

## **Review Questions for Data Communications**

### **Section A: Multiple Choice Questions**

- 1. Which of the following describes the difference between "Data" and "Information"?**
  - A) Data is processed, while information is raw facts.
  - B) Data refers to raw facts collected, whereas information is processed data used for decision-making.
  - C) Data and information are identical in a computer network.
  - D) Information is the input, and data is the transformational process.
- 2. In a data communication system, what is the "Protocol"?**
  - A) The physical cable connecting two computers.
  - B) The device that sends the data.
  - C) An agreed-upon set of rules used by the sender and receiver to communicate.
  - D) The information or message being sent.
- 3. The variation in the packet arrival time is specifically known as:**
  - A) Accuracy.
  - B) Jitter.
  - C) Transmission Medium.
  - D) Latency.
- 4. Which characteristic of a protocol refers to the format or structure of data blocks?**
  - A) Semantics.
  - B) Timing.
  - C) Delivery.
  - D) Syntax.
- 5. Which data representation forms are commonly stored using encoding systems like ASCII or Unicode?**
  - A) Audio and Video.
  - B) Text and Numbers.

C) Images only.

D) Protocols.

**6. According to the text, what is the primary purpose of a signal in data communication?**

A) To store data in computer memory.

B) To act as a detectable physical carrier or messenger of information.

C) To provide electricity to the receiver.

D) To convert digital data into analog data.

**7. Which of the following is a characteristic of all signals?**

A) They must be non-periodic.

B) They must represent discrete values only.

C) They must be a physical phenomenon that can vary in time or space.

D) They can only travel through fiber optic cables.

**8. What is the main purpose of "Encoding" in the context of signal transmission?**

A) To increase the frequency of the signal.

B) To make information suitable for a medium and ensure robustness against errors.

C) To convert a signal back into raw data at the source.

D) To measure the wavelength of a light signal.

**9. In data communications, which combination of signals is most commonly used?**

A) Periodic digital signals and non-periodic analog signals.

B) Non-periodic analog signals and non-periodic digital signals.

C) Periodic analog signals and non-periodic digital signals.

D) Periodic analog signals and periodic digital signals.

**10. The peak amplitude of a signal is defined as:**

A) The number of cycles completed in one second.

B) The distance a signal travels in one period.

C) The absolute value of the highest intensity of the signal.

D) The forward or backward shift of the waveform from the axis.

**11. If a wave completes one cycle in 0.25 seconds, what is its frequency?**

A) 0.25 Hz

B) 2.5 Hz

C) 4 Hz

D) 100 Hz

**12. Which plot indicates the relationship between a signal's frequency and its peak amplitude?**

A) Time-domain plot.

B) Frequency-domain plot.

C) Phase-domain plot.

D) Wavelength plot.

**13. According to the mathematician Jean Baptiste (Fourier), a composite signal is:**

A) A single sine wave with high frequency.

B) A combination of simple sine waves with different amplitudes, frequencies, and phases.

C) A digital signal that has only two levels.

D) A signal that never repeats after a fixed time period.

**14. If a digital signal has 8 levels ( $L=8$ ), how many bits are required per level?**

A) 2 bits

B) 3 bits

C) 4 bits

D) 8 bits

**15. "Baud rate" is specifically defined as:**

A) The number of bits transmitted in one second.

B) The time required to send one bit.

C) The rate of signal speed, or the number of symbols per second.

D) The absolute value of signal intensity at time  $t$ .

**16. Which transmission medium is capable of transferring data at a rate of 1600 Gbps using wavelength-division multiplexing (WDM)?**

- A) Coaxial Cable
- B) Twisted-Pair Cable
- C) Fiber-Optic Cable
- D) Radio Waves

**17. In which mode of transmission can both stations transmit and receive data, but not at the same time?**

- A) Simplex
- B) Half-Duplex
- C) Full-Duplex
- D) Multicasting

**18. What is the frequency range typically associated with radio waves?**

- A) 1 GHz to 300 GHz
- B) 300 GHz to 400 THz
- C) Below 2 MHz
- D) 3 kHz to 1 GHz

**19. A significant advantage of fiber-optic cable over twisted-pair or coaxial cable is:**

- A) It uses metallic conductors for better electricity flow.
- B) It can run for 50 km without requiring signal regeneration.
- C) It is easier to tap for security monitoring.
- D) It is only used for ground propagation.

