Tecnologias de Redes de Computadores - 90398

Apresentação 19 – Modelo hierárquico

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Enterprise network design requirements

- Functionality
- Performance
- Scalability
- Availability
- Administration easyness
- Effective cost

How important are the requirements?

	Functionality	Performance	Scalability	Availability	Manageability	Cost Effectiveness
Building Access	Important	Critical	Important	Important	Important	Critical
Building Distribution	Important	Critical	Critical	Critical	Important	Critical
Campus Backbone	Important	Critical	Critical	Critical	Important	Critical
Network Management	Normal	Important	Normal	Important	Critical	Important
Server Farm	Critical	Critical	Critical	Critical	Important	Critical
Edge Distribution	Important	Important	Important	Critical	Important	Important

How to choose equipments?

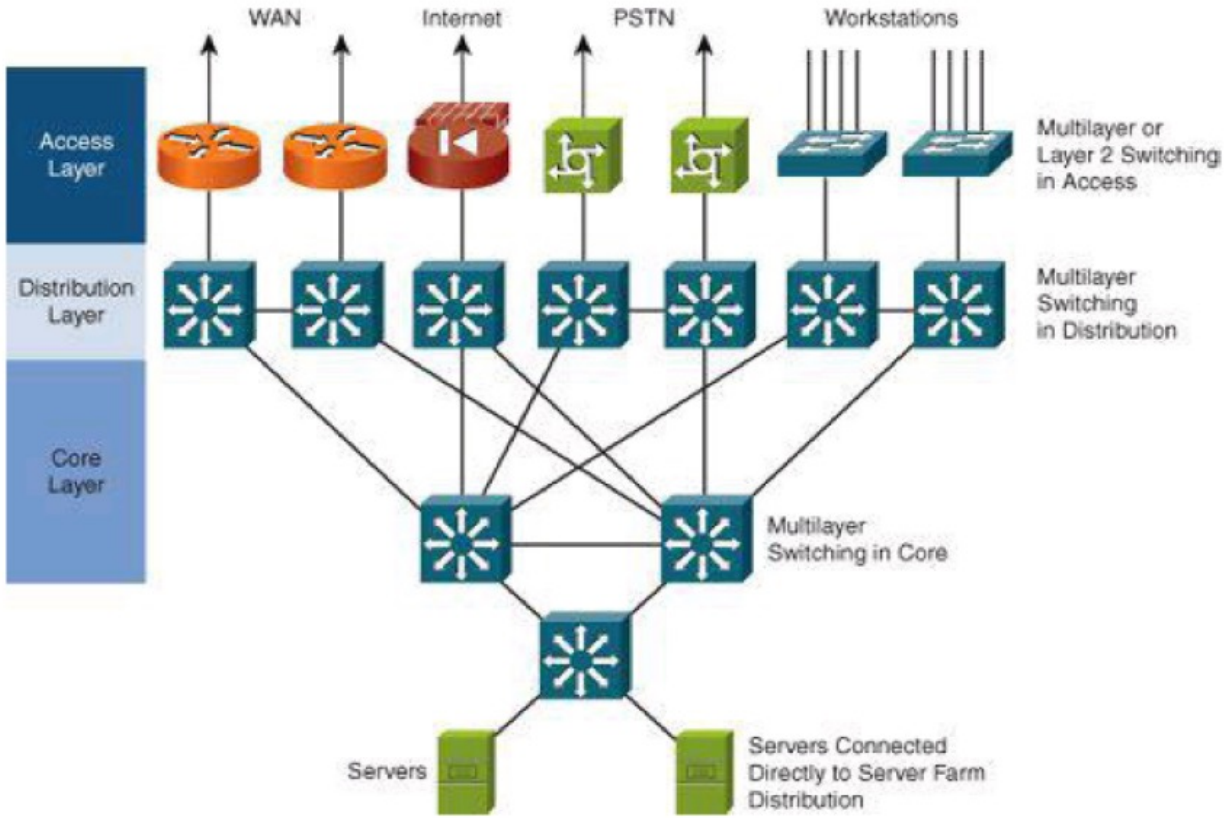
- Type
  - L2 Switch, L3 Switch, Router + Switching module, Router, ...
- Manufacturer
  - Reliability
    - (Expected) Maximum MTBF (mean time between failures) as possible.
    - Depends on multiple factors:
    - – Hardware/Electronics redundant architectures, inherent quality, environmental constrains, etc...
  - Price
    - Usually (not always), a lower price means lower reliability.
  - Assistance
- Range/Model
  - Processing/Commutation speed
    - Number of bytes/packets processed/commuted per second.
      - Lower than the sum of all ports speed.
  - Software version
  - Supported protocols and functionalities.
  - Determines also memory requirements.
  - Number of ports (and speed of ports)
  - Ethernet (10 Mbps, 100 Mbps, 1Gbps, 10Gbps, ...)
  - Connectors
  - – To copper or to fiber.
  - – RJ-45, Small form-factor pluggable (SFP), Enhanced small form-factor pluggable (SFP+) ... With or without PoE (Power over Ethernet)
  - – For VoIP phones, Access Points, etc... Number of slots
  - For additional port/processing modules.

Enterprise network modules

- Campus:
  - Operating center of an enterprise.
  - This module is where most users access the network.
  - Combines a core infrastructure of intelligent switching and routing with mobility, and advanced security.
- Data Center
  - Redundant data centers provide backup and application replication.
  - Network and devices offer server and application load balancing to maximize performance. Allows the enterprise to scale without major changes to the infrastructure.
  - Can be located either at the campus as a server farm and/or at a remote facility.
- Delegation:
  - Allows enterprises to extend head-office applications and services to remote locations and users or to a small group of branches.
  - Provides secure access to voice, mission-critical data, and video applications.
  - Should provide a robust architecture with high levels of resilience for all the branch offices.

