Scalable Networks

3-layer Hierarchical Design Model

The hierarchical design model consists of three layers:

- The core layer typically forms the WAN backbone. Existing as the center of the network, the core layer is designed to be fast and reliable. Access lists are avoided in the core because they add latency, or delay. Moreover, end users should not access the core directly. This layer is responsible for providing high-speed traffic forwarding. Core links should always be redundant to maximize reliability/availability.
- Marketed by Cisco as enterprise core routers, the 7000, 7200, and 7500 series routers feature the fastest switching modes available. The 12000 series router is also a core router, but it is designed to meet the core routing needs of Internet service providers.

- The distribution layer provides the primary functions of security, address aggregation and VLAN routing. The routers at this layer need fewer interfaces and less switching speed than their counterparts in the core because they should handle less traffic. They instead provide policy to the network through the use of a combination of access lists, route summarization, distribution lists, route maps, and other rules to define how a router should deal with traffic and routing updates.
- Cisco offers as modular distribution routers the 4000, 4500, and, most recently, the 3600 series router

- Access routers generally offer fewer physical interfaces than distribution and core routers. This layer accepts traffic into the network from both remote sites and end users.
- The common routers used at this layer are the ones we use in our labs at the school, the Cisco 2500 and 2600 series routers as well as the 1600 and 1700 series.

5 Characteristics of a Scalable Network

- **Reliable and available -** the network should be available 24/7. Fault tolerance and redundancy should be used to make outages and failures invisible to the end user. Redundant links provide fault tolerance by rerouting traffic when a link fails as well as providing for load balancing. Load balancing provides a way to distribute traffic across multiple links. The redundant links can be dedicated, or they can be DDR. DDR provide a very cost effective backup form of redundancy.
- **Responsive** - A responsive network should provide quality of service for various applications/protocols without affecting desktop response. The Cisco IOS addresses issues regarding priority and responsiveness queuing, queuing is the process a router uses to schedule packets for transmission during periods of congestion.

- **Efficient** - Large internetworks must optimize the use of resources, especially bandwidth. This can be achieved through the use of ACLs, snapshot routing and compression over WAN links. DDR, route summarization and incremental routing updates also improve efficiency. Snapshot routing allows distance-vector routers to exchange their complete tables during an initial connection, but then wait until active periods on the line before again exchanging routing information. This is important when the routers are connected via DDR. DDR provides a cost effective connection between routers. Routing table updates can be improved using route summarization and incremental routing updates. Routing summarization reduces the number of entries in a routing table by using one network address and mask to represent multiple networks or subnetworks. Routers exchange only changed routing information when incremental updates are being used.

- **Adaptable** - an adaptable network is capable of accommodating disparate protocols, applications, and hardware technologies. For example, non-routable protocols can be used with multiple routed and routing protocols.
- **Accessible but secure** - an accessible network allows for connections using dedicated, dialup, and switched services while maintaining network integrity. For example, using OSPF provides security because the routers can be required to authenticate prior to exchanging routing updates.