

ECE 2305 – D14

Homework 1 Solution

1. Two bits of data is required to send these four messages. In general, if a signaling device can transmit N distinct messages per transmission, then it conveys $\log_2 N$ bits of information per transmission. For this example, there are several possible coding schemes that assign bit sequences to the difference messages, and here is one possibility –

e.g Let '0' denotes steady, '1' denotes flashing.

Let '0' denotes blue, '1' denotes red.

The four messages are stated by

<i>Steady blue, clear view.</i>	<i>00</i>
<i>Flashing blue, clouds due.</i>	<i>10</i>
<i>Steady red, rain ahead.</i>	<i>01</i>
<i>Flashing red, snow instead.</i>	<i>11</i>

2. There are far too many communication standards to list them all, but here is a sampling. Note that data rate and bandwidth are not the same, as described in the article “Bits, Symbols, Bauds, and Bandwidth”.

e.g.

Standard	Alias	Bandwidth	Data rate	Media	Spectral Efficiency
IEEE 802.11a	WLAN	20 MHz	54 Mbps	Air	2.7 bits/s/Hz
IEEE 802.3ab / 1000BASE-T	Gigabit Ethernet	~100 MHz per pair	1Gbps	Cable	10 bits/s/Hz
IEEE 802.3ah	EFM	5 MHz	250Kbps	Air	5 bits/s/Hz

3. ping www.wpi.edu

The screenshot shows a Windows desktop environment. In the foreground, a Microsoft Word document titled 'hw1_sol' is open. The document contains a table with the following content:

Spectral Efficiency
55
bits/(s.Hz)
10
bits/(s.Hz)
5
bits/(s.Hz)

Overlaid on the Word document is a command prompt window titled 'C:\Windows\system32\cmd.exe'. The command prompt shows the following output:

```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7600]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Freepooh>ping www.wpi.edu

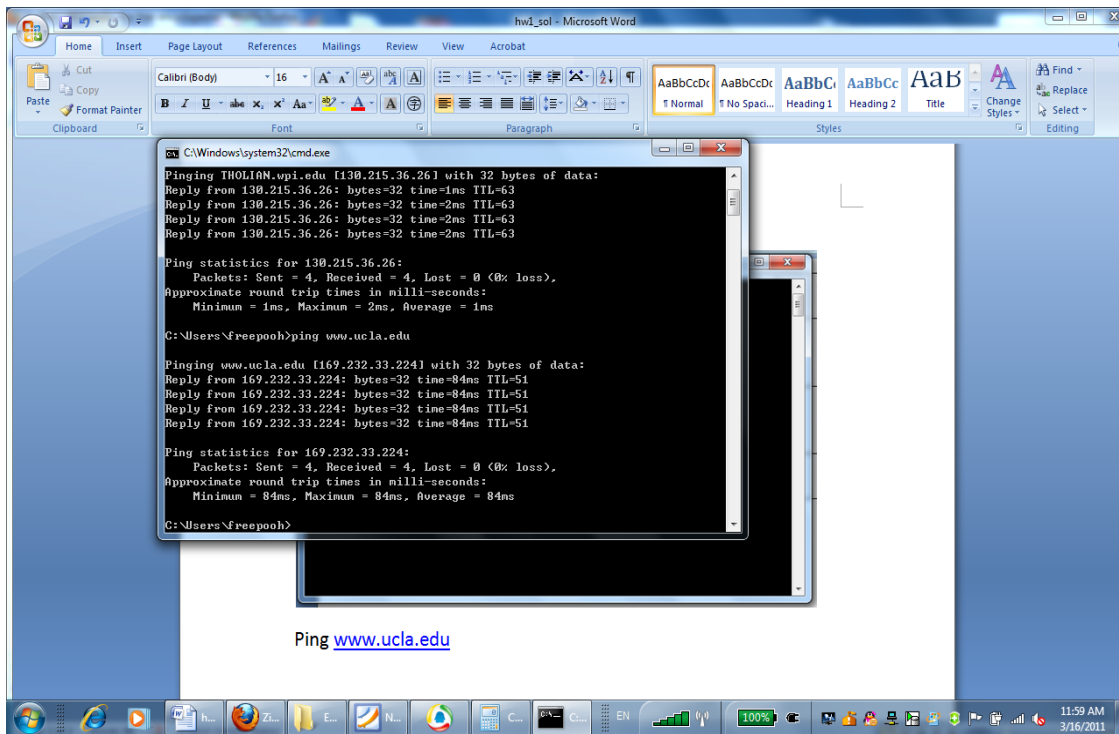
Pinging THOLIAn.wpi.edu [130.215.36.26] with 32 bytes of data:
Reply from 130.215.36.26: bytes=32 time=1ms TTL=63
Reply from 130.215.36.26: bytes=32 time=2ms TTL=63
Reply from 130.215.36.26: bytes=32 time=2ms TTL=63
Reply from 130.215.36.26: bytes=32 time=2ms TTL=63

Ping statistics for 130.215.36.26:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\Users\Freepooh>
```

The taskbar at the bottom of the screen shows the system clock as 11:58 AM on 3/16/2011.

Ping www.ucla.edu



```
C:\Windows\system32\cmd.exe
Pinging 130.215.36.26 [130.215.36.26] with 32 bytes of data:
Reply from 130.215.36.26: bytes=32 time=1ms TTL=63
Reply from 130.215.36.26: bytes=32 time=2ms TTL=63
Reply from 130.215.36.26: bytes=32 time=2ms TTL=63
Reply from 130.215.36.26: bytes=32 time=2ms TTL=63

Ping statistics for 130.215.36.26:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\Users\Freepooh>ping www.ucla.edu

Pinging www.ucla.edu [169.232.33.224] with 32 bytes of data:
Reply from 169.232.33.224: bytes=32 time=84ms TTL=51
Reply from 169.232.33.224: bytes=32 time=84ms TTL=51
Reply from 169.232.33.224: bytes=32 time=84ms TTL=51
Reply from 169.232.33.224: bytes=32 time=84ms TTL=51

Ping statistics for 169.232.33.224:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 84ms, Maximum = 84ms, Average = 84ms

C:\Users\Freepooh>
```

Ping www.ucla.edu

Differences:

1. Response IP address:

WPI: 130.215.36.26

UCLA: 169.232.16.224

2. Round trip time

WPI: 1ms/2ms

UCLA: 84ms

The ping times to the WPI server are shorter since it is geographically closer to us than the UCLA server.

How long would it take to send a beam of light to UCLA and back?