A Brief Introduction to O-RAN and xApps

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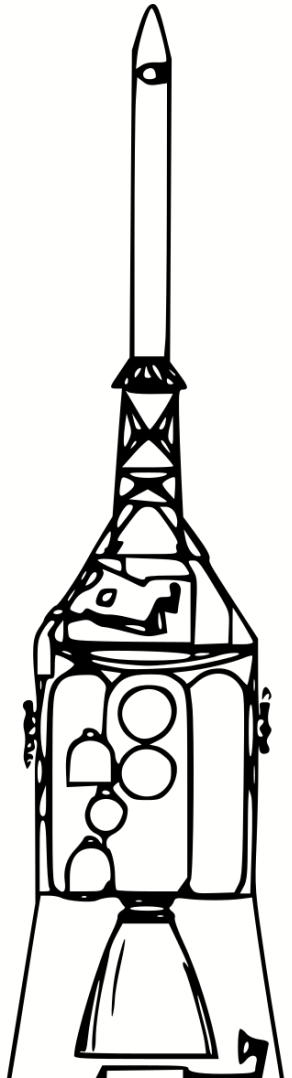
SANS 2024

University of Glasgow

Who Am I?

- Abridged history …
  - BSc (hons) in Computer Science
  - Worked in industry as a software engineer
  - Got a PhD in Artificial Intelligence
  - Teacher/Lecturer at Strathclyde and Caledonian Universities
  - Moved to industry with Rakuten Mobile
    - Academic collaborations on Autonomous Networks
  - … and now back to academia

What Am I Doing?



- **I am a research associate here at the University of Glasgow**
- Still in the field of Autonomous Networks
- The current goal is to create an App Store for xApps
  - **Funded by EPSRC IAA award EP/X5257161/1**
  - xApps are "cross-layer applications" that (hopefully) make mobile networks run smarter and more efficient

https://xkcd.com/1133

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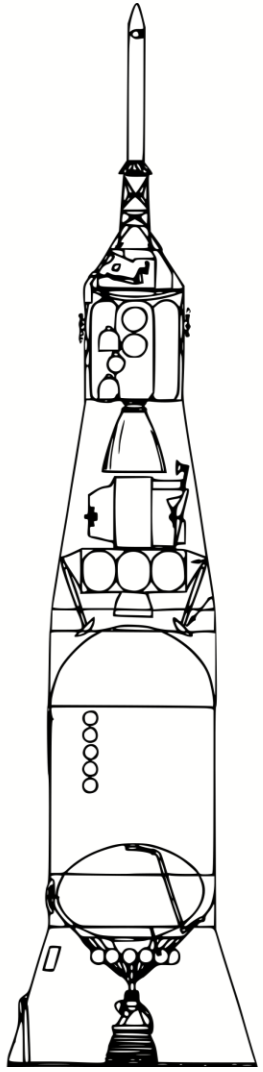
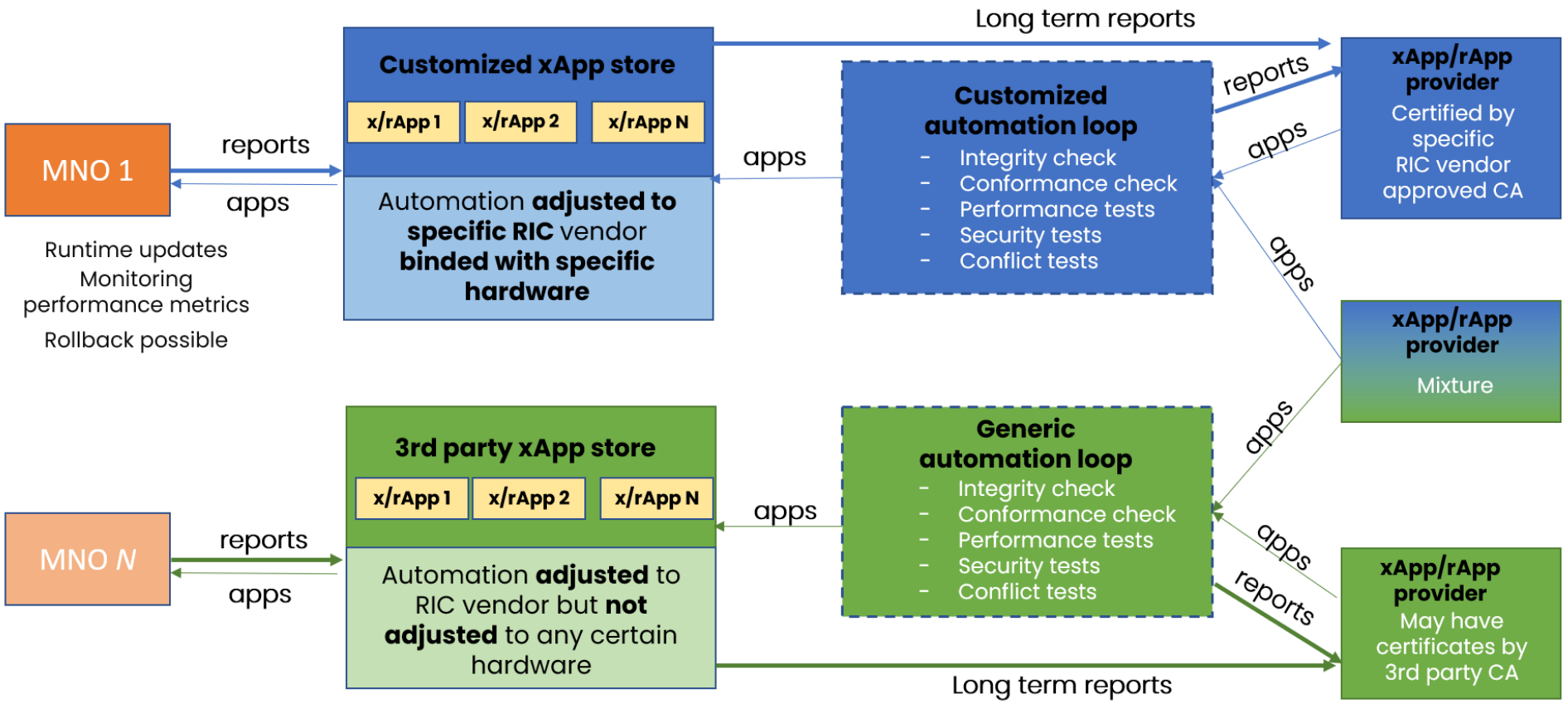
Towards Autonomous Open Radio Access Networks





