# Virtualisation For Network Testing & Staff Training

APRICOT 2016

Auckland

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# Virtualisation Technologies

- They are everywhere…
- By abstracting functionality away from hardware we gain:
  - Improved capacity usage
  - Lower power consumption
  - Better reliability (uptime, data loss)
  - Reduced costs for creating testbeds to verify new configurations or new code
  - More flexibility in designing architectures

# Two kinds of virtualisation

- **Consolidation**
  - Run many services and servers onto fewer physical machines: increases *efficiency*
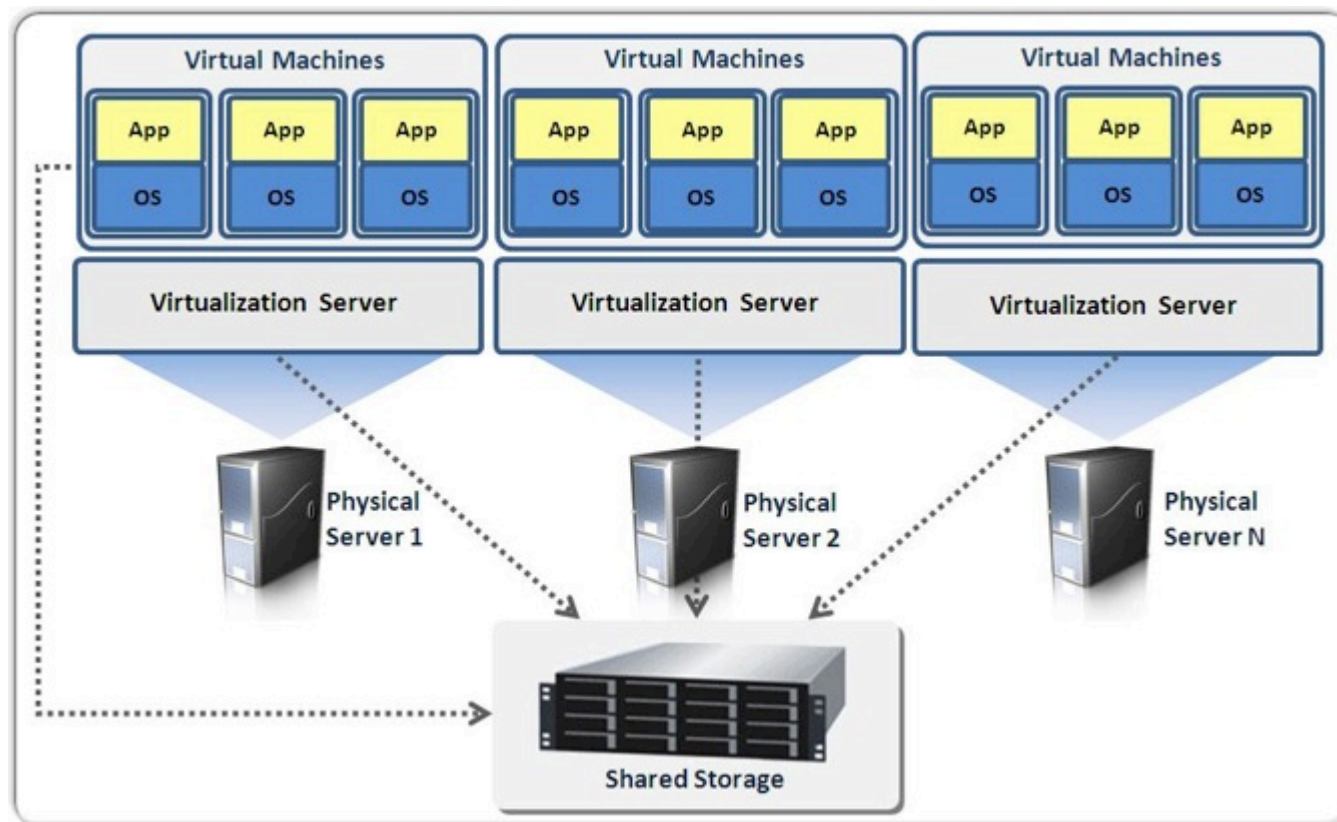
- **Aggregation**
  - Distribute applications and resources across as many virtual servers as required, turning resources on or off as need: increases *scalability*

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# Some virtualisation benefits

- **Reduced power use** and better use of resources through **consolidation**

# More benefits

- **Standardised** platform for people running services
  - Heterogeneous hardware platform hidden away behind virtualisation
  - Makes it easy to move hosts between platforms
  - Not tied to a particular vendor – migrations are easy
- **Open Source** offerings on par with commercial solutions and preferred by the "big boys"

