Campus Network Best Practices: Core and Edge Networks

Network Startup Resource Center

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

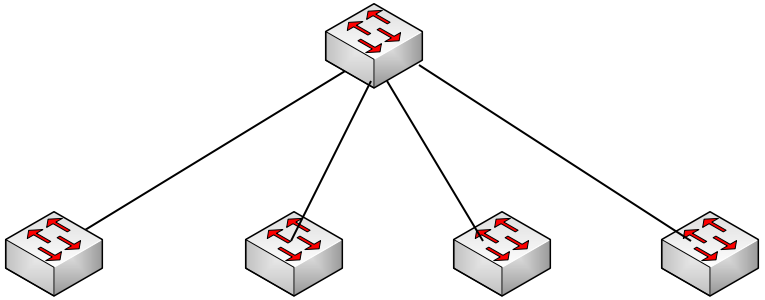
Provide opportunities to firewall and shape network traffic

Core versus Edge

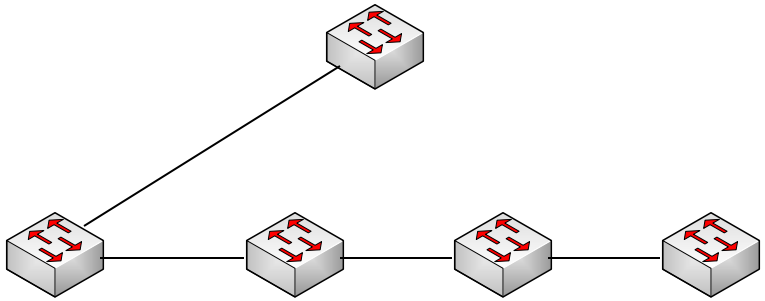
- Core network is the “core” of your network
  - Needs to have reliable power and air conditioning
  - May have multiple cores
  - Always route in the core
- Edge is toward the edges of your network
  - Provide service inside of individual buildings to individual computers
  - Always switch at the edge

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

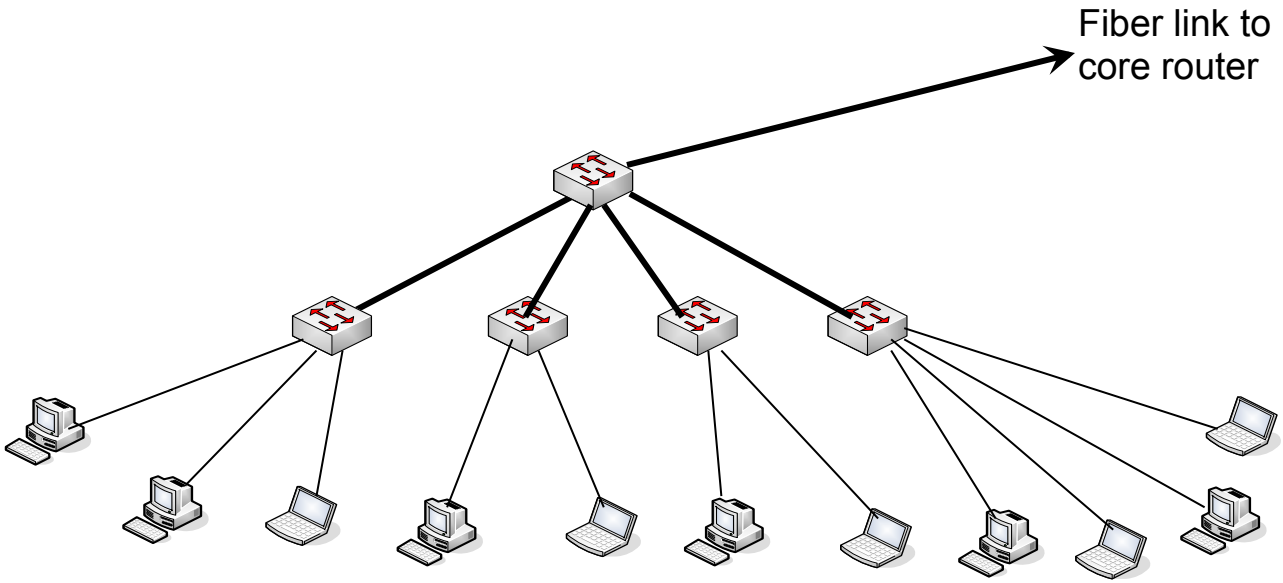
Should be one of these for every reasonable sized building

This network should only be switched

Always buy switches that are managed – no unmanaged switches!

Edge Networks

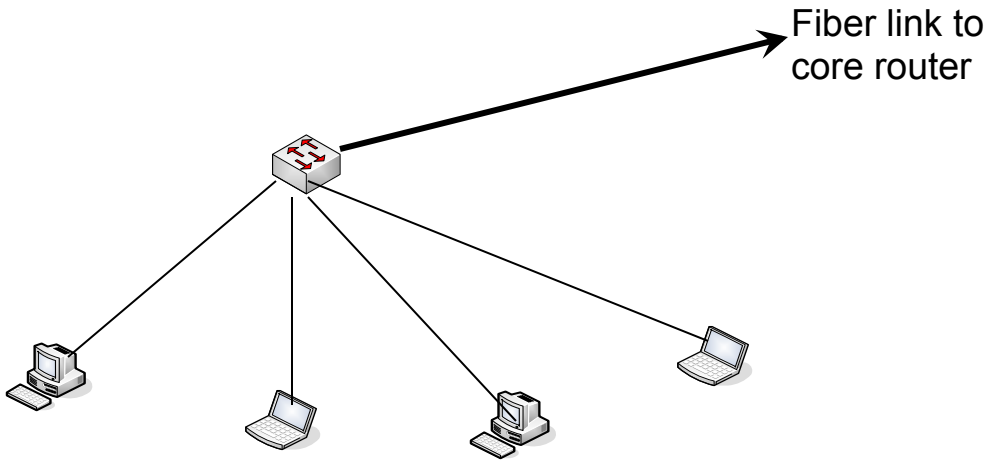
Make every network look like this:



Edge Networks Continued

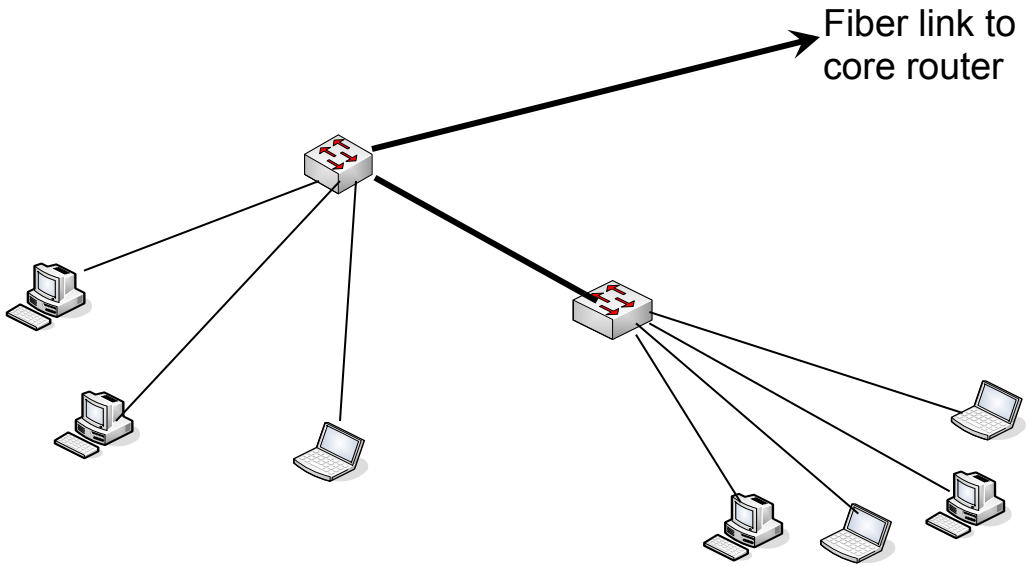
Build Edge network incrementally as you have demand and money

