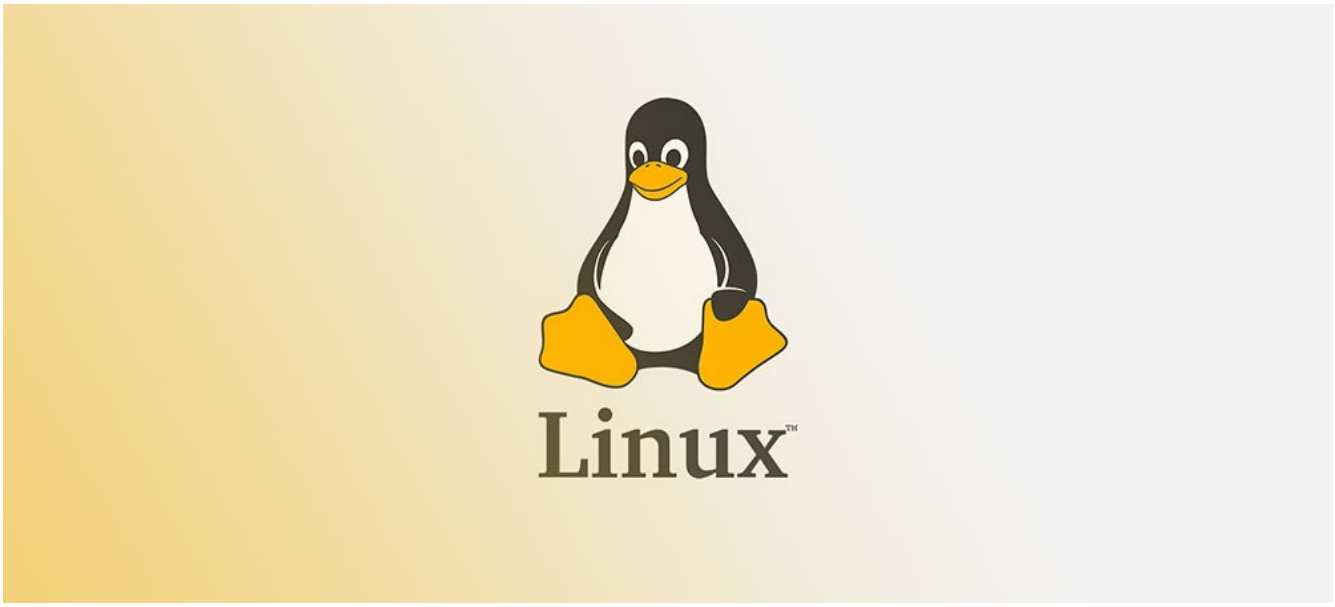

AZURETECH Linux Network Upgrade

Project Proposal

Version 0.1.2

Urban Home | SOLUTIONS

Urban Home Solutions
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Section 1 – Project Overview

1.1 Purpose of Document

The purpose of this document is to provide suggestions, solutions, and configurations for a major upgrade that will improve the current network.

1.2 Scope

The scope of the project involves an examination of the current network to ascertain where it can be improved. In addition, design and implemention of a prototype network to demonstrate what it could look like after the proposed upgrades. The proposed solutions must include detailed configurations and address potential growth of the business in the future.

Section 2 – Network Topology

2.1 Existing Network Design

The existing network utilizes 11 servers comprised of one (1) NIS authentication server, two (2) NFS file share servers, one (1) Telnet server, two (2) database servers, two (2) app servers, two (2) web servers, and one (1) backup server. (Fig. 1)

