TELECOM INFRA PROJECT®

UK DSIT Open Networks Ecosystem Competition

Accelerating RAN Intelligence across Network Ecosystems (ARIANE)

Oct 2023 – March 2025

UK DSIT Open Networks Ecosystem Competition

ARIANE™

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Accelerating RAN Intelligence across Network Ecosystems (ARIANE)

Department for Science, Innovation, & Technology

TELECOM INFRA PROJECT®
Programme lead

accenture | amdocs | ARQIT | BT

HCLTech | REPLY NET | VIAVI | vmware by Broadcom

ARIANE Industry objectives

 OPERATORS	Based on ARIANE learnings, inspire telecom operators to install, test and integrate Open RIC & xAPPs/rAPPs that deliver performance and opex benefit in RAN networks
 RIC MARKETPLACE	With TIP support, expand the number of RIC platforms and application developers in the global ecosystem
 STANDARDS BODIES	Offer technical insights on further standards development in security by design posturing, API flows between RIC platforms and applications, and A1, E2, O1 OpenRAN interfaces (where in scope)
 UK TELECOM ECOSYSTEM	With the support of UK DSIT and UK TIN, to upskill and inspire further innovation in UK based Open RIC and xAPPs/rAPPs development and operator-led trials

TIP OpenRAN 17 telco prioritised RIA use cases & ARIANE points of focus

UC1 (X1): Multi-User MIMO Pairing

UC2 (X2): Uplink Channel Estimation

UC3 (X3): Inter-frequency & Inter-RAT handover

UC4 (X4): Inter-Cell Interference Co-ordination

UC5 (X5): Accurate Real Time User Location Data based Handovers

UC6 (R1): SSB Beamset Optimization

UC7 (R2): Traffic Steering & Predictive Load Balancing HCLTech REPLY NET

UC8 (R3): Coverage & Capacity Optimisation

UC9 (R4): Power Saving by Load-Adaptive Mode amdocs

UC10 (R5): Atmospheric Ducting Interference Mitigation

UC11 (R6): PCI Configuration & Optimisation

UC12 (R8): Systemwide multi-carrier capacity optimisation

UC14 (R9): QoE Optimisation

UC15 (R10): NSSI Resource Allocation Optimisation

UC16: QoS Based Resource Optimisation REPLY NET

UC17: RAN Slice SLA Assurance

Performance benchmarking of E2 interface across RICs HCLTech

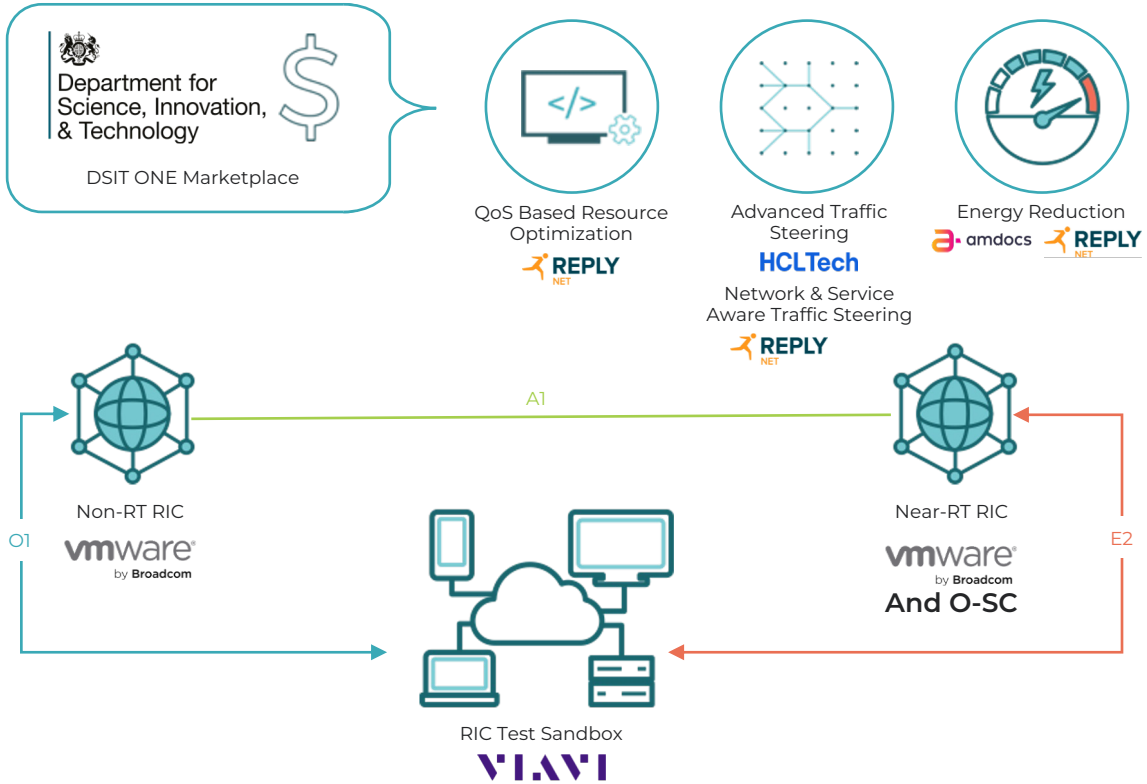
Cybersecurity across OpenRAN interfaces AROIT

