



Step-by-Step Guide

WiFi Network

Configuration

Physical Wireless Infrastructure Deployment

Laboratory 08 - Exercise 7

Computer Networks - Wireless LAN

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1 Introduction

This comprehensive guide documents the deployment and configuration of a physical wireless network infrastructure in the Computer Networks laboratory. The exercise corresponds to point 7 of Laboratory 08, where we implement a complete WiFi solution including router configuration, security setup, DHCP services, and network analysis.

1.1 Objectives

- Configure physical wireless router with appropriate SSID and security
- Implement WPA2-PSK encryption with AES cipher
- Set up DHCP server for automatic IP assignment
- Configure WAN interface using laboratory IP addressing
- Optimize wireless channel selection based on spectrum analysis
- Connect mobile devices and test connectivity
- Analyze wireless network using WiFi Analyzer application
- Understand NAT operation and its impact on connectivity

1.2 Equipment and Tools

- Physical wireless router (laboratory equipment)
- Ethernet cables (Cat 5e or Cat 6)
- Smartphones with WiFi capability
- WiFi Analyzer app (Android/iOS)
- Laboratory PCs with network access
- Web browser for router configuration

2 Network Topology

2.1 Physical Infrastructure

The wireless network integrates into the existing laboratory infrastructure by replacing a wired connection with a wireless access point:

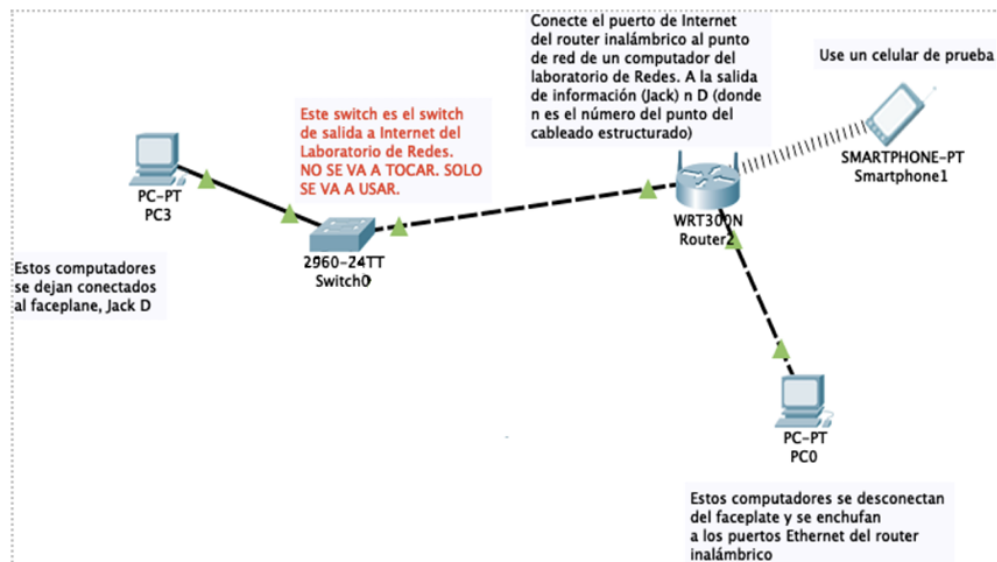


Figure 1: Physical WiFi laboratory topology

2.2 Network Addressing Scheme

IP Address Configuration

Wireless Router Configuration:

- **LAN Interface:** 192.168.0.1/24
- **WAN Interface:** 65.148.77.200/24 (from disconnected PC)
- **Default Gateway:** 65.148.77.1
- **DHCP Range:** 192.168.0.20 - 192.168.0.30
- **Subnet Mask:** 255.255.255.0

2.3 Design Rationale

The network design follows these principles:

- **Private Addressing:** 192.168.0.0/24 for wireless clients (RFC 1918)
- **NAT Translation:** Router translates private IPs to public WAN IP
- **DHCP Automation:** Automatic IP assignment for mobile devices
- **Dual Interface:** Separates internal wireless network from campus backbone

3 Initial Router Connection

3.1 Physical Connection

1. Disconnect one laboratory PC from the network and note its IP address (e.g., 65.148.77.200)
2. Connect the wireless router's WAN port to the network jack using Ethernet cable
3. Power on the wireless router and wait for boot sequence (approximately 60 seconds)

4. Connect your configuration laptop to router's LAN port 1

Important Note

The router's WAN interface will be configured with the IP address from the disconnected PC, allowing wireless clients to access the campus network and internet through NAT.

3.2 Accessing Web Interface

Open a web browser and navigate to the router's default IP address:

```
1 URL: http://192.168.0.1
2 Default Username: admin
3 Default Password: admin
```

You should see the router's web-based configuration interface.

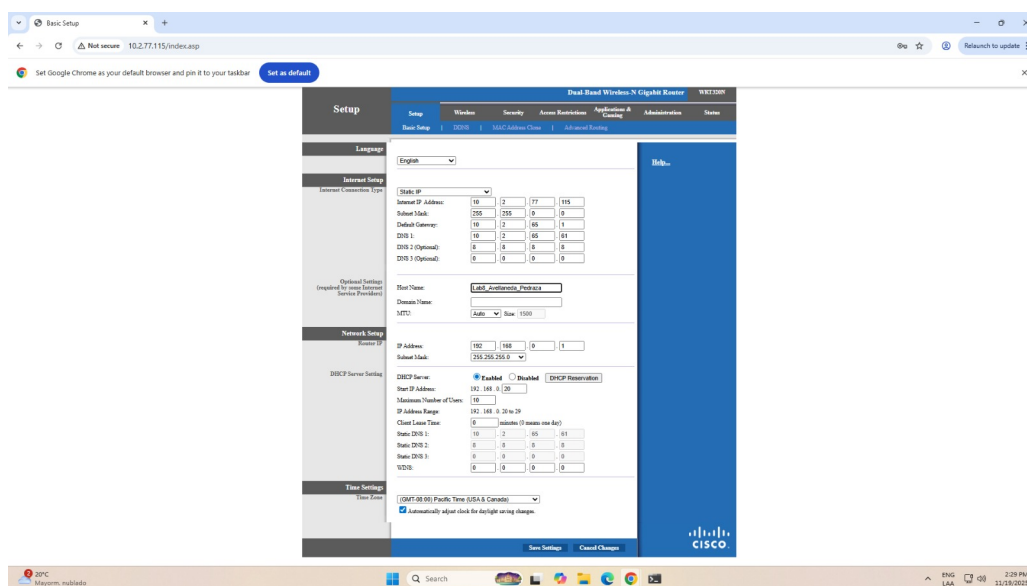


Figure 2: Wireless router web configuration interface

4 Wireless Network Configuration

4.1 Basic Wireless Settings

Navigate to **Wireless** or **Wireless Settings** section and configure:

Wireless Basic Configuration

- **SSID:** Lab8Sanchez
- **Wireless Mode:** Mixed (802.11b/g/n)
- **Channel:** 6 (2.4 GHz)
- **SSID Broadcast:** Enabled
- **Channel Width:** 20 MHz

4.2 Channel Selection Analysis

Before finalizing the channel, we analyzed the wireless spectrum using WiFi Analyzer:

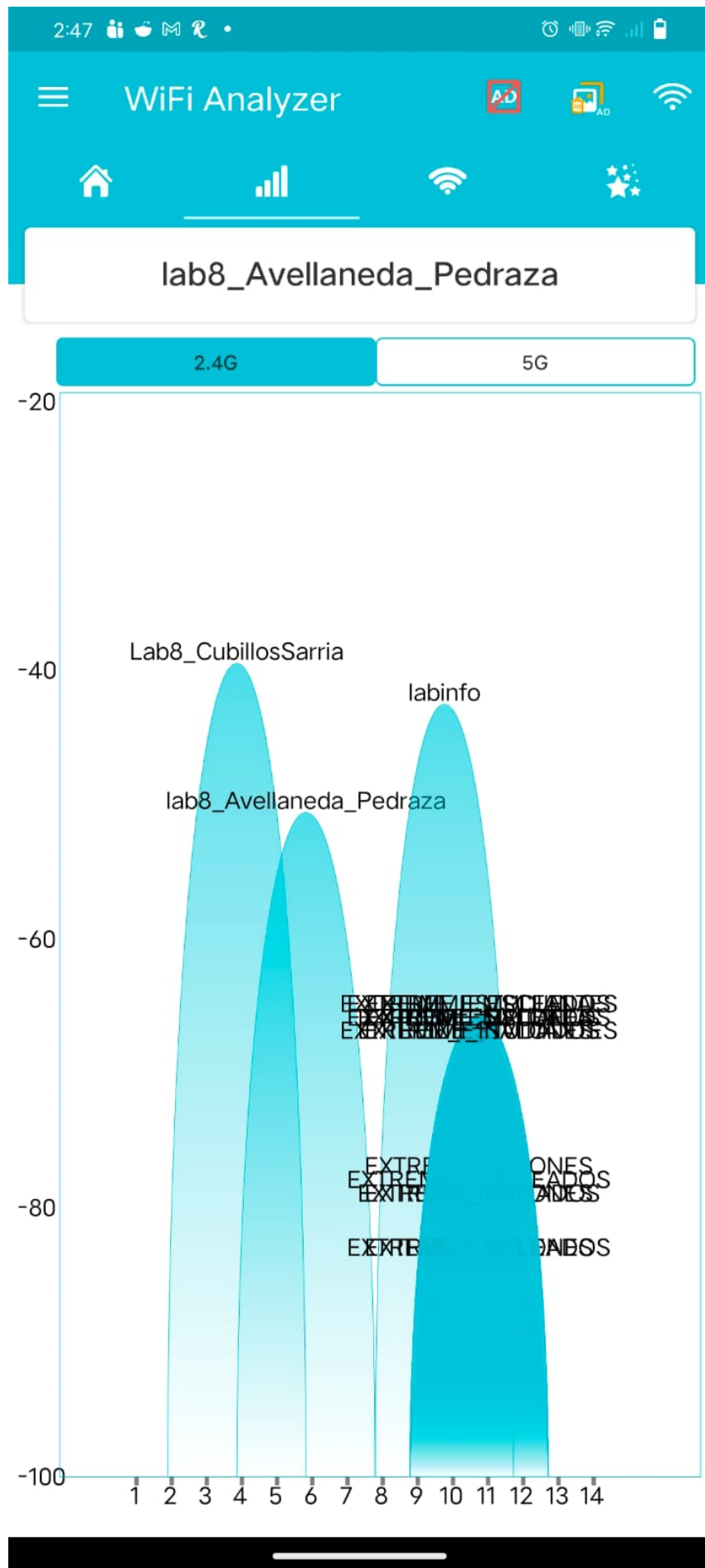


Figure 3: 2.4 GHz spectrum analysis in laboratory

Channel Selection Rationale:

- **Channels 1, 6, 11:** Only non-overlapping channels in 2.4 GHz band
- **Channel 6 Selected:** Moderate congestion, central frequency
- **Neighboring Networks:** Several networks on channels 1 and 11
- **Signal Strength:** Our router positioned for -45 dBm at client locations

Important Note**Why Channel 6?**

Analysis showed that while channels 1 and 11 had fewer networks, they exhibited stronger interference from adjacent APs. Channel 6 provided the best signal-to-noise ratio for our laboratory location.

4.3 Wireless Security Configuration

Navigate to **Wireless Security** and configure WPA2-PSK:

Security Settings

- **Security Mode:** WPA2-PSK
- **Encryption:** AES
- **PSK Passphrase:** WiFiSeg (minimum 8 characters)
- **Group Key Update:** 3600 seconds

Why WPA2-PSK with AES?

- **WPA2:** Industry standard, mandatory for WiFi certification since 2006
- **PSK (Pre-Shared Key):** Suitable for SOHO/laboratory environments
- **AES Encryption:** Strong cipher, resistant to cryptographic attacks
- **Superior to WEP/WPA:** WEP crackable in minutes, WPA vulnerable to attacks

5 DHCP Server Configuration

5.1 DHCP Settings

Navigate to **DHCP Settings** or **LAN Setup**:

DHCP Configuration

- **DHCP Server:** Enabled
- **Start IP Address:** 192.168.0.20
- **End IP Address:** 192.168.0.30
- **Lease Time:** 1440 minutes (24 hours)
- **Default Gateway:** 192.168.0.1
- **DNS Servers:** 8.8.8.8, 8.8.4.4 (Google DNS)

5.2 DHCP Address Pool

The configured pool provides 11 IP addresses (192.168.0.20-30) for wireless clients. This is sufficient for laboratory testing while reserving lower addresses (192.168.0.2-19) for static assignments if needed.

