POWDER Platform

Enabling O-RAN Experimentation

powderwireless.net

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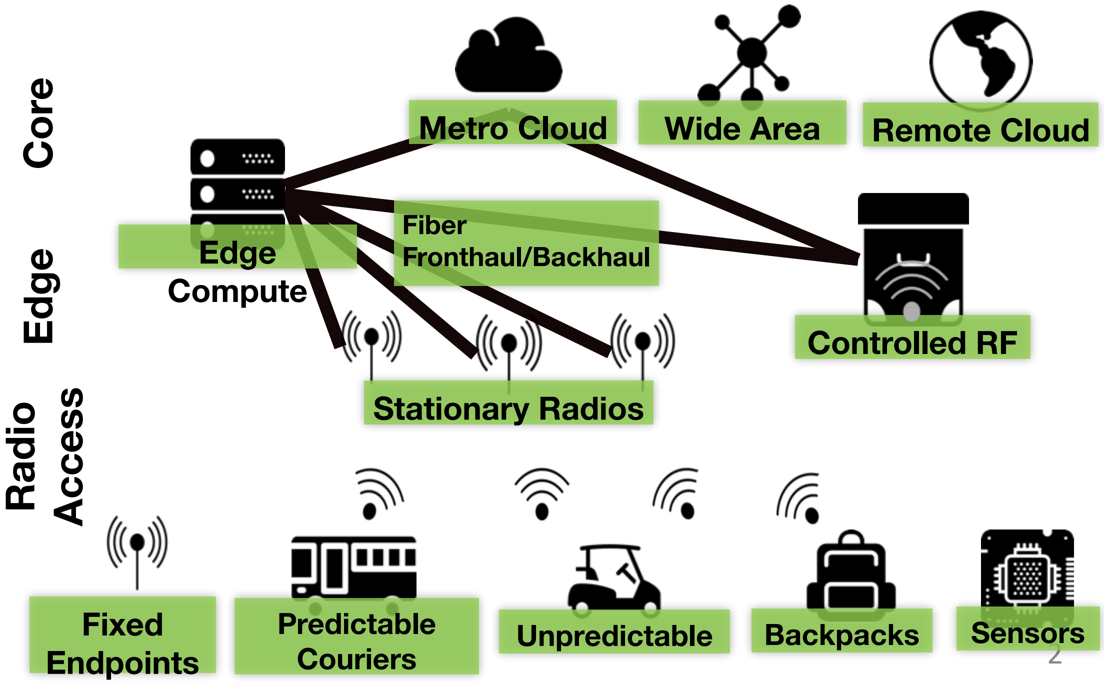
POWDER in brief

- End-to-end software-defined
- Flexible research infrastructure
- Sophisticated experimental workflow
- BYOD/BYOS capability
- Software and hardware "building blocks"
  - mMIMO (SDR based)
  - SDR (rooftops, human height, buses)
  - Compute clusters
  - 4G/5G open source stacks (OAI, srsRAN)
  - O-RAN, ONAP, OpenStack, Kubernetes



