What's New with the UHNet?

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Purpose of the UHNet

- Connect People to People
- Connect Machines to Machines
- Connect People to Machines (Information)

...to support the University community as they find new ways to use emerging applications to do research, teach/learn, and administer the University.

UHNet Qualities

- Capacity to support the bandwidth required
- Reliable
- Ubiquitous (everywhere at the same time)
- Standardized
- Secure
- Available 24-hours a day, 7 days a week

Today's Agenda

- How does it work?
- Project Updates
- What's Next?

How Does It Work?

- Scenario 1: LAN with hub
- Scenario 2: LAN with switch
- Scenario 3: LAN to LAN with router
- Scenario 4: LAN to LAN with DNS
Common Network Building Blocks

- Cable
- Equipment
- Protocol

UTP Cable

- Unshielded Twisted Pair
- Uses 4 pairs of twisted copper wire
- Speed – 10,000,000 – 1,000,000,000 bps
- Different levels of quality
  - Category 2-3
  - Category 5-5e
  - Installation standards

Fiber

- Made with glass with plastic cladding
- Speed - 100,000,000+ bps
- Not affected by electromagnetic interference
- 2 Types – single mode and multimode

Equipment: Nodes and Hosts

Node refers to any entity that can access a network.
Host usually refers to a computer system on a network.

Protocol

- An agreed-upon format for transmitting data between two nodes.
- Can be implemented either in hardware or in software

Addressing

1. Every node on the network is assigned a hardware address (MAC – Media Access Control)

2. Every node on the network is assigned an Internet Protocol (IP) address.
Encapsulation

Source and Destination IP Address

Source and Destination MAC address

1101101000111010110011010101010101

LAN with Hub

Hub

- Connects computers to a common network
- Regenerates the signal and sends it out to all of its ports
- Creates one big collision domain

Protocol to use the cable

- Each host operates independently from each other
- All hosts are connected to the shared cable
- Ethernet frame is sent serially, one bit at a time to all hosts on the shared cable

Carrier Sense Multiple Access with Collision Detection

- All hosts listen if anyone is using the wire (carrier sense)
- All hosts have an equal chance of using the wire (multiple access)
- If 2 hosts use the wire at the same time, they both stop transmitting (collision detection).

Host A transmits data to Host C

128.171.100.50
Host A

128.171.100.37
Host B

128.171.100.35
Host C
Host A checks ARP Table

- Address Resolution Protocol Table

<table>
<thead>
<tr>
<th>MAC Address</th>
<th>IP Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-60-08-92-D2-60</td>
<td>128.171.100.35</td>
</tr>
<tr>
<td>00-50-04-28-C8-2C</td>
<td>128.171.100.50</td>
</tr>
</tbody>
</table>

Host A transmits data to Host C

Host A transmits data to Host C

Sends out frame bit by bit to every computer within collision domain

11011010001110101100110101010101011

All hosts look at destination MAC
But only Host C processes the packet

Collision

- Collisions are normal in an ethernet network.
- When collision occurs, the hosts are notified and they resend the frame after waiting a random time interval.
- System designed to ensure most of collisions will not result in data lost.

Collision Domain

- Collision domain – group of hosts that contend for the use of the cable
- More hosts you add to a collision domain the more collisions you will have
LAN with Switch

Switch
- Connects computers to a common network
- Regenerates the signal
- Filters, forwards, and floods frames to a port based on MAC destination address
- Each port becomes a separate collision domain - segmentation

Switch checks MAC Forwarding Table
- Media Access Control Forwarding Table

<table>
<thead>
<tr>
<th>Destination MAC Address</th>
<th>Destination Switch Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-60-08-92-D2-60</td>
<td>Fastethernet port 23</td>
</tr>
<tr>
<td>00-50-04-28-C8-2C</td>
<td>Fastethernet port 1</td>
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Host A checks ARP Table
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Host A transmits data to Host C

Data

<table>
<thead>
<tr>
<th>Source = 128.171.100.50</th>
<th>Destination = 128.171.100.35</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-50-04-28-C8-2C</td>
<td>00-60-08-92-D2-60</td>
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Sends out bits to every computer within collision domain
Switch checks MAC Forwarding Table

- Media Access Control Forwarding Table

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Sends out bits to destination host based on MAC Forwarding Table

Switch configuration

- Auto negotiate speed - 10 or 100 megabits per second
- Auto negotiate half or full duplex transmission
- Type of cabling - category 5 / category 3

LAN to LAN with Routers

Router

- Allows hosts to communicate with hosts on another network
- Looks at the content of the packet to determine the network destination and makes path determination
- Switches the packet from one port to another