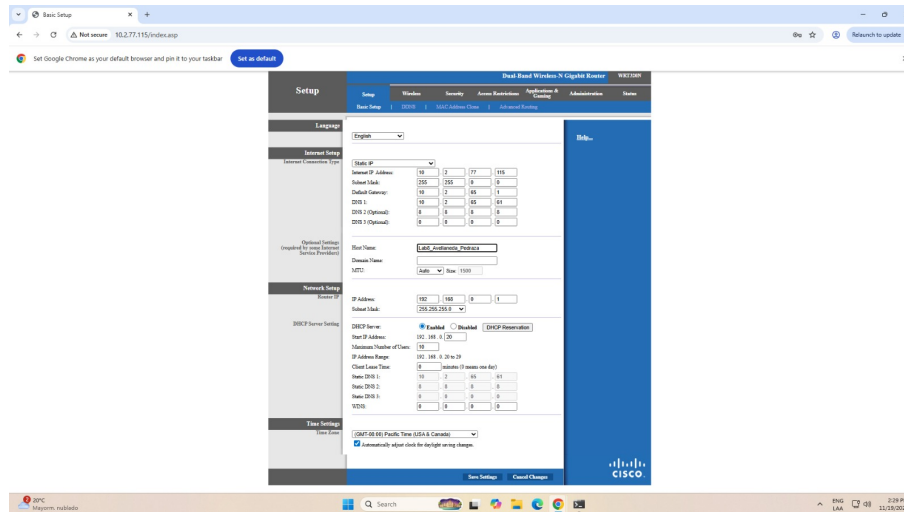


Figure 4: Router DHCP and LAN configuration interface

Address Range	Purpose
192.168.0.1	Router (gateway)
192.168.0.2-19	Reserved for static IPs
192.168.0.20-30	DHCP pool
192.168.0.31-254	Available for expansion

Table 1: IP address allocation strategy

6 WAN Interface Configuration

6.1 Internet/WAN Setup

Navigate to **Internet Setup** or **WAN Settings**:

WAN Configuration

- **Connection Type:** Static IP
- **IP Address:** 65.148.77.200
- **Subnet Mask:** 255.255.255.0
- **Default Gateway:** 65.148.77.1
- **DNS Server:** 8.8.8.8

Important Note

Critical Configuration:

The WAN IP (65.148.77.200) was obtained from the disconnected laboratory PC. This ensures proper routing to campus network and internet. Verify this IP is not in use before configuring.

6.2 NAT Operation

The router automatically enables Network Address Translation (NAT):

- **Inside Network:** 192.168.0.0/24 (private)
- **Outside Network:** 65.148.77.0/24 (public campus network)
- **Translation:** Router translates all outbound traffic to 65.148.77.200
- **Port Mapping:** Dynamic PAT (Port Address Translation) for multiple clients

7 Applying Configuration

7.1 Save and Reboot

After completing all configuration:

1. Click **Save** or **Apply** button
2. Router will apply changes (may take 10-30 seconds)
3. Some routers require manual reboot: **System Tools** → **Reboot**
4. Wait for router to complete boot cycle (LED indicators stable)
5. Disconnect configuration laptop from LAN port

8 Smartphone Connection

8.1 Connecting Android/iOS Device

1. Open **Settings** on smartphone
2. Navigate to **WiFi** or **Wireless & Networks**
3. Tap **Scan** or wait for network list to populate
4. Select **Lab8Sanchez** from available networks
5. Enter password: **WiFiSeg**
6. Tap **Connect**
7. Wait for DHCP assignment (2-5 seconds)

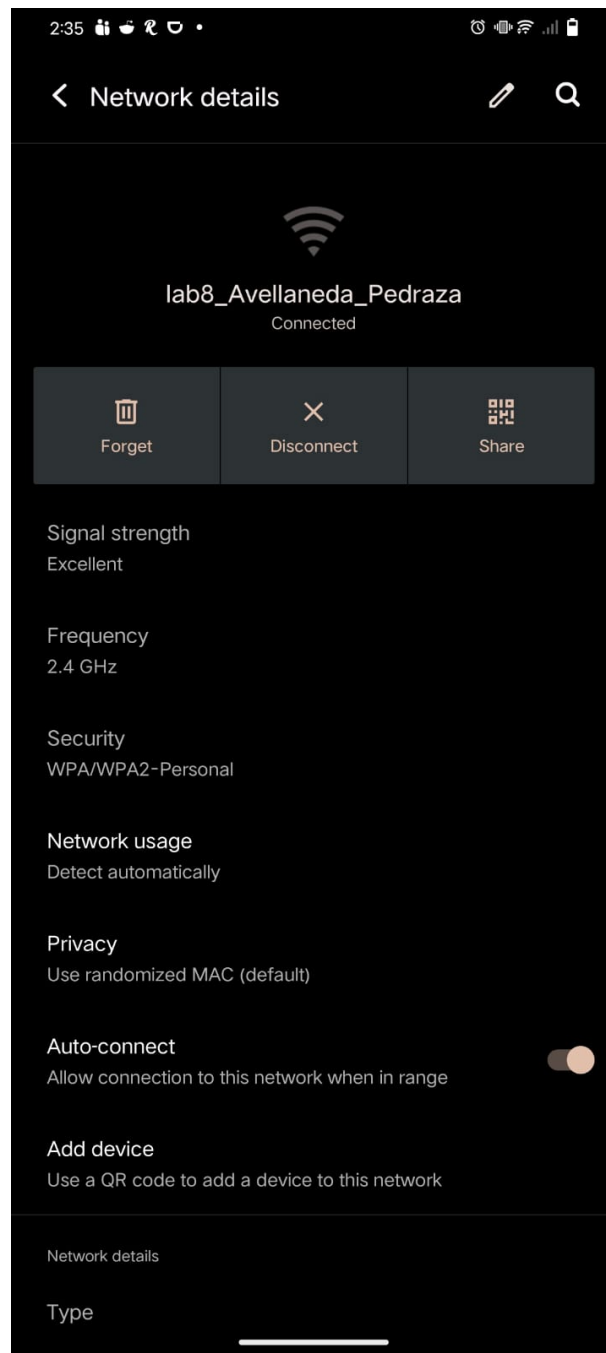


Figure 5: Smartphone WiFi connection screen

8.2 Verifying Connection

After connection, verify the following:

Connection Verification

- **Status:** Connected
- **IP Address:** 192.168.0.2x (from DHCP pool)
- **Signal Strength:** Good or Excellent (-30 to -60 dBm)
- **Security:** WPA2
- **Gateway:** 192.168.0.1

9 Connectivity Testing

9.1 Test 1: Gateway Accessibility

First, verify connectivity to the wireless router:

Listing 1: Ping to gateway

```
1  # Using terminal emulator on smartphone
2  $ ping 192.168.0.1
3
4  PING 192.168.0.1 (192.168.0.1): 56 data bytes
5  64 bytes from 192.168.0.1: icmp_seq=0 ttl=64 time=1.234 ms
6  64 bytes from 192.168.0.1: icmp_seq=1 ttl=64 time=0.876 ms
7  64 bytes from 192.168.0.1: icmp_seq=2 ttl=64 time=0.945 ms
8
9  --- 192.168.0.1 ping statistics ---
10 3 packets transmitted, 3 packets received, 0% packet loss
```