ARIANE focus

ARIANE Scope

1. Install & simulate a real-world Open RAN small cell deployment scenario in a controlled test environment
2. Arqit led security posturing assessment & report, with options to uplevel security hardening across interfaces and call flows
3. Develop, train and measure the before & after effects of xAPPs/rAPP application on RAN performance in simulated real-world traffic scenarios
4. Gather technical insights on the possible effects on RIC and Radio performance due to xAPPs/rAPPs conflicting & competing for RIC resources
5. Definition & feedback on common API requirements
6. Benchmark RIC platform performance using HCL built bouncer application based on messaging across interfaces (A1/E2/01)

ARIANE Solution Architecture



Use Cases:

QoS-Optimization (**Reply**): Near-RT: **VMWare**
TS (**Reply**): Hybrid: **VMWare**
TS (**HCL**): Hybrid: **VMWare**
TS (**HCL**): Near-RT: **OSC-RIC**
ER (**Amdocs**): Hybrid: **VMWare**
ER (**Reply**): Hybrid: **VMWare**
Benchmarking xApp (**HCL**): E2 only for **VMWare** near-RT RIC & **OSC-RIC**

RIC Platforms:

OSC near-RT RIC (I Release)
VMWare non-RT RIC
VMWare near-RT RIC

RIC Test:

Cloud setup (**BT**)
Individual instances for each App vendor
Same base SW on all instances

Adjacent Focus Areas:

- Conflict Detection **(All partners)**
- Interface/API Security (**Arqit**)
- Common APIs definition for apps onboarding & portability **(HCL)**
- E2 Interface Benchmarking (**HCL**)

Benefits to be realised

1

A technical and business blueprint to show how a multi-vendor, interoperable Open RAN & RIC system can offer opportunities to further RIC & apps development in UK for real-world deployment scenarios

2

Description and recommendations for improving standards development in the RIC space to further the evolution towards Open RIC

