

FALCON: A Framework for Fault Prediction in Open RAN Using Multi-Level Telemetry

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A. Motivation

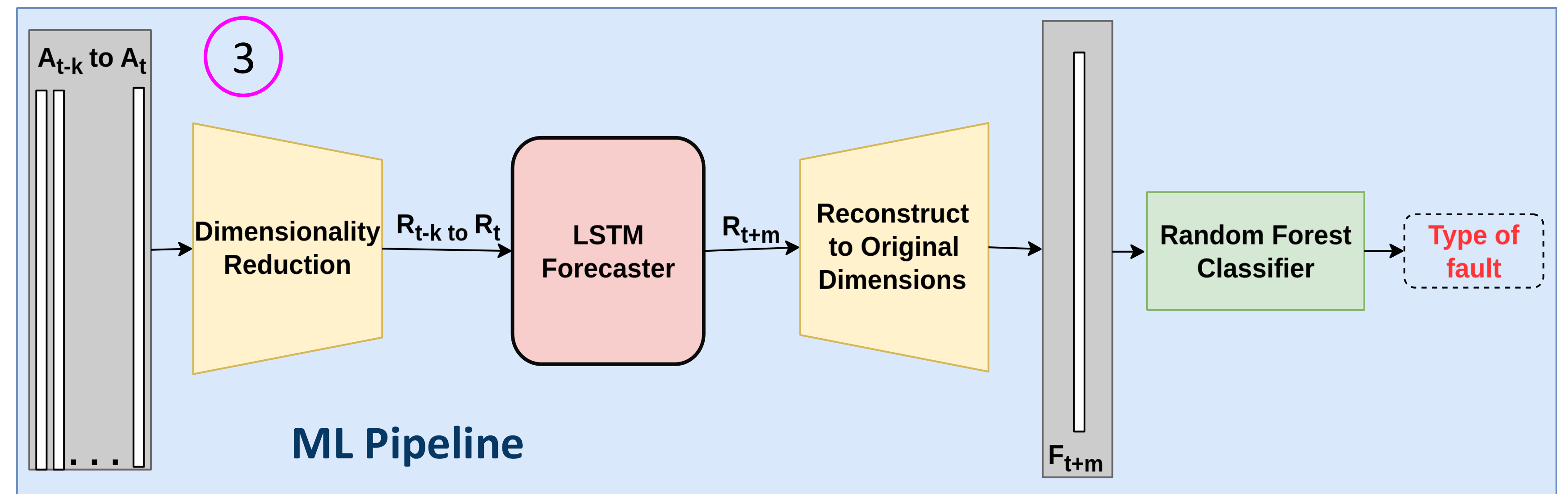
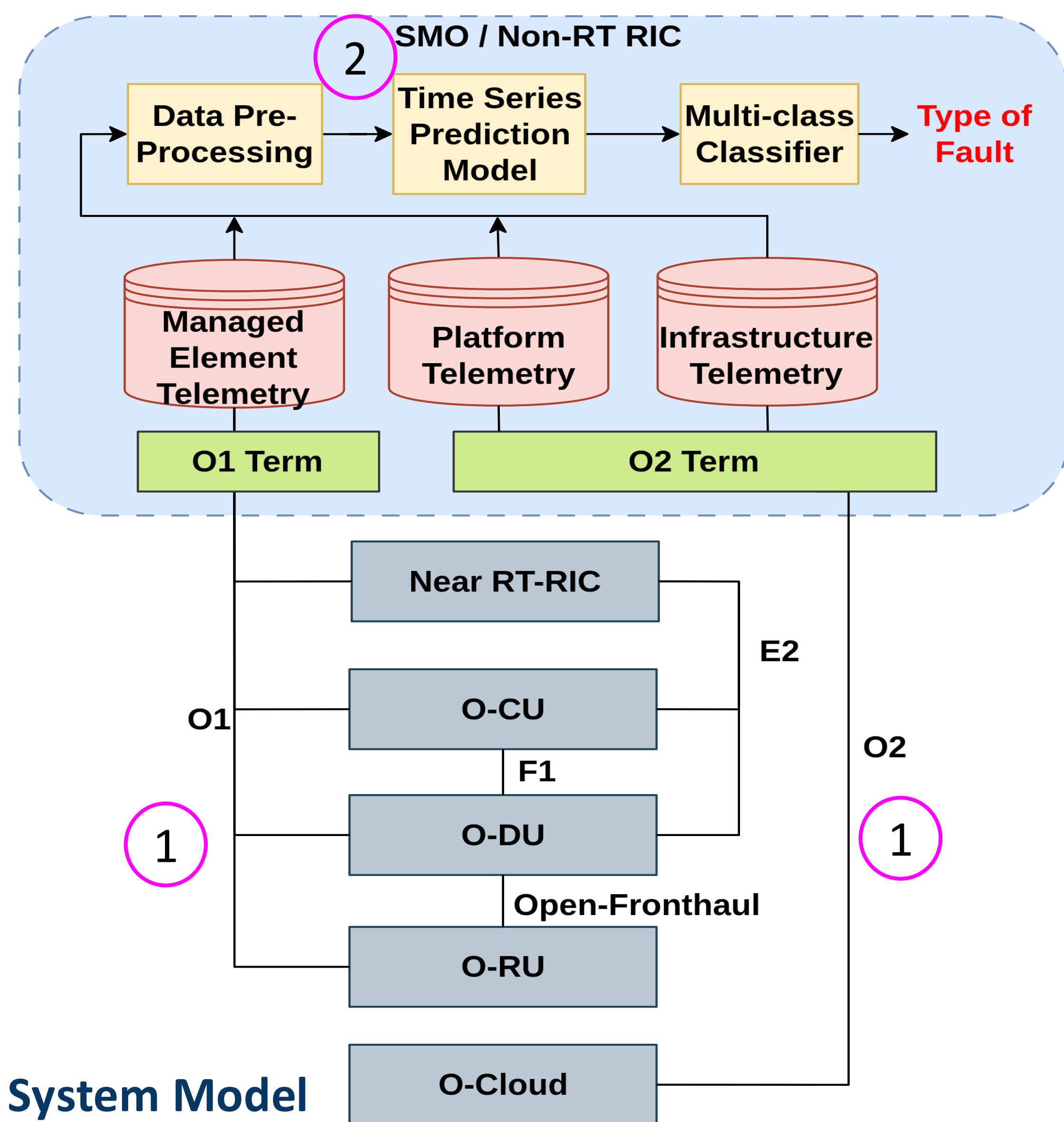
- O-RAN offers deployment flexibility and intelligent RAN control through its disaggregated arch. with open interfaces
- But it introduces complexities in system integration and network management as components could be from different vendors
- O-RAN deployments on commodity hardware using cloud-native technologies could suffer from failures at multiple levels

