Examination Assignment
Communication Protocols

In this assignment there are totally 18 questions and 27 points.
For G (godkänd), you need to earn at least 21 points and for VG (väl godkänd), you need to earn all the points. Please note that the submission deadline is 2024-06-02 23:59.

1. Parallel transmission method is not used for long-distance applications. Why? (1p)

Pararell communication sends data over multiple lines in close proximity, it can can cause errors by crosstalk. The data can become skewed with long distances.

2. Briefly explain how synchronization and sampling are done in UART. (1p)

No clock signal is used. The transmitting UART adds start and stop bits to the data packet being transferred. The receiver clock should be synchronized to the transmitter clock in order to sample the bitsproperly in correct times. The receiver clock is 16 times faster than the agreed baud rate will be synchronized on the falling edge of start bit. The data line gets sampled in the middle of the bit, every 8 cycles of the internal clock of the receiver.

3. What is handshaking in communication systems? Explain it by an example. (2p)

It's a signal between two devices or programs. Handshaking occurs before the transfer of data or other communication and just after the establishment of the physical channel between the two units. Handshaking plays a vital role in establishing and synchronizing communication links between devices or programs, ensuring smooth and reliable data transfer.

4. What is differential signaling? Why and in which application types is it used? (2p)

It's a method for electrically transmitting information using two complementary signals. It's typically used with a balanced pair of conductors. It is often used in computers to reduce electromagnetic interference. The main reason differential pairs are used in long links that might cross between two boards is their immunity to ground offsets. The primary reason that differential signaling is dominating is that far higher data bandwidths can be achieved over a pair of wires than with parallel, single-ended signaling protocols. The Internet as we know it would not be possible without differential signaling.

5. What is clock stretching in I2C? Why and how does a node use clock stretching? (2p)

It is a mechanism used in certain synchronous communication protocols. Clock stretching is used when the master's data rate will exceed the slave's ability to process the data. It slows down the bus. The node uses clock streching to manage the flow of data from the master device when it's not ready to process upcoming information.

6. CAN uses NRZ encoding. How can NRZ encoding improve EMC? (1p)

Using NRZ encoding, the CAN system can reach good communication and improved EMC execution. This makes them appropriate for environments where it is crucial to minimize electromagnetic interference, which is related to vehicles and the industry.

7. What is bit stuffing? How and why is it used by CAN? (2p)

It's on bit level and inserting or removing individual bits within the data stream. The main intention of it is to maintain synchronization between different nodes regarding to the CAN bus.
It is used to ensure synchronization of all bus nodes. Periodic edges allow receivers to resynchronize to sender clock. Make sure the receiver stays in sync with the transmitter by maintaining signal transitions. Prevents specific bit patterns, the start and end of the frame coming in the data field. It can be misinterpreted as control information.

8. Briefly explain how bus arbitration is done in CAN. (2p)

It is needed when several nodes are trying to transmit at the same time, but only one can that at a time. Nodes wait for the bus to become free or idle. When two nodes send different bits to the CAN bus at the same time, the dominant bit is sent into it. If a node notices a dominant level when itself is sending a recessive level, it will immediately end the arbitration and become a receiver instead of that. Arbitration is executed over the entire arbitration field, and once that field has been sent, there is exactly one transmitter left on the bus. This node is continuing the transmission as if nothing had happened. The other potential senders tries to retransmit their messages when the bus next becomes available. No time is lost in the arbitration.

9. LIN is a deterministic communication system. What does it mean? (1p)

A deterministic communication protocol is a protocol when the timing of data transmission is strictly regulated and predictable. This means that each message is sent at a very specific time and follows a predetermined schedule or sequence of it. This is especially important in systems where timing is critical, such as in automotive electronics, where different parts of the system must interact precisely to ensure proper functionality.

