# Advanced Business Data Communications
# ICT535

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# Network growth from...

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- Organisational expansion.
- Mergers.
- Individual site growth.
- New technology and applications.
  - Power over Ethernet
  - BYOD (Bring Your Own Device)
- Convergence
  - IP telephony.
  - IP/Ethernet security cameras.
  - Move to intelligent buildings.
- Internet-of-things

# Scalable networks

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- A network that can transition from small to large.
  - More sites, bigger sites, more throughput, new applications.
  - Without having to be rebuilt from scratch.
  - Availability maintained despite having more equipment that can fail.

- Uses a standard approach.
  - Easily visualised and well understood methodology.
  - Reduces errors.
  - Enhances security.
  - Simplifies documentation.

# Non scalable networks

Adhoc network designs tend to lead to networks that grow to reach technical limits.

- Badly designed networks often need to be replaced.
  - Downtime
  - Additional cost
  - Risky, with the potential for unanticipated and undocumented requirements.
- Tendency to defer upgrades until the network breaks.
- Bandaid fixes and work-arounds to keep the network going.
- **These absolutely exist! Some of WA's major listed companies have (past tense?) had scary networks!**

# OSI model and growth

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## Revision - OSI Model - (**Open Systems Interconnection)**

- Model for breaking down complex communication systems into a series of layers (seven).

- TCP/IP Model (Internet) can be mapped to the OSI.

- Layers
  - Application ]
  - Presentation ] - Network applications such as browsers
  - Session ]
  - Transport - TCP / UDP
  - **Network** - IP (Others exist that no-one cares about anymore!)
  - **Datalink** - Ethernet / DSL / PPP / WiFi / Carrier class technologies
  - **Physical** - Copper cable / Fibre / Wireless

- Last three are driven by hardware and affected by design decisions you make.

# Physical Layer (1) - Growth

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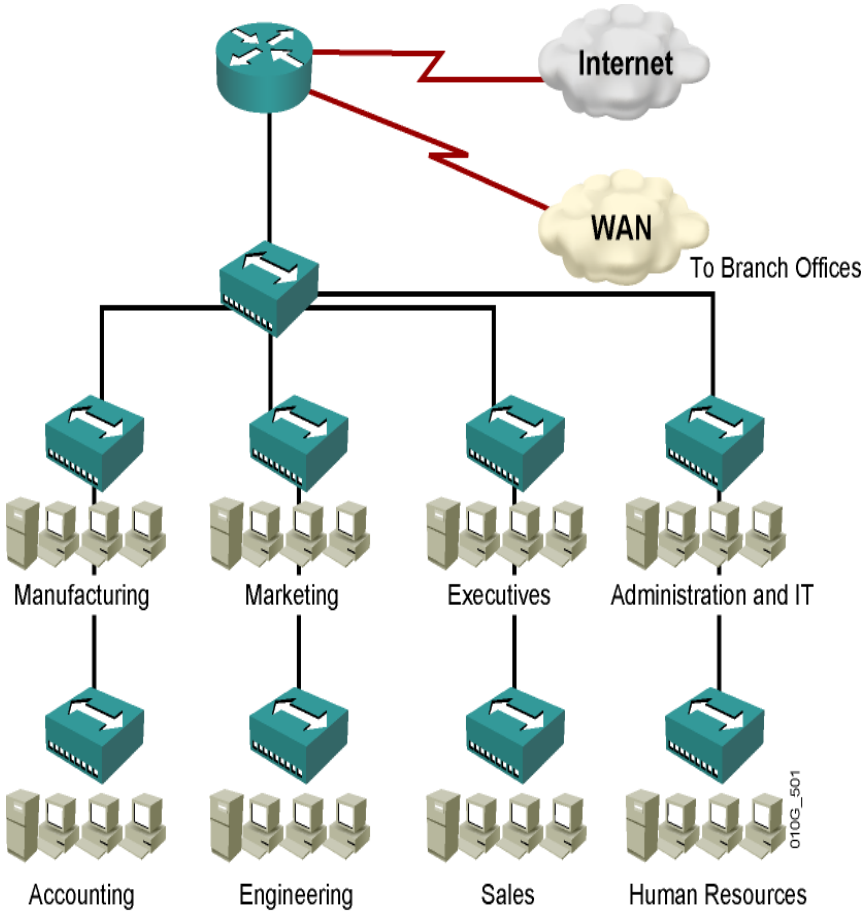
- Physical layer
  - Electrical voltage (UTP cable)
  - Light (Fiber)
  - Electromagnetic Radiation (Wireless)

- All diminish with distance.
  - ADSL/VDSL gets slower further from exchange/node.
  - WiFi gets slower as you move away from access point.

