School of Business
Eastern Illinois University

The Internet

(February 29, 2016)

Learning Objectives

- Understand and discuss:
  - Digital Subscriber Line
  - Internet addressing system; i.e.
    - IP address structure
    - Host names/Domain Name
  - Domain Name System
  - Autoconfiguration service

Test your Internet knowledge (1)

LANs are implemented to provide different kinds of services like file service, print service, and database service. Beside web service and email service, name other services provided through the Internet.

- Web service
- E-mail service
- .
- .
- .
- .

Test your Internet knowledge (2)

4

Your computer has a NIC and all needed software installed. What hardware components are needed on the user end in order to establish a DSL connection?

Hardware
-
-
-
-

Digital Subscriber Line- DSL

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Table 3-1
A summary of the characteristics of twisted pair wires

UTP Category	Typical Use	Signaling Technique	Maximum Data Rate	Maximum Range	Advantages	Disadvantages
Category 1	Telephone wire	Analog and digital	<100 Kbps	3–4 miles	Inexpensive, easy to install and interface, widely used	Security, noise
Category 2	T-1, ISDN	Digital	<2 Mbps	3–4 miles	Same as Category 1	Security, noise
Category 3	LANs	Digital	10 Mbps	100 m (328 feet)	Same as Category 1, with less noise	Security, noise
Category 4	LANs	Digital	20 Mbps	100 m	Same as Category 1, with less noise	Security, noise
Category 5	LANs	Digital	100 Mbps (100 MHz)	100 m	Same as Category 1, with less noise	Security, noise
Category 5e	LANs	Digital	100 Mbps (100 MHz)	100 m	4-pair specification includes connectors, patch cords, and other components	Security, noise
Category 6	LANs	Digital	250 MHz	100 m	Draft standard in late stages	Security, noise
Category 7	LANs	Digital	600 MHz (?)	100 m (?)	Draft standard in very early stages	Security, noise

Shannon Equation

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- The larger the bandwidth the higher the transmission speed
- The stronger the signal, the higher the transmission speed
- The 'louder" the noise, the lower the transmission speed

Shannon Equation:
Maximum speed = Bandwidth * Log_2 (1 + Signal Power/Noise)

Claude Shannon, *A Mathematical Theory of Communication*, 1948

Digital Subscriber Line (DSL)

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- Standard telephone line (Cat 1 UTP)
  - Capable of handling more than 3.1 Khz bandwidth
- DSL exploits Standard telephone line's "extra capacity" to transmit data without disturbing the line's ability to transmit voice
- Bandwidth usage for some Asymmetric DSL (ADSL) services:
  - 0 - 4 Khz band for Voice conversation
  - Upstream data transmission in 25 – 160 Khz band
  - Downstream data transmission in 240 – 1500 Khz band
- DSL uses filters (splitters) to separate voice and data signals
  - Typically a filter is needed for each analog device (telephone, fax, etc.)

Digital Subscriber Line (DSL)

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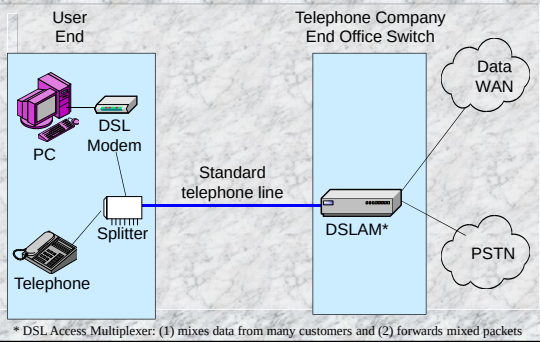

* DSL Access Multiplexer: (1) mixes data from many customers and (2) forwards mixed packets

Test Your Internet Knowledge (3)

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- If a customer has an operational telephone line, which of the following may be needed on the customer's end in order to establish a DSL connection? Assume that the customer has a fax machine and two telephones that need to be used for phone calls.
  - A switch
  - A DSLAM
  - One DSL filter
  - UTP cable
  - A DSL modem
  - Three DSL filters

Digital Subscriber Line (DSL)

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- DSL speed: 256 kbps – 24000 kbps depending on
  - DSL technology, line condition, service level, etc.
- Asymmetric DSL (ADSL)
  - Standard ADSL
    - Downstream (to customer): Up to 8 Mbps over 2km UTP
    - Upstream (from customer): 64 kbps or higher
  - ADSL2
    - Downstream (to customer): 5 Mbps to over 12 Mbps
    - Upstream (from customer): 1 Mbps to 3.5 Mbps

Q: How can a 3.5 Mbps upstream speed be achieved with Cat 1 UTP ?

