

Campus Network Best Practices: Core and Edge Networks

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Why Are We Doing This?

- Our goal is to build networking capacity to support Research and Education
 - Remember: University = Research & Education
- Most countries have Research and Education Networks (RENs) = MARWAN
- All RENs start with campus networks – they are the foundation of the REN



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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.



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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



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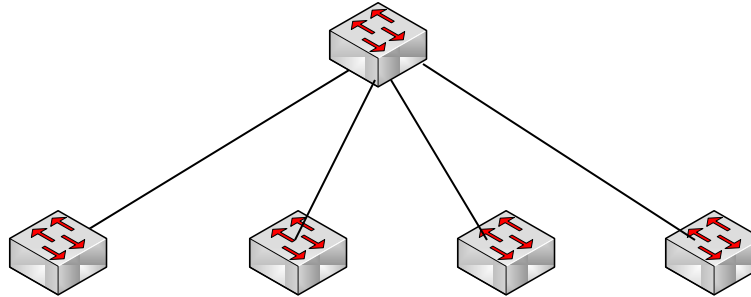
Core versus Edge

- 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

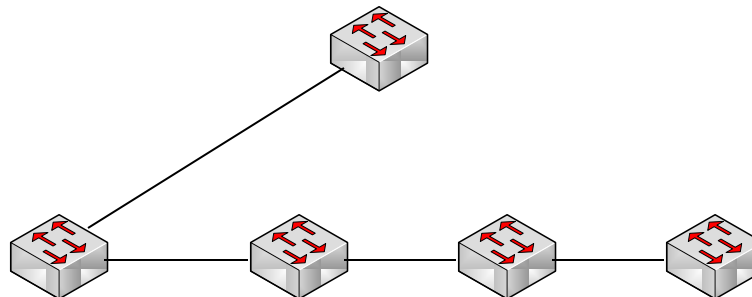


Minimize Number of Network Devices in the Path

- Build star networks



- Not daisy chained networks



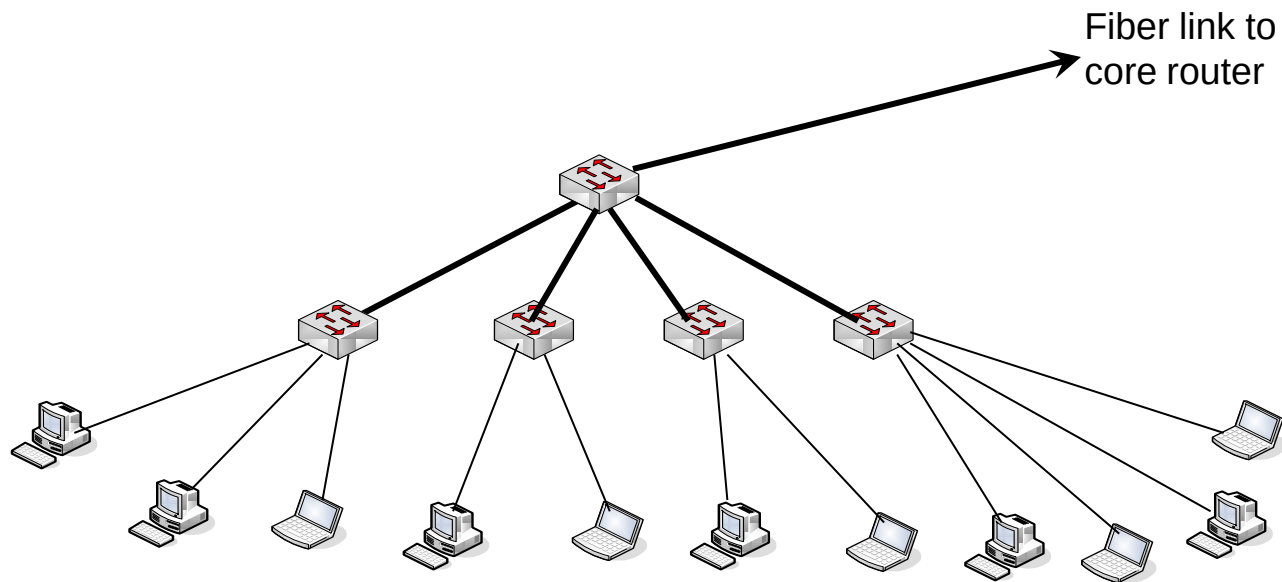
Edge Networks (Layer 2 LANs)

- 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:

