Overview

Attempt to answer the following questions:

• Why do we need the VAN?
• How did it evolve?
• How does it work?
• What can you do with it?
• Where is it going in the future?
In the beginning

- School of IT becomes Faculty of Information and Communication Technologies (circa 2005)
- Responsible for MCSE Labs
- Responsible for Cisco Labs
- Responsible for other labs where students require Administrator/root access

The Problems

- Re-image labs several times per week/day
- Rogue DHCP servers
- Dual boot PCs
- No domain login
- NT4 (no USB)
- Unplugging “Uplink” cable
The Idea

- VMware Player
- Linux
- Previous work at AIPC (VPN using ppp)
- Interest in Multicast

- No daily intervention
- Improve “Student Experience”

Technology

TAP
- TAP is a virtual Layer 2 (ethernet) interface
- TUN is a virtual Layer 3 (IP) interface
- Native to Linux
- OpenVPN for Windows
- Works well
- Comes with full source code
Technology

Multicast
• Programmers don’t understand multicast
• Network administrators don’t understand multicast
• OS vendors don’t understand multicast
• Unix Network Programming (Stevens) does understand multicast
• Properties of multicast are similar to ethernet

Problems

• Obtaining IP Addresses/multicast groups
• Rate limits
  - Difficult to test with bulk data
• Firewalls
  - IGMP
• Split groups
  - Cisco problem?
• Poor performance with high utilisation
Testing

The first use of the VAN for real work
- Build MCSE VPC images
- MCSE lab booked out
- SB202 available
- Random missing packets
- Wireshark
- Discovered Protocol Bindings
  - Able to configure full isolation

Technology

Protocol Binder
- http://www.chrysocome.net/proto
- MSYS
- COM Interface
- netsh
Implementing the VAN

Problem

- HET720 isolated network
- Can’t re-image PCs
- Can’t access Blackboard
- Can’t save work
- Can’t run any other classes
- Can’t change room
- VMware images are large and hard to deploy

Rejected Solution

LTPF Funding to:
- Put a 2nd PC on every desk
- Use a KVM to save desk space
- Install new network points & power
- Install new switch blade

- Does not solve many of the problems
Accepted solution

• Purchase more RAM
• Run VMware Player
• Purchase a server & storage
• Provide a method to download VMware images
• Connect VMware instances using the VAN
• Works across classrooms/buildings
• Solves all problems and more

Technology

• wget / tar / bash script
  – Cross platform downloads
• cygwin for windows support
• Virtual Machine Launcher
  – GUI front end for windows

• High Speed Downloader
  – peer to peer download
Problem

How can the virtual network get onto the physical network?

- 2nd network card
  - Not running TCP/IP
- Desk dongle
  - Make Console & Ethernet available on the desk
- Ready to change the Cisco world
- Wireless network cards
  - Eventually working

Problem

More LTPF funding for PIX hardware

- Can we use the VAN instead of physical connections?
- Needs one VAN per ethernet interface
- Requires VNET identifier
- Port state information Up/Down
- Bridge VAN to VLAN for physical connections
SwinGrid

- Need to run Globus in isolated environment
- 100 virtual machines in EN314
  - Hosted on 10 PCs
- 8 virtual machines on Green
  - Hosted on 2 nodes
- Communicate via VAN
- Route/NAT traffic to swinnet
  - Access to databases etc.

AD209

- Allow access outside of scheduled classes
- Rack of 2811 routers
- Control access via web site
- Access ethernet via VAN & Virtual Machine
  Launcher
- Power on and off individual devices
- Solve usability problems
  - Mix routers & switches
  - Colour codes
ATC Solution

- Less time setting up and packing up
- No moving heavy equipment
  - Safer
  - Less damage
- Less storage space required
- Able to use PoE, VoIP, Wireless
- Timetable flexibility
- Exam marking

How does it work?

/* This the packet data which comes from the TAP driver */
typedef struct
{
  unsigned char dest_mac[6];
  unsigned char src_mac[6];
  unsigned short ethertype;
  unsigned char payload[];
} tap_packet_t;

/* This is the payload we send over the UDP socket */
typedef struct
{
  unsigned char version;  // Up to version 2
  unsigned char vnet;    // like VLAN
  unsigned char fragment_id; // fragment counter
  unsigned char packet_id; // packet counter
  unsigned char host_id[2]; // lower 16 bits of IP address
  unsigned char payload[];
} virtual_ether_t;
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On the wire

How VNET works

- vnet works like the 802.1q VLAN Identifier
- No priority field
- Frames > 1500 octets don’t fit inside 1500 octets
- UDP should not require fragmentation but...
- VAN will fragment to prevent UDP fragmentation

Payload is an APR packet

4x80 = Entire fragment
How VDP works

• Similar in concept to CDP
• Advertises existence and some state information
• 0x7f <hostname>|L=U
  - Query switch via SNMP
• Virtual Machine Launcher shows a list of members
  - Hold time
• Ethernet state will reflect VDP link state

VMware networking

Guest
0 or more interfaces
Default VMnet
0 = bridged
1 = host only
8 = NAT
Others are custom

Host
LAN1
LAN2
VAN
Wireless
VMBridge Only

TCP/IP Only

Up to 10 VMnets are available per Host
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VMware networking

Multiple guests can talk to different interfaces or to each other

Basic Topology

All VMs can talk to each other
Multiple VNET Topology

VMs can talk in groups

VNET Server Topology

Every VM talks to the same server
**VNET Server Topology**

The server talks to the Control Switch

- VLAN trunk carries multiple networks
- Each switchport accesses one VLAN/VNET
- Software bridge between each VLAN interface and VAN interface

**Future Possibilities**

- Multiple VANs per Windows PC
  - Being a windows service there is no easy way to run multiple instances
- Change multicast IP address on the fly
- OS-X Support
- Access from home via VPN/unicast
- Virtual Switch
- VDP improvements
- Security
Unsolved Problems

- VMware
  - vmnet bindings are hard to configure
  - Suspended images can’t be configured
  - Limited UI controls for custom vmnet
  - UI has excessive features (create new etc.)
- Serial WIC cards

The End

- Questions?
- Hands on demonstration
Cisco Virtual Machines

Implemented by many ICT Subjects
Virtual Network Selector

High Speed Downloads