COSMOS Basic Usage Tutorial

MERIF Tutorial – Intro to Experimentation

May 23, 2023

The **COSMOS testbed design and deployment** is joint work with the COSMOS team (www.cosmos-lab.org)

Some Terminology

- **Node:** a resource to be used for experiments

- **Image:** the full disk image of a node

- **Console:** A machine used to set up nodes for an experiment

- **Domain:** A subnet which contains a set of nodes and their console
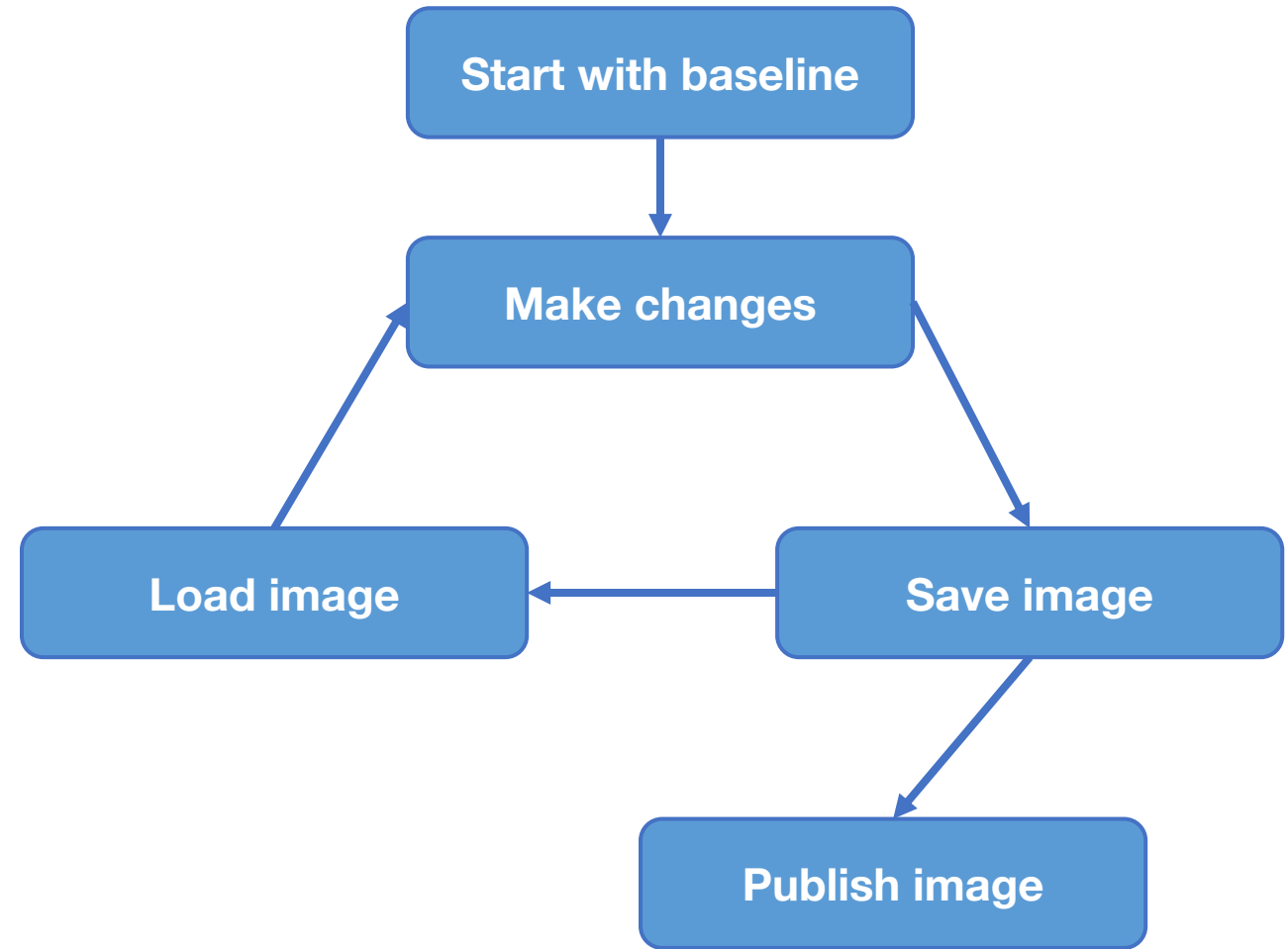
Resource Access