Start Small:



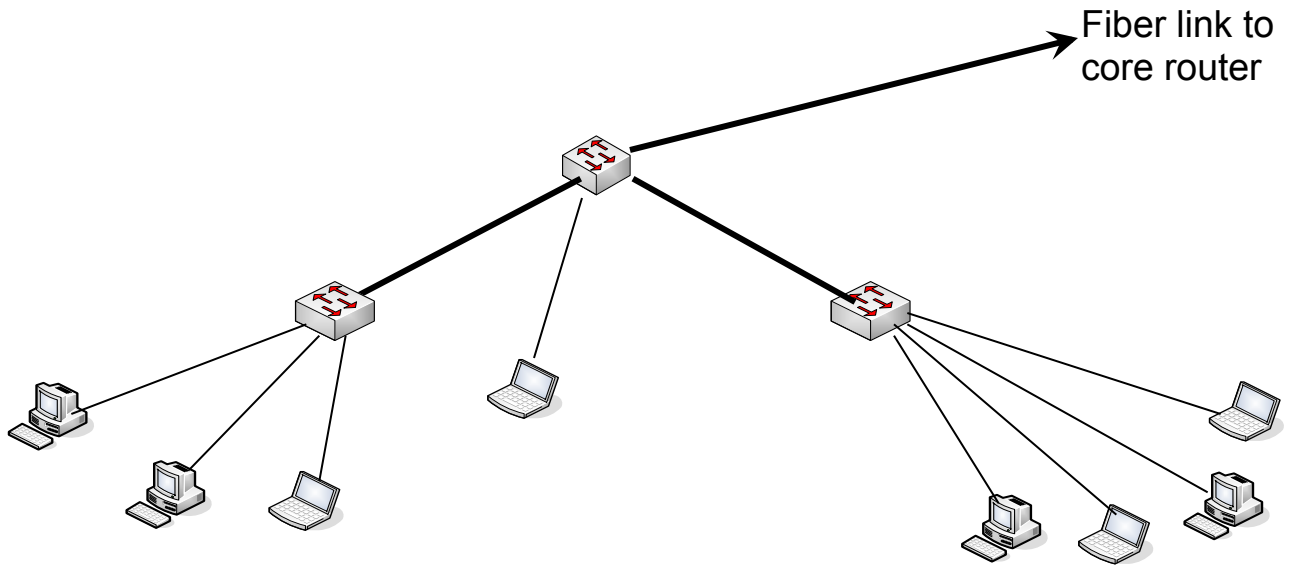
Edge Networks Continued

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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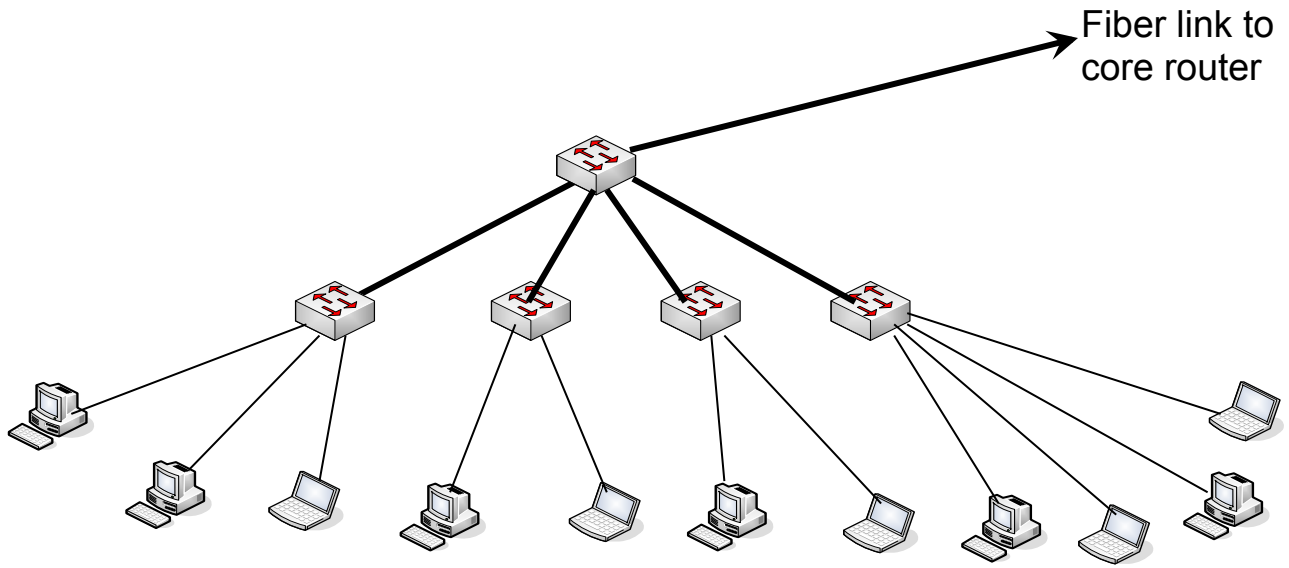
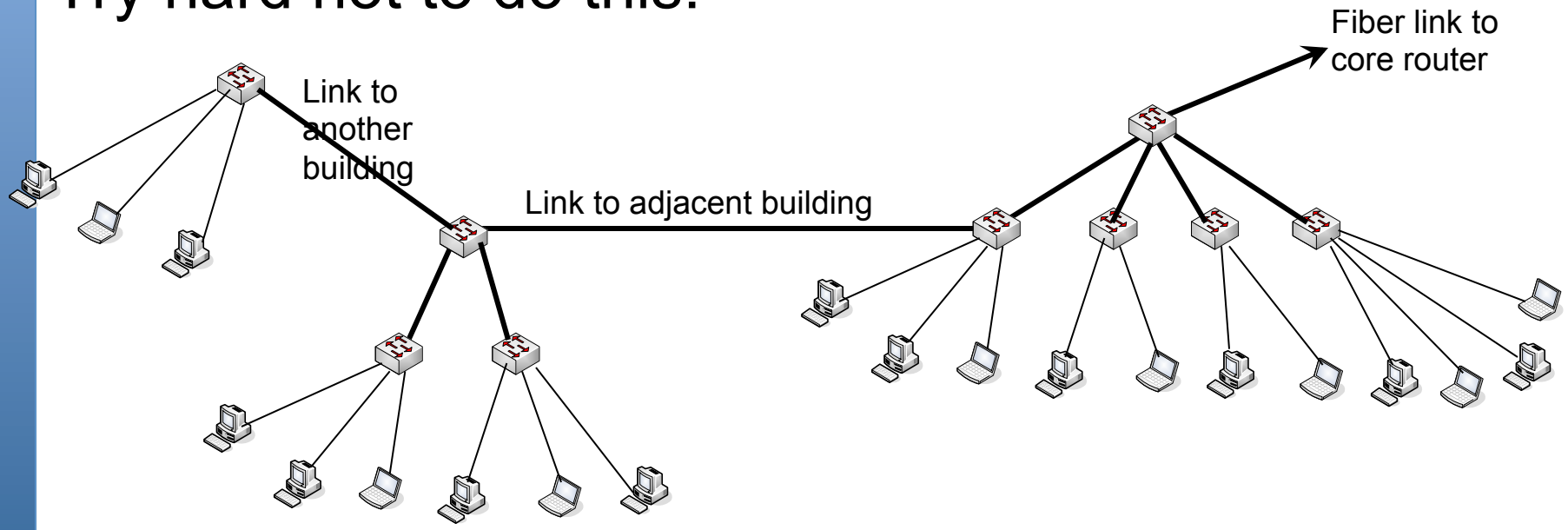