- Shared media
  - Doesn’t degrade gracefully (linearly) with the number of users.

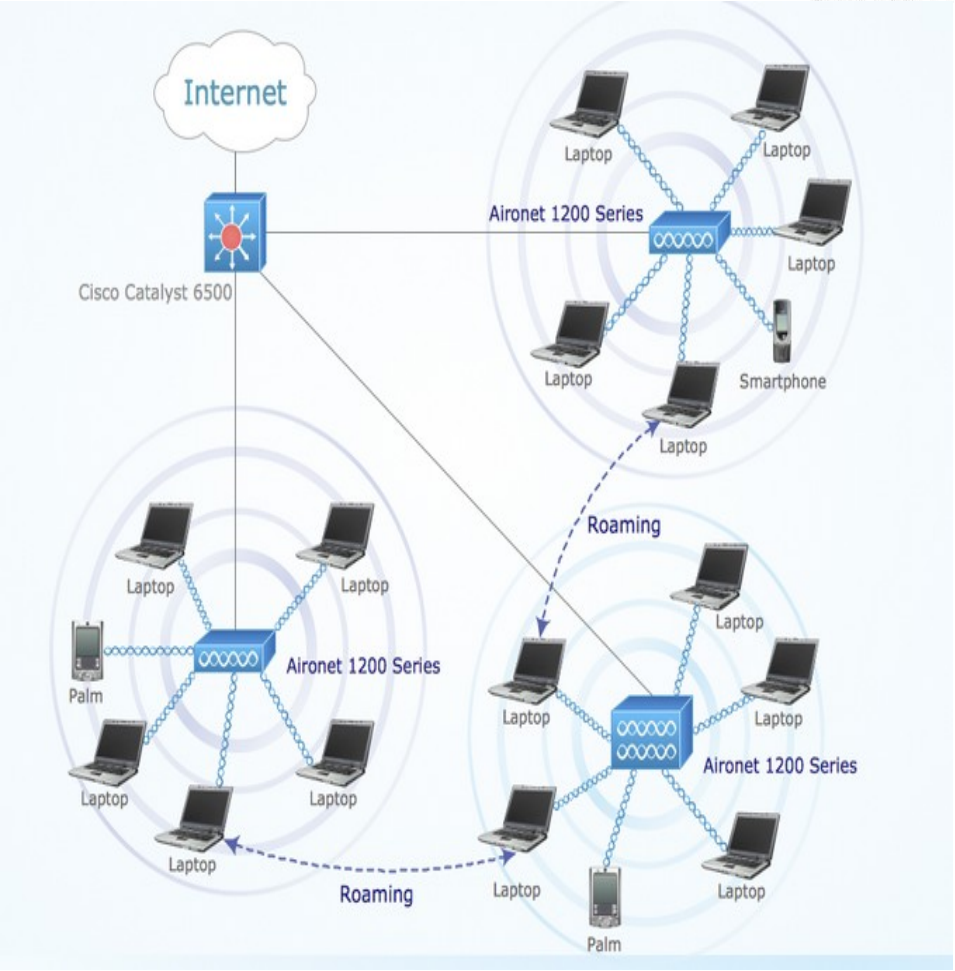
# Physical Layer (1) - Wired

- Collision domains limit growth
- Hubs are dumb and just relay signals without knowledge of destination.
- Only one device can communicate at a time.
- Legacy in the wired world because it doesn't scale well.