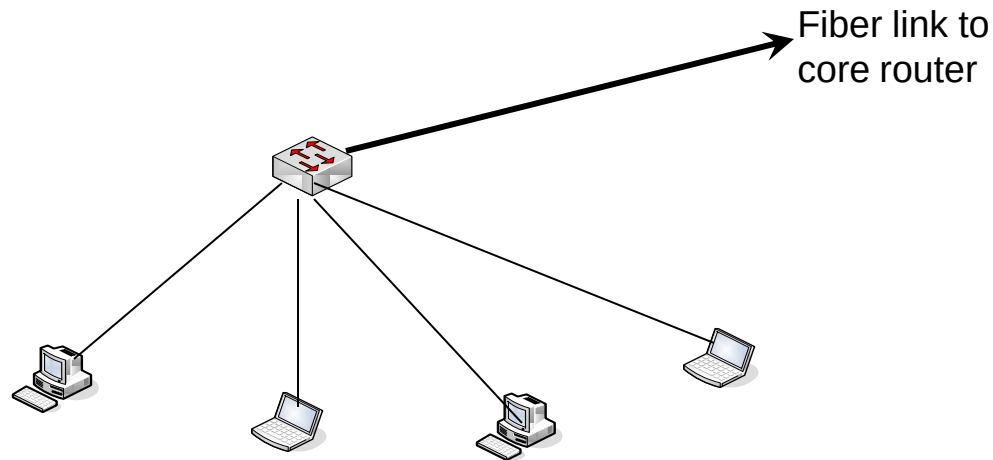


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Edge Networks Continued

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

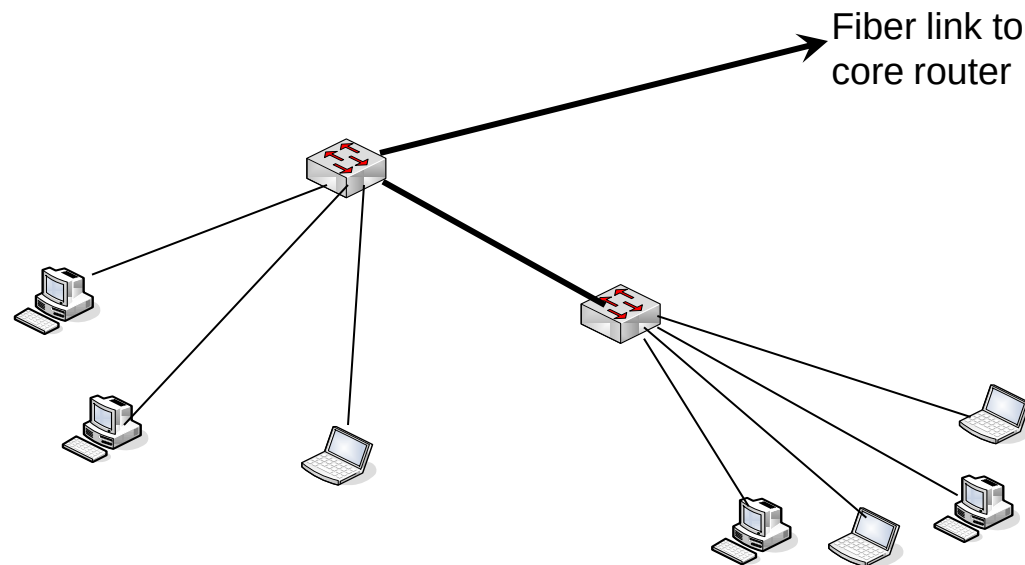


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Edge Networks Continued

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

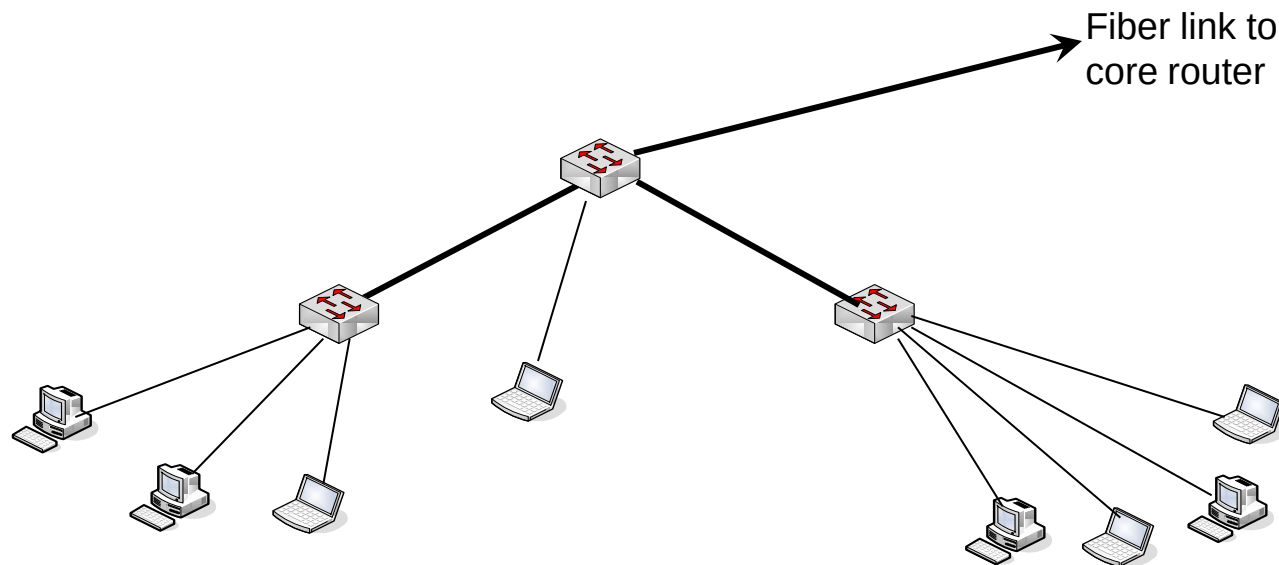


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Edge Networks Continued