Edge Networks Continued

Resist the urge to save money by breaking this model and daisy chaining networks or buildings together

Try hard not to do this:

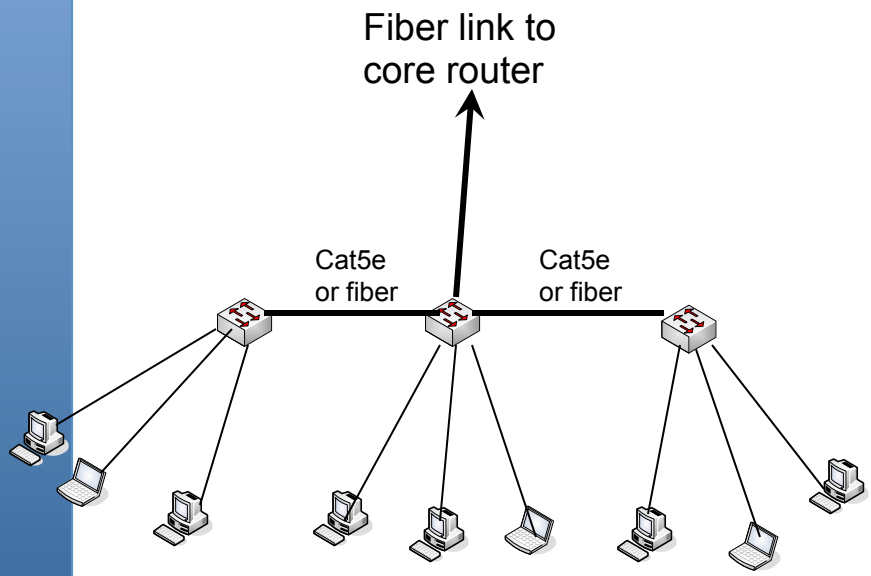


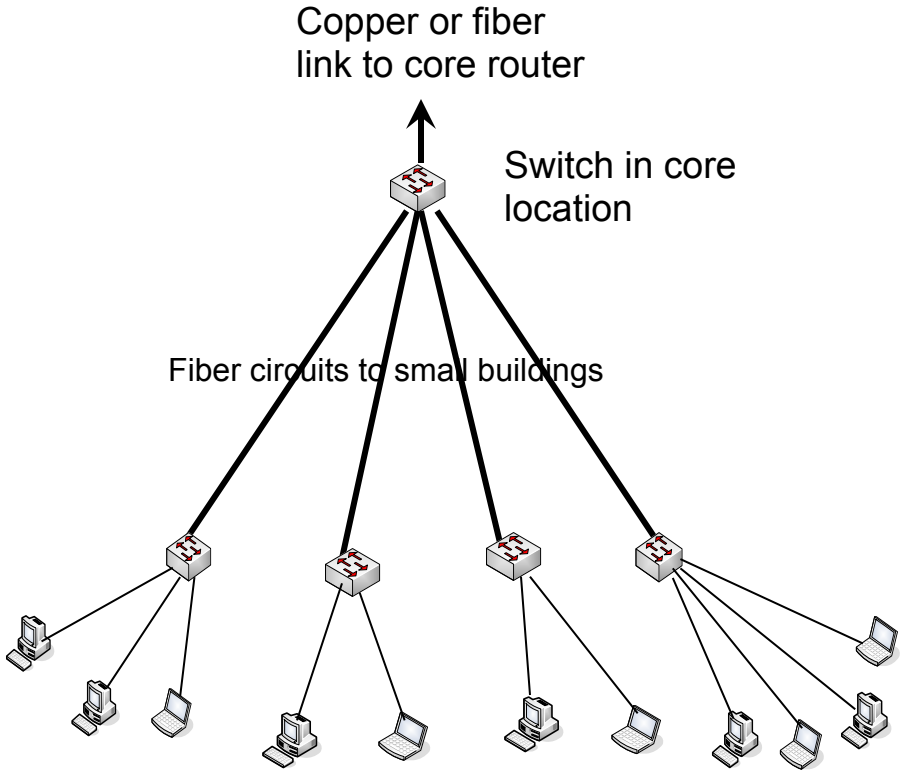
Edge Networks Continued

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

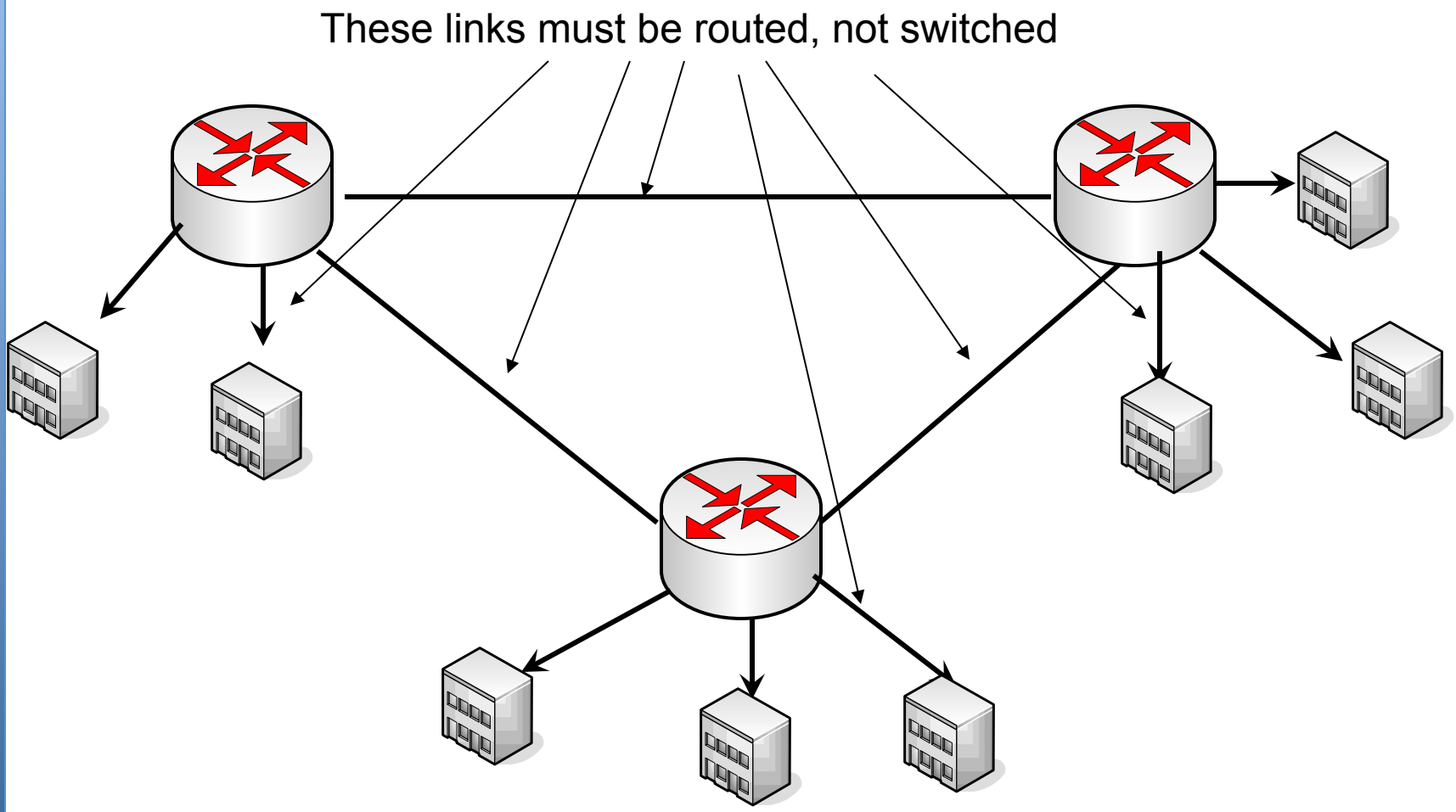
Many vendors use the term “Layer 3 Switch”.

