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CS 3590 Data Communications & Networking
Assignment #3
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REVIEW QUESTIONS:

Q.1. Review Question #4.3
What is the difference between unshielded twisted pair and shielded twisted pair?

Unshielded twisted pairs, as their name suggests, have no protection against external interference.

Shielded twisted pairs come in three forms, each offering a specific variant of protection from unintended external electromagnetic influence:

1) each pair of wires is insulated by metallic foil (FTP)

2) there is a single layer of shielding covering all wires grouped together (F/UTP)

3) both options 1) and 2) are implemented simultaneously across the medium (S/FTP)
   This is also referred to as a “fully shielded” twisted pair

Q.2. Review Question #4.4
Describe the components of an optical fiber cable

An optical fiber cable consists of any number of optical fiber strands, which are surrounded by a protective <u>jacket</u>. The primary components of an optical fiber strand are: the <u>core</u>, <u>cladding</u>, and the <u>buffer coating</u>.

The <u>core</u> consists of strands of either glass or plastic, whose diameter may range from 8μm to 62.5μm.

The cladding surrounds the core, and is also a glass or plastic coating, but with differing optical properties that that of the core, and a diameter of 125μm

The outermost layer of an optic strand is the the buffer coating is made of a hard plastic and is intended to protect the inner layers from moisture and physical damage.

Surrounding all optical fiber strands is the jacket, typically composed of layers of plastic and other materials, which is designed to protect the contained strands from moisture, as well as other environmental hazards.

Q.3. Review Question #4.5
What are some major advantages and disadvantages of microwave transmission?

Advantages:

- Microwave radiation encapsulates a large portion of the light spectrum
- highly-directional beams are possible at higher frequencies (1 GHz - 40 GHz) whose range is known as the range of microwave frequencies
- Omnidirectional at lower frequencies (30 MHz - 1 GHz) whose range is commonly referred to as the radio range

Disadvantages:

- at higher frequencies, most noticeably above 10 GHz, rainfall increases attenuation
- with the growing popularity of microwave frequency use, transmission areas may overlap and interferences is a constant issue

Q.4. Review Question #4.7
Why must a satellite have distinct uplink and downlink frequencies?

The uplink band is used to receive transmissions, while the downlink band is used to send transmissions. Without a dedicated sending and receiving frequency, a satellite could only either send or receive a single message at once.

Q.5. Problem Question #4.1
Suppose that data are stored on 8.54-Gbyte single-sided, double-layer DVDs that weigh 15 g each. Suppose that an Eurostar rail service train, London to Paris via Chunnel, carries 10,000 kg of these DVDs. The great circle distance of the line is 640 km, and the traveling time is 2 hours, 15 minutes. What is the data transmission rate in bits per second of this system.

Utilizing 10,000,000 g, at 15 g/DVD 666,666 units can be carried on a train, with 10 g left over.

666,666 * 8.52 Gbytes ≅ 5,693,327.64 Gbyte ≅ 45,546,621.12 Gbits

2.25 hours = 8,100 seconds

45,546,621.12 Gbits / 8100 seconds ≅ 5,623.0396444 Gbits/sec

5,623.0396444 Gbits/sec ≅ **5,623,039,644,400,000 bits/sec**

Q.6. Problem Question #4.2
A telephone line is known to have a loss of 20 dB. The input signal power is measured as 0.5 W, and the output noise level is measured as 4.5 μW. Use this information calculate the output signal-to-noise ratio in decibels.

P_1 is input signal, P_2 is output signal.

$10 * \log (P_2 / P_1) = -20$ dB
$P_2 / P_1 = 0.01$
$P_1 = 0.5$ W, therefore $P_2 = 0.005$ W

SNR = $(\text{Power}_{signal} / \text{Power}_{noise}) = (0.005 / 0.0000045) = 1{,}111.1\ldots$ dB

Q.7. Problem Question #4.5
Show that doubling the transmission frequency or doubling the distance between transmitting antenna and receiving antenna attenuates the power received by 6 dB.

$L = 10 * \log((4\pi d / \lambda)^2)$

By doubling the frequency, the wavelength (λ) is halved.
Alternatively, by doubling the distance, (d) is doubled.
In either case, the above equation for loss can be expressed as:

$L = 10 * \log(8\pi d / \lambda)^2 = 10 * \log(2^2) = 6.02059 = 6$ dB