

# Research and Innovation in Testing and Integration for Open Radio Access Networks (RitiRAN) Workshop

## Reporting on the latest development in TIFG

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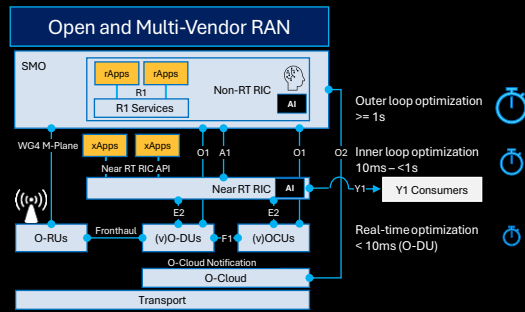
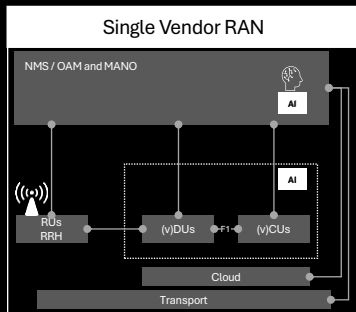
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## Benefits of Open RAN

- Diversifying Telecoms Supplier Chain
- Spurring Innovations
- Fostering Agility and Adaptability in network deployments

O-CU: O-RAN Central Unit  
 O-DU: O-RAN Distributed Unit  
 O-RU: O-RAN Radio Unit  
 RIC: RAN Intelligent Controller  
 SMO: Service Management & Orchestration



### 1 Open Dis-aggregation

12 Network Functions &  
 18 Interfaces – adding more

### 2 Open Cloudification

Separate software and hardware  
 Cloud components diversification

### 3 Open Intelligence

AI for Network Optimization  
 “O-RAN AI Applications Store”

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# Traditional RAN testing vs Open RAN testing

Testing is required for BOTH Cases – Open RAN is more complex due to multi-vendors environment

1<sup>st</sup> RAN Workshop - Reporting on the latest development in TIFG

	Single Vendor RAN	Open and Multi-Vendor RAN 12 Network Functions & 18 Interfaces – adding more...	
		Differences	Impacts
Testing Ownership	RAN Supplier tests each component and entire system	More parties and changes involved	Continuous integration, deployment/delivery and testing (CI/CD/CT)
Test Specifications	Mainly RAN suppliers owned test specifications	Increased dependency on public test specifications	Need to increase public test cases coverage and quality
Test labs, Processes & Experiences	RAN suppliers owned labs, dedicated teams and decades of experiences	New entrants – OTICs, labs, more suppliers, integrators	Learning curves for most – Plugfest including coordinated testing across labs can help
Certificates & Badging	3GPP Security – GSMA NESAS	Security and More...	O-RAN Certification and Badging

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## O-RAN ALLIANCE - Organization



301 Members

- 33 Operators
- 268 non-Operators including 33 small medium enterprises, 60 startups and 72 academic contributors

Technical Groups

- 11 working groups
- 5 focus groups
- 2 committees
- 1 next gen research group

Board	
Executive Committee (EC)	
TSC (Technical Steering Committee)	
Committees and Research Groups	Working Groups
MVP-C Minimum Viable Plan Committee	WG1 Use Cases and Overall Architecture
OCOP O-RAN Committee On Process	WG2 Non-Real-time RIC and A1 Interface
nGRG next Generation Research Group	WG3 Near-Real-time RIC and E2 Interface
	WG4 Open Fronthaul Interfaces
	WG5 Open F1/W1/E1/X2/Xn Interface
	WG6 Cloudification and Orchestration
	WG7 White-box Hardware (Reference Design)
	WG8 Stack Reference Design
	WG9 Open X-haul Transport
	WG10 OAM for O-RAN
	WG11 Security
Focus Groups	
OSFG Open-Source Focus Group	
SDFG Standard Development Focus Group	
IEFG Industry Engagement Focus Group	
TIFG Test & Integration Focus Group	
SuFG Sustainability Focus Group	
OSC O-RAN Software Community	

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1<sup>st</sup> RAN Workshop - Reporting on the latest development in TIFG

# Test and Integration Focus Group (TIFG)

## KEY ACTIVITIES

TIFG working on multiple initiatives to accelerate Open RAN adoption and deployment acceleration