# Physical Layer (1) - Wireless

- Growth limited:
  - Collision domain
  - Spectrum space
  - Airtime
- Solution
  - Smaller cells
  - Less power
  - More cells
- Complex
- Not going away.
- More power is NOT a solution




http://conceptdraw.com/samples/network-diagram-wireless-network

# Datalink Layer (2)

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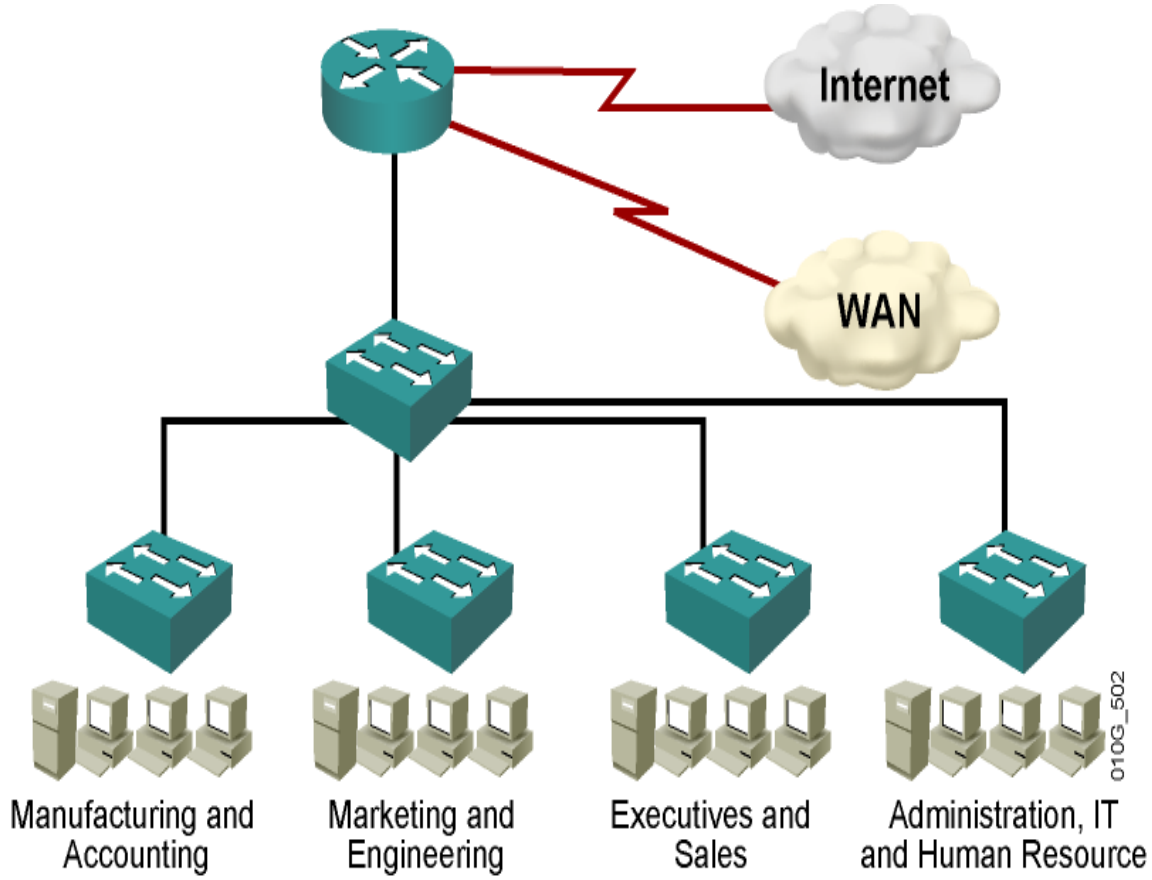
Ethernet Switches

- Traffic separated by MAC filtering
- Multiple Collision domains
- Broadcasts are flooded
- VLANs - solution
- Loops are an issue



