



# White Rabbit at the UNH InterOperability Laboratory

UNH-IOI's NSF POSE OpenPHASE & WRC

*March 22, 2024*

Introductions

# Today's Presenter



## Bob Noseworthy

Principal Engineer

Active with:

All things Ethernet, including:

- Time Sensitive Networks (TSN),
- Single Pair Ethernet (SPE),
- IEEE 1588 / PTP Technologies,
- IEEE P3335 Time Card
- IEEE P1952 Resilient PNT

& Several industry orgs:

Avnu Alliance, Ethernet Alliance,  
IBTA, OPEN Alliance, & now WRC



## Agenda

# Discussion Topics

- Introductions & Who we Are
- UNH-IOL and Ethernet
- UNH-IOL and Precision Timing
- NSF POSE Open PHASE & White Rabbit Collaboration

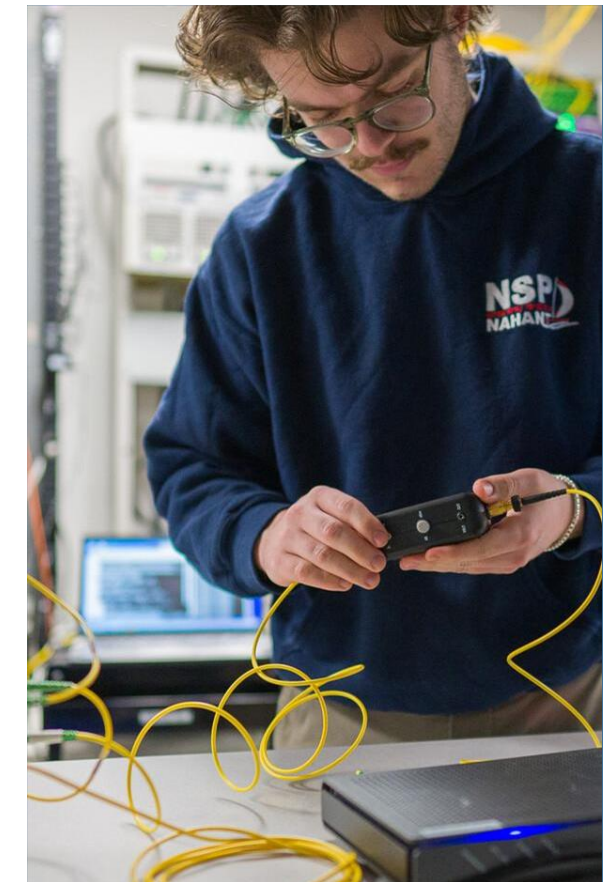
About

# Who We Are

The IOL is a neutral and independent lab that tests networking and data communications products for businesses across the globe.

We started in 1988 on the University of New Hampshire Durham, NH campus.

And we are a non-profit organization and ~100% funded by commercial industry.



