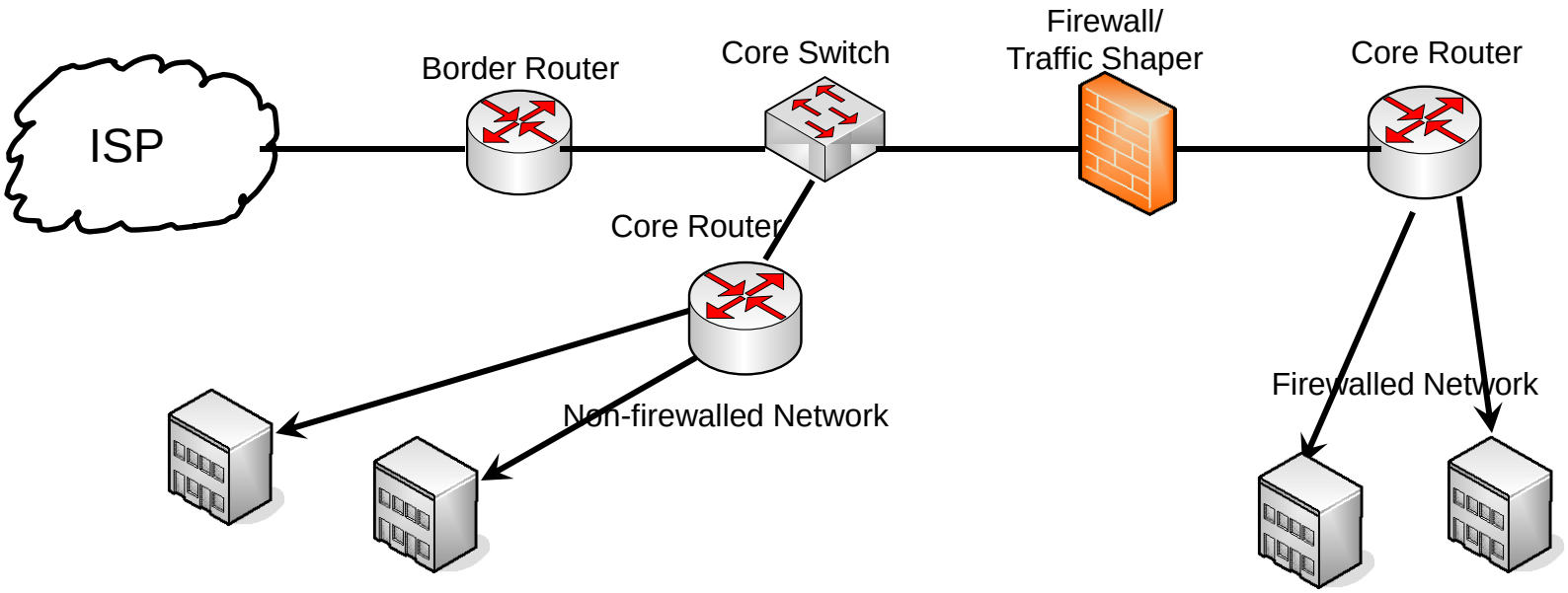
Where to put Firewalls

- Security devices must be place “in line”
- This means that the speed of the firewall affects access to the outside world
- This is a typical design, but should be avoided:



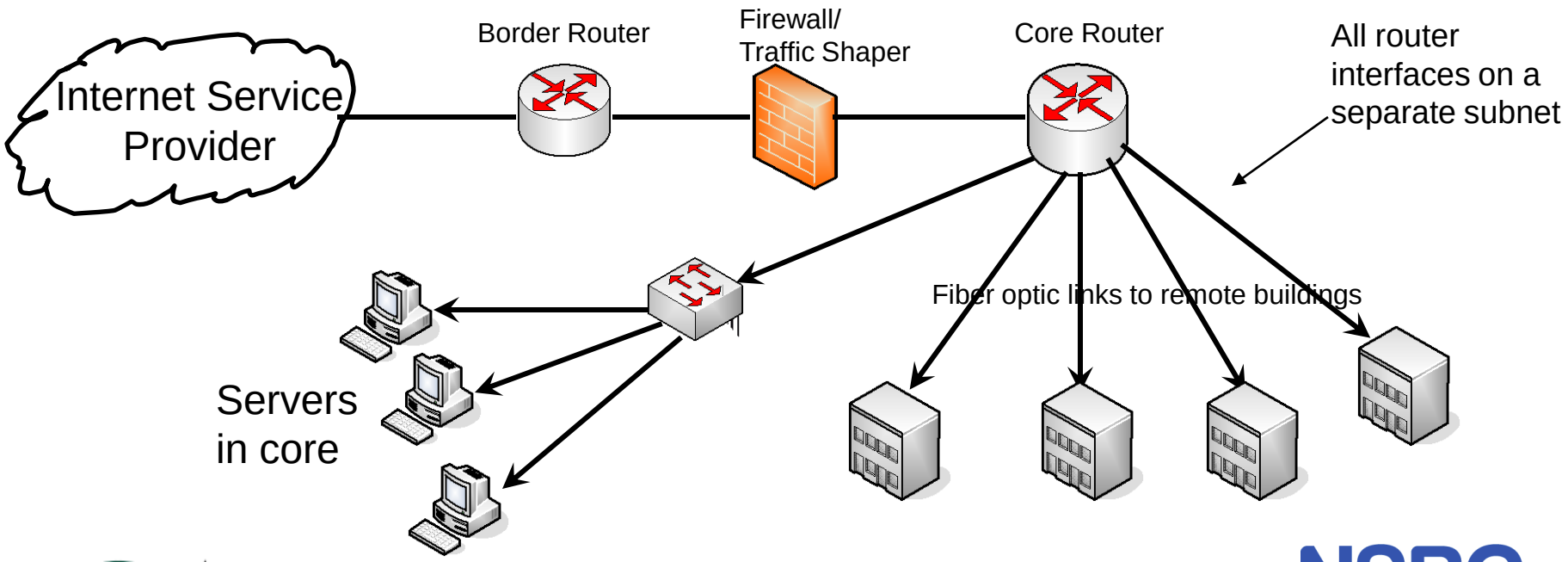
Where to put Firewalls

- Try to have parts of your network non-firewalled
- These will allow full bandwidth, un-filtered access to the Internet
- One configuration:



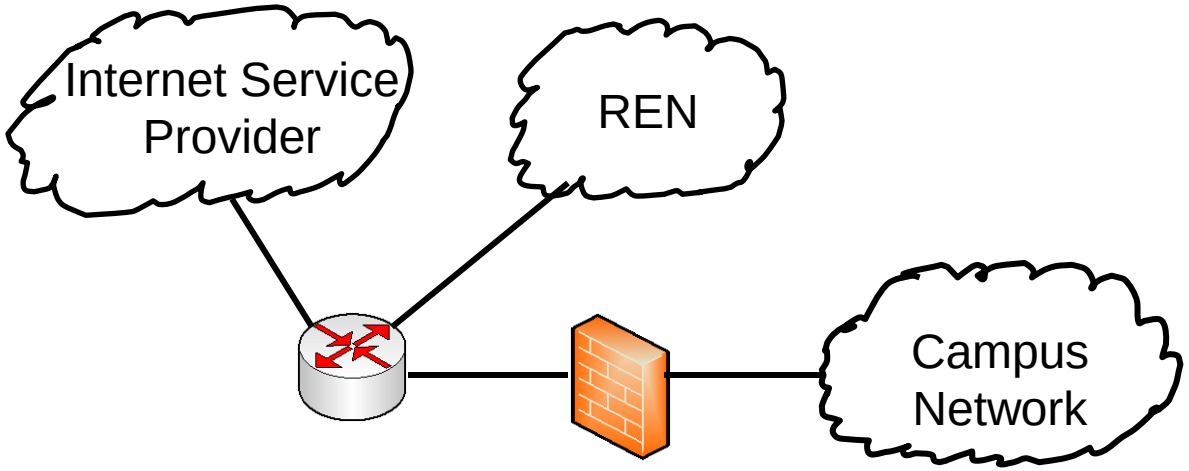
Where to put Servers?