B. Literature on Resiliency in Open RAN

Existing works focused on:

- Observability, fault detection, and Root Cause Analysis at either cloud, platform or RAN level
- Recovery of individual components (e.g., DU/CU, switches) rather than system-wide faulty management
- There is a need for proactive fault management in virtualized O-RAN deployments by using multi-level telemetry

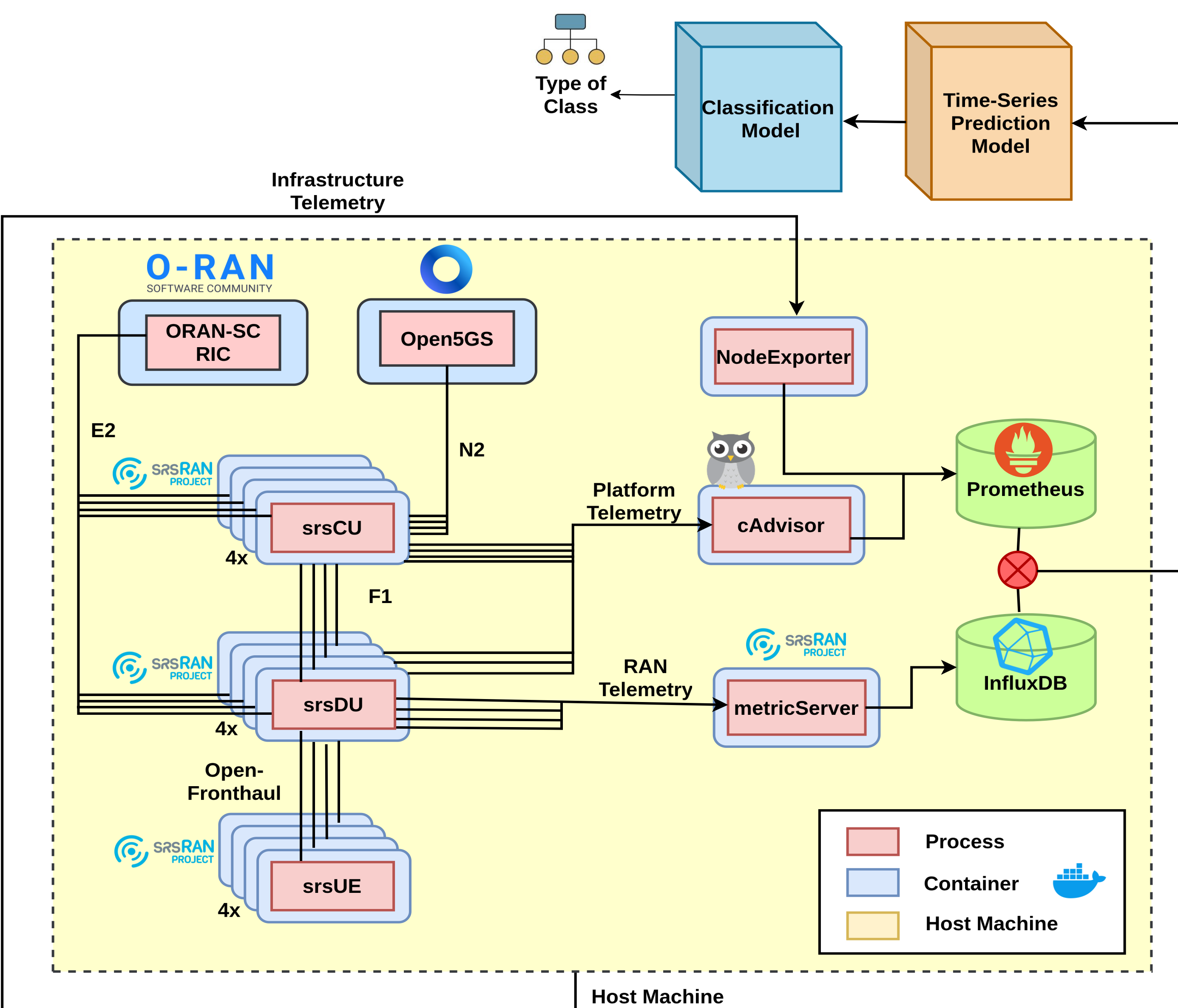
C. Proposed Framework: FALCON



- FALCON collects and integrates RAN, platform, and infrastructure telemetry via O1/O2 interfaces for holistic observability of O-RAN
- FALCON pre-processes data with imputation and dimensionality reduction to improve scalability and efficient analysis
- Spatial-temporal dependencies are leveraged to accurately forecast network state and identify faults