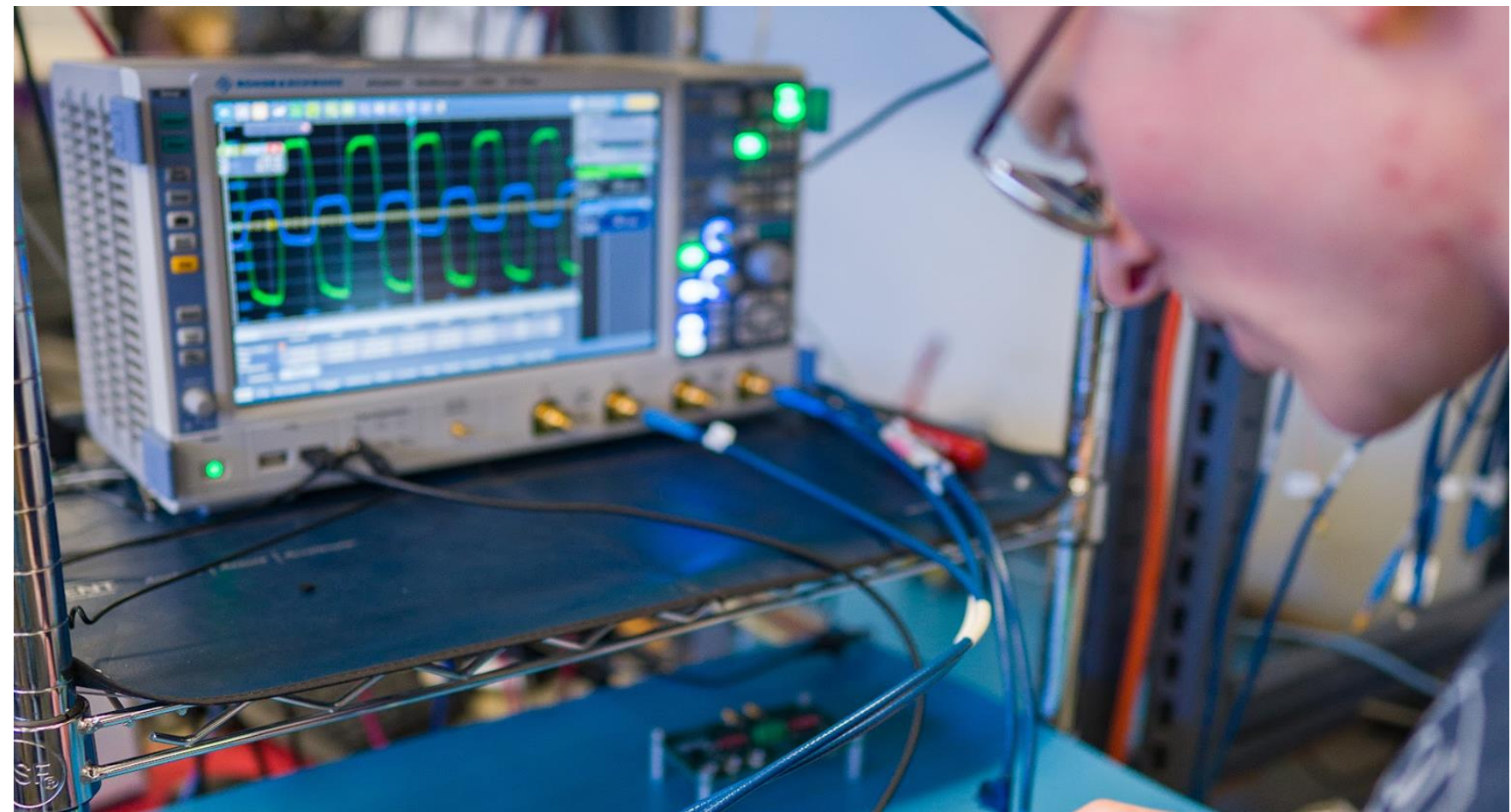
# Unique and Dual Mission of UNH-IOL

## 1. Industry Mission

Provide a neutral environment to foster interoperability, standards conformance, and development for the interconnected world.

## 2. Student Mission

Train and prepare UNH students for careers in networking technologies.



**150+**

UNIQUE MEMBER COMPANIES

**100+**

UNH STUDENT EMPLOYEES

**>32,000**

SQ. FT. OF LAB SPACE

Ethernet, IEEE 1588/PTP, & more....

## UNH-IOL's role in Ethernet

- Testing conformance and interoperability of all flavors of Ethernet (from 10Mbps thru 800Gbps (1.6Tbps soon!) for 36 years.
- Serving all silicon vendors and most major OEMs
- Largest test-bed of Ethernet equipment in the world e.g.:  
[iol.unh.edu/testing/ethernet/10gec/equipment](http://iol.unh.edu/testing/ethernet/10gec/equipment)
- Large collection of T&M gear  
[iol.unh.edu/testing/ethernet/partner-test-tools](http://iol.unh.edu/testing/ethernet/partner-test-tools)





# Community-driven Certification Examples



**Ethernet Alliance**

Developed and offer EA Power over Ethernet (PoE) Certification

<https://www.iol.unh.edu/poe>



**Avnu Alliance**

Developed and offer gPTP (802.1AS) Certification

[www.iol.unh.edu/avb](http://www.iol.unh.edu/avb)



**IEEE-SA Conformity Assessment Program (ICAP)**

PTP Certification for Power Profile

<https://standards.ieee.org/products-programs/icap/programs/ptp-power-profile/>

<https://www.iol.unh.edu/1588>



# Standards / Test Plan / Tools / Testing

## Standards:

IEEE (eg: 1588), ITU-T, etc

- Interoperability requirements
  - Conformance requirements
  - Performance requirements
- Testability requirements

## Testing:

- Test execution yields issues
- Issue resolution improves products, tools, test plans, and standards.

