Poster: Bridging the Gap: E2SM-SENS for ISAC-Native O-RAN Architectures

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Abstract

Integrated Sensing and Communication (ISAC) enables 6G networks to perform environmental sensing using communication infrastructure. We propose O-RAN extensions for monostatic sensing: (1) sensing dApps at the O-DU for IQ processing; (2) E2SM-SENS, a service model for sensing telemetry. Prototype evaluation demonstrates closed-loop latencies compatible with vehicular perception and UAV tracking use cases.

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1 Introduction

ISAC combines communication and environmental sensing within shared 6G infrastructure. While 3GPP Release 19 and O-RAN Alliance identify ISAC as a key capability, current architectures lack: (1) service models exposing sensing metrics; (2) O-DU frameworks for real-time sensing. We present **the first E2 service model for sensing telemetry** (E2SM-SENS), enabling xApps to subscribe to sensing KPIs through standard O-RAN interfaces.

2 Architectural Extensions

Sensing dApps: ISAC requires sub-ms feedback loops while the Near-RT RIC operates at 10–100 ms [3]. We introduce dApps [2] at the O-DU that process IQ samples directly, extracting delay, Doppler, and AoA.

E2SM-SENS: A new E2 service model enabling structured reporting of sensing KPIs over the E2 interface. KPIs include delay, Doppler shift, AoA, and environmental indicators. Telemetry subscriptions follow standard E2 procedures: xApps request periodic updates (e.g., every 5-100 ms) or event-driven triggers based on threshold crossings. Higher-level objectives are encoded via `A1_POLICY_TYPE_ISAC` policies, specifying geographic scope, temporal budgets, and sensing priority.

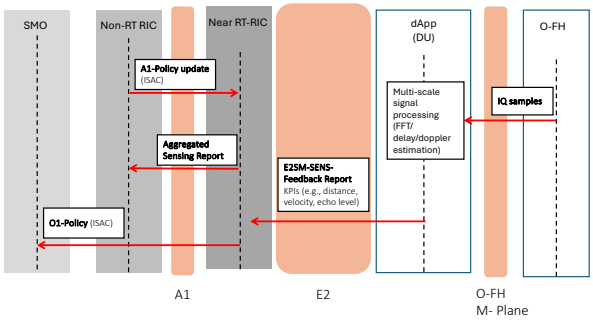
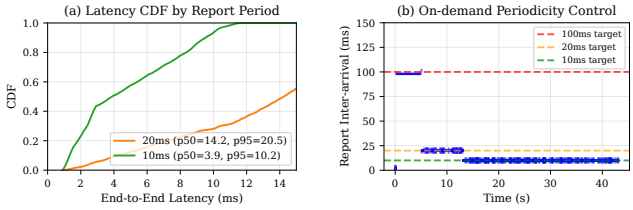


Figure 1: Proposed O-RAN ISAC Control



(a) Latency CDF **(b) Periodicity control**

Figure 2: E2SM-SENS evaluation

3 Evaluation

We implemented E2SM-SENS on FlexRIC [1] with a simplified mock dApp that emulates sensing signal processing, collecting approximately 35000 samples across 10 trials. The dApp publishes FFT-based features via E2SM-SENS to an xApp subscriber.

Results (Fig. 2): Periodicity control (b) tracks requested rates within 0.1 ms of target. Closed-loop latency (a): **4.6 ms median** (p95: 10.2 ms), decomposed as 3.9 ms telemetry + 0.7 ms control overhead. 93.4% of samples below the 10 ms vehicular threshold, 100% below the 20 ms UAV threshold. As shown in Fig. 1, the hierarchical control loop (dApp→xApp→rApp) enables seamless integration with existing O-RAN deployments while meeting real-time ISAC requirements. The E2SM-SENS message encoding adds negligible overhead (<50 μs per report), preserving compatibility with high-rate sensing scenarios.

References

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