	Research Paper	Engineering
PARIPET	Automation and Analysis of Enterpri Network Design	se Campus

Tus Yai	Iushar KrishnaSchool of Electronics Engineering Vellore Institute of TechnolYarathaVellore, India				
Archisman Banerjee		School of Electronics Engineering Vellore Institute of Technology Vellore, India			
Arun M		School of Electronics Engineering Vellore Institute of Technology Vellore, India			
ст	Internet is the need of the hour these days. Every enterprise has to be connected to the internet 24*7 to optimize its performance. However with the growing demand for internet, ensuring connectivity is becoming a major challenge and concern these days. A flat enterprise network is the one where all the PCs, servers and IP Phones are connected to a single switch. A flat network				

does not also have subnets. All devices on the subnet are on the same broadcast domain. This adds to a lot of network congestion. Therefore, we employ a hierarchical network design.

The network design has to be scalable and redundant as well. The objective of this project is to design an industry standard hierarchical layout of a campus networking topology using various routing and switching protocols like OSPF, BGP, EIGRP, STP, HSRP, VTP, etc. in accordance to customer/enterprise requirements. Few tedious tasks need to be automated in a network. This was done using various tools.

OSPF, EIGRP, Embedded Event Manager, Network Architecture, GNS3

## Introduction

A flat enterprise network is the one where all the PCs, servers and IP Phones are connected to a single switch. A flat network does not also have subnets. All devices on the subnet are on the same broadcast domain. This adds to a lot of network congestion. Therefore, we employ a hierarchical network design. The objective of this project is to design a hierarchical layout of a campus networking topology. Some of the analysis which is done on this network design can be automated. This automation will be useful in making the monotonous analysis of networks easier.

## Design

In GNS3, we have simulated a flat topology using 5 hosts and a switch. They are in the same broadcast domain. The image of the flat topology is appended below in Fig1.



# Fig1. Flat Topology

The hierarchical topology has been configured with a 3 layer topology. The three layers are Core, Distribution and Access Layers. The Core and Distribution Layers have routers. While,

the access layer has switches. The broadcast domains are neatly segregated in this type of design. The image of the Hierarchical Network Design is appended below in Fig2.



Fig2. Hierarchical Topology

**IMPLEMENTATION AND OBSERVATIONS** In the flat topology, the network congestion was observed to be really high. Fig3 proves the same.



Fig3. Packets/s in flat topology

The average Round Trip Time(RTT) was observed to be 38 ms. The packets/s were observed to be 560 approximately. This is quite a lot of traffic and the congestion might sometimes cause undesirable consequences.

In the implementation of the hierarchical network topology, various protocols such as VLAN Trunking Protocol (VTP), Dynamic Host Configuration Protocol (DHCP), Open State Path First (OSPF), Network Address Translation (NAT), Virtual Router Redundancy Protocol (VRRP) and Border Gateway Protocol (BGP) were used. The network congestion was observed to be a lot lesser in this topology. Fig4 proves the same. The network congestion was observed to be approximately 180 packets/s. The Round Trip Time (RTT) was observed to be 33 ms.



Fig4. Packets/s in hierarchical topology

Few additional features such as syslog, Embedded Event Manager (EEM), Role Based CLI Access and Tool Code Language (TCL) were tested in the hierarchical topology of the network.

Syslog is a method to collect messages from devices to a server running a syslog daemon. Logging to a central syslog server helps in aggregation of logs and alerts. A SYSLOG service simply accepts messages, and stores them in files or prints them. We have used KIWI Syslog Server for this purpose.