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

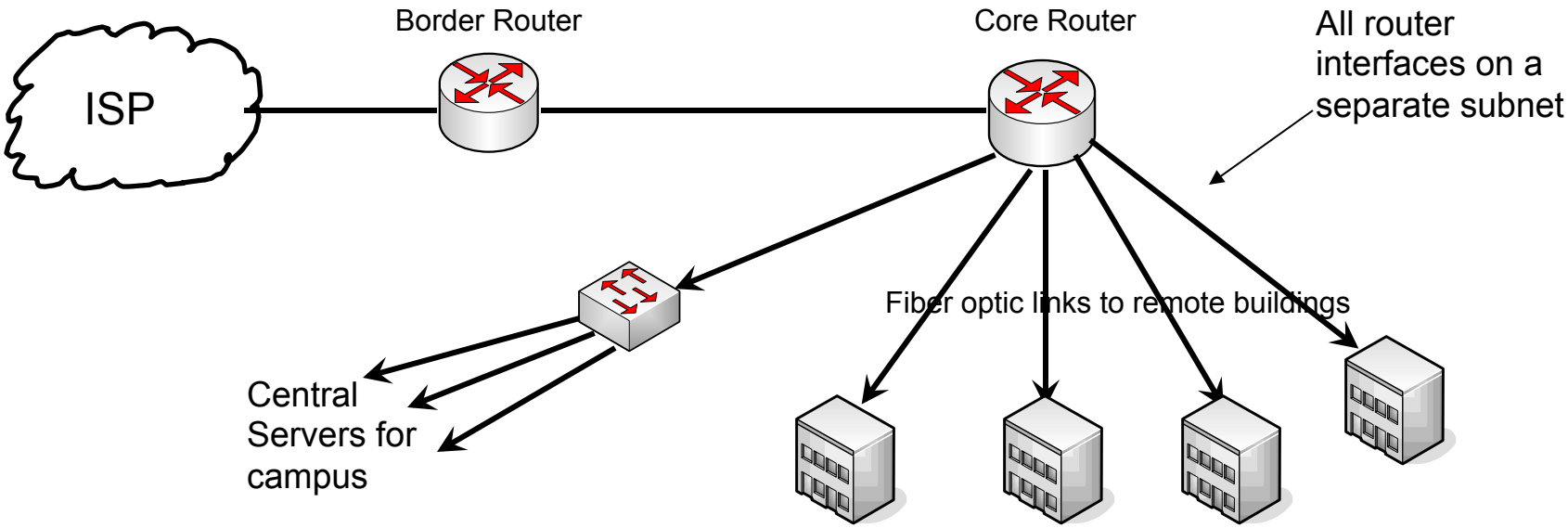
- Reliability is the key
  - remember many users and possibly your whole network relies on the core
- May have one or more network core locations
- Core location must have reliable power
  - UPS battery backup (redundant UPS as your network evolves)
  - Generator
  - Grounding and bonding
- Core location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