Intended usage is over SSH:

- Connect to the console, where you have permission to modify the state of your nodes

- From the console, connect to your nodes, where you have permission to do whatever you want

user@home

SSH

SSH

cosmos-user@console

root@node1-1

root@node1-2

root@node1-3
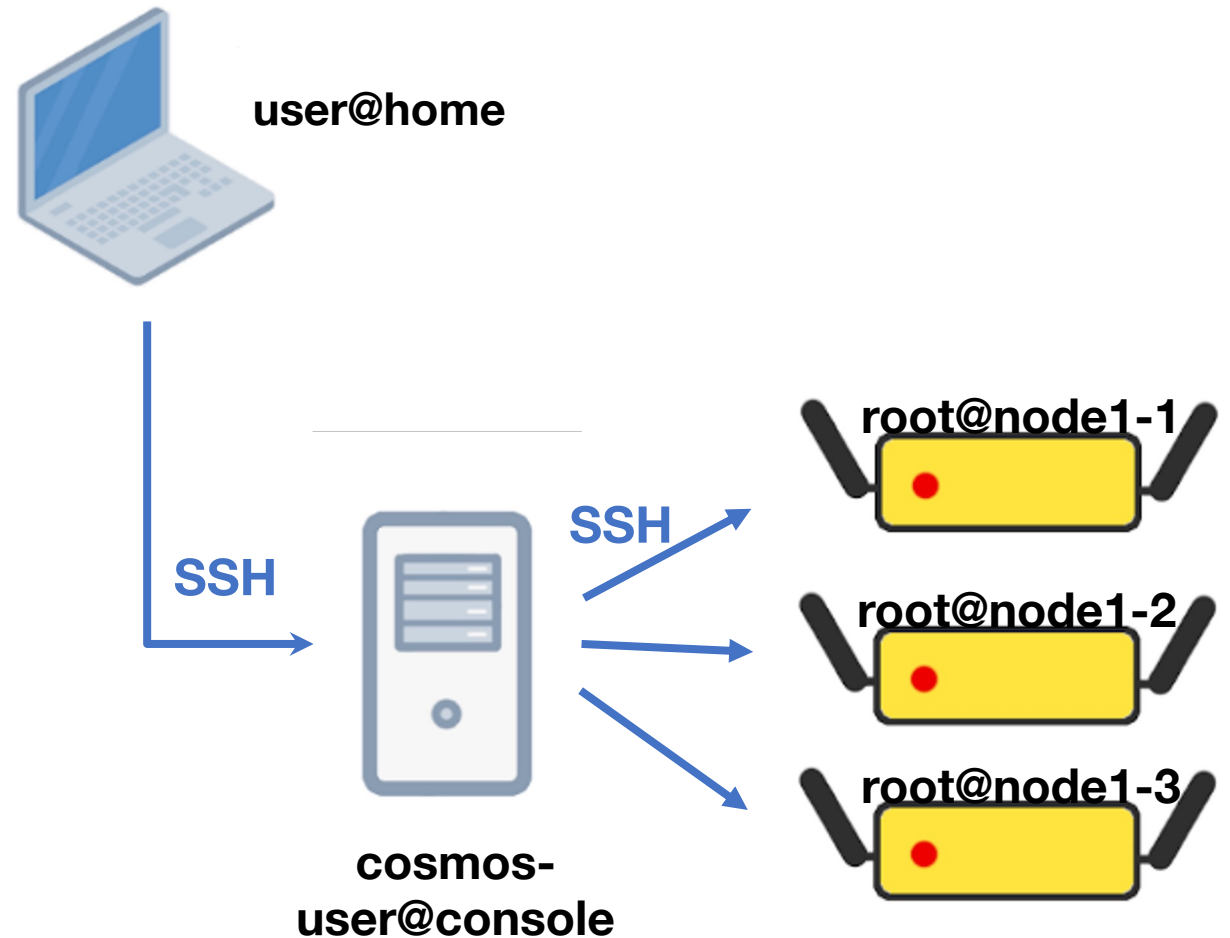
Resource Workflow

Workflow based around:

- Load a starting image

- Make and test changes

- Save the new image

- Either resume from saved image

- or, publish the image for others to use

Time Reservations

- Reserve a whole domain
- Resources outside a domain won't interfere
- Exclusive access during reservation
- You can invite others, but: they can interfere

Friday,9/25/2020 All times are Eastern/NY	12:00am	1:00am	2:00am	3:00am	4:00am	5:00am	6:00am	7:00am	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm
grid (ORBIT)												Prasad N...		Prasad N
intersection (ORBIT)														
outdoor (ORBIT)														
sb1 (ORBIT)	Michael ...		Michael ...		Michael ...		Michael ...		Michael ...		Michael ...		Michael ...	
sb2 (ORBIT)														
sb3 (ORBIT)														
sb4 (ORBIT)	Mohsen R...		Mohsen R...		Mohsen R...		Mohsen R...		Mohsen R...		Mohsen R...		Mohsen R...	
sb5 (ORBIT)														
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sb8 (ORBIT)														
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sb2 (COSMOS)	Tingjun Chen, Columbia Universit...			Ti	Tingjun Chen, Columbia Univer...						Tingjun Chen, Colu			

https://www.orbit-lab.org/cPanel/controlPanel/start

Consoles, Logging In

- Each domain has a "Console"

- use to provision resources

- SSH jump host

- access your files

- view node images

- Not suitable for arbitrary code

- Access revoked at the end of your reservation
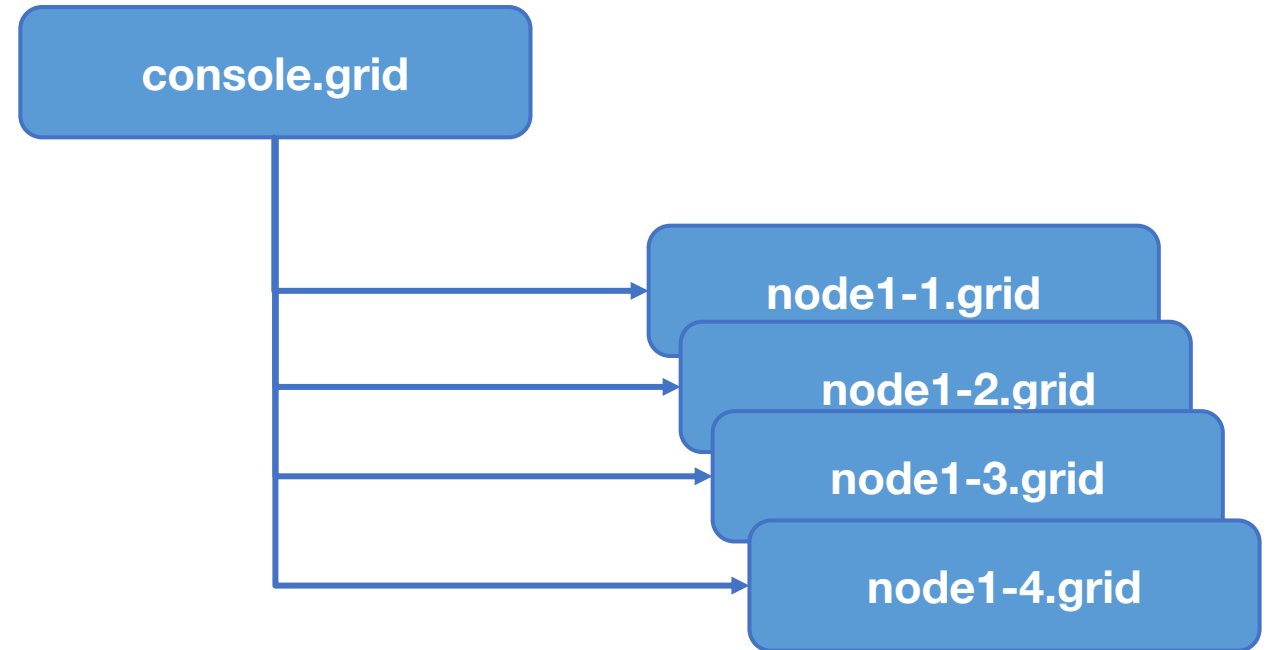
Types of Resources

