CN 211 Step-by-Step Implementation Guide (Team Edition)

Target: Any teammate should be able to build, configure, test, and present the full solution from scratch in Packet Tracer.

Submission alignment: Built to satisfy assignment requirements for DNS, WEB, DHCP, wireless, router configuration, and inter-site web accessibility.

0) What You Will Build

Site	Router	Users LAN	Server LAN	WiFi LAN	Server IP
UDOM	Cisco 2911 + HWIC-2T	10.1.1.0/24	10.1.2.0/24	10.1.3.0/24	10.1.2.2
BUNGE	Cisco 2911 + HWIC-2T	10.2.1.0/24	10.2.2.0/24	10.2.3.0/24	10.2.2.2
MIPANGO	Cisco 2911 + HWIC-2T	10.3.1.0/24	10.3.2.0/24	10.3.3.0/24	10.3.2.2
CBE	Cisco 2911 + HWIC-2T	10.4.1.0/24	10.4.2.0/24	10.4.3.0/24	10.4.2.2
WAN	Cloud-PT Frame Relay	10.10.10.0/24 on router serial links			

> **Why this IP plan:** Each site gets a clean block (10.site.subnet.0/24), making troubleshooting and presentation explanations simple and non-overlapping.

1) Place Devices in Packet Tracer

1.1 Add devices per site

For each of the 4 sites, place:

- 1 Router `CISCO2911/K9`
- 1 Switch (2960 or equivalent)
- 1 Server-PT
- 1 AccessPoint-PT
- At least 1 PC-PT and 1 Laptop-PT

1.2 Add WAN cloud

- Place 1 `Cloud-PT` in center as Internet/WAN cloud.
- Open cloud `Physical` tab, power off cloud, insert serial modules (`PT-CLOUD-NM-1S`) so ports `Se0, Se1, Se2, Se3` are available, power on.

1.3 Add serial modules on routers

- On each 2911 router, in `Physical`, power off, insert `HWIC-2T`, power on.
- Use `Serial0/1/0` as WAN interface.

2) Cable the Topology Exactly

Site	Users Switch Port	Server Port	AP Port	Cloud Port
UDOM	Router Gi0/0 -> Switch	Router Gi0/1 -> Server path	Router Fa0/0/0 -> AP	Router Se0/1/0 -> Cloud Se0
BUNGE	Router Gi0/0 -> Switch	Router Gi0/2 -> Server path	Router Fa0/0/0 -> AP	Router Se0/1/0 -> Cloud Se2
MIPANGO	Router Gi0/2 -> Switch	Router Gi0/1 -> Server path	Router Fa0/0/0 -> AP	Router Se0/1/0 -> Cloud Se1
CBE	Router Gi0/1 -> Switch	Router Gi0/0 -> Server path	Router Fa0/0/0 -> AP	Router Se0/1/0 -> Cloud Se3

> **Common mistake:** Server plugged into wrong Gig interface. If server LAN gateway is x.x.2.1, server must be connected behind that exact interface.

3) Configure Cloud Frame Relay (Critical)

3.1 Open Cloud -> Config -> Connections -> Frame Relay

Create full-mesh sublinks between serial ports:

- Se0 <-> Se1
- Se0 <-> Se2
- Se0 <-> Se3

- Se1 <-> Se2
- Se1 <-> Se3
- Se2 <-> Se3

If your cloud requires directional entries, add both directions for each pair.

3.2 Why this is needed

Without Frame Relay PVC pairs, serial interfaces may be up but routers will not pass traffic across WAN.

4) Configure Routers (CLI Manual Commands)

You can paste pre-clean files from `CONFIGURATIONS/routers_clean/`, or enter manually below.