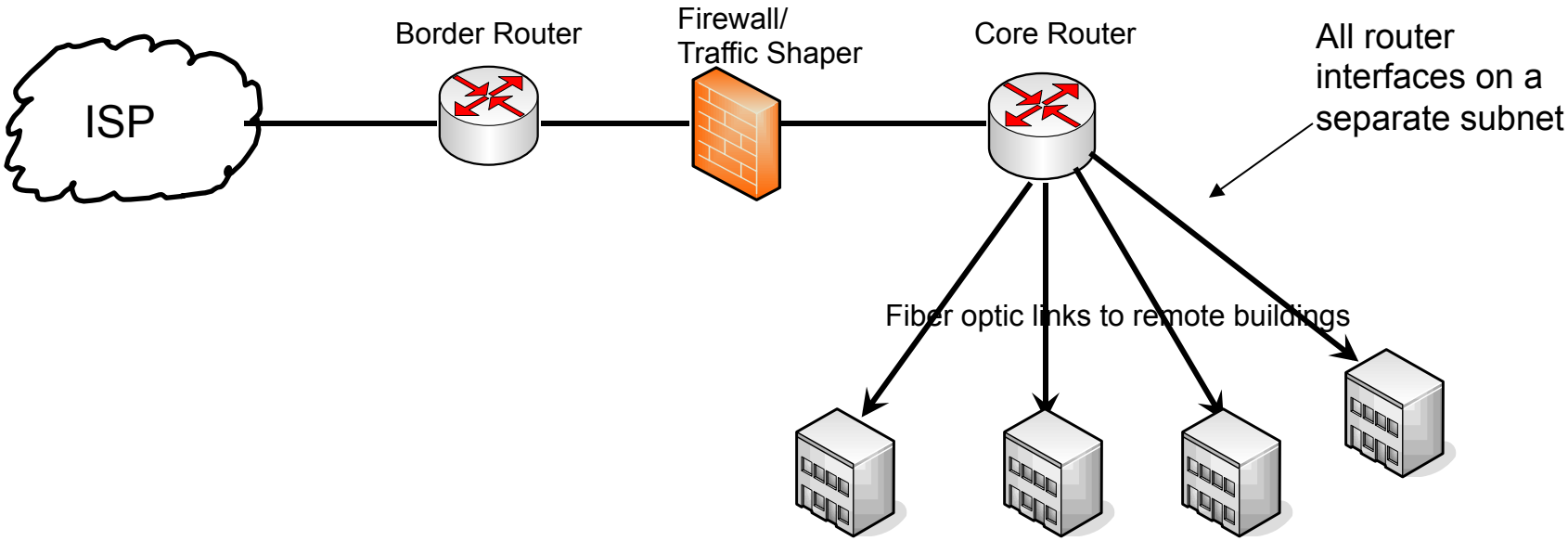


Where to put Firewalls

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:

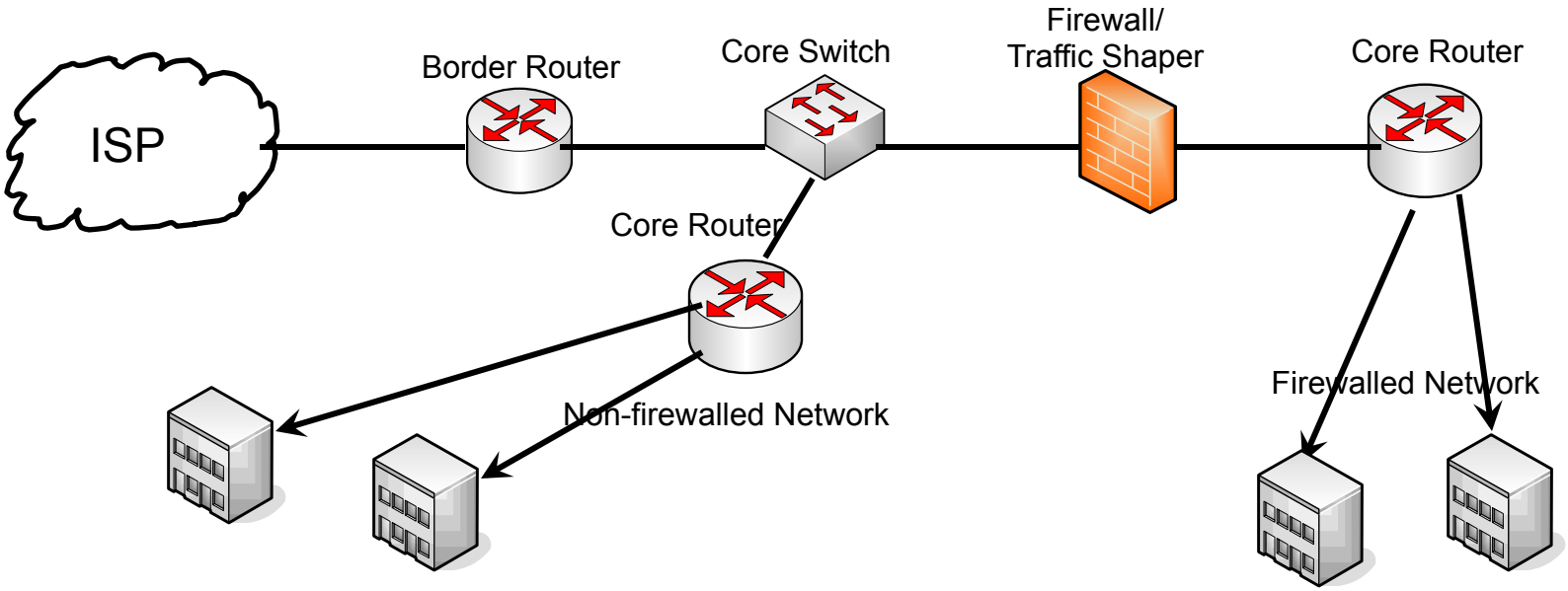


Where to put Firewalls

Try to have parts of your network non-firewalled

These will allow full bandwidth, un-filtered access to the Internet

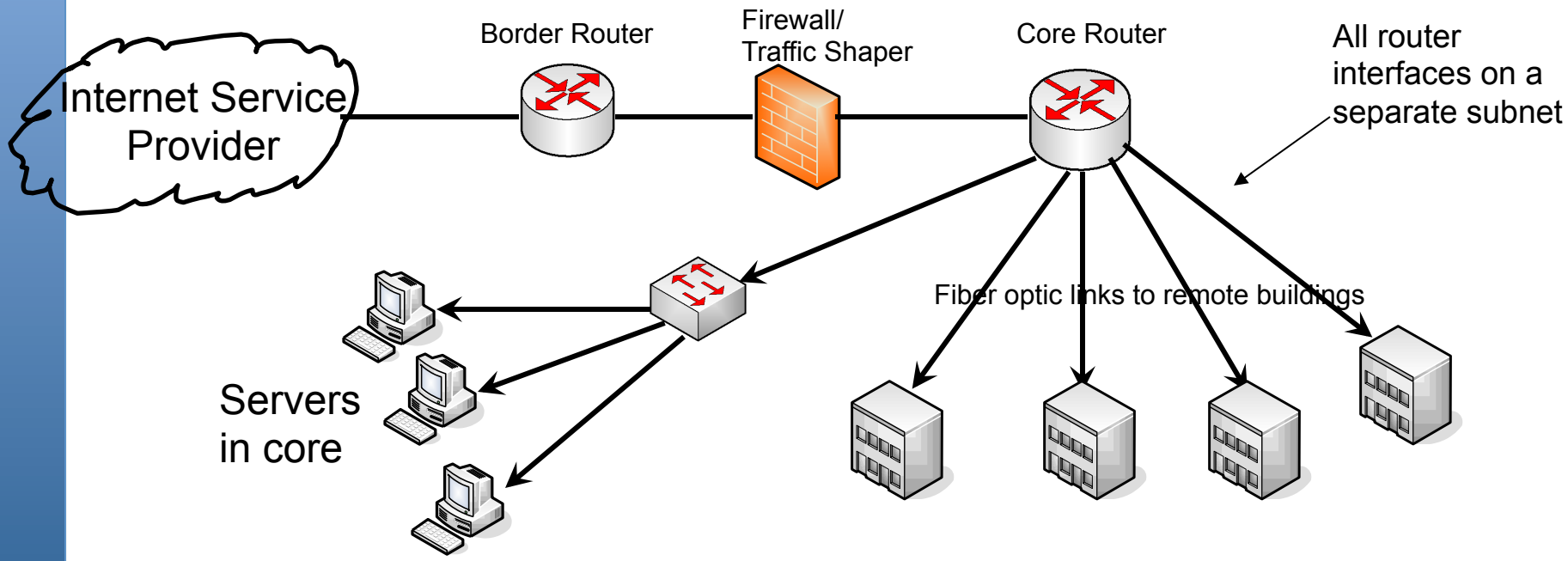
One configuration:



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

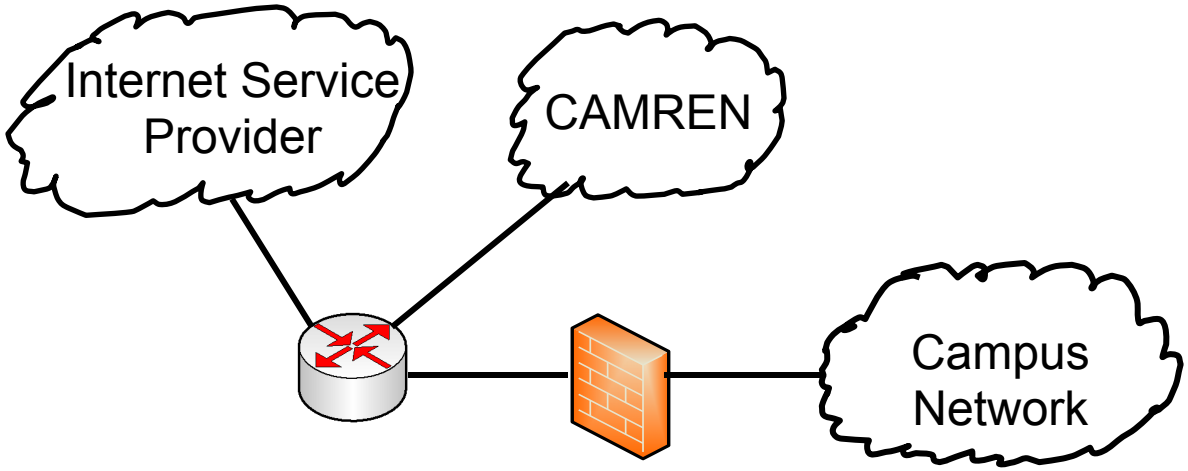


Border Router

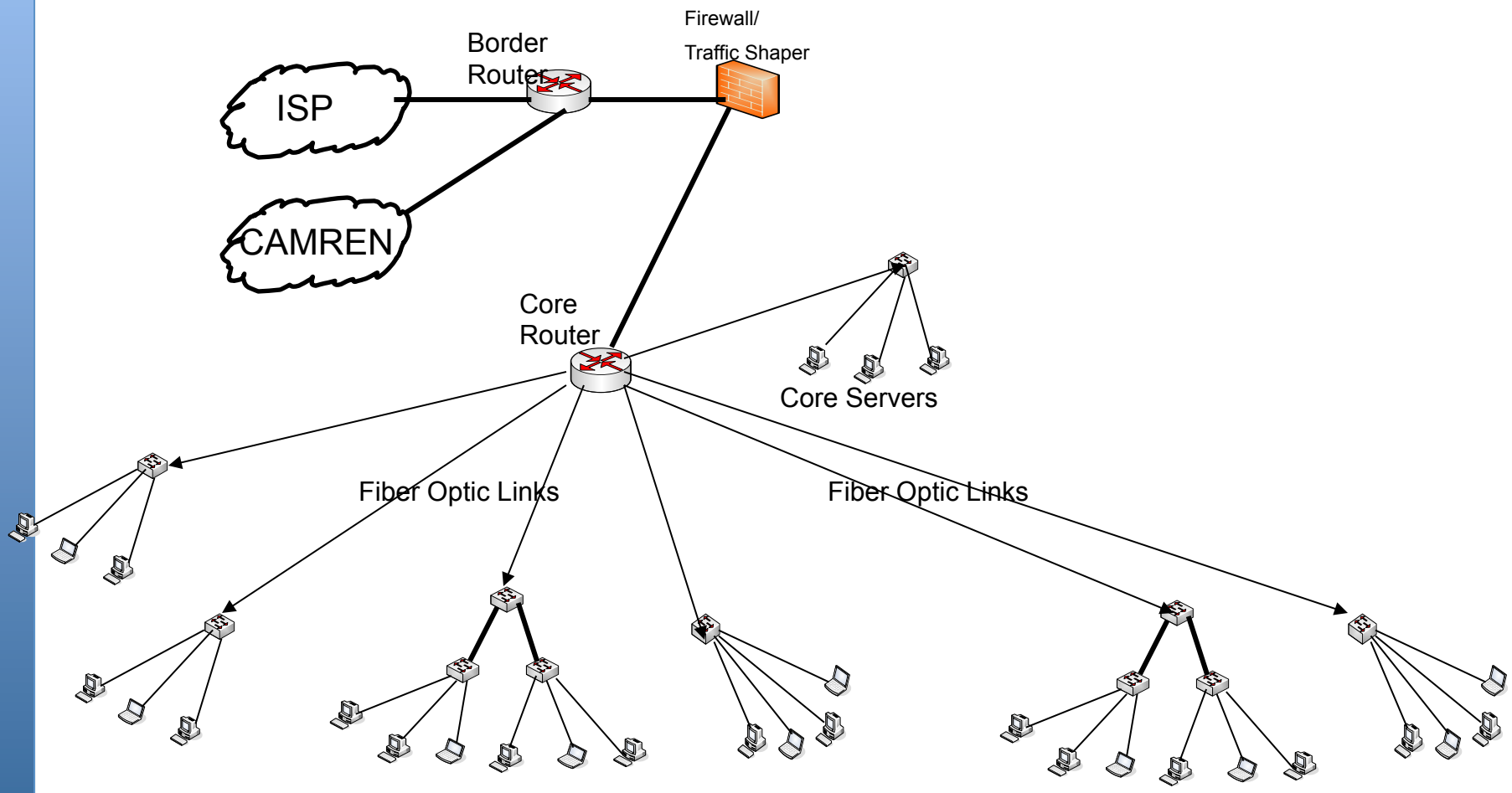
Connects to outside world

RENs and Peering are the reason you need them