Digital Subscriber Line (DSL)

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- HDSL (High-rate DSL)
  - Needed in business. (ADSL primarily for home and small business access.)
  - Maximum range: 3 kilometers
  - Symmetric speed over voice-grade twisted pair
    - HDSL: symmetric 768 kbps
    - HDSL2: symmetric 1.544 Mbps or symmetric 3.5 Mbps

Test your Internet knowledge (4)

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What are the technical reasons why we can get higher speed transmissions with ADSL service compared to Dial-up service?

DSL loop extender

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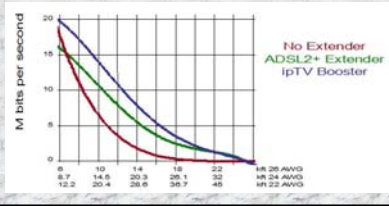
- DSL speeds are limited by the distance from the central office or DSLAM
- DSL loop extenders (or DSL repeaters) can be placed midway between the subscriber and the DSLAM to extend the distance and increase the channel capacity.



Internet addressing system

The Internet

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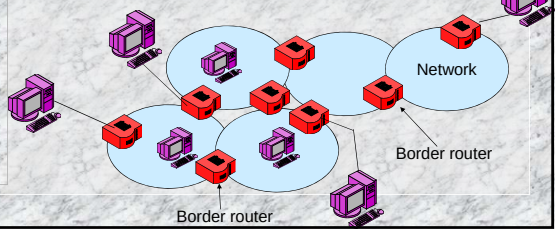
- The *Internet* is a Worldwide *Group* of Networks
  - Not a single network
  - Routers connect Individual networks



The Internet

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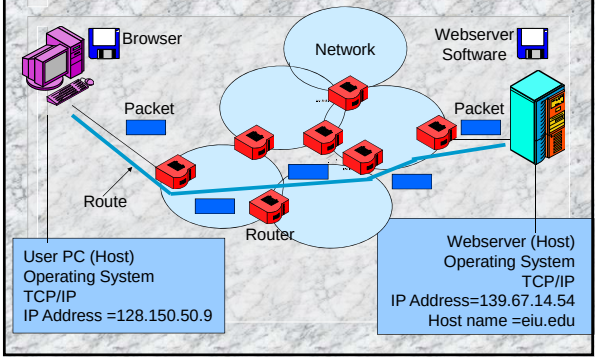

The Internet addressing system

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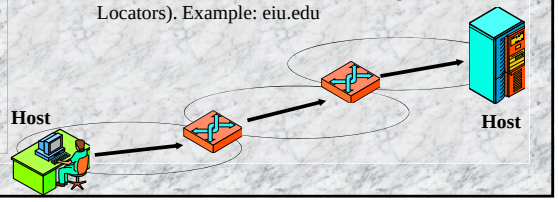
- Network deliver messages based on network addresses
  - The Internet has two addressing systems for hosts
    - IP addresses. Example: 139.67.14.57
    - Host names (or domain names or Unique Resource Locators). Example: eiu.edu



IP Address

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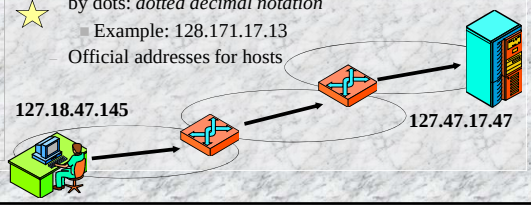
- IP addresses
  - Are really strings of 32 bits (1s and 0s)
    - Example: 10000000101010100001000100001101
  - Usually represented by four number segments separated by dots: *dotted decimal notation*
    - Example: 128.171.17.13
  - Official addresses for hosts



IP address

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- 32-bits and Dotted Decimal Notation
  - IP addresses are really strings of 32 bits (1s and 0s)
    - 10000000101010100001000100001101
  - To convert this to dotted decimal notation, first, divide them into four bytes (also called octets)
    - 10000000 10101010 00010001 00001101
  - (Both *octets* and bytes are collections of eight bits)
  - Convert each binary (Base 2) octet into decimal (Base 10)

IP address

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Binary 10100011 = Decimal 163

Position (N)	Place Value (2^N)	Bit	Decimal
7	128	1	128
6	64	0	0
5	32	1	32
4	16	0	0
3	8	0	0
2	4	0	0
1	2	1	2
0	1	1	1
			163

Note: Starts with 0 →

IP Address structure

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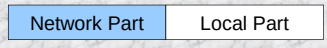
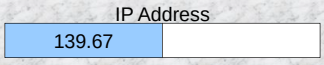
- Each IP Address has two main parts:



- Each Organization is given the Network Part by an IP address Registrar (e.g: www.arin.net)
- For Eastern Illinois University, this is 139.67
  - All IP Addresses for Eastern's computers begin with that Network Part



American Registry for Internet Numbers Check ARIN's IP registration info

IP Address structure

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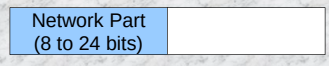
- Network Parts is 8 to 24 bits long
  - For Eastern, it is 16 bits long
  - 16 bits is only an example



- Local Part
  - Total address is 32 bits, so if the network part is 8 bits, the local part is 24 bits
- Common way to refer to IP address structure:
  - x.x.x.x/# (where # is the number of bits in the network part)
  - e.g. 139.67.0.0/16

Assigning Parts

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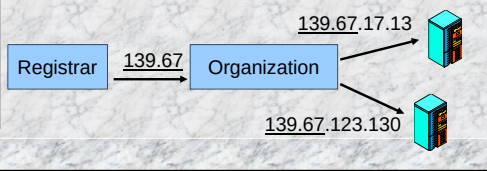
- Registrar gives organization a network part
- Organization assigns the local part to its computers internally



Assigning Parts

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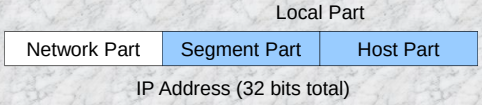
- Most Organizations have multiple *segments* within the organizational network
- So, usually Local Part is broken in two parts
  - a *Segment Part* to represent each segment
  - Remaining Bits are the *Host Part*, designating a particular computer on that segment



Network classes

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- The value of the bits in the first octet of an IP address determines the Network class

Class	Leftmost bits	Network Part Length	Address range
Class A	0xxx	8 bits	0.x.x.x to 127.x.x.x
Class B	10xx	16 bits	128.0.x.x to 191.255.x.x
Class C	110x	24 bits	192.0.0.x to 223.255.255.x

1) For each of the following IP addresses, give the class and the network bits.

10101010111110000101010100000001

01010100111110000101010100000001

2) To which class belong Eastern's network? (Net. Part =139.67)

Position (N)	Place Value (2^N)	Bit	Decimal
7	128		
6	64		
5	32		
4	16		
3	8		
2	4		
1	2		
0	1		

Class, # of networks, # of hosts

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Class	Leftmost bits	Network Part Length	Remaining Bits (a)	Bits in Local Part (b)	Number of Networks (~2^a)	Number of hosts Per Networks (~2^b)
Class A	0xxx	8 bits	7	24	126	16 million
Class B	10xx	16 bits	14	16	16,000	65,000
Class C	110x	24 bits	21	8	2 million	254

- A company is assigned the 199.164.3.0/24 set of IP addresses:
  - What is the network part? _____
  - How many computers could be assigned an IP address? ___
  - The company wants to assign IP addresses to each of the computers in its four departments in a way we can easily determine the department a computer belongs to based on its IP address. What is the maximum number of IP addresses per department assuming that there is the same number of computer in each department. _____

Host name / Domain name

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- *Host Name or Domain Name* **eiu.edu**
  - The other network addressing system on the Internet
  - Easy to remember
    - microsoft.com
    - eiu.edu
  - Two or more text "labels" separated by dots

Host name

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- *Host Name or Domain Name* **eiu.edu**
  - Like nicknames
    - Not official addresses
    - Each host must have an IP address
    - But only some hosts have host names
    - If you give it a host name, your browser must look up IP address of host

Domain Name System (DNS)

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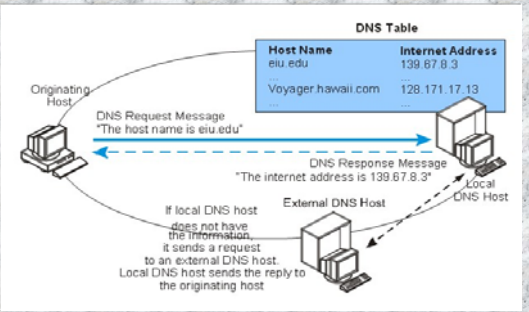

Domain Name System (DNS)

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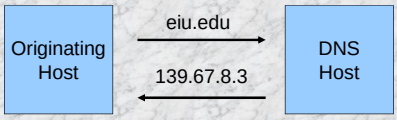
- User's computer sends a *DNS host* the target host's host name in a *DNS Request message*
- DNS host returns the target host's IP address in *DNS Response message*



Domain Name System (DNS)