**20. Which characteristic of infrared waves makes them ideal for preventing interference between systems in adjacent rooms?**

- A) They are omnidirectional.
- B) They can penetrate thick walls easily.
- C) They cannot penetrate walls.
- D) They travel via sky propagation.

**21. Which of the following best defines "Signal Encoding"?**

- A. The process of transmitting data over long distances.
- B. The conversion from analog or digital data to an analog or digital signal.
- C. The synchronization of transmitter and receiver clocks.
- D. The process of error detection in binary sequences.

**22. In a Polar NRZ-I (Non-Return to Zero-Inversion) scheme, how is a binary '1' typically represented?**

- A. By a constant positive voltage.
- B. By a transition to zero in the middle of the bit interval.
- C. By an inversion of the signal polarity.
- D. By a lack of change in the current signal level.

**23. What is a primary requirement for a receiver to correctly interpret incoming signals?**

- A. The receiver must use three voltage levels regardless of the scheme.
- B. The receiver's bit intervals must correspond exactly to the sender's bit intervals.
- C. The receiver must always use a faster clock than the transmitter.
- D. The signal must be unipolar to ensure synchronization.

**24. Manchester coding is described as a combination of which two schemes?**

- A. Unipolar NRZ and Bipolar AMI.
- B. Polar RZ and Multi-transition MLT-3.
- C. NRZ-L (Level) and RZ (Return to Zero).
- D. NRZ-I (Inversion) and Block Coding.

**25. Which line coding category includes AMI (Alternate Mark Inversion) and Pseudoternary?**

- A. Unipolar.
- B. Polar.
- C. Bipolar.

D. Multilevel.

**26. Which switching technique establishes a dedicated physical path between the sender and receiver before any data is transferred?**

- A. Packet Switching
- B. Message Switching
- C. Circuit Switching
- D. Datagram Switching

**27. Which of the following is a primary characteristic of Packet Switching?**

- A. Data is sent as a single, large block.
- B. Packets travel independently and may take different paths.
- C. A dedicated path is reserved for the entire duration of the session.
- D. It is primarily used in traditional telegraph networks.

**28. Look at the diagram below. Which specific type of switching is being illustrated here?**

- A. Message Switching
- B. Virtual Circuit Packet Switching
- C. Datagram Packet Switching
- D. Circuit Switching

**29. What is a significant disadvantage of Message Switching compared to other techniques?**

- A. Lack of a dedicated path.
- B. Low efficiency for bursty traffic.
- C. High delay due to the "store-and-forward" mechanism.
- D. Guaranteed bandwidth requirements.

**30. Which switching method is the foundation for modern Internet and IP networks?**

- A. Message Switching
- B. Circuit Switching
- C. Packet Switching

D. Telegraph Switching

**31. Which protocol is responsible for providing a scripting language similar to, but simpler than, JavaScript for mobile devices?**

- A) WML
- B) WMLScript
- C) WSP
- D) WTLS

**32. The Wireless Transaction Protocol (WTP) is considered the equivalent of which standard internet protocol, but optimized for wireless?**

- A) UDP
- B) TLS
- C) HTTP
- D) IP

**33. What is the primary function of Segmentation and Reassembly (SAR) in the Transport Layer (WDP)?**

- A) To encrypt data for privacy
- B) To convert HTML into WML
- C) To break large messages into smaller segments for bearers like SMS
- D) To establish a connection-oriented session

**34. Which layer of the WAP stack is specifically designed to handle connection interruptions common in wireless networks?**

- A) Application Layer (WAE)
- B) Session Layer (WSP)
- C) Transport Layer (WDP)
- D) Security Layer (WTLS)

**35. In the context of WAP, what is a "deck"?**

- A) A set of hardware sensors

- B) A collection of WAP pages created using WML
- C) A specific type of wireless bearer
- D) A security certificate used by WTLS

**36. Which of the following frequency bands is NOT commonly utilized by GSM networks?**

- A) 850 MHz
- B) 900 MHz
- C) 1500 MHz
- D) 1900 MHz

**37. The Mobile Station (MS) in a GSM architecture is composed of which two primary elements?**

- A) The BTS and the BSC
- B) The physical device and the SIM card
- C) The MSC and the HLR
- D) The radio interface and the antenna