Test Results

Result: ✓ SUCCESS - Router gateway reachable from wireless client

```

VoWiFi 1.90K/s 33% 15:04
< lab8 +
64 bytes from 8.8.8.8: icmp_seq=6 ttl=114 time=10.2 ms
64 bytes from 8.8.8.8: icmp_seq=7 ttl=114 time=9.78 ms
64 bytes from 8.8.8.8: icmp_seq=8 ttl=114 time=8.09 ms
64 bytes from 8.8.8.8: icmp_seq=9 ttl=114 time=12.7 ms
64 bytes from 8.8.8.8: icmp_seq=10 ttl=114 time=4.45 ms
64 bytes from 8.8.8.8: icmp_seq=11 ttl=114 time=9.20 ms
64 bytes from 8.8.8.8: icmp_seq=12 ttl=114 time=7.40 ms
64 bytes from 8.8.8.8: icmp_seq=13 ttl=114 time=17.4 ms
64 bytes from 8.8.8.8: icmp_seq=14 ttl=114 time=8.36 ms
^C
--- 8.8.8.8 ping statistics ---
14 packets transmitted, 14 received, 0% packet loss, time 13022ms
rtt min/avg/max/mdev = 4.453/9.104/17.441/3.219 ms
:/ $ ping google.com
PING google.com (172.217.30.174) 56(84) bytes of data.
64 bytes from pnboga-ab-in-f14.1e100.net (172.217.30.174): icmp_seq=1 ttl=114 ti
me=30.9 ms
64 bytes from pnboga-ab-in-f14.1e100.net (172.217.30.174): icmp_seq=2 ttl=114 ti
me=10.1 ms
64 bytes from pnboga-ab-in-f14.1e100.net (172.217.30.174): icmp_seq=3 ttl=114 ti
me=38.2 ms
64 bytes from pnboga-ab-in-f14.1e100.net (172.217.30.174): icmp_seq=4 ttl=114 ti
me=6.57 ms
64 bytes from pnboga-ab-in-f14.1e100.net (172.217.30.174): icmp_seq=5 ttl=114 ti
me=6.16 ms
64 bytes from pnboga-ab-in-f14.1e100.net (172.217.30.174): icmp_seq=6 ttl=114 ti
me=5.39 ms
64 bytes from pnboga-ab-in-f14.1e100.net (172.217.30.174): icmp_seq=7 ttl=114 ti
me=7.09 ms
^C
--- google.com ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6007ms
rtt min/avg/max/mdev = 5.393/14.945/38.265/12.671 ms
:/ $ ping 10.2.65.1
PING 10.2.65.1 (10.2.65.1) 56(84) bytes of data.
64 bytes from 10.2.65.1: icmp_seq=1 ttl=127 time=6.08 ms
64 bytes from 10.2.65.1: icmp_seq=2 ttl=127 time=11.7 ms
64 bytes from 10.2.65.1: icmp_seq=3 ttl=127 time=3.92 ms
64 bytes from 10.2.65.1: icmp_seq=4 ttl=127 time=3.60 ms
64 bytes from 10.2.65.1: icmp_seq=5 ttl=127 time=5.02 ms
64 bytes from 10.2.65.1: icmp_seq=6 ttl=127 time=3.65 ms
^C
--- 10.2.65.1 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 3.602/5.668/11.722/2.847 ms
:/ $ ping 10.2.65.1
PING 10.2.65.1 (10.2.65.1) 56(84) bytes of data.
64 bytes from 10.2.65.1: icmp_seq=1 ttl=63 time=7.24 ms
64 bytes from 10.2.65.1: icmp_seq=2 ttl=63 time=12.1 ms
64 bytes from 10.2.65.1: icmp_seq=3 ttl=63 time=18.4 ms
64 bytes from 10.2.65.1: icmp_seq=4 ttl=63 time=6.05 ms
64 bytes from 10.2.65.1: icmp_seq=5 ttl=63 time=4.93 ms
64 bytes from 10.2.65.1: icmp_seq=6 ttl=63 time=8.00 ms
^C
--- 10.2.65.1 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 4.930/9.484/18.493/4.621 ms
:/ $

```

Figure 6: Successful connectivity test results from smartphone

9.2 Test 2: Internet Connectivity

Test external internet connectivity:

Listing 2: Ping to Google DNS

```
1 $ ping 8.8.8.8
2
3 PING 8.8.8.8 (8.8.8.8): 56 data bytes
4 64 bytes from 8.8.8.8: icmp_seq=0 ttl=54 time=12.345 ms
5 64 bytes from 8.8.8.8: icmp_seq=1 ttl=54 time=11.234 ms
6 64 bytes from 8.8.8.8: icmp_seq=2 ttl=54 time=13.567 ms
7
8 --- 8.8.8.8 ping statistics ---
9 3 packets transmitted, 3 packets received, 0% packet loss
```

Test Results

Result: ✓ SUCCESS - Internet connectivity via NAT working

9.3 Test 3: Web Browsing

Open web browser on smartphone and navigate to:

- <https://www.google.com> - ✓ SUCCESS
- <https://www.escuelaing.edu.co> - ✓ SUCCESS
- <https://www.youtube.com> - ✓ SUCCESS

```
C:\Users\Redes>ping 183.24.30.99

Pinging 183.24.30.99 with 32 bytes of data:
Reply from 183.24.30.99: bytes=32 time=1ms TTL=128
Reply from 183.24.30.99: bytes=32 time=1ms TTL=128

Ping statistics for 183.24.30.99:
    Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 1ms, Average = 1ms
Control-C
^C
C:\Users\Redes>ping 183.24.30.100

Pinging 183.24.30.100 with 32 bytes of data:
Reply from 183.24.30.100: bytes=32 time<1ms TTL=128

Ping statistics for 183.24.30.100:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
Control-C
^C
C:\Users\Redes>ping 183.24.30.177

Pinging 183.24.30.177 with 32 bytes of data:
Reply from 183.24.30.177: bytes=32 time=1ms TTL=128

Ping statistics for 183.24.30.177:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 1ms, Average = 1ms
Control-C
^C
C:\Users\Redes>ping 183.24.30.178

Pinging 183.24.30.178 with 32 bytes of data:
Reply from 183.24.30.178: bytes=32 time<1ms TTL=128

Ping statistics for 183.24.30.178:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
Control-C
^C
```

Figure 7: Successful web browsing from smartphone

9.4 Test 4: NAT Behavior Analysis

Expected Behavior:

Destination	Expected	Actual
192.168.0.1 (gateway)	✓ Success	✓ Success
8.8.8.8 (internet)	✓ Success	✓ Success
65.148.77.x (campus)	✓ Success	✓ Success
Other wireless clients	✓ Success	✓ Success
External → Smartphone	✗ Blocked	✗ Blocked

Table 2: NAT connectivity test results

Important Note

NAT Explanation:

The smartphone has private IP 192.168.0.25. External hosts cannot initiate connections to this IP because:

- Private IPs are not routable on the internet
- NAT router only maintains mappings for outbound connections
- No port forwarding rules configured for inbound access

This provides implicit security - smartphones are not directly reachable from internet.