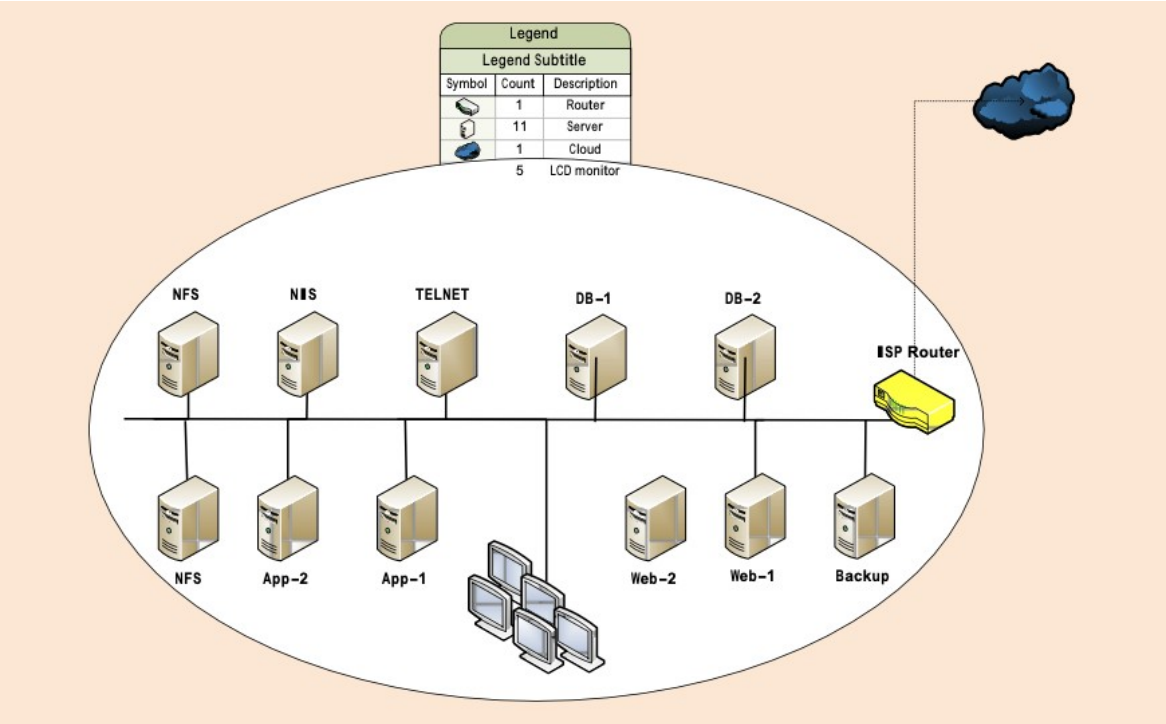
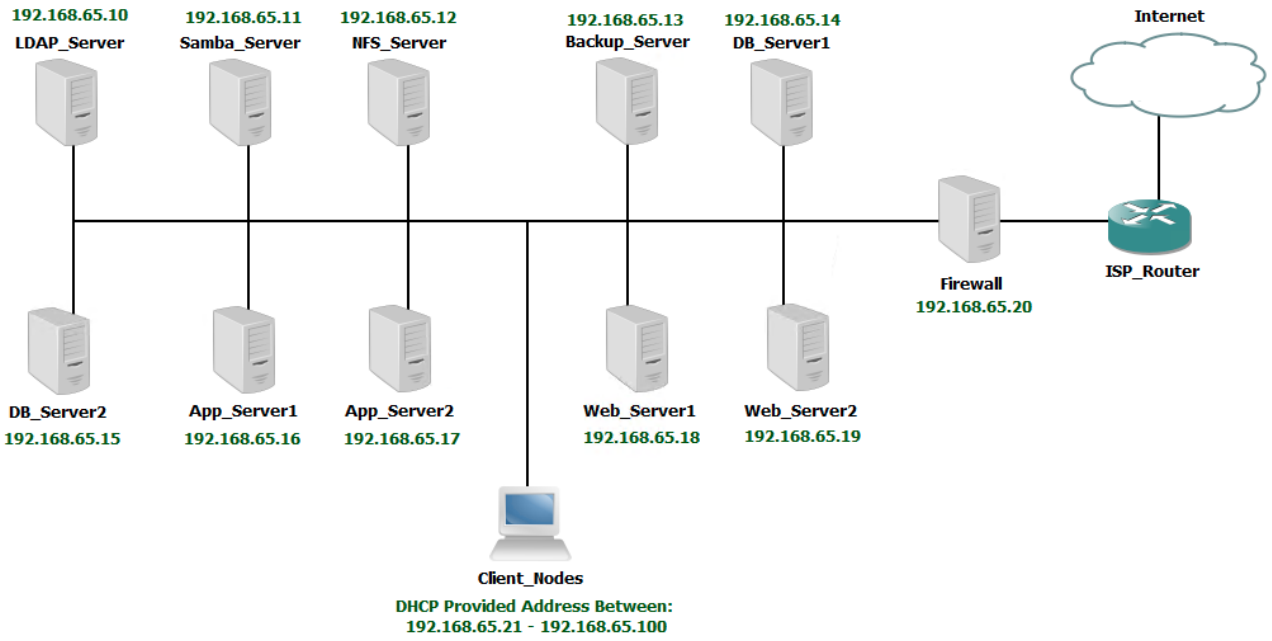


Figure 1

2.2 Proposed Network Topology

The proposed network utilizes 11 servers comprised of one (1) LDAP authentication server, one (1) Samba file share server, one (1) NFS file share server, two (2) database servers, two (2) app servers, two (2) web servers, one (1) backup server, and one (1) Firewall. (Fig. 2)

Figure 2



Section 3 – Upgrades

3.1 Server OS Upgrade

The existing servers are all running CentOS 5.0 currently which is starting to become old and losing community support. All servers should be upgraded to CentOS 7.0 as this will provide the most support while maintaining stronger stability that newer releases.

3.2 LDAP Centralized Authentication

Current network athentication is managed by a NIS server which only functions for Linux operating systems and passes sensitive information in plain text. The prototype network runs an LDAP server instead for many reasons. Eventually the Windows clients can be looped into the system to authenticate making it so that the total Linux and Windows structures would all be managed from the same place. In addition LDAP touts improved security as it utilizes TLS certifications to establish connections and pass information. The LDAP server can be used to authenticate against for all of the other services that the network contains.

3.3 Firewall Addition

No firewall is present with the existing network which places the system at significantly more risk. With the addition of a pfSense firewall in place all internal traffic is protected and blocked from the external. All traffic that accesses anything outside of the LAN, including and especially the internet, is routed through firewall so as to keep as small of an attack surface as possible.

3.4 Samba Share Server

While the two (2) NFS share servers are useful they are overkill and could be downsized to make room for something that may grow better with the company in the future. One (1) of the NFS servers has been replaced in the prototype network for a Samba server. At the moment the Samba server is just acting as a share but the possibilities for it to be so much more are endless. In the future it could be utilized alongside the LDAP server to provide authentication for both Windows and Linux clients. All users could sign in on whatever device while the Samba server acts as an NT4 primary domain serveror even an Active Directory domain controller, all with an LDAP backend. This would all for a possibility to add a secondary domain server to add redundancy to the system and provide stability as the business grows.

3.5 Telnet & FTP

The current system utilizes Telnet for communications amoung servers which has been long recognized as very insecure and should not be used in production. Hence all Telnet services have been replaced with SSH servers so as to secure and encrypted communications. Having SSH servers allows us to take advantage of Secure Copy Protocol which will also replace the very insecure File Transfer Protocol servers the occupy the system now. Neither

Telnet nor FTP servers should be used as long as we have better options like SSH and SCP available to us.

Section 4 – Configurations

4.1 LDAP Configuration

The LDAP server has an NFS server running on it to export the home directories to the client servers so that they can automount them when they login to various users. The LDAP structure has been generated on the LDAP server using the following ldif files...