- Servers should be on a high speed interface off of your core router
- Servers should be at your core location where there is good power and air conditioning

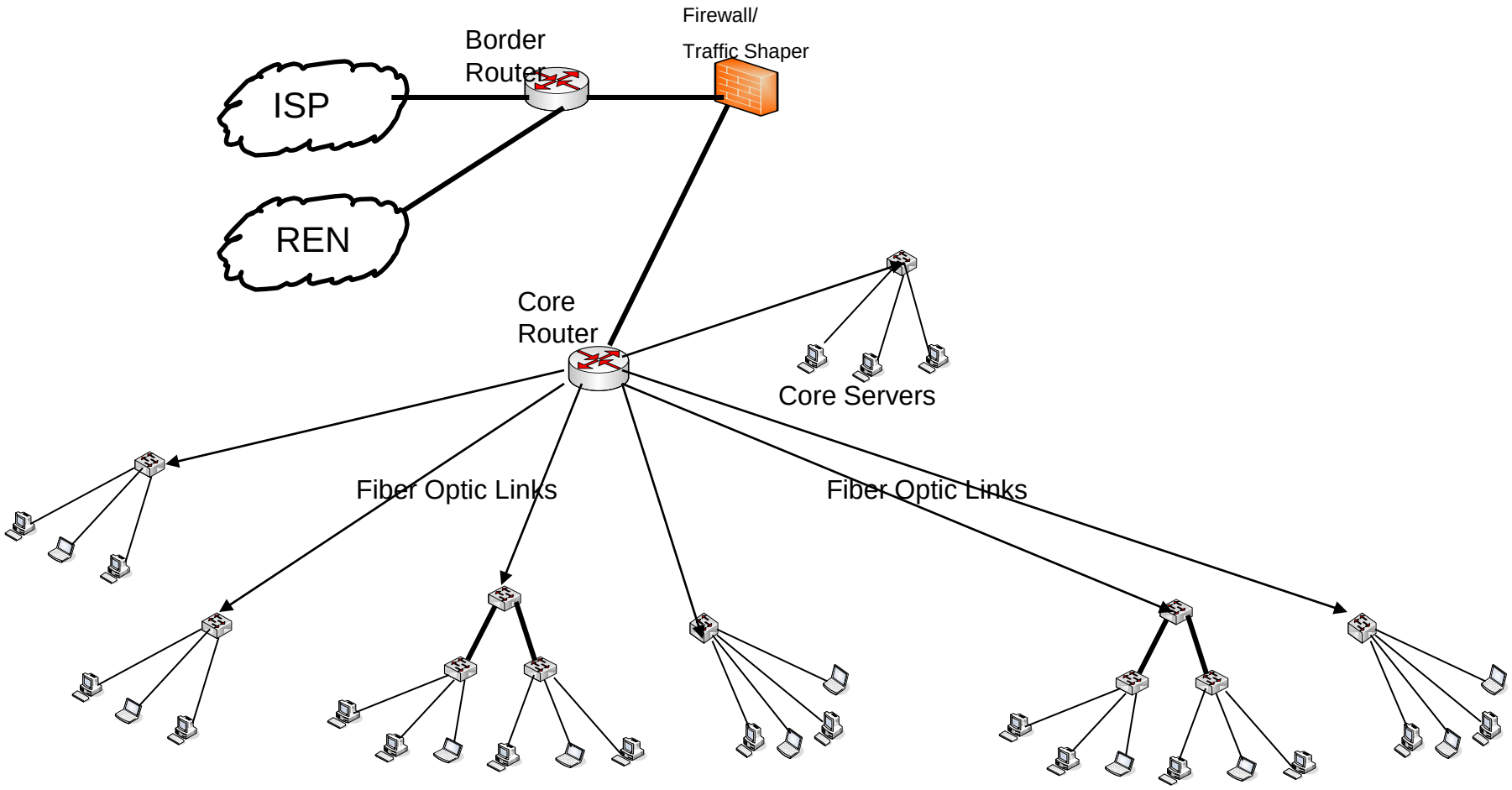


Border Router

- Connects to outside world
- RENs and Peering are the reason you need them
- Must get Provider Independent IP address space to really make this work right