Adrian Kliks, Marcin Dryjanski, Vishnu Ram OV, Leon Wong, Paul Harvey. May, 2023

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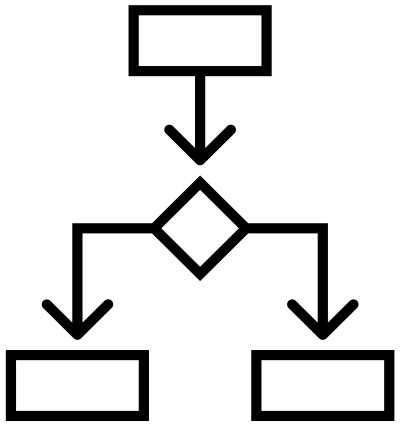
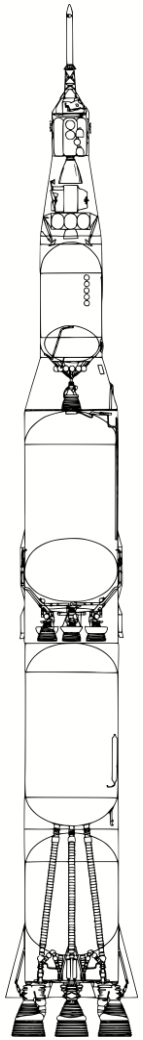
xApps



- xApps are intended to implement RAN functions: -
  - Dynamic optimisation
  - Closed-loop automation
  - Service differentiation
  - Load balancing
  - Mobility
  - Energy efficiency
  - Coverage optimisation

