STTJK3013

NETWORK CONNECTION AND SCALING (A242)

ASSIGNMENT 1

GROUP 7

PREPARED FOR :

MOHD SAMSU BIN SAJAT

PREPARED BY :

NAME	MATRIC
NURFATHIAH ATIQAH BINTI AFENDY	292680
SARAH AISYAH BINTI SUHAIMI	294400
MUHAMMAD ISHAQ BIN HAJAH ALAVUDIN	297463

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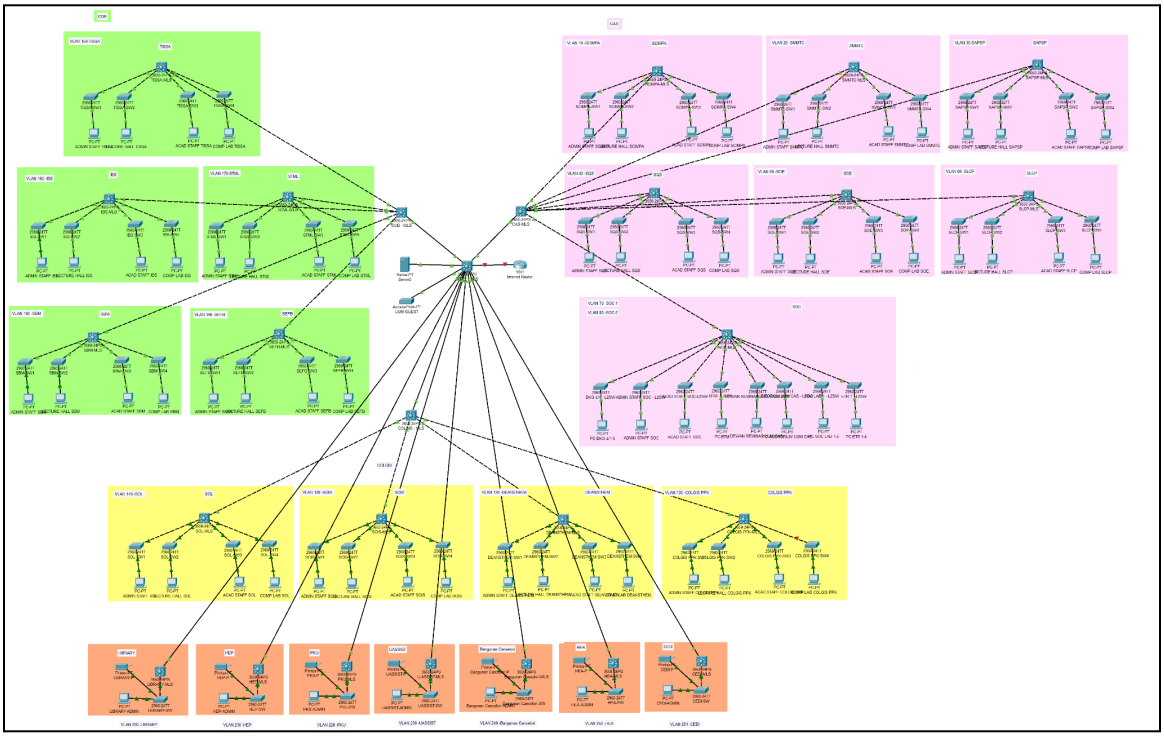
1.0 NETWORK REQUIREMENTS (number of buildings, approximate number of devices, staff, students, server needs, etc.).

- Number of Buildings: 7 (SCIMPA, SMMTC, SAPSP, SOC, SQS, SOE, SLCP)
- Core Layer Device: Layer 3 Switch (CAS-MLS)
- Distribution Layer Device: Layer 3 Switch (SCIMPA-MLS, SMMTC-MLS, SAPSP-MLS, SOC-MLS, SQS-MLS, SOE-MLS, SLCP-MLS)
- Devices per building: 4 Access Switches + 1 L3 Switch (total: 7 L3 switches, 32L2 switches)
- End Devices: Admin Staff PC, Lecturer Hall PC, Acad Staff PC, Comp Lab PC
- Approximately 15 Admin Staff PCs per building (105 total)
- Approximately 25 Academic Staff PCs per building (175 total)
- Around 10 Lecture Hall PCs per building (70 total)
- Around 100 student devices (laptops, phones) connecting via Wi-Fi per building (700 total)