*# **db.ldif***

dn: olcDatabase={2}hdb,cn=config

changetype: modify

replace: olcSuffix

olcSuffix: dc=azuretech,dc=local

dn: olcDatabase={2}hdb,cn=config

changetype: modify

replace: olcRootDN

olcRootDN: cn=ldapadm,dc=azuretech,dc=local

dn: olcDatabase={2}hdb,cn=config

changetype: modify

replace: olcRootPW

olcRootPW: {SSHA}GBlGYcFck5dRl6+FwVlArdlJywiCsCfK

*# **monitor.ldif***

dn: olcDatabase={1}monitor,cn=config

changetype: modify

replace: olcAccess

*olcAccess: {0}to * by dn.base="gidNumber=0+uidNumber=0,cn=peercred,cn=external, cn=auth" read by dn.base="cn=ldapadm,dc=azuretech,dc=local" read by * none*

*# **base.ldif***

dn: dc=azuretech,dc=local

dc: azuretech

objectClass: top

objectClass: domain

dn: cn=ldapadm,dc=azuretech,dc=local

objectClass: organizationalRole

cn: ldapadm

description: LDAP Manager

dn: ou=People,dc=azuretech,dc=local

objectClass: organizationalUnit

ou: People

dn: ou=Group,dc=azuretech,dc=local

objectClass: organizationalUnit

ou: Group

*# **users.ldif***

dn: uid=ldapuser1,ou=People,dc=azuretech,dc=local

uid: ldapuser1

cn: ldapuser1

sn: ldapuser1

mail: ldapuser1@azuretech.local

objectClass: person

objectClass: organizationalPerson

objectClass: inetOrgPerson

objectClass: posixAccount

objectClass: top

objectClass: shadowAccount

userPassword: {crypt} 6SCUZRM.D$B4l.n2hipD4IvghGaaJiQtLkiOF62YS7PhDy30EpVd81noq4KkDU2EqORUW. 8Dq4k5GhPkChklxZIYiKMvcFx1

shadowLastChange: 19159

shadowMin: 0

shadowMax: 99999

shadowWarning: 7

loginShell: /bin/bash

uidNumber: 1000

gidNumber: 1000

homeDirectory: /home/ldapuser1

dn: uid=ldapuser2,ou=People,dc=azuretech,dc=local

uid: ldapuser2

cn: ldapuser2

sn: ldapuser2

mail: ldapuser2@azuretech.local

objectClass: person

objectClass: organizationalPerson

objectClass: inetOrgPerson

objectClass: posixAccount

objectClass: top

objectClass: shadowAccount

userPassword: {crypt} 6CbncYy5y$JlNL4899lmlZAgqnLYersesFTLkFJNY6DQdNvwOFU8LyHNXPMMrfCaUo7Br SdYw/KFlDOubpyn2b242re1Zea/

shadowLastChange: 19159

shadowMin: 0

shadowMax: 99999

shadowWarning: 7

loginShell: /bin/bash

uidNumber: 1001

gidNumber: 1001

homeDirectory: /home/ldapuser2

dn: uid=ldapuser3,ou=People,dc=azuretech,dc=local

uid: ldapuser3

cn: ldapuser3

sn: ldapuser3

mail: ldapuser3@azuretech.local

objectClass: person

objectClass: organizationalPerson

objectClass: inetOrgPerson

objectClass: posixAccount

objectClass: top

objectClass: shadowAccount

userPassword:

{crypt}6J5mrmTYw$bKruVOsucaiHJFS3S6MKG4jyC.o/P62DeLW/R.YVpktFaYlpHzjjjxIGW5HpAmsf5OCN9dId5s/F33HptMfvG0

shadowLastChange: 19159

shadowMin: 0

shadowMax: 99999

shadowWarning: 7

loginShell: /bin/bash

uidNumber: 1002

gidNumber: 1002

homeDirectory: /home/ldapuser3

*# **groups.ldif***

dn: cn=ldapuser1,ou=Group,dc=azuretech,dc=local

objectClass: posixGroup

objectClass: top

cn: ldapuser1

userPassword: {crypt}x
gidNumber: 1000

dn: cn=ldapuser2,ou=Group,dc=azuretech,dc=local
objectClass: posixGroup
objectClass: top
cn: ldapuser2
userPassword: {crypt}x
gidNumber: 1001

dn: cn=ldapuser3,ou=Group,dc=azuretech,dc=local
objectClass: posixGroup
objectClass: top
cn: ldapuser3
userPassword: {crypt}x
gidNumber: 1002

 # /etc/sysconfig/network-scripts/ifcfg-ens33
TYPE="Ethernet"
PROXY_METHOD="none"
BROWSER_ONLY="no"
BOOTPROTO="none"
DEFROUTE="yes"
IPV4_FAILURE_FATAL="no"
IPV6INIT="no"
#IPV6_AUTOCONF="yes"
#IPV6_DEFROUTE="yes"
#IPV6_FAILURE_FATAL="no"
#IPV6_ADDR_GEN_MODE="stable-privacy"
NAME="ens33"
UUID="93f56d12-8057-4ca0-af7f-6c8e6fcffccd"

DEVICE="ens33"

ONBOOT="yes"

IPADDR="192.168.65.10"

PREFIX="24"

GATEWAY="192.168.65.20"

DNS1="192.168.65.10"

DNS2="8.8.8.8"

DNS3="8.8.4.4"

DOMAIN="azuretech.local"

4.2 LDAP Client Configuration

The LDAP Clients need to install some packing and create some automap files for autofs to automount LDAP user home directories. I used the follow script to accomplish this...

