



AfREN Meeting 2013

Lusaka, Zambia

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Network Startup Resource Center

Capacity Building and Virtual Technologies



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Virtualization Technologies

They are everywhere... But why?

By abstracting functionality away from hardware we gain

- Improved capacity usage
- Lower power consumption
- Greatly reduced system administration overhead
- Better reliability (uptime, data loss)
- Possibilities that we are still thinking of...

Two kinds of virtualization

Consolidation

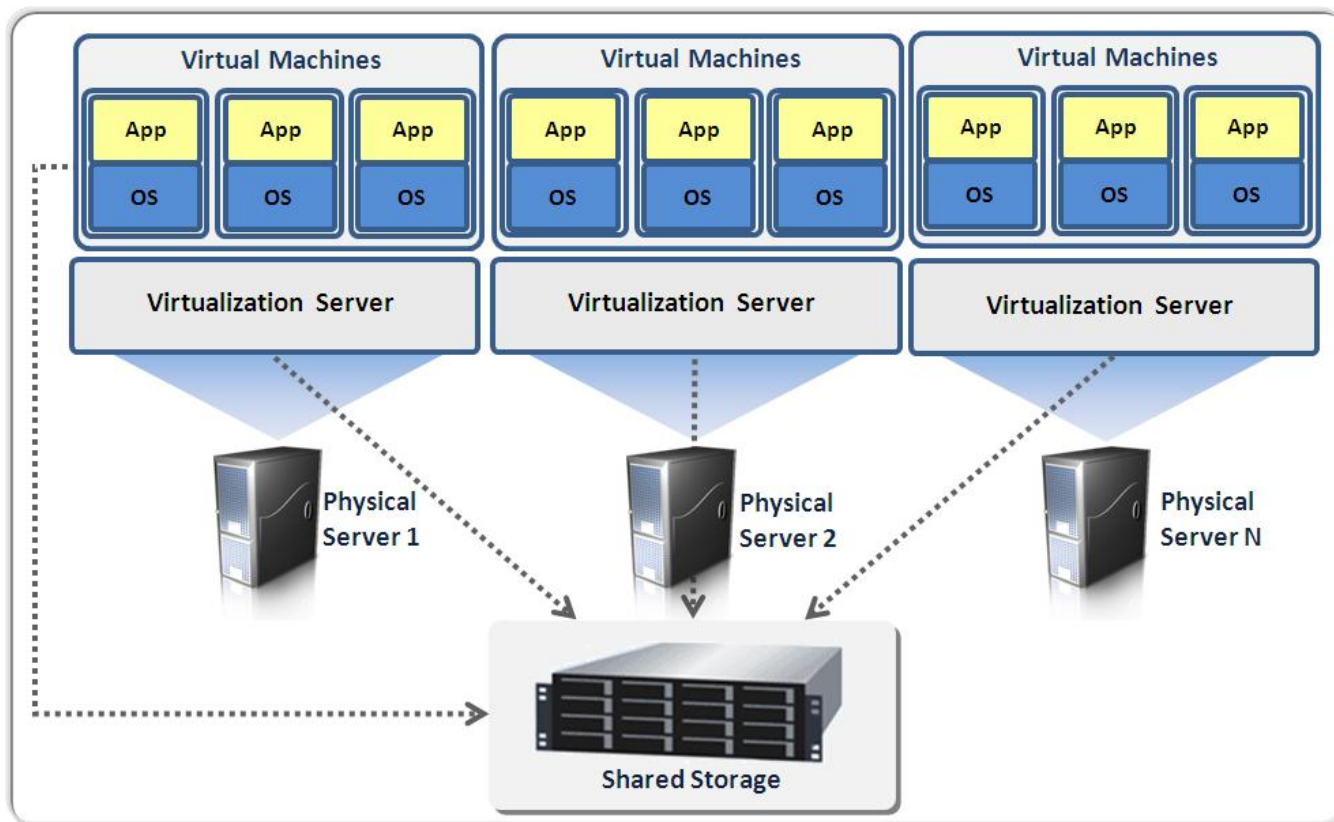
Run many services and servers onto fewer physical machines: increases ***efficiency***