2.0 NETWORK DIAGRAMS

a. PHYSICAL

b. LOGICAL



3.0 IP ADDRESSING SCHEME

ACADEMIC BUILDING	SCHOOL	VLAN ID	VLAN NAME	IP RANGE
CAS	SCIMPA	VLAN 10	Admin Staff	10.10.10.10 - 10.10.10.254
			Lecture Hall	10.10.10.11 - 10.10.10.254
			Acad Staff	10.10.10.12 - 10.10.10.254
			Comp Lab	10.10.10.13 - 10.10.10.254
	SMMTC	VLAN 20	Admin Staff	10.10.20.10 - 10.10.20.254
			Lecture Hall	10.10.20.11 - 10.10.20.254
			Acad Staff	10.10.20.12 - 10.10.20.254
			Comp Lab	10.10.20.13 - 10.10.20.254
	SAPSP	VLAN 30	Admin Staff	10.10.30.10 - 10.10.30.254
			Lecture Hall	10.10.30.11 - 10.10.30.254
			Acad Staff	10.10.30.12 - 10.10.30.254
			Comp Lab	10.10.30.13 - 10.10.30.254
	SQS	VLAN 40	Admin Staff	10.10.40.10 - 10.10.40.254
			Lecture Hall	10.10.40.11 - 10.10.40.254
			Acad Staff	10.10.40.12 - 10.10.40.254
			Comp Lab	10.10.40.13 - 10.10.40.254
	SOE	VLAN 50	Admin Staff	10.10.50.10 - 10.10.50.254
			Lecture Hall	10.10.50.11 - 10.10.50.254

			Acad Staff	10.10.50.12 - 10.10.50.254
			Comp Lab	10.10.50.13 - 10.10.50.254
	SLCP	VLAN 60	Admin Staff	10.10.60.10 - 10.10.60.254
			Lecture Hall	10.10.60.11 - 10.10.60.254
			Acad Staff	10.10.60.12 - 10.10.60.254
			Comp Lab	10.10.60.13 - 10.10.60.254
	SOC	VLAN 70	Admin Staff Soc	10.10.70.11 - 10.10.70.254
			Acad Staff Soc	10.10.70.12 - 10.10.70.254
			Dkg 4/1-5	10.10.70.10 - 10.10.70.254
			Btm	10.10.70.13 - 10.10.70.254
		VLAN 80	Dewan Seminar Uum Cas	10.10.80.14 - 10.10.80.254
			Auditorium Uum Cas	10.10.80.15 - 10.80.254
			Soc Lab 1-5	10.10.80.16 - 10.10.80.254
			Etr 1-4	10.10.80.17 - 10.10.80.254

Vlan	Department	Subnet	Subnet Mask	Gateway IP	Broadcast
10	SCIMPA	10.10.10.0/24	255.255.255.0	10.10.10.1	10.10.10.255
20	SMMTC	10.10.20.0/24	255.255.255.0	10.10.20.1	10.10.20.255
30	SAPSP	10.10.30.0/24	255.255.255.0	10.10.30.1	10.10.30.255
40	SQS	10.10.40.0/24	255.255.255.0	10.10.40.1	10.10.40.255
50	SOE	10.10.50.0/24	255.255.255.0	10.10.50.1	10.10.50.255
60	SLCP	10.10.60.0/24	255.255.255.0	10.10.60.1	10.10.60.255
70	SOC-1	10.10.70.0/24	255.255.255.0	10.10.70.1	10.10.70.255
80	SOC-2	10.10.80.0/24	255.255.255.0	10.10.80.1	10.10.80.255

4.0 HARDWARE LIST

- **Core layer**
  - 3650-24PS Multilayer Switch
  - 1841 Internet Router
  - Server-PT Server
  - AccessPoint-PT

- **Distribution layer**
  - 3650-24PS Multilayer Switch

- **Access layer**
  - 3650-24PS Multilayer Switch
  - 2960-24TT Switch

- **End devices**
  - PC-PT Personal Computer
  - Printer-PT

5.0 BUILDINGS LIST

- ADMINISTRATIVE
    - LIBRARY
    - HEP
    - PKU
    - UASSIST
    - BANGUNAN CANSELORI
    - HEA
    - CEDI

- ACADEMIC

  <u>COB</u>

    - TISSA
        - Lecture Halls
        - Computer labs
        - Academic Staff Offices
        - Admin Staff Offices

    - IBS
        - Lecture Halls
        - Computer labs
        - Academic Staff Offices
        - Admin Staff Offices

