Study guide by ExamNotes.net

Exam 640-503

BSCN

Abstract

This ExamNotes Study Guide intends to provide you with information to prepare for the Cisco 640-503 Exam.

Before you start

This study guide provides you with information on the many different aspects of "Building scalable Cisco Network". Before you proceed with this subject, please read through the study material for the following and make sure you are 100% comfortable with the Routing technology:

- CCNA 1.0 and 2.0

You need the basic knowledge about Cisco Router as well as concepts of routing. It would be nice for you to have real experience with IOS. Use Router Simulator if you do not have access to real routers:

www.routersim.com

According to Cisco's published objective at this site, students must possess certain prerequisite skills using Cisco equipment:

- Working knowledge of the OSI reference model and the hierarchical model
- Understanding internetworking fundamentals
- Operating and configuring a Cisco IOS device
- Working knowledge of the TCP/IP stack and how to configure a routed protocol such as IP
- Understanding distance vector routing protocol operation and configuring RIP and IGRP

- Determining when to use static and default routes and enabling them on a Cisco router
- Displaying and interpreting a Cisco router routing table
- Enabling a WAN serial connection
- Configuring Frame Relay PVCs on interfaces and subinterfaces
- Configuring an IP standard and extended access list
- Verifying router configurations with available tools like show and debug commands

This study guide was written with Cisco's official documentation as the primary source of information. Do NOT rely solely on this study notes for the exam. By all means read more than one book on the subject and make sure you understand the material well enough so that you could be ready for the questions. There is no quick way to succeed for this topic. Ideally you must work things out and gain experience before even trying to sign up for the exam.

Another important thing to note is that this study guide was not written with the IOS commands in mind, as you can find much better coverage of all related IOS commands from Cisco's web site directly.

Your Study Track for BSCN

1, Make sure you are comfortable with TCP/IP. There are many tutorials for TCP/IP on the net, and additionally you are encouraged to visit 3com's tutorial on IP addressing at: http://www.3com.com/nsc/501302.html

For information on the OSI model, visit
http://www.rad.com/networks/1994/osi/intro.htm

2, Make sure you know the basic concept of Router configuration, Routing Protocol and IOS. To gain a better understanding, visit the following links:

The following links include tutorial on routing protocols:

http://www.nas.nasa.gov/Groups/LAN/ClassNotes/routing/allison/

http://www.nas.nasa.gov/Groups/LAN/ClassNotes/routing/cgw_greg/

http://www.rad.com/networks/1995/ospf/ospf.htm

Additional Suggested Readings from bookstore to build up your background in routing knowledge:

- Internet Routing Architectures -- Sam Halabi, Danny McPherson(Contributor); Hardcover
- CCIE Professional Development: Routing Tcp/Ip -- Jeff Doyle; Textbook Binding
- Internet Routing Architectures -- Bassam Halabi; Hardcover

- Advanced IP Routing in Cisco Networks by Terry Slattery, Bill Burton. Paperback (September 15, 2000)
- BGP4 Inter-Domain Routing in the Internet by John W. Stewart. Paperback (January 15, 1999)
- Cisco Tcp/Ip Routing Professional Reference (Technical Expert) by Chris Lewis. Paperback (June 9, 2000)

3, Know the 503 specific topics. According to Cisco (http://www.cisco.com/warp/public/10/wwtraining/cust/classes/C-TRN-BSCN.html), topics covered will include:

- Routing Principles
- Extending IP Addresses
- Configuring OSPF in a Single Area
- Interconnecting Multiple OSPF Areas
- Configuring EIGRP
- Configuring Basic Border Gateway Protocol
- Implementing BGP in Scalable Networks
- Optimizing Routing Update Operation
- Implementing Scalability Features in Your Internetwork
- Job Aides and Supplements
- Router Password Recovery

As you can see, there are many areas overlapped with CCNA. This study guide assumes that you already have the knowledge and skills regarding routing IP addressing and Routing protocols. We will have our focus on the scalability issues.

You may also find books on 503 from Amazon:

CCNP 2.0: Advanced Cisco Router Configuration, Exam 640-503
by Robert Myhre. Hardcover (December 22, 2000)

General

Scalable network

- A network that are experiencing constant growth
- A network that can be adjusted without major modification as time and resources require.
- A network that is flexible and expandable.
- typically designed with a hierarchical model that allows for controlled growth
- typical three-layer hierarchical internetworking model include: Core layer, Distribution layer and Access layer

Characteristics of "Scalable network"

- Reliable
- Available
- Responsive
- Efficient
- Adaptable
- Accessible
- Secure
- Scalable protocols such as Open Shortest Path First (OSPF), NetWare Link Services Protocol (NLSP), and Enhanced IGRP (EIGRP) provide: Reach ability, Fast convergence time and Congestion control
- Software tunnels provide communication across WAN links into network areas previously unreachable to provide availability and to eliminate the overhead associated with running an additional routing protocol over the link.