 # LDAP_Client_Install.sh

#!/bin/bash

yum install -y openldap-clients nss-pam-ldapd nfs-utils autofs

authconfig --enableldap --enableldapauth --ldapserver=192.168.65.10 --ldapbasedn="dc=azuretech,dc=local" --update

systemctl restart nslcd

setsebool -P use_nfs_home_dirs=1

echo "/home /etc/home.map" >> /etc/auto.master

echo " -fstype=nfs,rw,nosuid,soft 192.168.65.10:/home/&" >> /etc/home.map*

systemctl enable rpcbind

systemctl start rpcbind

systemctl enable autofs

systemctl start autofs

exit

4.3 Firewall Configuration

Configured as seen in figures below. (Figs. 3, 4, & 5)

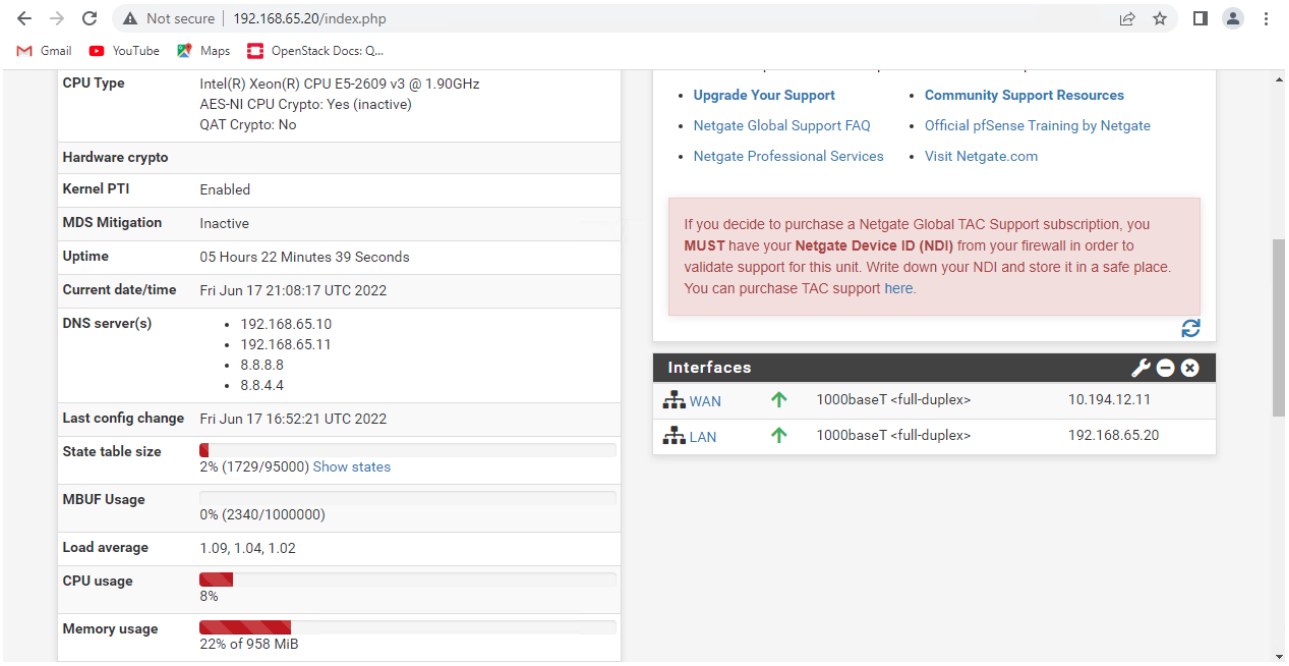


Figure 3

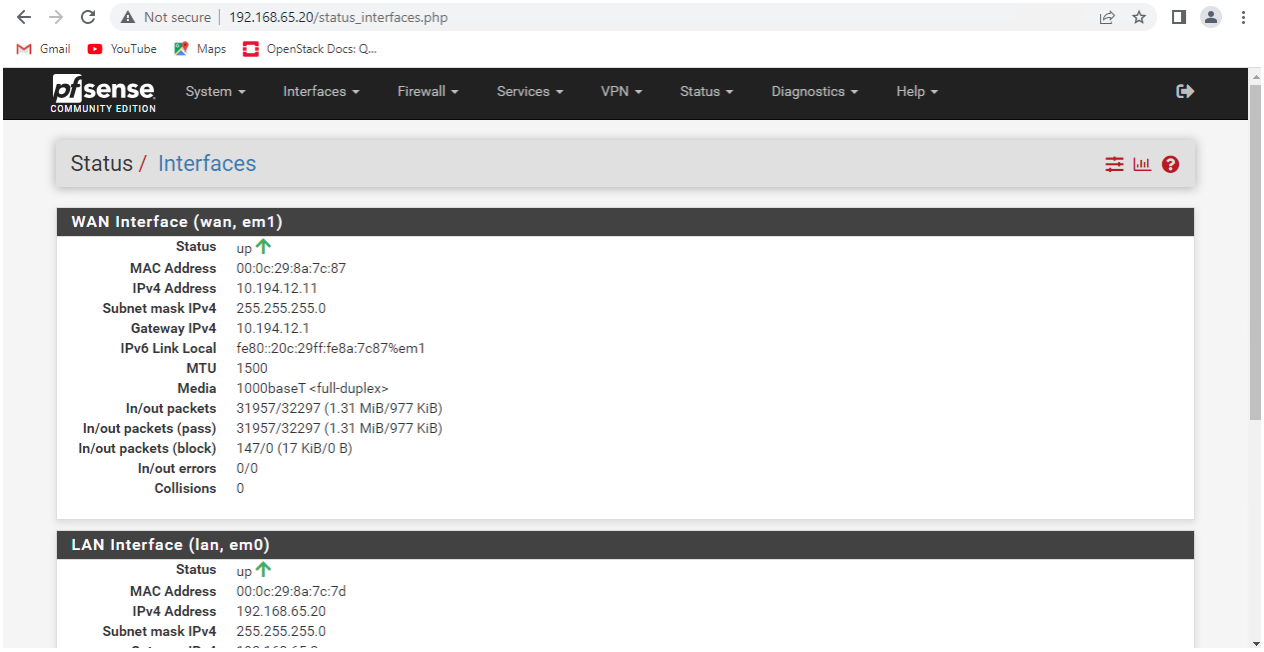


Figure 4

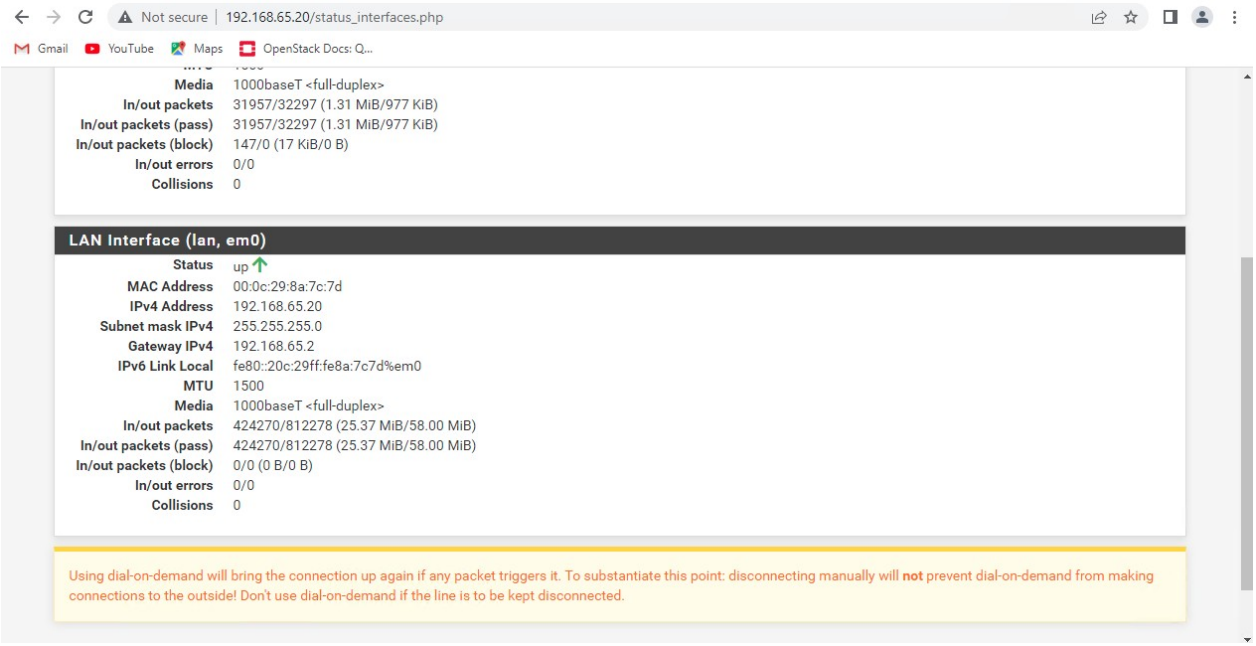


Figure 5

4.4 DNS Master Server Configuration

The DNS master server was installed on the same server as the LDAP so it is referred to as LDAP in the configuration files. The main config, the forward zone, and the reverse zone files shown below...

 # /etc/named.conf

//

// named.conf

//

// Provided by Red Hat bind package to configure the ISC BIND named(8) DNS

// server as a caching only nameserver (as a localhost DNS resolver only).

//

// See /usr/share/doc/bind/sample/ for example named configuration files.*

//

// See the BIND Administrator's Reference Manual (ARM) for details about the

// configuration located in /usr/share/doc/bind-{version}/Bv9ARM.html

```
options {
        listen-on port 53 { 127.0.0.1; 192.168.65.10; };
//      listen-on-v6 port 53 { ::1; };
        directory       "/var/named";
        dump-file       "/var/named/data/cache_dump.db";
        statistics-file "/var/named/data/named_stats.txt";
        memstatistics-file "/var/named/data/named_mem_stats.txt";
        recursing-file  "/var/named/data/named.recursing";
        secroots-file   "/var/named/data/named.secroots";
        allow-query     { localhost; 192.168.65.0/24; };
        allow-transfer  { localhost; 192.168.65.11; };

        /*
         - If you are building an AUTHORITATIVE DNS server, do NOT enable recursion.
         - If you are building a RECURSIVE (caching) DNS server, you need to enable
           recursion.
         - If your recursive DNS server has a public IP address, you MUST enable access
           control to limit queries to your legitimate users. Failing to do so will
