Wireless Network Simulation
Cisco Packet Tracer

COMP431 Wireless Networks and Security | Professor Haleh Khojasteh | Grace Smalley, Isabella Russell, Alexandria Arbia

Project Overview

Description: Used Cisco Packet Tracer to examine the impact of increased traffic and physical obstacles on wireless performance metrics—bandwidth, signal strength, and latency. We simulated a network and conducted tests to measure these metrics under varying conditions. Our goal was to gain insight into how the relationship between these factors impacts overall network performance and reliability.

Initial Hypothesis: With increased traffic, it is expected that bandwidth will degrade. Latency will increase due to congestion. Signal strength should weaken with added obstacles, especially when dealing with materials that cause high rates of attenuation, therefore resulting in reduced bandwidth and increased latency.

Review of Terms/Relationships

Signal Strength: The power level of the wireless signal received by a device from a router or access point (dBm)

Bandwidth: The maximum amount of data that can be transmitted over a network per second (Mbps)

Latency: The time it takes for a packet to travel from source to destination and back (ms)

Signal Strength -> Bandwidth -> Latency

Weaker signals translate to potential retransmissions, consuming available bandwidth and contributing to latency.

Experiment Outline

- Scenario 1

  Use the Traffic Generator interface to send intermittent PDUs (Protocol Data Units) to simulate a high traffic environment.

- Scenario 2

  Reducing the bandwidth manually from 100 Mbps to 10 Mbps and observing the impact on latency.

- Scenario 3

  Introducing physical obstacles (mimicked by moving devices further away from access points) into the simulation to evaluate their impact on performance metrics.

→ We measured the latency of 20 ping requests in each condition and calculated the average to compare the results among each scenario.

Challenges

→ Packet Tracer does not support simulating physical objects as obstacles, so we were unable to investigate signal attenuation and interference. To compensate, we mimicked weaker signals by increasing device distance manually.

→ Cisco also does not provide specific noise and signal strength metrics, which are critical real-world factors, so we could not calculate the SNR for better insight.

→ Packet Tracer acts in the same manner whether there is a lot of traffic or not. Therefore, our latency results were the same regardless of the different conditions.

Results

After conducting multiple tests across various scenarios, we found out that Cisco Packet Tracer exhibited consistent behavior, regardless of traffic intensity. Despite the varying conditions, the results consistently showed similar latency values. This indicates that our initial hypothesis overestimated Packet Tracer's ability to simulate real-world network dynamics, leading to results that differed from our expectations.

Technology Alternatives

- GNS3 (Graphical Network Simulator-3)
  - Offers a more advanced network emulation, supports a wider range of devices and configurations allowing for more complex simulations.
  - Reportedly is more difficult to use that Packet Tracer and is less user friendly.
  - Free, open-source.
- Cisco VIRL (Virtual Internet Routing Lab)
  - More advanced simulation tools that Packet Tracer, but requires a license, it is not free.
- EVE-NG (Emulated Virtual Environment Next Generation)
  - Offers similar benefits as GNS3 but has a more user-friendly interface.
  - Requires paid subscription for full functionality

Stretch Goal

Since Cisco Packet Tracer does not simulate real-world environments, our initial stretch goal of creating an interfering network to observe performance impacts would not have yielded any meaningful results. Instead, we shifted our focus to a new stretch goal: incorporating a wireless controller to connect our two access points. Currently, both access points broadcast the same SSID but appear as separate networks because they are not connected in any way beyond their shared SSID. By integrating a wireless controller, we aimed to unify the management and connectivity of the two access points, simulating a more cohesive network infrastructure.