**38. What type of switching technology is primarily used by GSM?**

- A) Packet switching
- B) Message switching
- C) Circuit switching
- D) Hybrid switching

**39. Which component is specifically responsible for managing multiple Base Transceiver Stations (BTS) and optimizing radio resource allocation?**

- A) Mobile Switching Center (MSC)
- B) Home Location Register (HLR)
- C) Base Station Controller (BSC)
- D) Operation and Maintenance Center (OMC)

**40. The "heart" of the GSM architecture that enables communication through base stations and network elements is known as the:**



- A) Core network interface
- B) Subscriber Identity Module
- C) Base Station Subsystem
- D) GSM Core/Architecture

**41.** According to the provided material, what is the primary result of imperfections in transmission media? 1

- A) Increase in signal frequency
- B) Signal impairment 2
- C) Uniformity between the beginning and end of the medium
- D) Elimination of background noise

**42.** Which cause of impairment is specifically associated with the loss of energy as a signal overcomes the resistance of the medium? 3

- A) Distortion
- B) Noise
- C) Attenuation 44
- D) Crosstalk

**43.** Distortion is most commonly observed in which type of signals? 5

- A) Single-frequency sine waves
- B) Digital-only signals
- C) Composite signals made of different frequencies 6
- D) Amplified signals

**44.** Based on the provided formula, if a signal's power at Point 2 ( $P_2$ ) is exactly ten times the power at Point 1 ( $P_1$ ), what is the attenuation in decibels (dB)? 77

- A) 1 dB
- B) 10 dB 88
- C) 0 dB
- D) 100 dB

45. Which type of noise is described as the random movement of electrons in a wire that creates an extra signal? 9

- A) Induced noise
- B) Impulse noise
- C) Crosstalk
- D) Thermal noise 10

### Section B: Multiple True or False Questions

Indicate whether the following statements are True or False.

1. \_\_\_\_\_ A data communication system requires five components: Message, Sender, Receiver, Transmission Medium, and Protocol.
2. \_\_\_\_\_ "Accuracy" in data communication means the data is delivered to the correct destination and user.
3. \_\_\_\_\_ Real-time transmission refers to the delivery of data, such as audio or video, without any delay.
4. \_\_\_\_\_ Transmission media for computer networks can be either wired or wireless.
5. \_\_\_\_\_ Semantics in a protocol deals with speed matching and sequencing of data.
6. \_\_\_\_\_ Computer networks transfer data from one point to another in the form of electromagnetic signals.
7. \_\_\_\_\_ Analog data refers to information that has discrete states, such as 0s and 1s.
8. \_\_\_\_\_ A simple analog signal, like a sine wave, can be further decomposed into simpler signals.
9. \_\_\_\_\_ The amplitude of a signal is proportional to the energy it carries.
10. \_\_\_\_\_ Frequency and period are directly proportional to each other ( $f = T$ ).
11. \_\_\_\_\_ Phase is measured in degrees or radians.
12. \_\_\_\_\_ Wavelength is independent of the medium through which the signal travels.
13. \_\_\_\_\_ A periodic composite signal, when decomposed, gives a series of signals with discrete frequencies.
14. \_\_\_\_\_ A digital signal with only two levels (0 and 1) will have the same baud rate and bit rate.
15. \_\_\_\_\_ Bit interval is measured in bits per second (bps).
16. \_\_\_\_\_ In simplex communication, such as a CPU sending data to a monitor, the communication is unidirectional.