# Technical capacity training

- NSRC has actively participated for many years in Technical Capacity training around the world:
  - Africa – AfNOG and country NOGs
  - Asia Pacific – APRICOT, SANOG, PacNOG
  - Middle East – MENOG
  - Many national and regional R&E networks around the globe
  - etc
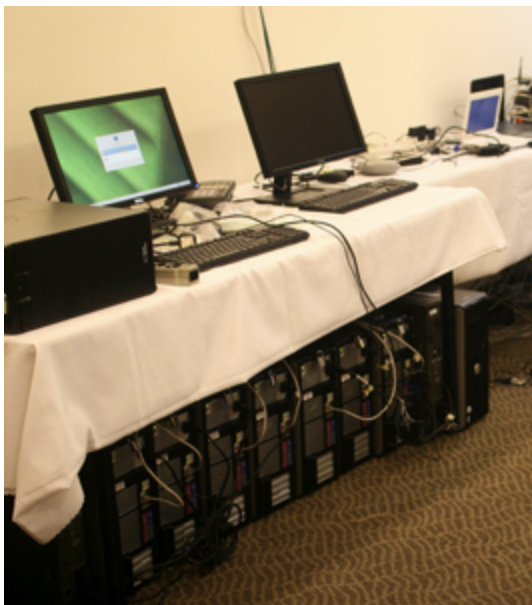- Instructors, staff, students and the institutions have clearly benefited…

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# AfNOG Training 2000-2010…

# …lots of setup

# Logistical benefits are obvious

- In the context of regional and local training:
  - "Virtualising" = less hardware (better use)
  - Reduced shipping costs
  - Reduced Logistics
    - Customs / import
      - Network equipment is often considered to be "telecommunications" – taxation issues, licensing
    - Small footprint – fits in a backpack or carry-on
    - Peripheral infrastructure (access points, desktop switches) are very small

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# For AfNOG 2013 we virtualised

- After successful pilot experiences at APRICOT, SANOG, etc…

- Typical AfNOG Workshops have
  - 140 PCs
  - 40 routers
  - 30 switches
  - 3-5 full-sized tower PCs
  - Keyboards, monitors, mice and network

- This became…

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# Virtual AfNOG 2013

- This represents significant overkill (2x or more).
- Much more could be virtualised…

- Students must bring their own laptop
  - Most did already
  - (Previously AfNOG provided desktop PCs)



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# Motivations and benefits

- Other benefits than logistics are well aligned with the needs of regional / decentralised training:

    - Adaptability

    - Educational

- We will cover these in the next slides

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# Benefits: Adaptability

- Single architecture supporting multiple workshops

- Architecture and platform uncoupled
  - A **Mac** running **Linux** running **FreeBSD**
  - A **PC** running **Linux** running **Windows**

- Fast reconfiguration!
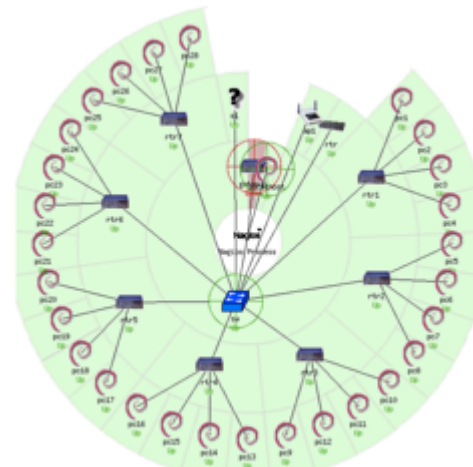  - Can be done in minutes with templates.