## Test Plan:

- Details conformance & interoperability test procedures
  - Tool agnostic

## Tools:

- Industry standard tools
- Automation Test Harnesses
  - Instantiate Test Plans
  - Multiple solutions
  - Enables 1<sup>st</sup> & 3<sup>rd</sup> party common test

The UNH-IOL views on

# Conformance & Interoperability

Conformance test **predicts** future interoperability

Interoperability test **proves** current interoperability

Both are essential.

Conformance testing is only as good as:

- The standard's coverage

- The test plan's coverage

- The test tools employed

Interoperability testing is only as good as the devices, topologies and traffic patterns scrutinized

# UNH-IOL and the White Rabbit community

- In late 2023, UNH-IOL was awarded a PHASE-II Grant from the NSF POSE (Pathways to Enable Open-Source Ecosystems) Program



U.S. National  
Science  
Foundation

- With thanks to supporters:



**NIST**  
National Institute of  
Standards and Technology  
U.S. Department of Commerce

**Nikhef**

and others



**White Rabbit**  
COLLABORATION

- UNH-IOL has joined as a founding member of the
- With the goal of aiding in the definition of an Associate Lab and offering calibration services, developer resources, testing for conformance, interoperability, performance and more

UNH-IOL supporting community needs

# Announcing the UNH-IOL Open PHASE



**Open PHASE**

**(Open PHASE) Open-Source Precision, High Accuracy and Security Environment for Time Verification, Calibration and Interoperability**

Complimentary effort to the goals of the White Rabbit Collaboration

# Open PHASE

## Thesis

Open PHASE is a community collaboration for high accuracy precision time synchronization (  $< 1\text{ns}$  ).

It will create consistent calibration methodologies, provide open source tools, host testing validation services, and act as a hub of knowledge.

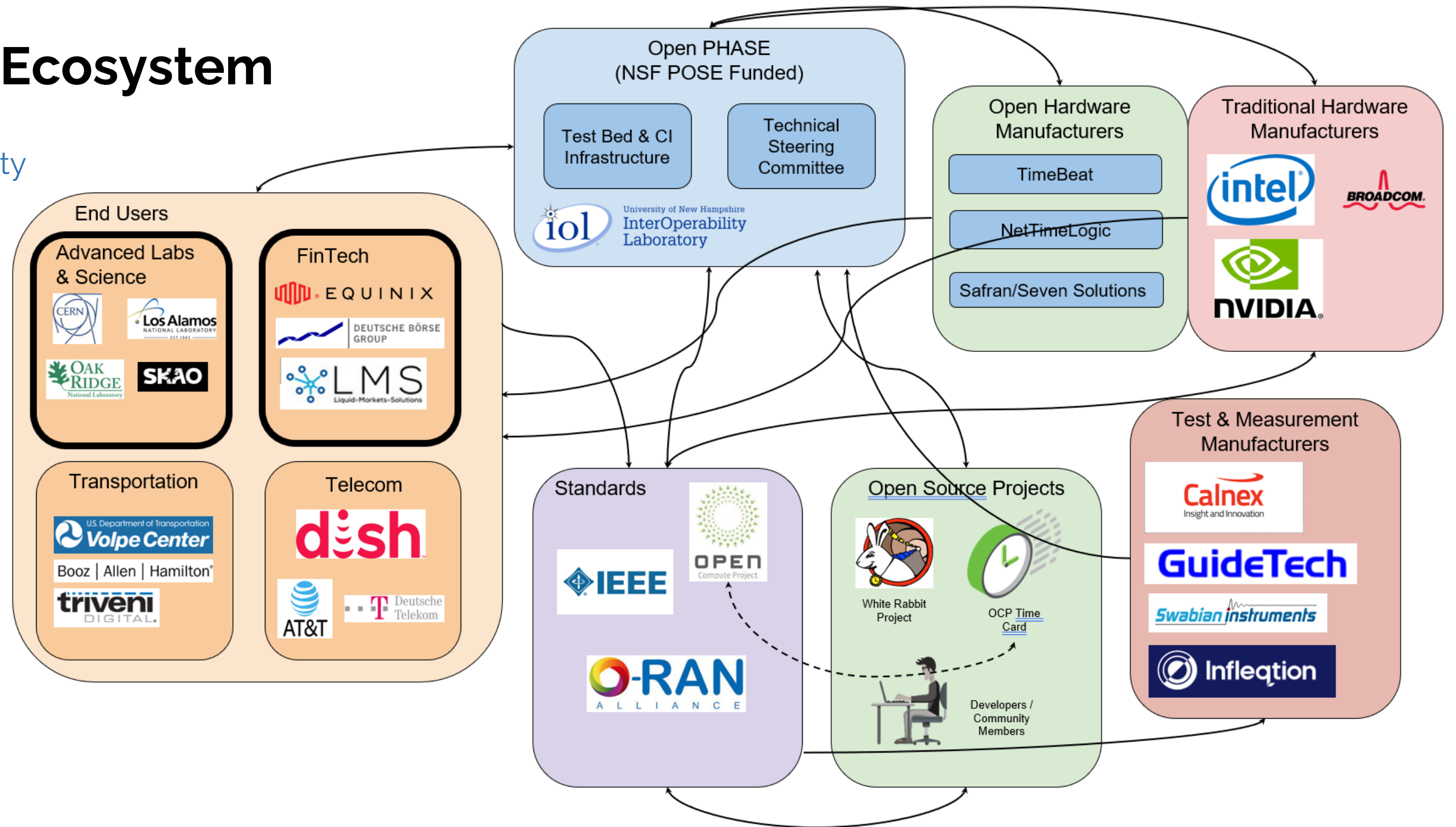
## Why?

