

**1. Equipment Required**

| **Equipment** | **Quantity** | **Purpose** |
| --- | --- | --- |
| Cisco Router 2811 | 2 | For interconnecting and routing |
| Cisco Switch | 4 | For connecting PCs to the routers |
| PC | 4 | For end devices in each subnet |
| Copper Straight-through Cable | 4 | Connect PCs to switches |
| Copper Cross-over Cable | 2 | Connect switches to router FastEthernet ports |
| Serial DCE Cable | 1 | Connect routers via Serial2/0 |

**. Network Design Plan**

**Router A**

* FastEthernet0/0 → 192.168.1.0/24
* FastEthernet1/0 → 192.168.3.0/24
* Serial2/0 → 10.10.10.1/30 (point-to-point link to Router B)

**Router B**

* FastEthernet0/0 → 192.168.2.0/24
* FastEthernet1/0 → 192.168.4.0/24
* Serial2/0 → 10.10.10.2/30

**3. Step-by-Step Implementation**

**Step 1: Place Equipment**

* Add **2 Routers** (Router0, Router1)
* Add **4 Switches** (Switch0–Switch3)
* Add **4 PCs** (PC0–PC3)
* Place everything neatly.

**Step 2: Connect Devices**

* **PC0 → Switch0 → Router0 (Fa0/0)**
* **PC1 → Switch1 → Router0 (Fa1/0)**
* **PC2 → Switch2 → Router1 (Fa0/0)**
* **PC3 → Switch3 → Router1 (Fa1/0)**
* **Router0 Serial2/0 ↔ Router1 Serial2/0** using Serial DCE Cable

Right-click Serial2/0 on Router0 and make it **DCE** (to provide clock rate).

**Step 3: Configure Router A (Router0)**

1. Enter CLI:

Router>enable

Router#configure terminal

1. **Configure Interfaces**

interface FastEthernet0/0

ip address 192.168.1.1 255.255.255.0

no shutdown

interface FastEthernet1/0

ip address 192.168.3.1 255.255.255.0

no shutdown

interface Serial2/0

ip address 10.10.10.1 255.255.255.252

clock rate 64000

no shutdown

1. **Enable RIP**

router rip

version 2

network 192.168.1.0

network 192.168.3.0

network 10.0.0.0

no auto-summary

**Step 4: Configure Router B (Router1)**

1. Enter CLI:

Router>enable

Router#configure terminal

1. **Configure Interfaces**

interface FastEthernet0/0

ip address 192.168.2.1 255.255.255.0

no shutdown

interface FastEthernet1/0

ip address 192.168.4.1 255.255.255.0

no shutdown

interface Serial2/0

ip address 10.10.10.2 255.255.255.252

no shutdown

1. **Enable RIP**

router rip

version 2

network 192.168.2.0

network 192.168.4.0

network 10.0.0.0

no auto-summary

**Step 5: Configure PCs**

* **PC0**: IP 192.168.1.10, Subnet Mask 255.255.255.0, Gateway 192.168.1.1
* **PC1**: IP 192.168.3.10, Subnet Mask 255.255.255.0, Gateway 192.168.3.1
* **PC2**: IP 192.168.2.10, Subnet Mask 255.255.255.0, Gateway 192.168.2.1
* **PC3**: IP 192.168.4.10, Subnet Mask 255.255.255.0, Gateway 192.168.4.1

To configure, click PC > Desktop > IP Configuration.

**Step 6: Verify the Network**

On **Router0**, check routing table:

Router#show ip route

You should see RIP routes to 192.168.2.0/24 and 192.168.4.0/24.

Ping from:

Router0#ping 192.168.2.10

Router0#ping 192.168.4.10

Also try pinging between PCs.

**✅ Recommended Switch: Cisco 2960**

**Name in Packet Tracer:** Switch0 (model: **Cisco Catalyst 2960**)

**Number of Switches to Use:**

You'll need **4 Cisco 2960 switches** for this setup:

| **Switch** | **Connects To** |
| --- | --- |
| Switch0 | PC0 ↔ Router0 Fa0/0 (192.168.1.0/24) |
| Switch1 | PC1 ↔ Router0 Fa1/0 (192.168.3.0/24) |
| Switch2 | PC2 ↔ Router1 Fa0/0 (192.168.2.0/24) |
| Switch3 | PC3 ↔ Router1 Fa1/0 (192.168.4.0/24) |

**How to Find in Packet Tracer:**

* Go to the **bottom-left "Switches" category**.
* Drag **Switch0 (Cisco 2960)** onto the workspace.
* Rename it if needed (e.g., "Switch\_1" for clarity).

