Technical Details for Implementation of Kamehameha Institute's Network

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Site Details and Challenges

There are two major challenges that are described in the scenario. The first challenge is addressing, Kamehameha Institute (K.I.) is a large school with three locations on different islands. They want their network to have enough network addresses to be able to grow without issue and large enough to accommodate at least two subnets, one for Management and one for Production. The second challenge is to ensure that network design is flexible. K.I. has large networks in different locations and with a need for all devices to communicate with each other while maintaining peak performance and redundancy in case hardware goes down.

Site Solution(s) and Technologies

The approach to the network addressing challenge was based on having a network that can be divided easily with plenty of room to grow. By going with the private address of 172.16.0.0 and a subnet mask of 255.255.252.0, each subnet on the network would have 1,022 hosts available for use (Keenetic, 2021). The plan is to provide two Virtual Local Area Networks (VLANs) with three subnets each. Each location would have a subnet available for use with each VLAN. For example, Honolulu would have two subnets, 172.16.4.0 for Management and 172.16.16.0 for Production. This would allow for the minimum 300 machines to connect to the Management VLAN and allow for future growth. Network addressing is also the greatest challenge. A simple misconfigured port could mean that some workstations will not communicate or will end up with an IP address that is not part of the VLAN.

I decided to go with a three-tier spine-and-leaf architecture for the challenge of a large network that can communicate efficiently and with redundancy built in. A three-tier spin-and-leaf architecture will allow for the consistently short paths between workstations by creating a fully meshed topology (TestOut, 2021).

Sample Configuration

In Figure 1, you will see the current three-tier spine-and-leaf architecture for Kamehameha Institute. All devices are communicating with each other, and in the event a piece of hardware goes down there are ample alternative pathways that the data can take to get to the destination host. The design also implements a firewall and cloud services so that all three locations can communicate with each other and the internet, despite being on separate islands.

