TLEN 5462 - Advanced Telecommunication Lab - Midterm Practical Exam

Fall 2018

Episode VIII.3.0

THE RENOVATION ENDS

In its determination to squelch the Rebel Alliance and assert control of the galaxy, the Galactic Empire nears completion of its unprecedented new weapon: The Death Star. Only shaped like a cube. With lasers. And disproportionately filled by a sprawling, noisy HVAC system seemingly intended to replicate the environment of planet Hoth...but that's beside the point...

The Emperor has convened a crack squad of Imperial Network Engineers to finalize the Death Star ("DSv4") communications systems to maximize redundancy and allow the whole battle-station to be controlled from the safety his Command Ship. His crony advisors and systems architects have recommended a network "design" that they believe is robust enough to thwart any Rebel attack.

To ensure the engineer’s work is completed to the highest standards, the Emperor has dispatched his chief proxy, the insidious Darth Mesh, dark lord of the Sith and Craigslist, to oversee the final stages of development. Owing mostly to his extreme cheapness, Darth Mesh is requiring the network infrastructure to be assembled entirely from equipment salvaged from the wreck of the previous Death Star.

Interconnected Layer-2 devices will be positioned at each vertex of the DSv4, with the navigation system, laser-firing controls, and Spacebook server (all Linux-based) housed near the battle-station's core, where the power generator used to be, before being displaced by the HVAC. Most crucial of all, the outbound communications will be multiplexed into the DSv4's hyper-laser, so that enemies will be unable to differentiate an attack from an ARP request.

The only thing capable of converting the hyper-laser signal into meaningful, non-annihilation-based communication is a specially modified Star Destroyer acting as relay using BGP.

The Rebel Alliance, led by whichever heroic princess character Disney tosses into the mix, has learned of the Emperor's plan and seeks to infiltrate the Empire's communications network, steal the technical plans for the Death Star, and put an end to the nonsense once and for all.

The team with most robust and efficient death star communication system design will be awarded highest rank in United Federation of planets by the Dark Lord of Sith and Craigslist the Darth Mesh. The analysis on efficiency and robustness is based on the analysis made by the Lord himself.

Instructions:

**Reports:**

One written report per group, submitted to the class D2L Dropbox. Submissions shall depict the configuration of network devices, explanations for choices of any algorithms/protocols used, justifications for any proposed or implemented changes to the given network design, with topological diagrams to reflect any creative decisions. Groups do not need to submit screenshots of every configuration, but you will need to provide verification of the objective results. Midterm reports should not exceed 15 pages.

**Practical Exam Grading:**

▪ 70% - Services operational w/o QoS or high availability (HA)

▪ 75% - Server Services operational with network HA

▪ 80% - Server Services Operational with Authentication and network HA.

▪ 85% - Network HA, Authentication and QoS

▪ 90% - Network HA, Authentication, QoS and Single Site Server HA

▪ 95% - Network HA, Authentication, QoS and Multi-Site Server HA

▪ 100% - Minimal packet drop

**▪ Extra Credit:**

Measures taken to improve security are encouraged. Find a method to run tunneling between a user's system and the virtual machines in order for these devices to operate as a private overlay network, analogous to the functionality VXLAN.

Constraints

**I. Core**

(1) All network devices must be labeled according to the architectural diagram.

(2) The load balancing solution may be any of the following:

(a) Layer-2 Brocade SLB

(b) Layer-3 Brocade SLB

(c) BGP Load Balancing

(d) Whatever Darth Mesh is in the mood for.

(3) The load balancers can be relocated from their position on the diagram according to HA design proposed by each team.

**II. Death Star ("DSv4")**

1. Death Star only understands Massive.Activity.Control (MAC) Vehicles.

1. Due to the size and cheapness of the Death Star, all links operate at 10 Mb/s, unless specified otherwise on the architectural diagram.
2. Of the Cube's eight switches, no less than four of them shall be Arista 7050Q. Submit a diagram to show the outcome of the Spanning Tree method used.
3. A RADIUS server is required in the DSv4's topology, but no final decision about its location in the network has been made.
4. All devices not part of the DSv4's dedicated Cube network must be subject to authentication before gaining access to the network.
5. Operations:
   1. Systems used by Imperial staff on the DSv4 are guaranteed for at least 3.5 Mb/s, accessed directly through the switch fabric, when no other congestion is present.
   2. Connected systems receive addresses from vlan DHCP pool 172.48.64.0/22.
6. Server management:
   1. The ESXi servers will host at least three virtual Linux-based services.
   2. The SLAs should reflect the highest priority to the Command Ship's access to the hyper-laser firing control system.
   3. All server systems should achieve fault-tolerance, using vMotion and centralized storage.
   4. Load-balancing shall be used to ensure uniform distribution of server resources and mitigate the risk of a Rebel DoS-style attack.
   5. The location of load-balancers is upon network designer.
7. The routing connection to the Relays will need to act as a single gateway but be fully redundant while propagating BGP routes. Authentication is required between the routers. Each should connect to at least one Cube switch.

**III. Star Destroyers**

1. You will have 2 start destroyers in your topology
2. All interfaces on Relay1 communicate my encoding data onto laser beams. All interfaces on Relay2 communicate my encoding data using copper quantum technology.
3. The management of the relay is not directly overseen by the Emperor, so you may use any Layer-3 switching device of your choosing.
4. The Relays are part of the BGP route, but together act as a distinctive autonomous system.
5. Any connection to the Internet must occur through the Relay.
6. The traffic across the laser connection to the DSv4 should be weighted/distributed evenly between the NE, NW, SE, SW dsR's.

**IV. Command Ship**

1. The Emperor's Command System must have highest-priority management access to the Death Star's firing control, with a guaranteed 16 Mb/s bandwidth, and must be a physical machine capable of accessing everything management-related.
2. The Emperor's Command System must be able to send messages to PC-3, but PC-1 & PC-2 may not communicate with the Command System.
3. Imperial officers expect the capability to hold holographic video conferencing between the Command Ship and DSv4, which will require a minimal latency and bandwidth of 7.5 Mb/s for 6 hours each day, with 70% assurance outside of this period and must not conflict with the Emperor's command system access.
4. Secondary user systems may need to be hosted virtually.
5. While the ship's edge router is required to communicate with the Relay via laser beam, the internal network routes are already established using OSPF.
6. To honor the United Federation of Planets, the Emperor wants to keep the same hierarchy in end-to-end communication system`s allocated speeds for PC-1, PC-2 and PC-3. PC-1 should be awarded highest honor by giving higher priority on the communication system of 5 Mb/s, PC-2 should have 3 Mb/s and PC-3 with 2 Mb/s. The Emperor wants you to strictly abide by this ruling.

**V. SAN**

1. The Emperor wants the teams to configure multipath such that the two datastores are accessed by different laser links from the Initiator when both of the laser guns are working.
2. If one of the laser gun stops working, the Initiator should access both the Targets from the working laser gun.
3. Each team should secure their LUNs against attacks from other teams as well as attacks from Darth Mesh.
4. If an Initiator has no path to reach the Target then all the three virtual Linux-based services on that Initiator should shift to the other Initiator which still has Target connectivity.
5. The Emperor wants one of his services to have a direct attached LUN which allows the data to be stored directly on the LUN ( Not through ESXi )

Note: The ESXi Cluster part in the diagram is for reference. Students can tweak the ESXi network design and setup as per their requirement to make the network and services highly available along with maintaining the parameters of robustness and efficiency. Death Star Cube however cannot be touched.