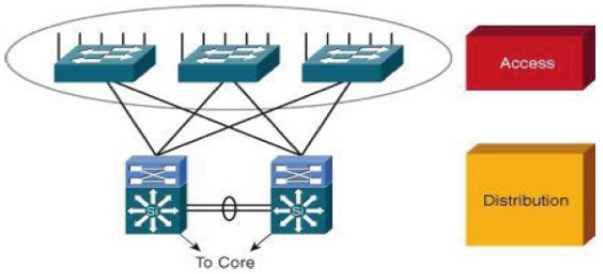
Hierarchical model

Hierarchical network example



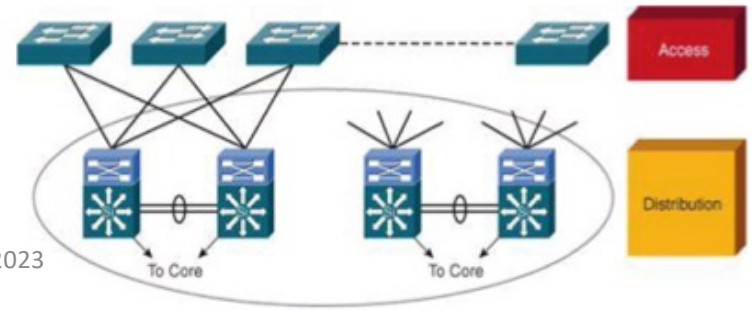
Access network design

- High availability
  - Default gateway redundancy using multiple connections from access switches to redundant distribution layer switches.
  - Redundant power supplies.
- Other considerations
  - Convergence: the access layer should provide seamless convergence of voice into data network and providing roaming wireless LAN (WLAN).
  - Security: for additional security against unauthorized access to the network, the access layer should provide tools such as IEEE 802.1X, port security, DHCP snooping and dynamic ARP inspection (DAI).
  - Quality of service (QoS): The access layer should allow prioritization of critical network traffic using traffic classification and queuing as close to the ingress of the network as possible.
  - IP multicast: the access layer should support efficient network and bandwidth management using features such as Internet Group Management Protocol (IGMP) snooping.



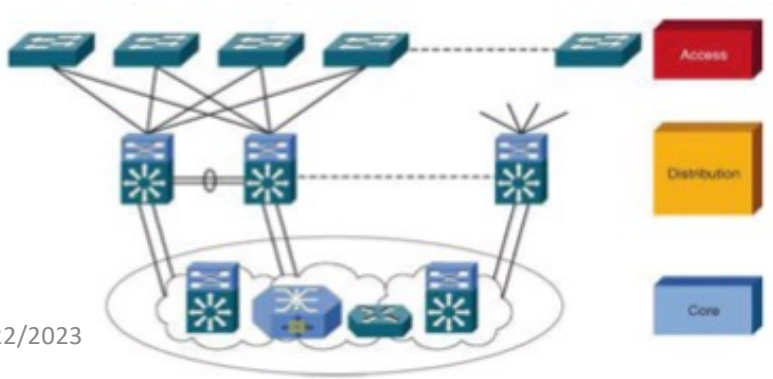
Distribution network design

- Uses a combination of Layer 2 and multilayer switching to segment workgroups and isolate network problems, preventing them from impacting the core layer.
- Connects network services to the access layer and implements QoS, security, traffic loading balancing, and implements routing policies.
- Major design concerns: high availability, load balancing, QoS, and provisioning.
- In some networks, offers a default route to access layer routers and runs dynamic routing protocols when communicating with core routers.
- The distribution layer it is usually used to terminate VLANs from access layer switches.
- To further improve routing protocol performance, summarizes routes from the access layer.
- To implement policy-based connectivity, performs tasks such as controlled routing and filtering and QoS.

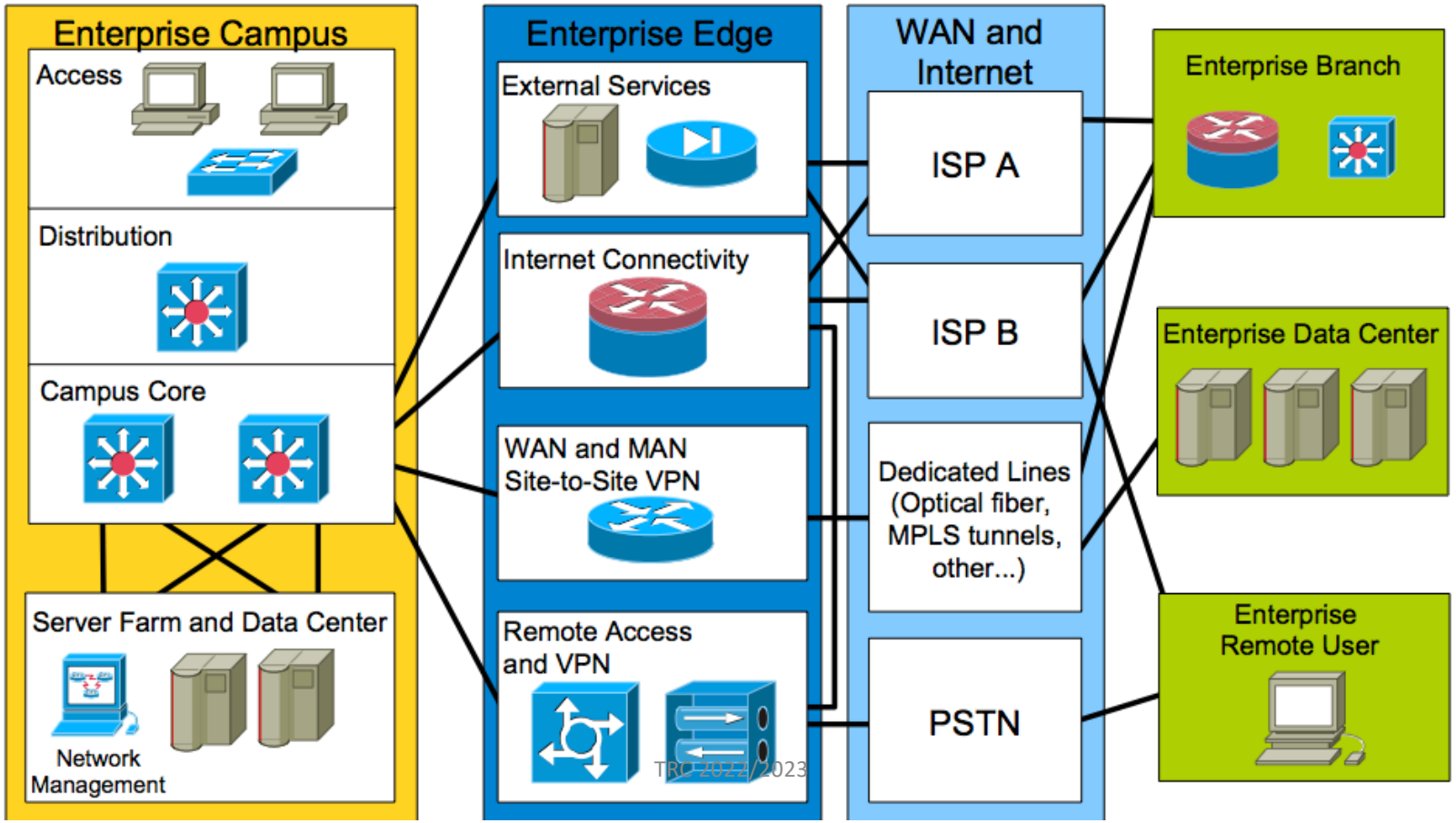


Core network design

- Backbone for campus connectivity and is the aggregation point for the other layers.
- Should provide scalability, high availability, and fast convergence to the network. The core layer should scale easily.
  - High-speed environment that should use hardware-acceleration, if possible.
  - The core should provide a high level of redundancy and adapt to changes quickly.
    - Core devices should be more reliable
    - Accommodate failures by rerouting traffic and respond quickly to changes in the network topology.
  - Implements scalable protocols and technologies.
  - Provides alternate paths and load balancing.
  - Packet manipulation should be avoided, such as checking access lists and filtering, which could slow down the switching of packets.
- Not all campus implementations require a campus core.
- The core and distribution layer functions can be combined at the distribution layer for a smaller campus.

