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NF NAI

Designing a Dynamic, Slice-Aware Monitoring Framework for Open 5G Networks: Toward Lightweight, Flexible, and Adaptive Observability

Context

5G introduces slicing, virtualization, and programmability, which challenge traditional monitoring. Observability must now be:

- **End-to-End Coverage:** Monitors both *5G Core and RAN*

- **Open-Source:** Utilizes open-source technologies

- **Slice-Aware & Granularity:** Enables *per-slice* and *per-UE observability*

- **Lightweight & Non-Intrusive:** Minimizes overhead in real-time environments

- **Modular:** Integrates easily with existing observability stacks

- **Dynamic & Adaptive:** Deploys probes *on-demand* for detailed insight
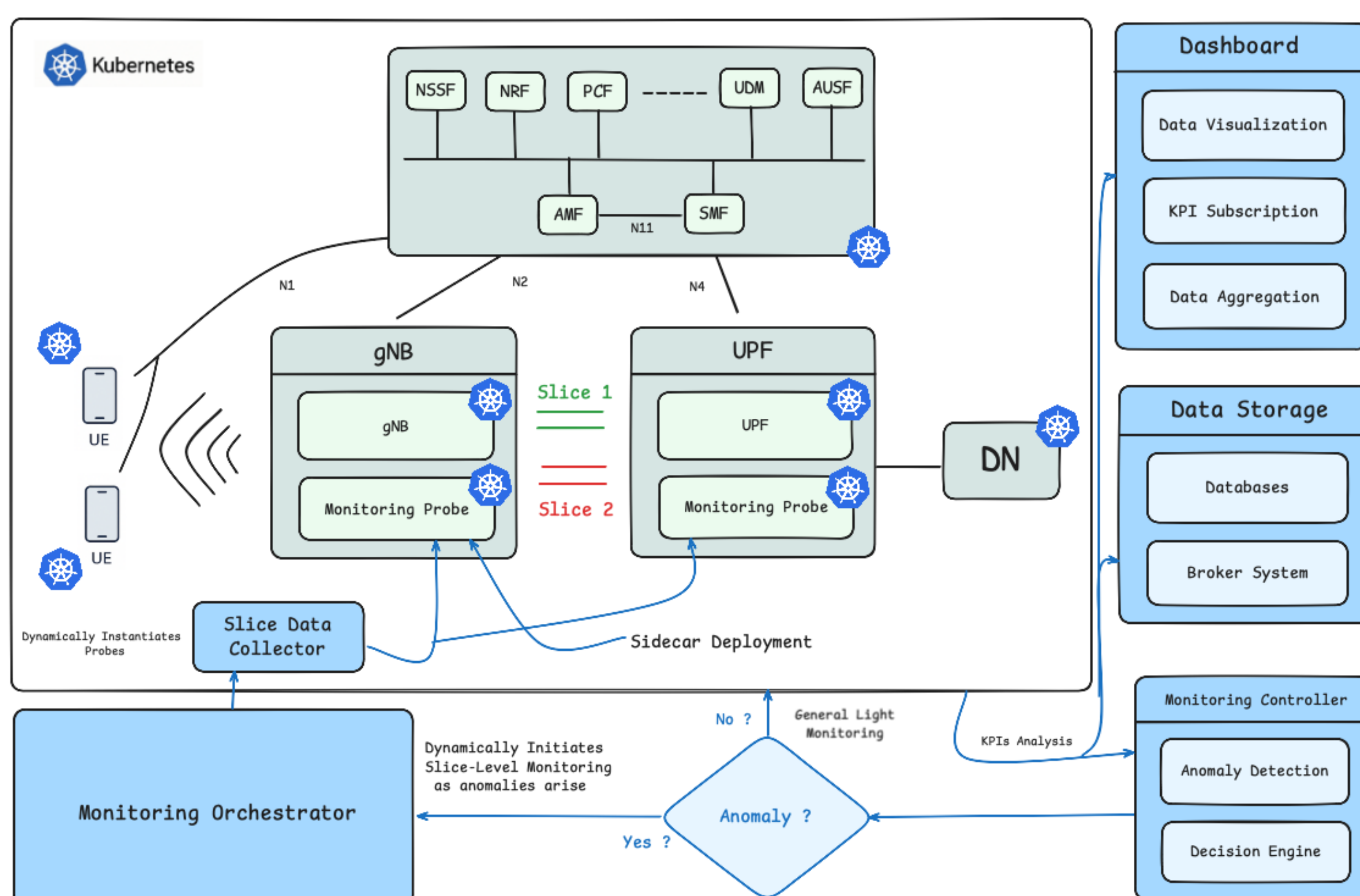