### (1) O-RAN Test Strategy

- Internal within O-RAN
- External
- Operators Inputs

### (2) O-RAN Test Specifications

### (3) O-RAN Certification & Badging

### (4) Open Test & Integration Centers (OTICs)

### (5) O-RAN Global PlugFests

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# (1) O-RAN Test Strategy

## CURRENT AND CONTINUING TO ENHANCE | WORK IN PROGRESS | TO BE FURTHER DISCUSSED

TIFG defines O-RAN ALLIANCE's overall approach for testing and integration

### Current and Continuing to Enhance

#### Coordination within O-RAN ALLIANCE

- **Test Specifications Progression** in WGs
- **Explore leverages with existing test specifications** such as 3GPP Conformance and 3GPP Security Assurance Specification (SCAS)

#### Co-ordination with external organizations

- Such as with GSMA NESAS on Security Assurance (working in collaboration with WG11)

#### Gather Operators' Guidance on Priorities

### Work In Progress

#### Test Specifications Coordination

- **Test methods coordination** e.g., on RIC enabled use cases with WG2 and WG3
- **Test Specifications Framework** (common testing terminology, methodology and principles)

### To be (further) discussed

- **Enhancing testing co-ordination with external organizations**
- **Emerging test areas** such as
  - AI/ML lifecycle management – feature planning in progress
  - Non-Terrestrial Networks (NTN) – RIC study started in WG1

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# (1) O-RAN Test Strategy

## GLOBAL OPERATORS TEST AND INTEGRATION PRIORITIES

Operators' Priorities for O-RAN Test & Integration Specifications Shifting towards Deployment Readiness Testing

Operators Survey	Operators Sessions Feedback on Proposed Actions
<ul style="list-style-type: none"> <li>Maturity of O-RAN product performance, functionality, quality and security</li> </ul>	<ul style="list-style-type: none"> <li>Define/improve <b>performance testing and characterization methodology</b> for O-RAN network functions/interfaces and gNB</li> <li>Define <b>deployment readiness testing</b> – performance, functionality, quality including stability</li> <li>Prioritize <b>O-RAN Security</b> certification and badging work item</li> </ul>
<ul style="list-style-type: none"> <li>Testing alignment with Operators' deployment goals and requirements</li> </ul>	<ul style="list-style-type: none"> <li>Define <b>operators' blueprints-based</b> testing, certification, and badging system</li> <li>Create <b>use-case driving test cases</b>, e.g., energy saving, resilient, failovers, robustness</li> </ul>
<ul style="list-style-type: none"> <li>Operators' priorities for interfaces/services/APIs for testing, certification and badging</li> </ul>	<ul style="list-style-type: none"> <li>Focus on getting a complete set of base and test specs in place - now focusing on completion of <b>RIC and management interfaces</b> (1) base spec (stage 3), (2) associated conformance/IOT tests, (3) certificates/badges</li> </ul>

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### (2) O-RAN Test Specifications

- E2E Test Specification
- Coordinate Test Specifications across WGs and FGs

### (3) O-RAN Certification & Badging

### (4) Open Test & Integration Centers (OTICs)

### (5) O-RAN Global PlugFests

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## (2) O-RAN Test Specifications

### CURRENT AND CONTINUING TO ENHANCE | WORK IN PROGRESS | TO BE FURTHER DISCUSSED

O-RAN ALLIANCE continue to make good progress in developing test specifications made available in the public domain

Current and Continuing to Enhance	Work In Progress
<p><b>TIFG develops E2E Test Specification</b> - keeping up to date</p> <ul style="list-style-type: none"> <li>5 categories of test cases specified to date - Functional, Performance, Services, Load and Stress, RIC-enabled use cases</li> <li>Enables O-RAN E2E Badging with Functional Test Cases</li> </ul> <p><b>WGs develop Conformance and Interoperability Test Specifications</b></p> <ul style="list-style-type: none"> <li>Interfaces Conformance, Interoperability</li> <li>Security</li> <li>Cloud</li> <li>Reference Stack</li> <li>Transport</li> </ul>	<p><b>New Test Specifications / Cases in Development</b></p> <ul style="list-style-type: none"> <li>WG2 and WG3 RIC-enabled use cases testing</li> </ul> <p><b>Test Specifications Coordination</b></p> <ul style="list-style-type: none"> <li>Test Reports - <b>Machine Readability</b></li> </ul>
	To be (further) discussed
	<ul style="list-style-type: none"> <li>Define or improve <b>performance</b> test and characterization methodology, test cases and KPIs for multi-vendor gNB</li> <li>Define O-RAN products <b>energy test methods</b></li> <li>Additional test cases (<b>resilience, robustness</b> etc.)</li> </ul>