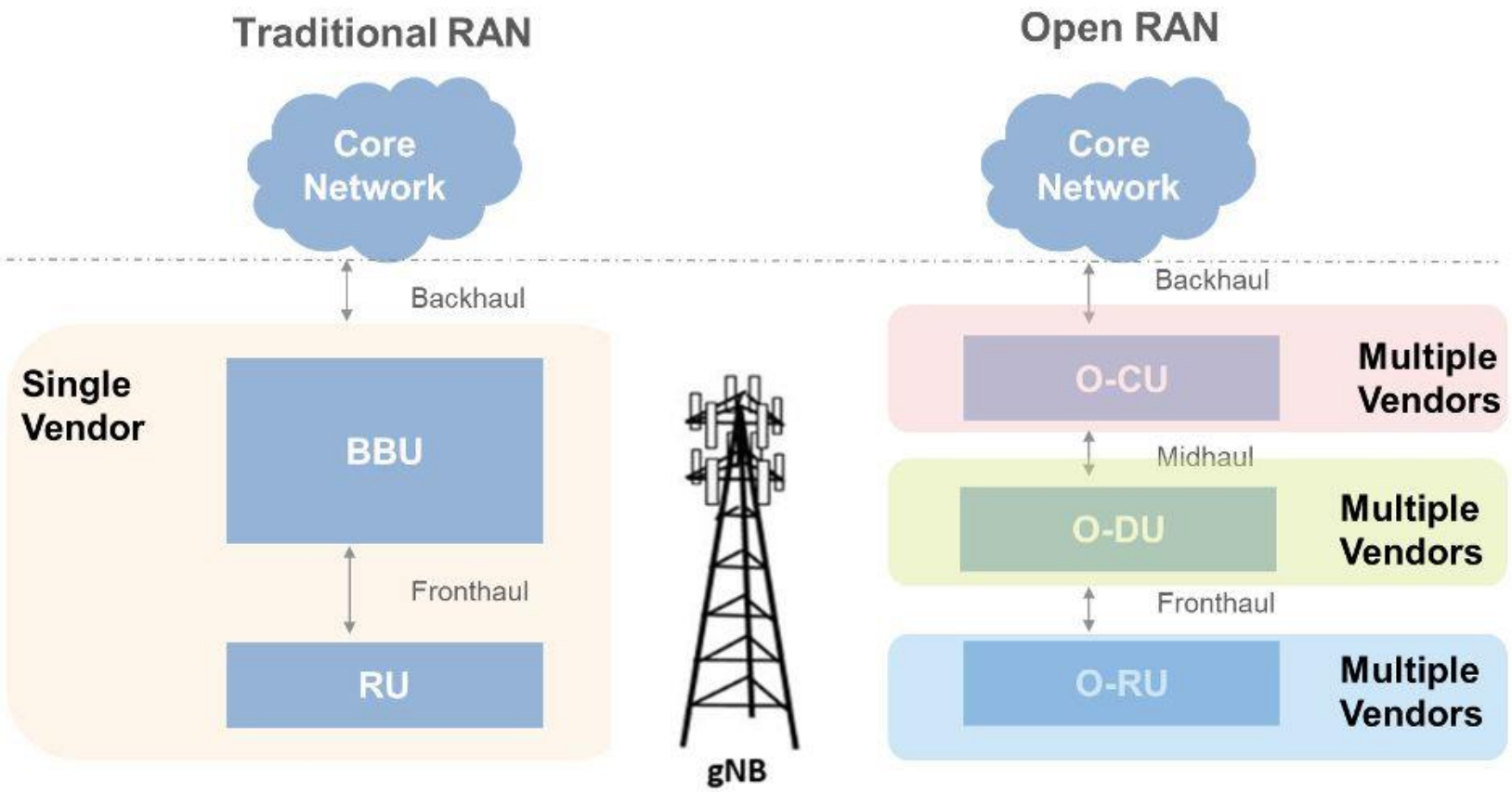
Open RAN



- **Open Radio Access Network**
- A paradigm shift in the telecommunications industry
  - Away from single-vendor, monolithic solutions
  - To multi-vendor, modular solutions
- Open and flexible
- Lower barrier to entry and TCO
- Scalable

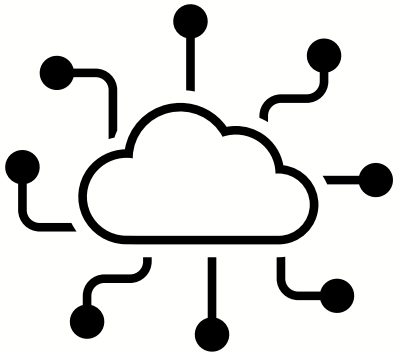
https://xkcd.com/1133

A Quick Comparison



https://uk.mathworks.com/discovery/o-ran.html

Key O-RAN Features



- **Open Interfaces**
  - Interoperability and Compatibility
  - Mix and Match components
  - "Off-the-shelf" components
- **Virtualisation**
  - Emphasis on software-based solutions running on standard hardware
  - Software Defined Networks (SDN)
  - Network Function Virtualisation (NFV)
- **Cloud-Native Architecture**
  - Micro-services, containers, resource allocation, cost effectiveness

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O-RAN Alliance

"O-RAN ALLIANCE is a world-wide community of mobile operators, vendors, and research & academic institutions with the mission to re-shape Radio Access Networks to be more intelligent, open, virtualized and fully interoperable."