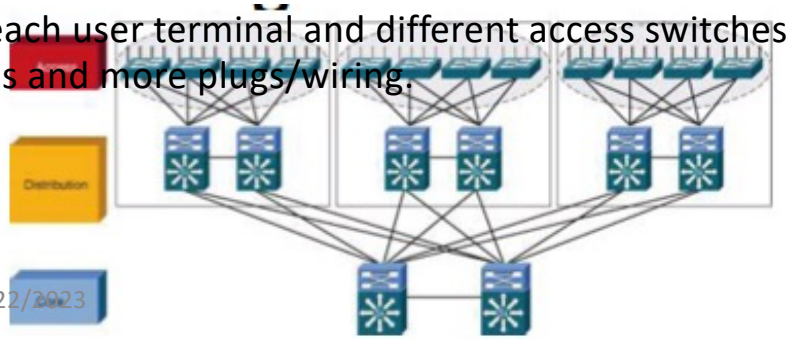


Modular design



Avoiding failure points

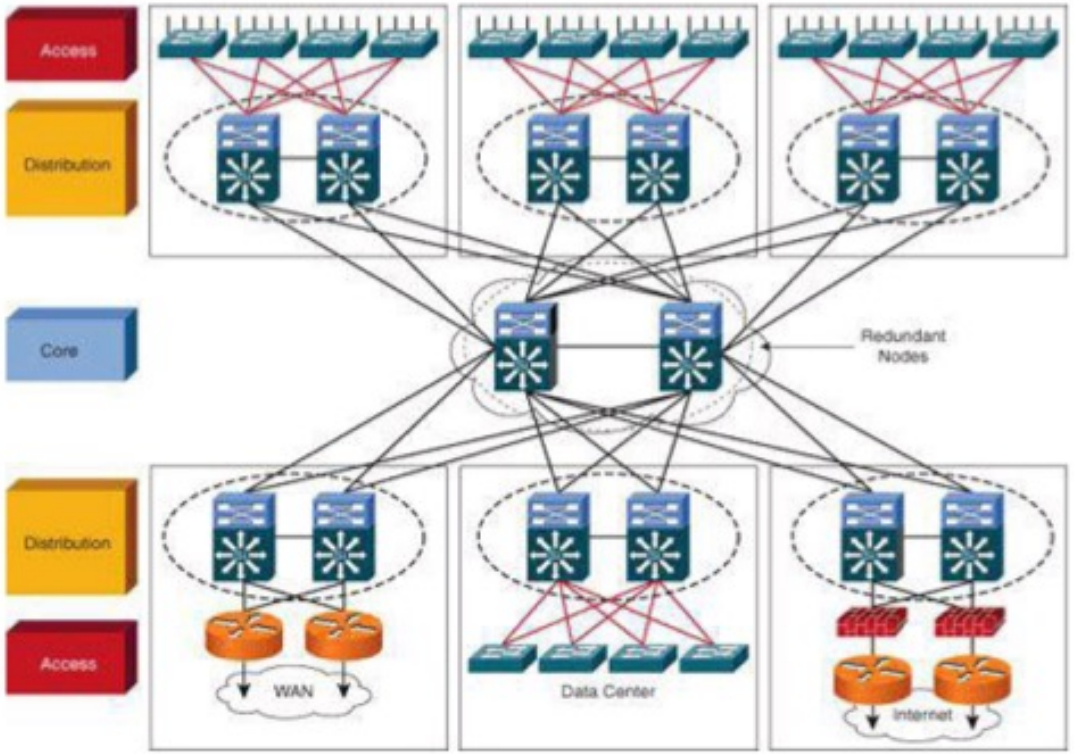
- With an hierarchical design,
  - In Distribution and Core Layers the single points of failure are easy to avoid with redundant links.
    - Don't forget redundant power and cooling!
  - In Access Layer, all L2 switches are single points of failure (only) to the user connected to them,
    - Solution 1, redundant backup hardware activated by a (proprietary) supervision mechanism to “replace” faulty equipment.
      - – Copies full configuration and state to backup hardware.
    - Solution 2, have multiple connections between each user terminal and different access switches – Requires multiple network cards in user terminals and more plugs/wiring.
      - – Cheaper?



Too much redundancy

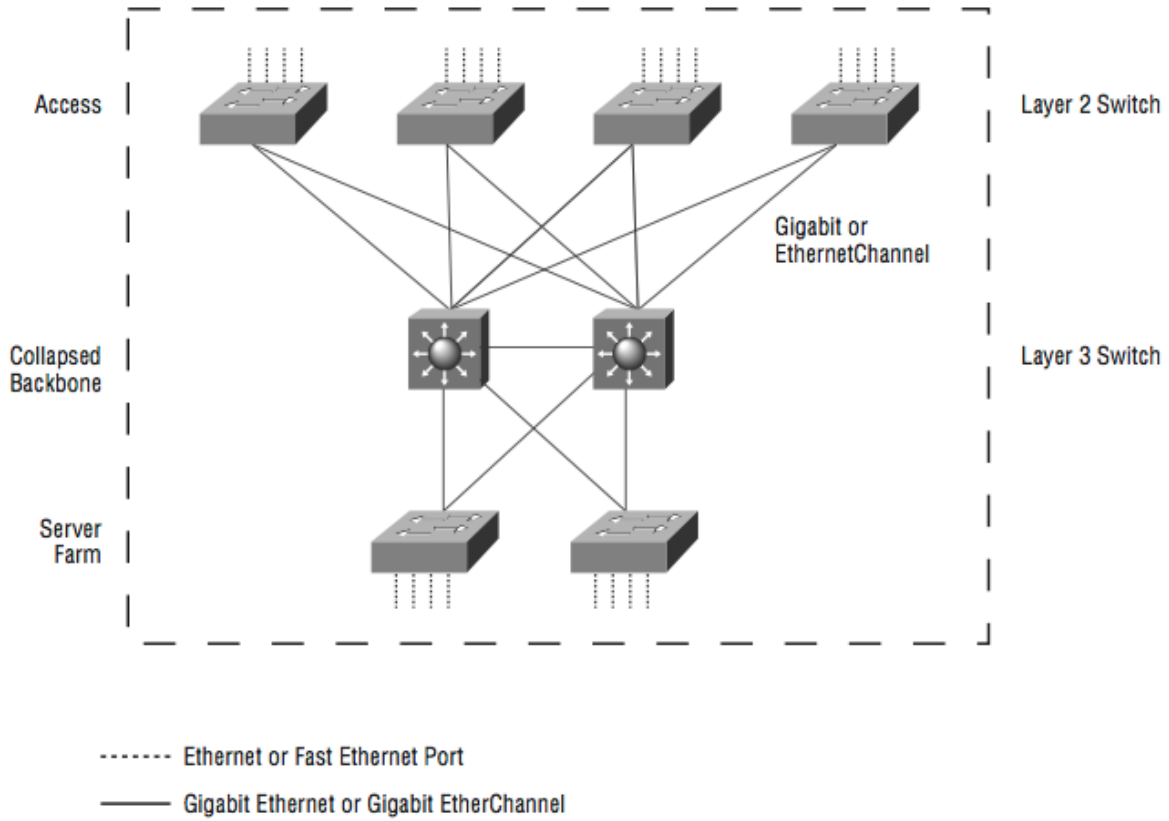
- High cost:
  - Number of used ports
  - The number of cables
  - Messing the routing