17. \_\_\_\_ Twisted-pair cables consist of two copper conductors, where both wires are used simultaneously to carry different data signals to the receiver.
18. \_\_\_\_ Coaxial cables are constructed with a central core conductor and an outer metallic wrapping that serves as both a shield and a second conductor.
19. \_\_\_\_ Microwaves are omnidirectional, meaning the sending and receiving antennas do not need to be aligned.
20. \_\_\_\_ Attenuation, distortion, and noise are factors that can negatively affect signal quality during transmission.
21. \_\_\_\_ If the clock frequency at the receiver is faster than the transmitter's bit intervals, the received data will match the transmitted data.
22. \_\_\_\_ The Polar RZ (Return to Zero) scheme is considered more complex because it utilizes three distinct voltage values: +, 0, and -.
23. \_\_\_\_ In Unipolar NRZ encoding, signal levels are distributed on both sides of the time axis (positive and negative).
24. \_\_\_\_ Line encoding is the process of converting a sequence of bits into a sequence of discrete, discontinuous voltage pulses.
25. \_\_\_\_ In Differential Manchester coding, every symbol contains a level transition in the middle of the bit interval.
26. \_\_\_\_ In Circuit Switching, the communication path remains exclusively reserved even if no data is being transmitted.
27. \_\_\_\_ Packet switching is inefficient for bursty data traffic like web browsing.
28. \_\_\_\_ Message switching requires the entire message to be stored at intermediate nodes before it is forwarded to the next node.
29. \_\_\_\_ In Datagram Packet Switching, a logical path must be established before data transfer begins.
30. \_\_\_\_ VoIP (Voice over IP) utilizes packet switching techniques for communication.

31. \_\_\_\_ The Wireless Application Protocol (WAP) is dependent on specific network technologies and cannot function across different types of wireless bearers.
32. \_\_\_\_ WTP offers a "Reliable Two-Way Transaction" service that ensures both request and response delivery, commonly used for client-server interactions.
33. \_\_\_\_ The WAP Gateway is responsible for content adaptation, such as compressing data to fit small mobile screens.
34. \_\_\_\_ WDP provides a "reliable" data transport service that automatically re-transmits lost packets.
35. \_\_\_\_ Wireless communication uses electromagnetic waves, such as infrared or microwave signals, to transmit data.
36. \_\_\_\_ GSM is a digital mobile network that was conceived in the early 1980s.
37. \_\_\_\_ The Visitor Location Register (VLR) stores the permanent subscription details and service profiles of all users.
38. \_\_\_\_ The Base Transceiver Station (BTS) contains the radio equipment used for the transmission and reception of signals.
39. \_\_\_\_ The Authentication Center (AuC) generates unique security parameters to protect communication integrity.
40. \_\_\_\_ The Network Switching Subsystem (NSS) is responsible for managing radio resources but does not handle call routing.
41. Attenuation means the signal gains energy as it travels increasing distances through a medium.
42. \_\_\_\_ Amplifiers are used to compensate for attenuation by giving back the original signal.
43. \_\_\_\_ In a composite signal, distortion occurs because every frequency component travels at the same propagation speed.
44. \_\_\_\_ Impulse noise is characterized by high energy and can be caused by lightning or power lines.
45. \_\_\_\_ An ideal, noiseless channel would have a Signal-to-Noise Ratio (SNR) of zero.

### Section C: Matching Items

**Instructions: Match the terms in Column A with the most appropriate description in Column B**

Column A (Items)	Column B (Responses)
1. Message	A. The physical path for message travel.
2. Sender	B. Format of data blocks.
3. Jitter	C. The information to be communicated.
4. Transmission Medium	D. Device capable of sending the data.
5. Timing	E. Variation in packet arrival time.
	F. Control information for error handling.
	G. Speed matching and sequencing.

	H. Raw facts collected for processing.
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Column A	Column B (Responses)
1. Wavelength ( $\lambda$ )	A. The time taken to complete one single cycle.
2. Bit Rate	B. The absolute value of signal intensity at a specific time t.
3. Phase	C. Information that is continuous, like a human voice.
4. Peak Amplitude	D. The distance a signal travels in one period.
5. Baud Rate	E. The number of bits transmitted in one second.
	F. The position of the waveform relative to time 0.
	G. The absolute value of the highest intensity.
	H. The rate at which the signal changes (symbols per second).

Column A (Item)	Column B (Response)
1. Twisted-Pair Cable	A. Used in backbone networks like SONET.
2. Fiber-Optic Cable	B. Signals are narrowly focused and require alignment.
3. Microwaves	C. Primarily used in telephone lines for voice/data.
4. Infrared	D. One sender transmits to many receivers (multicasting).
5. Radio Waves	E. Frequencies ranging from 300 GHz to 400 THz.
	F. Propagation through the ionosphere (Sky propagation).
	G. Transmits signals in the form of electric current.
	H. Only used for line-of-sight propagation above 30 MHz.