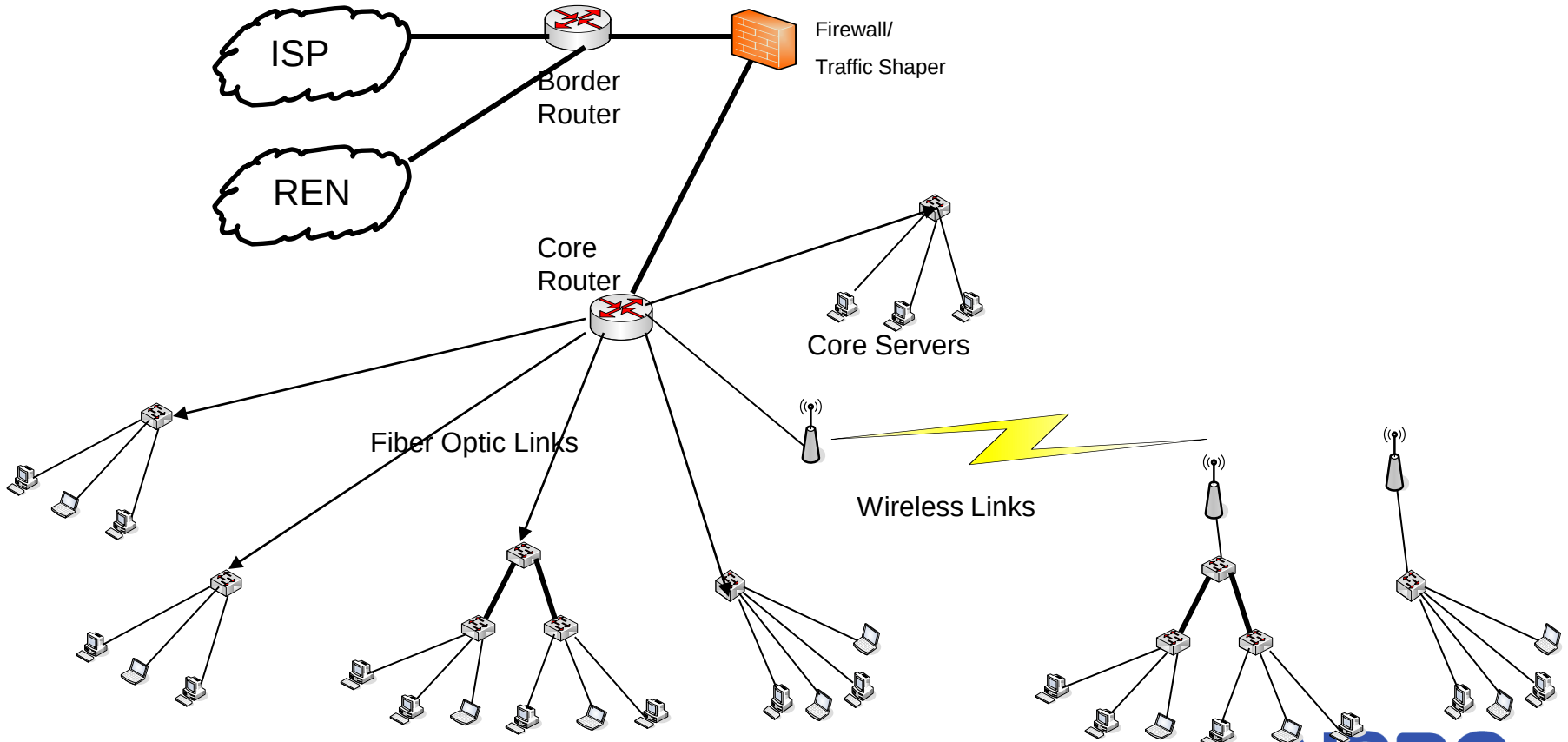


Putting it all Together



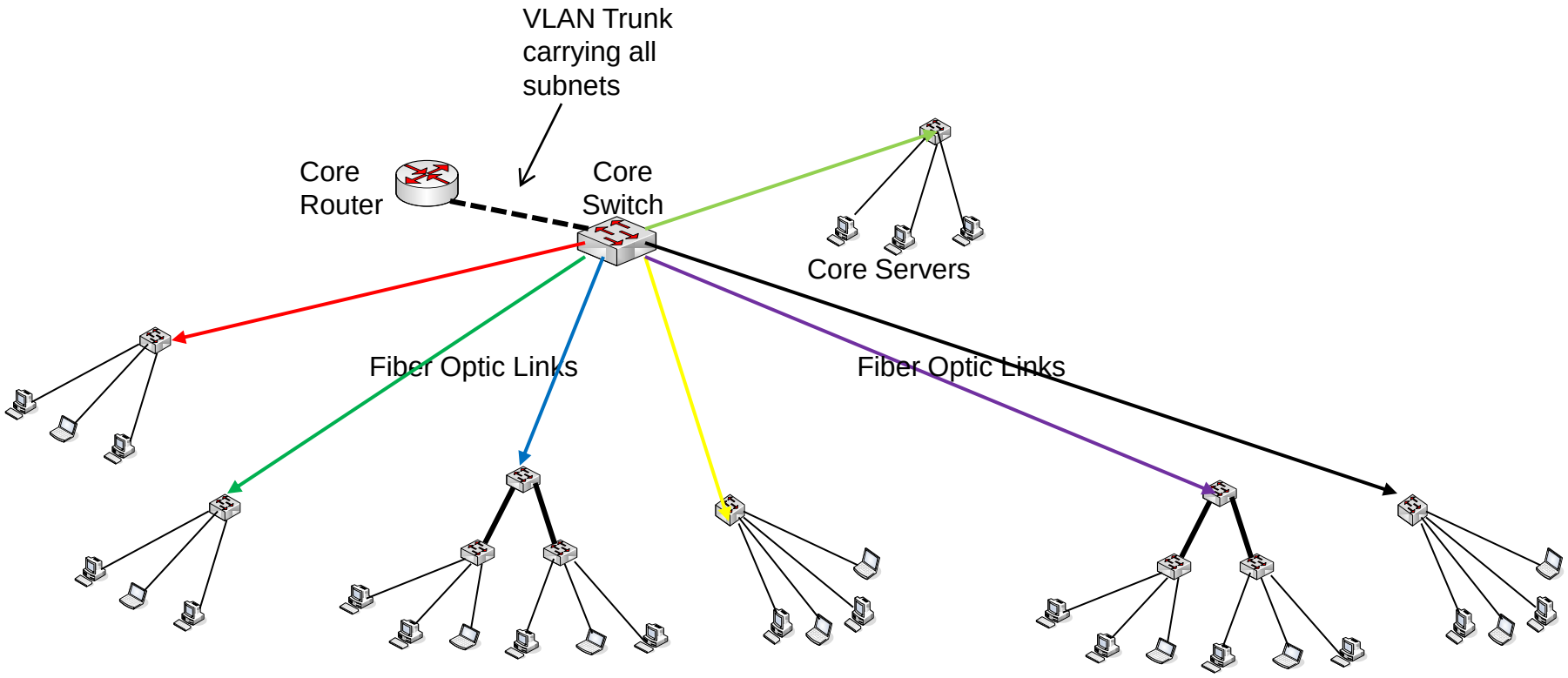
Alternative Core Designs

- Wireless Links versus Fiber



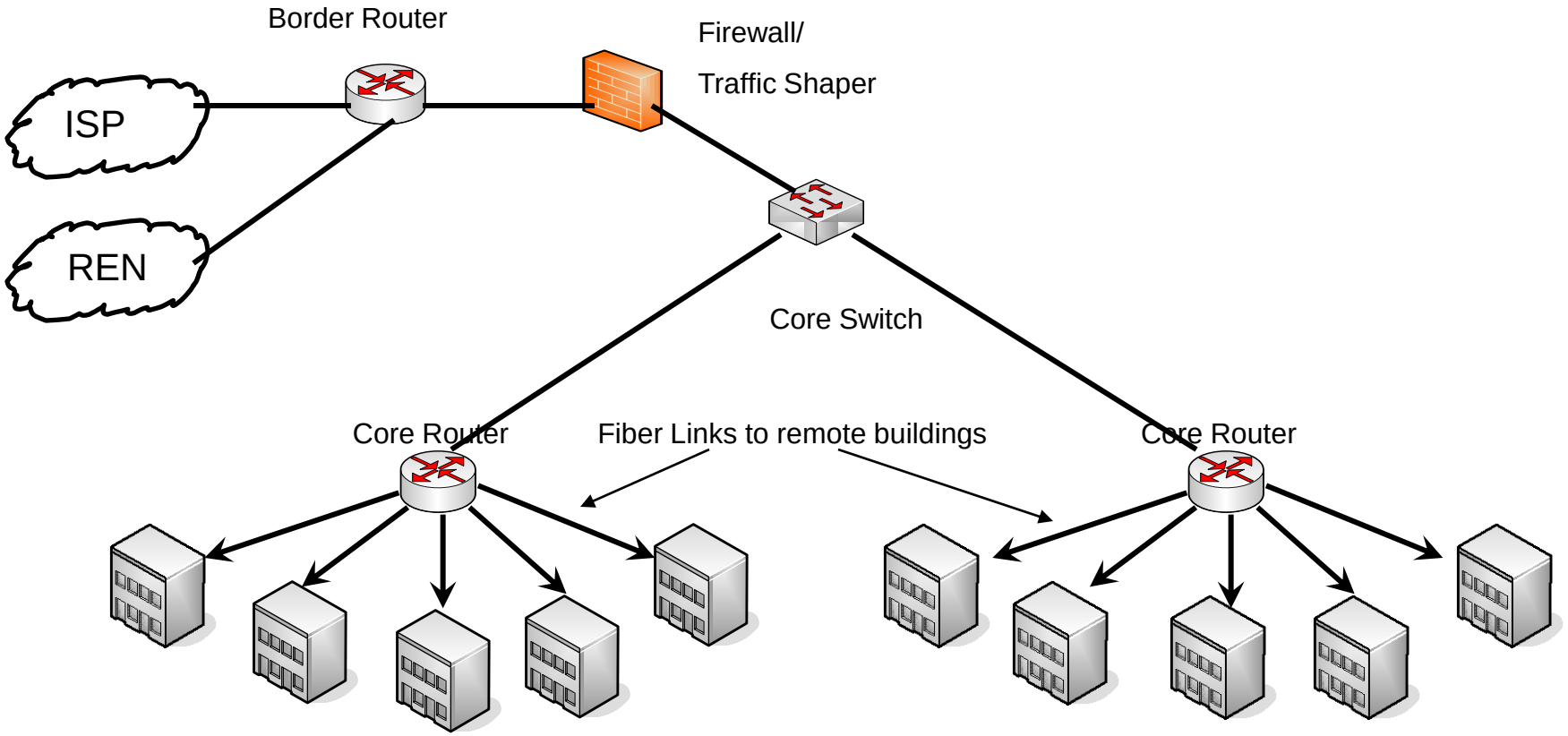
