Comprehensive Communication Theory Answers

Your Name

1 Disadvantages of Asynchronous Transmission

1.1 Answer

Asynchronous transmission is a communication method in which data is sent one byte at a time, typically accompanied by start and stop bits. The main disadvantage is its inefficiency due to the overhead of start and stop bits, which increases the amount of data sent, slowing down the actual data transmission rate.

1.2 Related Theory

- **Start and Stop Bits**: Each byte in asynchronous transmission is encapsulated with start and stop bits, which adds approximately 20% overhead.

- **Error Handling**: Limited error detection due to reliance on timing tolerances, making it susceptible to errors in noisy environments.

- **Efficiency**: While simpler, asynchronous transmission is less efficient for continuous and high-volume data transfer compared to synchronous methods.

2 Stop-and-Wait Flow Control

2.1 Answer

Stop-and-wait flow control is a protocol where the sender transmits a frame and waits for an acknowledgment (ACK) from the receiver before sending the next frame. This ensures reliable communication.

2.2 Related Theory

- **Flow Control Mechanism**: Manages the pacing of data transmission between sender and receiver.

- **Protocol Operation**: The sender waits for an ACK; if not received within a timeout, the frame is retransmitted.

- **Advantages and Limitations**: Simple and ensures reliable communication but inefficient for high-latency or high-bandwidth networks.

3 CRC Technique for Error Detection

3.1 Answer

Cyclic Redundancy Check (CRC) detects errors by performing a binary division of the data bits and appending a remainder (CRC code) to the data stream. The receiver performs the same division to verify accuracy.

3.2 Related Theory

- **Binary Division and Polynomial Representation**: Data is represented as a polynomial and divided by a generator polynomial.

- **Remainder Verification**: A remainder of zero at the receiver confirms error-free transmission.

- **Advantages**: Efficient and capable of detecting common errors.

4 HDLC Transfer Modes

4.1 Answer

High-level Data Link Control (HDLC) provides three modes for data transfer: NRM, ARM, and ABM, each suited for different network setups.

4.2 Related Theory

- **Normal Response Mode (NRM)**: Unidirectional mode where primary controls communication; ideal for point-to-multipoint networks.

- **Asynchronous Response Mode (ARM)**: Secondary stations can send data without primary's explicit permission, giving more flexibility.

- **Asynchronous Balanced Mode (ABM)**: Full-duplex mode allowing peer-to-peer communication.

5 Delta Modulation Technique

5.1 Answer

Delta Modulation (DM) encodes analog waveforms by recording differences between successive samples, transmitting either an increase or decrease in amplitude.

5.2 Related Theory

- **Sampling and Quantization**: Encodes change from the previous sample.

- **Advantages and Limitations**: Simple and uses fewer bits, but may suffer from slope overload distortion and granular noise.

6 Nyquist Bandwidth

6.1 Answer

The Nyquist bandwidth defines the minimum bandwidth required to transmit data without inter-symbol interference, with the maximum data rate for a noiseless channel being twice the channel's bandwidth.

6.2 Related Theory

- **Nyquist Theorem**: Maximum data rate $R = 2B$, where B is the bandwidth in Hertz.

- **Applications**: Critical for ensuring data rates align with the channel's capacity.

7 Shannon Capacity Formula

7.1 Answer

The Shannon capacity formula defines the maximum data rate of a channel in the presence of noise, given by $C = B \cdot \log_2(1 + \text{SNR})$.

7.2 Related Theory

- **Formula Explanation**: Indicates how channel capacity increases with bandwidth and SNR.

- **Applications**: Used in system optimization for noisy environments.

8 Benefits of Spread Spectrum

8.1 Answer

Spread spectrum spreads signals over a wide frequency band, providing robustness, security, and resistance to interference.

8.2   Related Theory

- **Types of Spread Spectrum**: Includes Frequency-Hopping Spread Spectrum (FHSS) and Direct Sequence Spread Spectrum (DSSS).

- **Benefits**: Interference resistance, security, reduced crosstalk, and multipath resistance.