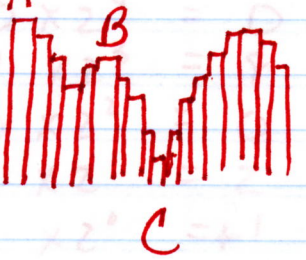
Digital Commun. HW

Phy10
C1

(1.) The sound wave will be converted into a series of amplitudes reflecting the loudness of the sound. These numbers are then converted to a digital signal comprised of 1s & 0s — binary code.



Each block represents a numerical amplitude which will be changed into binary code.

(2.) Point A is a high amplitude sound, e.g. loud. It will have a large number assigned to it. Point B is an intermediate, or medium, loud sound Point C is a low sound and would have a small number assigned to it.

For example, If the maximum loudness were 65. Point A might be 60, Pt. B - 45, & Pt. C - 15.

whoops!
(4.) (3.) 8-bit binary for 115

$2^7 = 128$
$2^6 = 64$
$2^5 = 32$
$2^4 = 16$
$2^3 = 8$
$2^2 = 4$
$2^1 = 2$
$2^0 = 1$

To make 115 ⟹

$0 \times 2^7 = 0$
$1 \times 2^6 = 64$
$1 \times 2^5 = 32$
$1 \times 2^4 = 16$
$0 \times 2^3 = 0$
$0 \times 2^2 = 0$
$1 \times 2^1 = 2$
$1 \times 2^0 = 1$

115
−64
51
−32
19
−16
3
−2
1

115

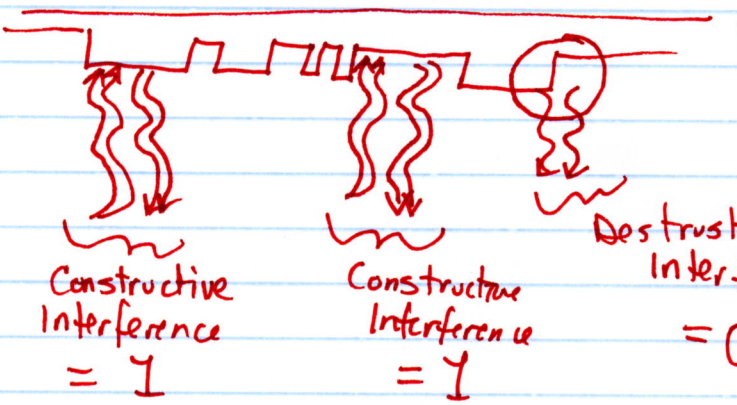
8bit Binary is: 01110011

(3.) 8 bit binary code = 10001011

$1 \times 2^7 = 128$
$0 \times 2^6 = 0$
$0 \times 2^5 = 0$
$0 \times 2^4 = 0$
$1 \times 2^3 = 8$
$0 \times 2^2 = 0$
$1 \times 2^1 = 2$
$1 \times 2^0 = +1$
139

This binary number represents the amplitude of 139.

(5.)

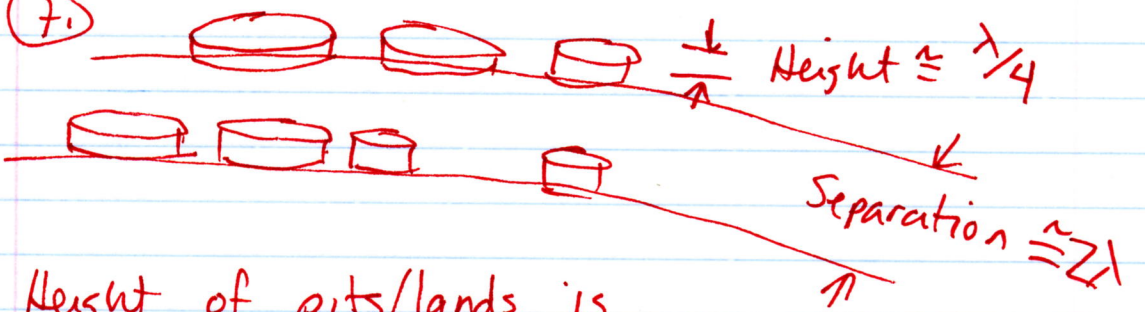


When light reflects off either a pit or a land you get constructive interference of reflected beam = 1.
When light reflects partially off a pit & partially off a land, you get destructive interference between two parts & this is a 0.

