Dead Zones and Degraded Connections: Mapping Internet Connectivity Across the UCF Campus Using a Cloud-Based Heatmap Pipeline

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Background

Reliable internet connectivity is essential infrastructure for academic success. Students depend on campus networks for coursework, online exams, cloud collaboration, and remote lab access. When connectivity underperforms, it creates inequitable conditions that directly affect academic outcomes.

UCF enrolls nearly 70,000 students on a 1,415-acre campus with more than 200 buildings, making it one of the largest universities by enrollment in the United States (UCF Office of Institutional Knowledge Management, 2024). A 2022 EDUCAUSE survey of 820 undergraduate students found that 64% had experienced unstable internet connections in the past academic year — the single most common technology problem reported — and 35% said the issue caused them significant stress (EDUCAUSE, 2022).

UCF Information Technology collects network performance data at the infrastructure level but does not publish georeferenced, device-level metrics. No publicly available student-generated dataset documents real-world download speed, upload speed, latency, or packet loss across campus locations. This project fills that gap: a systematic connectivity audit of 100 campus sites, processed through a cloud-based AWS pipeline, and published as an interactive public heatmap.

Methodology

Data collection proceeds in three phases across spring semester 2027 (January through April).

Phase 1 — Site Selection and Setup (January–February 2027): One hundred measurement locations will be identified using UCF campus GIS data, arranged across five zone types: academic buildings (25), libraries and study spaces (20), outdoor common areas (20), residential and dining areas (20), and campus perimeter zones (15). Each location is a fixed, GPS-tagged coordinate visited sequentially with a single set of portable equipment — no duplicate hardware is required across sites. A Python script using speedtest-cli (Martz, 2022) will record download speed (Mbps), upload speed (Mbps), latency (ms), and packet loss (%) at each session. A paired

Bluetooth GPS receiver will log sub-5-meter coordinates. Results will push automatically to AWS S3 via boto3 and be tagged by a Lambda function.

Phase 2 — Data Collection (February 1 – March 14, 2027): Each location will be visited during three temporal conditions — peak hours (10 AM–2 PM weekdays, representing mid-morning through early afternoon when classrooms, labs, and offices are at peak simultaneous use by students, faculty, and staff), off-peak hours (7–9 PM weekdays), and weekend afternoons — yielding 300 total sessions. Locations will be grouped geographically, with 7–10 sites visited per outing, yielding approximately 50 sessions per week. Three consecutive 30-second tests per session will be averaged to reduce measurement noise.

Phase 3 — Analysis and Visualization (March 17 – April 11, 2027): Data will be queried from S3 using Amazon Athena and analyzed in Python (pandas, scipy). Each location will be classified into four performance tiers: high-performance (above 100 Mbps), adequate (25–100 Mbps), degraded (5–25 Mbps), or dead zone (below 5 Mbps). The 100 Mbps threshold reflects the FCC's updated 2024 fixed broadband benchmark (FCC, 2024). An interactive Leaflet.js heatmap layered over the UCF campus map will be deployed on AWS CloudFront, color-coded by tier and filterable by zone and time of day.

Anticipated Outcomes

This project will produce a georeferenced dataset of 900 connectivity measurements published as an open CSV on GitHub, an interactive public heatmap deployed on AWS CloudFront, a replicable open-source pipeline repository under MIT license, a written summary report submitted to UCF Information Technology, and a poster presentation at the UCF SURE Showcase.

Significance

Use of the Project: Infrastructure-level IT metrics do not capture the student experience of connectivity. A georeferenced, device-level dataset gives administrators actionable evidence to prioritize access point upgrades and bandwidth reallocation. The open-source pipeline is replicable at any institution without proprietary tools.

Intended Audience: UCF students experiencing connectivity issues and UCF Information Technology are the primary audiences. Secondary audiences include network engineers, higher education IT administrators, and researchers studying campus digital equity.

Project Benefits: This project will establish the first student-generated, georeferenced baseline of Wi-Fi performance across UCF's campus. The findings will give administrators evidence-based insight to prioritize access point upgrades and bandwidth reallocation. The open-source pipeline will also demonstrate that institutions can conduct low-cost connectivity audits without proprietary tools, contributing replicable methodology to the field of higher education IT research.

Works Cited

FCC INCREASES BROADBAND SPEED BENCHMARK. The Federal Communications Commission, 14 Mar. 2024, p. 2, https://docs.fcc.gov/public/attachments/DOC-401205A1.pdf.

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Robert, Jenay. "2022 Students and Technology Report: Rebalancing the Student Experience." *EDUCAUSE*, EDUCAUSE, 3 Oct. 2022, https://www.educause.edu/ecar/research-publications/2022/students-and-technology-report-rebalancing-the-student-experience/introduction-and-key-findings.

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Timeline

Dates	Tasks
Jan 1 – Jan 31, 2027	**Phase 1: Site Selection & Setup** • Identify 100 locations using UCF GIS data across 5 zone types • Build Python speedtest-cli + boto3 data collection script • Provision AWS S3, Lambda, Athena, and CloudFront pipeline
Feb 1 – Mar 14, 2027	**Phase 2: Data Collection** • Complete 300 sessions across 100 locations (3 time conditions each) • Run 3 speed tests per session
Mar 17 – Apr 11, 2027	**Phase 3: Analysis & Visualization** • Clean and classify dataset using updated FCC 100 Mbps tier thresholds • Build Leaflet.js heatmap over UCF campus map; deploy to CloudFront • Run ANOVA analysis by zone type and time of day (scipy)
Apr 14 – Apr 30, 2027	**Dissemination** • Deliver report and dataset to UCF Information Technology • Publish pipeline to GitHub under MIT license

	• Prepare poster for UCF SURE Showcase (spring 2028)

Budget

All items are required for project execution and unavailable through UCF resources. No off-campus travel required. Total is $530.00.

Item & Justification	Units & Cost	Total
Samsung Galaxy Tab A9 (64GB) Dedicated device ensures consistent Wi-Fi chipset across all 300 sessions. Using a personal phone risks variable antenna sensitivity and data loss during extended field sessions.	1 unit @ $200.00	$200.00
Garmin GLO 2 Bluetooth GPS Receiver Smartphone GPS degrades significantly inside multi-story buildings. This receiver provides sub-5-meter positional accuracy for reliable indoor georeferencing.	1 unit @ $130.00	$130.00
Anker 737 Power Bank (24,000 mAh) Multi-hour outdoor sessions require sustained power for both the tablet and GPS receiver. Prevents interruptions during 3-4 hour peak-hours collection windows.	1 unit @ $120.00	$120.00
AWS Services (S3, Lambda, Athena, CloudFront) Cloud storage, serverless processing, SQL querying, and public heatmap hosting for the full data pipeline. 4 months of sustained usage exceeds AWS Free Tier limits.	4 months @ ~$20/mo	$80.00
TOTAL REQUESTED		**$530.00**