# Network Layer (3)

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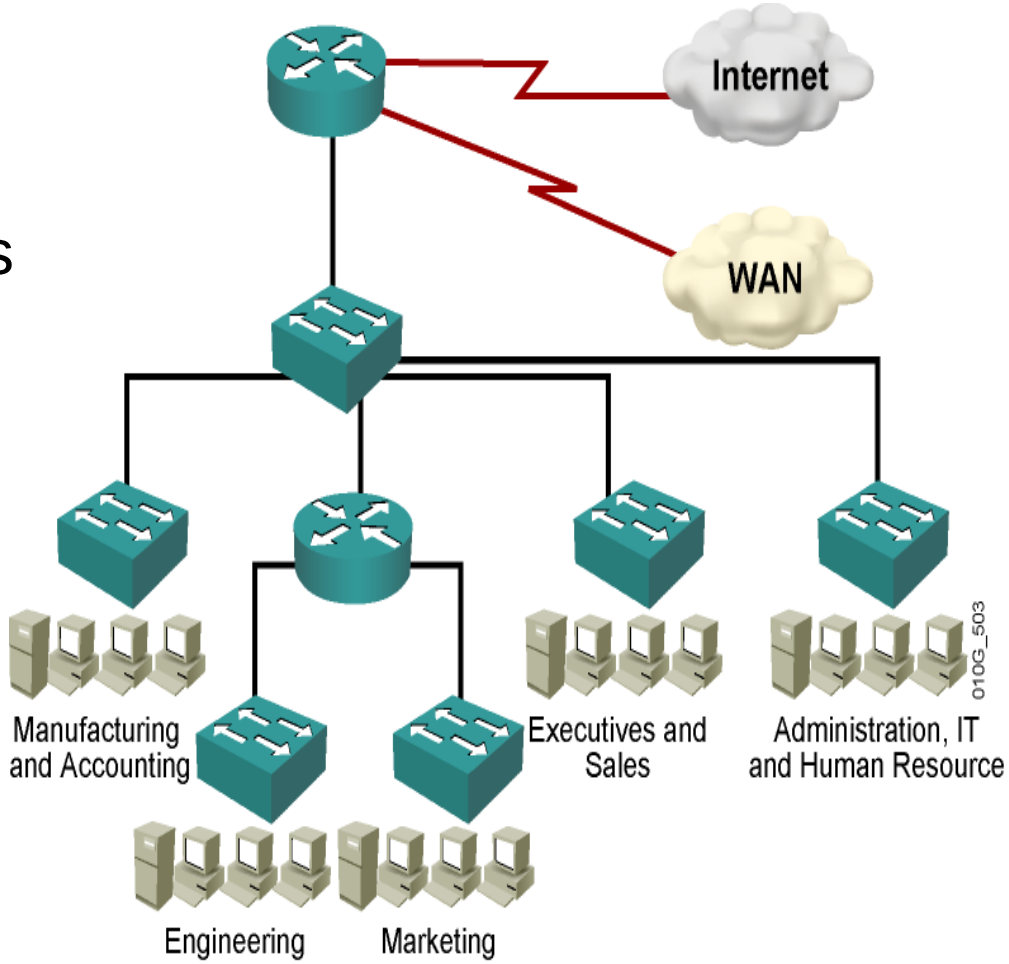
IP Routers

- Don’t forward broadcasts
- Multiple Collision domains
- Loops are beneficial
- Flexible security
- Slower than switches of the same cost.
- Higher cost.



# OSI Conclusions

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- Physical layer - shared media
  - Wired hubs - replace
  - Wireless - smaller cells bounded by routers or switches.
- Datalink Layer - Switches
  - Limit number of hosts
  - Use VLANs
- Network Layer - Routers
  - Increasingly important as networks grow.
  - Security benefits.
  - Cost limits their use.

# Other growth issues

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- Management:
  - In-band vs Out-of-band management
  - Migration of servers to dedicated facilities and away from work groups.
  - Cloud based?

- Homogenous equipment
  - Same device used throughout network.
  - Where cost can be justified.
  - Lower spare parts inventory
  - Simplification.
  - Less downtime.