Fig5. Network Topology with Syslog Server

Data in the	Park	Distant.	hear	
4.84 48	A local links		In the Control and the second as in the Control and Annual Annual State	
	A Local Index	10.0011	IN THE VALUE AND THE OWNERS AND AND AND AND ADDRESS AND ADDRESS ADDRES ADDRESS ADDRESS	
	A Local Dates	1010010	it for 1997 \$180 OF observed as 19 W11 as \$10011, being \$10, but heads	
	A local balance	10.0011	IT NOT THE PART OF THE REPORT OF THE REPORT OF THE PART OF THE PAR	
	C. Land Dates	10.001	A Tex TANF S.M. (INF out-out-out as TAT NOT AN A STATE STATE AND A STATE STATE AND A STATE	
	in land these	10.0011	16 No. 1 INTERNAL INTRADUCT. I Comparison courts to courts	
	A land links	The second second	to the 100 kills of the second as 10 kills as it will be a second to 1 key and	
	A Local Dates	10,000.04	10 No 10 KULD OF object a 10 KULD ( KNO L being NU, but had)	
6.00 100	A Local Dates	100108-04	18 To 1998 111 IN objected a 1998 11 of 8 1814 table \$10 bord and	
	A Local Dates	10,000.00	18 No. 1 COMPANY OF AN ADVANCE AND ADVANCE AND ADVANCE AND ADVANCED ADVANCES.	
6.00 ISA	A Local Dates	100100-014	18 Yes 1 19 KI 198 199 offendered as 10 KI 1, as 8 KI 1, being MI, bus 1 and	
	F Local Balance	10,000.00	12 No. 1 HOME IN MICH (MIC) Collapsifies much branch	
A	<ul> <li>Local Index</li> </ul>	100108-0.0	In the 1 Hard In the second as 10 Million 20 Million and 201 Australia	
	i land being	10,000.0	10 No. 1 10 King Str. (SP. roke-roke-rol, as 10 King and 1, having Str., for Faculty	
A. ANS. 19.01	I have been	101108-1-1	If he have been and a first with a first sector with the sector of	
	E Local Dates	101100-011	A TAY TO REAL TO REAL PROPERTY AND A DESCRIPTION OF A DES	
	# Local Dates	101103-1-1	IS No. 110 KIND OF the second of WIRLLAND WILLIAMS WILLIAMS WILLIAMS	
	a local data	100000	It has I have all the I have been a standing standing strategy and the	
A.84	V Local Index	1001001.0	of the Toronto No. 607 selection of the No. 1 and No. 1 and No. 1 and No. 1 and No. 1	
6.00 H 10	V Local Dates	10,000.0	A to 17 Kit 3 OF elements at 3 Kit 4 Kit 3 Kit 4 Kit 4 Kit 4 Kit 4	
A	V Local Index	10010014	IN THE TAXABLE REPORTED AND ADDRESS AND ADDRESS ADDRES ADDRESS ADDRESS	
6.85 1101	V Local Dates	101001-0	In the STORE IS HER whereas an IS WILL AN IS WILL AND WILL AND AND	
	V Local Dates	10.001	AL MAY THE WARRANT AND	
6.86 110.	# Lond Beller	100108-1	at the STORE M. M. MARKENSKI, Comparison country and the second	
	II Lond Rates	10.001	at the STERNAR WARACTER Comparison and the service	
6.00 1101	it hand blo	101001-0	In the United States and Annual Control of Control of States and S	
			100 1000	ing income

Fig6. Sample output of the logs

Fig6 shows the results of the logs which have been populated on the Syslog Service. These logs are the debug ICMP packets.

A packet analysis of the link between R1 and GW1 has been analyzed. This was done using two protocols i.e. Open State

Path First (OSPF) and Enhanced Interior Gateway Routing Protocol (EIGRP). We observe in Fig7 that in EIGRP, there are frequent updates. Therefore, the traffic is a lot more as compared to OSPF. In Fig8, we observe that the traffic is lot lesser.



Fig7. EIGRP packet analysis



# Fig8. OSPF packet analysis

Cisco IOS Embedded Event Manager (EEM) is a powerful and flexible subsystem that provides real-time network event detection and automation. It gives you the ability to adapt the behavior of your network devices to align with the needs of the network. We have incorporated various features of the EEM in the project such as getting the interface up if its shutdown and not allowing debugs as it consumes a lot of processing.

We used Cisco's EEM to keep the interfaces always up. So, whenever we try to shut an interface, it comes back up again. In Fig9 we observe that when we try to shut down one of the interfaces, it comes back again due to EEM.

AT Lower & And B
a construction of the second second
A Design of the second s
Verpoint 1 a + n.2. P
Vierostians, K.
Wypanetry-Lt 1
No. A DESCRIPTION ADDRESS PRODUCTS ADDRESS AND ADDRESS
ANY A DESCRIPTION OF AN AD A DOLL DANAGED CONTRACTOR AND A DESCRIPTION OF A DOLLAR AND ADDRESS
the state of the second st
A REAL PROPERTY AND
AND TO REAL METERS WAS AN ADDRESS OF A DESCRIPTION OF A D
A DESCRIPTION OF A DESC
the substitute and the provide and the second
AND A DESCRIPTION OF A
CONTRACTOR AND ADDRESS AND ADDRESS AND A THE ADDRESS AND A THE ADDRESS
No. 4 18 (1) (1) (10) 100, P. 4 (0) (1) (non-charge flag loss, 75/10) (100000000, 15/10) (1) (10) (10) (10) (10) (10) (10) (1
Her & Millery VI. 1991 No. 10 - Sold Anterine Stations (No. ) 1000 Sold (1995 ) - VI SHI (MATE STATE
AND A STATE OF A DATE AND A DATE
and a short strategy
Epr. 8 (BATTER-BECAUS) has now going chrouge and denial arguments
ing - 1 to 10 to
A DECEMBER OF
an substantiation

Fig9. Interfaces are always kept up

Debugs are really CPU intensive. To prevent it, we have used EEM to prevent the debug command by automatically selecting the no option. Fig10 shows the same.



Fig10. Preventing the debug command

We observe in Fig11 that the PC is not able to ping for a while as the port was shut down due to heavy traffic. The interface at the gateway is marked down when the traffic increases considerably. This was also done using EEM.



Fig11. Traffic Monitoring

We observe in Fig11 that the gateway is unreachable for a while as the traffic load was too high.

The "reload" command in Cisco devices will lead to the loss of the Running Configuration present on the Cisco devices. Therefore, the reload command was disabled using EEM. Fig12 shows that the reload command is being entered, but we observe a syslog message which says that the reload command is disabled.