Column A (Item)	Column B (Response)
1. WAE	A. Uses 16-bit port numbers to direct data to the correct process.
2. WSP	B. Provides data integrity, privacy, and authentication.
3. WTP	C. A simplified version of HTML used for mobile pages.
4. WTLS	D. Provides connection-oriented and connection-less session services.
5. WDP	E. Handles reliable data transfer without the full overhead of TCP.
	F. Defines the application programming model for the user environment.
	G. An intermediary that translates WML to HTML.
	H. A high-bandwidth fiber optic transmission standard.

Column A: Component	Column B: Function/Description
1. SIM Card	A. Acts as a bridge for call switching and routing.
2. BSC	B. Centralized hub for monitoring network health and performance.
3. MSC	C. Temporary registration storage for roaming users.
4. AuC	D. Manages multiple BTS units and allocates radio resources.
5. OMC	E. Holds user identity and subscription details.
	F. Facilitates radio signal transmission and reception.
	G. Generates unique security parameters for authentication.
	H. Permanent repository for all subscriber service profiles.

Column A (Terms)	Column B (Descriptions)
1. Attenuation	A. Signal with high energy from lightning
2. Distortion	B. One wire affecting another wire
3. Decibels (dB)	C. Loss of energy
4. Induced Noise	D. Changes in the form or shape of the signal
5. Crosstalk	E. Relative measure of signal strengths
	F. Noise from motors and appliances
	G. Movement of electrons in a wire
	H. Unwanted signal mixing with the original

### Section D: Short Answer Questions

1. Define "Data Communication" in the context of computer networks.
2. List the three key features of a Protocol.
3. What happens to the effectiveness of a system if "Accuracy" is compromised?

4. Identify four forms of data representation mentioned in the presentation. What are the three main characteristics a signal must have to carry information?
5. What are the three main characteristics a signal must have to carry information?
6. Define "Periodic Signal."
7. Write the mathematical formula for Wavelength in terms of propagation speed and frequency.
8. Distinguish between Analog data and Digital data.
9. What does a time-domain plot show?
10. If a digital signal has a bit interval of 0.001 seconds, what is its bit rate?
11. Identify the physical quantities that vary to create a "Sound Signal" and a "Light Signal."
12. What is a "Composite Signal"?
13. List and briefly define the three ways data can flow between two communicating devices.
14. Name the three specific types of guided media mentioned in the text and state what physical form the signal takes in each.
15. Based on the provided diagram, identify the three ways unguided signals travel from source to destination.
16. Explain the practical difference between radio waves being "omnidirectional" and microwaves being "unidirectional" regarding antenna placement.
17. Compare the distance a signal can travel in fiber-optic cable versus copper-based cables before requiring a repeater.
18. Label the four main components of the cable shown in the diagram and explain the purpose of the outer metallic wrapping.
19. What are the two specific types of coding methods used to convert digital data into digital signals?
20. Briefly describe the characteristic of a "Unipolar" line code.
21. According to the provided technical diagrams, what occurs in a Differential Manchester scheme if the next bit is a '0'?
22. What happens to the interpretation of the received signal if the receiver's clock is slower than the transmitter's clock?
23. List the four possible combinations of data-to-signal encoding mentioned in the text.
24. Explain why the Polar RZ scheme lacks error detection capability despite its complexity.
25. Define a "switching technique" in the context of data communication.
26. List two real-world applications of Circuit Switching.
27. What are the three main phases of the Circuit Switching working principle?
28. Why is addressing not needed during the "Data Transfer" phase of Circuit Switching?
29. Identify two advantages of Packet Switching over Message Switching.
30. Referring to the image below, why are "storage" icons present at each intermediate node?
31. Define **mobile data communication** as described in the presentation.
32. What are the three specific types of electromagnetic waves used in wireless communication?

33. Explain the difference between **WML** and **WMLScript**.
34. What are the three types of transaction services offered by the **Wireless Transaction Protocol (WTP)**?
35. Why is the **WAP stack** described as "optimized" compared to the standard OSI or TCP/IP models?
36. Identify two functions performed by a **WAP Gateway** regarding security and protocol handling
37. Identify the four frequency bands used by GSM globally.
38. According to the provided architecture diagram, which component acts as the primary interface between the Base Station Subsystem (BSS) and the Network Switching Subsystem (NSS)?
39. Name the two specific components that make up the Base Station Subsystem (BSS).
40. What is the primary purpose of the SIM card within the Mobile Station?
41. Define the role of the Operation and Maintenance Center (OMC) in a mobile network.
42. How does the Visitor Location Register (VLR) support a user who has moved into a new service area?
43. Define "Signal-to-Noise Ratio" (SNR) as described in the text.
44. What is the specific mathematical formula for calculating Attenuation in decibels?
45. List two sources of "Induced Noise" mentioned in the presentation.
46. What happens to a signal's phase at the receiver end due to distortion?