# Hierarchical Design

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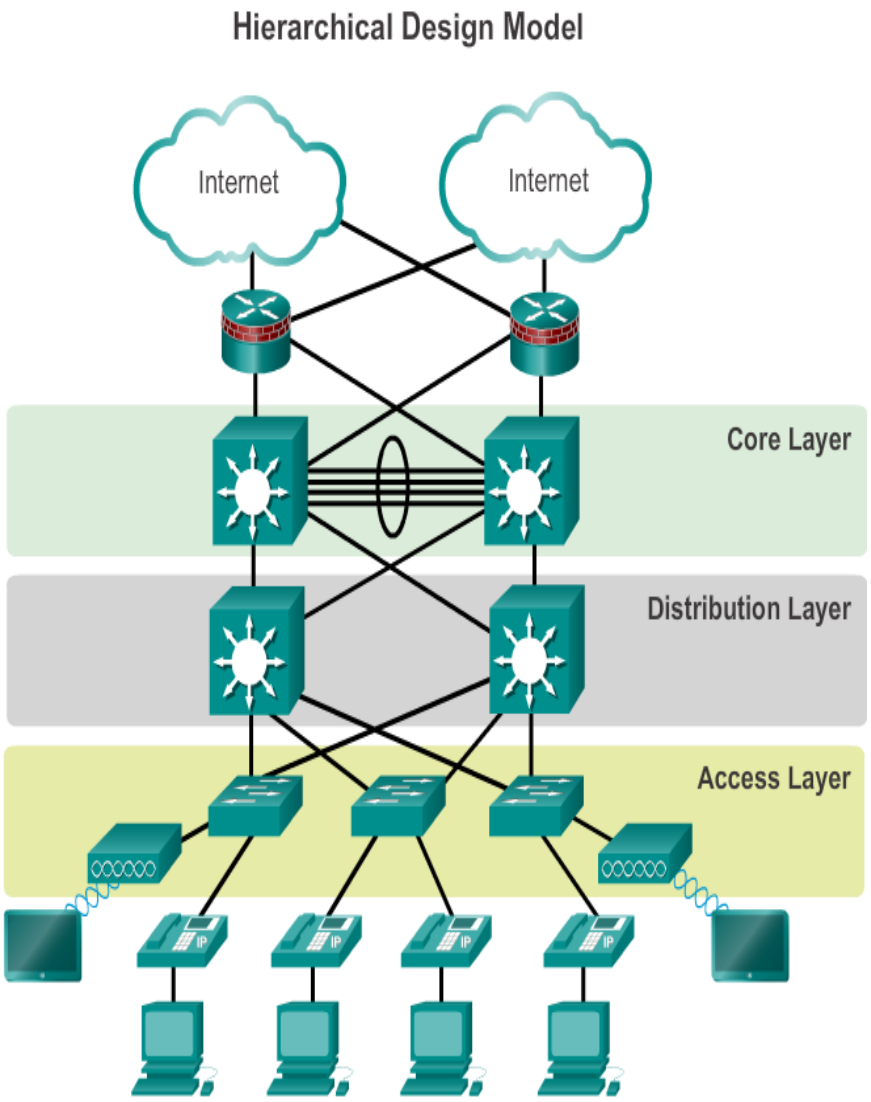
This is the standard model we will consider.

- More later ...
- Note redundancy
  - Devices
  - Links
  - ISP
  - Not seen but assumed:
    - Modules
    - Power supply