    - STML
        - Lecture Halls
        - Computer labs
        - Academic Staff Offices
        - Admin Staff Offices

- SBM
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- SEFB
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

CAS

- SCIMPA
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- SMMTC
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- SAPSP
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- SQS
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- SOE
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- SOC
    - SOC Lab 1 / SOC Lab 2 / SOC Lab 3 / SOC Lab 4 / SOC Lab 5
    - Auditorium
    - Dewan Seminar
    - Lecture halls DKG 4/1 - 4/5
    - BTM10 / BTM11
    - ETR 1 / ETR 2 / ETR 3 / ETR 4
    - Academic Staff Offices
    - Admin Staff Offices

- SLCP
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

COLGIS

- SOL
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- SOIS
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- DEANSTHEM
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

- COLGIS PPK
    - Lecture Halls
    - Computer labs
    - Academic Staff Offices
    - Admin Staff Offices

6.0 OSPF CONFIGURATIONS

1. CAS-MLS (CORE)

```
router ospf 1
 router-id 2.2.2.2
 network 10.10.10.0 0.0.0.255 area 0
 network 192.168.10.0 0.0.0.3 area 0
network 10.10.20.0 0.0.0.255 area 0
 network 192.168.20.0 0.0.0.3 area 0
network 10.10.30.0 0.0.0.255 area 0
 network 192.168.30.0 0.0.0.3 area 0
network 10.10.40.0 0.0.0.255 area 0
 network 192.168.40.0 0.0.0.3 area 0
network 10.10.50.0 0.0.0.255 area 0
 network 192.168.50.0 0.0.0.3 area 0
network 10.10.60.0 0.0.0.255 area 0
 network 192.168.60.0 0.0.0.3 area 0
network 10.10.70.0 0.0.0.255 area 0
 network 192.168.70.0 0.0.0.3 area 0
network 10.10.80.0 0.0.0.255 area 0
 network 192.168.80.0 0.0.0.3 area 0
```

2. **SCIMPA-MLS (VLAN 10)**

```
router ospf 1
 router-id 1.1.1.1
 network 10.10.10.0 0.0.0.255 area 0
 network 192.168.10.0 0.0.0.3 area 0
```

3. **SMMTC-MLS (VLAN 20)**

```
router ospf 1
 router-id 3.3.3.3
 network 10.10.20.0 0.0.0.255 area 0
 network 192.168.20.0 0.0.0.3 area 0
```

4. **SAPSP-MLS (VLAN 30)**

```
router ospf 1
 router-id 4.4.4.4
 network 10.10.30.0 0.0.0.255 area 0
 network 192.168.30.0 0.0.0.3 area 0
```

5. **SQS-MLS (VLAN 40)**

```
router ospf 1
 router-id 5.5.5.5
 network 10.10.40.0 0.0.0.255 area 0
 network 192.168.40.0 0.0.0.3 area 0
```

6. **SOE-MLS (VLAN 50)**

```
router ospf 1
 router-id 6.6.6.6
 network 10.10.50.0 0.0.0.255 area 0
 network 192.168.50.0 0.0.0.3 area 0
```

7. **SLCP-MLS (VLAN 60)**

```
router ospf 1
 router-id 7.7.7.7
 network 10.10.60.0 0.0.0.255 area 0
 network 192.168.60.0 0.0.0.3 area 0
```

8. **SOC-MLS (VLAN 70, VLAN 80)**

```
router ospf 1
 router-id 8.8.8.8
 network 10.10.70.0 0.0.0.255 area 0
 network 192.168.70.0 0.0.0.3 area 0
router ospf 1
 router-id 9.9.9.9
 network 10.10.80.0 0.0.0.255 area 0
 network 192.168.80.0 0.0.0.3 area 0
```

7.0 JUSTIFICATION OF SINGLE-AREA OSPF DESIGN CHOICE

1. Simplicity

- A single-area design (Area 0 only) simplifies both configuration and troubleshooting.
- Since all routers utilize the same OSPF database, it becomes easier to grasp the routing behavior.

2. Size of the Network

- The network consists of 7 buildings, each featuring just 2 subnets where one for internal VLAN and another for uplink to the core. This setup is relatively small and does not necessitate the use of multiple areas.
- Scalability issues with OSPF usually come into play when managing hundreds of routers or LSAs, which is not applicable in this situation.

