Virtual Computing Lab (VCL) And Network Isolation

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What is a VCL?

- Pool of computers
  - Remotely accessible (screen, keyboard, mouse)
  - Reusable
  - Real or virtual
  - Provisionable (ideally)
- NCSU and IBM popularized concept
  - Software is being open-sourced
- Applies mainly to CSS/ITS programs
  - Use in CES program would require more thought

VCL Architecture

- Compute Nodes (cns)
  - Multi-core, multi-GB RAM physical computers that:
    - host VMs ("virtual computers" or VCs) allocated to users, or
    - are allocated to user to install an OS (also a VC)
- Storage Nodes (sns)
  - Simple computers which:
    - provide long-term storage for VMs and disk images
    - are replicated and optimized for moving multi-GB files
- Management Nodes (mns)
  - Computers which:
    - manage the VCL: configuring, provisioning, etc.
    - provide the interface to reservation system

Benefits

- Allows users to have admin privileges
- Provides 24x7 access to computing environment
  - From labs, classrooms, home, conferences, etc.
    - Computer and TCP/IP network are required
- Allows access to software only installable on university-owned equipment
- Provides resources for short-term research/teaching
- Allows for distance learning when labs are required
- Provides network control:
  - Isolate VCs from campus network for security testing
  - Define own network without impacting campus network
    - preconfigured to prevent possible student misconfigurations

Network Isolation

- Physical switch and NICs support VLANs
- Virtual network
  - provided by Virtual Machine Manager (VMM)
  - e.g., VirtualBox
    - allows changing NICs, MAC addresses, promiscuity
    - networking mode: NAT, bridged, host-only, internal
      - DHCP service, NAT port forwarding and PXE booting
- Vyatta network appliance for layer 3
  - router, firewall, DHCP/NAT/ssh services, etc.
- Future: Open vSwitch for layer 2
  - connect VMs across VCLs
  - isolate projects/classes on same VCL

Current Process

- Faculty or students in senior project (i.e., "requester"):
  - Requests VCs
  - Describes desired operating systems, application(s) and network accessibility
- Institute Lab staff:
  - Prepares the virtual computers and network as desired
  - Notifies requester when request is complete
  - Instructs requester on how to use
- Requester:
  - Uses [manage_vc app](#) on Windows to:
    - Retrieve specific information for her VC(s)
    - Start VC(s)
    - Connect to VC (which opens display)
    - Use VC as a real computer, logging in, entering commands and information via the keyboard, and possibly moving/clicking mouse
    - Ultimately logs off or indicates that the VC(s) are no longer needed
    - Stop VC(s) if desired
  - Could also use rdesktop on Mac OS X or Linux
    - But it's much more difficult to use

Future Process

- Using web
  - Person reserves computer at a time for a duration
    - Individual or Class
    - Ultimately, also requests what software is installed, etc.
  - Remote computer is prepared or restored by system
  - Person receives IP address and port
- Using remote display software
  - Person connects to remote computer via IP and port
  - Uses remote computer until:
    - Quits session
    - Session duration time expires
  - System saves copy of remote computer

Limitations

- Defined for short-term use to maximize re-use
- Intensity of resource use
  - CPU time: probably okay with multicore CPUs
  - Disk I/O: can be problem unless multiple real disks used
  - Network traffic: could prevent display access
    - VLANs and prioritizing traffic help
  - Dynamic Graphics (video, 3D software, animations, etc.)
    - problem unless special software purchased
- Limited number of available compute nodes
- Transferring VM and disk images between cns and sns
- Users exchanging massive data
  - between local system and VCs
- Users getting copy of disk image or VM

Status

- Hardware (started in 2009)
  - VCL 1: 10 blades (dual quadcore processors per blade)
  - VCL 2: 20 workstations (single quadcore processor)
  - VCL 3: 30 workstations (single quadcore processor)
- Storage cloud (sns) installed
  - configured once before
- Virtual switch under investigation
- Manual provisioning of VCs
- To-do: adopt and adapt Apache VCL
  - partially configured once before
  - reservation system and automatic provisioning