3

Test results that can be certified by TIP and promoted on a global platform

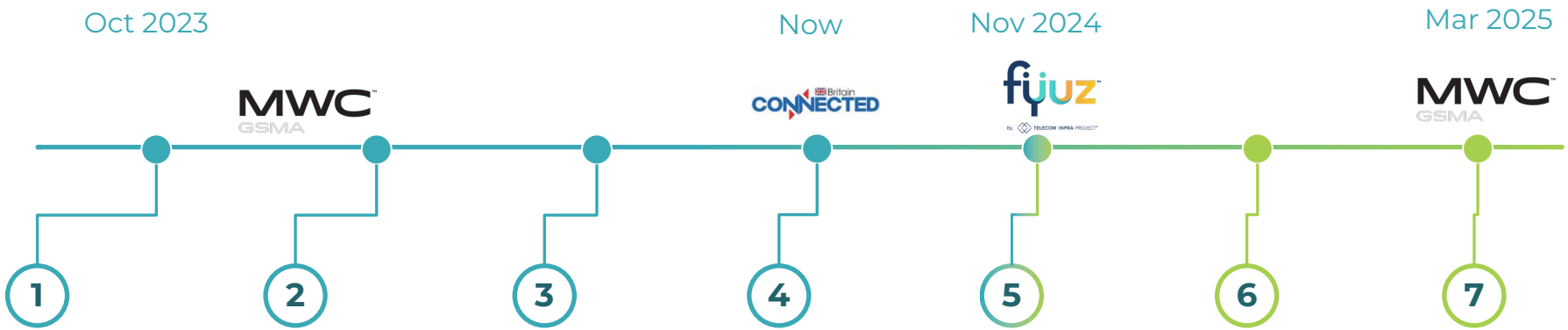
4

Further xAPP/rAPPs use case development for RT & non RT scenarios

5

Further RIC development to enhance performance and interfaces

Progress made



1. Project setup and requirements definition
2. Applications labs set up and BT Test Bed setup
3. Initial Security assessment & recommendations
4. Applications developed & tested in local labs
5. Applications tested within BT testbed
6. Further testing
   - Apps conflict detection
   - Security post changes;
   - E2 interface performance benchmarking
7. Final deliverables and promotion post MWC

Early successes

Apps developed and 1st indicator test results

E2 Interface Performance Benchmarking application

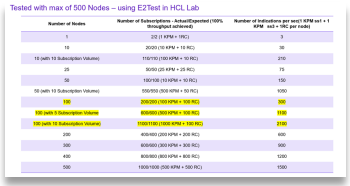
HCLTech

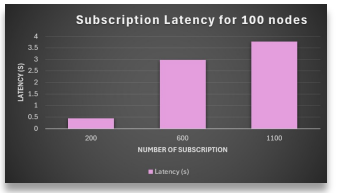
Objective: O-RAN Compliant E2 interoperability testing, and benchmarking and dimensioning between RICs and RAN in a multi-vendor integration loading the system with different real-world test scenarios

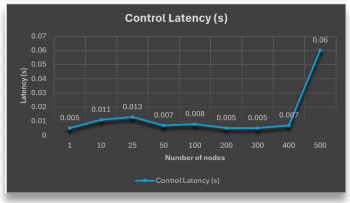
Approach
Loaded test runs for OSC RIC and VMWare d-RIC using Viavi RIC Test and E2AP Protocol, looking at End-to-End E2 message flows.

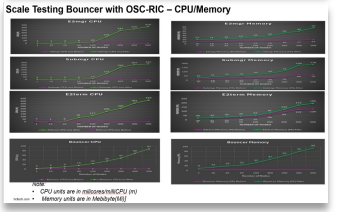
Outputs: Round Trip Transaction, Latency, Throughput metrics for different E2 message types and E2E flows

E2E E2 performance with OSC RIC and VMWare d-RIC for different loads









Benefit: Operator's ability to benchmark & monitor performance & dimension configuration for different integrated RICs in real-world scenarios

Early successes

Apps developed and 1st indicator test results

Advanced Traffic Steering xAPP on OSC RIC

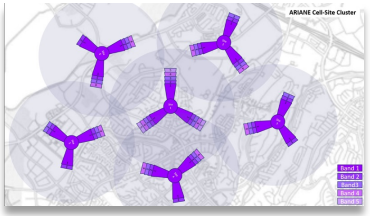
HCLTech

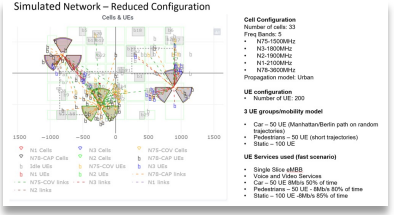
Objective: Perform predictive analysis of network and users' traffic using AI/ML algorithms and improve network performance and user experience in a predictive manner.

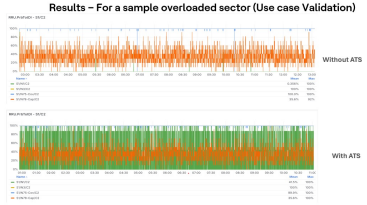
Approach

- Near Real Time app solving Traffic Steering problems (e.g. load balancing, handover) by monitoring network traffic (i.e., UE and Cell KPIs)
- Algorithms learn and adapt to dynamic patterns of different services, user, and cells, and optimize throughput & network resources

4.89% average improvement in UE throughput across all spectrum bands in simulated network traffic scenarios







tesults – Average Total UE Throughput Per Band for ALL sectors over 0 hours

Bands	Average throughput per band (Mb/s) without ATS (A)	Average throughput per band (Mb/s) with ATS (B)	Variation (Mb/s) (B-A)	%
N78	47,40	47,2	-0,20	
N75	5,61	5,96	0,35	
N1	13,30	13,3	0	
N2	7,90	7,92	0,02	
N3	1,13	4,65	3,52	
	75,34	79,03	3,69	4,89

