Title: Warehouse Robot Mobility Using SONiC FRRouting Environment

Description:
Are you ready to tackle a cutting-edge engineering challenge? This capstone project offers students the unique opportunity to delve into the world of robotics and advanced networking technologies.

In modern warehouses, robots play a critical role in accomplishing tasks assigned by a central controller. These robots maintain constant communication with the warehouse controller via access points (APs) connected to routers or local area networks (LANs). Here are some key details:

- A small warehouse may have **10 APs** serving up to **100 robots**.
- Large-scale warehouses can scale up to **5,000 APs** and **50,000 robots**.
- Robots move at an average rate of **five times per minute** and exchange instructions every **100ms**, requiring robust and seamless communication.

In this project, you will emulate robot mobility in a warehouse environment using the **SONiC FRRouting** platform:

- https://frrouting.org/
- https://docs.frrouting.org/projects/dev-guide/en/latest/index.html#

Robots will be treated as hosts, while the IP fabric will utilize **eBGP underlay** with a **VxLAN-EVPN control plane**. The project's goal is to:

1. Characterize current mobility techniques. For example, EVPN has an embedded mobility mechanism but was not design for the requirements discussed here (i.e., scalability issues). See the following links for more details:
    1. https://www.rfc-editor.org/rfc/rfc7432.html#page-45
    2. https://datatracker.ietf.org/doc/rfc9721/
2. Develop and evaluate new techniques, revising the protocol and infrastructure design and code, based on criteria such as warehouse size, robot movement rate, communication reliability, and BGP route management.

Project Phases:
This project will be structured into the following four phases, in collaboration with a “real” client from CISCO:

Phase 1: **Setup of your personal environment**

- **macOS**: Install and configure Colima.
- **PC**: Install and configure Ubuntu.

Phase 2: **Familiarity with FRRouting**

- Clone the FRRouting Git repository.
- Compile the code.
- Create network topologies and configure routers.
- Bring up the simulation environment.

- Modeling robot mobility using FRRouting

Phase 3: **Identify key monitoring metrics**

- Determine what metrics to measure, how to measure them, and when to collect data to characterize robot mobility.

Phase 4: **Characterization and fine-tuning**

- Analyze mobility performance and scalability.
- Develop strategies to improve mobility in terms of performance, scale, and convergence.
- Study the impact of various failures, such as robot failure, AP failure, router failure (optional).

Skills Required:

To succeed in this project, students should have:

- **Proficiency in C and Python** programming.
- Knowledge of **BGP**, **EVPN**, and **Linux** (highly valuable).
- Strong interest in **networking**

Student Expectations:

We are looking for **motivated, curious, and resourceful students** who are eager to take ownership of the project and contribute their own ideas. This is a hands-on opportunity to work with real-world technologies and make meaningful contributions to the field of robotics and networking.

Are you up for the challenge? Take this opportunity to push your skills to the next level while working on a project that has real-world applications in the rapidly evolving warehouse automation space!

Note:

If multiple teams are selecting this project, each team will work on a different strategy to improve performance.