Documentation for Channel Class

Project: Fairness in WiFi and 5G Coexistence

1 Channel Class Documentation

The `Channel` class is a core component of the wireless coexistence simulator, representing a multi-band wireless medium. It handles signal propagation, capacity constraints, and ongoing transmission state across different frequency bands.

Attributes

- **env**: The SimPy simulation environment controlling time and events.
- **bands**: A tuple defining the frequency bands available (e.g., 2.4GHz, 5GHz, 6GHz).
- **tx_power_dBm**: Transmit power of the sender node in decibels-milliwatts (default = 20).
- **pathloss_exponent**: Exponent used for modeling free-space signal decay (default = 3.0).
- **noise_floor_dBm**: Ambient background noise level (default = -95 dBm).
- **rx_sensitivity_dBm**: Minimum signal strength required for successful reception (default = -82 dBm).
- **max_capacity**: Maximum allowed channel usage per simulation second (1.0 represents full utilization).
- **used_capacity**: Tracks how much of the channel is currently being used.
- **transmissions**: Dictionary mapping each band to its list of ongoing transmissions (each as a tuple of transmitter and end time).

Constructor

```
def __init__(self,
             env: simpy.Environment,
             bands=('2.4GHz', '5GHz', '6GHz'),
             tx_power_dBm=20,
             pathloss_exponent=3.0,
             noise_floor_dBm=-95,
             rx_sensitivity_dBm=-82):
```

- Initializes a channel object with configurable radio characteristics.
- Prepares an internal registry for each band to track ongoing transmissions.

Purpose in Project

This class is essential to simulate real-world behavior of wireless media in a coexistence environment. It enables:

- Simulating interference and collisions across multiple radios (Wi-Fi vs. 5G NR-U).
- Estimating whether a message can be received based on signal strength and interference.
- Supporting Cellular Automata rules by giving feedback on signal conditions.

The `Channel` object models the local view of the medium required for CA-based decentralized decision-making.