https://www.o-ran.org/

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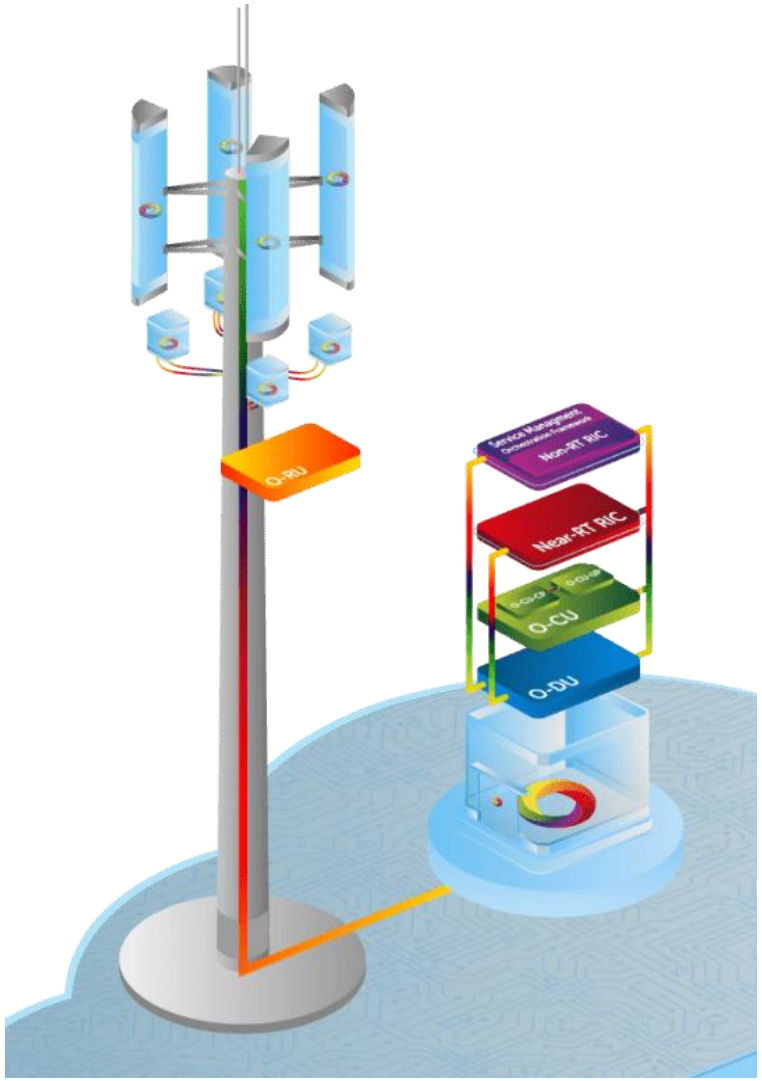
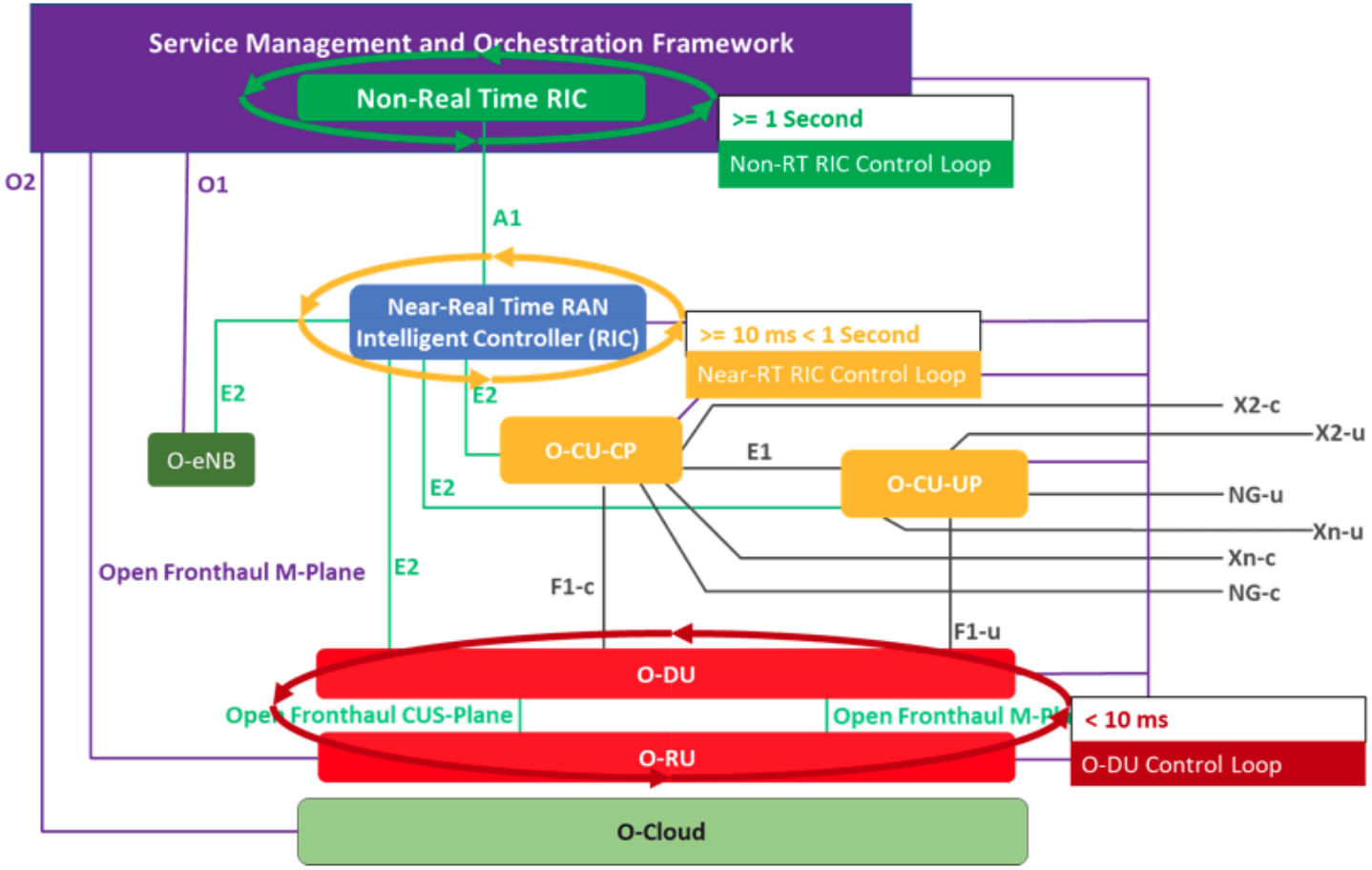
High-level Overview of O-RAN