4.1 UDOM Router

```
enable

conf t

hostname UDOM-ROUTER

ip domain-lookup

ip name-server 10.1.2.2

ip host www.udom.ac.tz 10.1.2.2

ip host www.bunge.gov.tz 10.2.2.2

ip host www.mipango.ac.tz 10.3.2.2

ip host www.cbe.ac.tz 10.4.2.2



interface g0/0

 ip address 10.1.1.1 255.255.255.0

 no shut

exit

interface g0/1
```

```
 ip address 10.1.2.1 255.255.255.0
 no shut
exit
interface g0/2
 no ip address
 shut
exit
interface range fa0/0/0 - 3
 switchport mode access
 switchport access vlan 1
 no shut
exit
interface vlan1
 ip address 10.1.3.1 255.255.255.0
 no shut
exit
interface s0/1/0
 ip address 10.10.10.2 255.255.255.0
 encapsulation frame-relay
 no shut
exit
interface s0/1/1
 shut
exit
```

```
ip dhcp excluded-address 10.1.1.1 10.1.1.20

ip dhcp excluded-address 10.1.2.1 10.1.2.20

ip dhcp excluded-address 10.1.3.1 10.1.3.20

ip dhcp pool UDOM_LAN_USERS

 network 10.1.1.0 255.255.255.0

 default-router 10.1.1.1

 dns-server 10.1.2.2

exit

ip dhcp pool UDOM_WIFI

 network 10.1.3.0 255.255.255.0

 default-router 10.1.3.1

 dns-server 10.1.2.2

exit



ip route 10.2.1.0 255.255.255.0 10.10.10.3

ip route 10.2.2.0 255.255.255.0 10.10.10.3

ip route 10.2.3.0 255.255.255.0 10.10.10.3

ip route 10.3.1.0 255.255.255.0 10.10.10.4

ip route 10.3.2.0 255.255.255.0 10.10.10.4

ip route 10.3.3.0 255.255.255.0 10.10.10.4

ip route 10.4.1.0 255.255.255.0 10.10.10.5

ip route 10.4.2.0 255.255.255.0 10.10.10.5

ip route 10.4.3.0 255.255.255.0 10.10.10.5
```

```
end

wr
```

4.2 BUNGE Router

```
enable

conf t

hostname BUNGE-ROUTER

ip domain-lookup

ip name-server 10.2.2.2

ip host www.udom.ac.tz 10.1.2.2

ip host www.bunge.gov.tz 10.2.2.2

ip host www.mipango.ac.tz 10.3.2.2

ip host www.cbe.ac.tz 10.4.2.2



interface g0/0

 ip address 10.2.1.1 255.255.255.0

 no shut

exit

interface g0/1

 no ip address

 shut

exit

interface g0/2

 ip address 10.2.2.1 255.255.255.0

 no shut
```

```
exit

interface range fa0/0/0 - 3

 switchport mode access

 switchport access vlan 1

 no shut

exit

interface vlan1

 ip address 10.2.3.1 255.255.255.0

 no shut

exit

interface s0/1/0

 ip address 10.10.10.3 255.255.255.0

 encapsulation frame-relay

 no shut

exit

interface s0/1/1

 shut

exit



ip dhcp excluded-address 10.2.1.1 10.2.1.20

ip dhcp excluded-address 10.2.2.1 10.2.2.20

ip dhcp excluded-address 10.2.3.1 10.2.3.20

ip dhcp pool BUNGE_LAN_USERS

 network 10.2.1.0 255.255.255.0
```

```
 default-router 10.2.1.1

 dns-server 10.2.2.2

exit

ip dhcp pool BUNGE_WIFI

 network 10.2.3.0 255.255.255.0

 default-router 10.2.3.1

 dns-server 10.2.2.2

exit



ip route 10.1.1.0 255.255.255.0 10.10.10.2

ip route 10.1.2.0 255.255.255.0 10.10.10.2

ip route 10.1.3.0 255.255.255.0 10.10.10.2

ip route 10.3.1.0 255.255.255.0 10.10.10.4

ip route 10.3.2.0 255.255.255.0 10.10.10.4

ip route 10.3.3.0 255.255.255.0 10.10.10.4

ip route 10.4.1.0 255.255.255.0 10.10.10.5

ip route 10.4.2.0 255.255.255.0 10.10.10.5

ip route 10.4.3.0 255.255.255.0 10.10.10.5

end

wr
```