- Dial backup can increase availability when experiencing congestion
- End users should not experience delays in responsiveness as the network grows - Cisco IOS supports responsiveness on slow wide-area links with queuing.
- 3 forms of IOS queuing: weighted fair queuing (default), priority and custom queuing
- IOS Release 11.2 and later uses the following to make your network more responsive: Frame Relay Traffic Shaping, Generic Traffic Shaping and Random Early Detection

Core Layer

- provide services that optimize communication among routes at different sites
- routers need to provide maximum availability and reliability
- need a fault tolerant network design
- Cisco 7000 and 12000 series routers

Distribution Layer

- control access to resources that are available at the core layer
- efficient use of bandwidth is important
- routers should select the best path to different locations
- router must address the quality of service needs for different protocols
- use policy-based traffic control to isolate backbone and local environments
- Cisco 4000 series routers

Access Layer

- localize broadcasts and service requests to access media
- routers must not compromise network integrity
- routers should provide security and filtering
- Cisco 1000 and 2500 series routers

Traffic Optimization Measures

- Access lists to permit or deny protocol update traffic, data traffic, and broadcast traffic
- Snapshot routing to exchange full distance vector routing information upon initial connection, and then on a predefined interval, to reduce WAN costs
- Compression over WANs
- Dial-on-demand routing for connections of infrequent traffic flow
- Switched access enables nodes to share bandwidth by sending data in packets
- Reduce the number of routing table entries with Route summarization and Incremental updates

Top 5 factors to consider

- Network Topology
- Addressing and Route Summarization
- Route Selection
- Convergence
- Network Scalability
- Security

Routing Load Balancing

Different Routing protocols have different techniques for assigning metrics to individual networks as well as for forming metric aggregation. Some routing protocols can use multiple paths when paths have an unequal cost - load balancing.

In multiple path routing, the two most common mechanisms are per-packet load balancing and per-destination load balancing:

- Per-packet load balancing distributes packets across possible routes in a round-robin scheme.
- Per-destination load balancing distributes packets across possible routes based on destination to preserve packet order.

- When fast switching is enabled by default, route selection is on a per-destination basis. Otherwise, route selection is on a per-packet basis.

2 top factors of Network scalability

Operational issues

- More significant
- Encourage using large areas or protocols that do not require hierarchical structures

Technical issues

- More about hierarchical protocols
- Encourage using small areas

Resource Consumption

- Memory for storing routing tables and topology information.
- Route summarization cuts memory consumption.
- Keeping areas small reduces memory consumption only for hierarchical routing protocols.
- CPU usage is more or less protocol-dependent, while in general protocols that use CPU cycles to regenerate routing tables after a topology change consumes more CPU power.
- Keeping areas small and using summarization can reduce CPU power consumption
- Bandwidth usage is completely protocol-dependent.
- Periodic routing information updates are sent at regular intervals.
- Flash routing information updates are sent when a change occurs.
- Partial routing information updates contain only changed information.
- Flooded routing information updates are sent to all routers.
- Bounded routing information updates are sent to routers affected by a change.

EIGRP

- nonhierarchical topology
- automatically summarizes subnet routes
- you may configure route summarization at any interface with any bit boundary to allow ranges of networks to be summarized arbitrarily
- uses the same vector of metrics as IGRP, meaning there are separate metric values being assigned for bandwidth, delay, reliability, and load
- computes metric for a route by using the minimum bandwidth of each hop in the path, plus the media-specific delay for each hop
- metric of the best route in the summary is used as the metric for the summary

DUAL

- convergence algorithm
- short for Diffusing Update Algorithm
- each EIGRP router stores its neighbors' routing tables to allow the router to use a new route to a destination instantly if another feasible route is known
- routers not affected by a topology change do not need to be involved in the query and response
- receives full routing tables from its neighbors when it first communicates. Subsequently only changes to the routing tables are sent to routers that are affected.
- routing table keeps a list of computed costs of reaching networks and topology table keeps a list of all routes advertised by neighbors, meaning each router can keep the real cost
- during failure convergence is instant when there is a feasible successor - a neighbor that meets the feasibility condition set by DUAL

Scalability

- automatic route aggregation bounds the routing table growth naturally to conserve memory
- DUAL recomputes only routes that are affected, thus saving CPU power
- partial updates ensure efficient bandwidth usage

OSPF

- distributes routing information between routers of a single autonomous system AS
- based on link-state technology
- critically factor to a successful OSPF implementation include definition of area boundaries and address assignment
- works best in hierarchical routing environment
- restrict the number of routers in an area to no more than 50 routers to conserve CPU power
- restrict the router to have no more than 60 neighbors, since OSPF floods all link-state changes to all routers in an area, and that routers with many neighbors will have huge workload
- use routers that are not heavily loaded to be the designated router and backup designated router
- do not select the same router to be the designated router on many LANs simultaneously
- backbones must be contiguous, meaning all backbone routers should be directly connected to other backbone routers.
- virtual link creates a path between two area border routers not directly connected, and can be used to heal a partitioned backbone, although not recommended
- do not place hosts in backbone area to simplify future expansion