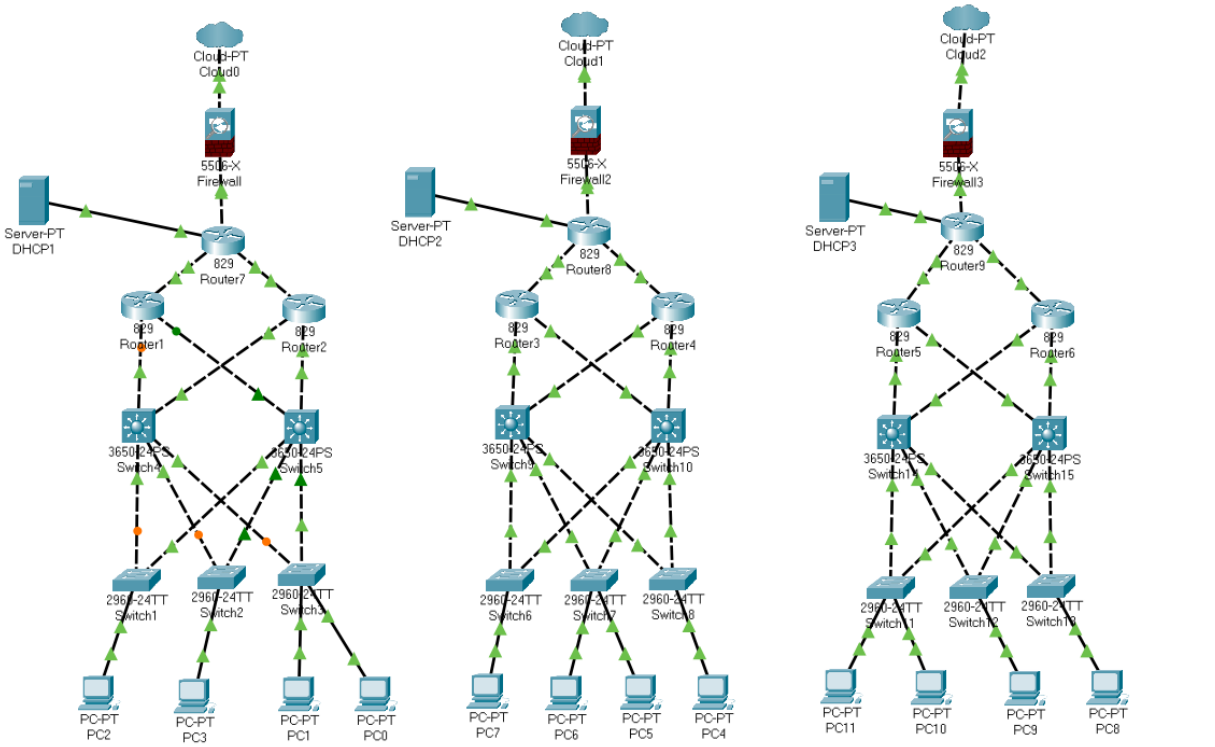
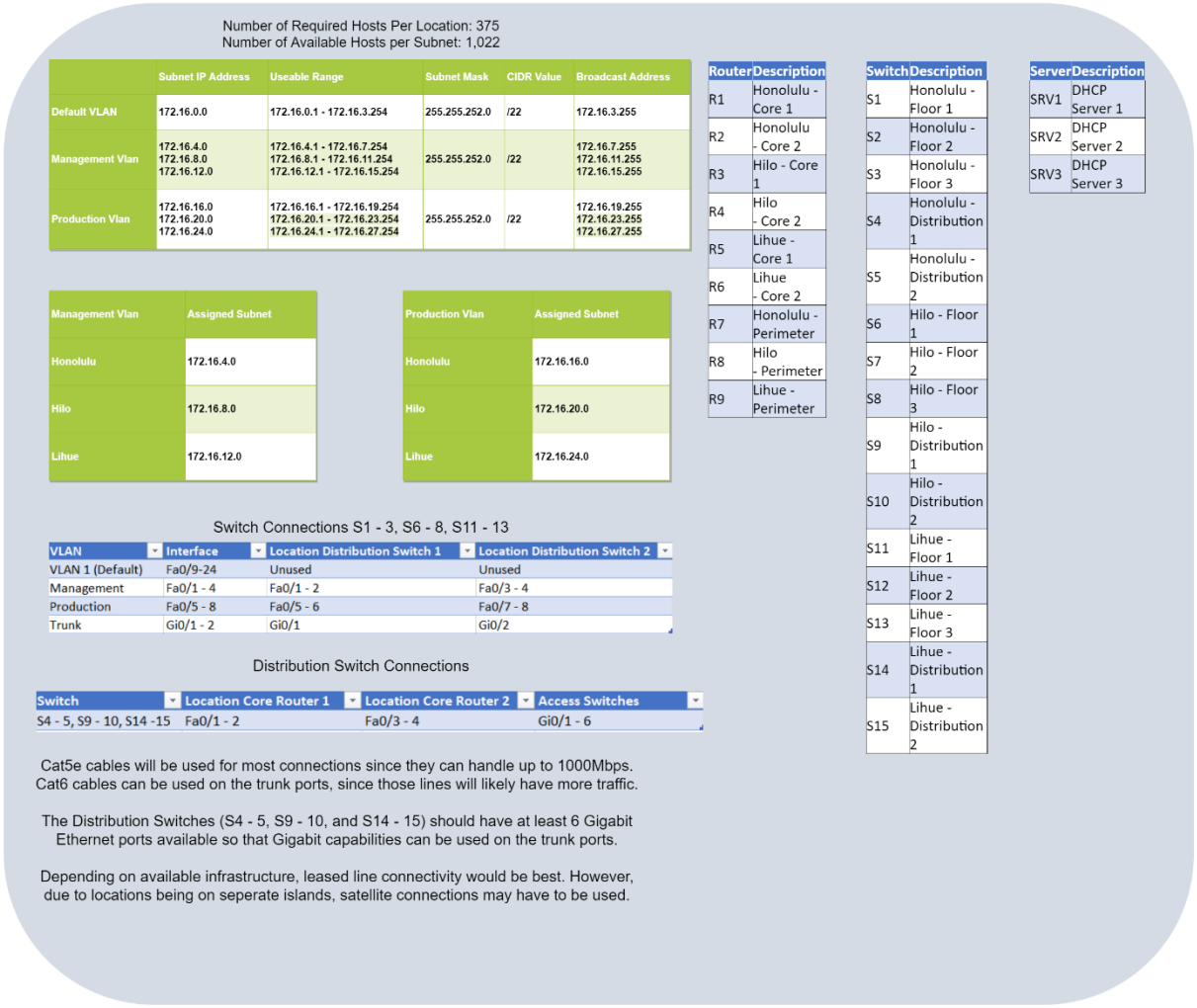


Figure 1: Three-Tier Spine-and-Leaf Architecture for Kamehameha Institute

Supporting Tables/Diagrams

Figure 2 shows charts with the subnets and VLANs and how they will be implemented across all three sites. The port configurations for access and trunk are annotated as well as cable type.