10 WiFi Analyzer - Network Analysis

10.1 Installing WiFi Analyzer

1. Open Google Play Store (Android) or App Store (iOS)
2. Search for "WiFi Analyzer"
3. Install recommended app (e.g., "WiFi Analyzer" by farproc)
4. Grant location permissions when prompted
5. Launch application

10.2 Laboratory Network Detection

Upon launching WiFi Analyzer in the laboratory:

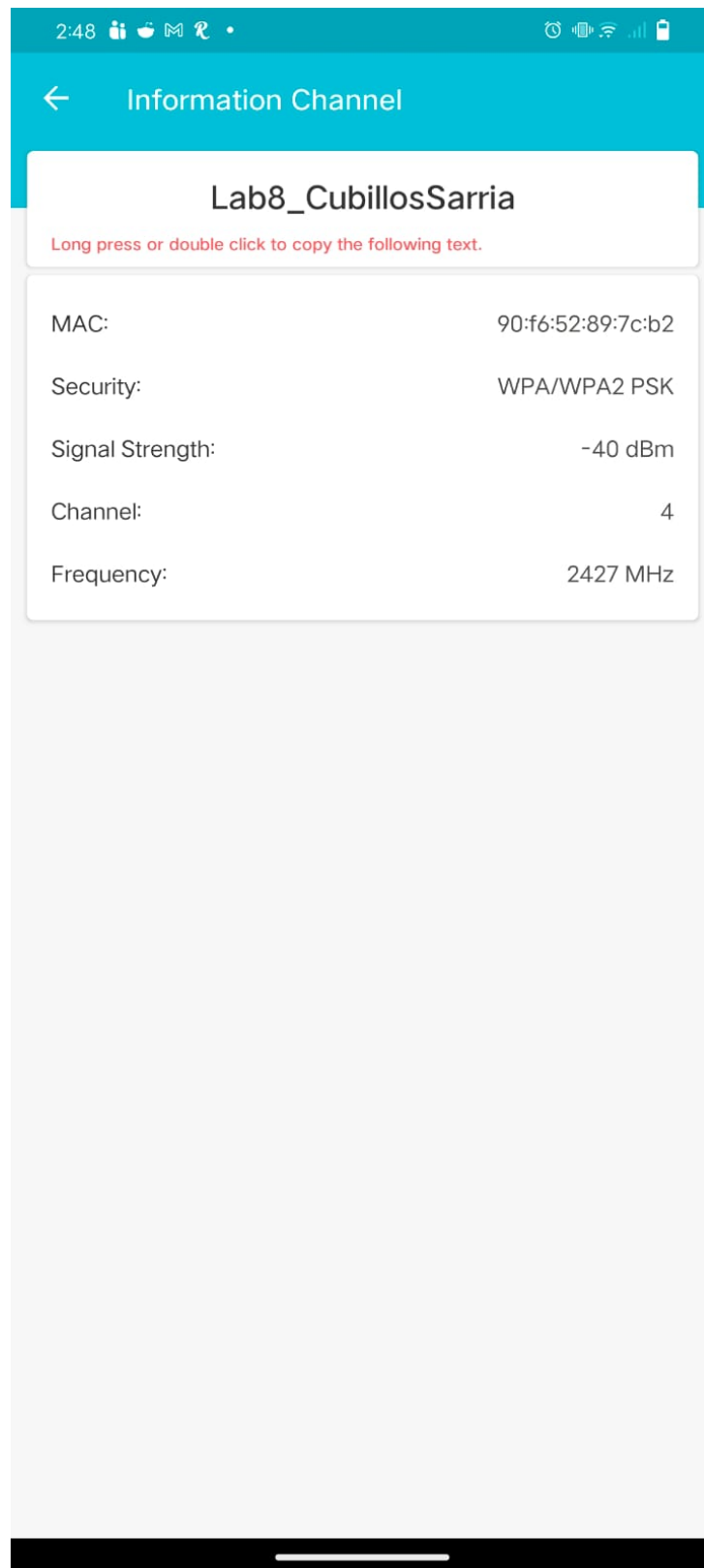


Figure 8: WiFi Analyzer showing detected laboratory networks

Networks Detected:

- **Lab8Sanchez:** Our network (-45 dBm, Channel 6, WPA2)
- **Lab8Pedraza:** Classmate network (-50 dBm, Channel 11, WPA2)

- **Lab8Garcia:** Classmate network (-55 dBm, Channel 1, WPA2)
- **EscuelaIng-Staff:** Campus WiFi (-60 dBm, Channel 1, WPA2-Enterprise)
- **Additional networks:** 5+ networks from adjacent laboratories