- Radio Unit (O-RU)
- Distributed Unit (O-DU)
- Centralised Unit (O-CU)
- (Near) Real-Time RIC (rtRIC)
  - This is where xApps live
- Non-Real-Time RIC (ntRIC)
  - This is where rApps live

https://www.o-ran.org/

Control Loops and Interfaces of O-RAN



https://www.aspiretechnology.com/blog/open-ran-series-open-ran-intelligence-part-3-of-3/

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Building the Testbed

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Testbed

OAIC Near-RT RIC

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Testbed

OAIC Near-RT RIC

NAMESPACE	NAME	STATUS
ricplt	deployment-ricplt-a1mediator-6ccd8896d7-9zfkp	Running
ricplt	deployment-ricplt-alarmmanager-56d79dc55-phsjg	Running
ricplt	deployment-ricplt-appmgr-6fd6664755-dvjt9	Running
ricplt	deployment-ricplt-e2mgr-66cdc4d6b6-kvwlj	Running
ricplt	deployment-ricplt-e2term-alpha-db9c45968-524bc	Running
ricplt	deployment-ricplt-jaegeradapter-76ddbf9c9-hhcbw	Running
ricplt	deployment-ricplt-o1mediator-677ff764d7-g7vsr	Running
ricplt	deployment-ricplt-rtmgr-578c64f5cf-l6rrn	Running
ricplt	deployment-ricplt-submgr-7f6499555d-jxh46	Running
ricplt	deployment-ricplt-vespamgr-84f7d87dfb-6g7kx	Running
ricplt	deployment-ricplt-xapp-onboarder-5958856fc8-7qvk8	Running
ricplt	r4-infrastructure-kong-646b68bd88-9g7fc	Running
ricplt	r4-infrastructure-prometheus-alertmanager-75dff54776-tff7m	Running
ricplt	r4-infrastructure-prometheus-server-5fd7695-l82mm	Running
ricplt	ricplt-influxdb-meta-0	Running
ricplt	statefulset-ricplt-dbaas-server-0	Running
ricxapp	ricxapp-scp-kpimon-7f8f588455-mhrhv	Running