# Hierarchical Design

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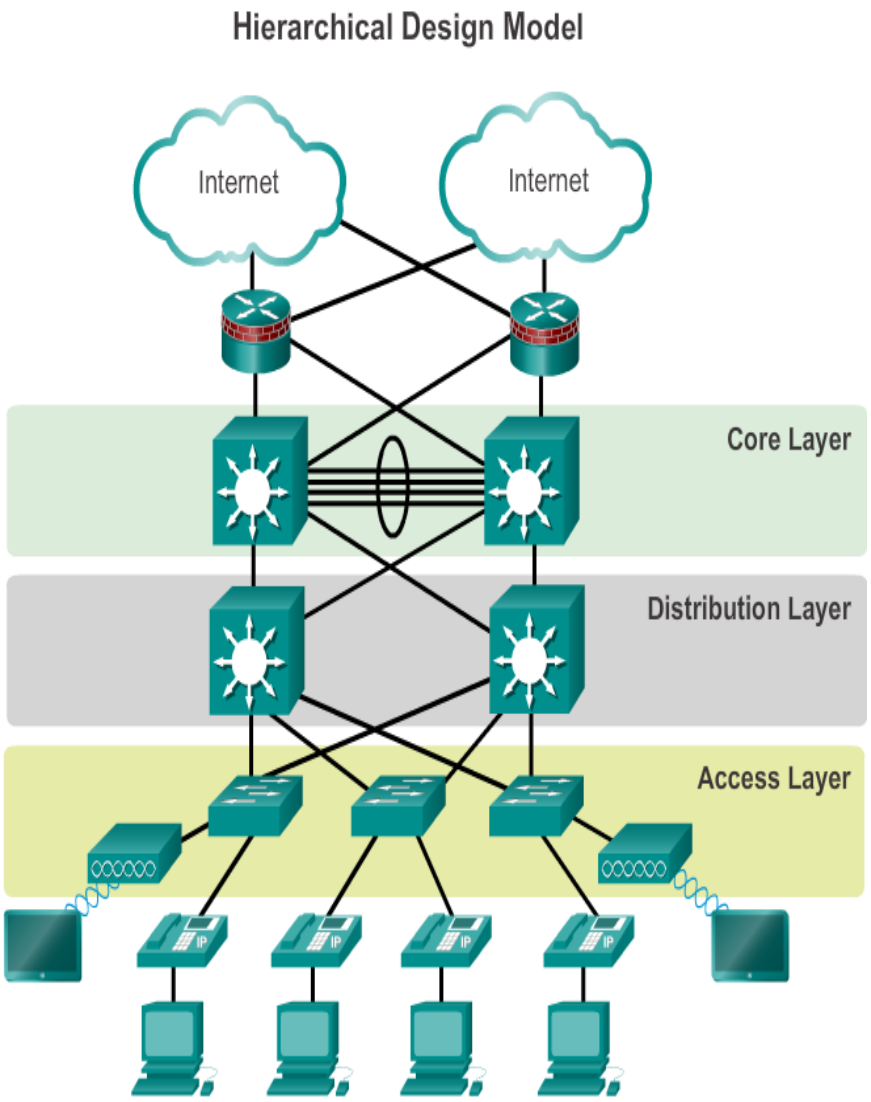
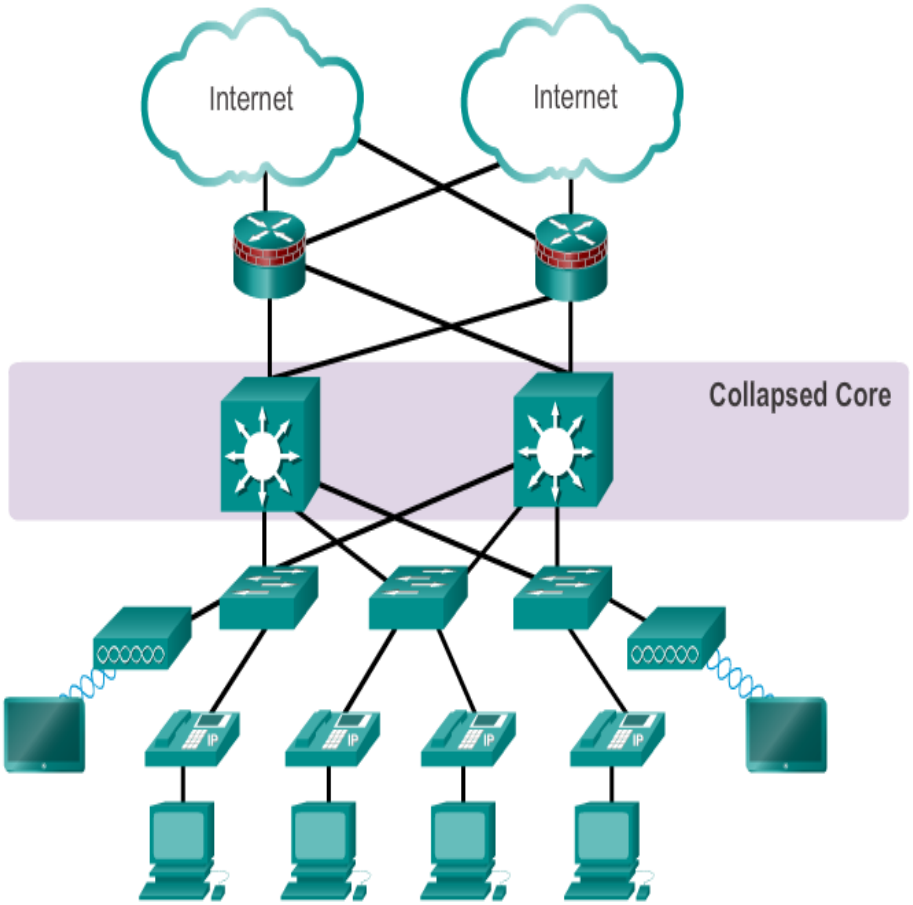
Three layers