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## (2) O-RAN Test Specifications

### TEST SPECIFICATION STATUS AND PLANS

Current test specifications continue to add test cases | New interfaces (R1) and Use Cases test specifications introduced

WGs/FGs	Focus	Test Specifications	Work in Progress
WG1	Architecture	Not applicable	
WG1	Use Cases	Not applicable	
WG2	Non-RT RIC (A1, R1)	A1 interface (conformance, interoperability)	R1 starting, use cases test methods in works
WG3	Near RT RIC (E2, Near RT RIC API)	E2 interface (conformance, interoperability)	Use cases test methods in works
WG4	Open Fronthaul (OFH)	OFH Conformance	Adding test cases for ULPI support
		OFH Interoperability	Adding test cases / profiles for ULPI support
WG5	X2, Xn, F1	X2, Xn, F1 Interoperability	Continue to add test cases
WG6	Cloud, O2	Cloud Interface	Continue to add test cases
WG7	Whitebox Reference Design		Indoor Pico Cell
WG8	Protocol Stack Reference Design	Interoperability	Continue to add test cases
WG9	Transport	Transport	Continue to add test cases
WG10	OAM, SMO	Not available	Needing to start new test specification
WG11	Security	Security	Continue to add test cases (ETSI PAS process)
TIFG	Test and Integration	E2E Test	Continue to add test cases (RIC-enabled QoS/QoE)

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## (2) O-RAN Test Specifications

### PERFORMANCE TEST, CHARACTERIZATION METHODOLOGY, TEST CASES AND KPIS FOR MULTI-VENDOR GNB

Goal is to define / enhance performance test with scenarios which are highly representative of operators' deployments

TIFG E2E Test Spec. Chapters	Test Objectives	Next Steps
5 Functional	Single UE - evaluating and assessing the functionality of the radio access network from a network end-to-end perspective	-
6 Performance	Single to up to 10 UEs – evaluating and assessing the performance of radio access network from network end-to-end perspective	Expecting new test cases and KPIS to be added to for performance benchmarking purpose with realistic test environment <ul style="list-style-type: none"> <li>• Higher UE numbers</li> <li>• Channel models</li> <li>• Mobility Profiles</li> <li>• Improve consistency and repeatability</li> <li>• Energy measurements</li> </ul>
7 Services	Single to up to 2 UEs - Services which should be tested to validate that the O-RAN system can be deployed and optimized to deliver great end user service experience in a telecom network	
8 Load and Stress	Multiple UEs - evaluating and assessing the load and stress tests of the radio access network from a network end-to-end perspective. The focus of the testing is on the tolerability of the eNB/gNB under load based on 3GPP and O-RAN specifications	
9 RIC enabled Use Cases	Multiple UEs - evaluating and assessing the performance of a radio access network with Non-RT RIC and Near-RT RIC optimizations from a network end-to-end perspective – traffic steering and network energy savings (cell on/off specified)	Work in Progress - QoS and QoE optimization

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#### (2) O-RAN Test Specifications