Equilibrium point

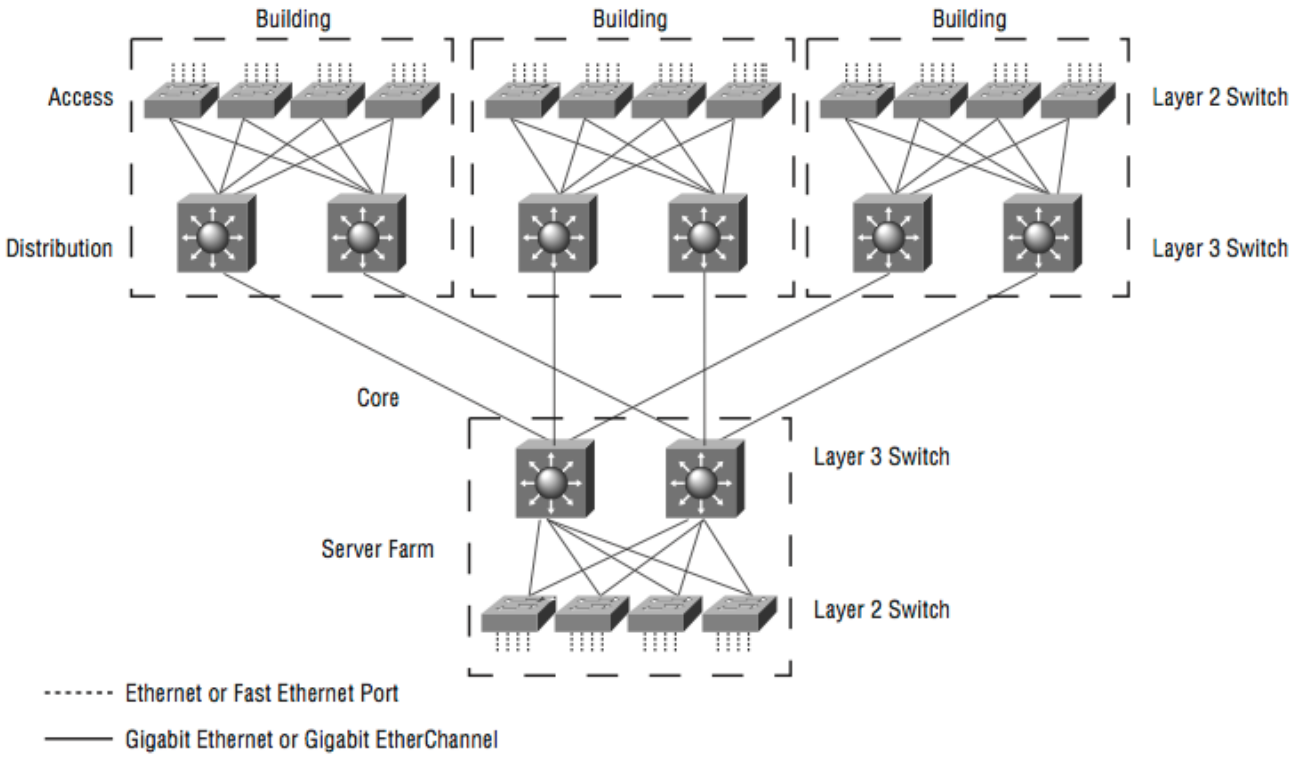


Enterprise network Design examples

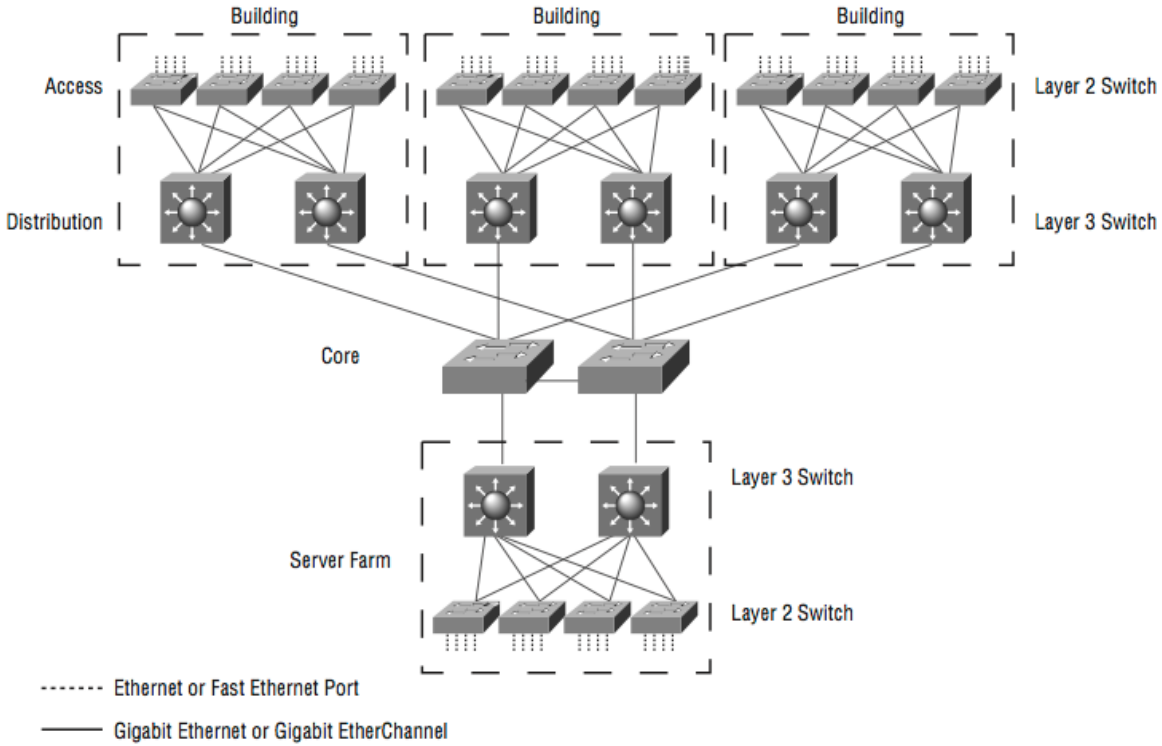
Collapsed backbone – small campus