- Switches for cheap **access**
- Routers for flexible control and policy enforcement **distribution layer**
- Routers for their superior ability to handle multiple paths at the core.



# Collapsed Core

Where the are few sites
the distribution routers
can also serve the role of the c



# Hierarchical Campus Model

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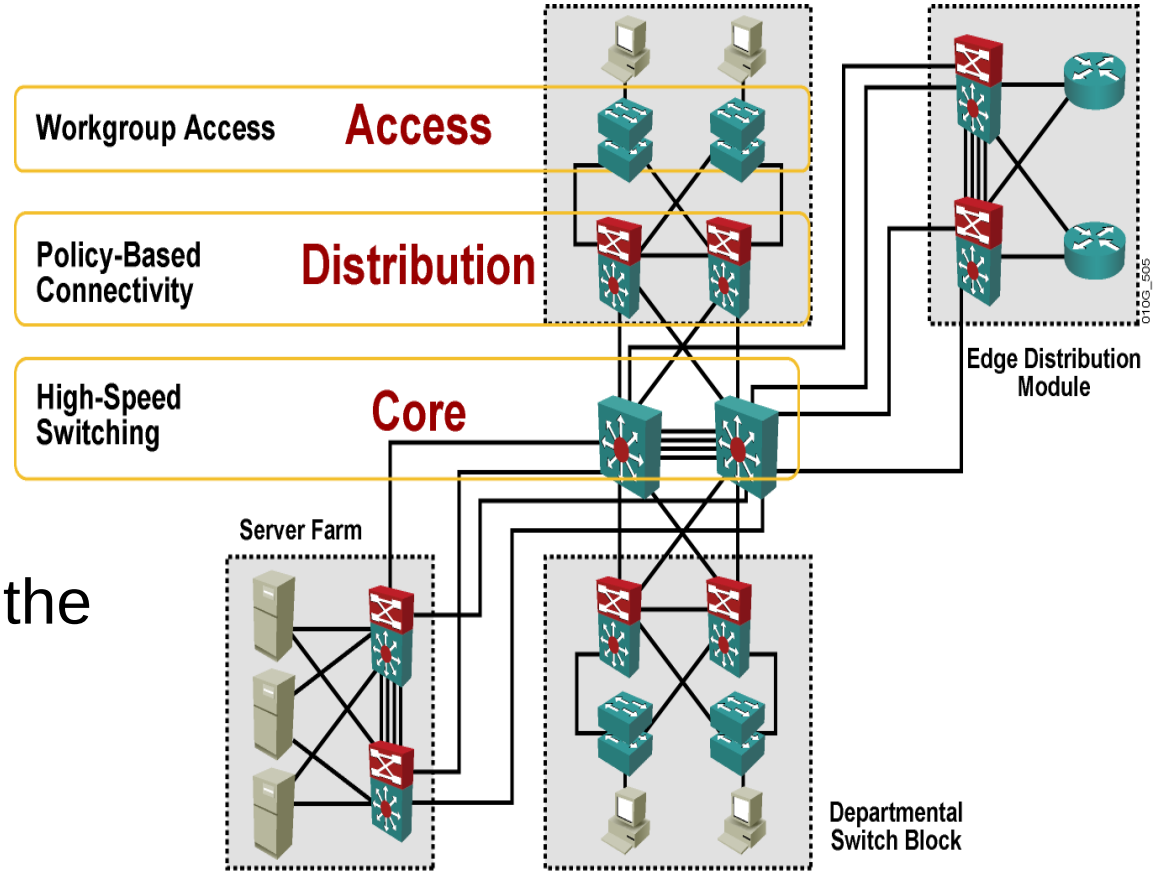
Cisco marketing hype clouds
an otherwise consistent and valid approach.