- And keep adding switches to get to the final configuration

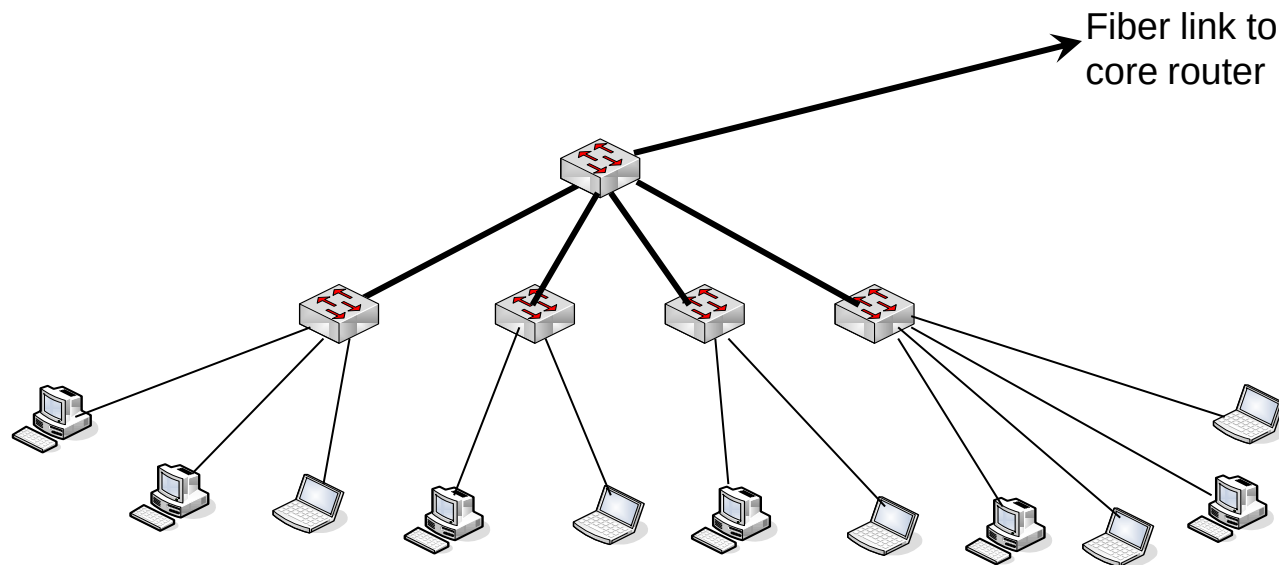


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Edge Networks Continued

- And keep adding switches to get to the final configuration

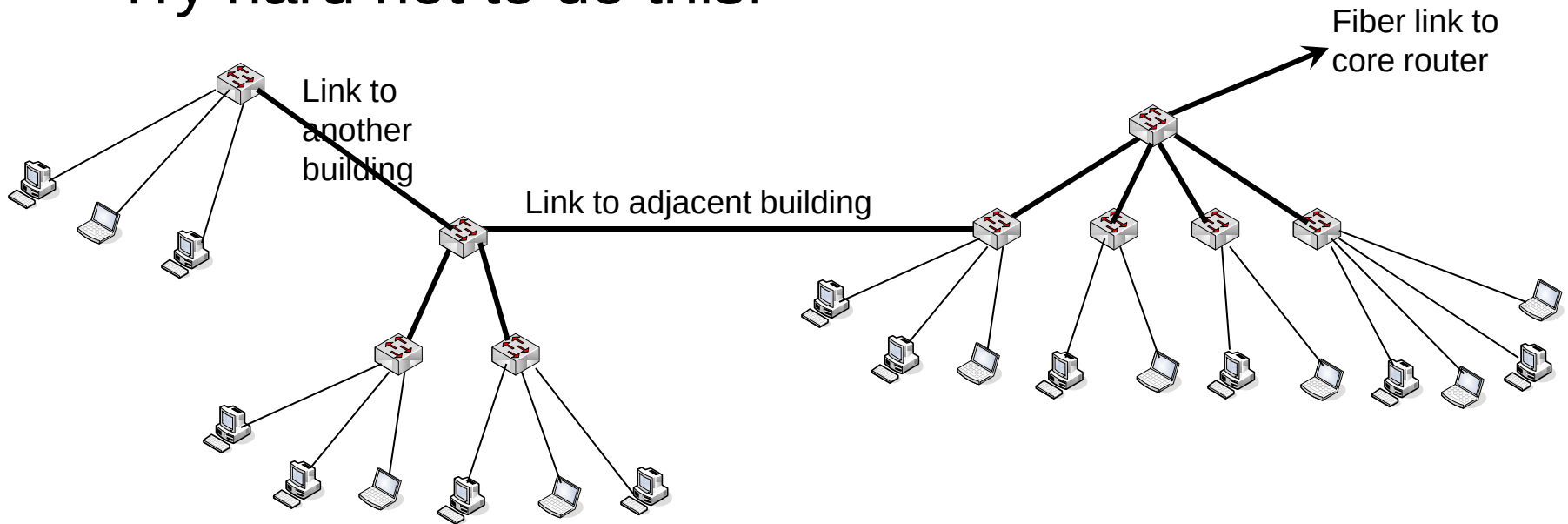


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Edge Networks Continued

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

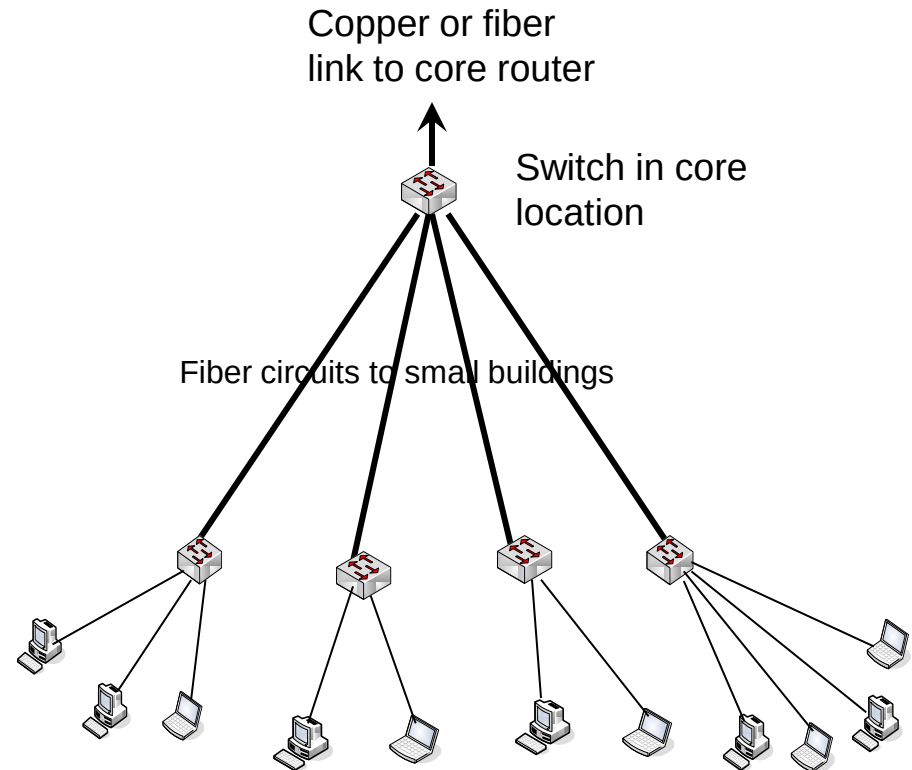
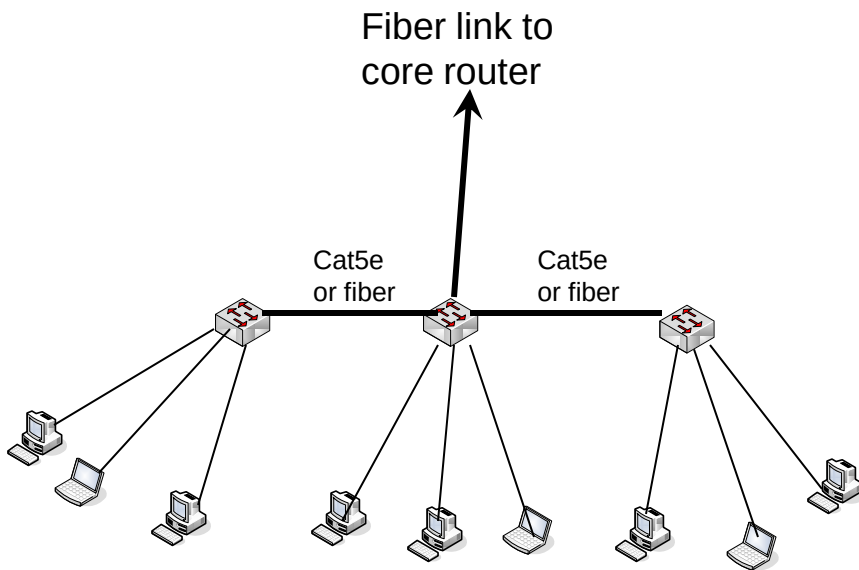


