Figure 1: Bump-in-the-Wire System Architecture

Cloud Phase: Federated Learning & Policy Training

- Physics-Informed Neural ODEs
- Multi-Agent RL Training
- Federated Aggregation
- Transfer Learning

Edge Phase: Real-Time Inference (<10ms)

- Bump-in-the-Wire HW
- ONNX Runtime
- Control Barrier Functions
- Safety Enforcement

100Hz

MAS Phase: Distributed Coordination

- Primary (ms): Frequency
- Secondary (s): Restoration
- Tertiary (min): Optimization
- GNN-ADMM Acceleration

1kHz