Aggregation

Distribute applications and resources across as many virtual servers as required, turning resources on or off as need: increases ***scalability***

Some virtualization benefits

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



More benefits

Standardized platform

- Heterogeneous hardware platform hidden away behind virtualization
- 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”



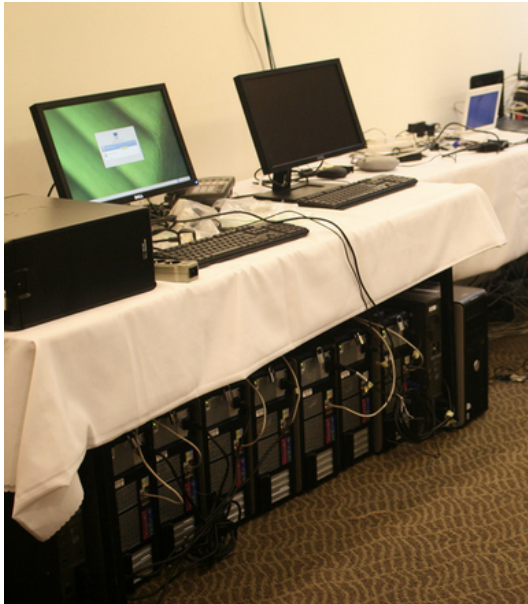
AfNOG technical capacity trainings

Instructors, staff, students and the institution have clearly benefitted...

AfNOG Trainings 2000-2010...



...lots of setup



Logistical benefits are obvious

In the context of regional and local training:

- “Virtualizing” = less hardware
- 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

AfNOG 2013 we've virtualized

Approximate numbers

- 140 PCs
- 40 routers
- 30 switches
- 3-5 full-sized tower PCs
- Keyboards, monitors, mice and network cabling down to...

Virtual AfNOG 2013

- This represents ***significant overkill*** (2x or more).
- Much more could be virtualized...



Motivations and benefits

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

- Adaptability
- Educational

We will cover these in the next slides

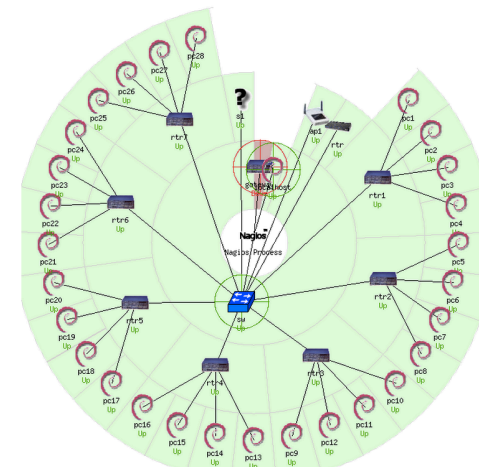
Benefits: Adaptability

- Single architecture 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)

NMM Live in the room



A smorgasbord of choices!

Paravirtualization

- FreeBSD / Linux Jails/LXC/OpenVZ

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



Network Simulation

- Marionnet
- Navy CORE

Network Emulation

- Dynamips /
Dynagen /
GNS3
- Olive (Juniper)
- Cisco IOU (private)

What do we use?