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Edge Networks Continued

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



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Core Network



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Routing versus Switching

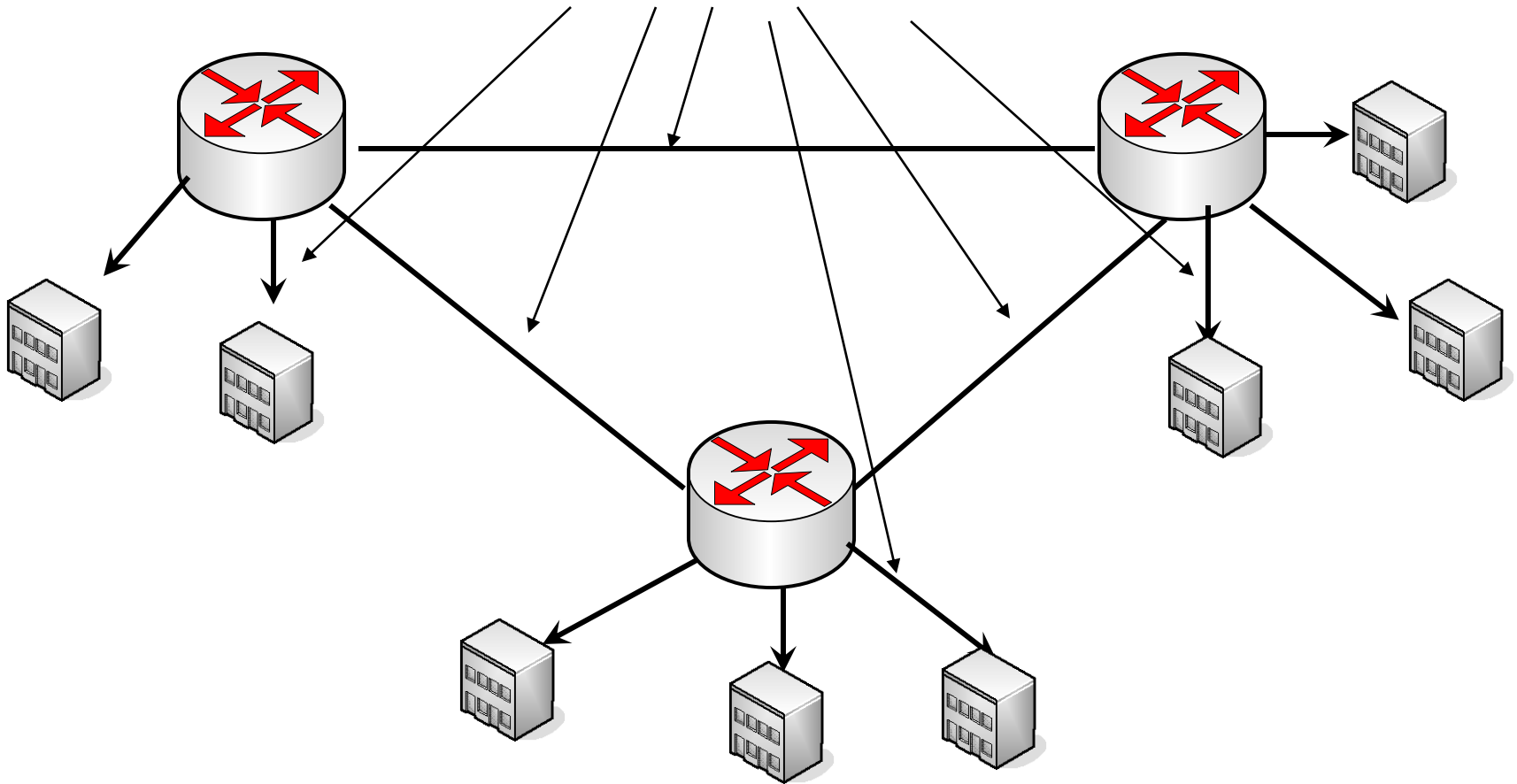
Layer 2 versus Layer 3

- 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



Switching versus Routing

These links must be routed, not switched



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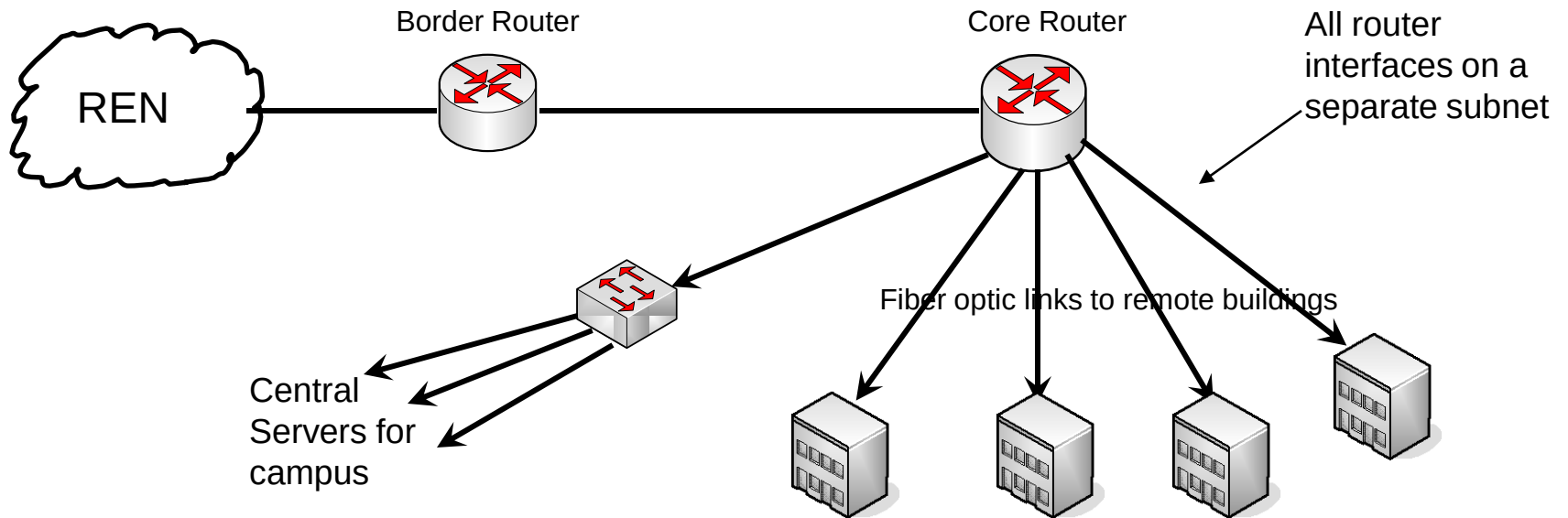
Core Network