- Don't worry about detail yet.

- Key aspect is that the principal of 3 layers holds true Throughout the network.

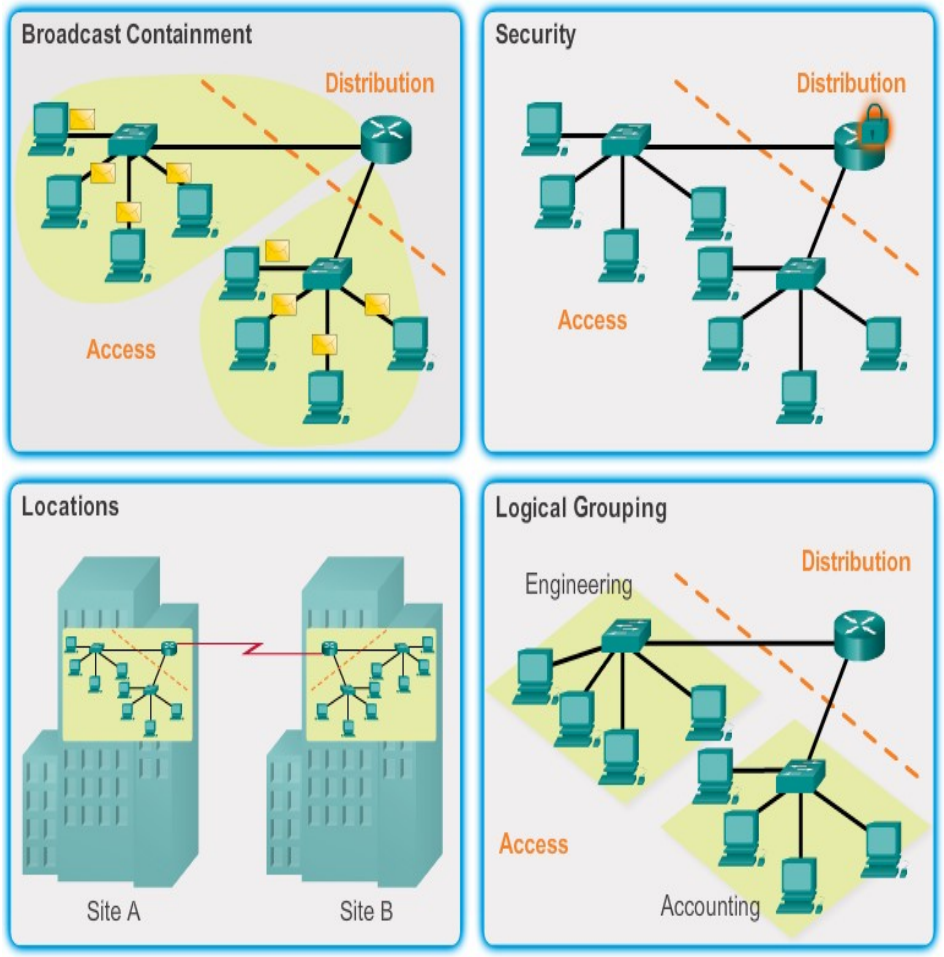
- What is different within the blocks and why?



# How the model aids scaling

Addresses technical performance issues.

- Broadcasts
- Security and organisational structure.
- Interconnectivity and routing
- Balances cost and flexibility



# Other growth issues

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- Redundancy introduced to improve reliability.
  - Equipment, modules and links.
  - Expensive.
  - Unit emphasis:
    - Preference for using redundant devices for extra capacity when there are no faults.
    - Spanning-tree tends to be wasteful.

Questions ?