- E2E Test Specification
- Coordinate Test Specifications across WGs and FGs

#### (3) O-RAN Certification & Badging

- Define O-RAN Certification and Badging Processes and Procedures

#### (4) Open Test & Integration Centers (OTICs)

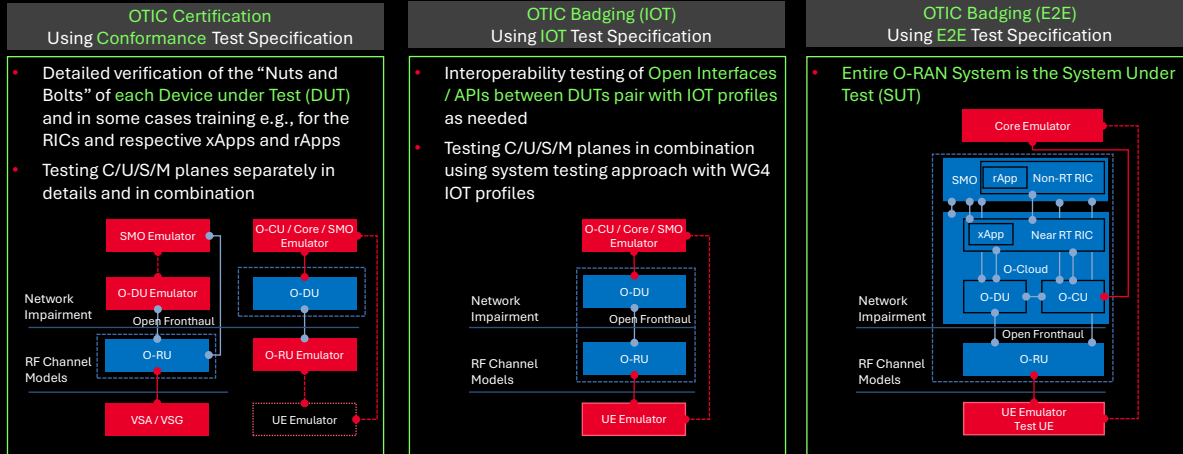
#### (5) O-RAN Global PlugFests

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### (3) O-RAN Certification & Badging

#### INTRODUCTION

C&B program represents a comprehensive mechanism to ensure confidence in O-RAN based products and solutions



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### (3) O-RAN Certification & Badging

#### CURRENT AND CONTINUING TO ENHANCE | WORK IN PROGRESS

O-RAN Certification and Badging Scheme Continue to Gain Momentum – Next Steps Increase Coverage & Improve Quality

Current and Continuing to Enhance	Work In Progress
<p><b>Certification and Badging Scheme</b> - keeping up to date</p> <ul style="list-style-type: none"> <li><b>Certificates</b> – O-RU fronthaul, O-DU fronthaul</li> <li><b>Badging (IOT)</b> – Fronthaul, X2, Xn, F1</li> <li><b>Badging (E2E)</b> – E2E (functional, security)</li> </ul> <p><b>24 O-RAN Certificates &amp; Badges issued in total</b> - <a href="#">Public web with overview of certificates/badges</a></p> <ul style="list-style-type: none"> <li>14 Certificates, all on Open Fronthaul (OFH) interface</li> <li>8 E2E Badges (3 unique Badge ID)</li> <li>2 IOT Badges on OFH interface (1 unique Badge ID)</li> <li>10 issued in 2024, 9 issued in 2023, 5 issued in 2022</li> </ul>	<p><b>Certification and Badging Scheme to add</b></p> <ul style="list-style-type: none"> <li><b>A1 interface</b> (service-based interface)</li> <li><b>Security</b> in collaboration with GSMA NESAS</li> <li><b>RIC enabled use cases</b> badging</li> </ul> <p><b>Improve Quality of O-RAN Certificates and Badges</b></p> <ul style="list-style-type: none"> <li>OTIC classification/accreditation</li> <li>Completeness of O-RAN certificate/badge test and summary reports</li> <li>Sharing and storing of O-RAN certificate/badge test and summary reports</li> </ul>

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### (3) O-RAN Certification & Badging

#### EXPAND CURRENT CERTIFICATION AND BADGING SCHEME

Current focus is to increase coverage and explore improving quality of the certificates and badges driving adoption

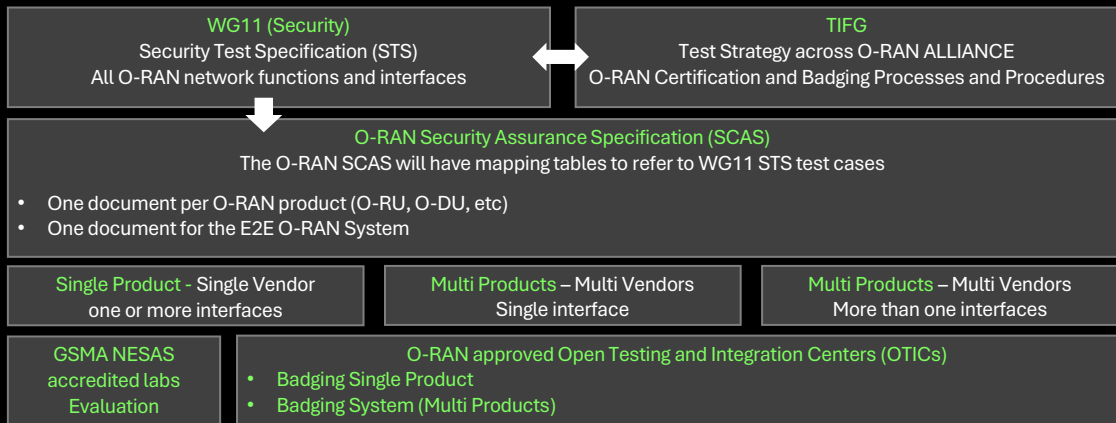
WGs/FGs	Focus	Test Specifications	Certificates and Badges
WG1	Architecture	Not applicable	Not applicable
WG1	Use Cases	Not applicable	Not applicable
WG2	Non-RT RIC (A1, R1)	A1 interface, (R1 starting, use cases in works)	A1 interface - Work in progress
WG3	Near RT RIC (E2, Near RT RIC API)	E2 interface, (use case in works)	Not started
WG4	Open Fronthaul (OFH)	OFH Conformance	Certificate (O-RU, O-DU)
		OFH Interoperability	Badge (OFH)
WG5	X2, Xn, F1	X2, Xn, F1 Interoperability	Badge (X2, Xn, F1)
WG6	Cloud, O2	Cloud Interface	To be started based on WG6 feedback
WG7	Whitebox Reference Design	Indoor Pico Cell	Not applicable
WG8	Protocol Stack Reference Design	Interoperability	Not applicable
WG9	Transport	Transport	Not started
WG10	OAM, SMO	Needing to start new test specification	Not started
WG11	Security	Security	Work in progress - Consider to expand GSMA NESAS
TIFG	Test and Integration	E2E Test	Badge (E2E)