- 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
- Core location must have reliable air conditioning
- Firewalls and Traffic Shaping Devices
 - Network Address Translation



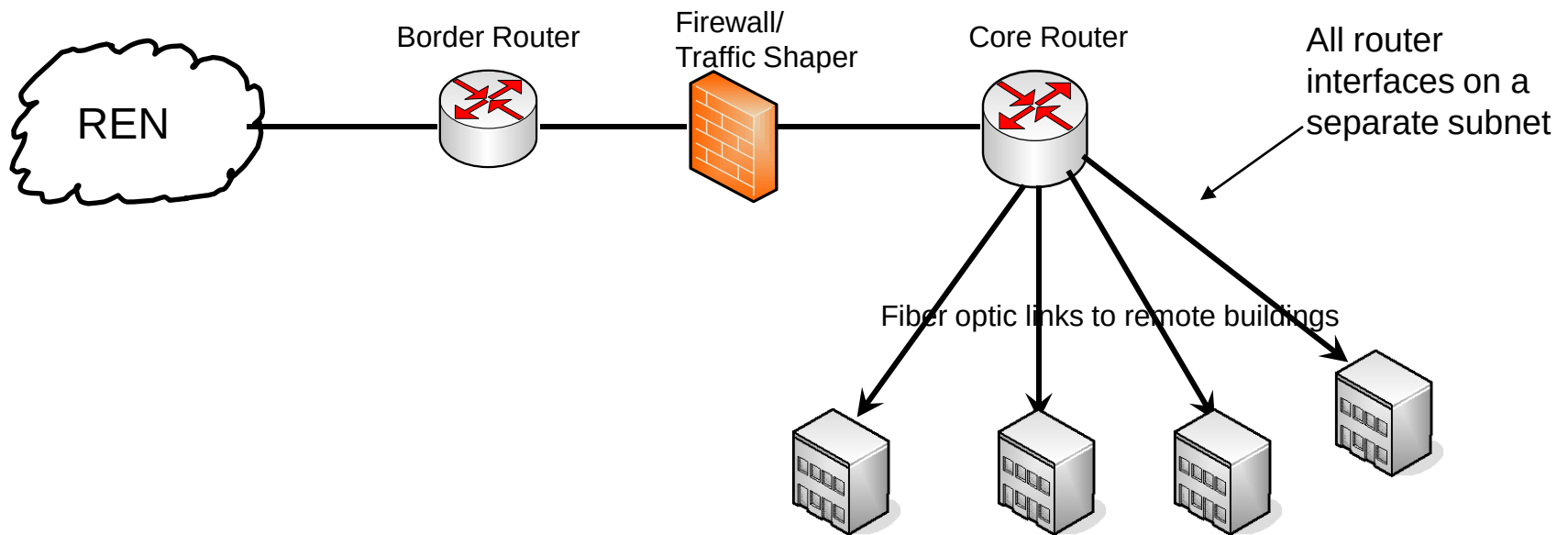
Core Network

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