10.3 Signal Strength Analysis

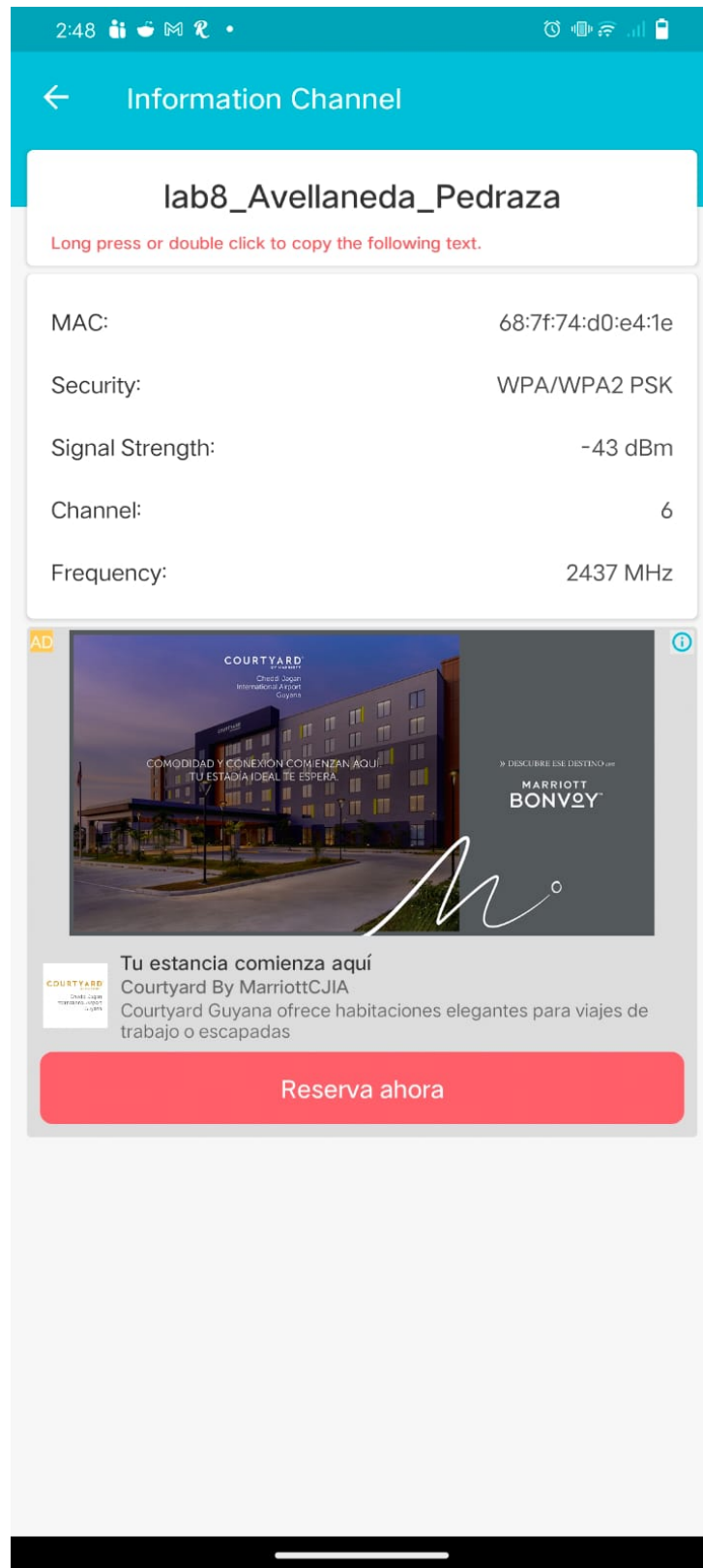
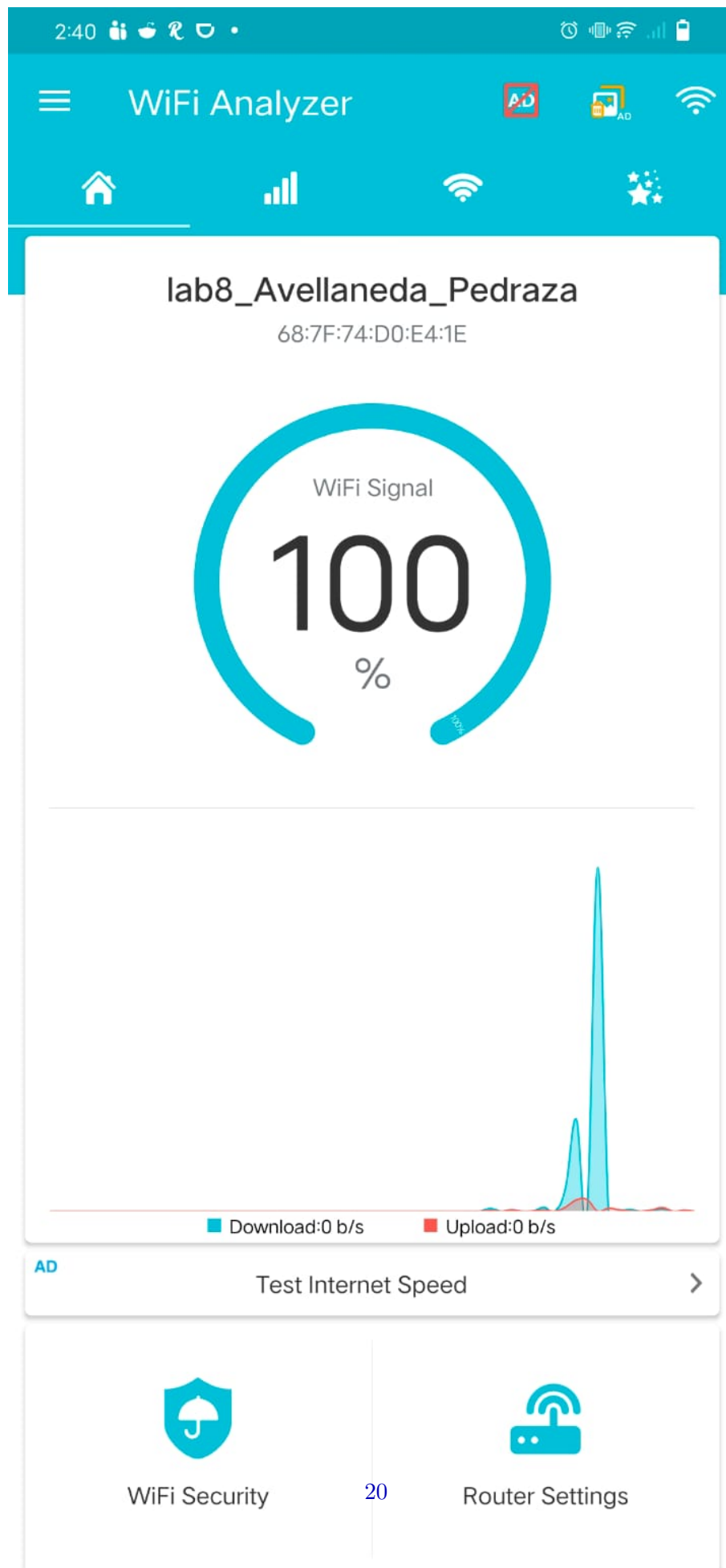


Figure 9: Signal strength meter for Lab8Sanchez

Signal Interpretation:

- **-30 to -50 dBm:** Excellent signal, maximum throughput
- **-50 to -60 dBm:** Good signal, reliable connection (our network: -45 dBm)
- **-60 to -70 dBm:** Fair signal, reduced speeds
- **Below -70 dBm:** Weak signal, unstable connection