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Testbed

OAIC Near-RT RIC

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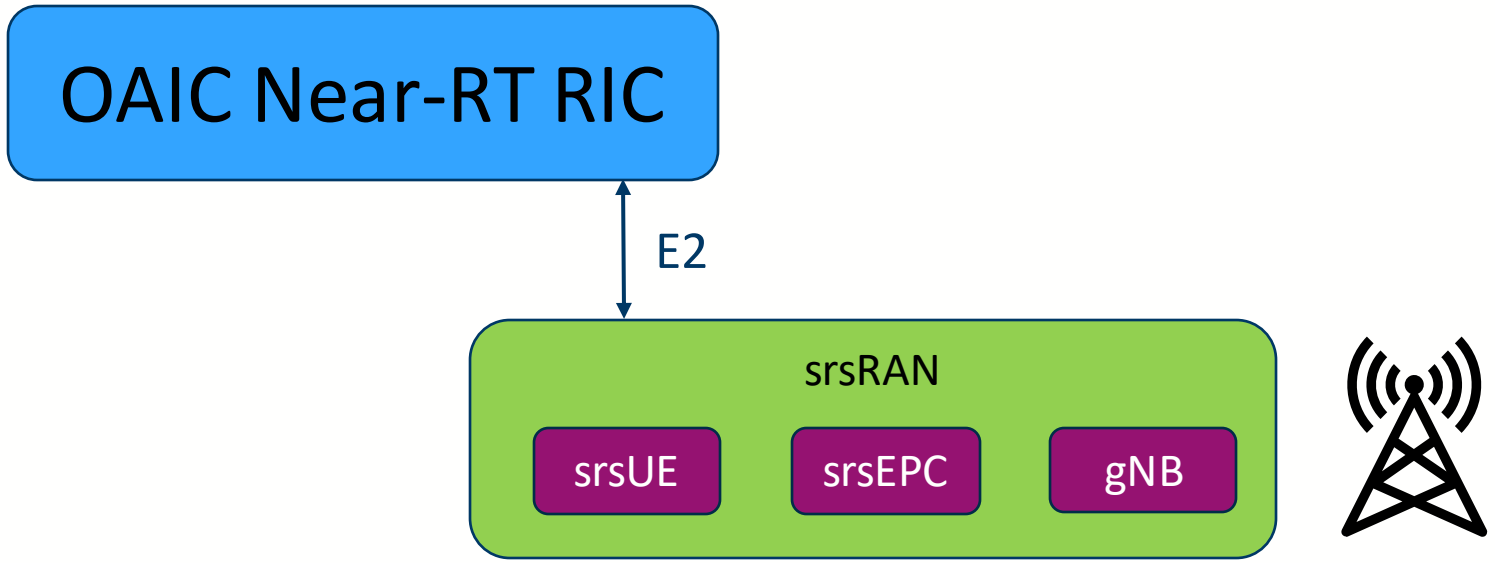
Testbed



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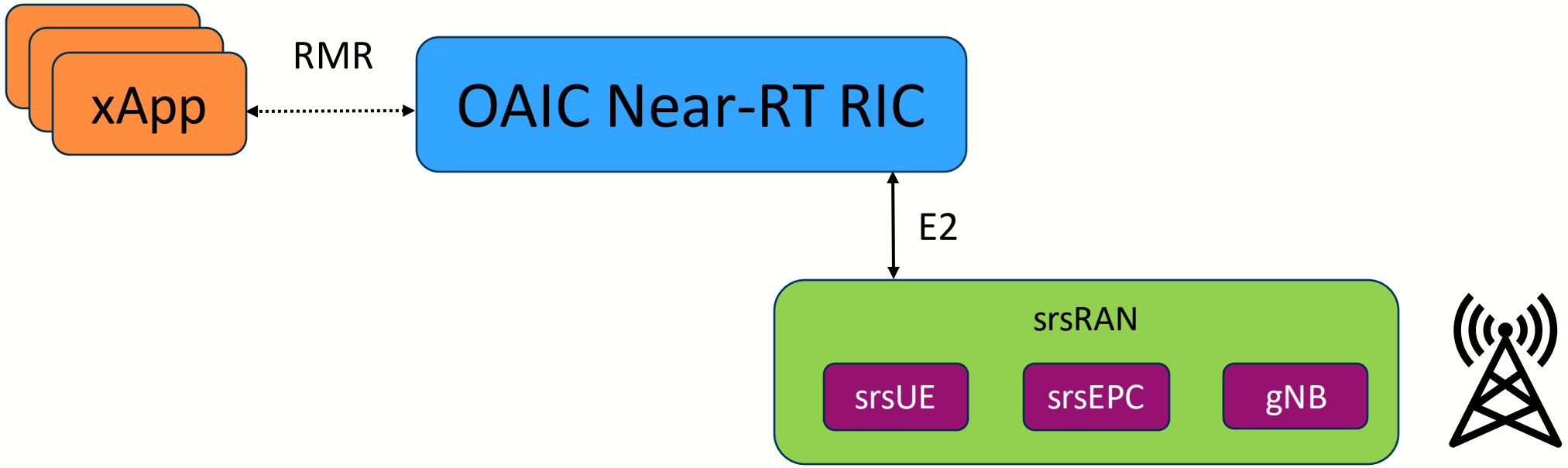
Testbed