**✅ Checklist to Connect Router0 ↔ Router1 Using Serial Ports**

**1. Use the Right Cable:**

✅ Use a **Serial DCE Cable** (also called **Serial Connection** or **Serial Cable** in Packet Tracer).

* You’ll find it under the **Connections** tab (lightning bolt icon).
* It's usually the **7th cable** in the list (gray one with "clock").

**2. Choose Serial Ports (Manually if Needed)**

**When connecting:**

* Click **Router0** → Choose **Serial2/0**
* Click **Router1** → Choose **Serial2/0**

If Serial2/0 is not available, do this:

**3. Add WIC-2T Serial Module (If Serial Port Missing)**

If you're getting **“No serial port”**, here's how to add one:

**🔧 Add WIC-2T module to the routers:**

1. **Turn off the router** (click router → Physical tab → switch off).
2. On the left module area, **drag and drop WIC-2T module** into an empty WIC slot.
3. Turn the router back on.
4. Now you’ll see Serial2/0 appear in the interface list.

Do this for **both Router0 and Router1**

**4. Set Up IP Addresses and Clock Rate**

On **Router0 (DCE end)**:

Router>enable

Router#configure terminal

interface Serial2/0

ip address 10.10.10.1 255.255.255.252

clock rate 64000 ! Only needed on the DCE end

no shutdown

On **Router1 (DTE end)**:

interface Serial2/0

ip address 10.10.10.2 255.255.255.252

no shutdown

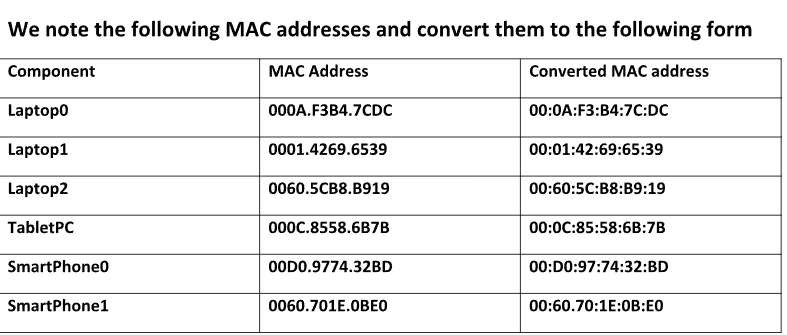
**5. Test the Connection**

* Use ping 10.10.10.2 from Router0
* Use show ip interface brief to check if Serial2/0 is **up/up**

**OTHER 2ND**

| **Device Type** | **Model Used** | **Quantity** |
| --- | --- | --- |
| Wireless Router | **WRT300N** | 1 |
| Laptop | **Laptop-PT** | 3 |
| Smartphone | **SMARTPHONE-PT** | 2 |
| Tablet | **TabletPC-PT** | 1 |