4.3 MIPANGO Router

```
enable

conf t

hostname MIPANGO-ROUTER
```

```
ip domain-lookup

ip name-server 10.3.2.2

ip host www.udom.ac.tz 10.1.2.2

ip host www.bunge.gov.tz 10.2.2.2

ip host www.mipango.ac.tz 10.3.2.2

ip host www.cbe.ac.tz 10.4.2.2



interface g0/0

 no ip address

 shut

exit

interface g0/1

 ip address 10.3.2.1 255.255.255.0

 no shut

exit

interface g0/2

 ip address 10.3.1.1 255.255.255.0

 no shut

exit

interface range fa0/0/0 - 3

 switchport mode access

 switchport access vlan 1

 no shut

exit
```

```
interface vlan1
 ip address 10.3.3.1 255.255.255.0
 no shut
exit
interface s0/1/0
 ip address 10.10.10.4 255.255.255.0
 encapsulation frame-relay
 no shut
exit
interface s0/1/1
 shut
exit



ip dhcp excluded-address 10.3.1.1 10.3.1.20
ip dhcp excluded-address 10.3.2.1 10.3.2.20
ip dhcp excluded-address 10.3.3.1 10.3.3.20
ip dhcp pool MIPANGO_LAN_USERS
 network 10.3.1.0 255.255.255.0
 default-router 10.3.1.1
 dns-server 10.3.2.2
exit
ip dhcp pool MIPANGO_WIFI
 network 10.3.3.0 255.255.255.0
 default-router 10.3.3.1
```

```
 dns-server 10.3.2.2

exit



ip route 10.1.1.0 255.255.255.0 10.10.10.2

ip route 10.1.2.0 255.255.255.0 10.10.10.2

ip route 10.1.3.0 255.255.255.0 10.10.10.2

ip route 10.2.1.0 255.255.255.0 10.10.10.3

ip route 10.2.2.0 255.255.255.0 10.10.10.3

ip route 10.2.3.0 255.255.255.0 10.10.10.3

ip route 10.4.1.0 255.255.255.0 10.10.10.5

ip route 10.4.2.0 255.255.255.0 10.10.10.5

ip route 10.4.3.0 255.255.255.0 10.10.10.5

end

wr
```

4.4 CBE Router

```
enable

conf t

hostname CBE-ROUTER

ip domain-lookup

ip name-server 10.4.2.2

ip host www.udom.ac.tz 10.1.2.2

ip host www.bunge.gov.tz 10.2.2.2

ip host www.mipango.ac.tz 10.3.2.2

ip host www.cbe.ac.tz 10.4.2.2
```

```
interface g0/0
 ip address 10.4.2.1 255.255.255.0
 no shut
exit
interface g0/1
 ip address 10.4.1.1 255.255.255.0
 no shut
exit
interface g0/2
 no ip address
 shut
exit
interface range fa0/0/0 - 3
 switchport mode access
 switchport access vlan 1
 no shut
exit
interface vlan1
 ip address 10.4.3.1 255.255.255.0
 no shut
exit
interface s0/1/0
 ip address 10.10.10.5 255.255.255.0
```

```
 encapsulation frame-relay

 no shut

exit

interface s0/1/1

 shut

exit



ip dhcp excluded-address 10.4.1.1 10.4.1.20

ip dhcp excluded-address 10.4.2.1 10.4.2.20

ip dhcp excluded-address 10.4.3.1 10.4.3.20

ip dhcp pool CBE_LAN_USERS

 network 10.4.1.0 255.255.255.0

 default-router 10.4.1.1

 dns-server 10.4.2.2

exit

ip dhcp pool CBE_WIFI

 network 10.4.3.0 255.255.255.0

 default-router 10.4.3.1

 dns-server 10.4.2.2

exit



ip route 10.1.1.0 255.255.255.0 10.10.10.2

ip route 10.1.2.0 255.255.255.0 10.10.10.2

ip route 10.1.3.0 255.255.255.0 10.10.10.2
```

```
ip route 10.2.1.0 255.255.255.0 10.10.10.3

ip route 10.2.2.0 255.255.255.0 10.10.10.3

ip route 10.2.3.0 255.255.255.0 10.10.10.3

ip route 10.3.1.0 255.255.255.0 10.10.10.4

ip route 10.3.2.0 255.255.255.0 10.10.10.4

ip route 10.3.3.0 255.255.255.0 10.10.10.4

end

wr
```

5) Configure Each Server (DNS + HTTP)

5.1 Desktop -> IP Configuration (Static)

Server	IP	Mask	Gate way	DNS
UDOM	10.1.2.2	255.255.255.0	10.1.2.1	127.0.0.1
BUNGE	10.2.2.2	255.255.255.0	10.2.2.1	127.0.0.1
MIPANGO	10.3.2.2	255.255.255.0	10.3.2.1	127.0.0.1
CBE	10.4.2.2	255.255.255.0	10.4.2.1	127.0.0.1

5.2 Services -> DNS (On)

On each server add all 4 A records:

```
www.udom.ac.tz    10.1.2.2

www.bunge.gov.tz  10.2.2.2

www.mipango.ac.tz 10.3.2.2
```

```
www.cbe.ac.tz     10.4.2.2
```

5.3 Services -> HTTP (On)

Edit `index.html` for each institution identity.