This technology is critical for systems ranging from high frequency stock trading to advanced science research to modern telecommunications networks.

The outcome of this work will shorten the time for adoption of high precision time synchronization technologies.

# Open PHASE Ecosystem

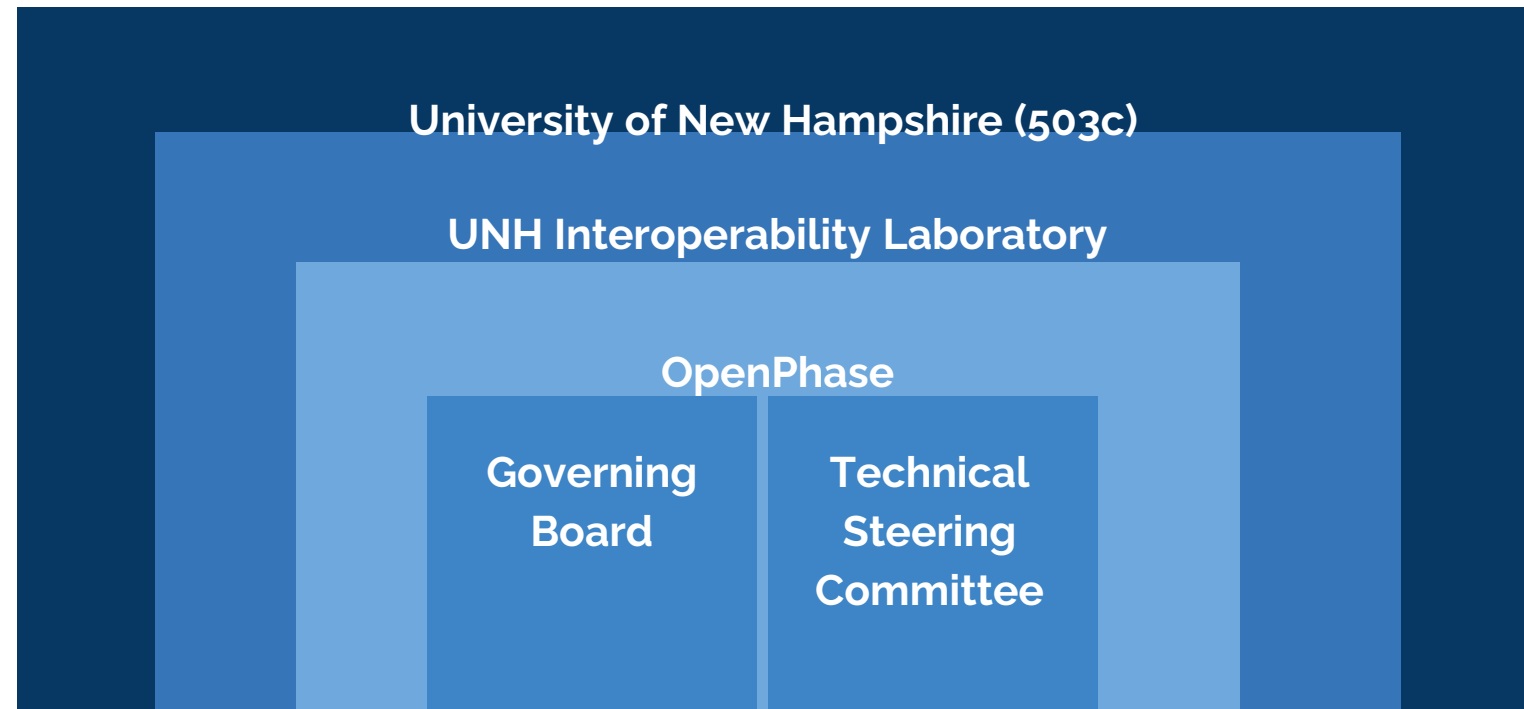
Open Source Community



OpenPHASE

# Governance Model

Empowering the community



## Responsibilities:

- 1 UNH-IOL (aka UNH)**
  - Operational framework / Legal
  - Accounting / Financial Sponsor
  - Physical equipment hosting / Including CI/CD systems
- 2 Open PHASE GB**
  - Project governance
  - Definition of project access (i.e. utilization of test bed resources, allocation of funds for T&M equipment, etc.)
- 3 Open PHASE TSC**
  - Project technical oversight
  - Approval of changes to technical materials (e.g. published specifications, test bed changes)

Governing Board and Technical Steering Committee Policies and Membership still open for input and your participation

# Open PHASE Scope

## Time Transfer

- Principal focus: supporting calibration, conformance, interoperability and performance testing of White Rabbit solutions
- Aligned with the efforts of the White Rabbit Collaboration, with goal of aiding in the definition of Associate Labs and required test plans, tools, and coverage .

## Time Keeping

Why transfer time if you can't keep it?