Then go in each LAPTOP and PUT PT-LAPTOP-NM-1W

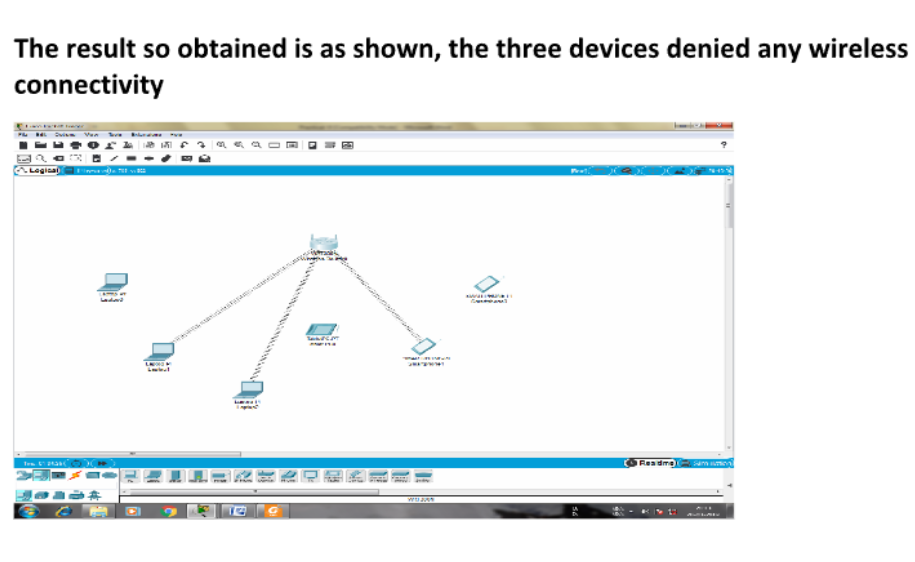


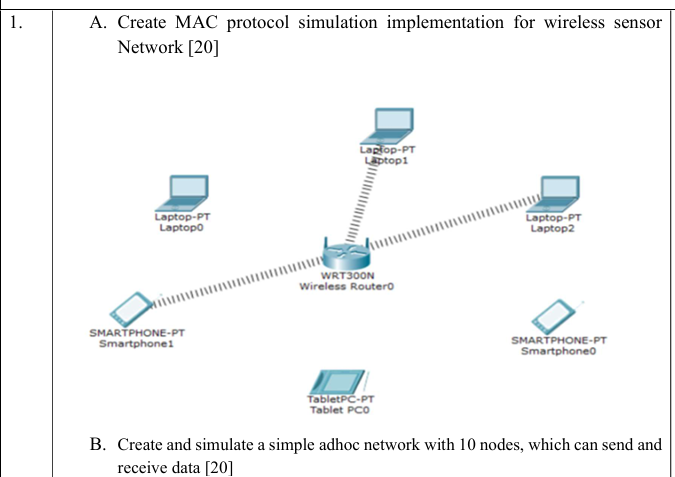
**Step-by-Step Recap:**

1. **Click on the WRT300N Router** → **GUI Tab**
2. Go to **Wireless > Wireless MAC Filter**
3. Enable it
4. Choose:  
   ✅ **Prevent PCs listed below from accessing the wireless network**
5. Add the MAC addresses:
   * Get them from each device:

Click Device → Config tab → Wireless → MAC Address

1. Save settings.





**1. A. Create MAC Protocol Simulation Implementation for Wireless Sensor Network [20]**

**Objective:**

Simulate a wireless sensor network (WSN) where selected nodes are restricted using MAC filtering.

**Steps:**

1. **Open Cisco Packet Tracer**.
2. **Place Devices:**
   * 1 Wireless Router (**WRT300N**)
   * 3 Laptops (Laptop0, Laptop1, Laptop2)
   * 2 Smartphones (Smartphone0, Smartphone1)
   * 1 TabletPC (TabletPC0)
3. **Configure Wireless Router:**
   * SSID: WSN-MAC
   * Security: **Disabled** (for simplicity)
4. **Connect Devices:**
   * Open each device → Desktop → PC Wireless → Connect to WSN-MAC
5. **Enable MAC Filtering on Router:**
   * Click Router → GUI tab → Wireless > Wireless MAC Filter
   * Select “**Enabled**”
   * Choose: “**Prevent PCs listed below from accessing the wireless network**”
   * Add MAC addresses of: Laptop0, Smartphone0, TabletPC0
   * Save settings
6. **Verification:**
   * Blocked devices fail to connect
   * Others can ping each other
   * Use arp -a to verify MAC-based communication

**Result:**

MAC protocol simulation works with controlled access at data link layer (MAC level), demonstrating wireless sensor access filtering.

**1. B. Create and Simulate a Simple Ad-Hoc Network with 10 Nodes, Which Can Send and Receive Data [20]**

**Objective:**

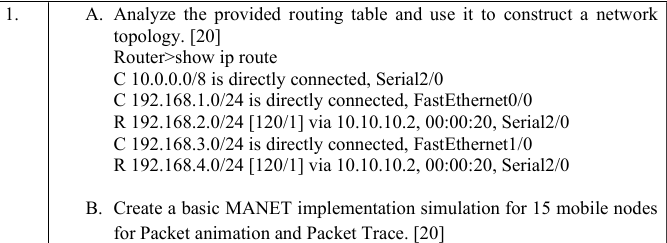
Set up a peer-to-peer **ad-hoc wireless network** where nodes directly communicate without a router.