           cause your server to become part of large scale DNS amplification
           attacks. Implementing BCP38 within your network would greatly
           reduce such attack surface
        */
        recursion no;

        dnssec-enable yes;
        dnssec-validation yes;
//      dnssec-lookaside auto;

        /* Path to ISC DLV key */
        bindkeys-file "/etc/named.root.key";
```

```
        managed-keys-directory "/var/named/dynamic";

        pid-file "/run/named/named.pid";
        session-keyfile "/run/named/session.key";
};

logging {
        channel default_debug {
                file "data/named.run";
                severity dynamic;
        };
};

zone "." IN {
        type hint;
        file "named.ca";
};

zone "azuretech.local" IN {
type master;
file "forward.azuretech";
allow-update { none; };
};

zone "65.168.192.in-addr.arpa" IN {
type master;
file "reverse.azuretech";
allow-update { none; };
};
```

```
include "/etc/named.rfc1912.zones";
include "/etc/named.root.key";

# /var/named/forward.azuretech
$TTL 86400
@       IN SOA  ldap.azuretech.local. root.azuretech.local. (
                                2022061101 ; serial
                                3600    ; refresh
                                1800    ; retry
                                604800  ; expire
                                86400 ) ; minimum TTL

;Name Servers
        IN      NS      ldap.azuretech.local.  ; Master
        IN      NS      samba.azuretech.local.      ; Slave

        IN      A       192.168.65.10           ; Name Server to IP resolve
        IN      A       192.168.65.11

ldap            IN      A       192.168.65.10      ; Host
samba           IN      A       192.168.65.11      ; Host
nfs             IN      A       192.168.65.12      ; Client
backup          IN      A       192.168.65.13      ; Client
db1             IN      A       192.168.65.14      ; Client
db2             IN      A       192.168.65.15      ; Client
app1            IN      A       192.168.65.16      ; Client
app2            IN      A       192.168.65.17      ; Client
web1            IN      A       192.168.65.18      ; Client
web2            IN      A       192.168.65.19      ; Client
firewall        IN      A       192.168.65.20   :  Firewall
```