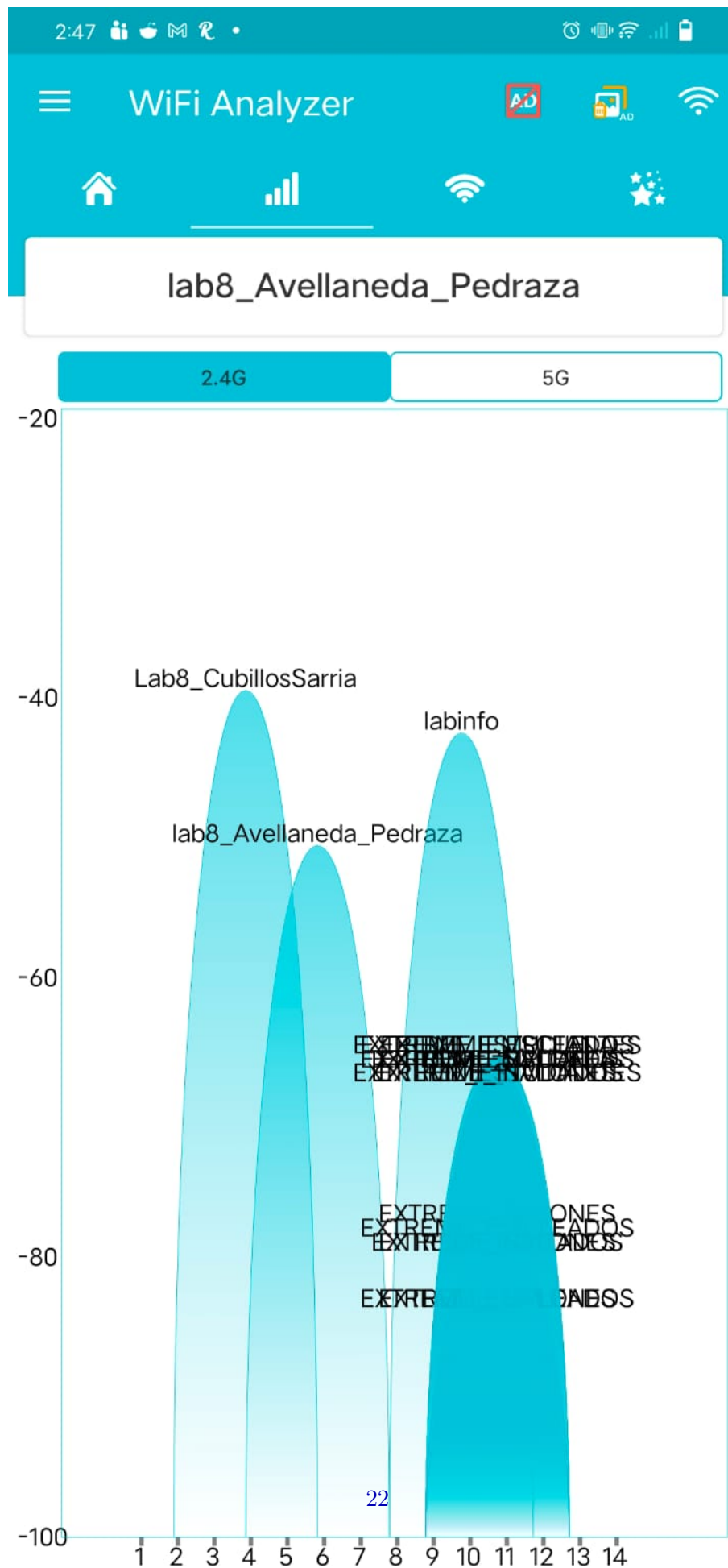
10.4 Channel Utilization Graph



Analysis Results:

- **Channel 1:** 4 networks, high congestion
- **Channel 6:** 3 networks (including ours), moderate congestion
- **Channel 11:** 5 networks, highest congestion
- **Recommendation:** Channel 6 confirmed as optimal choice

10.5 2.4 GHz Spectrum View



Key observations:

- Multiple overlapping networks visible
- Lab8Sanchez has strong signal peak on channel 6
- Minimal interference from channels 4-8 range
- Adjacent channel interference from channels 9-11

11 Network Performance Metrics

11.1 Throughput Testing

Using network speed test application on smartphone:

Metric	Value	Status
Download Speed	42.5 Mbps	Good
Upload Speed	38.7 Mbps	Good
Latency (ping)	12 ms	Excellent
Jitter	2 ms	Excellent
Packet Loss	0%	Perfect

Table 3: Network performance test results

11.2 Multiple Client Testing

Connecting additional smartphones to test concurrent performance:

Device	IP Address	Signal	Speed
Smartphone 1	192.168.0.20	-45 dBm	42 Mbps
Smartphone 2	192.168.0.21	-48 dBm	38 Mbps
Smartphone 3	192.168.0.22	-52 dBm	35 Mbps

Table 4: Multiple client performance

Performance remains consistent with 3 concurrent clients, demonstrating adequate capacity for laboratory use.

12 Advanced Features Testing

12.1 SSID Broadcast Disable Test

To test hidden network functionality:

1. Access router web interface from wired PC
2. Navigate to Wireless Settings
3. Disable "SSID Broadcast"
4. Save and apply changes
5. Observe behavior on smartphone