**Steps:**

1. **Place 10 Wireless Devices** (Laptop-PT or Smartphone-PT or mix):
   * Example: Laptop0–Laptop4, Smartphone0–Smartphone2, Tablet0–Tablet2
2. **Configure Each Device:**
   * Go to **Config > Wireless0**:
     + Mode: Ad-Hoc
     + SSID: AdhocNet
     + Channel: 6
3. **Assign Static IP Addresses:**
   * Laptop0: 192.168.1.1
   * Laptop1: 192.168.1.2
   * ...
   * Up to 192.168.1.10
   * Subnet Mask: 255.255.255.0
4. **Test Communication:**
   * Open Command Prompt on Laptop0
   * Ping other nodes: ping 192.168.1.5
   * All nodes should communicate successfully

**Result:**

An ad-hoc wireless network is created where all nodes can send/receive data without a central access point.



**🖥️ Required Equipment:**

* 3 Routers (Router0, Router1, Router2)
* 3 Switches
* 6 PCs or end devices (2 for each local network)
* 2 Serial connections between Routers
* Cables: Serial (DCE/DTE), Straight-through

**🛠️ Steps to Create the Network in Cisco Packet Tracer:**

**Router0:**

* **Interfaces:**
  + Serial2/0 → to Router1 via 10.10.10.1
  + FastEthernet0/0 → to Switch0 (Network: 192.168.1.0/24)
  + FastEthernet1/0 → to Switch1 (Network: 192.168.3.0/24)

**Router1:**

* Serial2/0 → to Router0 via 10.10.10.2
* FastEthernet0/0 → to Switch2 (Network: 192.168.2.0/24)
* FastEthernet1/0 → to Switch3 (Network: 192.168.4.0/24)

**IP Configuration:**

| **Device** | **Interface** | **IP Address** | **Network** |
| --- | --- | --- | --- |
| Router0 | Serial2/0 | 10.10.10.1 | 10.0.0.0/8 |
| Router1 | Serial2/0 | 10.10.10.2 | 10.0.0.0/8 |
| Router0 | FastEthernet0/0 | 192.168.1.1 | 192.168.1.0/24 |
| Router0 | FastEthernet1/0 | 192.168.3.1 | 192.168.3.0/24 |
| Router1 | FastEthernet0/0 | 192.168.2.1 | 192.168.2.0/24 |
| Router1 | FastEthernet1/0 | 192.168.4.1 | 192.168.4.0/24 |

**Enable Routing (e.g., RIP) on All Routers:**

Router(config)# router rip

Router(config-router)# version 2

Router(config-router)# network 10.0.0.0

Router(config-router)# network 192.168.1.0

Router(config-router)# network 192.168.2.0

Router(config-router)# network 192.168.3.0

Router(config-router)# network 192.168.4.0

**Verify:** Use show ip route to check routing tablePing from PC in 192.168.1.0 to 192.168.2.0 to test connectivity

**1. B. Create a Basic MANET Simulation with 15 Mobile Nodes [20]**

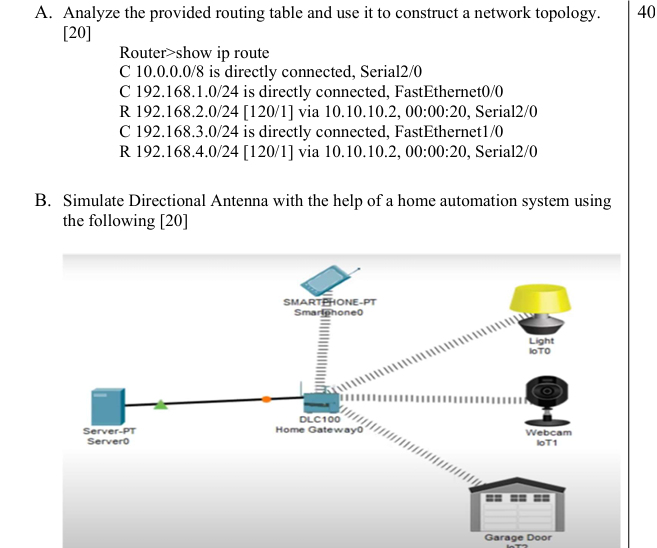
**Required Equipment:**

* **15 Wireless Devices (Laptop-PT or Smartphone-PT)**
* **No router or switch is needed**
* **Wireless Adapters configured in Ad-Hoc mode**