Areas

- individual areas must be contiguous, meaning there should be a continuous path tracable from any router in an area to any other router in the same area
- areas should have a contiguous set of address space to implement route summarization. At the same time, try to create an address space that permit you to split areas easily as the network grows
- four potential types of routing information in an area include: Default, Intra-area routes, Interarea routes and External routes
- three types of areas include: Nonstub areas, Stub areas and Stub areas without summaries
- consider physical proximity when you define areas
- reduce the maximum size of areas if you find the links unstable

Addressing options

- Separate network numbers for each area
- NIC authorized address areas created using bitwise subnetting and VLSM
- Private addressing with DMZ buffer to the official Internet world

Route Summarization and Selection

- occurs in the area border routers
- can summarize on any bit boundary in a network or subnet address because of VLSM support
- requires manual summarization
- Route Selection can be influenced by tuning the OSPF Metrics or controlling Interarea Traffic
- If area border routers inject only the default route, traffic will go to the area border router closest to the source of the traffic, which is desirable as the backbone typically has higher bandwidth lines available
- Sometimes you may want to have the traffic to use the area border router nearest to the destination so to keep the traffic to leave the area as late as possible. To do this the area border routers should inject summaries into the area instead of just injecting the default route
- if equal-cost paths exist between nodes, Cisco routers automatically load balance, with a max of four equal-cost paths for one destination, either on a per-destination or a per-packet basis, with per-destination load balancing as the default

Convergence

- 2 mechanisms to detect topology changes: Interface status changes and dead timer
- when a dead timer expires, the router assumes the neighbor is down. The dead configure the dead timer using the ip ospf dead-interval interface configuration command
- dead timer has a default of 40 seconds for broadcast networks and two minutes for nonbroadcast networks
- routers recalculate all routes using the Dykstra or SPF algorithm, with the time of running the algorithm determined by a combination of area size and number of routes

Scalability

- summarization and stub areas can reduce memory use
- keep areas small and use summarization to reduce CPU use
- OSPF uses partial updates that minimizes bandwidth used

On Demand Circuit

- enhancement to OSPF
- allows efficient operation over on-demand circuits like ISDN, X.25 SVCs, and dial-up lines
- periodic Hellos are suppressed
- periodic refreshes of LSAs are not flooded over demand circuits
- Hellos and LSAs are transferred only upon initial setup and when there is a change in the topology
- save connection cost
- useful in a setup where you want to have an OSPF backbone at the central site and you want to connect telecommuters or branches to the central site
- to take full advantage, every router in the area must load on demand circuit
- not useful for broadcast-based network topology as Hellos cannot be successfully suppressed anyway

NBMA networks

- support more than two routers
- no broadcasting
- neighboring routers are maintained using OSPF's Hello Protocol
- need additional configuration information to aid in the discovery of neighbors
- runs in one of two modes: non-broadcast multiaccess or point-to-multipoint

BGP

- routers belonging to the same AS and exchange BGP updates are running internal BGP IBGP
- routers belonging to different ASs and exchange BGP updates are running external BGP EBGP
- before information exchanges, BGP ensures that networks within the same AS are reachable by a combination of internal BGP peering among routers within the AS and by redistributing BGP routing information to Interior Gateway Protocols in the same AS
- uses TCP as its transport protocol in port 179
- initially exchange full BGP routing tables
- peers send only incremental updates, given the requirement that within an AS router must establish a peer relationship with one another
- when a router receives an update from other routers in its own AS via IBGP, the receiving BGP router uses EBGP to forward the update to external BGP routers
- loopback interfaces are often used by IBGP peers to eliminate dependency occurred when you use the IP address of a physical interface to configure BGP. Note that loopback interfaces are rarely used between EBGP peers
- disabling Synchronization might allow BGP to converge more quickly at the expense of dropped transit packets. Do this when your AS does not pass traffic from one AS to another, or that all transit routers run BGP.
- route maps are used to control and modify routing information and to define the conditions by which routes are redistributed between routing domains
- match command specifies a criteria that must be matched
- set command specifies an action to be taken if the routing update meets the condition defined by the match command
- to advertise networks, you use the network router configuration command. To specify the networks that the AS originates.
- attributes BGP uses in the decision-making process include the AS_path Attribute, the Origin Attribute, the Next Hop Attribute, the Weight Attribute, the Local Preference Attribute, the Multi-Exit Discriminator Attribute and the Community Attribute
- BGP version 4 supports classless interdomain routing to eliminate the concept of classes and to aggregate routes