Must get Provider Independent IP address space to really make this work right

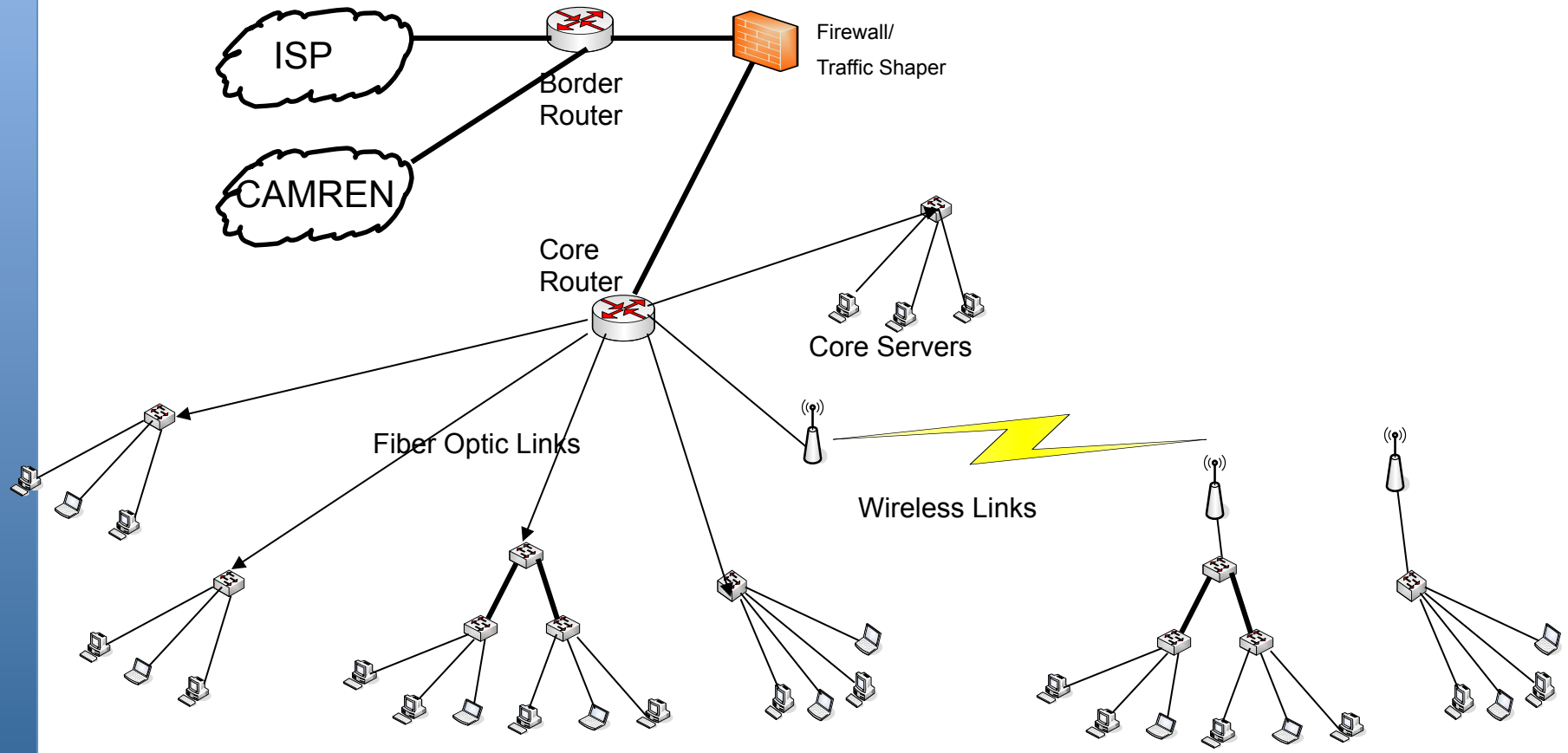


Putting it all Together



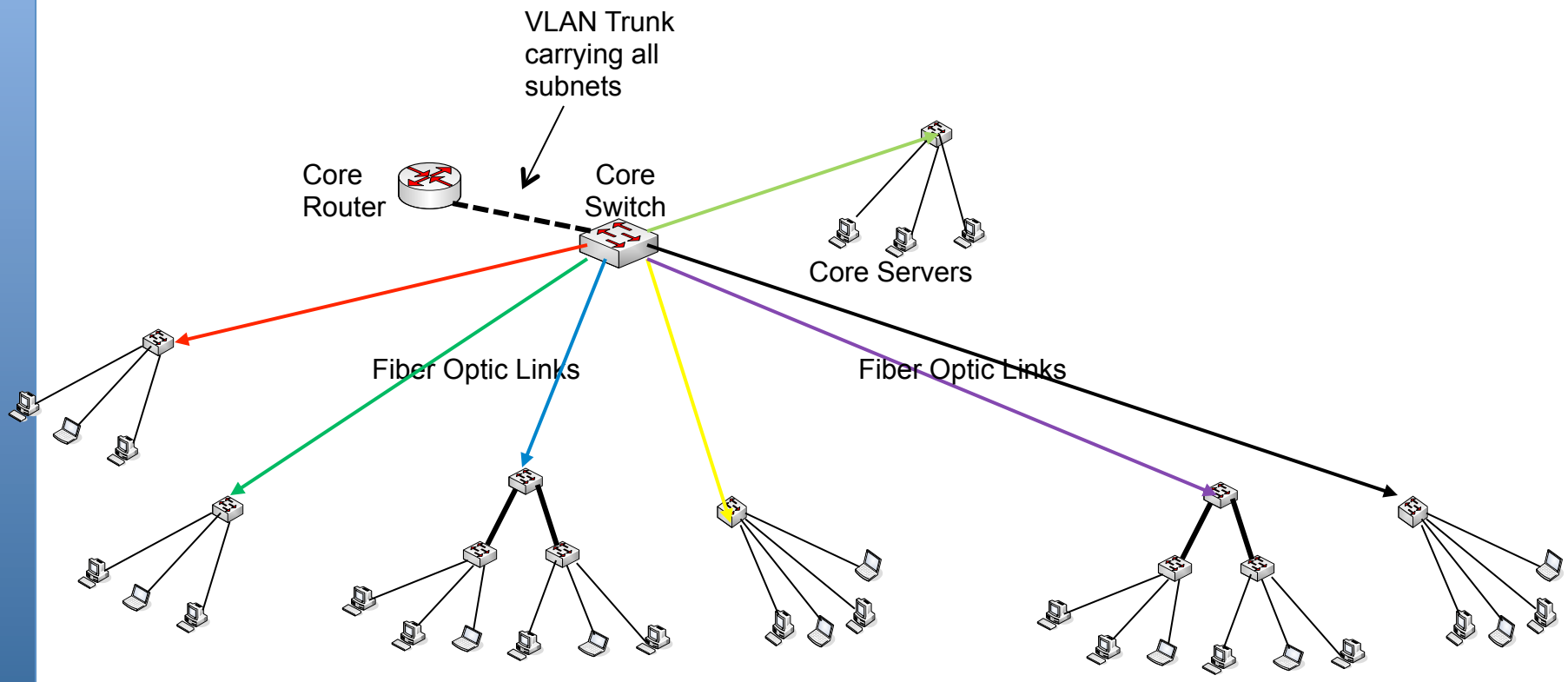
Alternative Core Designs

Wireless Links versus Fiber



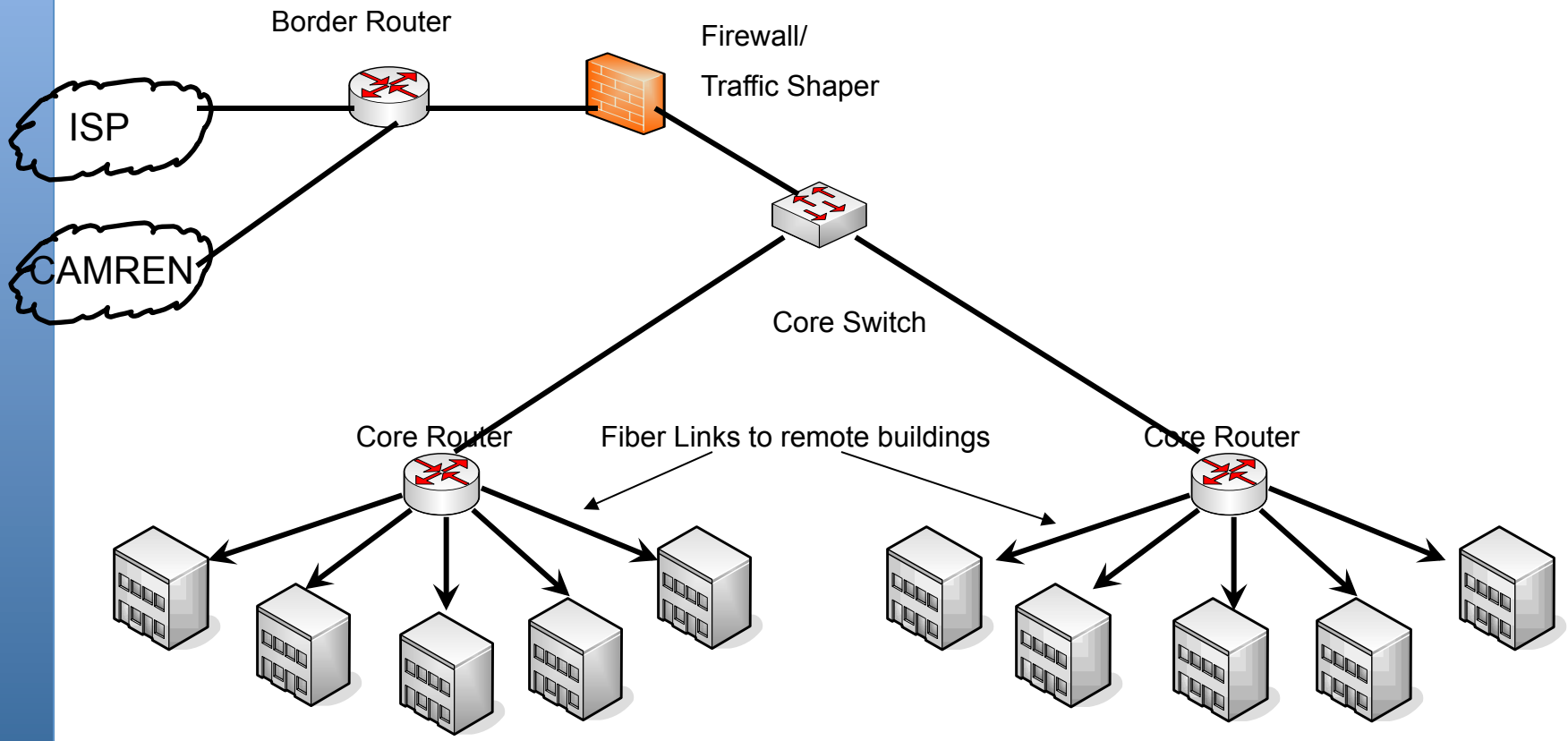