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### (3) O-RAN Certification & Badging

#### DEFINE O-RAN SECURITY ASSURANCE PROGRAM IN COLLABORATION WITH WG11

O-RAN Security Assurance Program – Development in Progress



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- Define O-RAN Certification and Badging Processes and Procedures

### (4) Open Test & Integration Centers (OTICs)

- Define Criteria and Guidelines of Open Testing and Integration Centers
- Facilitate Updates and Exploring Synergies

### (5) O-RAN Global PlugFests

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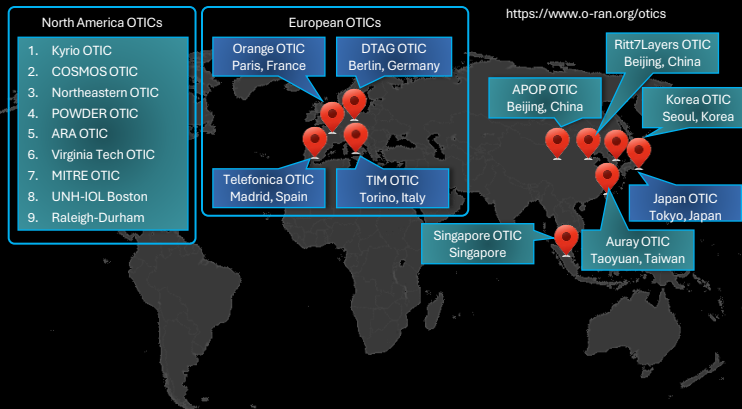
# (4) Open Test & Integration Centers (OTICs)

## INTRODUCTION

O-RAN ALLIANCE has approved 19 OTICs

Open Testing and Integration Centres (OTIC) provide an open, collaborative, vendor independent, and impartial working environment to support the progress of the O-RAN industry ecosystem, including:

1. Testing Services
2. Award O-RAN Certificates, Badges
3. Hosting O-RAN PlugFests
4. Providing reference setups, testbeds
5. Demos, community events or trials, workshops or tutorials to foster and develop technical skills of the O-RAN community



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## (4) Open Test & Integration Centers (OTICs)

### CURRENT AND CONTINUING TO ENHANCE | WORK IN PROGRESS

Approved OTICs are continuing to make progress – Next Steps to explore possible improvements in relation to Cert and Badge

Current and Continuing to Enhance	Work In Progress
<p><b>Open Testing and Integration Centers</b></p> <ul style="list-style-type: none"> <li>• 19 approved to date by O-RAN ALLIANCE</li> <li>• Progress reports at each of the O-RAN F2F meeting (3x / year)</li> <li>• O-RAN web updates to better reflect OTICs services offered and ensuring that these are up to date</li> </ul>	<p><b>Criteria and Guidelines of Open Testing and Integration Centers</b></p> <ul style="list-style-type: none"> <li>• Consider OTIC classification/accreditation in relation to exploring improvements with O-RAN Certification and Badging                             <ul style="list-style-type: none"> <li>• High level proposals shared for discussions and alignment</li> <li>• Ideas include ISO 17025 accreditation and demonstration of expertise and equipment/tools to conduct the required tests</li> </ul> </li> </ul>