- **Compute resource:** server with CPU, GPU, and/or FPGA
- **Radio resource:** either "black box" transmitter, or some combination of FPGA and RF front end
- **Node:** combination of compute and radio device as one "unit"
- Some devices are in multiple categories

OMF Command (aka "NodeHandler")

> omf [SUBCOMMAND] [ARGUMENT]...

Subcommand	Description
omf help	Display the help for using omf commands.
omf exec	Execute an experiment script.
omf load	Load a disk image on a given set of nodes.
omf save	Save a disk image from a given node into a file.
omf tell	Switch a given set of nodes ON/OFF.
omf stat	Returns the status of a given set of nodes

Viewing and Changing Resource State

- Topologies:
  - srv1-lg1: a single machine, by hostname
  - "-t all" : compute resources, provisioned with omf load
  - "-t system:topo:allres" : all resource types that can power on/off
- omf stat:
  - what is powered on, off, or not available
- omf tell:
  - -a on: power on
  - -a offh: power off
  - -a reset: power cycle

Nodes and Imaging

- When we say "image, we mean a full disk image.

- Set of baseline images available.
    - Ubuntu 18.04 + customizations
    - UHD, gnuradio, CUDA, and so on available

- Two "default" users: root/no password and native/native
    - Some programs don't like running as root.

- omf load –t (set of nodes) –i (image name) –r (resize the disk)

- Defaults to power off afterward, so as not to interfere

- Turn back on to use them

Connecting to a Compute Resource (node)

- SSH from the console

- You have full access to the compute resource

- But no guarantees outside your reservation

- A standard acceptable use policy applies:
  - Don't be malicious
  - You're responsible for your own data
  - https://wiki.cosmos-lab.org/wiki/UserGuide/AcceptableUse

Making Changes, Saving State

- Make whatever changes you want:
  - Compile software, install packages, develop code
- BUT:
- Save large results elsewhere:
  - Home directory (on console)
  - External resources (ask us if you need a lot of space)
- Active code development
  - Use Git, and sync to an external repo.
  - Update your base image only when needed

Saving Disk Images

- Image is a full disk copy: Slow, and makes a large file
- On the node: run /root/prepare.sh: generalizes image, cleans up temp files
- On the console, run "omf save –n node_name.domain.cosmos-lab.org
- This is the only OMF command that runs on a single device, not a set.
- Saves to /mnt/images/ on the console

Working With Image Files

- All images are ".ndz" files: (frisbee, imagezip, imageunzip)
- Standard linux permissions, defaults:
  - User: Read Write
  - Group: Read
  - Everyone: Read
- Use chmod and chown to change this
- Use mv to give it a descriptive name
- Use rm to clean up old copies (be kind to our disk space)

Security and Privacy

- Next reservation has root access to the resources you used

- Images default to readable by all users

- This means: don't put secrets in your images.

- Don't reuse passwords.

- Don't reuse private keys (especially Github)

- Put a passphrase on your private keys (especially Github)

Conclusion, Further Reading

- Our wiki: https://wiki.cosmos-lab.org/wiki goes more in depth on all of these topics

- Following the basic tutorials: https://wiki.cosmos-lab.org/wiki/Tutorial will walk you through these steps

- You will some more examples today.

- Try interesting things and let us know how it goes!