UHNet Standardized Protocol

- TCP/IP protocol suite (Transmission Control Protocol/Internet Protocol)
- Every host on the network has a unique IP address
IP Address

128.171.100.32

Network mask of 255.255.255.0

128.171.100 32

How to determine the network portion of an IP address

100000000.1010101.1100100.00100000

Boolean Logic using “And”

11111111.11111111.11111111.00000000
equals

10000000.10101011.1100100.00000000

Encapsulation

Data

Source = 128.171.100.32
Destination = 128.171.45.133

Source = 00-50-04-28-CB-2C
Destination = Router MAC address

11011000011101010101010101

Routing Table

<table>
<thead>
<tr>
<th>IP Network</th>
<th>Router Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>128.171.100</td>
<td>1</td>
</tr>
<tr>
<td>128.171.45</td>
<td>2</td>
</tr>
</tbody>
</table>

Router determines destination network

Source = Host A
Destination = router

Source = 128.171.100.32
Destination = 128.171.45.133

128.171.100.32 – 128.171.45.133

1011010101
1011010101

128.171.100.32 – Router

128.171.100.32 - 128.171.45.133

Router - 128.171.100.1

Routing Table
Enapsulation

Data

Source = 128.171.100.32
Destination = 128.171.45.133

Source = Router MAC address
Destination = MAC address for host
128.171.45.133

110110000110101100110101010101011

Host 128.171.100.32 - Host 128.171.45.133

Source = 128.171.100.32
Destination = 128.171.45.133

Source = Router
Destination = MAC address for host
128.171.45.133

11011010001110101100110101010101011

Host 128.171.45.133

IP address

MAC address

Source = Router
Destination = MAC address for host
128.171.45.133

Domain Name Server

- Translates hostname = fiscal2.fmo.hawaii.edu
- To IP address = 128.171.45.133

LAN to LAN with DNS

Domain Name Server

HostA.its.hawaii.edu

Fiscal2.fmo.hawaii.edu

Encapsulation - DNS

Data

Source = 128.171.100.32
Destination = 128.171.45.133

Source = Router
Destination = Router MAC address

MAC Address

IP Address

110110000110101100110101010101011
Enapsulation

Data

Source = 128.171.100.32
Destination = 128.171.45.133

Source = 00-50-04-28-C8-2C
Destination = Router MAC address

11011000011010100101010101011

Summary

- Network uses MAC addresses (hardware) and IP addresses
- Switches create smaller collision domains
- Routers make path determination and switches packets.
- DNS allows the use of host names

Project Updates

UH-GigaPoP

Purpose:
- Exchange point for national and international high performance networks
- Share expensive wide-area network resources
UHNet - Oahu

- Shared OC-3 backbone on SONET using Fujitsu FLM
- Shared Gigabit ethernet backbone

Microwave Network

- Shared OC-3 backbone on SONET using Fujitsu FLM
- Shared Gigabit ethernet backbone

Hawaii Internet eXchange

- DS3 (45 million bit per second) Verizon Frame Relay
- DS3 (45 million bit per second) Time Warner

Inter-island IP Network
Frame-Relay and DSL

Verizon Frame Relay

DSL

DS3 (45 million bits per second)

Verizon Frame Relay

Manoa Net Upgrade

UHCore

P3DDI

Building switch

Keller DHCP

Manoa Wireless Project

- Secure authentication
- Closed network
- Roaming

Manoa Wireless Network

UH Core

Authentication Servers

Bldg. 27

Nomadix

Building switch

Current Configuration

Current Configuration
What’s Next –

National & International

Upgrade Kauai CC link

Redundant fiber link to Maui and Hawaii

UHNet

- Monitoring and developing tools for IT community
- Provide current information on network status

ManoaNet

- Complete redundancy plan
- DHCP
- Working with departments to expand wireless
- New ways to provide secure wireless network
DHCP Service

- Manoa-wide DHCP
- Why?
  - Managing IP addresses is resource intensive
  - Resolve duplicate IP address problems
  - Better utilize our IP address space

Classroom Access Project

- Presenters will have access to UHNet/Internet access from every Manoa general purpose classroom
- Separate LAN serviced by DHCP

Video conferencing Network

- Allow UH community to use H.323 video conferencing equipment between more than 2 locations.
- Will also support some H.320 ISDN connections

IP-Based Video Conference Network

- Gatekeeper - Control resources
- ISDN (H.320)
- Multipoint Conference Unit - Connects 3 or more systems in same conference
Resources

- www.hawaii.edu/spit/its2002/
- net.its.hawaii.edu
- www.hawaii.edu/wireless
- www.internet2.edu
- www.southerncrosscables.com

Feedback

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