Fig12. Prevention of the Reload Command

Another script was used to create loopbacks. The script which is run automatically creates loopbacks based on the input given i.e. number of loopbacks. Fig13 shows that 3 loopbacks were created with their ip addresses.

Elitation metright parts						
New Neur Lunchers Link	and the state of the	1.1 1.1 100401				
and the second second second second	Management of the local	and a local set				and the state of
the D BUTCHERE	ACCURATE ACCURATE ACCURATE	State Line of	output and here	1000	International Property	and the late over
Of the state of the state	ALCONTRACTOR OF COMPANY	Service Links of	States and States	and the second states	Contraction of the local state	
THE R. LEWIS CO.						THE REAL PROPERTY AND IN CONTRACT OF
No. 21-21127116-041-	1010-1-0000101111	Cistrarulat	socie contactie ti		differences of	A SING DOM: N
ADDRESS OF SHEEP CONTRACTOR						
	1000000000	ALC: NOT THE OWNER OF				
A CONTRACTOR OF	and the second second	and the second	2			
The start and the start start and the		and the second	2			
Contractory and the local division of the		THE REPORT				
Personal Long-				In case of		
Distant for		LOS HOURS				
Service of the servic		127 101644				
Destant 1-2	State States	TO BUSINE	A DESIGNATION OF THE OWNER OWNER OF THE OWNER OWNER OF THE OWNER	of the second second		
A DATA STOLEN	100 200					
The balance of the	A DECEMBER OF THE OWNER OWNER OF THE OWNER	and the same	3			
and a state of the		the WINAR				
The second second						
Completents						
Complete 181						

## Fig13. Script to create loopbacks

The Tool Control Language (TCL) script was used to test the reachability to other network devices. In Fig14, we see that three addresses are reachable.

GNE (scl)#foresch VAR (
+910:0:10:22
+>) ( puts [exec "ping WAR"] )
Type Barbar sequence to abort. Aending 5, 100-kgre ICMO Kohne to 193.148.1.1, timeout is 2 seconds: 1221
Success rate is 100 percent (3/5), cound-trip min/avg/mas = 12/27/60 ms
Type escape sequence to abort.
Sending 5, 100-byte IDMF Echas to 10.0.10.22, timeout is 2 seconds:
Success rate is 100 percent (5/5), round-trip min/arg/max = 32/41/54 mm
Type escape segience to abort.
Sending 5, 100-byte 1008 Echos to 200-161-200.2, timecut is 2 seconds: (111)
Success rate is 100 percent (5/5), round-trip min/arg/max = 20/28/68 ms
GR1 (tc1)#

#### Fig14. TCL script to test the reachability

The Role-Based CLI Access feature allows the network administrator to define "views," which are a set of operational commands and configuration capabilities that provide selective or partial access to Cisco IOS EXEC and configuration.

Views restrict user access to Cisco IOS command-line interface (CLI) and configuration information; that is, a view can define what commands are accepted and what configuration information is visible.

1011				
Childrenial of the different				
CONTRACTOR OF CONT				
and a second sec				
Children II				
finitiant manager same	metale apple southeast this apple			
classic classical inter-		4		
1120401	BRAILING BROWN ALLAND THEN PUPPER			
The second se	and the second second state second			
capacity Ethnian parts	En gannage and			
ALOTTO MARGINE INTO	matter score aleren beza agarten			
A DECISION OF A DECISIONO OF A DECISI	mailine status shilts - rile eretes			
	and the second second			
In the low of the low				
Difference entering-moltly				
HARPORT AND ADDRESS AND ADDRESS				
I then martipustics mange al	TRANSPORTATION AND ADDRESS			
NAMES OF TAXABLE PARTY.				
Manager Linescone Are entating				
C				
Birthese Str.				
and the second second				
Contraction of the local division of the loc				
* /				
and the second				
the last state of the last state and the				
TR ME				
a state of the second				

Fig15. First User



# Fig16. Second User

In Fig15, we observe that the first user is given access only to the "show ip interface brief" and the "show startup-config" commands. While in Fig15, we observe that the user is given access to "show cdp neighbours" and "show version" commands. In this way the network administrator can give preferential access to the users.

### **IV.CONCLUSION**

The difference between the flat topology and the hierarchical topology was analyzed with the help of GNS3 and Wireshark. The network congestion was observed to be pretty low in the case of the hierarchical network design as compared to the flat topology. Therefore, the hierarchical topology is preferred in most of the cases.

Problems like the interfaces of a network device going down, the debugs are a huge problem in a network. Therefore, EEM was used to tackle these problems. TCL was used to test the reachability to multiple devices. Role Based CLI Access on the other hand gives preferential access to the user.

These methods, if employed on a real time network, will be really useful in administering the network.

#### **V.REFERENCES**

[1] Enterprise Networking Planet
 [2] Official GNS3 Documentation
 [3] RFC 2328
 [4] RFC 4271
 [5] RFC 1541
 [6] Cisco Documents on various protocols