## Section E: Explanation Questions

1. Explain the five components of a data communication system and how they interact.
2. Using the analogy provided in the presentation, explain why a protocol is necessary for effective communication.
3. Discuss the "Timeliness" characteristic and how "Jitter" can affect it.
4. Describe how Text and Numbers are represented in a computer system according to the presentation.
5. Explain the importance of encoding in data communication.
6. Contrast the Time-Domain representation and Frequency-Domain representation of a signal.
7. Using the image below as a reference, explain how a signal can have a phase of 180 degrees.
8. Why is a simple sine wave generally not useful for data communication? What is used instead?
9. Explain the relationship between Bit Rate and Baud Rate. Under what circumstances are they different?
10. Describe how digital signals represent information using voltage levels.
11. Explain the effect of a "Non-Periodic" composite signal being decomposed.
12. Discuss how the amplitude of a signal relates to the energy it transmits. 44
13. Explain how light travels through a fiber-optic cable. Include a discussion on how the density of substances affects the direction of the light ray.
14. Compare and contrast guided and unguided media. Your explanation should include how the signal is contained (or not) and the role of physical conductors.
15. Discuss three reasons why fiber-optic cable is preferred for backbone networks, specifically addressing bandwidth, interference, and physical properties.
16. Using the diagram as a reference, explain why a mobile phone is considered a full-duplex device while a walkie-talkie is considered half-duplex.
17. Using the image above and the provided text, explain why it is critical for the transmitter and receiver clocks to have the same frequency. What is the physical consequence of a mismatch in these frequencies?

18. Compare and contrast Manchester and Differential Manchester encoding. Specifically, explain how they handle transitions in the middle of a bit and how the beginning of a symbol interval differs between the two.
19. Explain the fundamental difference in how bit values are determined in NRZ-L versus NRZ-I. How does the concept of "inversion" play a role in one but not the other?
20. Observe the "Polar RZ" waveform in the provided diagrams. Explain the sequence of voltage changes that occur for a single binary '1' bit in this scheme. Why is this scheme considered to use three voltage levels?
21. Compare and contrast the efficiency of Circuit Switching and Packet Switching when handling "bursty" traffic.
22. Explain the difference between Datagram Packet Switching and Virtual Circuit Packet Switching.
23. Discuss why Message Switching is considered unsuitable for real-time applications like voice or video calls.
24. Analyze how Packet Switching achieves robustness in a network if an intermediate node or path fails.
25. Explain how the WAP architecture serves as a bridge between the "mobile world" and the "internet." Why was this bridge necessary for older mobile devices?
26. Discuss the role of the Wireless Datagram Protocol (WDP). How does it ensure that higher layers remain functional regardless of the underlying network technology (bearer)?
27. Analyze the importance of the Wireless Session Protocol (WSP) in a mobile environment. Specifically, explain how it addresses the challenges of wireless network stability.
28. WTLS is based on the industry-standard TLS/SSL but is "tailored for low-bandwidth networks." Elaborate on what security features it provides and why a standard TLS implementation might not be ideal for mobile data communication.
29. Explain the different roles the Home Location Register (HLR) and the Visitor Location Register (VLR) play in managing subscriber data and roaming.
30. Discuss the importance of the Network Switching Subsystem (NSS) in the exchange of information and resource utilization within the telecommunications network.
31. Explain how the Authentication Center (AuC) ensures secure access to network services through mutual authentication.
32. Analyze how the relationship between the BTS and the BSC ensures "seamless connectivity" for a mobile user.

33. Using the concepts of propagation speed, explain why composite signals experience distortion.
34. Compare and contrast "Thermal Noise" and "Impulse Noise."
35. Discuss the concept of a "Noiseless Channel" and why it is considered an "ideal" that cannot be achieved in real life