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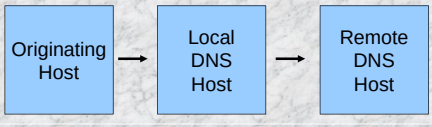
- Organizations or ISPs have local DNS hosts
- These hosts must know only local host names and IP addresses
- For other host names, local DNS host passes request to another DNS host



Domain Name System (DNS)

33

- Remote DNS host passes information back to the local DNS host
- Local DNS host passes information back to user PC

Domain Name System (DNS)

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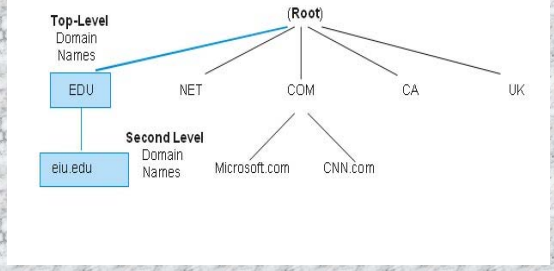

Autoconfiguration

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- Every computer attached to the Internet is a host
  - Including servers, desktops, laptops, PDA, etc.
- Every host must have an IP address
- Some hosts, such as routers and webservers, get permanent IP addresses
  - So that they can be found easily

Autoconfiguration

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- User PCs do not need permanent IP addresses
  - They only need to be found within a use session
  - They usually are given *temporary IP addresses* to use on the Internet for a couple of days
  - The duration of temporary address is usually a few days. When the lease expired another temporary address is a given.

Autoconfiguration

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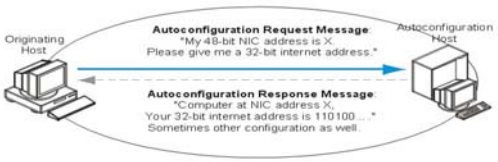
- Request-Response Cycle
  - User software requests IP address for the user PC in *Autoconfiguration Request* message
  - *Autoconfiguration Response* message contains temporary IP address to use in current session



Autoconfiguration

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- Most popular autoconfiguration protocol is *DHCP*
  - *Dynamic Host Configuration Protocol*
  - Built into Windows after Win 3.1
  - Supplies host with temporary IP address
- DHCP can give more information too
  - Usually gives IP address of a default *gateway* (Microsoft terminology for router)
  - Can give IP address of a local DNS host
  - Can give other information

Summary Questions

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1. a) Distinguish between IP address and host name. b) Which is the official address of a host? c) Does a server host need an IP address? d) Does your home PC need an IP address when you are on the Internet? e) Does a server host need a host name? f) Does your home PC need a host name when you are on the Internet?

2. Using the conversion system in slide #10, convert the following IP address to dotted decimal notation: 10101010 11110000 11001100 01010101. (spaces are included to facilitate reading.)

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Summary Questions

3. What are the two parts in IP addresses?
4. a) Who assigns the Network part? b) The Local part?
5. a) When do we need DNS? b) What information do you send in a DNS request message? c) What information do you receive in a DNS response message?
4. a) What is autoconfiguration? b) What information do we get back, at a minimum, in an autoconfiguration response message? c) What other information may we get back?

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Test your Internet knowledge (2)

What hardware and software components are needed on the user end in order to establish a DSL connection?

Software	Hardware
- Workstation Operating System - Client application programs (email program, web browser, etc.) - TCP/IP	- Computer with a NIC - DSL modem - filter(s) - Cat5/6 UTP (computer-DSL modem) - Cat1 UTP (telephone)

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Test your Internet knowledge (4)

What are the technical reasons why we get higher speed transmissions with ADSL service compared to Dial-up service?

According to the Shannon equation, Maximum speed = Bandwidth Log_2 (1 + Signal Power/Noise). Compared to Dial-up, The DSL technology uses larger bandwidths for upload and download transmissions. DSL modems and DSLAM generate stronger signals for upload and download.

Test your Internet knowledge (1)

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LAN are implemented to provide services like file service, print service, and database service. Beside web service and email service, name other services provided by the Internet.