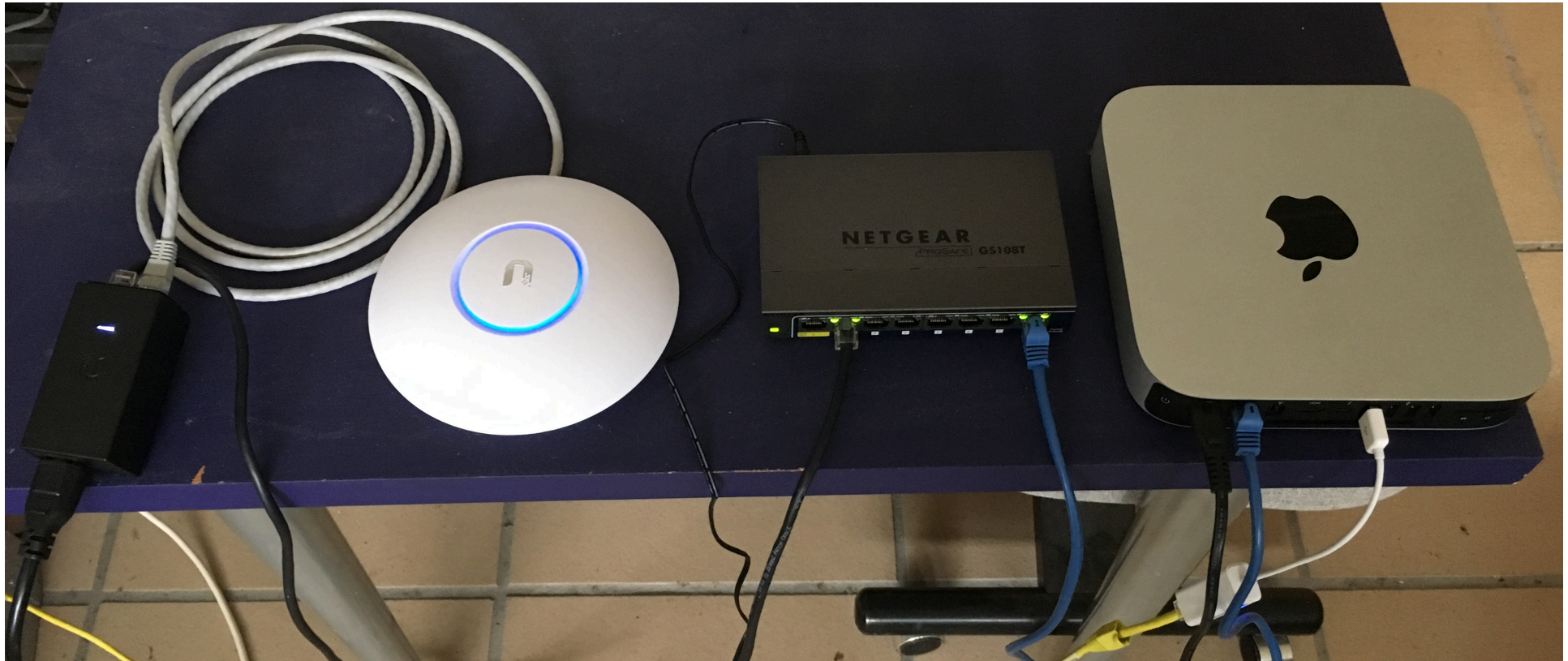- Let's see this now!

            (Next slide for images)

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# Network Management and Monitoring Workshop: Live in the room

# Three items of equipment



Many workshop labs contained here-in!

# A smorgasbord of choices!

- Full virtualization
  - KVM (Linux and Solaris only)
  - Parallels (Mac OS X only)
  - QEmu
  - VirtualBox (Windows, Linux, Mac, FreeBSD)
  - Virtual PC (Windows only)
  - VMware (Workstation / Fusion, ESX)
  - Windows Hyper-V
  - Xen

- Lightweight/pseudo
  - FreeBSD / Linux Jails / LXC / OpenVZ
- Network Simulation
  - Marionnet
  - Navy CORE
- Network Emulation
  - Dynamips / Dynagen / GNS3
  - Olive (Juniper)
  - IOU & VIRL (Cisco)

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# Some virtualisation frameworks

- Manage/deploy virtualisation in a controlled fashion
    - VMWare vCenter (commercial – enterprise)
    - Libvirt (for managing KVM, Xen, VirtualBox)
    - Ganeti, Synnefo – clustering, small to med. size
    - OpenStack, Eucalyptus – large scale (cloud provider)
    - Kubernetes, Flannel – container support

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# What does NSRC use?

- **Hardware**
  - MacMini Server (6,2), 16GB RAM, 2x256 SSD, i7 quad core
  - Netgear GS108T fanless, Gigabit, managed 8-port switch
  - Ubiquiti UniFi AP AC Lite (2.4GHz/5GHz)

- **Software**
  - Ubuntu Linux 14.04 LTS 64-bit
  - KVM (Kernel based Virtual Machine)
  - Dynamips/Dynagen
  - Ansible
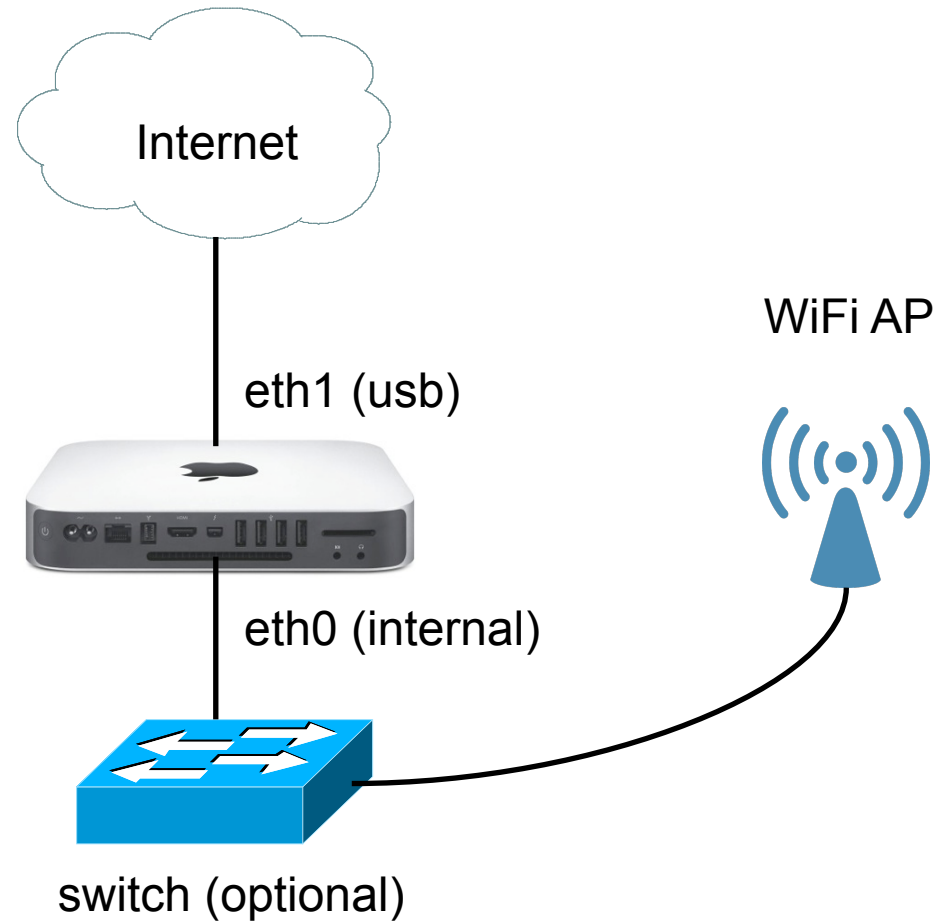
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# What does NSRC use?