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- Define Criteria and Guidelines of Open Testing and Integration Centers
- Facilitate Updates and Exploring Synergies

#### (5) O-RAN Global PlugFests

- 2x per year
- Global Themes for Scale while catering for innovative demonstrations flexibility

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# (5) O-RAN Global PlugFests

## CURRENT AND CONTINUING TO ENHANCE | TO BE FURTHER DISCUSSED

PlugFest events facilitate collaborations to jointly demonstrate O-RAN products and solutions progress

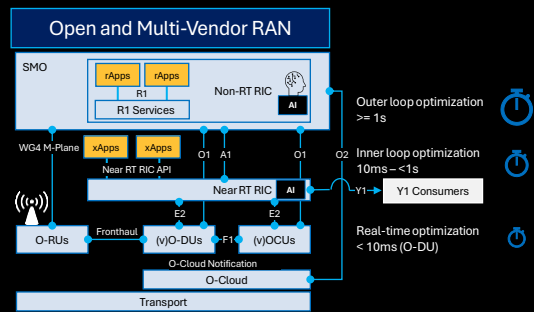
Current and Continuing to Enhance	To be (further) discussed
<p><b>Global PlugFest events – twice per year since 2019</b></p> <ul style="list-style-type: none"> <li>Multiple updates and readouts for each of the plugfest event                             <ul style="list-style-type: none"> <li>Share learnings and recommendations for improvements</li> </ul> </li> <li>Ongoing Fall 2024 PlugFest                             <ul style="list-style-type: none"> <li>14 venues/24 labs – 7 in Asia, 3 in Europe, 4 in America</li> <li>Hosted by 31 operators and vendor-independent institutions</li> </ul> </li> <li>6 approved themes – host to support at least 1 approved theme                             <ul style="list-style-type: none"> <li>Spring 2024 PlugFest demonstrations for 2 of the approved themes selected for presentation in the recent IORS 2024 event (consistent, repeatable testing – fronthaul and energy)</li> </ul> </li> <li>Demos not within the set of approved themes can be hosted</li> </ul>	<p><b>Continue to refine/enhance/add PlugFest Themes</b></p> <ul style="list-style-type: none"> <li>Refinement of existing PlugFest Themes</li> <li>Additional PlugFest Themes (for further discussions)                             <ul style="list-style-type: none"> <li>Consistent and repeatable testing for additional interfaces (such as RIC interfaces)</li> <li>Performance</li> <li>Security</li> <li>RIC enabled use cases (xApps, rApps)</li> </ul> </li> </ul>

# (5) O-RAN Global PlugFests

## PLUGFEST THEMES APPROVED IN TIFG

PlugFest Themes are designed to help the O-RAN ecosystem focus and collaborate in key areas of common interests

- O-RAN Energy Consumption, Efficiency and Savings Testing** – planned by nine PlugFest venues
- O-RAN E2E Deployment Templates, DevOps, and Test Automation** – planned by eight PlugFest venues
- Demonstration of consistent and repeatable open fronthaul testing in multiple labs** – planned by six PlugFest venues
- O-RAN System Testing with Layer 1 Acceleration** – planned by six PlugFest venues
- O-RAN White-box Hardware diversity ecosystem** – planned by two PlugFest venues
- Open Fronthaul Transport Testing with multiple O-RUs** – planned by three PlugFest venues



# Test and Integration Focus Group (TIFG)

## IN CONCLUSION

Join TIFG in our quest and work to accelerate O-RAN adoption and deployments

### (1) O-RAN Test Strategy

- Test methods coordination (use cases)
- Test Specifications Framework
- \*Enhance external orgs co-ordinations
- \*Continue to seek operators' guidance
- \*Explore emerging areas – AI/ML, NTN

### (2) O-RAN Test Specifications

- Add test cases to current test specs
- New R1 and Use Cases test specs
- Test reports machine readability
- \*Define or improve performance test
- \*Energy, resiliency, robustness tests

### (3) O-RAN Certification & Badging

- Introduce new schemes for A1, Security, RIC enabled use cases
- Improve Quality of O-RAN Certificates and Badges (encourage adoption)

### (4) Open Test & Integration Centers (OTICs)

- Consider OTIC classification/accreditation in relation to exploring improvements with O-RAN Certification and Badging

### (5) O-RAN Global PlugFests

- Refinement of existing Plugfest Themes
- Additional PlugFest Themes (for further discussions)

\* To be further discussed

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