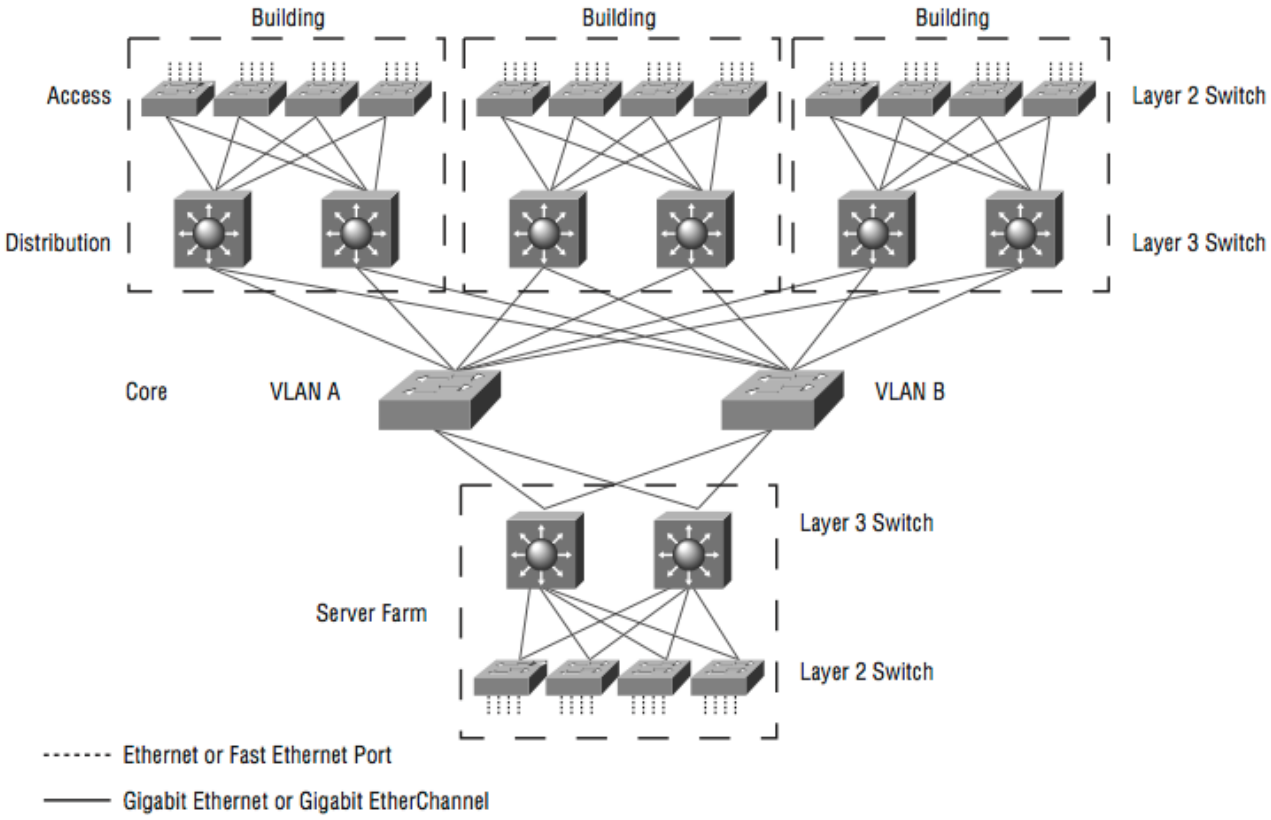
Partial Mesh—Small Campus Design



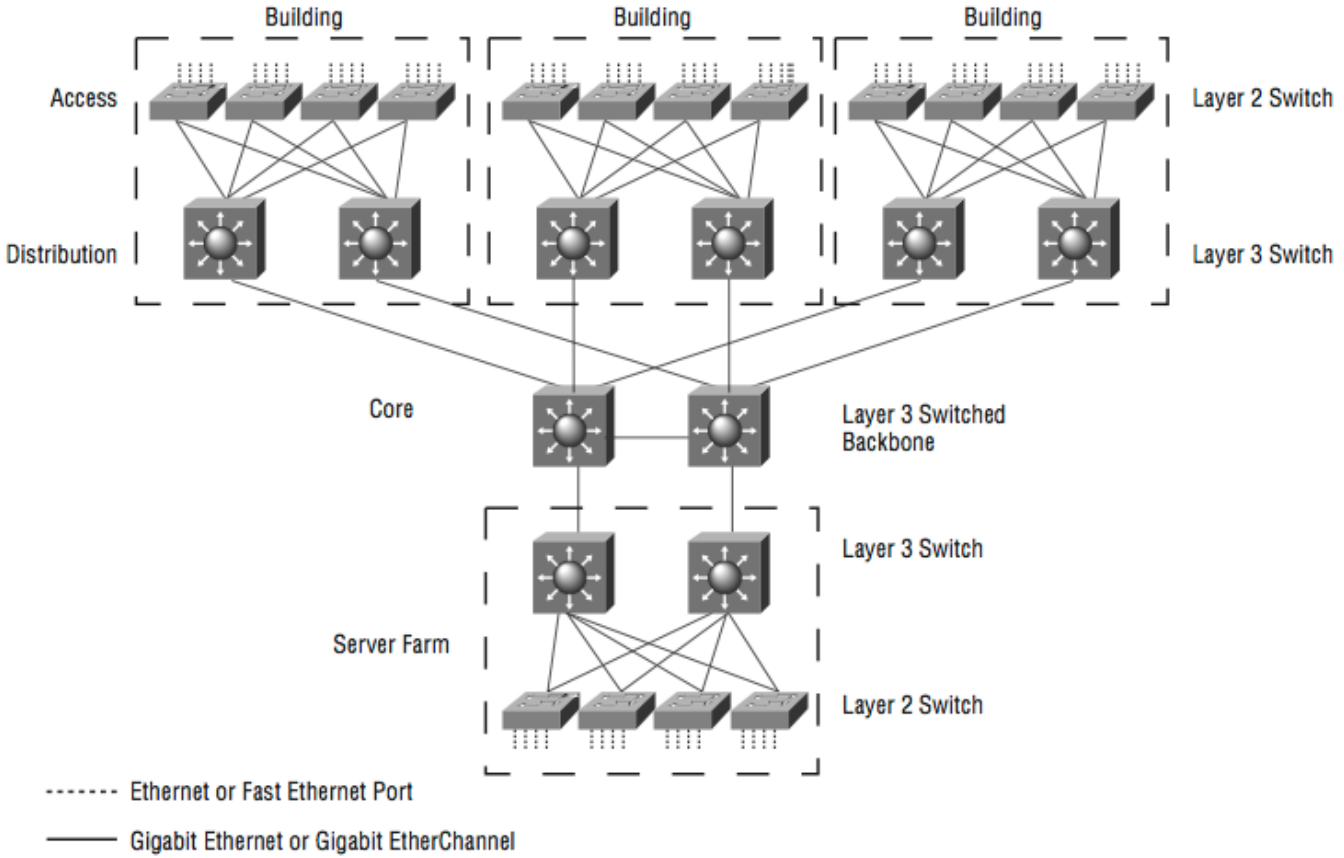
Backbone L2 – unique VLAN