Alternative Core Designs

One Armed Router for Core

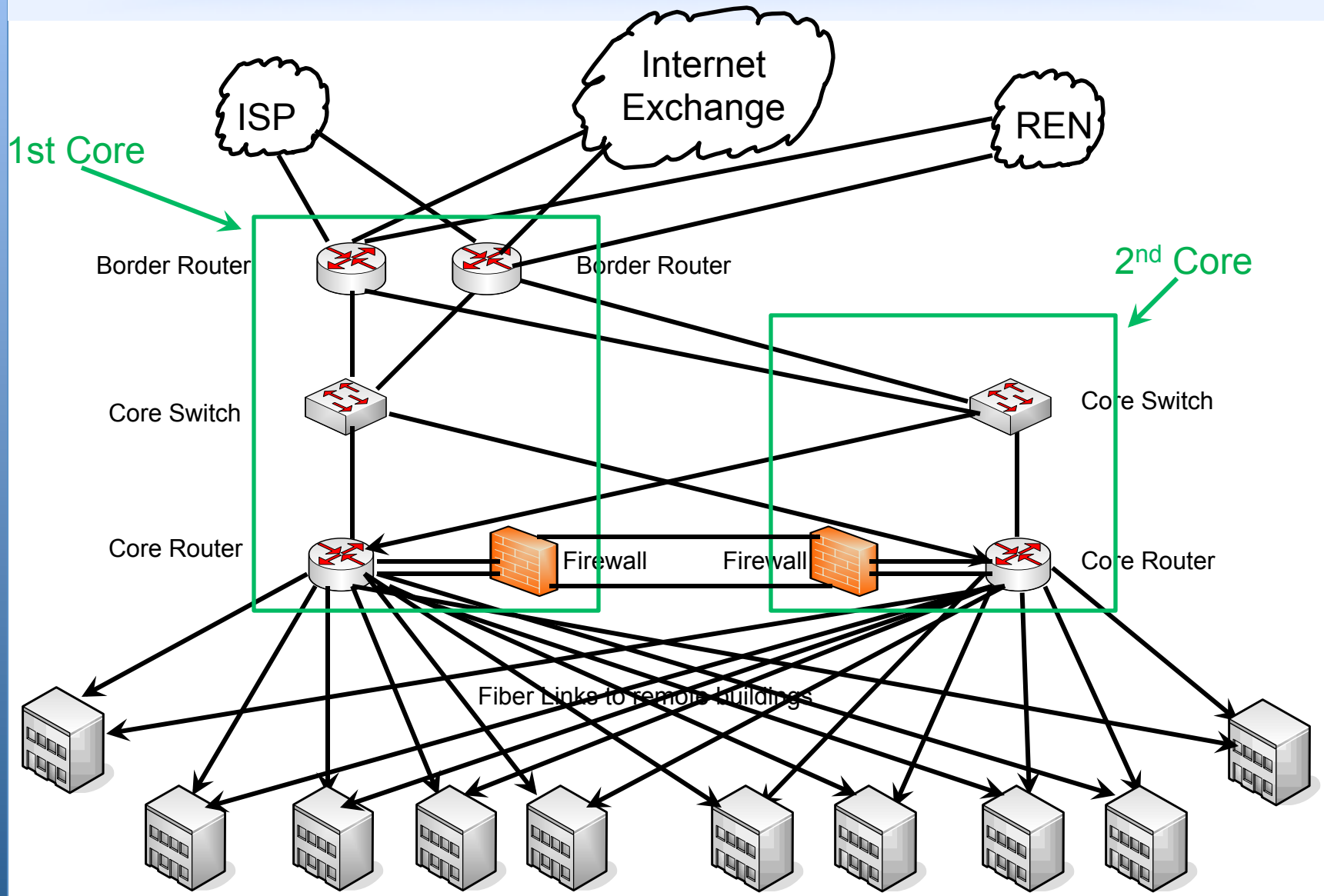


Complex Core Designs

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 CAMREN?

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