Hardware

- MacMini Server, 16GB RAM, 2x256 SSD, i7 quad core
- (Optional) fanless, Gigabit, managed 8-port switch
- Ubiquiti UniFi Pro AP or Buffalo HP-G54 w/OpenWRT

Software

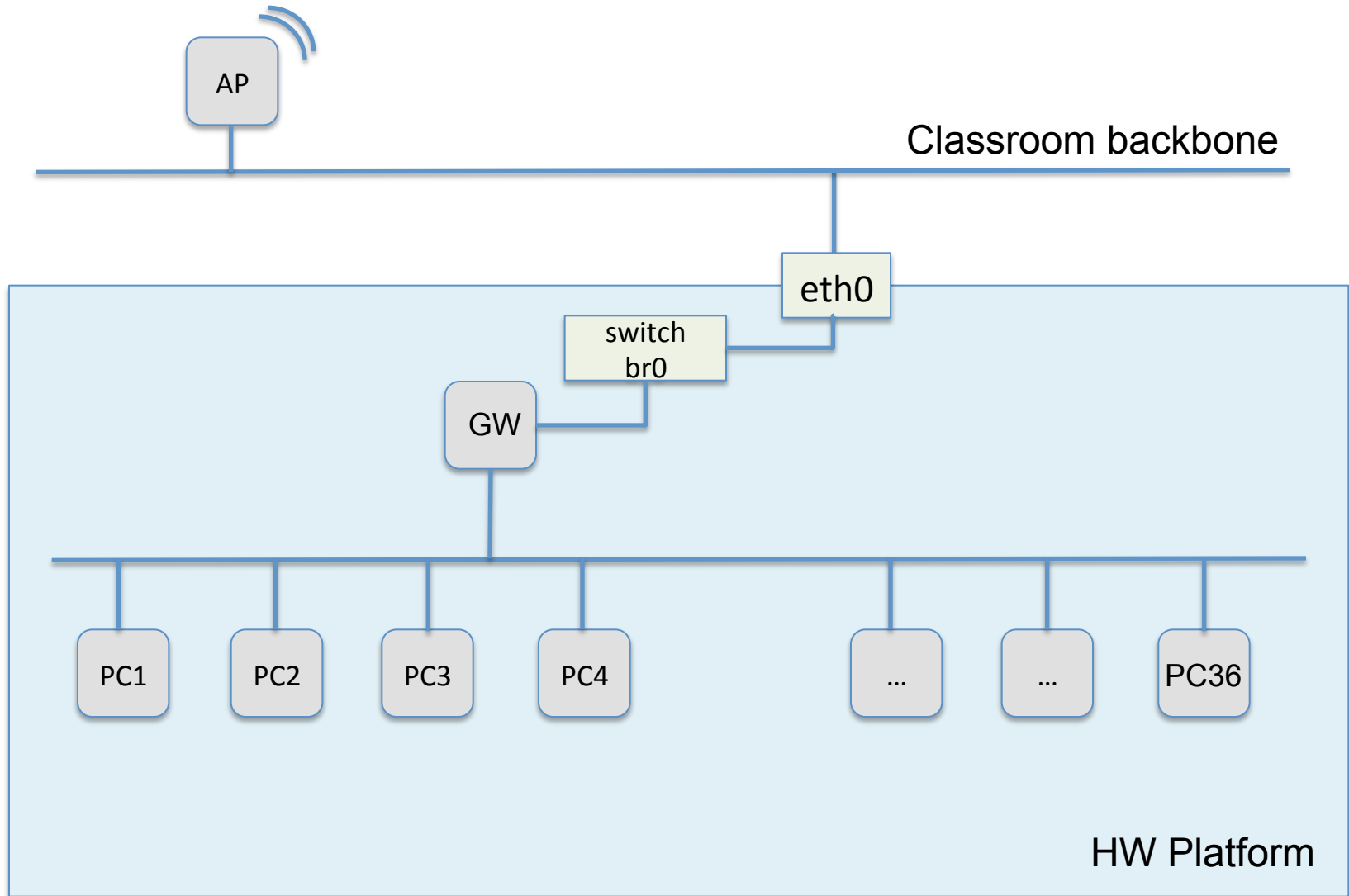
- Ubuntu Linux 12.04 LTS 64-bit
- KVM (Kernel based Virtual Machine)
- Linux bridging utilities (brctl on cli)
- virt-manager (vmbuilder)
- dynamips
- dynagen