Benefit: Operator's ability to in near real time optimise network throughput and network resources at the RAN edge

Early successes

Apps developed and 1st indicator test results

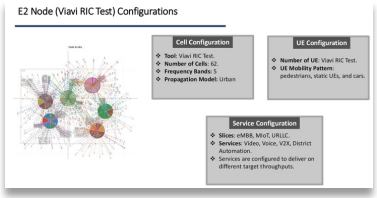
QoS Based Resource Optimisation xAPP

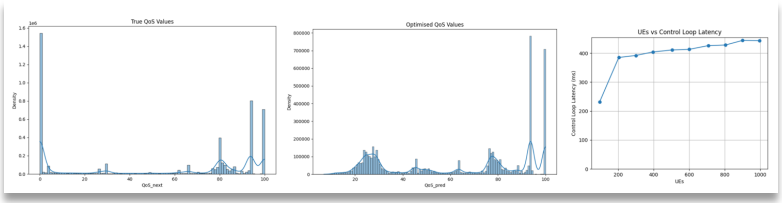
Objective: Based on pre-configured Quality of Service policies, isolate network slices and dynamically allocate and continuously monitor network resource allocation for users and services competing for RAN resources

Approach

- Pre-configured Priority Allocation Policy & Dedicated Resources Reservation Policy for slices, and services during peak time
- Solution includes DRB Control, Radio Access Control, Connection Mobility Control, Radio Resource Allocation
- Test application for dynamic user and service patterns in real world scenarios

Real time QoS optimisation for UEs and services against assigned policies whilst continuously monitoring traffic patterns





Benefit: Operator's ability to avoid RAN congestion or degradation of throughput for various services including mission critical services, and end users services

Early successes

Apps developed and 1st indicator test results

Energy saving rAPP

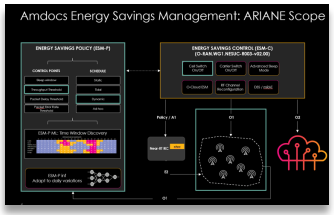
amdocs

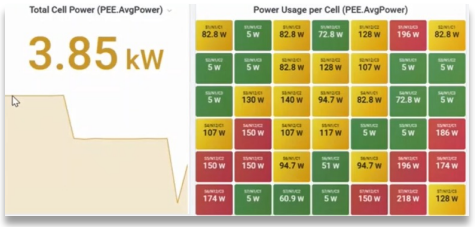
Objective: rAPP targeting 15%+ reduction in energy consumption by reducing radio resources during low usage periods whilst minimizing QoS impact of energy reduction through machine learning

Approach

- Long term learning: AI/ML algorithm continuously monitoring QoS vs. Load
- Energy Savings Policy Discovery to determine optimal time windows and shutoff thresholds
- Energy Savings Control function to implement cell switch off (and other energy reduction mechanisms) in line with policies

Lab testing indicates 20% reduction in energy consumption in real world test scenarios

