CSCI 7000-010 – Network Management and Automation

Lab 10

Network Design Group Project

University of Colorado Boulder

Department of Computer Science

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Week 1 – Network Design

Summary

Network design involves evaluating and scoping the network to be implemented. The entire design could be considered as a blueprint for implementing the network physically and logically. Planning is an integral part of the network design process, and includes the essential requirement gathering phase that enables the Network Engineer to design the network as per customer needs.

Organization Information

A renowned Tier 2 ISP called WDTC Inc. is planning to expand its footprint in the central US. The investors and the board of directors have selected Denver, Colorado as the location due to the large number of Tier 3 ISPs, and to leverage fresh talent from CU Boulder that would ultimately bring in enormous profits to the company in coming years.

Being a Principle Network Architect for a renowned company called Barista Networks, the planning team at WDTC Inc. has approached you and your team to design the network for their upcoming site at Denver, and present a detailed proposal to win the bid for this implementation contract. You will work with your assigned teammates at Barista Networks to develop a network design proposal and present it in front of the higher management of WDTC Inc.

Network Requirements/Information:

Use the following information provided to create your network design proposal.

The network requirements/information gathered after talking to the planning team at WDTC Inc. are:

1. WDTC Inc. already has offices at three sites:
   1. Las Vegas, Nevada
   2. Los Angeles, California
   3. Phoenix, Arizona

(Do not design the network for these three sites. You can have a high level representation of these sites in your proposal.)

WDTC is planning to serve 10 small Tier 3 ISPs in the Colorado Region. The number of expected hosts (employee workstations, IP Phone, Servers, Printers, etc.) at each Tier 3 ISP are 1027, 2078, 654, 6498, 76, 196, 876, 5989, 46, 63 respectively.

Assume any Public IP space of your choice for WDTC Inc, and carefully allocate the IPs from this space to them (T3 ISPs) with minimum wastage. (Do not design the network for the T3 ISPs unless specified.)

1. The backbone network of the Denver Site is required to have the following:
   1. 10 Routers – of which 4 are Edge, 2 are Core and the remaining are Internal, and any number of switches. Determine which model of routers/switches would be required in each case and the protocol that will be running inside the backbone network. (Label the devices in your proposal diagram).
   2. WDTC is a customer of the Tier 1 ISP called Level 4 and should have an external session with it in the Denver site. The two companies need to communicate with each other through edge devices.
   3. Due to the growing demand for virtualization, WDTC Inc. has acquired a cloud company named Savvis Cloud, and they want to have the VoIP network for the Denver site hosted in the cloud. Ensure high availability and redundancy for the VoIP network.
   4. WDTC Inc. needs to construct a data center at the Denver location with the following devices/capabilities:

* Physical Servers (Memory, Storage, Quantity)
* Efficient routing capabilities
* Cloud Orchestration technology. Justify the reason for choosing one over other in your design report.
* Storage networks (SAN/NAS etc.) (Optional)
* High availability/ Fault Tolerance

(You can design a private cloud or host the Data Center services on any public cloud. Also, you can include the Data Center design in your main diagram or have it as a separate section).

* 1. A centralized network management system and deployment unit that will be used for managing the entire Denver site.
  2. With SDN on the rise, WDTC Inc. has decided to propose SDN for two of its customers (Tier 3 ISP1 and Tier 3 ISP2) as a proof of concept project (POC) design. Depict any one customer site using SDN as the core networking solution.
  3. While you are working on the network design, it is announced that WDTC will be getting merged with another ISP Tomcast who are using the same private IP space as WDTC. You have to come up with a solution that takes this into consideration and connects the two same IP spaces over the Internet.

1. Network security is an important aspect of network design as it defines the organization’s strategy to secure their assets and network traffic. One of WDTC Inc.’s sites at Las Vegas was hit by a major DDOS attack from a Russian hacker, which affected many of its customers on the west coast. Since the majority of the Denver customers (T3 ISPs’) are financial institutions, the management team needs a secure solution for this site. Make sure you propose a solution considering these security parameters:

* Types of Firewalls/Proxies
* ACL’s
* DMZ design
* SSL/any other encryption technique
* Load Balancing

1. Also, there are other players like Isco technologies, Juneepur networks, etc. who have submitted their bid to WDTC Inc. Along with the technical considerations, it is important to take the CapEx/OpEx into account, so that you can win the contract. This deal would be very profitable to Barista Networks in case you manage to achieve this, as Barista Networks would also receive a 10 year AMC (Annual Maintenance Contract) from them. Define a cost-effective solution and prepare an inventory list of the network gear along with the unit price/quantity required and calculate the final amount to achieve this task.
2. Provide a timeline required for your proposed network design to be implemented.

Week 1 - Final Deliverables

* Network Design Diagram (can be on any software)
* Design Report (3-4 pages summarizing the design)
* Inventory List (spreadsheet consisting of network gear required and cost)
* Group Presentation Slides.

Grading

The group’s network design will be graded on the following criteria:

* General design completeness (meeting requirements and thinking outside of the box)
* Scalability
* Reliability
* Complexity
* Presentation

Week 2 – Proof of Concept (PoC)

Summary

The final step in the network design process is to implement a Proof of Concept (PoC). The objective of the Proof of Concept (PoC) is to extrapolate from the network design created during week-1 and encourage the team to come up with a working solution which incorporates technologies and libraries learned during the Network Management coursework.

WDTC is planning to add another data center at Boulder which connects to the Denver data center over the Internet. You must demonstrate the configuration, management and monitoring of the new data center devices using routers in GNS3. Use the knowledge you have gained so far from all the lectures and labs to design and demonstrate an automation plan to configure network devices in GNS3 and to automate their connectivity with each other and the other WDTC Inc. site. In addition, the PoC must also incorporate an automated solution for the management and monitoring of these devices. Please ensure that you do not use more than 30 devices to represent the WDTC Inc. site and the new data center devices for this PoC.

The PoC is composed of two parts: Presentation and Report.

Topics

Topics for the PoC should be related to Network Management and can include topics discussed in class lectures and labs. See below for a list of recommended topics that can be incorporated in the POC implementation.

Report

The first page of the report should contain an executive summary explaining the approach and the PoC. The remainder of the report should explain the implementation in detail along with the topology, code outputs, and the results.

Recommended Topics

You can choose from the recommended topics listed below. Topologies from this course or other courses cannot be re-used. This will be considered plagiarism. However, reuse of code and building upon the existing code from previous labs is permitted.

* SNMP
* DHCPv4/DHCPv6
* Scapy
* Netmiko
* Napalm
* NETCONF/NETCONF-YANG
* Ansible-YAML-Jinja2
* ZTP
* Migration
* Database
* Monitoring – Wireshark/Tcpdump
* GUI

Week 2 - Final Deliverables

* Proof of Concept Topology Diagram
* Implementation Report
* Python codes and configuration files used in PoC
* Demo video.

Grading

The PoC Implementation will be graded on the following criteria:

* Applicability
* Novelty
* Scalability
* Reliability
* Complexity

Extra Credit 1

Extra credit will be awarded if the PoC incorporates topics/technologies which are not covered in the Network Management coursework.

Extra Credit 2

Extra credit will be awarded to the top three presentation teams. The top presentations will receive extra credit applied to their final grade.