**Advanced Diploma of Information Technology**

**ICTNWK541 Assessment**

**Assessment Task 2: Project Portfolio**

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**ABC Enterprises WAN Expansion**



ABC Enterprises is a growing company with headquarters in Melbourne and two branch offices in Sydney and Brisbane. The company currently operates with an outdated network infrastructure that lacks secure, reliable WAN connectivity between sites. The IT department has been tasked with designing, implementing, and securing a new WAN infrastructure that ensures:

* Secure VPN connectivity between all sites.
* Optimised bandwidth usage with reliable routing protocols.
* Proper IPv6 deployment for future scalability.
* Enhanced security mechanisms including firewall rules and access control lists (ACLs).
* Troubleshooting and monitoring tools to detect and rectify network issues efficiently.

As part of the project, you will act as a network engineer responsible for implementing the required WAN connectivity for ABC Enterprises.

# Simulation Software & Tools:

Software installed to develop this protect.

* Cisco Packet Tracer 8.2.2
* Ubuntu 24.04 LTS
* Wireshark 4.2.2

# Network Design Review & Planning

## Network Details

### Topology and type

* Sydney Branch:
  + Type: WAN
  + Topology: Dual-Star high availability
  + Architecture: 3-Tier
* Brisbane Branch:
  + Type: LAN
  + Topology: Star

### Network Nodes

|  |  |  |
| --- | --- | --- |
| **Type** | **Quantity** | **Location** |
| PC | n | Sydney |
| Laptop | n | Sydney |
| Smartphone | n | Sydney |
| Tablet | n | Sydney |
| Printer | 1 | Sydney |
| Switch | 4 | Sydney |
| Switch Multi-layer | 2 | Sydney |
| W Access Point | 2 | Sydney |
| Router | 2 | Sydney |
| Server | 1 | Sydney |
| Laptop | n | Brisbane |
| Smartphone | n | Brisbane |
| Tablet | n | Brisbane |
| Switch | 2 | Brisbane |
| W Access Point | 2 | Brisbane |
| Router | 1 | Brisbane |
| Cloud Cluster | 1 | ABC Enterprises |

## Legal And Security Protocol

## Installation Plan

# WAN Configuration

## Overview Implementations

1. Implement Network Topology
2. Implement Secure Access by SSH
3. Implement Additional Protocols: DHCPv6, IPV6
4. Implement Additional Protocols: LACP
5. Implement Additional Protocols: HSRPv2 IPv6
6. Implement Additional Protocols: WEB Server
7. Implement Additional Protocols: OSPFv3
8. Implement Additional Protocols: DualStack, DHCP
9. Implement Additional Protocols: OSPF
10. Implement WAN protocols: Extended Access Control List (ACL)
11. Implement WAN Protocols: VPN Site-To-Site over IPv4
12. Legal & security: Policies and Procedures

## Implement Network Topology

Rename all devices:   
sw (switches), RT (souters), ap (Wireless Access Points), ss ( Servers)

Install 1 servers for WEB Server 2000::1 and (1) its own switch

Connect server’s switch and both switch multi-layer

## 3. Additional Protocols: DHCPv6, IPV6

### Router 1 (RT1)

Firstly, IPv6 will be enable and then DHCPv6 will be set up

enable

configure terminal

hostname RT1

ipv6 unicast-routing

interface gigabitEthernet 0/0

ipv6 address 2000::2/64

no shutdown

ipv6 dhcp pool STATEFUL\_POOL

domain-name milestones.com

dns-server 2000::10

prefix-delegation pool STATEFUL\_POOL

exit

interface gigabitEthernet 0/0

ipv6 dhcp server STATEFUL\_POOL

ipv6 nd managed-config-flag

exit

Do wr

exit

exit

### Router 3 (RT3)

enable

configure terminal

hostname RT3

ipv6 unicast-routing

interface gigabitEthernet 0/0

ipv6 address 2001:a::1/64

no shutdown

ipv6 dhcp pool STATEFUL\_POOL

domain-name milestones.com

dns-server 2001:a::10

prefix-delegation pool STATEFUL\_POOL

exit

interface gigabitEthernet 0/0

ipv6 dhcp server STATEFUL\_POOL

ipv6 nd managed-config-flag

exit

Do wr

exit

exit

## 4. Implement Additional Protocols: LACP

Implementation of Link Aggregation Control Protocol (LACP) on links:

* swm1 gigabitEthernet 1/0/22 <—> swm2 gigabitEthernet 1/0/22
* swm1 gigabitEthernet 1/0/23 <—> swm2 gigabitEthernet 1/0/23
* swm1 gigabitEthernet 1/0/24 <—> swm2 gigabitEthernet 1/0/24
* swm3 gigabitEthernet 1/0/22 <—> swm4 gigabitEthernet 1/0/22
* swm3 gigabitEthernet 1/0/23 <—> swm4 gigabitEthernet 1/0/23
* swm3 gigabitEthernet 1/0/24 <—> swm4 gigabitEthernet 1/0/24

The LACP link will be the **channel-group** number **1** on all switches.

### Switch Main 1 (swm1)

enable

configure terminal

interface range gigabitEthernet 1/0/22, gigabitEthernet 1/0/23, gigabitEthernet 1/0/24

channel-group 1 mode active

exit

interface Port-channel 1

switchport mode trunk

exit

do wr

exit

exit

enable

configure terminal

interface gigabitEthernet 1/0/1

switchport

no shutdown

Exit

Do wr

exit

### Switch Main 2 (swm2)

enable

configure terminal

interface range gigabitEthernet 1/0/22, gigabitEthernet 1/0/23, gigabitEthernet 1/0/24

channel-group 1 mode passive

exit

interface Port-channel 1

switchport mode trunk

exit

do wr

exit

exit

enable

configure terminal

interface gigabitEthernet 1/0/1

switchport

no shutdown

Exit

Do wr

exit

### Switch Main 3 (swm3)

enable

configure terminal

interface range gigabitEthernet 1/0/22, gigabitEthernet 1/0/23, gigabitEthernet 1/0/24

channel-group 1 mode active

exit

interface Port-channel 1

switchport mode trunk

exit

do wr

exit

exit

enable

configure terminal

interface gigabitEthernet 1/0/1

switchport

no shutdown

Exit

Do wr

exit

### Switch Main 4 (swm4)

enable

configure terminal

interface range gigabitEthernet 1/0/22, gigabitEthernet 1/0/23, gigabitEthernet 1/0/24

channel-group 1 mode passive

exit

interface Port-channel 1

switchport mode trunk

exit

do wr

exit

exit

enable

configure terminal

interface gigabitEthernet 1/0/1

switchport

no shutdown

Exit

Do wr

exit

## 5. Implement Additional Protocols: HSRPv2 IPv6

Links:

* HSRP IPv6 Address: 2000::1/64
* RT1 gigabitEthernet 0/0 <—> 2000::2 (primary router)
* RT2 gigabitEthernet 0/0 <—> 2000::3 (secondary router)

### Router 1 (RT1)

enable

configure terminal

interface gigabitEthernet 0/0

ipv6 address 2000::2/64

standby version 2

standby 1 ipv6 autoconfig

standby 1 priority 120

no shutdown

Exit

Do wr

exit

exit

### Router 2 (RT2)

Firstly, It will be set up RT2 same as RT1 before set up RT2 as a secondary router.

enable

configure terminal

hostname RT2

ipv6 unicast-routing

interface gigabitEthernet 0/0

ipv6 address 2000::3/64

no shutdown

ipv6 dhcp pool STATEFUL\_POOL

domain-name milestones.com

dns-server 2000::10

prefix-delegation pool STATEFUL\_POOL

exit

interface gigabitEthernet 0/0

ipv6 dhcp server STATEFUL\_POOL

ipv6 nd managed-config-flag

exit

Do wr

exit

exit

enable

configure terminal

interface gigabitEthernet 0/0

ipv6 address 2000::3/64

standby version 2

standby 1 ipv6 autoconfig

no shutdown

Exit

Do wr

exit

exit

## 6. Additional Protocols: WEB Server

Firstly, enable HTTP and HTTPs services and disable all other services, then edit index.html

<html>

<center><font size='+2' color='blue'>ABC ENTERPRISES Sydney</font></center>

<hr>Welcome to ABC Enterprises WEB server. This is a project for an assessment task 2 - May 2025.