Core

Edge

Radio Access

Metro Cloud

Wide Area

Remote Cloud

Edge Compute

Fiber Fronthaul/Backhaul

Controlled RF

Stationary Radios

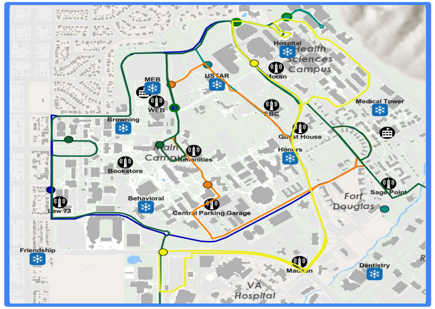
Fixed Endpoints

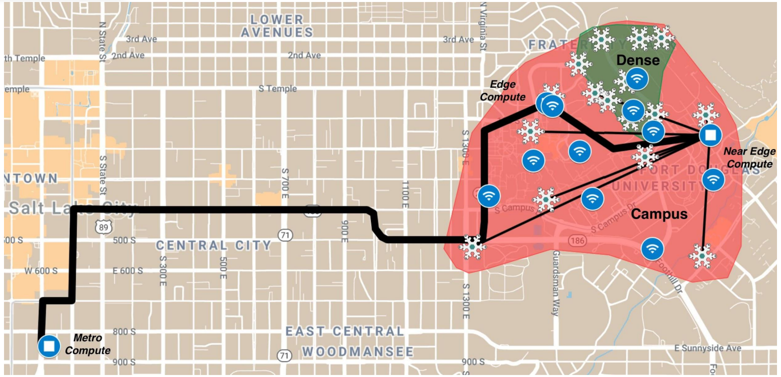
Predictable Couriers

Unpredictable

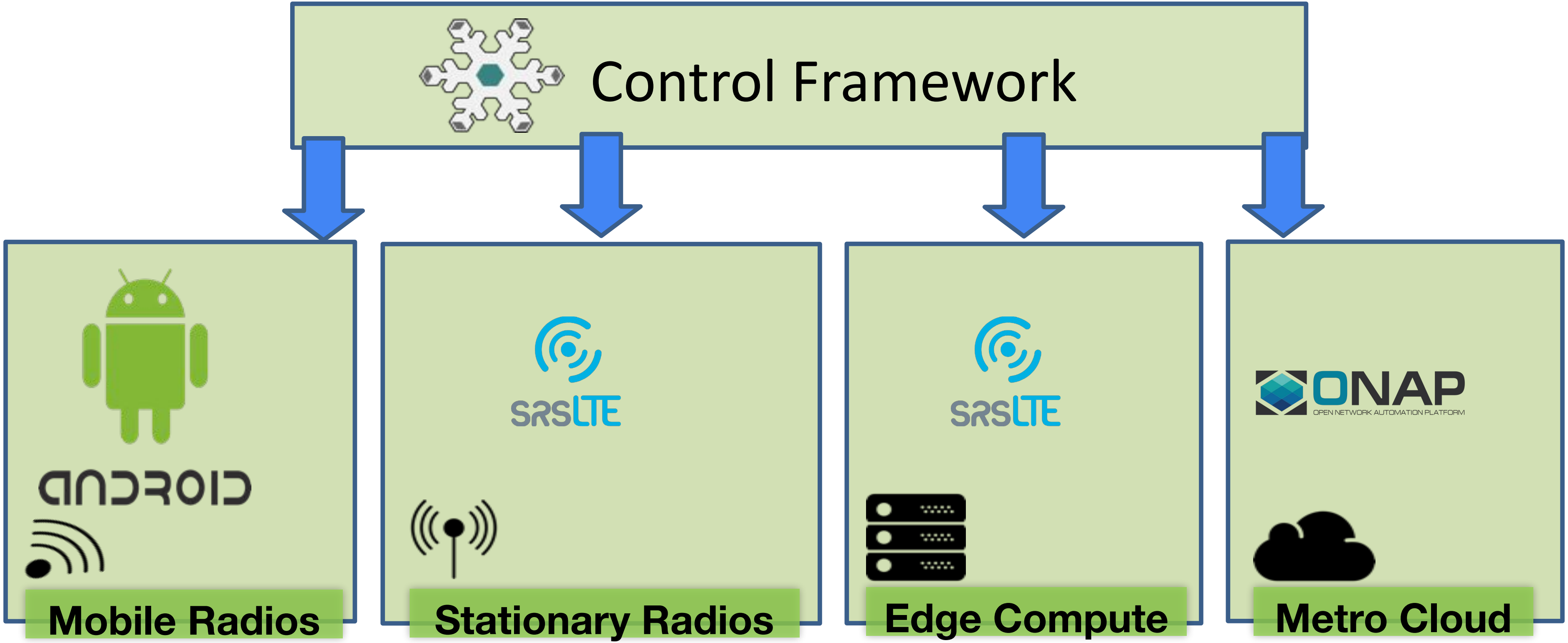
Backpacks

Sensors





Experimental process



Software building blocks

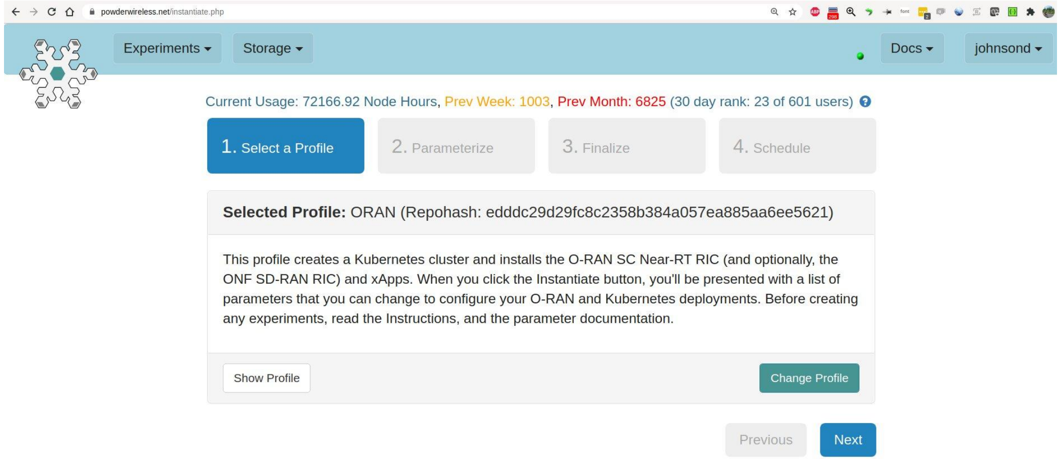
Using POWDER profile mechanism:

- Parameterized “recipe” specifying software, hardware, configuration etc.
  - Complex stacks, many parameters, flexible
- Instantiate automatically
- Typical workflow:
  - Start with “base” profile
  - Extend/modify as needed
  - Capture modifications for future
- API for experiment automation

Available profiles:

- Kubernetes
- OpenStack
- ONAP
- O-RAN: OSC/ONF RICs
- (many RAN/Core/RF/SDR profiles)