(6.) Loudness = amplitude = a number = binary code

Louder ⇒ higher amplitude ⇒ larger number

(7.)



Height of pits/lands is about ¼ of the wavelength of the reading laser for DVDs.

Separation is around twice the wavelength because the shorter the wavelength (bluer) the tighter the focus (blue bends better).

(8.) When CDs were created, the lasers were all about $\lambda = 800nm$, or $0.8\mu m$. Then DVDs came along and the lasers are shorter wavelengths. This means pits/lands can be shorter & closer together. AND we can get more information packed on a DVD than on a CD. We can also get move information on DVDs because they are multi-layered.

(9.) Optical Communication System

Message → Converted to Digital (A to D converter) → Sent into Fiber (Laser & Optics) → Travel down fiber (Router, Amplifier, Switches) → (cont.)

(9.) cont.

Converted back to Analog → Listen to or Read Message

D to A converter

(10.) A signal is sent by taking the digital binary code & turning the 1's & 0's into laser pulses. Then the laser pulses are ~~confined~~ sent into the fiber. Each message has to have its own λ associated with it. The messag (pulses) are routed around from one place to another. Sometimes they have to be amplified, to strengthen them, from losses in the fiber.

(11.) Routers → send messages from one place to another

Switches → how a router shifts a message from one fiber to another

Multi-plexers → mix several messages together (each being produced from a different wavelength of laser light so they can be separated later)

De-multiplexers → separate out different messages by separating the different λ pulses.

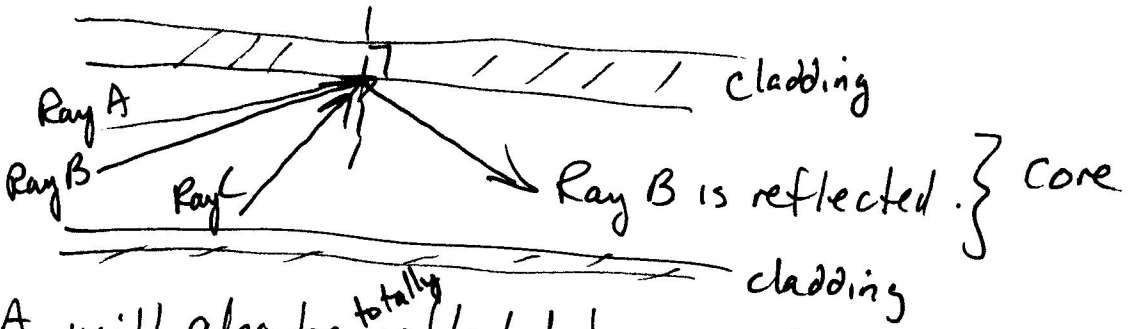
Dig. Comm HW

Phy 101
(5)

(12.)

Digitize Messag — computer & Modulator
Imprint message — via laser pulses
Send message — with lenses to focus laser pulses into fiber
— with amplifier over long distances
Detect messages — with photodiode
Decode message — with computer

(13.)



Ray A will also be totally reflected because it is at a larger angle than Ray B & thus will be at an angle greater than the critical angle (since we know Ray B is reflected).

Ray C is less likely to be totally reflected, but by using the critical angle formula, we could figure that out.

(14.)

d = 100 km	Amplitude = 90	(loses 10%)
d = 200 km	Amplitude = 81	
d = 300 km	Amplitude = 0.9(81) = 72.9	
d = 400 km	Amp = 0.9(72.9) = 65.6	
d = 500 km	Amp = 0.9(65.6) = 59 = Amplitude	