Some classroom virtual environments

- Flat, simple network (UNIX / Linux intro)
- Campus Network Design (L2 and L3)
- Network Monitoring and Management
- Hybrid of virtual networks
- DNS/DNSSEC workshop

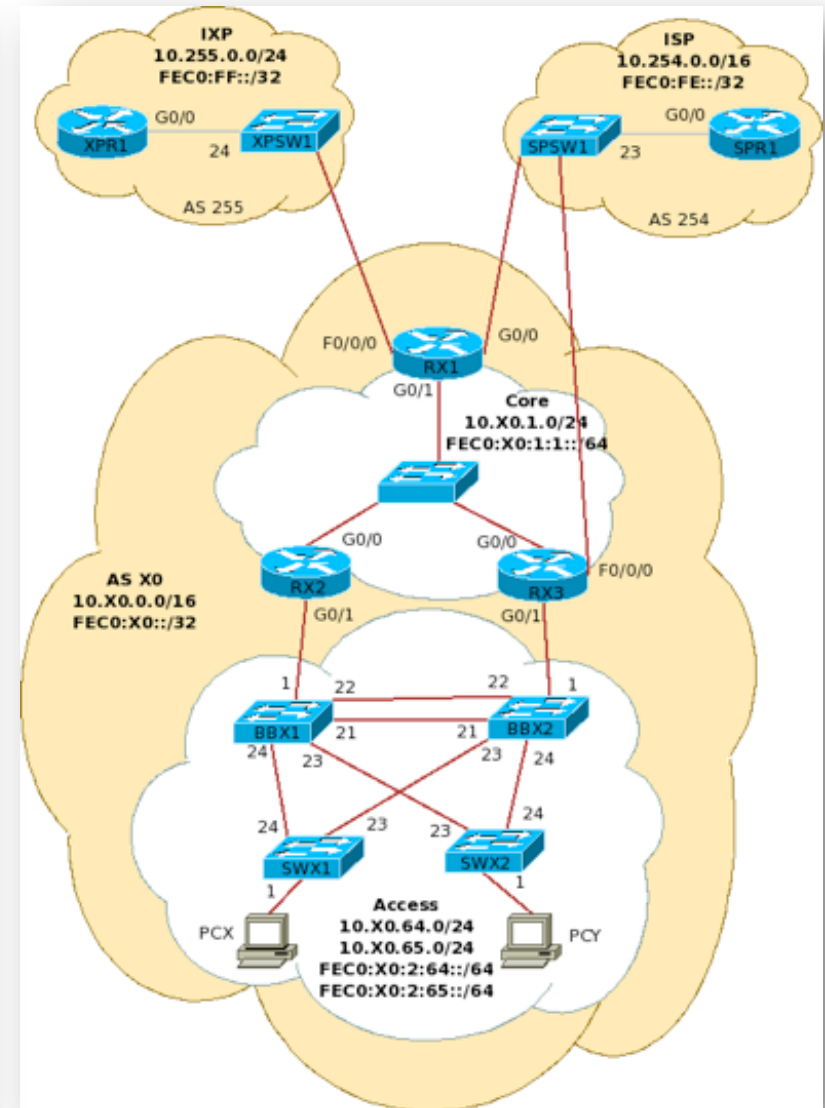
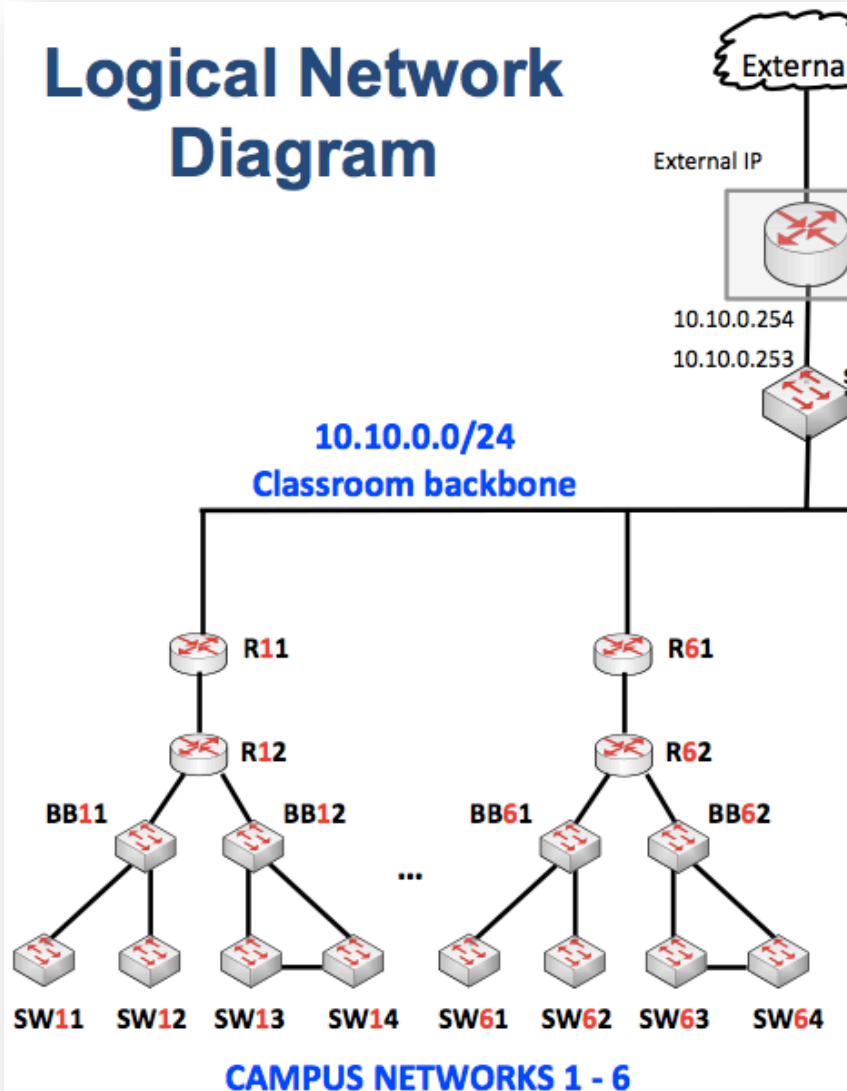
UNIX / Linux Introduction