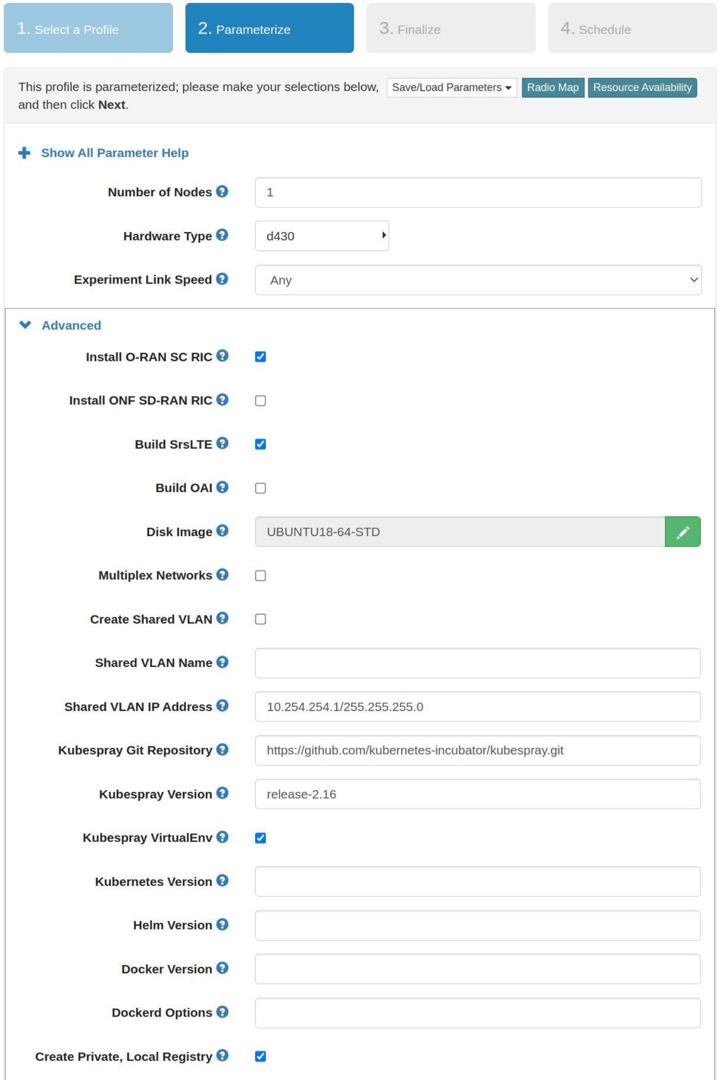
POWDER O-RAN Profile



Current Usage: 72166.92 Node Hours, Prev Week: 1003, Prev Month: 6825 (30 day rank: 23 of 601 users)

Selected Profile: ORAN (Repohash: edddc29d29fc8c2358b384a057ea885aa6ee5621)

This profile creates a Kubernetes cluster and installs the O-RAN SC Near-RT RIC (and optionally, the ONF SD-RAN RIC) and xApps. When you click the Instantiate button, you'll be presented with a list of parameters that you can change to configure your O-RAN and Kubernetes deployments. Before creating any experiments, read the Instructions, and the parameter documentation.



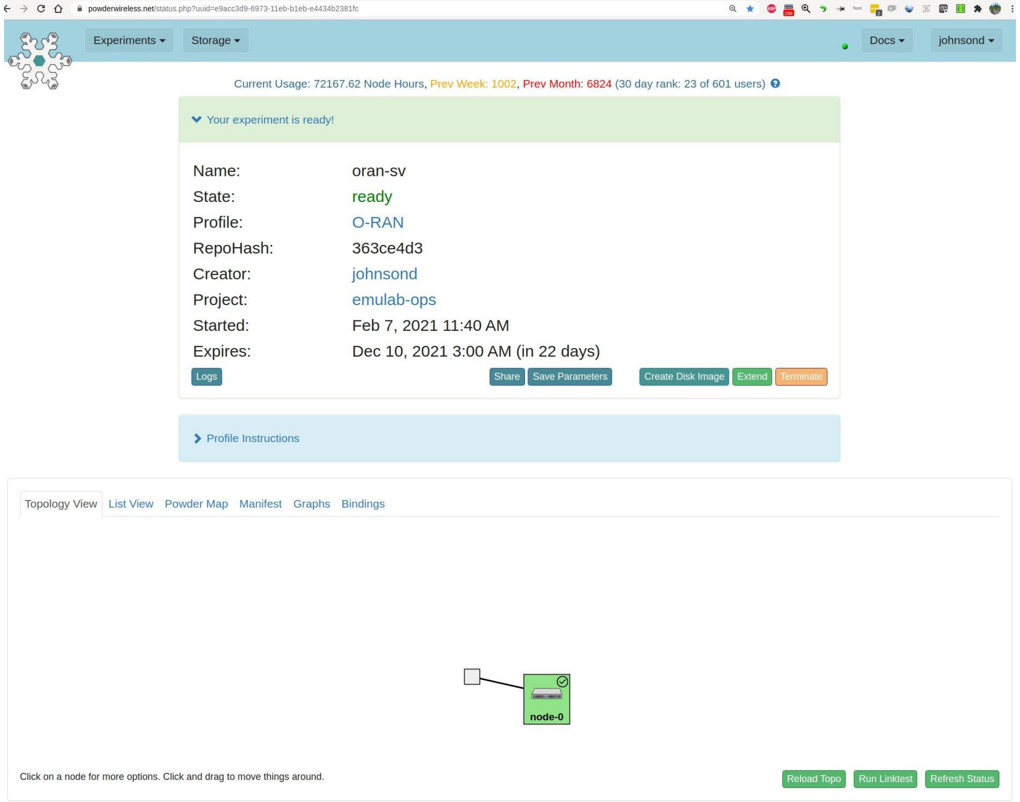
This profile is parameterized; please make your selections below, and then click **Next**.