<p>Quick Links:

<br><a href='helloworld.html'>A small page</a>

<br><a href='copyrights.html'>Copyrights</a>

<br><a href='image.html'>Image page</a>

<br><a href='cscoptlogo177x111.jpg'>Image</a>

</html>

## 7. Additional Protocols: OSPFv3

Links:

* RT1 Network gigabitEthernet 0/0
* RT1 gigabitEthernet 0/1 <—> RT-M gigabitEthernet 0/0
* RT3 Network gigabitEthernet 0/2
* RT-M gigabitEthernet 0/2 <—> RT-3 gigabitEthernet 0/1

Addressing:

* RT1 —> 2000::2/64
* RT1 <—> RT-M, 2001:c::1/64
* RT-M <—> RT1, 2001:c::2/64
* RT3 —> 2001:a::1/64
* RT-M <—> RT3, 2001:b::2/64
* RT3 <—> RT-M, 2001:b::1/64

Checking, reload:

* show ipv6 ospf neighbor
* clear ipv6 ospf process
* Show ipv6 ospf database

### Router 1 (RT1)

**!general config, IP link**

enable

configure terminal

interface gigabitEthernet 0/1

ipv6 address 2001:c::1/64

no shutdown

exit

**!enabling unicast and giving id**

ipv6 unicast-routing

ipv6 router OSPF 10

router-id 1.1.1.1

exit

**!enabling OSPF on network link**

interface gigabitEthernet 0/0

ipv6 OSPF 10 area 0

exit

**!enabling OSPF between RT1 and RT-M**

interface gigabitEthernet 0/1

ipv6 OSPF 10 area 0

exit

do wr

### Router Main (RT-Main)

**!general config, IP link**

enable

configure terminal

interface gig0/0

ipv6 address 2001:c::2/64

no shutdown

exit

interface gig0/2

ipv6 address 2001:b::2/64

no shutdown

exit

**!enabling unicast and giving router id**

ipv6 unicast-routing

ipv6 router OSPF 10

router-id 2.2.2.2

exit

**!enabling OSPF between RT-Main and RT1**

interface gig0/0

ipv6 OSPF 10 area 0

exit

**!enabling OSPF between RT-Main and RT3**

interface gig0/2

ipv6 OSPF 10 area 0

exit

do wr

### Router 3 (RT3)

**!general config, IP link**

enable

configure terminal

interface gigabitEthernet 0/1

ipv6 address 2001:b::1/64

no shutdown

exit

**!enabling unicast and giving router id**

ipv6 unicast-routing

ipv6 router OSPF 10

router-id 3.3.3.3

exit

**!enabling OSPF on network link**

interface gigabitEthernet 0/2

ipv6 OSPF 10 area 0

exit

**!enabling OSPF between RT3 and RT-Main**

interface gigabitEthernet 0/1

ipv6 OSPF 10 area 0

exit

do wr

exit

## 8. Implement Additional Protocols: DualStack, DHCP

### Router 1 (RT1)

**!setting up IPv4, dhcp**

enable

configure terminal

do wr

interface gigabitEthernet 0/0

ip address 192.168.10.1 255.255.255.0

no shutdown

exit

do wr

ip dhcp pool STATEFUL\_POOL

network 192.168.10.0 255.255.255.0

default-router 192.168.10.1

dns-server 192.168.10.10

exit

do wr

### Router 3 (RT3)

**!setting up ipv4, dhcp**

enable

configure terminal

do wr

interface gigabitEthernet 0/2

ip address 192.168.30.1 255.255.255.0

no shutdown

exit

do wr

ip dhcp pool STATEFUL\_POOL

network 192.168.30.0 255.255.255.0

default-router 192.168.30.1

dns-server 192.168.30.10

exit

do wr

### Router 4 (RT4)

Enabling IPv4 to ensure full compatibility with DSL protocol connection.