3. Efficient Resource Use

- Eliminates the requirement for Area Border Routers ABRs and translations of Link-State Advertisements (LSAs) from Type 1/2 to Type 3.
- Lowers CPU and memory usage, as all routers only need to manage a single link-state database.

4. Faster Convergence

- In a single-area OSPF setup, routing updates are transmitted rapidly and reliably.
- There’s no need for route summarization or redistribution between areas, which can lead to delays or inconsistencies.

5. Appropriate for Hierarchical Campus Topology

- The CAS network follows a structured three-layer hierarchy which are core, distribution, and access.
- Using a single OSPF area (Area 0) aligns seamlessly with this architecture. Since all Layer 3 switches in the distribution layer are directly or indirectly connected to the core switch, there's no operational need to divide the network into multiple areas. This makes the design more straightforward while still supporting scalability and efficient routing.

8.0 FINAL TEST RESULTS

A. PC-to-PC Ping Tests

SCIMPA

1. **Ping between two PC (same building)**

```
C:\>ping 10.10.10.11

Pinging 10.10.10.11 with 32 bytes of data:

Reply from 10.10.10.11: bytes=32 time<1ms TTL=128
Reply from 10.10.10.11: bytes=32 time=1ms TTL=128
Reply from 10.10.10.11: bytes=32 time<1ms TTL=128
Reply from 10.10.10.11: bytes=32 time<1ms TTL=128

Ping statistics for 10.10.10.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

2. **Ping Default Gateway**

```
C:\>ping 10.10.10.1

Pinging 10.10.10.1 with 32 bytes of data:

Reply from 10.10.10.1: bytes=32 time=72ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.10.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 72ms, Average = 18ms
```

3. **Ping SCIMPA-MLS**

```
C:\>ping 192.168.10.1

Pinging 192.168.10.1 with 32 bytes of data:

Reply from 192.168.10.1: bytes=32 time=1ms TTL=255
Reply from 192.168.10.1: bytes=32 time<1ms TTL=255
Reply from 192.168.10.1: bytes=32 time<1ms TTL=255
Reply from 192.168.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

4. **Ping CAS-MLS**

```
C:\>ping 192.168.10.2

Pinging 192.168.10.2 with 32 bytes of data:

Reply from 192.168.10.2: bytes=32 time<1ms TTL=254
Reply from 192.168.10.2: bytes=32 time<1ms TTL=254
Reply from 192.168.10.2: bytes=32 time<1ms TTL=254
Reply from 192.168.10.2: bytes=32 time<1ms TTL=254

Ping statistics for 192.168.10.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

5. **Ping between two PC (different building)**
    a. **From PC-SCIMPA to PC-SMMTC**

```
C:\>ping 10.10.20.10

Pinging 10.10.20.10 with 32 bytes of data:

Reply from 10.10.20.10: bytes=32 time<1ms TTL=125
Reply from 10.10.20.10: bytes=32 time<1ms TTL=125
Reply from 10.10.20.10: bytes=32 time<1ms TTL=125
Reply from 10.10.20.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.10.20.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

    b. **From PC-SCIMPA to PC-SAPSP**

```
C:\>ping 10.10.30.10

Pinging 10.10.30.10 with 32 bytes of data:

Reply from 10.10.30.10: bytes=32 time<1ms TTL=125
Reply from 10.10.30.10: bytes=32 time<1ms TTL=125
Reply from 10.10.30.10: bytes=32 time<1ms TTL=125
Reply from 10.10.30.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.10.30.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

    c. **From PC-SCIMPA to PC-SQS**

```
C:\>ping 10.10.40.10

Pinging 10.10.40.10 with 32 bytes of data:

Reply from 10.10.40.10: bytes=32 time<1ms TTL=125
Reply from 10.10.40.10: bytes=32 time<1ms TTL=125
Reply from 10.10.40.10: bytes=32 time<1ms TTL=125
Reply from 10.10.40.10: bytes=32 time=10ms TTL=125

Ping statistics for 10.10.40.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

d. From PC-SCIMPA to PC-SOE

```
C:\>ping 10.10.50.10

Pinging 10.10.50.10 with 32 bytes of data:

Request timed out.
Reply from 10.10.50.10: bytes=32 time<1ms TTL=125
Reply from 10.10.50.10: bytes=32 time<1ms TTL=125
Reply from 10.10.50.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.10.50.10:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

e. From PC-SCIMPA to PC-SLCP