- Hardware
  - We use the MacMini for convenience
    - power / size ratio = very good
  - Can use any reasonably modern machine with virtualization extensions (VT-x/VT-d) in the CPU
    - Tower PC with Core i7, 7200 RPM disks
    - Rackmount server, Xeon/Opteron, faster disks
  - SSD disks are very nice, but not critical
  - RAM is a big factor
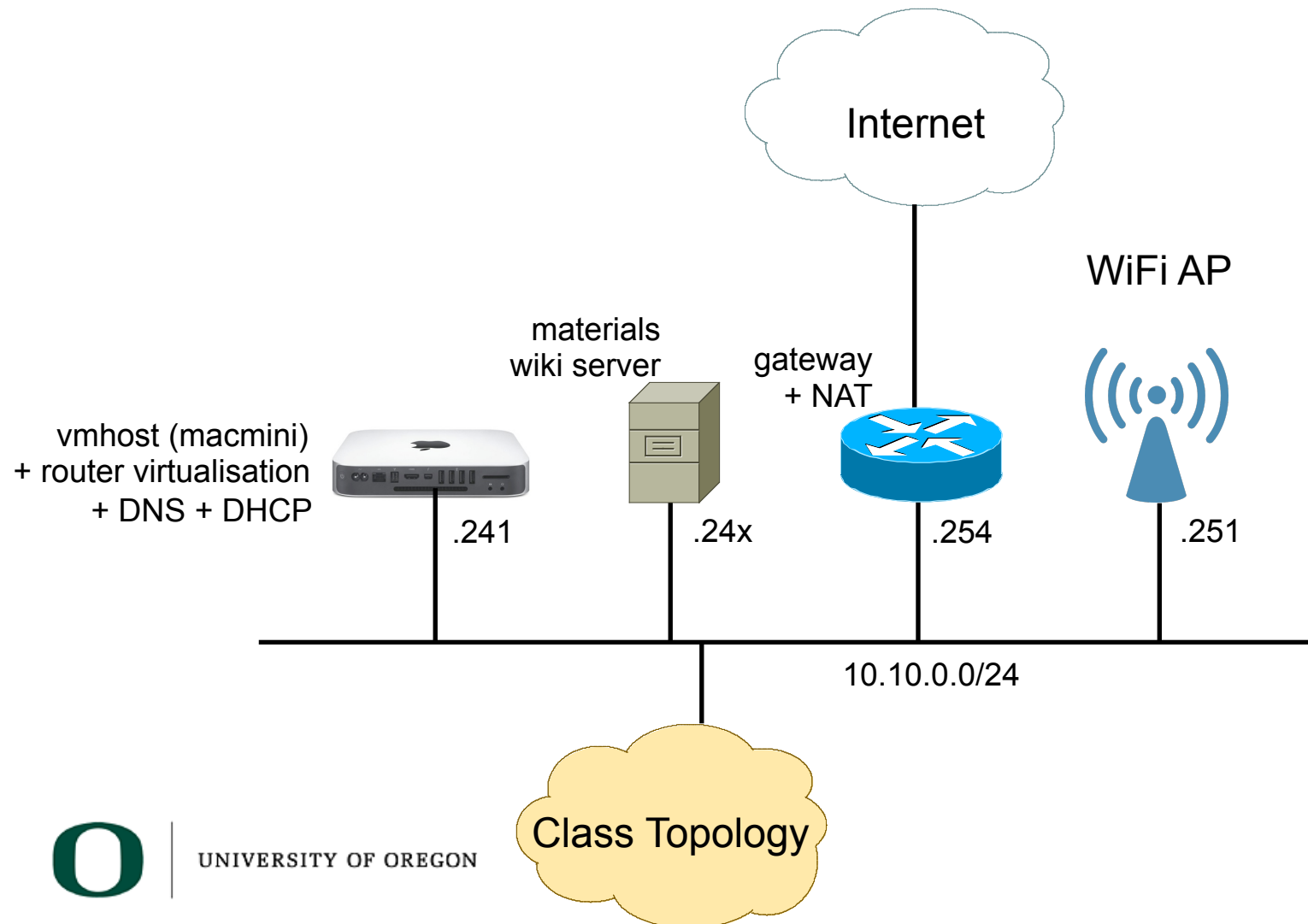  - Number of CPU cores important (MacMini6,2 has 8)