**🛠️ Steps in Cisco Packet Tracer:**

1. **Place 15 devices (Laptop0 to Laptop14).**
2. **For each device:**
   * **Go to Config → Wireless0**
     + **Mode: Ad-Hoc**
     + **SSID: MANET15**
     + **Channel: 6**
3. **Assign Static IP Addresses:**
   * **192.168.10.1 → Laptop0**
   * **...**
   * **192.168.10.15 → Laptop14**
   * **Subnet Mask: 255.255.255.0**
4. **Position devices within range for packet delivery.**
5. **Use Simulation Mode:**
   * **Add Simple PDU or use Ping**
   * **Example: Laptop0 → Laptop5**
   * **Click "Capture/Forward" to see packet movement**

**Verification: All devices should communicate directly.**

****

**A PART : Steps to Simulate in Packet Tracer:**

1. **Devices Needed:**
   * **2 Routers (Router0, Router1)**
   * **3 Switches**
   * **6 PCs or IoT Devices (2 per subnet)**
   * **Serial DCE cable, Ethernet cables**
2. **Router0 Interfaces:**
   * **Serial2/0: IP 10.10.10.1**
   * **FastEthernet0/0: IP 192.168.1.1**
   * **FastEthernet1/0: IP 192.168.3.1**
3. **Router1 Interfaces:**
   * **Serial2/0: IP 10.10.10.2**
   * **FastEthernet0/0: IP 192.168.2.1**
   * **FastEthernet1/0: IP 192.168.4.1**
4. **Routing Configuration (RIP):**

**Router(config)# router rip**

**Router(config-router)# version 2**

**Router(config-router)# network 10.0.0.0**

**Router(config-router)# network 192.168.1.0**

**Router(config-router)# network 192.168.2.0**

**Router(config-router)# network 192.168.3.0**

**Router(config-router)# network 192.168.4.0**

1. **Test using ping from any PC in 192.168.1.0 to 192.168.4.0.**

**B. Simulate Directional Antenna with Home Automation System [20]**

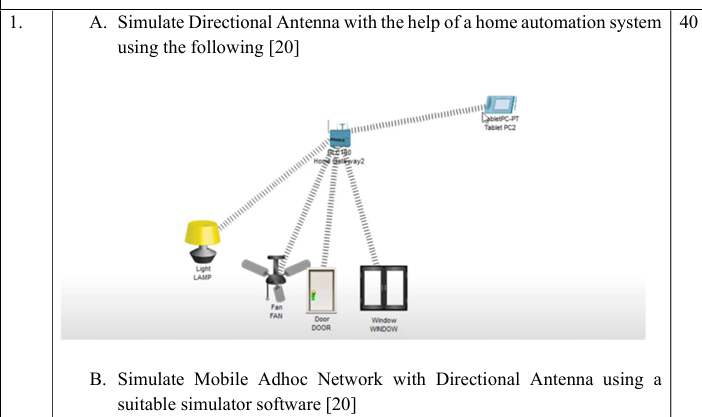
**Devices in Simulation:**

* **DLC100 Gateway – Central control point for smart devices.**
* **IoT Devices:**
  + **Light (IoT0)**
  + **Webcam (IoT1)**
  + **Garage Door (IoT2)**
* **Smartphone-PT**
* **Server-PT – for managing devices via web.**
* **Directional Antenna Link – shown by pointed wireless path from Smartphone to Gateway**

**🛠️ Steps in Cisco Packet Tracer:**

1. **Place Devices:**
   * **Add 1 DLC100 Gateway**
   * **Connect Light, Webcam, Garage Door to it via wireless.**
   * **Add Smartphone0 and set to connect to the Gateway using Directional Antenna.**
   * **Connect Server to Gateway using wired connection.**
2. **Configuring Devices:**
   * **DLC100 Gateway:**
     + **Assign IP: e.g., 192.168.0.1**
     + **Enable IoT registration services.**
   * **Server-PT:**
     + **Assign IP: 192.168.0.2**
     + **Install and run web services.**
   * **IoT Devices (Light/Webcam/Garage Door):**
     + **Connect to DLC100 via wireless**
     + **Register devices using the Gateway's IP.**
3. **Directional Antenna Setup:**
   * **Go to Smartphone0 > Config > Wireless0**
     + **Set Mode: Infrastructure**
     + **SSID: same as DLC100**
     + **Set Directional Antenna to focus signal toward DLC100**
   * **Adjust position of smartphone to be within directional range of the DLC100**
4. **Simulation:Go to Simulation modeTrigger actions like turning ON/OFF Light from Smartphone.Watch packets move via focused path**