6) Configure Access Points

1. Open AP -> Config -> Wireless.
2. Set SSID (e.g., UDOM_WIFI, BUNGE_WIFI, MIPANGO_WIFI, CBE_WIFI).
3. Security:
    - Testing: Open
    - Final demo: WPA2-PSK recommended
4. AP management IP can be DHCP.

Why AP DHCP initially fails in many labs: AP is on Fa0/0/0 L2 port, but wireless gateway was wrongly configured on routed Gi interface instead of `vlan1`.

7) Configure End Devices

1. On each PC/Laptop: Desktop -> IP Configuration -> DHCP.
2. For wireless laptop: Desktop -> PC Wireless -> connect to site SSID.
3. Confirm IP/GW/DNS assigned in correct subnet.

8) Verification Commands and Tests (Order Matters)

8.1 Router layer checks

```
show ip int brief

show frame-relay pvc

show ip route

show ip dhcp binding

show hosts
```

8.2 WAN checks from UDOM router

```
ping 10.10.10.3

ping 10.10.10.4
```

```
ping 10.10.10.5
```

8.3 Inter-site server checks from UDOM router

```
ping 10.2.2.2

ping 10.3.2.2

ping 10.4.2.2
```

8.4 DNS + web checks from PCs (grading-critical)

```
nslookup www.udom.ac.tz

nslookup www.bunge.gov.tz

nslookup www.mipango.ac.tz

nslookup www.cbe.ac.tz
```

Open browser and access all four domains from at least one remote site each.

9) Quick Troubleshooting Flow

1. If WAN ping fails: check Cloud PVC pairs and serial interface `up/up`.
2. If domain does not resolve: check DNS service ON and A records on server.
3. If domain resolves but ping fails: routing or cabling mismatch.
4. If local server unreachable from local router: server on wrong interface/subnet.
5. If AP clients get no IP: verify `Vlan1` IP and WiFi DHCP pool.

10) Why Each Main Configuration Exists (Presentation-Ready)

Config Block	Why it exists
`interface Serial0/1/0 + frame-relay`	WAN transport over Cloud-PT Frame Relay PVCs.
`ip route ...`	Static inter-campus connectivity to all remote subnets.
`ip dhcp pool ...`	Automatic host addressing for users and wireless clients.
`dns-server x.x.2.2` in	Clients use local site DNS server for all domain

DHCP	lookups.
`interface Vlan1`	Wireless gateway on integrated switchport VLAN where AP is connected.
Server static IP	Stable addressing for DNS records and web hosting.
DNS A records on each server	Cross-site name resolution with local resilience.
HTTP index pages	Demonstrates institutional website requirement.

11) Viva / Presentation Question Bank (Practice)

1. Why did you use Frame Relay cloud PVCs instead of direct point-to-point links?
2. Why does each site have three subnets?
3. Why is AP traffic gatewayed on Vlan1 and not a routed Gi interface?
4. How did you ensure no IP overlap across institutions?
5. What is the advantage of using /24 per LAN here?
6. Why do servers use static IP while clients use DHCP?
7. How did you prove DNS works for remote domains?
8. How did you prove web access from any LAN?
9. How do you identify DNS issue vs routing issue quickly?
10. How would you add a fifth institution?
11. What are the scalability limits of static routing?
12. What security improvements can be added for wireless?
13. How can you verify cloud PVC status from router CLI?
14. Why is consistent addressing important during troubleshooting?
15. What assignment marks are covered by custom web pages?

12) Team Files to Use

- `CONFIGURATIONS/routers_clean/*.txt` for router CLI pasting.
- `CONFIGURATIONS/servers/*.txt` for server click-by-click setup.
- `CONFIGURATIONS/reference/CLOUD_FRAME_RELAY_PVC_TABLE.txt` for WAN cloud setup.
- `CONFIGURATIONS/reference/AP_SETUP.txt` for AP setup.

End of step-by-step guide.