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# Classroom layout (physical)

Internet

eth1 (usb)

WiFi AP

eth0 (internal)

switch (optional)

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# Classroom layout (logical)

# Workshop materials

- The class materials need to be hosted somewhere so students can access them

- The best place is the website describing what the training event is

- NSRC has been using wikis
  - We have used **trac** for this up to now
  - **dokuwiki** becoming a likely replacement

- A local copy of materials is very useful too:
  - To save bandwidth
  - In cases of sporadic Internet access

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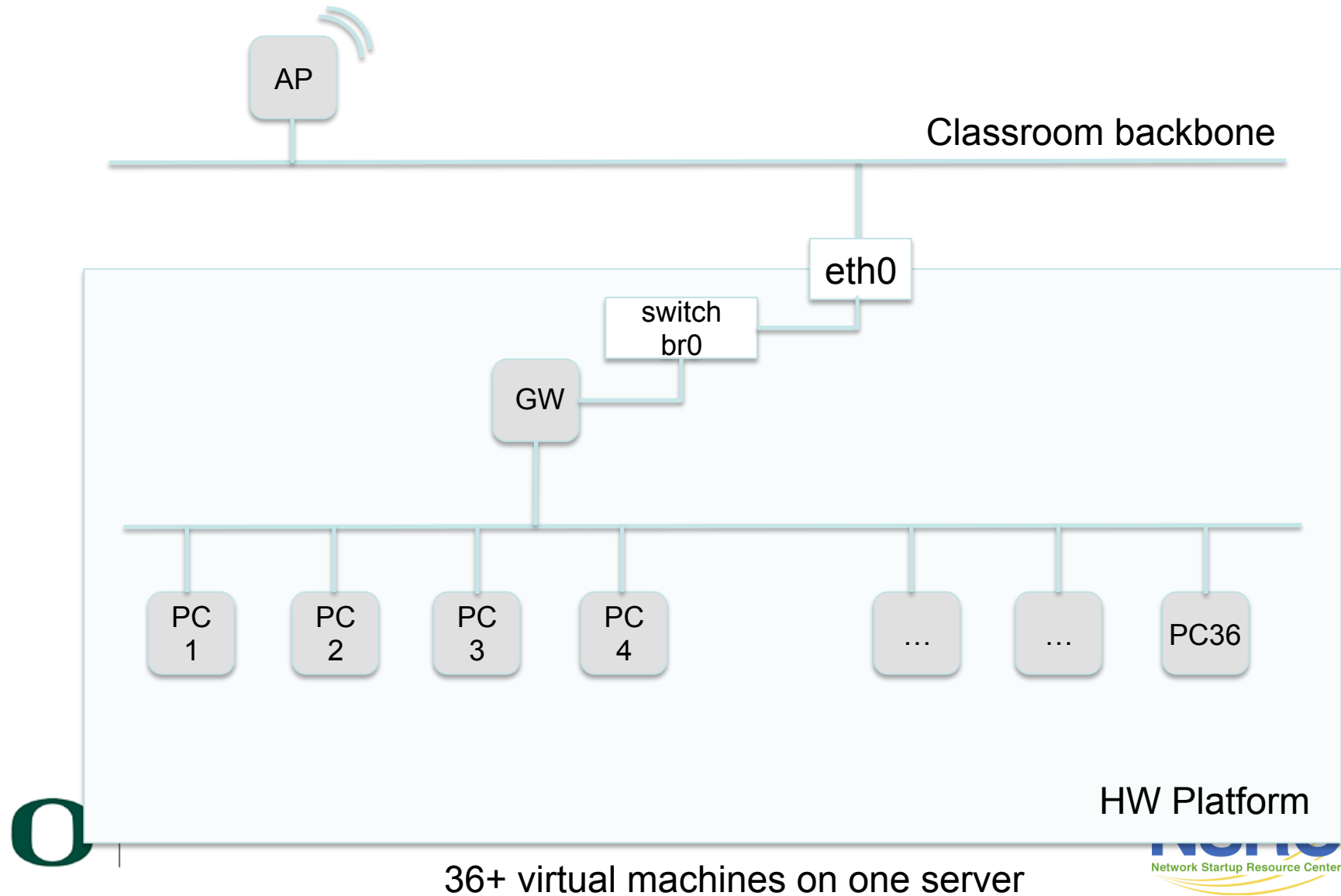# Some NSRC classroom virtual environments