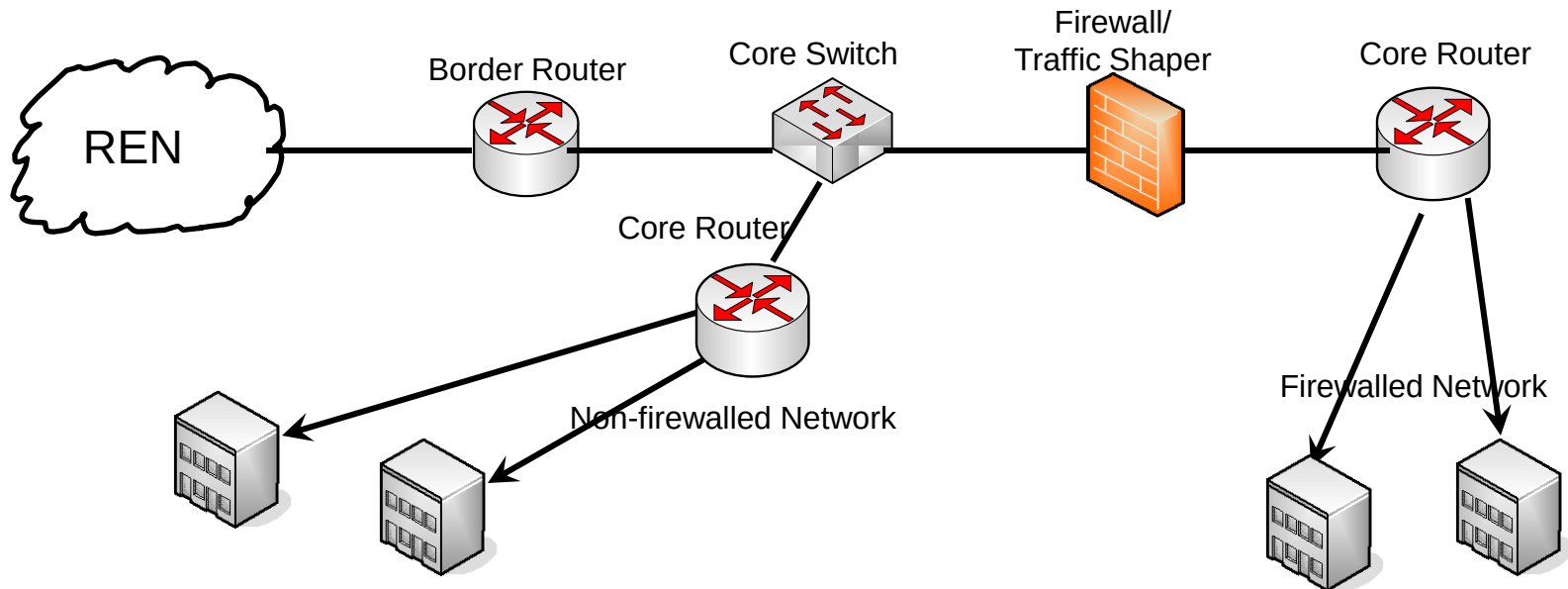
Where to put Firewalls

- 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:



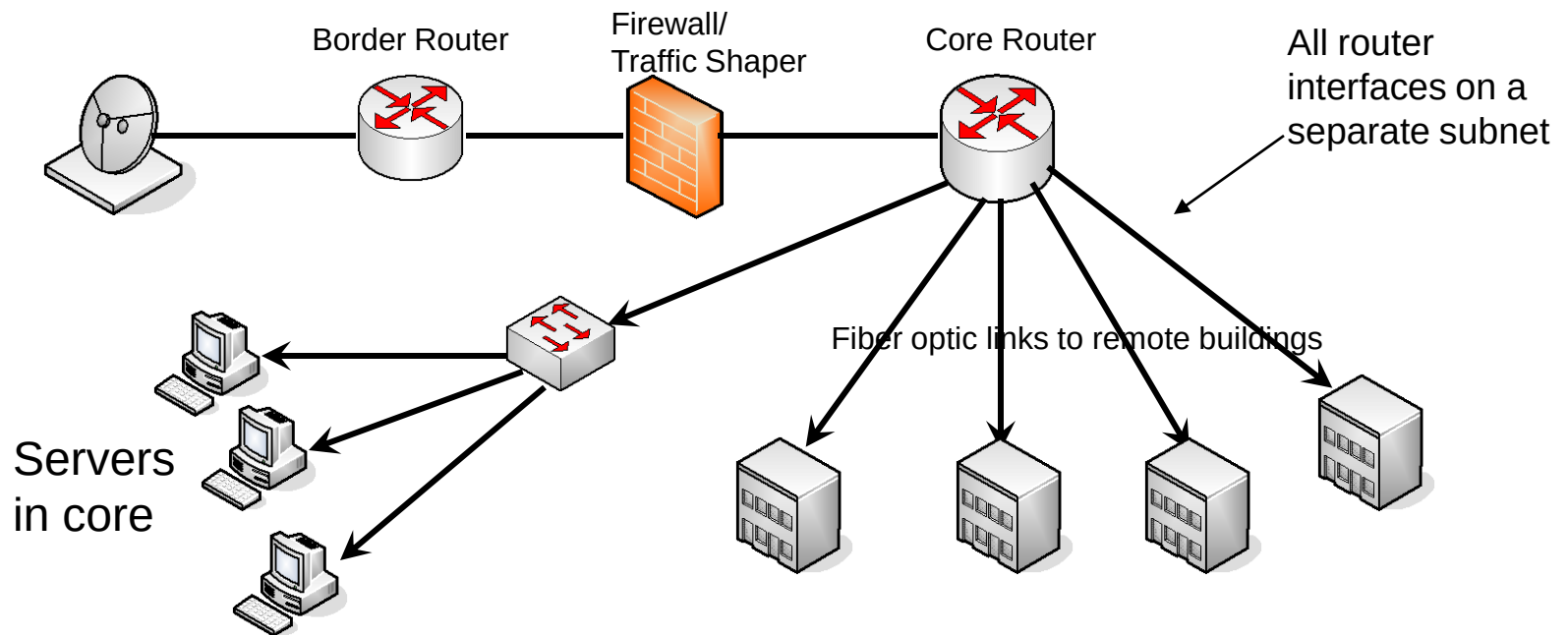
Where to put Firewalls

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



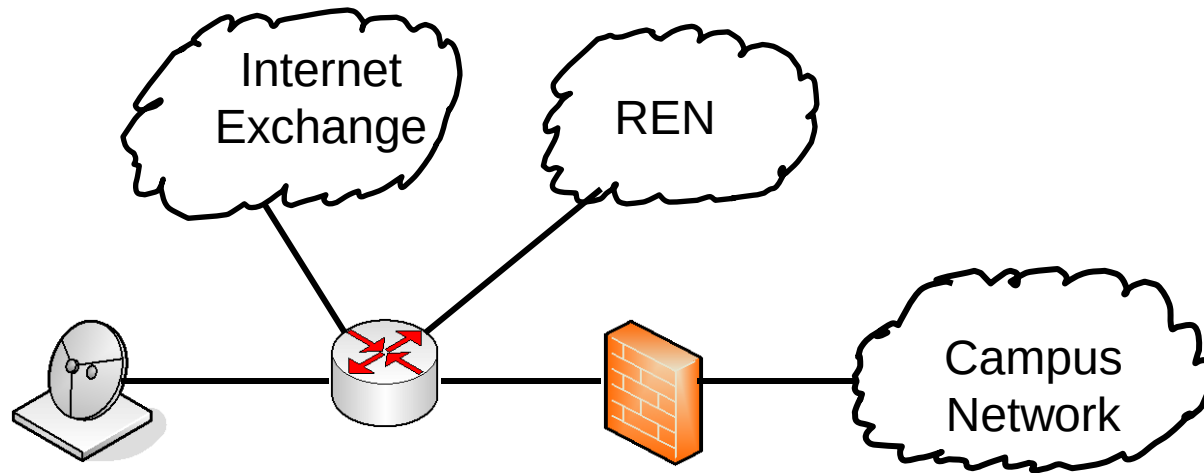
Where to put Servers?