Alternative Core Designs

- One Armed Router for Core

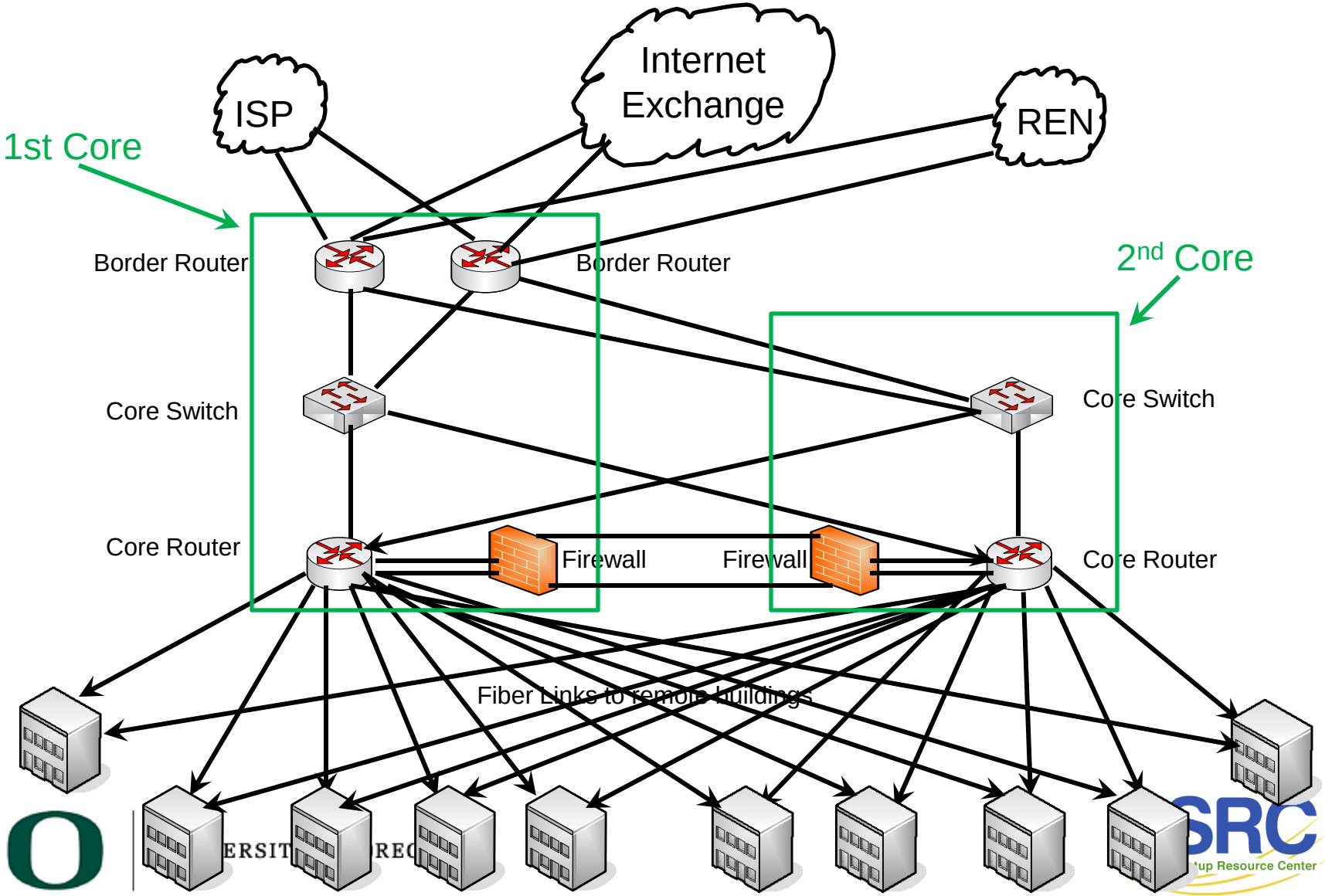


Complex Core Designs

- Multiple Core Routers



More Complex Core Designs



Layer 2 and 3 Summary

- Route in the core
- Switch at the edge
- Build star networks – don't daisy chain
- Buy only managed switches – re-purpose your old unmanaged switches for labs

No Network is Perfect

- What happens to your network when you get a 1000Mbs connection from your REN?
- Where are the bottlenecks?
- How will you improve performance?
- What is your plan?
- Let's talk about your networks

Questions?

Symbols to use for diagrams