 # /var/named/reverse.azuretech

```
$TTL 86400
@       IN SOA  ldap.azuretech.local. root.azuretech.local. (
                                2022061101 ; serial
                                3600    ; refresh
                                1800    ; retry
                                604800  ; expire
                                86400 ) ; minimum TTL

;Name Servers
        IN      NS      ldap.azuretech.local.     ; Master
        IN      NS      samba.azuretech.local.    ; Slave
        IN      PTR     azuretech.local.

;Record (IP) points to hostname
ldap            IN      A       192.168.65.10      ; Master Nameserver
samba           IN      A       192.168.65.11      ; Slave Nameserver
nfs             IN      A       192.168.65.12      ; Client
backup          IN      A       192.168.65.13      ; Client
db1             IN      A       192.168.65.14      ; Client
db2             IN      A       192.168.65.15      ; Client
app1            IN      A       192.168.65.16      ; Client
app2            IN      A       192.168.65.17      ; Client
web1            IN      A       192.168.65.18      ; Client
web2            IN      A       192.168.65.19      ; Client
firewall        IN      A       192.168.65.20      ;  Firewall

10      IN      PTR     ldap.azuretech.local.
11      IN      PTR     samba.azuretech.local.
12      IN      PTR     nfs.azuretech.local.
13      IN      PTR     backup.azuretech.local.
```

```
14    IN    PTR    db1.azuretech.local.
15    IN    PTR    db2.azuretech.local.
16    IN    PTR    app1.azuretech.local.
17    IN    PTR    app2.azuretech.local.
18    IN    PTR    web1.azuretech.local.
19    IN    PTR    web2.azuretech.local.
20    IN    PTR    firewall.azuretech.local.
```

4.5 DNS Slave Server Configuration

The DNS slave server was installed on the same server as the Samba, so it is referred to as samba in the configuration files. The main config file is shown below...

```
# /etc/name.conf
//
// named.conf
//
// Provided by Red Hat bind package to configure the ISC BIND named(8) DNS
// server as a caching only nameserver (as a localhost DNS resolver only).
//
// See /usr/share/doc/bind*/sample/ for example named configuration files.
//
// See the BIND Administrator's Reference Manual (ARM) for details about the
// configuration located in /usr/share/doc/bind-{version}/Bv9ARM.html

options {
        listen-on port 53 { 127.0.0.1; 192.168.65.11; };
//      listen-on-v6 port 53 { ::1; };
        directory       "/var/named";
        dump-file       "/var/named/data/cache_dump.db";
        statistics-file "/var/named/data/named_stats.txt";
        memstatistics-file "/var/named/data/named_mem_stats.txt";
```

```
        recursing-file  "/var/named/data/named.recursing";
        secroots-file   "/var/named/data/named.secroots";
        allow-query     { localhost; 192.168.65.0/24; };

        /*
         - If you are building an AUTHORITATIVE DNS server, do NOT enable recursion.
         - If you are building a RECURSIVE (caching) DNS server, you need to enable
           recursion.
         - If your recursive DNS server has a public IP address, you MUST enable access
           control to limit queries to your legitimate users. Failing to do so will
           cause your server to become part of large scale DNS amplification
           attacks. Implementing BCP38 within your network would greatly
           reduce such attack surface
        */
        recursion no;

        dnssec-enable yes;
        dnssec-validation yes;

        /* Path to ISC DLV key */
        bindkeys-file "/etc/named.root.key";

        managed-keys-directory "/var/named/dynamic";

        pid-file "/run/named/named.pid";
          session-keyfile "/run/named/session.key";
};

logging {
        channel default_debug {
                file "data/named.run";
```

```
        severity dynamic;
    };
};

zone "." IN {
    type hint;
    file "named.ca";
};

zone "azuretech.local" IN {
type slave;
file "slaves/azuretech.fwd.zone";
masters { 192.168.65.10; };
};

zone "65.168.192.in-addr.arpa" IN {
type slave;
file "slaves/azuretech.rev.zone";
masters { 192.168.65.10; };
};

include "/etc/named.rfc1912.zones";
include "/etc/named.root.key";
```