- UNIX / Linux introduction
  - Flat, simple network
- Campus Network Design (L2 and L3) Workshop
  - Based on lots of routers and switches
- NREN BGP Workshop
- Network Monitoring and Management Workshop
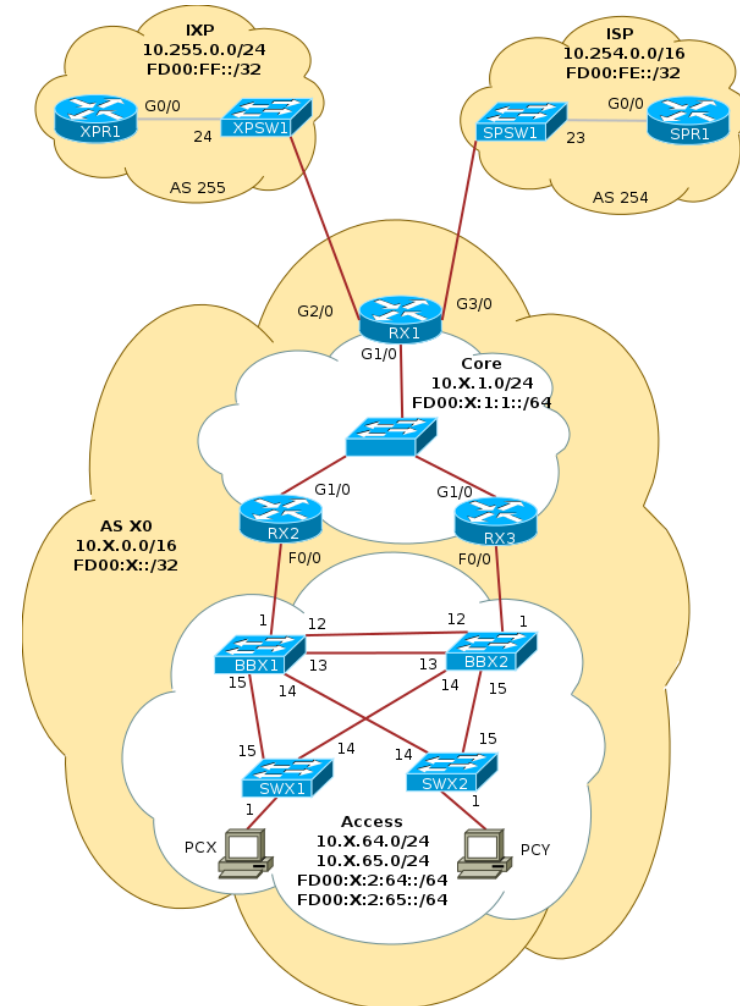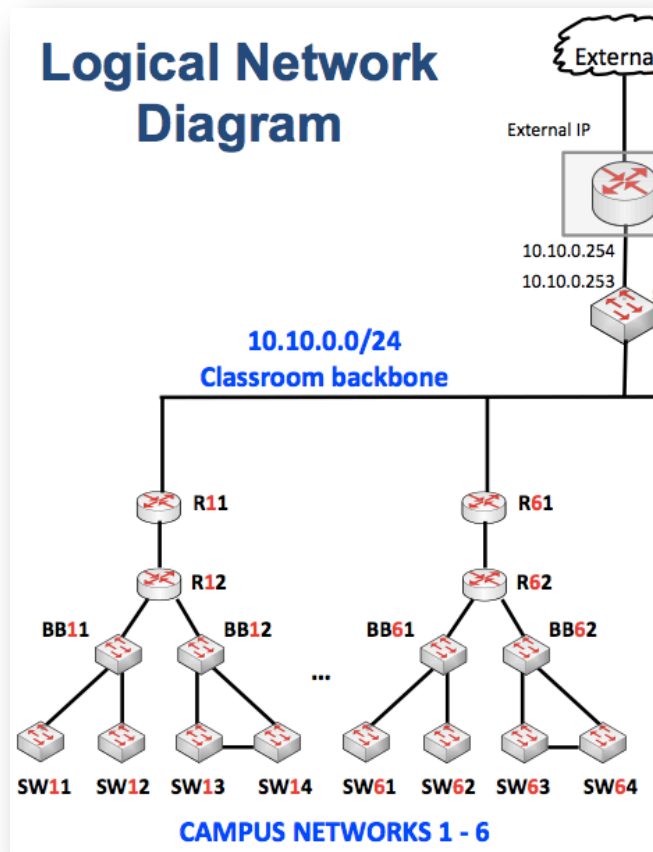- Virtualisation Workshop (of course!)
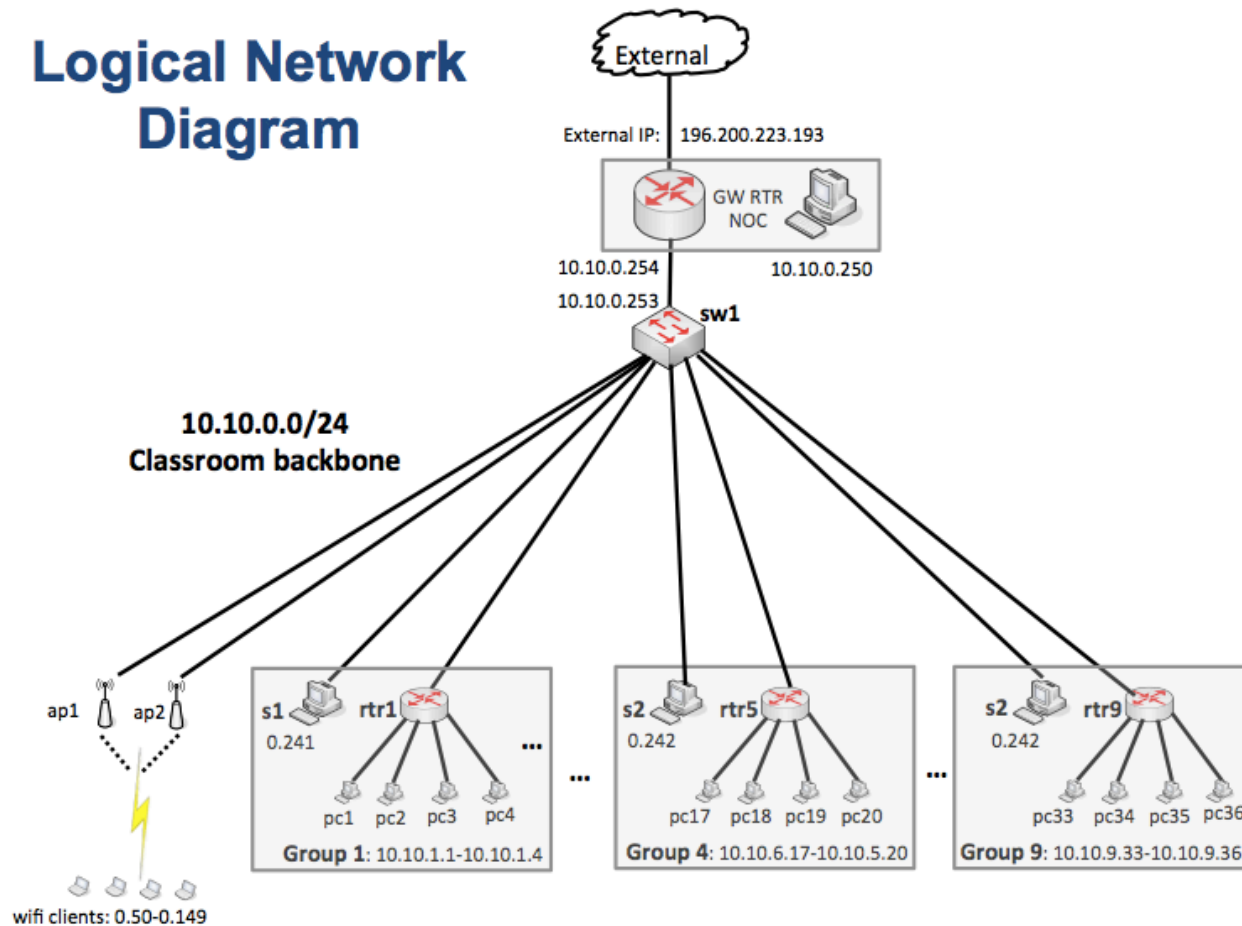- DNS/DNSSEC Workshop