- IEEE P3335 TimeCard, grown out of the Open Compute Project Time Appliances Project (OCP-TAP) Time Card.
- Host / Time Card compatibility, PCIe PTM use, TGPIO and equivalent CPU sync verification
- Similar calibration, conformance, interoperability and performance test needs as White Rabbit

## Additional scope: resilience, reliability and security

- Open Source solutions that meet requirements of IEEE P1952 Resilient PNT
- Redundancy solutions similar to: Hot Standby - P802.1ASdm
- Open Source Time scale algorithms - for example:
  - IEEE P802.1DP TSN Profile for Aerospace proposed fault-tolerant timing Module (FTTM) – as of 2024/3/14 to be spun out as a new PAR (project) in 802.1
  - Work by VU (Vrije Universiteit Amsterdam)



# HW / FW / SW Developers / Open Source Maintainers

- Lab as a Service (LaaS)
- Two approaches: Continuous Integration (CI) test and Scheduled access test
- CI: Automated verification (and perhaps calibration) for devices in a testbed
- Scheduled Access: Developers / Open Source Contributors / Users / etc
  - Gain remote scheduled access to resources to aid your development efforts
  - Test bed of switches, bare-metal servers with TimeCards / NICs etc.

# LaaS CI example

- Linux Foundation's Data Plane Development Kit (DPDK) Community CI lab - UNH-IOL hosts equipment from: ARM, Broadcom, Intel, Nvidia & others
- Testing of all patches occurs automatically to better inform maintainers:

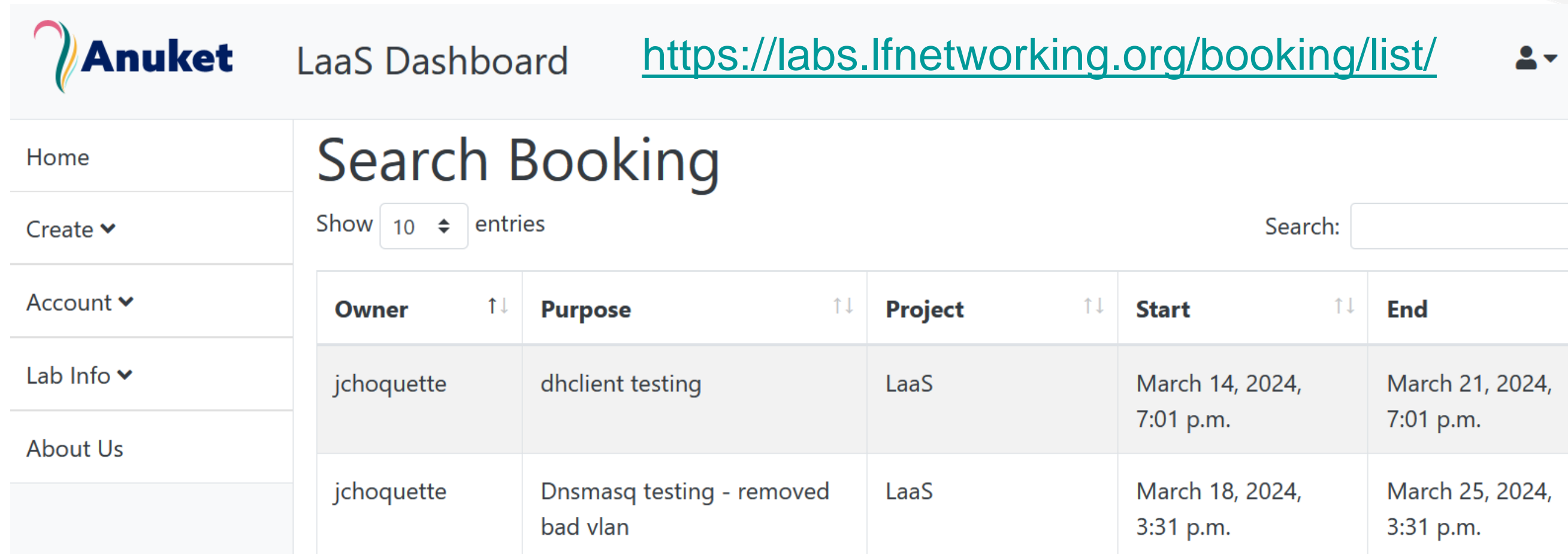
<https://lab.dpdk.org/results/dashboard/patchsets/>

The screenshot shows the DPDK CI Dashboard interface. At the top, there is a navigation bar with links for 'DPDK CI Dashboard', 'Patch sets', 'Tarballs', 'Periodic Testing', 'Stats', 'CI Status', 'Test Coverage', and 'About'. A 'Log in' button is located on the right side of the navigation bar. Below the navigation bar, there is a breadcrumb trail: 'Home / Patch sets'. The main content area contains a paragraph explaining the current CI testing status for active patch sets in the DPDK Patchwork instance, listing possible statuses: Pending, Waiting, Apply Error, Build Error, Possible Regression, and Pass. It also notes that NIC vendors can log in to view detailed performance results. A dropdown menu on the right indicates 'Showing: active patch sets'. Two patch sets are displayed as examples:

- Patch 138656**: Status 'Pass', dated 'March 21, 2024, 4:20 p.m.', by 'Yu Jiang'. Description: '[V1] doc: add tested Intel platforms with Intel NICs'. The test results are represented by three rows of green checkmarks.
- Patch 138655 v3**: Status 'Pass', dated 'March 21, 2024, 8:35 a.m.', by 'Arkadiusz Kuztal'. Description: '[v3] app/test: fix rsa tests in qat suite'. The test results are represented by three rows of green checkmarks.

# LaaS Scheduled Access example

- Linux Foundation Networking's Anuket LaaS - UNH-IOL hosts 60 servers (14 ARM, 46 HPE, with 10G or 25G Ethernet – all schedulable as a bare-metal resource for remote access by users