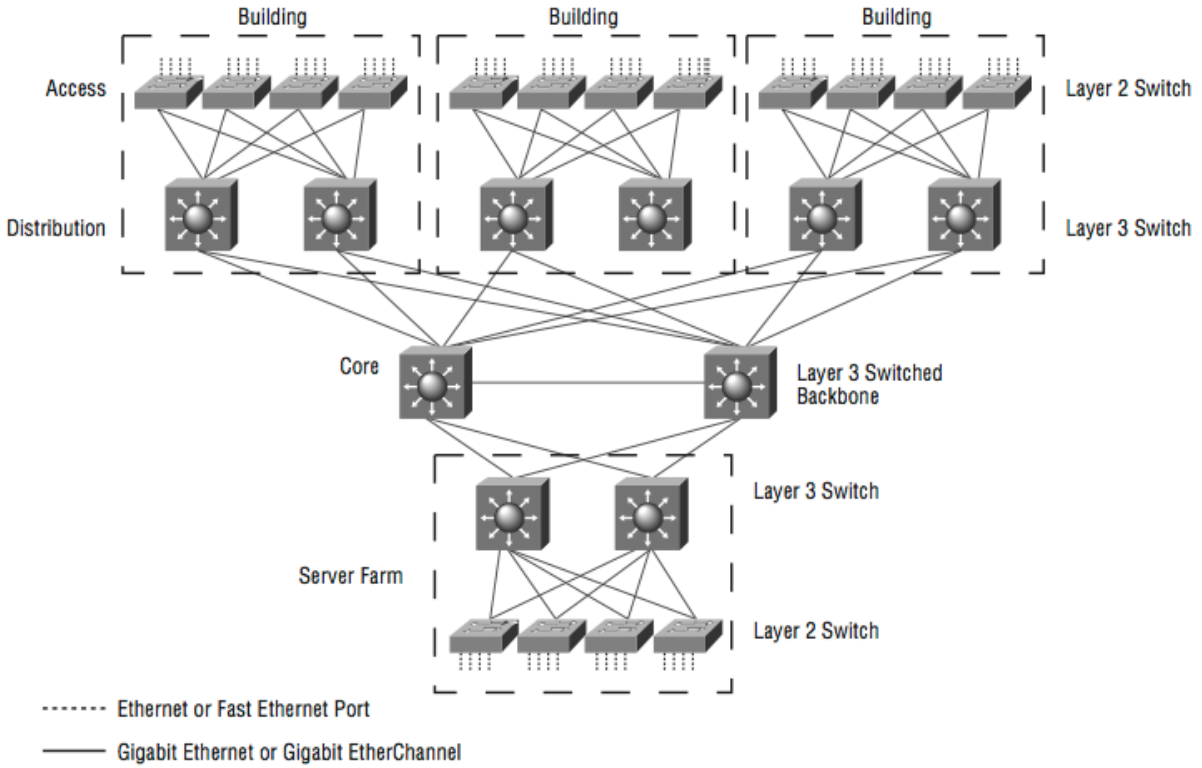
Divided campus L2 Backbone



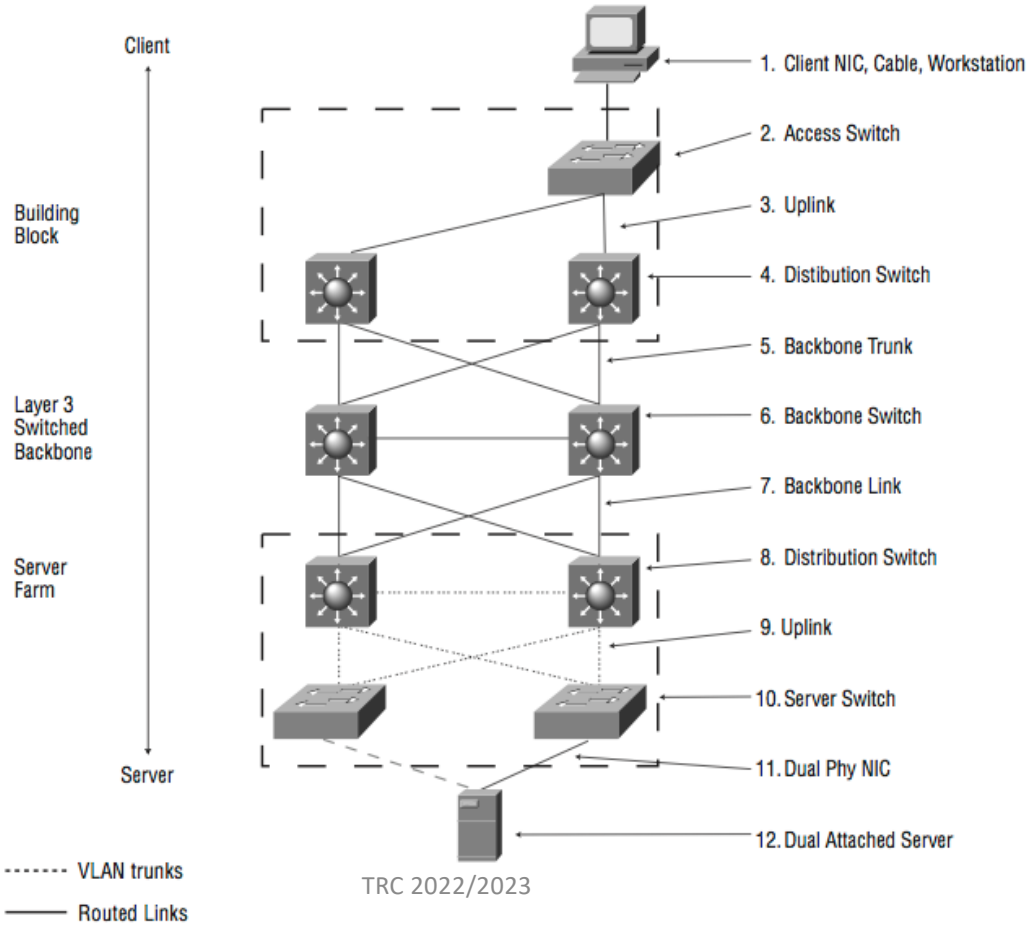
Commuted L3 backbone campus