```
C:\>ping 10.10.60.10

Pinging 10.10.60.10 with 32 bytes of data:

Reply from 10.10.60.10: bytes=32 time<1ms TTL=125
Reply from 10.10.60.10: bytes=32 time<1ms TTL=125
Reply from 10.10.60.10: bytes=32 time=11ms TTL=125
Reply from 10.10.60.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.10.60.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 2ms
```

f. From PC-SCIMPA to PC-SOC

```
C:\>ping 10.10.70.10

Pinging 10.10.70.10 with 32 bytes of data:

Reply from 10.10.70.10: bytes=32 time<1ms TTL=125
Reply from 10.10.70.10: bytes=32 time<1ms TTL=125
Reply from 10.10.70.10: bytes=32 time<1ms TTL=125
Reply from 10.10.70.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.10.70.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

B. Routing Test

1. Show ip ospf neighbor

```
CAS-MLS#show ip ospf neighbor


Neighbor ID     Pri   State           Dead Time   Address         Interface
3.3.3.3           1   FULL/DR         00:00:31    192.168.20.1    GigabitEthernet1/0/2
1.1.1.1           1   FULL/BDR        00:00:31    192.168.10.1    GigabitEthernet1/0/1
6.6.6.6           1   FULL/DR         00:00:31    192.168.50.1    GigabitEthernet1/0/5
4.4.4.4           1   FULL/DR         00:00:31    192.168.30.1    GigabitEthernet1/0/3
5.5.5.5           1   FULL/DR         00:00:31    192.168.40.1    GigabitEthernet1/0/4
7.7.7.7           1   FULL/DR         00:00:31    192.168.60.1    GigabitEthernet1/0/6
9.9.9.9           1   FULL/DR         00:00:31    192.168.70.1    GigabitEthernet1/0/7
```

2. Show ip route ospf

```
CAS-MLS#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 8 subnets
O       10.10.10.0 [110/2] via 192.168.10.1, 00:00:22, GigabitEthernet1/0/1
O       10.10.20.0 [110/2] via 192.168.20.1, 00:00:22, GigabitEthernet1/0/2
O       10.10.30.0 [110/2] via 192.168.30.1, 00:00:22, GigabitEthernet1/0/3
O       10.10.40.0 [110/2] via 192.168.40.1, 00:00:22, GigabitEthernet1/0/4
O       10.10.50.0 [110/2] via 192.168.50.1, 00:00:22, GigabitEthernet1/0/5
O       10.10.60.0 [110/2] via 192.168.60.1, 00:00:22, GigabitEthernet1/0/6
O       10.10.70.0 [110/2] via 192.168.70.1, 00:00:22, GigabitEthernet1/0/7
O       10.10.80.0 [110/2] via 192.168.70.1, 00:00:22, GigabitEthernet1/0/7
     192.168.10.0/30 is subnetted, 1 subnets
C       192.168.10.0 is directly connected, GigabitEthernet1/0/1
     192.168.20.0/30 is subnetted, 1 subnets
C       192.168.20.0 is directly connected, GigabitEthernet1/0/2
     192.168.30.0/30 is subnetted, 1 subnets
C       192.168.30.0 is directly connected, GigabitEthernet1/0/3
     192.168.40.0/30 is subnetted, 1 subnets
C       192.168.40.0 is directly connected, GigabitEthernet1/0/4
     192.168.50.0/30 is subnetted, 1 subnets
C       192.168.50.0 is directly connected, GigabitEthernet1/0/5
     192.168.60.0/30 is subnetted, 1 subnets
C       192.168.60.0 is directly connected, GigabitEthernet1/0/6
     192.168.70.0/30 is subnetted, 1 subnets
C       192.168.70.0 is directly connected, GigabitEthernet1/0/7
```

3. Ping Test

a. From CAS-MLS to SCIMPA- MLS

```
CAS-MLS#ping 192.168.10.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/3/16 ms
```

b. From PC in vlan 10 to PC in vlan 20

```
C:\>ping 10.10.20.10

Pinging 10.10.20.10 with 32 bytes of data:

Reply from 10.10.20.10: bytes=32 time=23ms TTL=125
Reply from 10.10.20.10: bytes=32 time<1ms TTL=125
Reply from 10.10.20.10: bytes=32 time<1ms TTL=125
Reply from 10.10.20.10: bytes=32 time<1ms TTL=125

Ping statistics for 10.10.20.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 23ms, Average = 5ms
```