- Web service
- E-mail service
- Remote login (Telnet)
- File transfer (using FTP)
- Internet Chat Relay (or Instant Messaging or “Chatting”)
- Wide Area Information System
- IP Telephone
- Videoconferencing
- Remote Access and VPN services

Web service

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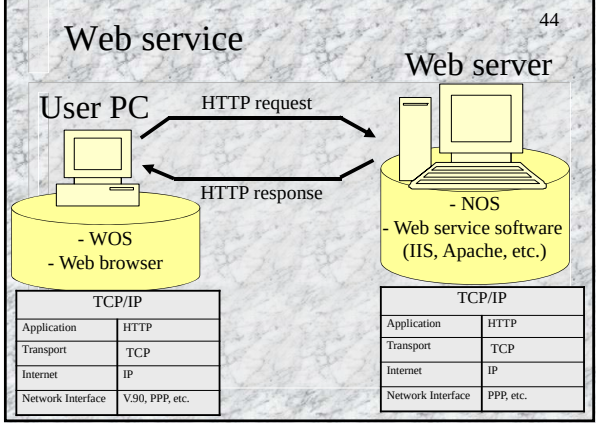

Email service

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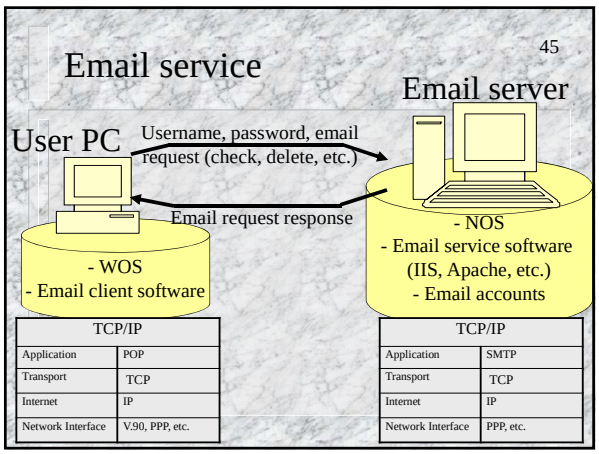

Typical configuration for Internet access from home

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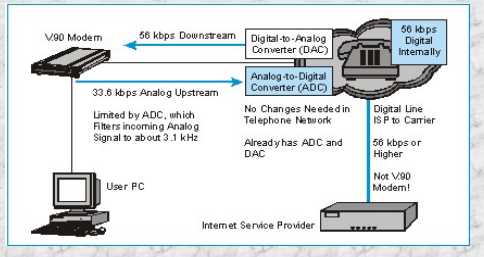

Domain names

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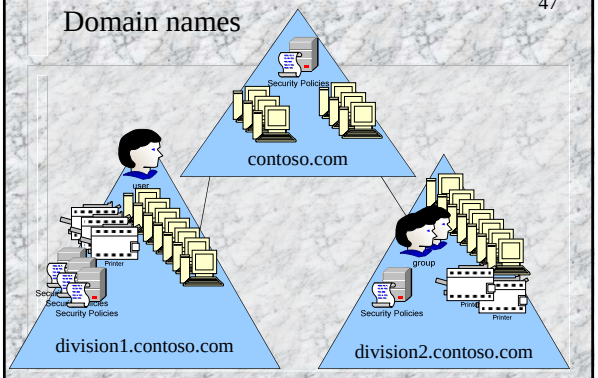

DNS operation

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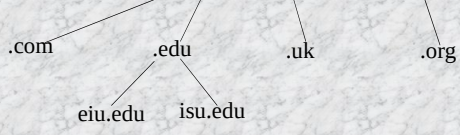
Domain name	IP Address
eiu.edu	139.67.14.57
.edu	10.1.10.21
.com	10.2.21.23
……	…….



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by barracuda1.eiu.edu (Spam Firewall) with ESMTP id B10BA1F52DC
for <cillia@eiu.edu>; Wed, 8 Feb 2006 18:14:59 -0600 (CST)
Received: from mail pickup service by hotmail.com with Microsoft SMTPSVC;
Wed, 8 Feb 2006 16:14:58 -0800
Message-ID: <BAY103-F2195A2F82610991D56FEC0B1030@phx.gbl>
Received: from 65.54.174.200 by by103fd.bay103.hotmail.msn.com with HTTP;
Thu, 09 Feb 2006 00:14:58 GMT
X-Originating-IP: [192.30.202.14]
X-Originating-Email: [macolas@hotmail.com]
X-Sender: macolas@hotmail.com
In-Reply-To: <10E30E5174081747AF9452F4411465410C5BB560@excma01.cmamdm.enterprise.corp>
X-PH: V4.4@ux1
From: <macolas@hotmail.com>
To: cillia@eiu.edu
X-ASG-Orig-Subj: RE: FW: Same cell#
Subject: RE: FW: Same cell#
Date: Thu, 09 Feb 2006 00:14:58 +0000
Mime-Version: 1.0
Content-Type: text/plain; format=flowed
X-OriginalArrivalTime: 09 Feb 2006 00:14:58.0614 (UTC) FILETIME=[DCA31D60:01C62D0D]
X-Virus-Scanned: by Barracuda Spam Firewall at eiu.edu
X-Barracuda-Spam-Score: 0.00