4.6 DHCP Server Configuration

The DHCP server was installed on the same server as the LDAP. The main config file is shown below...

```
# /etc/dhcp/dhcpd.conf
#
# DHCP Server Configuration file.
```

```
#   see /usr/share/doc/dhcp*/dhcpd.conf.example
#   see dhcpd.conf(5) man page
#
option domain-name "azuretech.local";
option domain-name-servers ldap.azuretech.local, samba.azuretech.local, 8.8.8.8, 8.8.4.4;

default-lease-time 86400;  # 24 hours
max-lease-time 604800;    # One week

# Use this to enble / disable dynamic dns updates globally.
#ddns-update-style none;

# If this DHCP server is the official DHCP server for the local
# network, the authoritative directive should be uncommented.
authoritative;

subnet 192.168.65.0 netmask 255.255.255.0 {
  range 192.168.65.21 192.168.65.100;
  option domain-name-servers 192.168.65.10, 192.168.65.11, 8.8.8.8, 8.8.4.4;
  option domain-name "azuretech.local";
  option routers 192.168.65.2;
  option subnet-mask 255.255.255.0;
  option broadcast-address 192.168.65.255;
}

host nfs {
  hardware ethernet 00:0c:29:08:dc:1c;
  fixed-address 192.168.65.12;
}

host backup {
```

```
  hardware ethernet 00:0c:29:0e:59:b4;
  fixed-address 192.168.65.13;
}

host db1 {
  hardware ethernet 00:0c:29:d1:f5:0c;
  fixed-address 192.168.65.14;
}

host db2 {
  hardware ethernet 00:0c:29:95:46:a9;
  fixed-address 192.168.65.15;
}

host app1 {
  hardware ethernet 00:0c:29:83:8c:60;
  fixed-address 192.168.65.16;
}

host app2 {
  hardware ethernet 00:0c:29:f2:40:5c;
  fixed-address 192.168.65.17;
}

host web1 {
  hardware ethernet 00:0c:29:a7:d9:38;
  fixed-address 192.168.65.18;
}

host web2 {
  hardware ethernet 00:0c:29:e9:fa:2b;
```

```
  fixed-address 192.168.65.19;
}
```

4.7 NFS Server Configuration

The NFS server's export file and client fstab config file are shown below...

```
# /etc/exports
/nfsfileshare 192.168.65.0/24(rw,sync,no_root_squash)

# /etc/fstab
#
# /etc/fstab
# Created by anaconda on Wed May 11 18:06:18 2022
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/mapper/centos-root /                       xfs     defaults        0 0
UUID=747f3e8d-9501-43e8-9ed3-3fae6fea9f23 /boot                   xfs     defaults        0 0
/dev/mapper/centos-swap swap                    swap    defaults        0 0
nfs:/nfsfileshare /mnt/nfsfileshare     nfs     nosuid,rw,sync,hard,intr        0 0
```

4.8 Samba Server Configuration

The Samba server's interface config and smb.conf files are shown below...

```
# /etc/sysconfig/network-scripts/ifcfg-ens33
TYPE="Ethernet"
PROXY_METHOD="none"
BROWSER_ONLY="no"
BOOTPROTO="none"
DEFROUTE="yes"
```

IPV4_FAILURE_FATAL="no"
IPV6INIT="no"
#IPV6_AUTOCONF="yes"
#IPV6_DEFROUTE="yes"
#IPV6_FAILURE_FATAL="no"
#IPV6_ADDR_GEN_MODE="stable-privacy"
NAME="ens33"
UUID="eb0d3098-d1cd-4d11-9e74-e7478d56b0c5"
DEVICE="ens33"
ONBOOT="yes"
IPADDR="192.168.65.11"
PREFIX="24"
GATEWAY="192.168.65.20"
DNS1="192.168.65.10"
DNS2="192.168.65.11"
DNS3="8.8.8.8"
DNS4="8.8.4.4"
DOMAIN="azuretech.local"

 # /etc/samba/smb.conf
 # See smb.conf.example for a more detailed config file or
 # read the smb.conf manpage.
 # Run 'testparm' to verify the config is correct after
 # you modified it.

[global]
    workgroup = SAMBA
    security = user

    passdb backend = tdbsam

```
        printing = cups
        printcap name = cups
        load printers = yes
        cups options = raw

[homes]
        comment = Home Directories
        valid users = %S, %D%w%S
        browseable = No
        read only = No
        inherit acls = Yes

[printers]
        comment = All Printers
        path = /var/tmp
        printable = Yes
        create mask = 0600
        browseable = No

[print$]
        comment = Printer Drivers
        path = /var/lib/samba/drivers
        write list = @printadmin root
        force group = @printadmin
        create mask = 0664
        directory mask = 0775

[smb]
    path = /samba
    browseable = yes
    read only = no
```

force create mode = 0660

force directory mode = 2770

valid users = smb @sadmin

4.9 Email Server Configuration

The email servers' were installed on the samba server machine and that is why it is labelled as samba in the config files. The Postfix and Dovecot config file alterations are shown below...

 # /etc/postfix/main.cf

 # line 75: uncomment and specify hostname
myhostname = samba.azuretech.local

 # line 83: uncomment and specify domain name
mydomain = azuretech.local

 # line 99: uncomment
myorigin = $mydomain

 # line 116: change
inet_interfaces = all

 # line 164: add
mydestination = $myhostname, localhost.$mydomain, localhost, $mydomain

 # line 264: uncomment and specify your local network
mynetworks = 192.168.65.0/24

 # line 419: uncomment (use Maildir)
home_mailbox = Maildir/

 # line 574: add
smtpd_banner = $myhostname ESMTP

 # add follows to the end
 # limit an email size with 10M
message_size_limit = 10485760

 # /etc/dovecot/dovecot.conf
 # line 24: uncomment
protocols = imap pop3 lmtp

 # line 30: uncomment and change (if not use IPv6)
*listen = **

 # /etc/dovecot/conf.d/10-auth.conf
 # line 10: uncomment and change (allow plain text auth)
disable_plaintext_auth = no

 # line 100: add
auth_mechanisms = plain login

 # /etc/dovecot/conf.d/10-mail.conf
 # line 30: uncomment and add
mail_location = maildir:~/Maildir

 # /etc/dovecot/conf.d/10-master.conf
 # line 96-98: uncomment and add like follows
 # Postfix smtp-auth
unix_listener /var/spool/postfix/private/auth {
* mode = 0666*
* user = postfix*
* group = postfix*
}

 # /etc/dovecot/conf.d/10-ssl.conf
 # line 8: change (not require SSL)
ssl = no

Section 5 – Network Administrator's Utilities

5.1 Password Generator Script

As an administration tool I created a random password generator script that asks how long you want the password to be. After it generates the password is asks if the user wants to output it into a file and if so what should the filename be. The bash script code for the file is below...