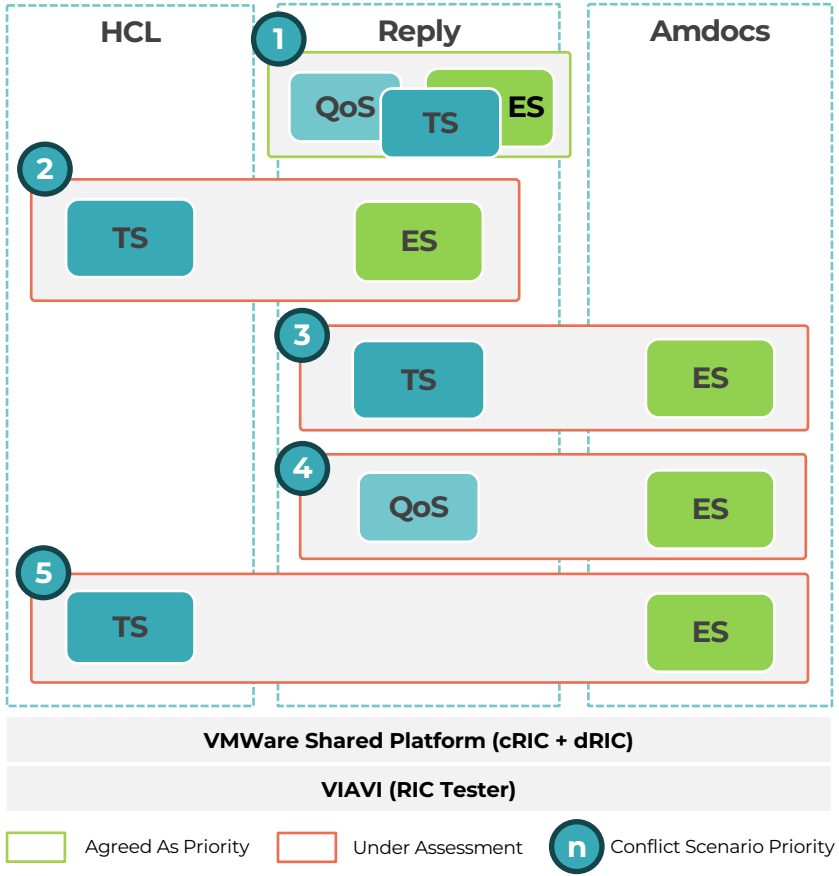




Benefit: Operator's ability to switch off cells and control energy output during low usage periods, to reduce overall energy costs in RAN (which accounts for 19 – 23% of RAN OPEX)

Conflict detection scenarios

- Candidate scenarios for conflict observation testing, based on each **app function, inputs** and **output network actions.**
- Intra-vendor & inter-vendor scenarios
- Conflict detection testing during two or more apps running concurrently where engineers will be analysing traces and log files to identify conflicted actions, and compared against the baseline results from standalone testing.
- Analysis and results will be used to enrich Conflict Management ORAN Alliance standards.



ARQIT

The 1st Quantum safe multi-vendor OpenRAN system

Strengthen Authentication between API EPs & Harden Encryption Ciphers for IPsec & TLS

1. Regularly authenticate each API endpoint

Strong, mutual authentication & provisioning
(lowering certificate, key-fill burden & cost)

2. Harden encryption using quantum-safe configuration

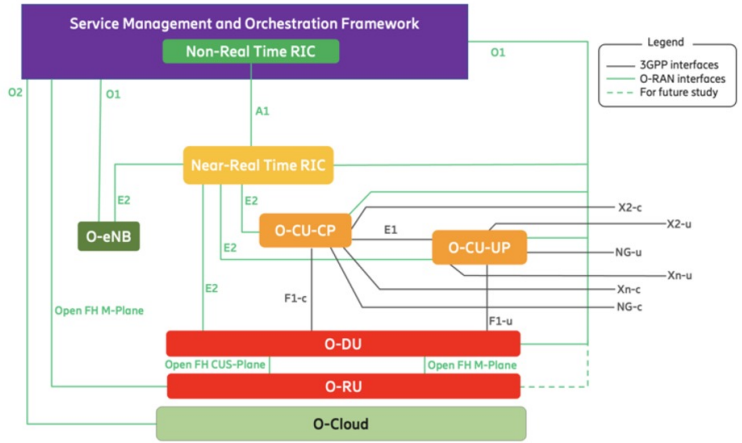
Symmetric Key Encrypted Comms Between Devices *(keys not known to cloud)*

Promote the use of the following in vendor implementations:

- IPsec with RFC8784 (e,g, with strongSwan)
- TLS1.3 with PSK (e,g with OpenSSL)
- 'Secure by Design' security analysis on software in-use

Security Control	A1	O1	O2	E2	Open Fronthaul			
					C-Plane	U-Plane	S-Plane	M-Plane
Authenticity	TLS	TLS	TLS	Ipsec				TLS/SSH
Confidentiality	TLS	TLS	TLS	IPsec		PDCP		TLS/SSH
Integrity	TLS	TLS	TLS	IPsec		PDCP		TLS/SSH
Authorization	OAuth	NACM	OAuth					NACM
Data Origination	TLS	TLS	TLS	IPsec				TLS/SSH
Replay Prevention	TLS	TLS	TLS	IPsec		PDCP		TLS/SSH

Mandatory O-RAN interface security controls



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membership@telecominfraproject.com

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