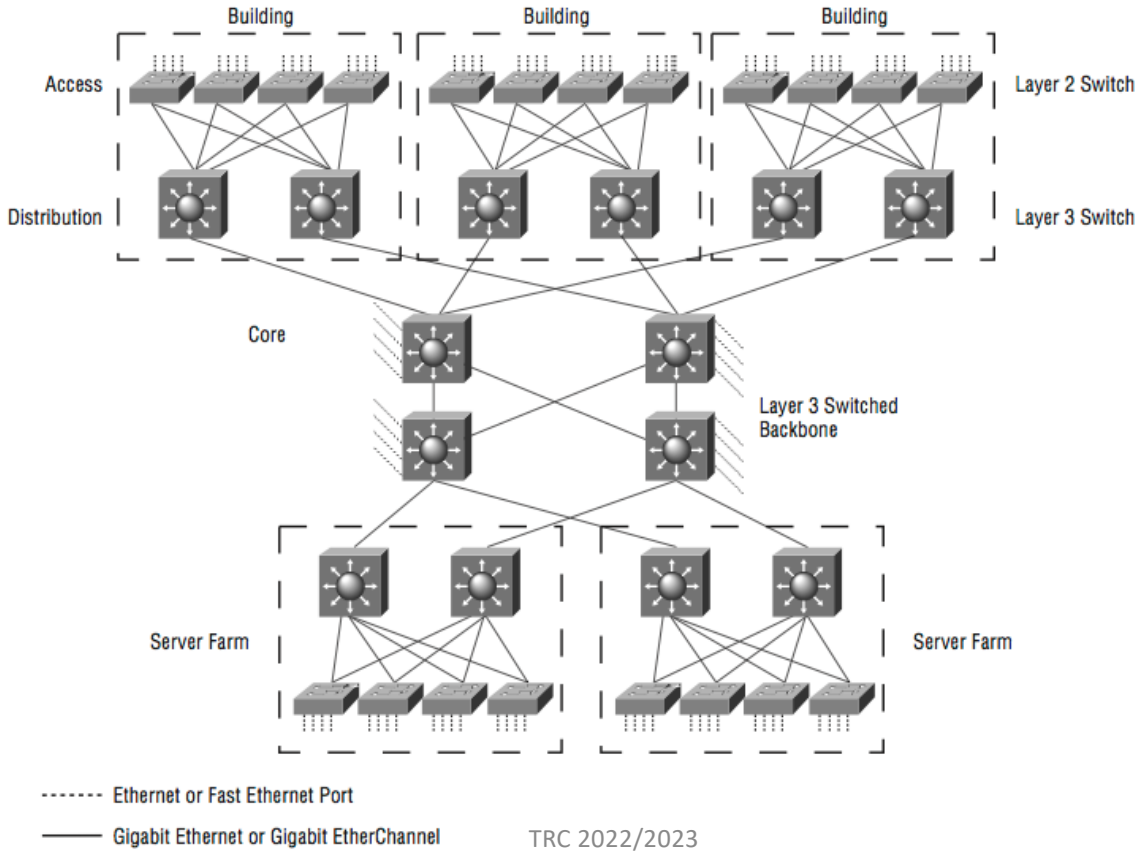
L3 backbone with dual connection



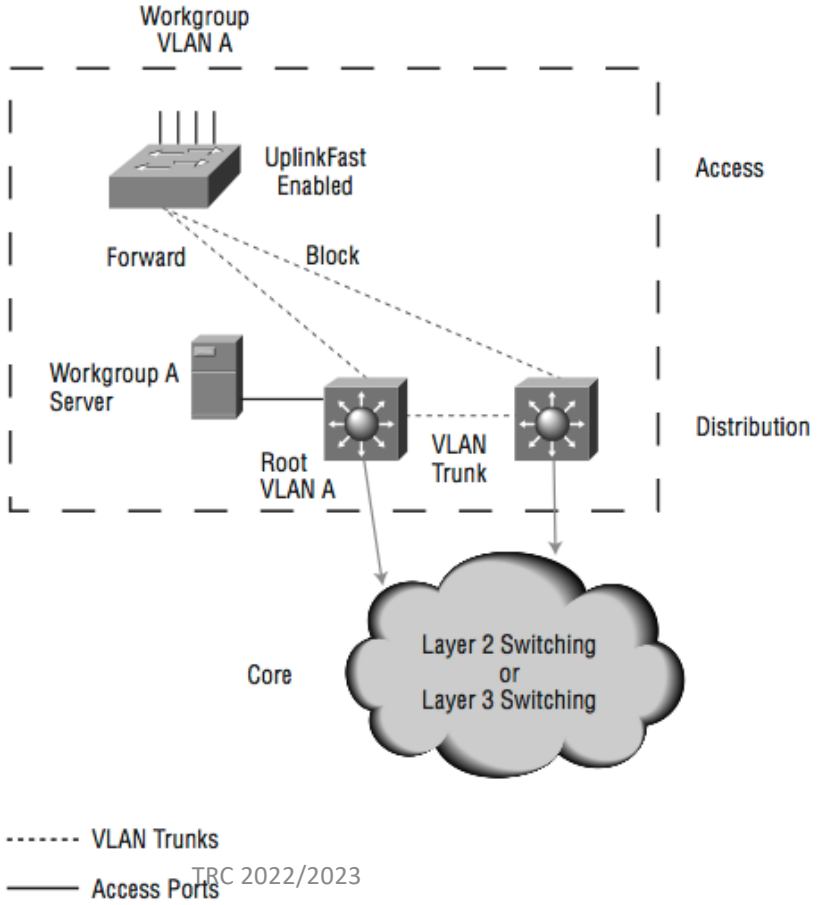
Redundancy and the increase of availability