10. Briefly explain how slaves in a LIN cluster get synchronized to the master. (1p)

The master sends synchronization signals over the LIN bus. The slaves uses the received synchronization signals to calibrate their internal clocks. This ensures that their clocks are synchronized with the master's clock. After calibrating their clocks, the slaves is waiting instructions from the master. The master sends instructions according to a preset schedule to the slaves. The slaves is responding to these instructions as needed.

11. Briefly explain the time-triggered and the event-triggered transmission methods. (2p)

In time-triggered transmission, data is sent or tasks are executed according to a predefined schedule based on time intervals or specific time points. With a time-triggered schedule, you can define a specific date and time when the scheduled task should run. For example, you can complete a task every Monday night. Time-triggered schedules are useful for allowing large, resource-intensive tasks to run during off-peak hours, such as overnight or over a weekend. An event trigger is an association between a predefined event and the script to run when that event occurs. These scripts fall into two categories based on when they occur and whether they modify records in the database. In event-triggered transmission, data is sent or tasks are executed in response to specific events or conditions. Unlike time-triggered systems, event-triggered systems respond dynamically to changes in the environment or system state.

12. How are multicast and broadcast transmissions handled in Ethernet? (1p)

In multicasting, multiple of nodes get messages, which is delivered to them. When a device wants to send a multicast packet, it specifies the multicast MAC address as the destination address in the Ethernet frame. Switches and routers use multicast routing tables to determine which ports to forward the packet to based on the multicast group membership of the nodes.
In broadcasting, messages are delivered to all the nodes. When a device wants to send a broadcast packet, it specifies the broadcast MAC address as the destination address in the Ethernet frame. Switches forward broadcast packets out of all ports except the one they were received on, ensuring that the packet reaches all nodes on the network.

13. What is a VLAN and what are the advantages of using VLANs? (2p)

VLAN is a switch-only feature. It allows you to logically arrange and manage devices based on your requirement without changing their physical locations. You can use this feature on any Cisco switch. The advantages of using it is that it can solve broadcast problems, it's making the management of the device easier, It helps you to enhance network security, you can keep hosts separated by VLAN, it allow us to add an additional layer of security and reduces the size of broadcast domains also.

14. Explain the main responsibilities of the Internet Protocol(IP) in the TCP/IP stack. (2p)

For IP, it is Error handling, framentation and reassembly, packet routing, packet encapsulation and addressing. For TCP, it is link layer, transport layer, internet layer and application layer. IP plays a crucial role in the TCP/IP stack by providing addressing, routing, encapsulation, fragmentation and reassembly, and error handling capabilities, enabling devices to communicate across interconnected networks.

15. Explain what a subnet is and how CIDR addresses a subnet. (2p)

A subnet is a network within a network. It makes networks more efficient.
It addresses a subnet by network prefix and host identifier and through aggregation. Subnetting allows network administrators to divide a single network into multiple smaller subnetworks, each with its own unique network address.

16. Explain the main difference between the UDP and the TCP protocols. (1p)

UDP is faster than TCP. UDP has a speed advantage because the user doesn't have to allow or acknowledge receipt of the data to be resent. TCP is a stable and reliable protocol for transferring data and not losing any. Another advantage of UDP is that if you need a fast and constant data transmission for an application to work properly it's perfect.

17. What is a Generic Access Profile (GAP) in BLE? (1p)

It is responsible for the connection functionality and allows BLE devices to interoperate with each other. Every BLE devices are using GAP. It's to define device roles, network topology, discovery process, device management, security and connection process between different BLE devices. GAP defines a couple of roles, four, which are: Central, peripheral, broadcaster and observer.

18. What is a Generic Attribute Profile (GATT) in BLE? (1p)

GATT manages how attributes are transferred once devices have a dedicated connection. GATT has two roles, client and server. Client are requesting data from the server and are capable of reading and writing attributes. Server stores and makes attributes available upon client requests. GATT is focusing how data is formatted, packaged and exchanged between different kind of devices.