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# UNIX / Linux Introduction



36+ virtual machines on one server

# Campus Network Design (CND)

# Network Management (NMM)

# CND and NMM over 2-3 Machines

# DNS/DNSSEC workshop
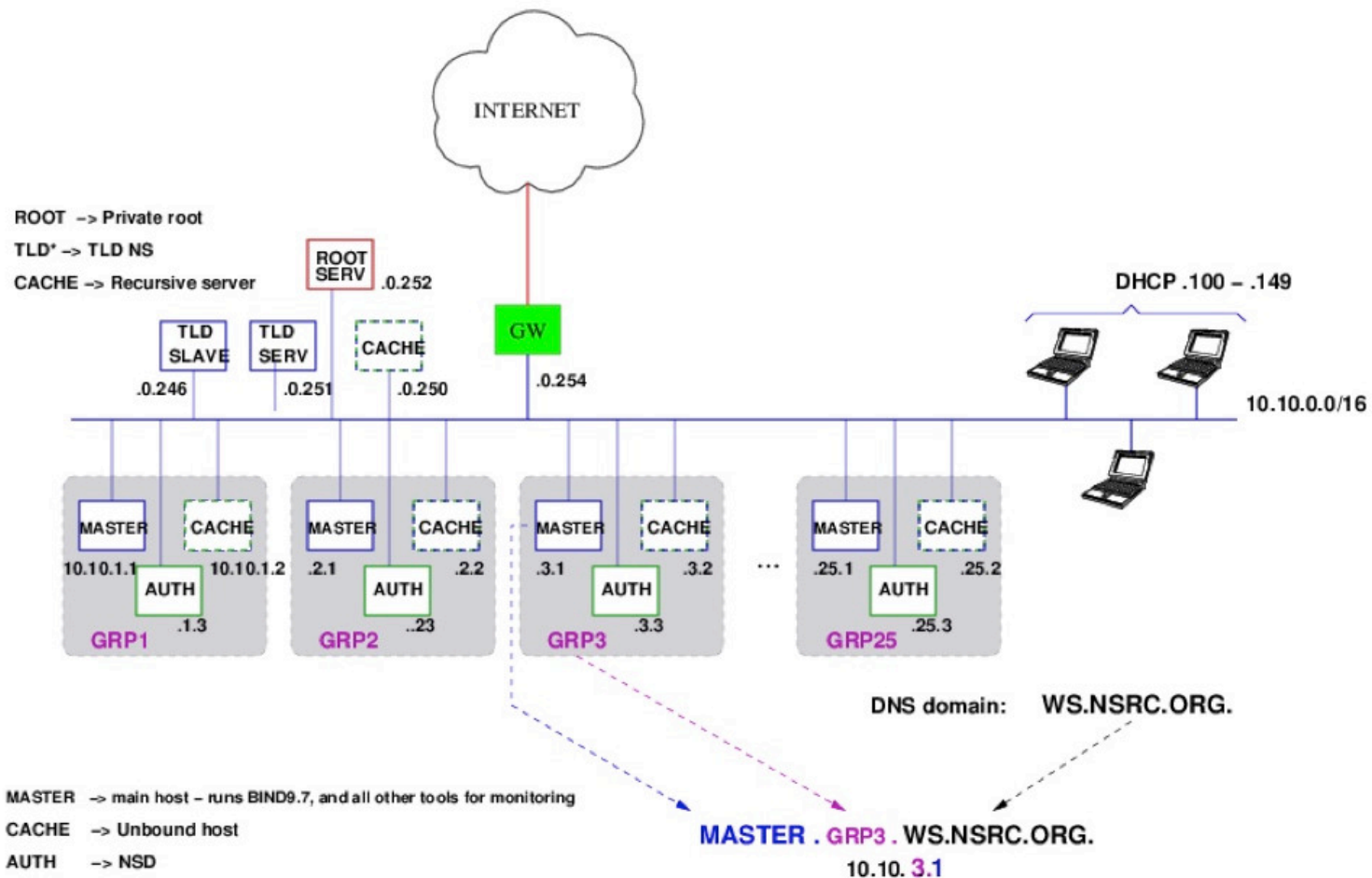
# Benefits:

- Creating labs with actual hardware that duplicates what is in the field is very costly just for training and testing.

- Adapting the environment to mimic a different topology is relatively easy.

- Virtualisation technologies are part of modern IT infrastructure
  - Not just for training
  - Virtualised OS ("hypervisors")
  - Virtualised network (VLANs, virtual switches, virtual routers, SDN)
  - Virtualised storage (iSCSI, disk images)

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# Benefits:  (cont')

- Clear benefits for organisations that use virtualisation for provision of services already.

- Professionally relevant for students and instructors in the case of Education institutions

- Employees or trainee participants can easily re-create lab environments on laptops

- Much simpler to provide network and systems training.

# Limitations…

- Hands-on is limited
  - No manipulation of "real hardware"
    - Some people grasp concepts better
    - Cables vs VLANs
    - Reality for present-day networks and systems
  - Not always possible to virtualise all hardware
  - With some vendors virtualisation of the actual OS running on the gear is not possible or available. (e.g TimOS for ALU) and with others not exactly free

- Keeping trainers current on the technology
  - Virtualisation technology moving faster than traditional metal solutions

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# Limitations…

- ## What tool(s) to use?
  - GNS/dynamips easily virtualises the Cisco MIPS architecture but what happens when the architecture is EOL?
  - Some vendors offer virtualisation for their architecture (e.g JUNOScope) but as a cloud solution so multivendor environments are challenging to build sometimes.
  - Internal vendor training tools (e.g Cisco's IOU) are not available for use by non-staff of the vendor except in rare cases

- ## Provisioning for different layouts is sometimes cumbersome requiring some effort to plumb packets between tools
  - NSRC currently uses ansible to help.

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# Approaches

- Where close-to-live equipment virtualisation is available that is a plus.

- Some larger companies have persuaded the vendors to have local installations of their virtualisation offerings (e.g. JUNOScope)

- In some cases the training will be limited to concepts and the virtualised labs will similarly test ideas rather than verify final configuration.
  - In either case something that virtualises the next-best gear is still better than something that simulates would be packet flows.

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# Questions?

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