Number of Nodes	1
Hardware Type	d430
Experiment Link Speed	Any

Advanced

Install O-RAN SC RIC	☑
Install ONF SD-RAN RIC	□
Build SrsLTE	☑
Build OAI	□
Disk Image	UBUNTU18-64-STD
Multiplex Networks	□
Create Shared VLAN	□
Shared VLAN Name	
Shared VLAN IP Address	10.254.254.1/255.255.255.0
Kubespray Git Repository	https://github.com/kubernetes-incubator/kubespray.git
Kubespray Version	release-2.16
Kubespray VirtualEnv	☑
Kubernetes Version	
Helm Version	
Docker Version	
Dockerd Options	
Create Private, Local Registry	☑

POWDER O-RAN Experiment



powderwireless.net/status.php?uuid=e9acc3d9-6973-11eb-b1eb-e4434b2381fc
Experiments
Storage
Docs
johnsond

Current Usage: 72167.62 Node Hours, Prev Week: 1002, Prev Month: 6824 (30 day rank: 23 of 601 users)

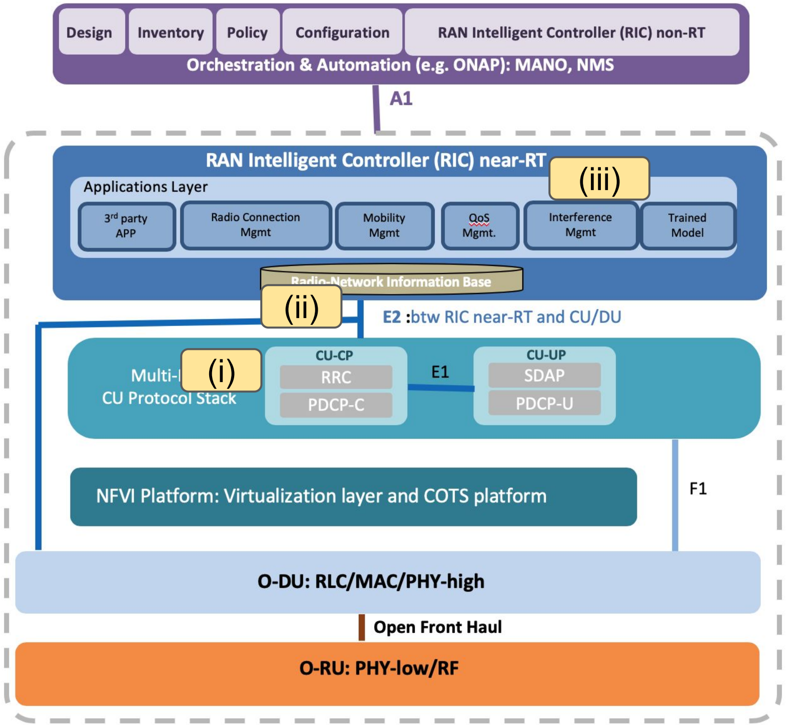
Your experiment is ready!

Name:	oran-sv
State:	ready
Profile:	O-RAN
RepoHash:	363ce4d3
Creator:	johnsond
Project:	emulab-ops
Started:	Feb 7, 2021 11:40 AM
Expires:	Dec 10, 2021 3:00 AM (in 22 days)

Click on a node for more options. Click and drag to move things around.