36+ virtual machines on one server

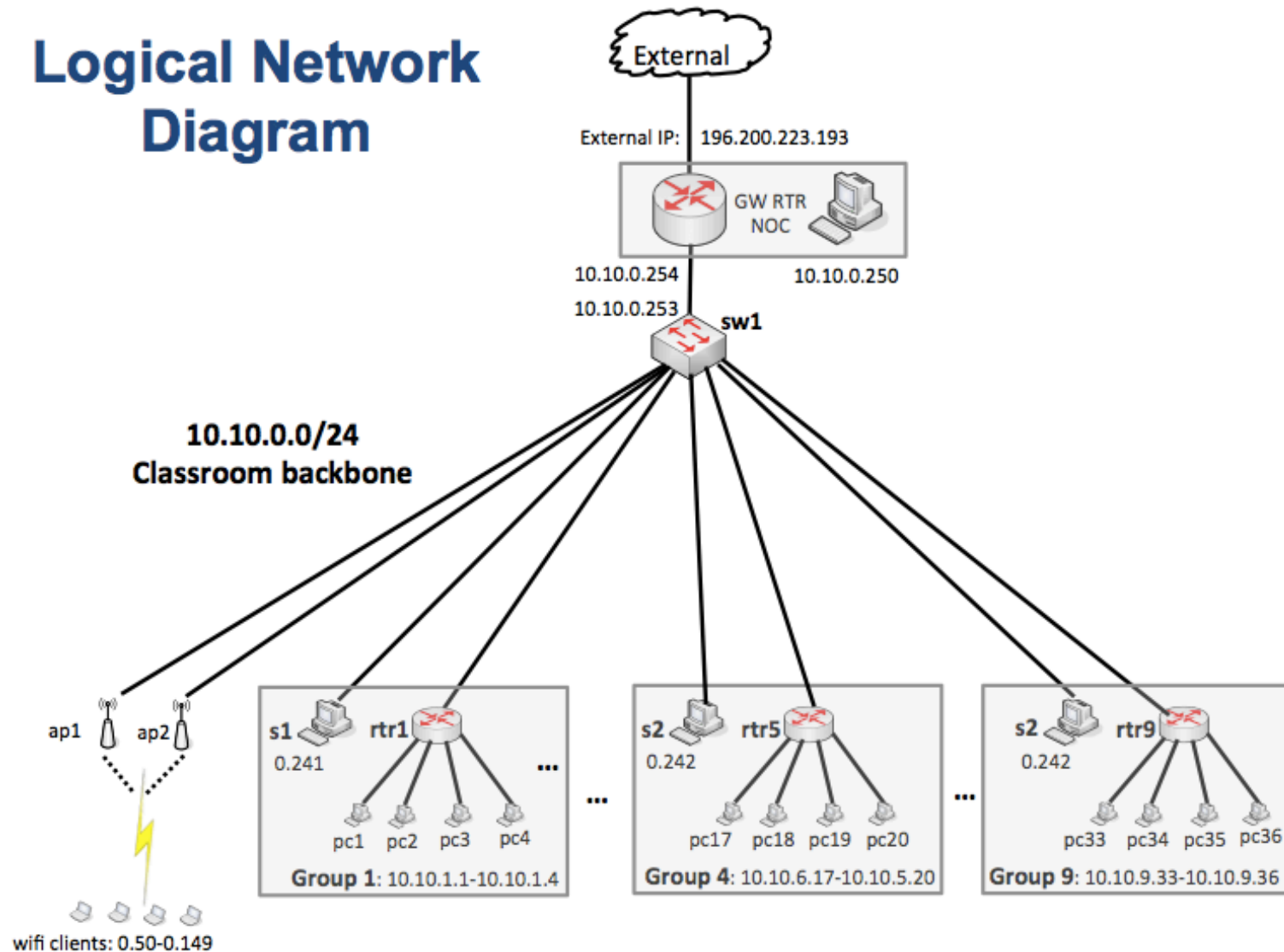
Campus Network Design (CND)