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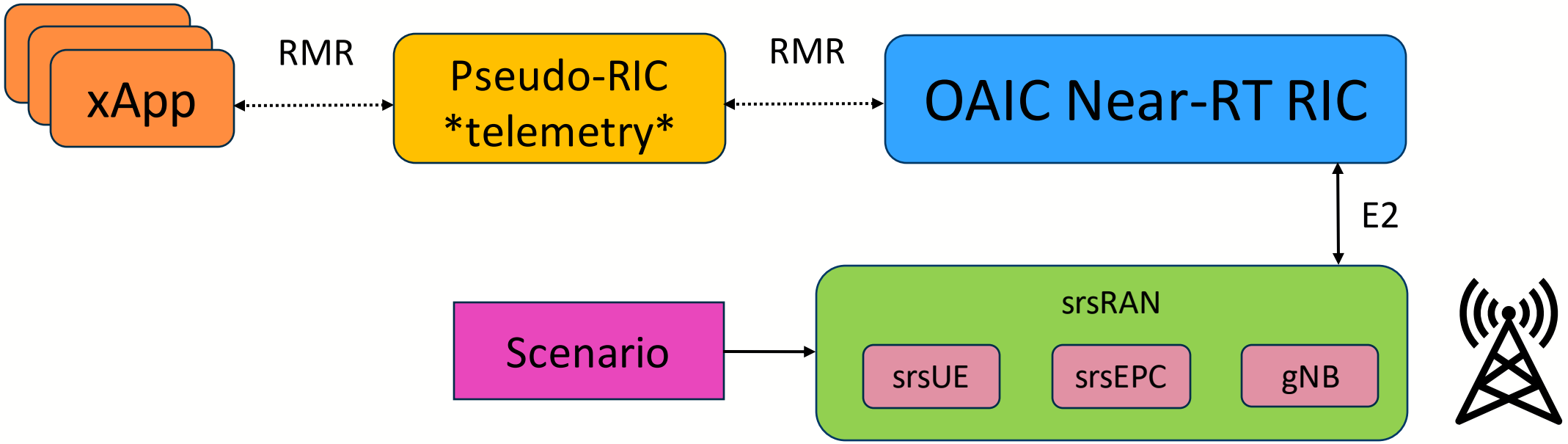
Testbed



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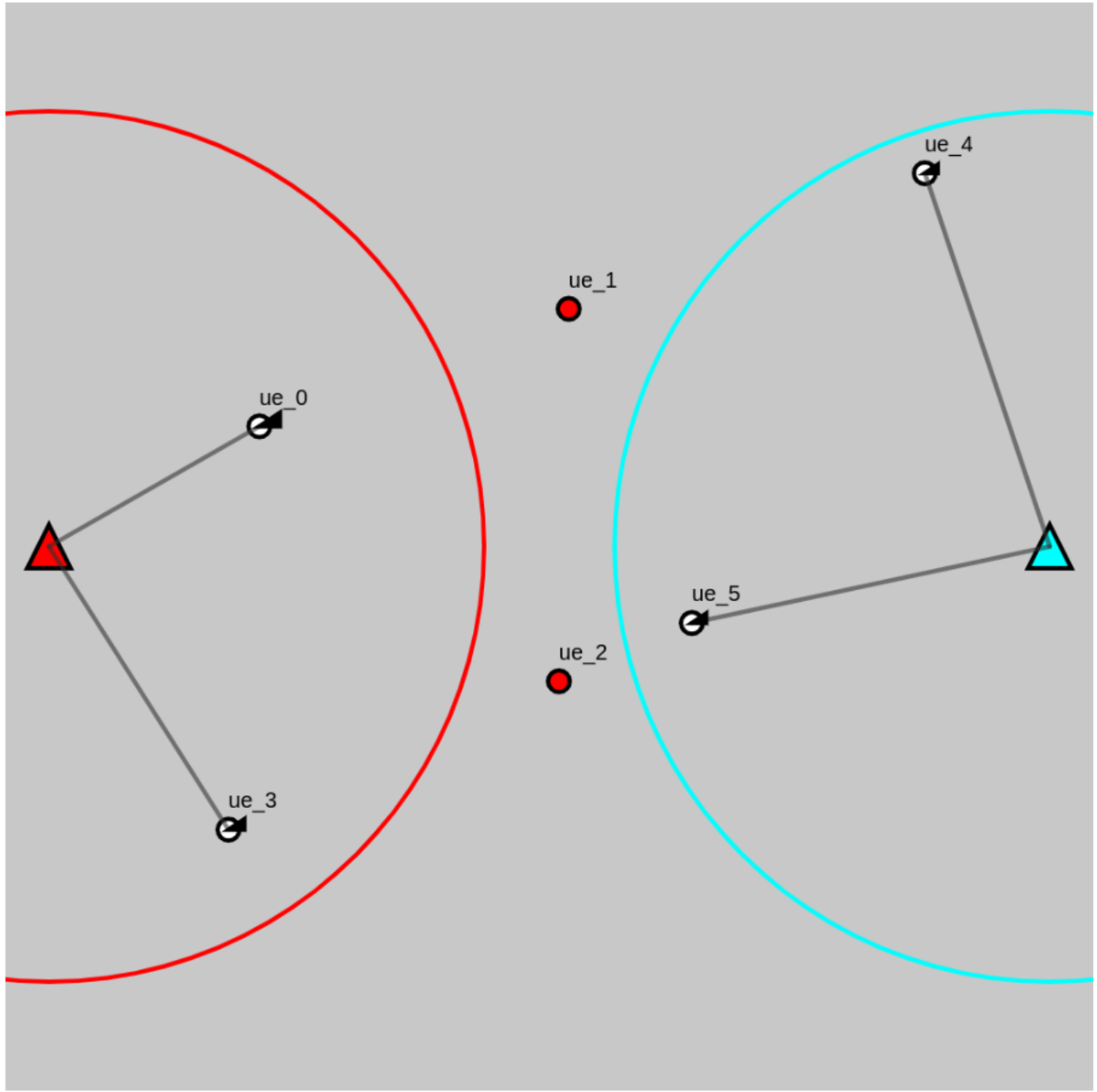
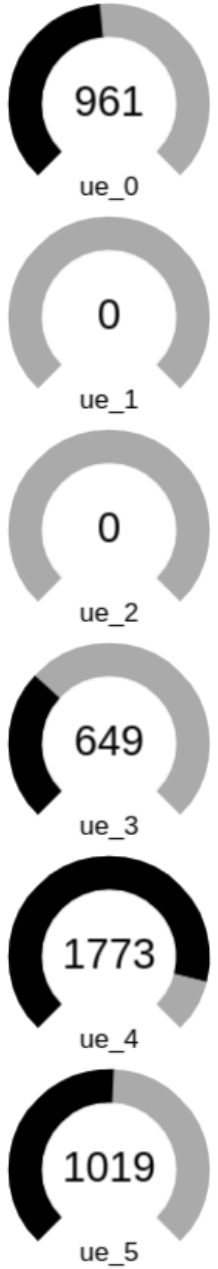
Scenario