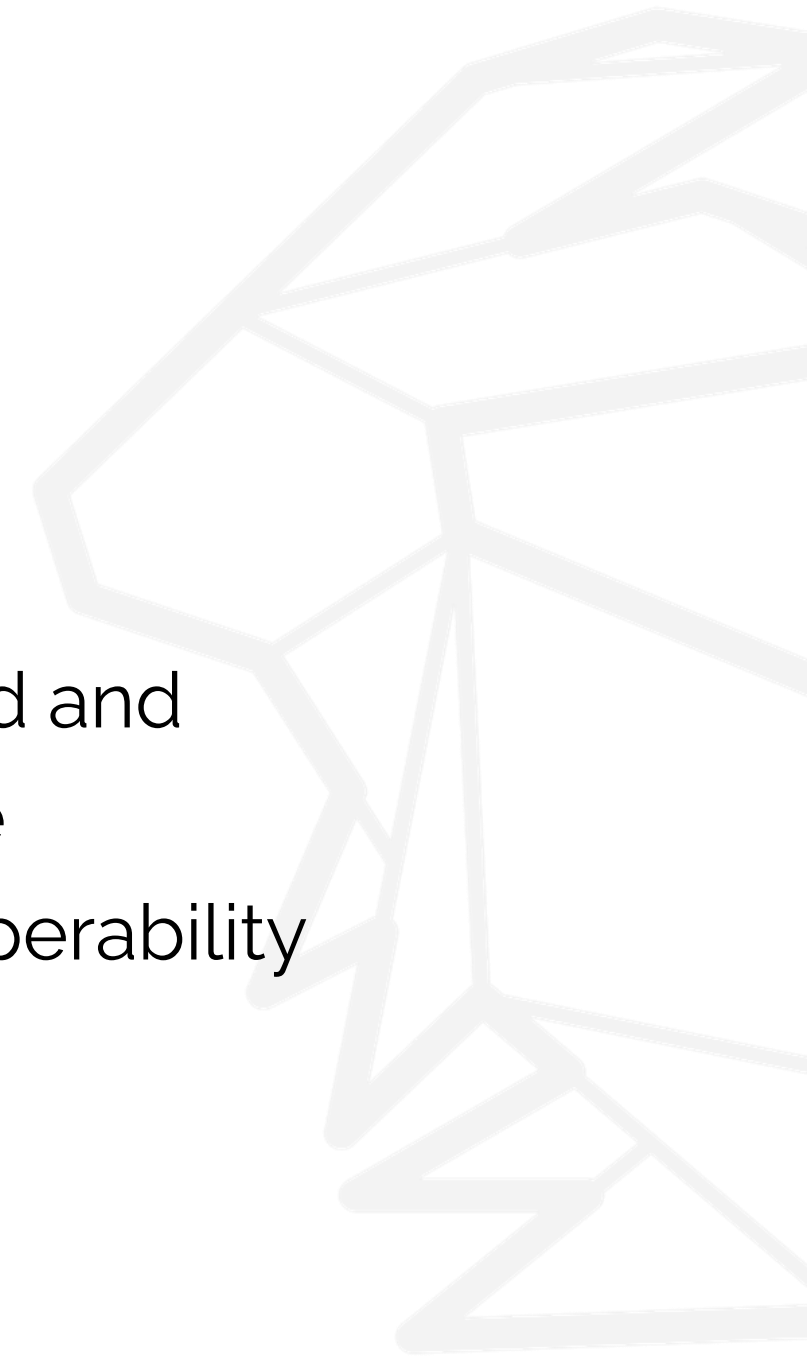


The screenshot shows the Anuket LaaS Dashboard interface. The top navigation bar includes the Anuket logo, the text 'LaaS Dashboard', the URL <https://labs.lfnetworking.org/booking/list/>, and a user profile icon. A left sidebar contains navigation links: Home, Create, Account, Lab Info, and About Us. The main content area is titled 'Search Booking' and features a 'Show 10 entries' dropdown and a search input field. Below this is a table with the following data:

Owner	Purpose	Project	Start	End
jchoquette	dhclient testing	LaaS	March 14, 2024, 7:01 p.m.	March 21, 2024, 7:01 p.m.
jchoquette	Dnsmasq testing - removed bad vlan	LaaS	March 18, 2024, 3:31 p.m.	March 25, 2024, 3:31 p.m.