Number of Required Hosts Per Location: 375
Number of Available Hosts per Subnet: 1,022

	Subnet IP Address	Useable Range	Subnet Mask	CIDR Value	Broadcast Address
Default VLAN	172.16.0.0	172.16.0.1 - 172.16.3.254	255.255.252.0	/22	172.16.3.255
Management Vlan	172.16.4.0 172.16.8.0 172.16.12.0	172.16.4.1 - 172.16.7.254 172.16.8.1 - 172.16.11.254 172.16.12.1 - 172.16.15.254	255.255.252.0	/22	172.16.7.255 172.16.11.255 172.16.15.255
Production Vlan	172.16.16.0 172.16.20.0 172.16.24.0	172.16.16.1 - 172.16.19.254 172.16.20.1 - 172.16.23.254 172.16.24.1 - 172.16.27.254	255.255.252.0	/22	172.16.19.255 172.16.23.255 172.16.27.255

Management Vlan	Assigned Subnet
Honolulu	172.16.4.0
Hilo	172.16.8.0
Lihue	172.16.12.0

Production Vlan	Assigned Subnet
Honolulu	172.16.16.0
Hilo	172.16.20.0
Lihue	172.16.24.0

Router	Description
R1	Honolulu - Core 1
R2	Honolulu - Core 2
R3	Hilo - Core 1
R4	Hilo - Core 2
R5	Lihue - Core 1
R6	Lihue - Core 2
R7	Honolulu - Perimeter
R8	Hilo - Perimeter
R9	Lihue - Perimeter

Switch	Description
S1	Honolulu - Floor 1
S2	Honolulu - Floor 2
S3	Honolulu - Floor 3
S4	Honolulu - Distribution 1
S5	Honolulu - Distribution 2
S6	Hilo - Floor 1
S7	Hilo - Floor 2
S8	Hilo - Floor 3
S9	Hilo - Distribution 1
S10	Hilo - Distribution 2
S11	Lihue - Floor 1
S12	Lihue - Floor 2
S13	Lihue - Floor 3
S14	Lihue - Distribution 1
S15	Lihue - Distribution 2

Server	Description
SRV1	DHCP Server 1
SRV2	DHCP Server 2
SRV3	DHCP Server 3

Switch Connections S1 - 3, S6 - 8, S11 - 13

VLAN	Interface	Location Distribution Switch 1	Location Distribution Switch 2
VLAN 1 (Default)	Fa0/9-24	Unused	Unused
Management	Fa0/1 - 4	Fa0/1 - 2	Fa0/3 - 4
Production	Fa0/5 - 8	Fa0/5 - 6	Fa0/7 - 8
Trunk	Gi0/1 - 2	Gi0/1	Gi0/2

Distribution Switch Connections

Switch	Location Core Router 1	Location Core Router 2	Access Switches
S4 - 5, S9 - 10, S14 -15	Fa0/1 - 2	Fa0/3 - 4	Gi0/1 - 6

Cat5e cables will be used for most connections since they can handle up to 1000Mbps. Cat6 cables can be used on the trunk ports, since those lines will likely have more traffic.

The Distribution Switches (S4 - 5, S9 - 10, and S14 - 15) should have at least 6 Gigabit Ethernet ports available so that Gigabit capabilities can be used on the trunk ports.

Depending on available infrastructure, leased line connectivity would be best. However, due to locations being on seperate islands, satellite connections may have to be used.

Figure 2 Subnet, VLAN, and Port Configurations

V. References

Keenetic. (2021, February 25). *What is the difference between a public and private IP address?* Retrieved from Keenetic: https://help.keenetic.com/hc/en-us/articles/213965789-What-is-the-difference-between-a-public-and-private-IP-address-

TestOut. (2021, May 3). *Switch Architecture Facts*. Retrieved from TestOut: https://labsimapp.testout.com/v6_0_444/index.html/productviewer/1185/5.1.2