**!setting up IPv4, dhcp**

enable

configure terminal

hostname RT4

do wr

interface gigabitEthernet 0/0

ip address 192.168.40.1 255.255.255.0

no shutdown

exit

do wr

ip dhcp pool STATEFUL\_POOL

network 192.168.40.0 255.255.255.0

default-router 192.168.40.1

dns-server 192.168.40.10

exit

do wr

## 9. Additional Protocols: OSPF

Links:

* RT1 Network gigabitEthernet 0/0
* RT1 gigabitEthernet 0/1 <—> RT-M gigabitEthernet 0/0
* RT3 Network gigabitEthernet 0/2
* RT-M gigabitEthernet 0/2 <—> RT-3 gigabitEthernet 0/1
* RT4 Network gigabitEthernet 0/0
* RT4 gigabitEthernet 0/1 <—> RT-3 gigabitEthernet 0/0

Addressing:

* RT1 —> 192.168.10.1
* RT1 <—> RT-M, 192.168.70.1
* RT-M <—> RT1, 192.168.70.2
* RT3 —> 192.168.30.1
* RT-M <—> RT3, 192.168.60.2
* RT3 <—> RT-M, 192.168.60.1
* RT4 —> 192.168.40.1
* RT3 <—> RT4, 192.168.50.1
* RT4 <—> RT3, 192.168.50.2

Checking, reload:

* show ip ospf neighbor
* show ip ospf database
* clear ip ospf process

### Router 1 (RT1)

**!general config, IP link**

enable

configure terminal

interface gigabitEthernet 0/1

ip address 192.168.70.1 255.255.255.0

no shutdown

exit

**!enabling OSPF**

router ospf 20

network 192.168.70.0 0.0.0.255 area 0

network 192.168.10.0 0.0.0.255 area 0

exit

do wr

exit

exit

### Router Main (RT-M)

**!general config, IP link**

enable

configure terminal

interface gigabitEthernet 0/0

ip address 192.168.70.2 255.255.255.0

no shutdown

exit

interface gigabitEthernet 0/2

ip address 192.168.60.2 255.255.255.0

no shutdown

exit

**!enabling OSPF**

router ospf 20

network 192.168.70.0 0.0.0.255 area 0

network 192.168.60.0 0.0.0.255 area 0

exit

do wr

exit

exit

### Router 3 (RT3)

**!general config, IP link**

enable

configure terminal

interface gigabitEthernet 0/1

ip address 192.168.60.1 255.255.255.0

no shutdown

exit

interface gigabitEthernet 0/0

ip address 192.168.50.2 255.255.255.0

no shutdown

exit

**!enabling OSPF**

router ospf 20

network 192.168.60.0 0.0.0.255 area 0

network 192.168.30.0 0.0.0.255 area 0

network 192.168.50.0 0.0.0.255 area 0

network 192.168.40.0 0.0.0.255 area 0

exit

do wr

exit

exit

### Router 4 (RT4)

**!general config, IP link**

enable

configure terminal

interface gigabitEthernet 0/1

ip address 192.168.50.1 255.255.255.0

no shutdown

exit

**!enabling OSPF**

router ospf 20

router-id 4.4.4.4

network 192.168.50.0 0.0.0.255 area 0

network 192.168.40.0 0.0.0.255 area 0

exit

do wr

exit

exit

## 11. WAN Protocols: VPN Site-To-Site over IPv4

IPsec VPN will be used to implement VPN site to site on this network.

Compatible hardware:

* Router model No 2911
* Switche model No 2690

checking VPN Ipsec: look for technology: ipbasek9:permanent and secirityk9:evaluation

show version

show cryto IPsec sa

### Router 1 (RT1)

**!enabling security technology package**

license boot module c2900 technology-package securityk9

do write

exit

copy run start

reload

enable

configure terminal

crypto isakmp policy 10

encr aes 256

authentication pre-share

group 5

!

crypto isakmp key vpnpass address 192.168.60.1

!

crypto isakmp key vpnpass address 192.168.50.1

!

crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac

!

crypto map VPN-MAP 10 ipsec-isakmp

description VPN connection to Branch\_Router

set peer 192.168.60.1

set peer 192.168.50.1

set transform-set VPN-SET

match address 110

!

interface GigabitEthernet0/1

crypto map VPN-MAP

!

end

copy run start

### Router 3 (RT3)

**!enabling security technology package**

license boot module c2900 technology-package securityk9

do write

exit

copy run start

reload

enable

configure terminal

crypto isakmp policy 10

encr aes 256

authentication pre-share

group 5

!