Logical Network Diagram



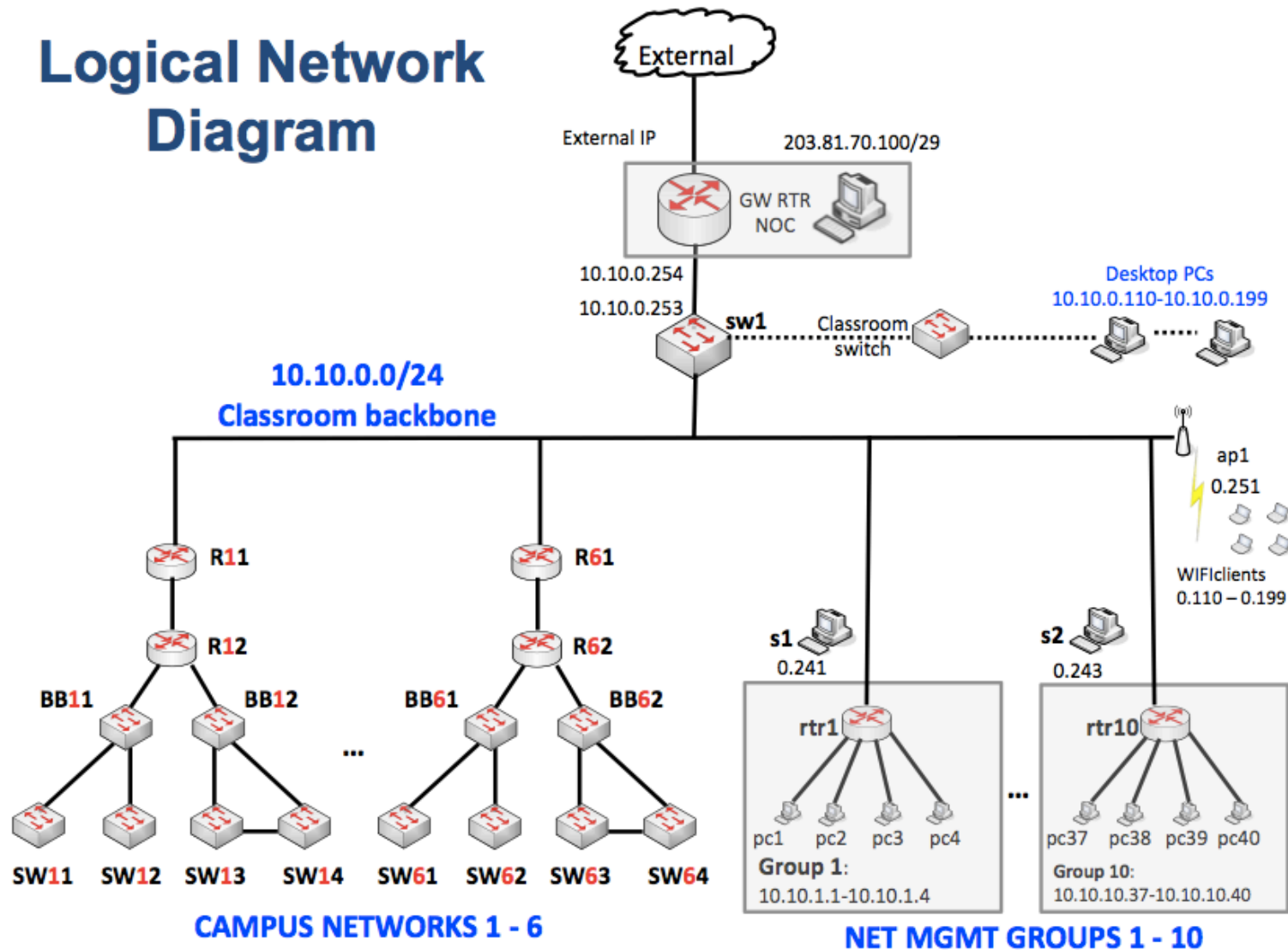
Network Management (NMM)