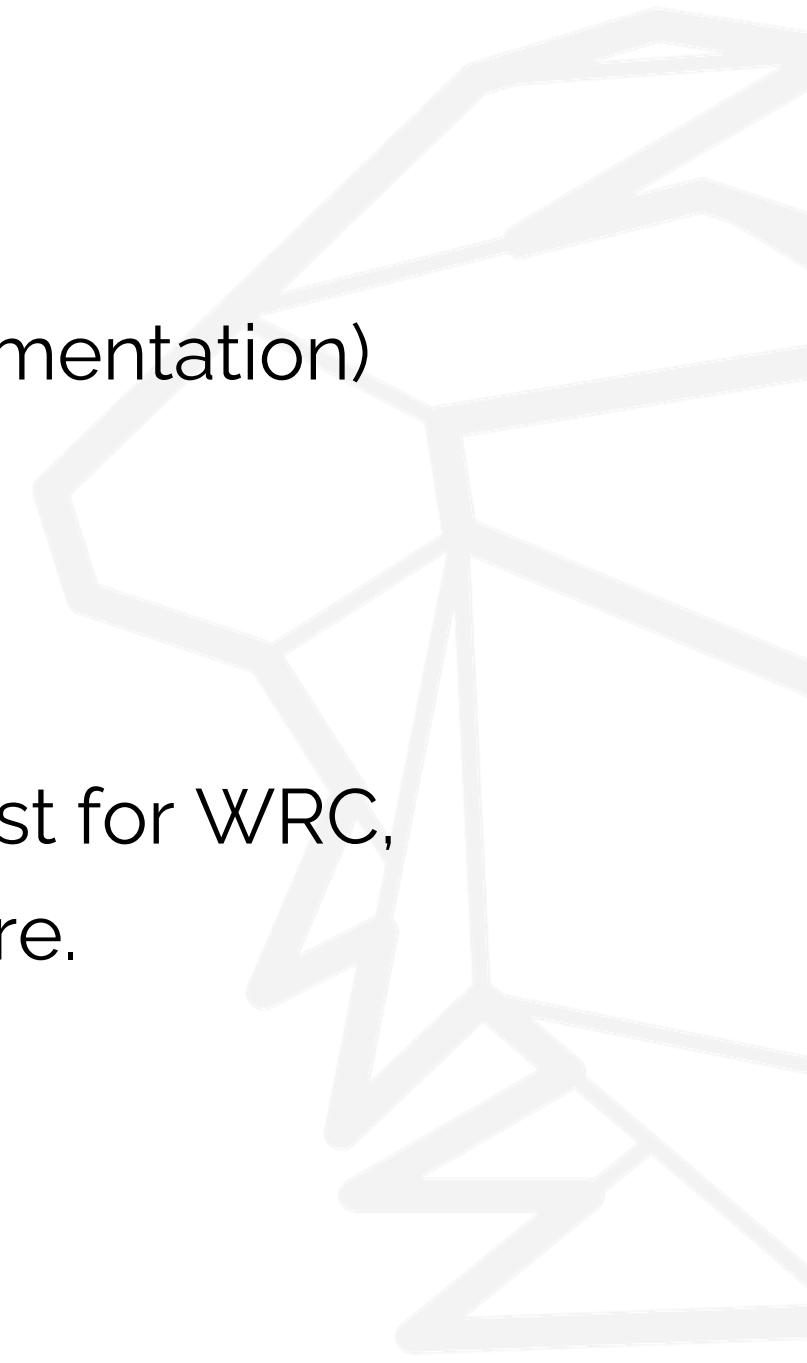
## Hardware Manufacturers

- Contribute devices to a shared Testbeds
  - for CI testing
  - for scheduled testing
  - To develop a large and growing testbed of WR, 1588 HA, Timecard and related solutions to demonstrate interoperability and performance
- Private testing for calibration, conformance, performance and interoperability
  - Debug and Improve your products
  - Utilize 3<sup>rd</sup> party neutral reports
- Demonstrate solutions meet certification requirements



## Test & Measurement (T&M) Tool Makers

- Vetting and inclusion of tooling in approved MOIs (Methods of Implementation)
- Drive new T&M capabilities needed in the sub-nanosecond space
- Within the Technical Steering Committee, help shape certification test for WRC, IEEE 1588 HA, IEEE P1952, P3335 Time Card, ORAN Alliance, and more.



## End-Users

- Look for 3<sup>rd</sup> Party Neutral Reports
- Join the Technical Steering Committee to drive needs and use-cases
- Look for White Rabbit Collaboration device approval
  - Full process to be defined by WRC
  - Passing devices can make use of the White Rabbit Trademark



**White Rabbit**

How Open PHASE may assist you

# Call to Action

## If you are a:

- HW / SW / FW Developer
- Open Source Maintainer
- T&M Tool Maker
- Hardware Manufacturer
- End-User

Share your needs, pain-points, and thoughts on how we can assist you

Help us grow an ecosystem of Interoperable, Conformant, and Verified White Rabbit, IEEE 1588 HA, and Time Card solutions

- **Join the White Rabbit Collaboration**
- **Join the Open PHASE Technical Steering Committee**
- **Help define test needs and coverage, refine test tools, and ensure a heterogeneous interoperable & performant sub-ns future!**



# Resources & Contacts



[iol.unh.edu/OpenPHASE](http://iol.unh.edu/OpenPHASE)



**Bob Noseworthy**, Principal Engineer



[ren@iol.unh.edu](mailto:ren@iol.unh.edu)



**Lincoln Lavoie**, Principal Engineer



[lylavoie@iol.unh.edu](mailto:lylavoie@iol.unh.edu)



**Michelle Whisnant**, Operations



[mwhisnant@iol.unh.edu](mailto:mwhisnant@iol.unh.edu)

**Mike Goding**

EmBase Sales Executive



[mgoding@iol.unh.edu](mailto:mgoding@iol.unh.edu)



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**Thank You!**

Q & A