crypto isakmp key vpnpass address 192.168.70.1

!

crypto isakmp key vpnpass address 192.168.50.1

!

crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac

!

crypto map VPN-MAP 10 ipsec-isakmp

description VPN connection to Branch\_Router

set peer 192.168.70.1

set peer 192.168.50.1

set transform-set VPN-SET

match address 110

!

interface GigabitEthernet0/1

crypto map VPN-MAP

!

end

copy run start

### Router 4 (RT4)

**!enabling security technology package**

license boot module c2900 technology-package securityk9

do write

exit

copy run start

reload

enable

configure terminal

crypto isakmp policy 10

encr aes 256

authentication pre-share

group 5

!

crypto isakmp key vpnpass address 192.168.60.1

!

crypto isakmp key vpnpass address 192.168.70.1

!

crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac

!

crypto map VPN-MAP 10 ipsec-isakmp

description VPN connection to Branch\_Router

set peer 192.168.70.1

set peer 192.168.60.1

set transform-set VPN-SET

match address 110

!

interface GigabitEthernet0/1

crypto map VPN-MAP

!

end

copy run start

# Network Security Implementation

## 10. Apply Access Control Lists (ACLS)

Implementing ALC over IPv4 networks.

Checking:

* do show start

### Router 1 (RT1)

access-list 110 permit ip 192.168.10.0 0.0.0.255 192.168.30.0 0.0.0.255

access-list 110 permit ip 192.168.10.0 0.0.0.255 192.168.40.0 0.0.0.255

access-list 110 permit ip 192.168.30.0 0.0.0.255 192.168.10.0 0.0.0.255

access-list 110 permit ip 192.168.40.0 0.0.0.255 192.168.10.0 0.0.0.255

!

copy run start

### Router 3 (RT3)

access-list 110 permit ip 192.168.30.0 0.0.0.255 192.168.10.0 0.0.0.255

access-list 110 permit ip 192.168.30.0 0.0.0.255 192.168.40.0 0.0.0.255

access-list 110 permit ip 192.168.10.0 0.0.0.255 192.168.30.0 0.0.0.255

access-list 110 permit ip 192.168.40.0 0.0.0.255 192.168.30.0 0.0.0.255

!

copy run start

### Router 4 (RT4)

access-list 110 permit ip 192.168.40.0 0.0.0.255 192.168.10.0 0.0.0.255

access-list 110 permit ip 192.168.40.0 0.0.0.255 192.168.30.0 0.0.0.255

access-list 110 permit ip 192.168.10.0 0.0.0.255 192.168.40.0 0.0.0.255

access-list 110 permit ip 192.168.30.0 0.0.0.255 192.168.40.0 0.0.0.255

!

copy run start

## 2. Secure Access By SSH

service password-encryption enables plain-text password encryption on switches, encrypts information using RSA.

Checking:

* show running-config
* ssh -l admin <ip\_switch>
* service password-encryption

### Switch 1

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw1

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

!end

### Switch 2

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw2

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Switch 3

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw3

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Switch 4

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw4

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Switch 5

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw5

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Multi-layer Switch 1

Before configure, install AC-POWER-SUPPLY module.

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname swm1

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Multi-layer Switch 2

Before configure, install AC-POWER-SUPPLY module.

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname swm2

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Switch 6

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw6

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

!end

### Switch 7

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw7

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Switch 8

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw8

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Switch 9

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname sw9

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Multi-layer Switch 3

Before configure, install AC-POWER-SUPPLY module.

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname swm3

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

### Multi-layer Switch 4

Before configure, install AC-POWER-SUPPLY module.

enable

configure terminal

service password-encryption

username administrator password cisco

ip domain-name milestones.com

hostname swm4

crypto key generate rsa general-keys modulus 1024

ip ssh version 2

line vty 0 15

transport input ssh

login local

exit

do wr

exit

exit

!end

# Troubleshooting & Testing:

## Testing WAN Connectivity

# Bibliography

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* VPN site-to-site, IPsec: [Gurutech Networking Training - VPN IPsec](https://www.youtube.com/watch?v=CsAROSbZF-Y)