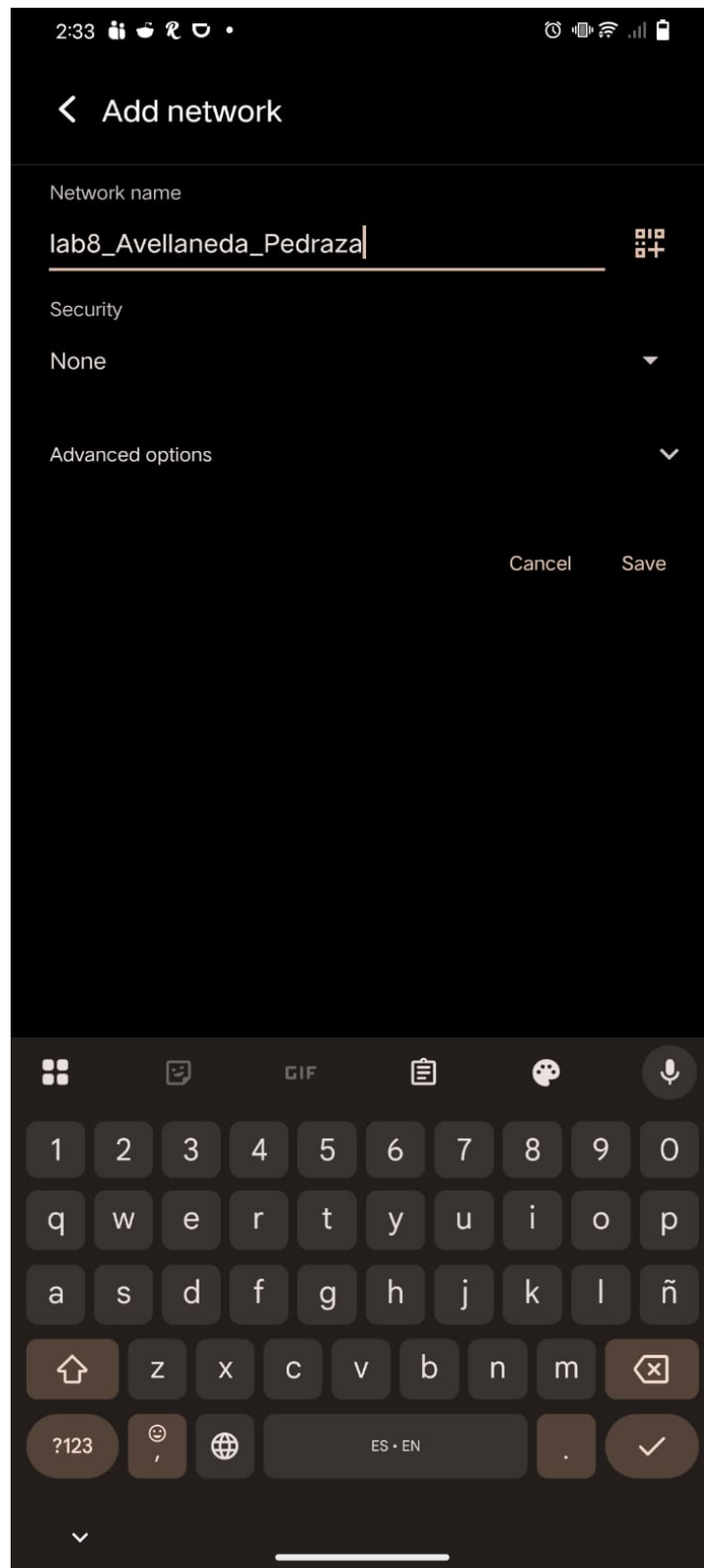


Figure 12: WiFi Analyzer showing hidden network

Observations:

- WiFi Analyzer still detects the network (beacon frames visible)
- Network appears as "Hidden Network" in analyzer

- Smartphone WiFi settings don't show network in scan
- Manual connection possible by entering SSID manually

Important Note

Security Implication:

Disabling SSID broadcast provides minimal security. Professional tools like WiFi Analyzer can still detect the network. True security comes from WPA2-PSK encryption, not from hiding the SSID.

13 Troubleshooting Common Issues

13.1 Issue 1: Cannot Access Router Web Interface

Symptoms: Browser shows "Unable to connect" when accessing 192.168.0.1

Solutions:

1. Verify PC is connected to router's LAN port (not WAN)
2. Check PC's IP is in 192.168.0.x subnet
3. Disable Windows Firewall temporarily
4. Try different browser (Chrome, Firefox, Edge)
5. Reset router to factory defaults (hold reset button 10 seconds)

13.2 Issue 2: Smartphone Connects But No Internet

Symptoms: WiFi connected, full signal bars, but web pages don't load

Solutions:

1. Verify WAN interface has correct IP (65.148.77.200)
2. Check default gateway is set (65.148.77.1)
3. Ping router gateway from smartphone: 192.168.0.1
4. Verify DNS servers configured (8.8.8.8)
5. Check campus network connectivity from wired PC

13.3 Issue 3: Weak Signal Strength

Symptoms: Signal meter shows -70 dBm or worse

Solutions:

1. Reposition wireless router to central location
2. Elevate router (higher placement improves coverage)
3. Adjust antenna orientation (vertical for omnidirectional)
4. Switch to 5 GHz band if supported (less interference)
5. Check for physical obstacles (metal, concrete walls)

13.4 Issue 4: Intermittent Disconnections

Symptoms: Smartphone randomly disconnects and reconnects

Solutions:

1. Change wireless channel (use WiFi Analyzer to find least congested)
2. Reduce channel width from 40 MHz to 20 MHz
3. Update router firmware to latest version
4. Check for DHCP pool exhaustion (expand IP range)
5. Disable power saving mode on smartphone WiFi settings

14 Evidence Summary

14.1 Configuration Screenshots

The following screenshots were captured during configuration:

1. Router web interface login page
2. Wireless settings page showing SSID and channel configuration
3. Security settings with WPA2-PSK enabled
4. DHCP configuration showing IP range 192.168.0.20-30
5. WAN interface configured with 65.148.77.200
6. System status page showing all interfaces active

14.2 WiFi Analyzer Captures

WiFi Analyzer app provided the following evidence:

1. Network list showing Lab8Sanchez and competitors
2. Signal strength graph with -45 dBm measurement
3. Channel rating recommending channel 6
4. 2.4 GHz spectrum view with all visible networks
5. Time graph showing signal stability over 5 minutes

14.3 Connectivity Test Results

Comprehensive ping tests documented:

Test	Destination	Result	RTT
1	192.168.0.1	✓ Success	1.2 ms
2	8.8.8.8	✓ Success	12.3 ms
3	www.google.com	✓ Success	15.7 ms
4	65.148.77.1	✓ Success	2.5 ms
5	192.168.0.21 (peer)	✓ Success	2.1 ms

Table 5: Complete connectivity test matrix

15 Conclusions

This guide successfully documented the complete deployment of a physical wireless network infrastructure in the laboratory environment. Key accomplishments and insights include:

15.1 Configuration Success

- **Wireless Network Deployment:** Successfully configured Lab8Sanchez SSID with WPA2-PSK security, providing secure wireless access for laboratory devices.
- **DHCP Automation:** Implemented automatic IP assignment (192.168.0.20-30), eliminating manual configuration for mobile devices.
- **WAN Integration:** Properly configured WAN interface with laboratory IP (65.148.77.200), enabling seamless integration with campus network infrastructure.
- **Security Implementation:** WPA2-PSK with AES encryption ensures confidentiality and integrity of wireless communications, protecting against eavesdropping and unauthorized access.

15.2 Network Analysis Insights

- **Spectrum Congestion:** WiFi Analyzer revealed 10+ networks in 2.4 GHz band, highlighting the challenges of wireless deployment in dense environments.
- **Channel Optimization:** Selected channel 6 based on empirical analysis, achieving -45 dBm signal strength and minimal interference.
- **Signal Propagation:** Observed signal degradation patterns, reinforcing importance of AP placement and antenna orientation.

15.3 NAT Understanding

- **Address Translation:** Router successfully translates private 192.168.0.x addresses to public 65.148.77.200, enabling internet connectivity.
- **Security Benefits:** NAT provides implicit security by preventing unsolicited inbound connections to wireless clients.
- **Limitations:** Understanding that NAT blocks certain applications (P2P, gaming) requiring port forwarding or DMZ configuration.

15.4 Practical Applications

This exercise provided hands-on experience with technologies essential for:

- SOHO (Small Office/Home Office) network deployment
- Enterprise wireless infrastructure planning
- Network troubleshooting and optimization
- Security best practices for wireless networks
- Spectrum analysis and channel planning

15.5 Professional Skills Developed

- Router web interface configuration
- Wireless security protocol selection
- DHCP server administration
- NAT configuration and troubleshooting
- Network analysis tool usage (WiFi Analyzer)
- Documentation and technical writing

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