**Verification: All IoT devices should respond when controlled via Smartphone.**

** A. Simulate Directional Antenna with a Home Automation System [20]**

**🖥️ Network Layout:**

**Devices involved:**

* **Home Gateway (IoT Gateway)**
* **Light (IoT Lamp)**
* **Fan**
* **Door**
* **Window**
* **Tablet PC2 (Laptop or Tablet acting as controller)**

**🛠️ Simulation Platform: Cisco Packet Tracer**

**✅ Step-by-Step Configuration:**

**Step 1: Add Devices**

* **From IoT devices, drag into the workspace:**
  + **1 x Home Gateway (Generic Gateway or IoT Gateway)**
  + **1 x Light**
  + **1 x Fan**
  + **1 x Door**
  + **1 x Window**
  + **1 x Tablet PC (or Laptop/Smartphone)**

**Step 2: Configure the Home Gateway**

1. **Click on Home Gateway > Config tab:**
   * **Set Display Name: HomeGateway2**
   * **Assign IP: 192.168.0.1**
2. **Go to Wireless Settings:**
   * **Set SSID: HomeNet**
   * **Authentication: WPA2-PSK**
   * **Password: 12345678**

**Step 3: Configure IoT Devices**

**Repeat for each IoT device (Light, Fan, Door, Window):**

1. **Go to Config > Wireless Settings:**
   * **Set Mode: Home Gateway**
   * **SSID: HomeNet**
   * **Security: WPA2-PSK**
   * **Password: 12345678**
2. **Save configuration.**

**Step 4: Configure Tablet PC**

1. **Go to Tablet PC2 > Config > Wireless0:**
   * **Mode: Infrastructure**
   * **SSID: HomeNet**
   * **Security: WPA2-PSK**
   * **Password: 12345678**
2. **Assign static IP (optional): 192.168.0.10**

**Step 5: Directional Antenna Simulation**

1. **From the Physical View (optional for realism), rotate device orientation.**
2. **Ensure wireless coverage lines go from Tablet PC2 directly toward HomeGateway2 and IoT devices, indicating directional communication.**
3. **You may simulate environment obstruction by placing walls to see signal behavior.**

**Step 6: Test Automation**

1. **On Tablet PC2, open IoT Monitor App.**
2. **Connect to the IP of the Gateway: 192.168.0.1**
3. **You’ll see registered devices (Light, Fan, Door, Window).**
4. **Toggle each device to verify control.**

**✅ Verification**

* **Devices should respond instantly.**
* **Directional antenna lines indicate targeted transmission.**
* **Packet simulation shows signal flow specifically directed from Tablet → Gateway → Devices.**

**B. Simulate Mobile Adhoc Network (MANET) with Directional Antenna [20]**

**🛠️ Recommended Simulator: Cisco Packet Tracer / NS-3 / OMNeT++**

**(*We'll use Cisco Packet Tracer for simplicity here*)**

**✅ Concept Recap:**

**A MANET (Mobile Adhoc Network) is a self-configuring wireless network with no fixed infrastructure. Devices can move and connect dynamically.**

**We now simulate it with directional antennas to restrict communication within certain angles.**

**✅ Steps in Cisco Packet Tracer:**

**Step 1: Add Mobile Nodes**

* **Place 5–10 laptops/smartphones randomly in the workspace.**
* **Go to Config > Wireless of each:**
  + **SSID: AdhocNet**
  + **Mode: Adhoc**
  + **No password (or WEP/WPA if desired)**

**Step 2: Assign IPs (Static)**

* **Example Range: 192.168.10.1 to 192.168.10.10**
* **Subnet Mask: 255.255.255.0**