 # passwdgen_script.sh

#!/bin/bash

#This is a script for generating secure random password suggestions for users

```
echo -e "\n****** Secure Random Password Generator ******\n\nLet's generate a random password...\n\nHow long would you like your password to be?\n\nCharacter Length: "
read length
passwd=`echo $RANDOM | md5sum | head -c ${length}`
echo -e "\nPassword Suggestion: ${passwd}\n\nWould you like to store this password in a file? (y/n): "
answer=null
while [ ${answer} != y ] || [ ${answer} != n ]; do
read answer
if [ ${answer} = "y" ]; then
    echo -e "\nWhat would you like you filename to be?: "
    read filenm
    echo ${passwd} > ${filenm}
    echo -e "\nFile has been saved in the current working directory... Goodbye!\n"
    return
elif [ ${answer} = "n" ]; then
    echo -e "\nOk... Goooodbye!\n"
    return
else
    echo -e "\nNot a valid answer, try again.. You must choose either (y/n): \r"
fi
done
return
```

5.2 IP Address Script

As an administration tool I created an IP address script that asks you for an IP address. Then it asks the user for the subnet mask in bits and after which it prints the given IP address' classification along with the subnet mask in decimal format. Thoughout the script if the user gives the wrong output it tells the user what they did wrong and lets them try the input again. The bash script code for the file is below...

 # *ipaddr_script.sh*

```
#!/bin/bash
#This script informs users about IP address class

echo -e "\n\n****** IP Address Classification ******\n"

ipaddr=null

while ! [[ ${ipaddr} =~ .[0-9] ]] || [ ${#ipaddr} -gt 15 ] || [ ${#ipaddr} -lt 7 ] || [ ${firstoct} -lt 1 ] || [ ${firstoct} -gt 255 ] || [ ${secoct} -lt 1 ] || [ ${secoct} -gt 255 ] || [ ${thirdoct} -lt 1 ] || [ ${thirdoct} -gt 255 ] || [ ${fourthoct} -lt 1 ] || [ ${fourthoct} -gt 255 ]; do

        echo -e "\nProvide IP Address: "

        read ipaddr

        firstoct=`echo ${ipaddr} | awk -F'.' '{print $1}'`
        secoct=`echo ${ipaddr} | awk -F'.' '{print $2}'`
        thirdoct=`echo ${ipaddr} | awk -F'.' '{print $3}'`
        fourthoct=`echo ${ipaddr} | awk -F'.' '{print $4}'`

        if [ ${#ipaddr} -gt 15 ]; then
                echo -e "\nIP address is too long, try again..."

        elif [ ${#ipaddr} -lt 7 ]; then
                echo -e "\nIP address is too short, try again..."

        elif ! [[ ${ipaddr} =~ .[0-9] ]]; then
                echo -e "\nMust be a number, try again..."

        elif [ ${firstoct} -lt 1 ] || [ ${firstoct} -gt 255 ] || [ ${secoct} -lt 1 ] || [ ${secoct} -gt 255 ] || [ $
```

```
{thirdoct} -lt 1 ] || [ ${thirdoct} -gt 255 ] || [ ${fourthoct} -lt 1 ] || [ ${fourthoct} -gt 255 ]; then
        echo -e "\nEach octect must be a number between 1-255, try again..."

    fi
done

sbmask=null

while ! [[ ${sbmask} =~ [0-9] ]] || [ ${sbmask} -gt 32 ] || [ ${sbmask} -lt 1 ]; do
    echo -e "\nHow many bits is the subnet mask?:"

    read sbmask

    if [ ${sbmask} -gt 32 ]; then
        echo -e "\nThere are only 32 bits in a subnet mask, try again..."

    elif [ ${sbmask} -lt 1 ]; then
        echo -e "\nMust have at least 1 bit in the subnet mask, try again..."

    elif ! [[ ${sbmask} =~ [0-9] ]]; then
        echo -e "\nMust be a number, try again..."

    fi
done

if [ ${firstoct} -gt 0 ] && [ ${firstoct} -lt 128 ]; then
    echo -e "\n** CLASS A ADDRESS **"

elif [ ${firstoct} -gt 127 ] && [ ${firstoct} -lt 192 ]; then
    echo -e "\n** CLASS B ADDRESS **"
```

```
elif [ ${firstoct} -gt 191 ] && [ ${firstoct} -lt 224 ]; then
        echo -e "\n** CLASS C ADDRESS **"

elif [ ${firstoct} -gt 223 ] && [ ${firstoct} -lt 240 ]; then
        echo -e "\n** CLASS D ADDRESS **"

elif [ ${firstoct} -gt 239 ] && [ ${firstoct} -lt 256 ]; then
        echo -e "\n** CLASS E ADDRESS **"

else
        return
fi
echo -e "\nIP Address: ${ipaddr}"

M=$(( 0xffffffff ^ ((1 << (32-sbmask)) -1) ))
echo -e "\nSubnet Mask: $(( (M>>24) & 0xff )).$(( (M>>16) & 0xff )).$(( (M>>8) & 0xff )).$(( M & 0xff ))"

echo -e "\nGoodbye!\n"
return
```

Section 6 – Security

6.1 Firewalld & SELinux

Many turn firewalld off to make it easier to configure their services but it is far better to add the port rules that you need to each server for their respective services. In addition it is a better practice to keep SELinux enabled and to change the security contexts where needed. Throughout the server configuration process these systems were constrantly adjusted in the prototype network to the services to run but were never disabled. This ensures that the network is as harderned as it can be to intruders.

Appendix A

References

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