Campus Networking
Best Practices

Dale Smith
University of Oregon & NSRC
dsmith@uoregon.edu

Victor Kyalo
University of Nairobi & KENET
vkyalo@kenet.or.ke
What We’re Going to Cover

- Network Architecture
- IP Routing
- Bandwidth Optimization
- Network Management
- Structured Cable Systems
- Finally, we’ll look at some case studies
Network Architecture 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
Minimize Number of Network Devices in the Path

• Build star networks

• Not daisy chained networks
Edge Networks

- 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
- Make every network look like this:

![Diagram of Edge Networks]

Fiber link to core router
Edge Networks Continued

• Build Edge network incrementally as you have demand and money

• Start Small:

Fiber link to core router
Edge Networks Continued

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

```
Fiber link to core router
```
Edge Networks Continued

• And keep adding switches to get to the final configuration
Edge Networks Continued

• And keep adding switches to get to the final configuration

Fiber link to core router
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:

- Fiber link to core router
- Link to adjacent building
- Link to another building
Edge Networks Continued

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

  1. Switch in core location
  2. Copper or fiber link to core router
  3. Fiber link to core router
  4. Cat5e or fiber
  5. Fiber circuits to small buildings
  6. Cat5e or fiber
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
• As your network evolves, core equipment should be equipped with dual power supplies, each powered from separate UPS
• Border routers separate from Core
• Firewalls and Traffic Shaping Devices
• Intrusion Detection
• Intrusion Prevention
• Network Address Translation
Core Network

- At the core of your network should be routers
- Several different designs
- A simple core:

![Diagram of core network with Border Router, Firewall/Traffic Shaper, Core Router, Central Servers, and Fiber optic links to remote buildings.](image-url)
Routing versus Switching

• Routers provide more isolation between devices
• 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
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.

![Network Diagram]

- Border Router
- Firewall/Traffic Shaper
- Core Router
- All router interfaces on a separate subnet
- Fiber optic links to remote buildings
A typical Core Network

- More complex core design
Putting it all Together
Notes on IP Addressing

- Probably need to do Network Address Translation (NAT) at firewall
- Make subnet IP space large enough for growth
- Use DHCP to assign addresses to individual PCs
- Use static addressing for switches, printers, and servers
Thanks

Questions?
Questions raised that need to be added to this presentation

- Talk about deploying wireless LAN over campus infrastructure
- Talk about using wireless links instead of fiber – omni directional vs directional
- Talk about building a core router using a single router and a switch by utilizing VLANs
Symbols to use for diagrams