Note: $t-k$, $t+m$ represent both look-backward and look-forward in ML pipeline

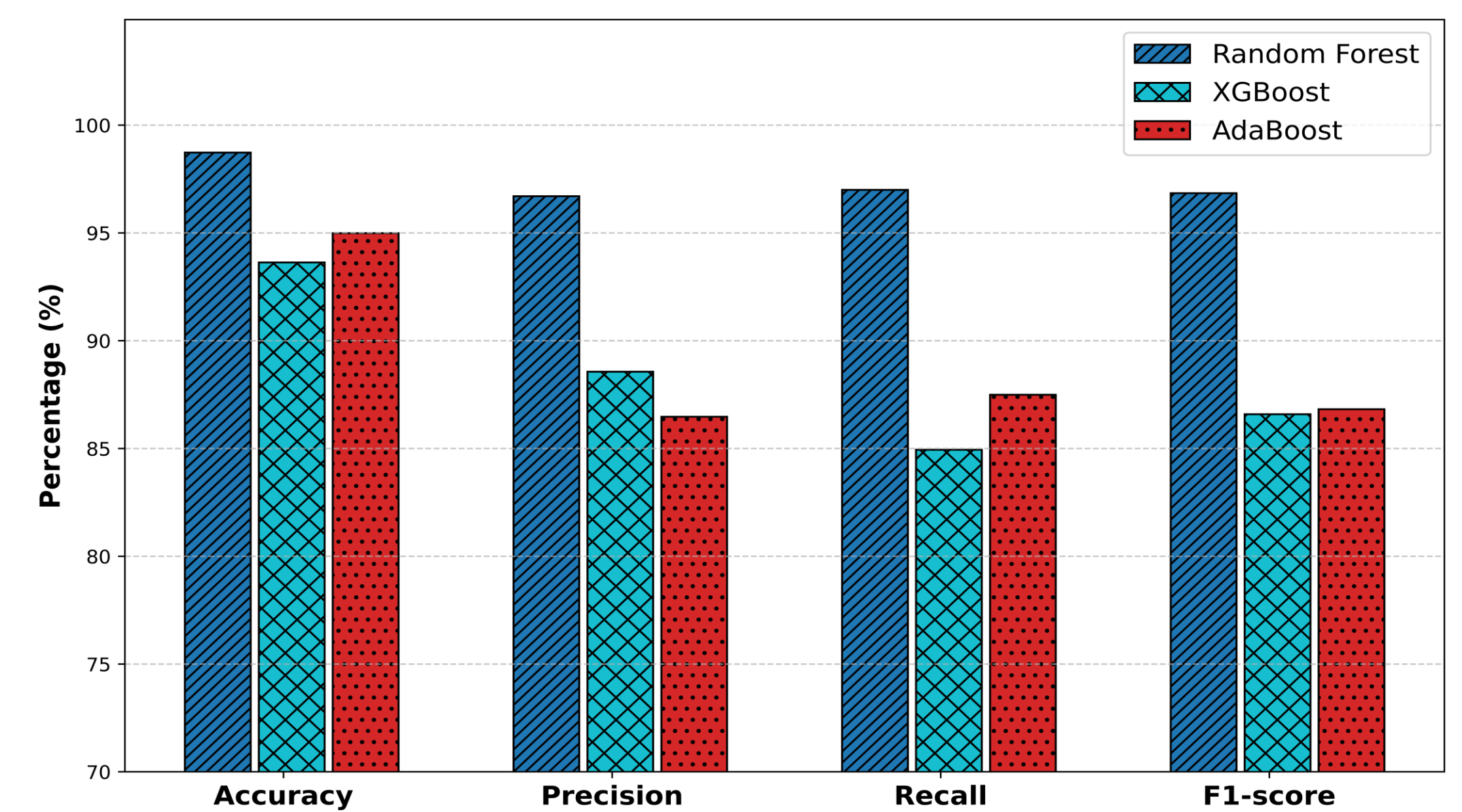
D. Experimental Setup



Tools like stress-ng and tc are used to inject faults:

- CPU contention test:** 40-90% stress on CU/DU cores during data collection
- Memory contention test:** 25-35% stress during data collection
- Packet loss test:** 1-3% packet loss

E. Performance Evaluation



- Average RMSE of 0.05789 is achieved for the predicted features after inverse PCA (before de-normalization)

Class	Precision	Recall	F1-Score
0 (Normal)	0.9888	0.9976	0.9931
1 (CPU Stress)	0.9982	0.9854	0.9918
2 (Memory Stress)	0.9109	0.9891	0.9471
3 (Packet Loss)	0.9702	0.9077	0.9304

F. Conclusions & Future Directions

- FALCON predicts faults (e.g., 5 secs in advance) with 98.73% accuracy
- Future work involves large-scale testing of the proposed framework and root cause analysis for the faults predicted for proactive network mgmt