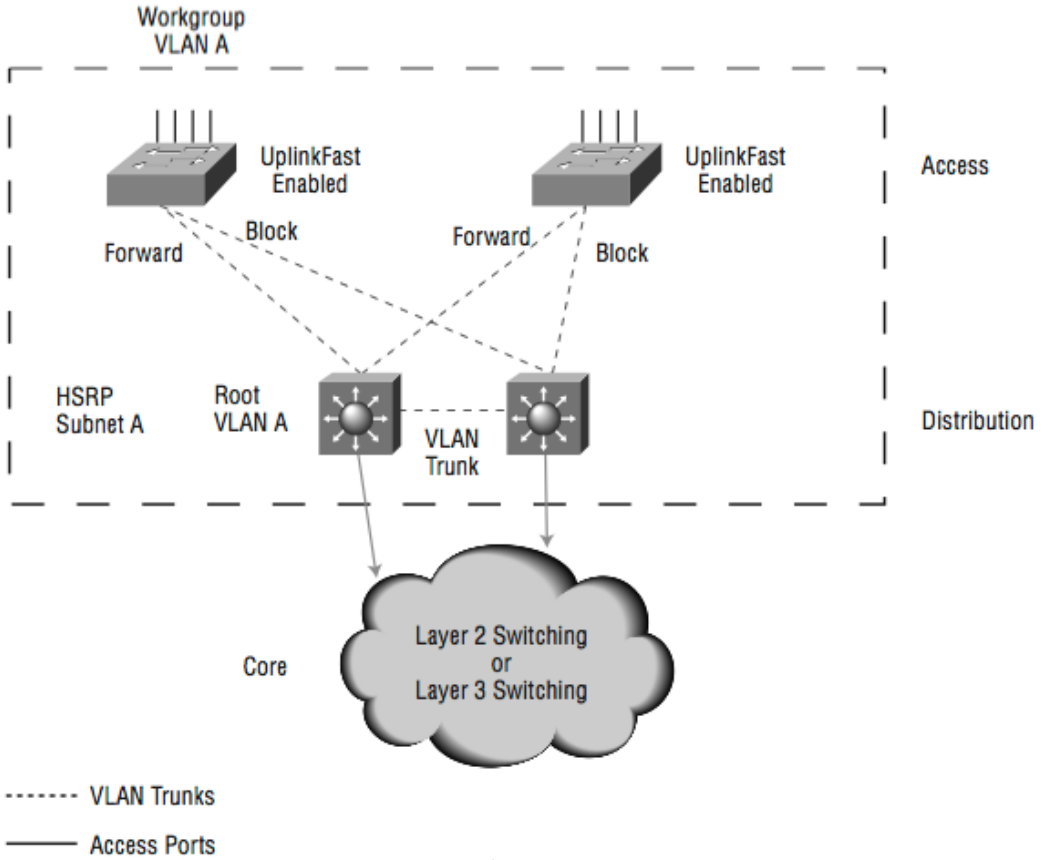
Scalling former solution …



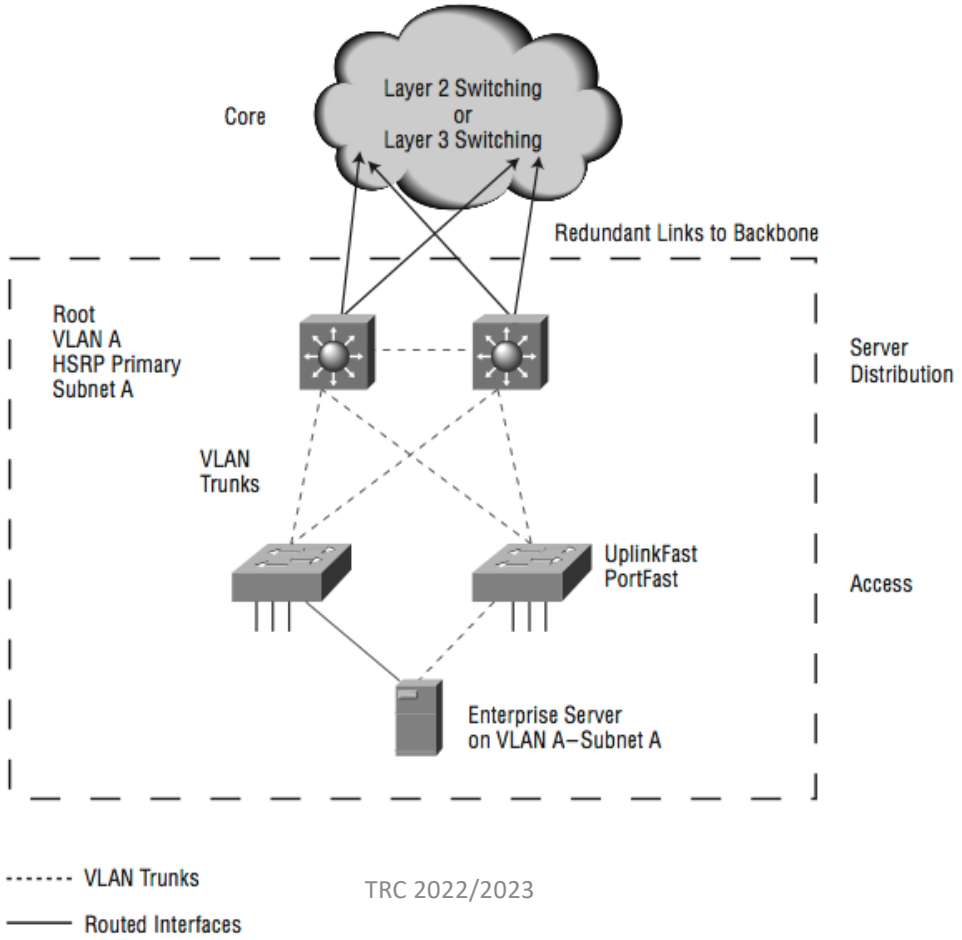
Placing a workgroup server



Extending VLANs outside cabinets



Redundância no servidor: Dual-homing



General tips about the network design process

- 64k x2 voz 2 M para video conf
- 20:1 e 4:1
- The scope of the failure domain should be reduced by restricting it to a single Layer 2 switch in one wiring closet if possible

- The gigabit uplinks from each wiring-closet switch connect directly to routed interfaces on Layer 3 switches
- achieve load balancing
  - the deployment of VLANs and VLAN trunking is restricted
  - To prevent spanning-tree protocol convergence events in the campus backbone, ensure that all links connecting backbone switches are routed links, not VLAN trunks

More info

- [Chapters 1 and 2] - A Practical Approach to Corporate Networks Engineering, António Nogueira, Paulo Salvador, River Publishers, ISBN-13: 978-8792982094, 2013.
- [Chapters 1 and 2] - Designing Cisco Network Service Architectures (ARCH), John Tiso, Cisco Press, ISBN-13: 978-1587142888, 3rd Edition, 2011.
- Cisco's White Paper, “Gigabit Campus Network Design Principles and Architecture”.

E é tudo...

- Questões?
- Comentários?