**Step 3: Simulate Directional Antenna**

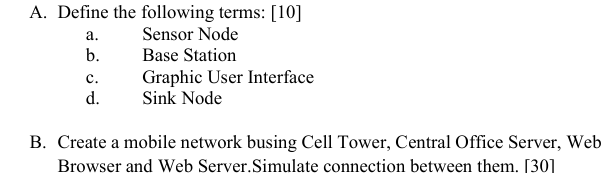
1. **From Device > Config > Wireless Interface:**
   * **Enable Directional Antenna**
   * **Set angle (e.g., 60°)**
   * **Point antenna toward a specific node**
2. **Repeat for all nodes to form a limited path mesh network.**

**Step 4: Test Communication**

* **From one node, ping others:**
  + **ping 192.168.10.5 (Only successful if within antenna range)**
* **Use Simulation Mode:**
  + **Send a message from one node to another**
  + **Observe how the signal follows antenna direction**

**✅ Expected Output:**

* **Devices only communicate when inside each other’s antenna cone.**

****

**A. Definitions [10 Marks]**

**a. Sensor Node:  
A sensor node is a tiny, low-power device used in wireless sensor networks (WSNs) to monitor physical or environmental conditions such as temperature, sound, or pressure and transmit the data to other nodes or a base station.**

**b. Base Station:  
A base station acts as a central communication point in a wireless sensor or mobile network. It collects data from sensor nodes and forwards it to servers or users for processing and analysis.**

**c. Graphic User Interface (GUI):  
A GUI is a user interface that includes graphical elements like windows, icons, and buttons. It allows users to interact with electronic devices visually rather than through command-line interfaces.**

**d. Sink Node:  
A sink node in a sensor network collects and aggregates data from multiple sensor nodes and forwards it to a centralized system or processing unit. It often acts as a gateway between the sensor network and the end user or application.**

**B. Create a Mobile Network with Cell Tower, Central Office Server, Web Browser, and Web Server [30 Marks]**

**🛠️ Simulation Tool: Cisco Packet Tracer**

**✅ Devices Required:**

* **1 x Cell Tower**
* **1 x Central Office Server**
* **1 x Web Server**
* **1 x Mobile Device (Smartphone or Tablet)**
* **1 x Wired Router or Switch (optional)**
* **1 x Cloud or Modem (for Internet simulation)**

**✅ Step-by-Step Configuration:**

**Step 1: Add & Connect Devices**

1. **Place the following from the IoT/End Devices section:**
   * **Cell Tower**
   * **Central Office Server**
   * **Web Server**
   * **Smartphone or Tablet**
   * **Switch (to connect office and servers)**
   * **Cloud (optional, to simulate internet)**
2. **Wiring:**
   * **Connect Web Server and Central Office Server to Switch**
   * **Connect Switch to Cloud**
   * **Mobile devices connect wirelessly to Cell Tower**

**Step 2: Configure the Cell Tower**

1. **Click on the Cell Tower > Config tab**
2. **Set:**
   * **SSID: MobileNet**
   * **Authentication: WPA2-PSK**
   * **Password: 12345678**
   * **Mode: Access Point / Internet Gateway**

**Step 3: Configure Central Office Server**

1. **IP Address: 192.168.1.2**
2. **Subnet Mask: 255.255.255.0**
3. **Default Gateway: 192.168.1.1 (if a router is used)**
4. **Services tab:**
   * **Enable DHCP Server (if needed)**
   * **Enable DNS Server**
   * **Hostname Mapping: www.simnetwork.com → 192.168.1.3**

**Step 4: Configure Web Server**

1. **IP Address: 192.168.1.3**
2. **Enable HTTP and HTTPS under Services tab**
3. **Add custom web content (optional)**

**Step 5: Configure Smartphone**

1. **Go to Config > Wireless**
2. **Join SSID: MobileNet**
3. **Password: 12345678**
4. **IP can be dynamic (via DHCP) or manual (e.g., 192.168.1.10)**
5. **DNS: 192.168.1.2 (Central Office Server IP)**

**Step 6: Test the Setup**

1. **On Smartphone:**
   * **Open Web Browser**
   * **Type URL: www.simnetwork.com**
2. **If DNS is properly mapped, the web page from the Web Server should load.**
3. **Use Simulation Mode to trace packet flow:**
   * **Mobile → Cell Tower → Central Office Server → Web Server**

**✅ Output Verification**

* **Ensure that:**
  + **Web Server responds with webpage.**