Logical Network Diagram



CND and NMM over 2-3 Machines

Logical Network Diagram

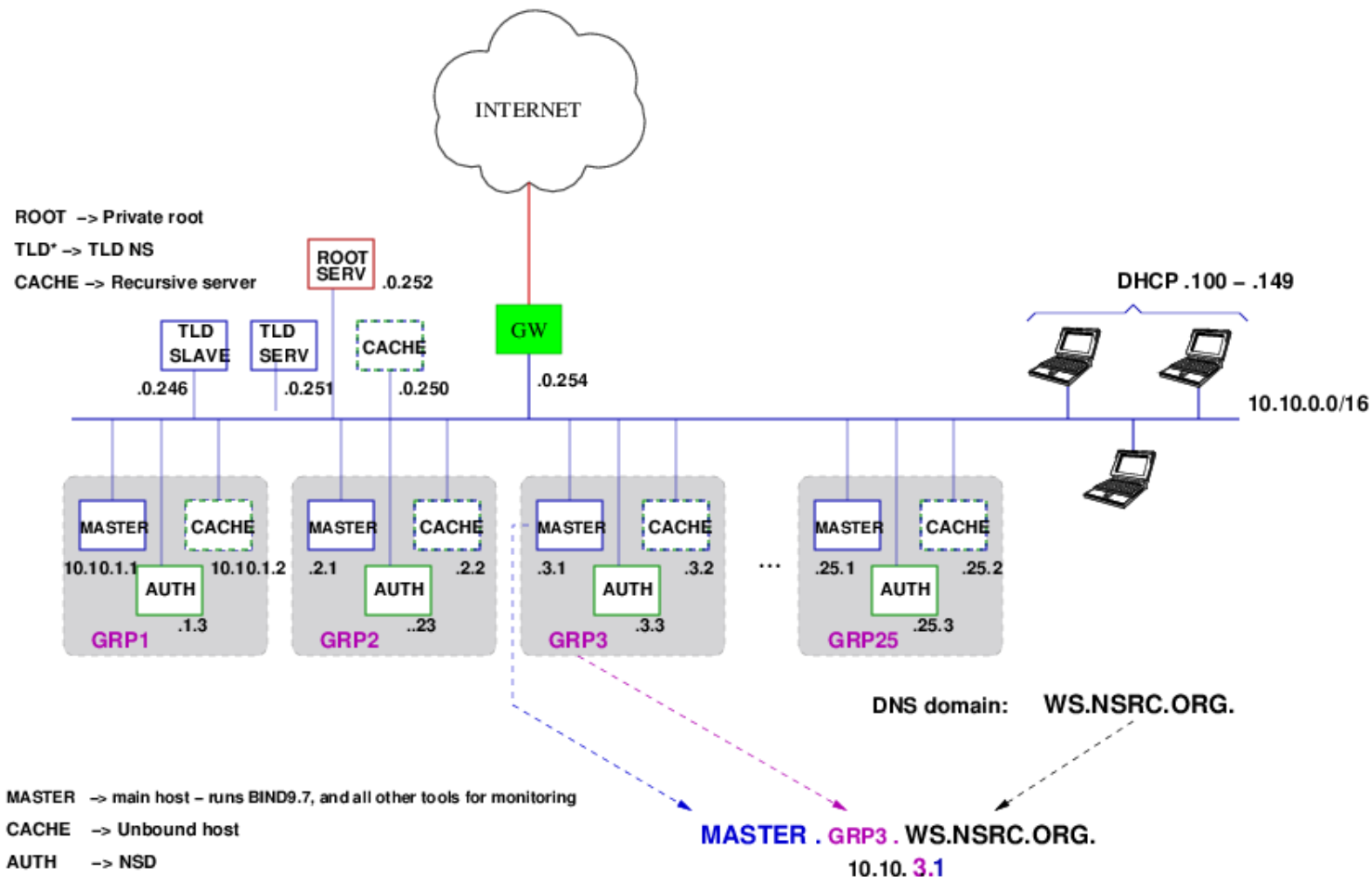


DNS/DNSSEC workshop

NETWORK LAYOUT

login: adm
pass: *given in class*

WiFi SSID: DNS or DNS2
WiFi pass: 8888888888



Benefits: Educational

- Shipping small CPUs or Sending instructors much less expensive.
- Improving REN connectivity means remote (e-learning) is increasingly attractive
- Other benefits not tied to simple cost/benefit or logistics...

Benefits: Educational (con't)

- Virtualization technologies part of modern IT curriculums.
- Not just for training
 - Virtualized OS (“hypervisors”)
 - Virtualized network (VLANs, virtual switches, routers, SDN)
 - Virtualized storage (iSCSI, disk images), aka “the Cloud”

Benefits: Educational (con't)

- Clear benefits for institutions offering applications and services to staff and faculty
- Professionally relevant for students and instructors
- Participants can easily re-create lab environments on laptops
- Much simpler to provide network and systems training.

Limitations...

There are, of course, some tradeoffs:

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 virtualize all hardware

Licensing questions

- Cooperation with vendors is necessary when using commercial platforms

What tool(s) to use?

... and new possibilities

All this simplifies capacity building...

- Lower cost, better outreach
- Increased adaptability
- More can be done
- Easy to adjust to new topics / themes
- Hybrid solutions possible (some hardware, some virtualization)

Clearly improving capacity training abilities can assist us to grow RENs going forward.

Questions?