Methodology

- **Latency Probe :** We use *eBPF* to implement a lightweight TCP latency probe that captures round-trip time at key interfaces (e.g., N3, N6). The probe correlates uplink PSH packets with downlink ACKs and tracks per-flow/slice latency

- **Throughput Probe:** Implemented using aggregated packet counters, aligned with slice or UE tags
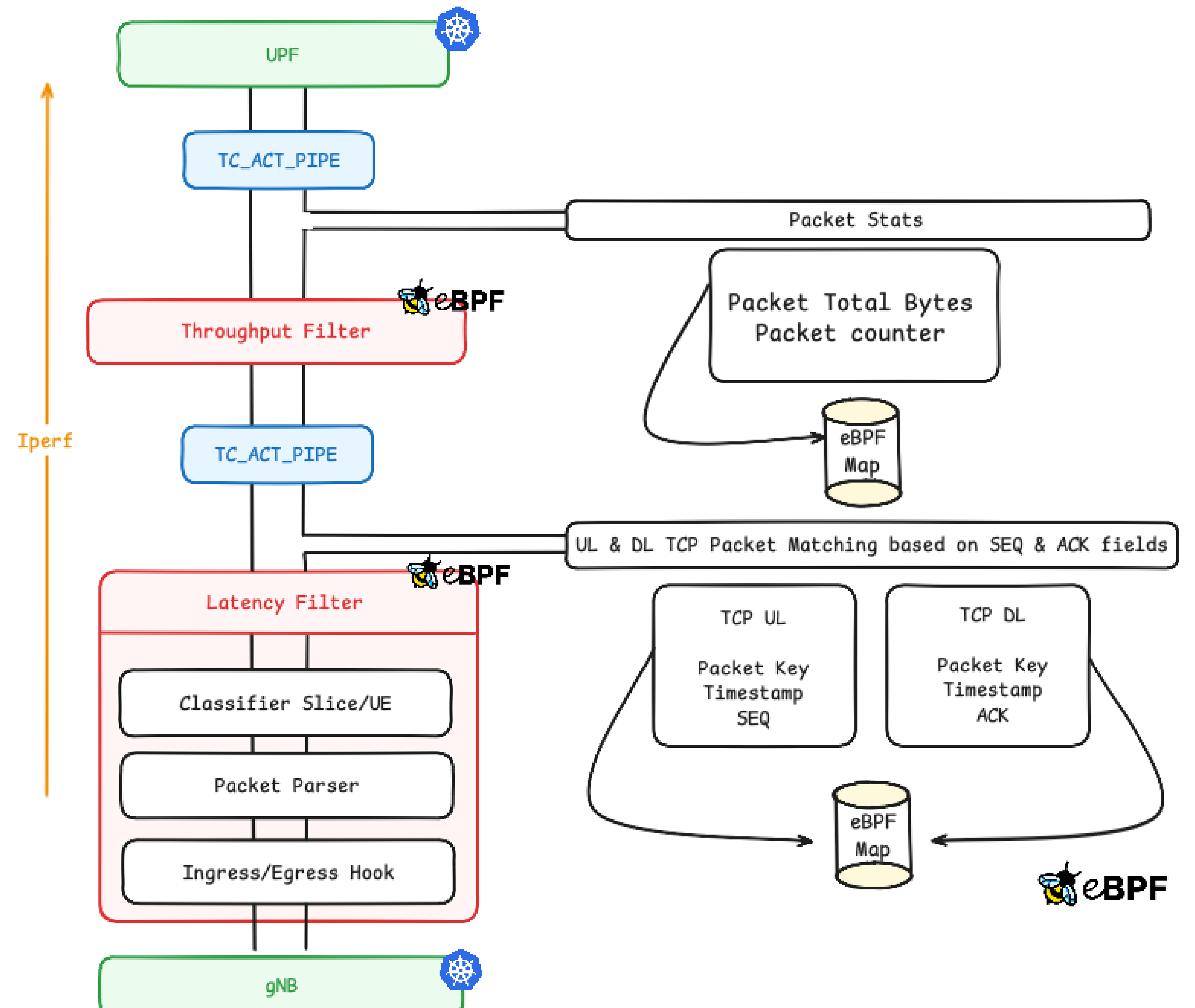
Results

