In modern digital life, reliable internet connectivity is essential for communication, entertainment, and work. Yet many users lack insight into how their networks perform or where problems occur. To address this, the Advanced Raspberry Pi Network Performance Monitoring System uses affordable, single-board computers to analyze network quality in real time.
This project leverages one Raspberry Pi 4 as a central monitoring server and several Raspberry Pi 3 units as satellite agents. All devices connect through a single home Wi-Fi router, allowing a distributed monitoring setup within one network. The system continuously measures latency, jitter, bandwidth, and packet loss, providing data visualization and even automated analysis to detect anomalies or signal degradation.

The project's core idea is to transform everyday Raspberry Pi boards into intelligent tools for network analysis. The Raspberry Pi 4, with its higher processing power and Gigabit Ethernet capability, serves as the central server that stores, processes, and visualizes the collected data. It hosts the dashboard, database, and optional machine-learning components. The Raspberry Pi 3 units act as client nodes, each performing periodic network tests using tools like ping, iperf3, or traceroute. These client nodes then transmit their readings to the Pi 4 over the same Wi-Fi connection.

This setup works well in a single-router environment because the goal is to monitor differences in performance within one local network rather than between separate networks. Each Pi 3 can be placed in different rooms or at varying distances from the router to measure how signal strength, interference, or obstacles affect network quality. The Pi 4, connected via Ethernet for stability, provides a baseline reading against which Wi-Fi results can be compared. Through this configuration, the system can visualize how network quality changes across physical spaces and over time.
The software architecture includes several key layers:

1. Data Collection Layer: Python scripts run automated tests on each Pi and log metrics such as latency and packet loss.
2. Communication Layer: Data is transmitted securely via MQTT or REST API to the central Pi 4.
3. Storage and Processing Layer: The Pi 4 stores readings in a time-series database such as InfluxDB or PostgreSQL, and performs optional analysis for trend detection.
4. Visualization Layer: A Flask or Grafana dashboard displays results in charts and heatmaps, allowing easy comparison between nodes.
5. Anomaly Detection and Reporting: The system can flag irregularities automatically or generate periodic summary reports to show performance trends.

This design provides a flexible balance between simplicity and sophistication. Even within one home router network, it simulates a distributed monitoring environment and can later scale to include additional routers or remote sites if desired. By emphasizing modularity and automation, the project also serves as a platform for learning about networking, IoT communication protocols, and data visualization tools.

The Advanced Raspberry Pi Network Performance Monitoring System demonstrates how low-cost hardware can deliver professional-level network insights. With only one router, a single Raspberry Pi 4, and several Raspberry Pi 3 units, the setup successfully creates a

distributed yet localized monitoring network. It measures how signal strength and connection stability vary throughout a home or office, providing valuable data through an interactive dashboard.

This project combines principles of computer networking, IoT design, and data analysis in a practical and educational way. It shows that network performance monitoring does not require expensive commercial equipment—only creativity, open-source software, and accessible hardware. In the future, the system could be expanded with additional routers or cloud connectivity, but even in a single-router configuration, it delivers meaningful, real-time insight into network behavior and reliability.