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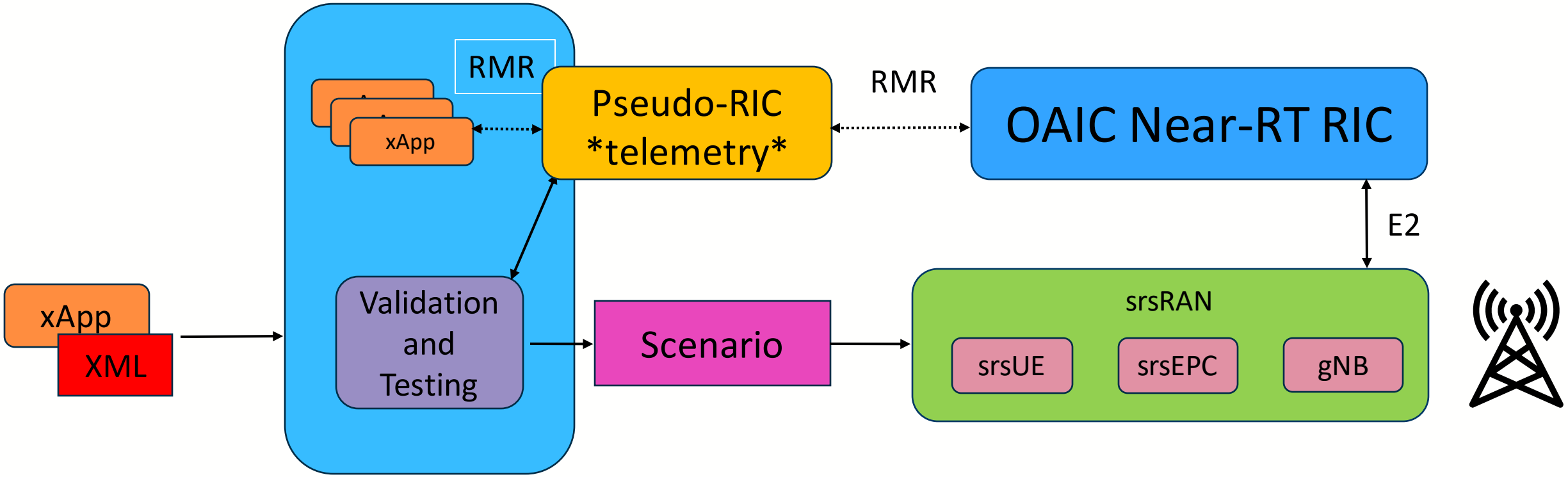
xApp Validation



Conclusions

- O-RAN offers a more open and inclusive alternative to vendor-specific solutions
- xApps are an important part of an O-RAN solution
- xApps afford the ability to introduce intelligence into the network
  - Bringing us closer to autonomous networks
- xApps do not need to be built by telcos
  - Specialist xApp developers/providers
  - Provided to telcos via an App Store

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