Our initial *eBPF* latency & bitrate probe tests on OAI gave promising results:
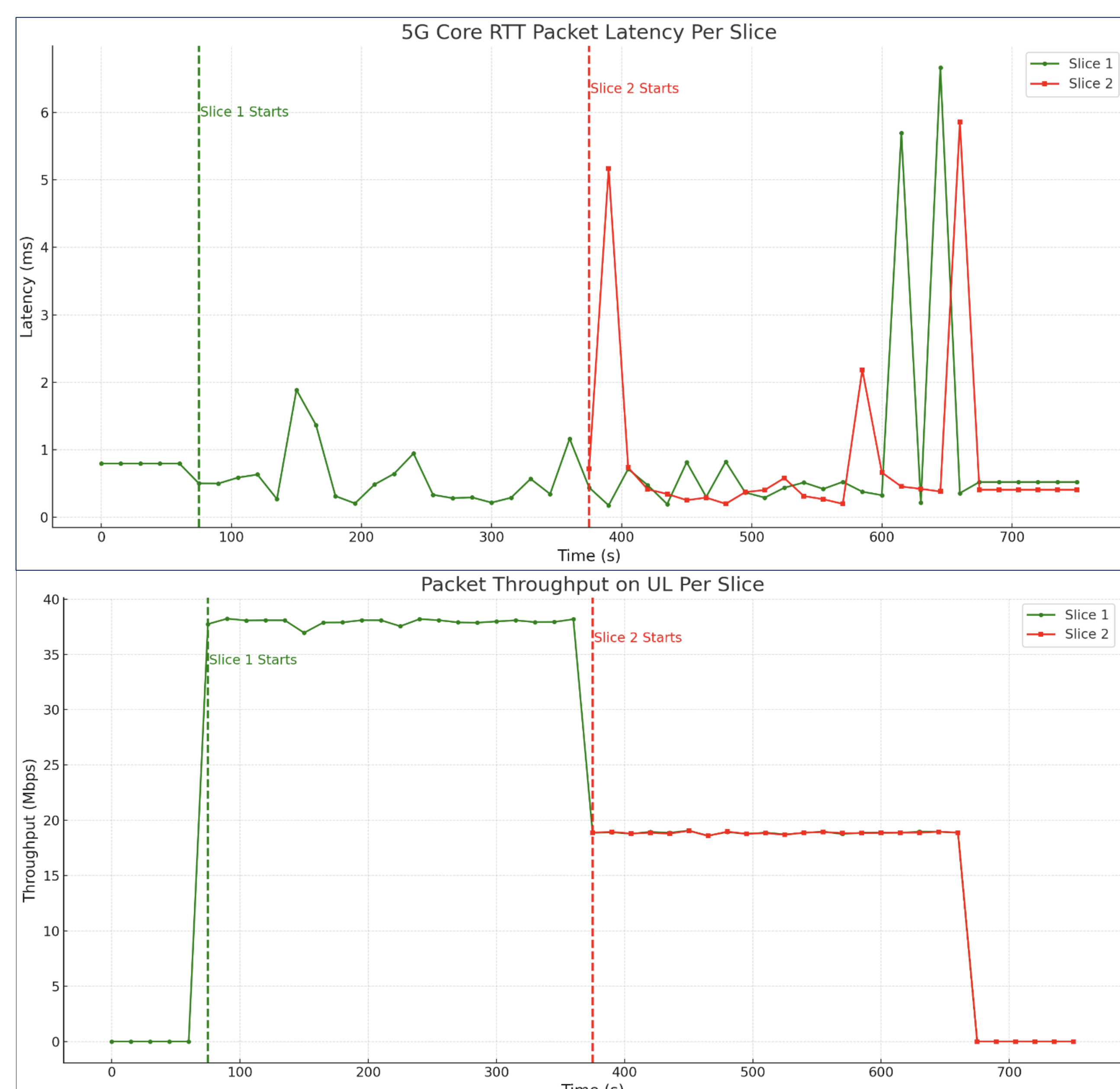
Scientific Cooperation

This project is open to collaboration across multiple domains:

- **Open-source 5G**: Contributions and feedback from OAI and Open5GS

- **Open-source 5G Monitoring Systems:** Possible enhancements to existing 5G monitoring solutions (e.g., Monarch, Janus)

- **Observability Research**: Collaboration with researchers exploring eBPF, telemetry, and other forms of monitoring

- **Cloud-native Ecosystems**: Exploring integrations with CNCF tools (e.g., Prometheus, OpenTelemetry)

- **Real-world Testbeds**: Planned deployment on larger-scale 5G testbeds (e.g., SLICES-RI)