- 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

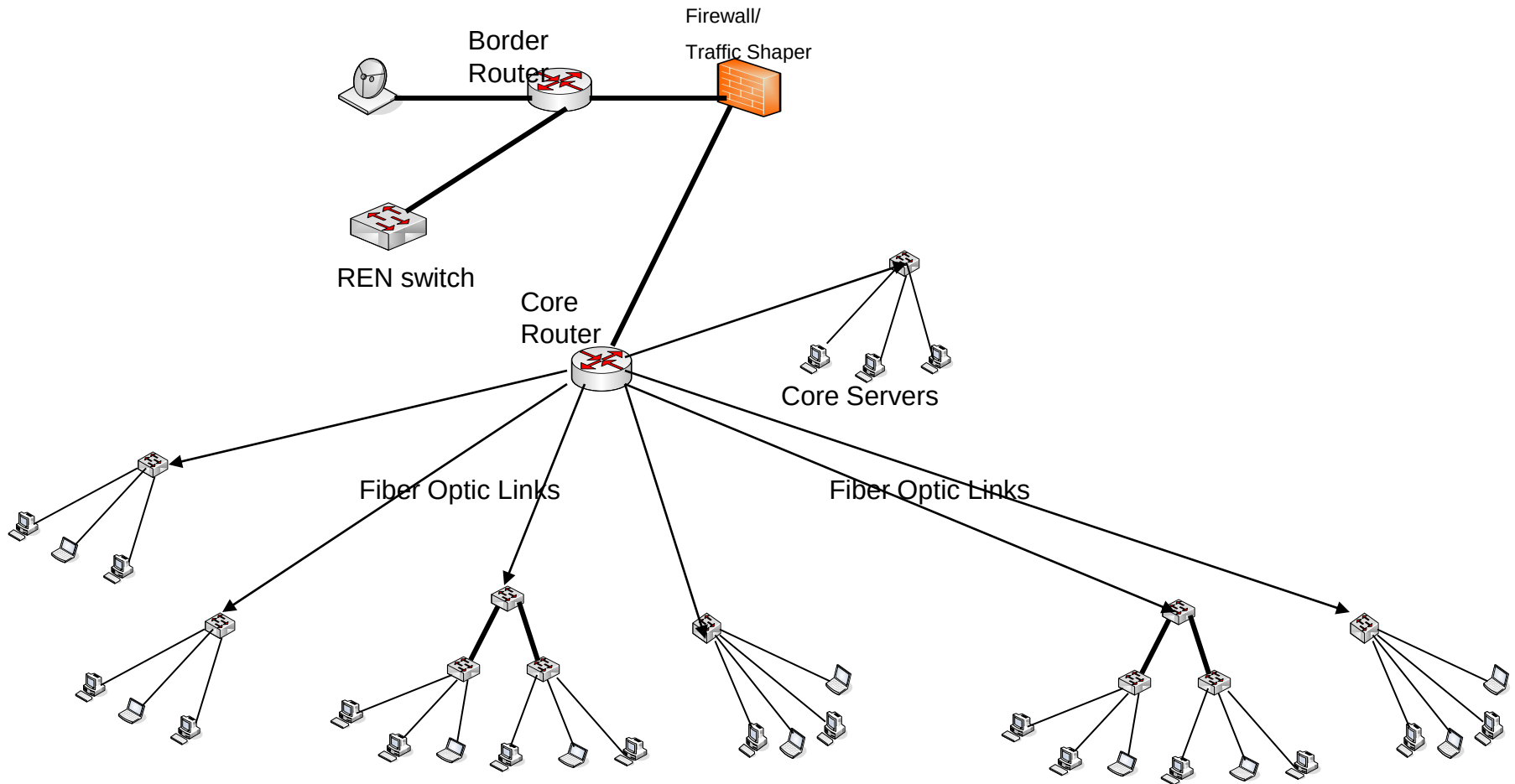


Border Router

- 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

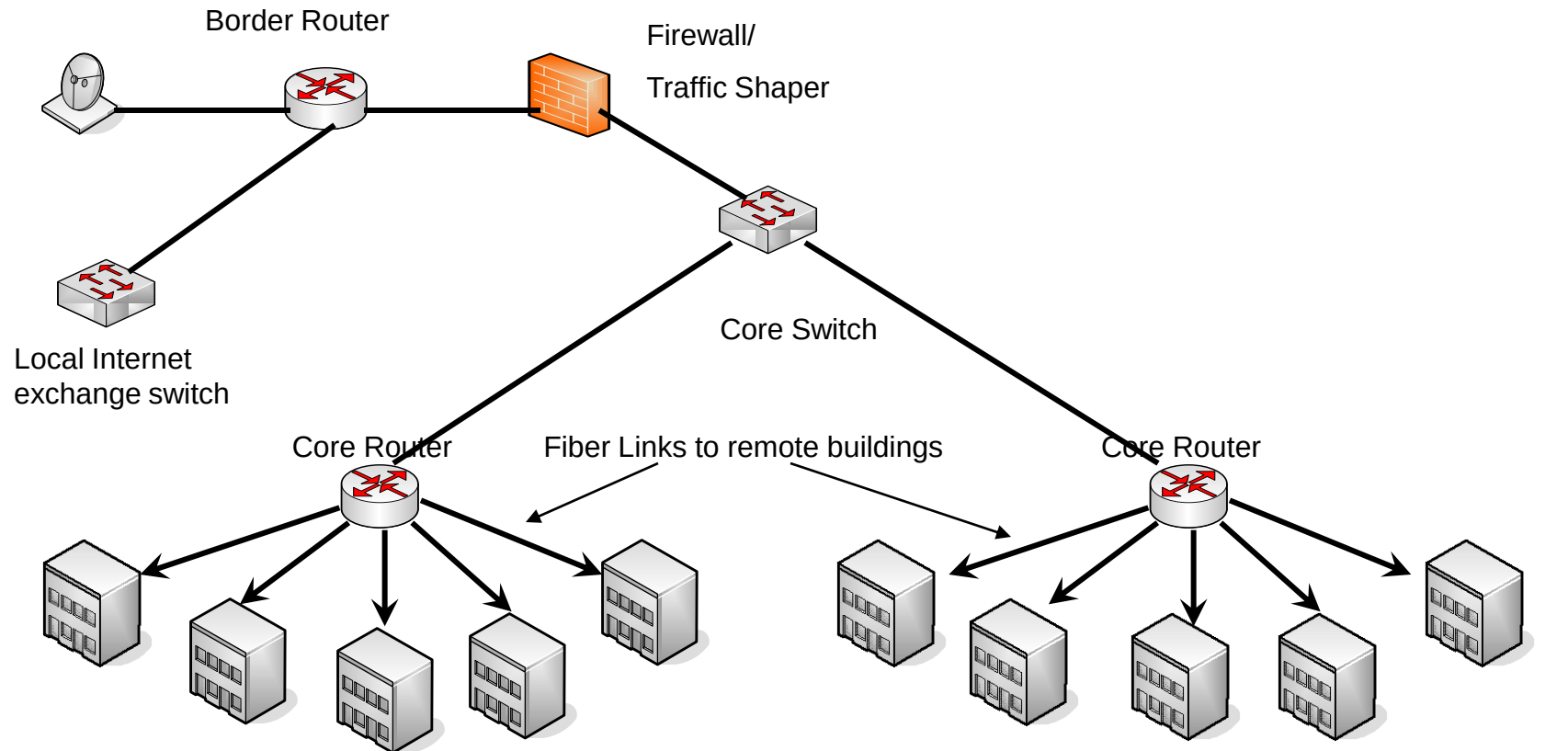


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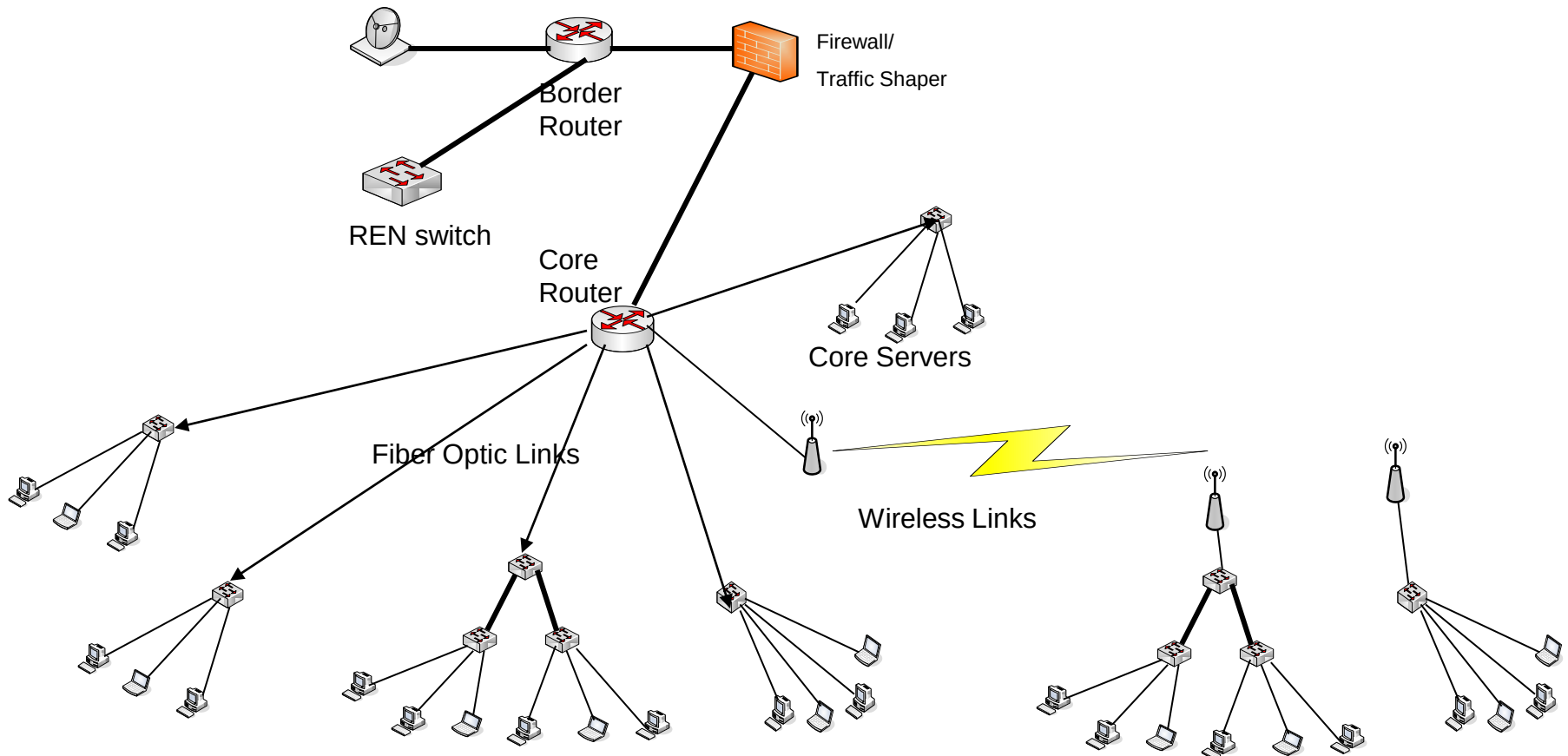
Complex Core Designs

- Multiple Core Routers



Alternative Core Designs

- Wireless Links versus Fiber



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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



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No Network is Perfect

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



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Questions?

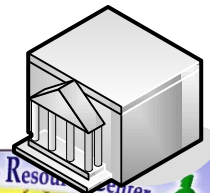
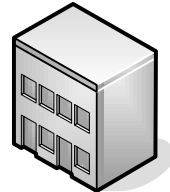
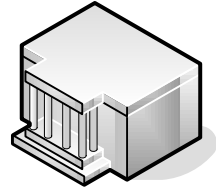
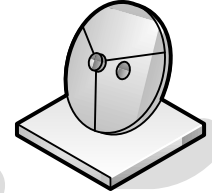
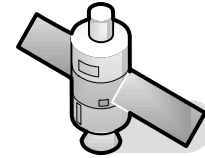
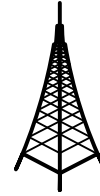
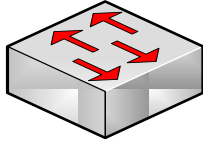
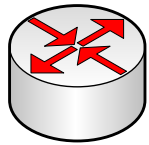
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Symbols to use for diagrams



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