O-RAN controlled RAN slicing

- End-to-end O-RAN stack to perform resource management in a sliced RAN environment
- Approach:
  - Slices share same spectrum
  - UEs dynamically assigned to a slice
  - Slice resources (RBs) dynamically adjusted
- Implementation:
  - OSC RIC source base + srsRAN
  - O-RAN E2 agent, RAN slicing/scheduling implemented in srsRAN eNodeB (i)
  - O-RAN E2 service model to expose functionality to RIC (ii)
  - Custom xApp to control (iii)



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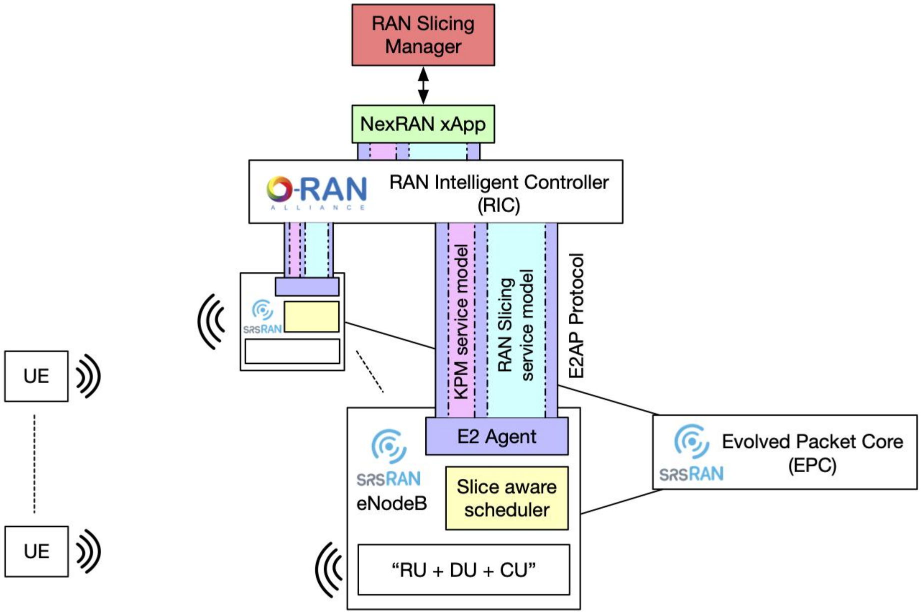

POWDER O-RAN pointers

- Demo videos in O-RAN Virtual Exhibition gallery:
  - https://www.virtualexhibition.o-ran.org/classic/generation/2020/category/open-ran-demonstrations/sub/open-interface/127
- WiNTECH ‘21 Paper:
  - http://www.flux.utah.edu/paper/oran-slicing
- E2 agents for srsLTE, OAI
  - https://gitlab.flux.utah.edu/powderrenewpublic/srslte-ric (e2sm-kpm, custom service models)
  - https://gitlab.flux.utah.edu/powderrenewpublic/oai-ric (no e2sm support)
- Custom RAN Slicing E2 service model
  - https://gitlab.flux.utah.edu/powderrenewpublic/nexran/-/blob/master/lib/e2sm/messages/e2sm-nexran-v01.00.asn1
- xApp with custom and KPM service models, closed-loop policy-driven slice control, RESTful NBI admin interface
  - https://gitlab.flux.utah.edu/powderrenewpublic/nexran
- POWDER profile with demo instructions (including OSC Cherry/Dawn, ONF SDRAN):
  - https://www.powderwireless.net/show/PowderProfiles/O-RAN
  - https://gitlab.flux.utah.edu/powder-profiles/oran
- Forked e2, dep repos; minor changes:
  - https://gitlab.flux.utah.edu/powderrenewpublic/dep
  - https://gitlab.flux.utah.edu/powderrenewpublic/e2
  - https://gitlab.flux.utah.edu/powderrenewpublic/xapp-frame-cpp

Thank you!

Thanks to the OSC RIC and RICAPP teams,
and the srsRAN team