CAN message compare

Controller Area Network (CAN) Bus Arbitration Principle
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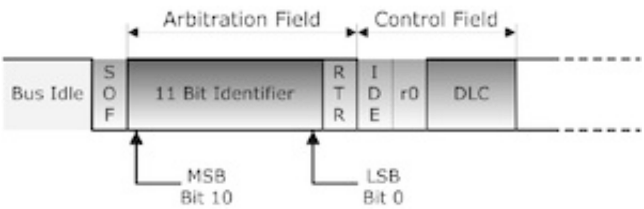
Since a serial communication system such as CAN is based on a two-wire connection between nodes in the network, i.e. all nodes are sharing the same physical communication bus, a method of message/data collision avoidance is mandatory to assure a safe data transfer and to avoid delays resulting from the necessary restoration of proper bus conditions after the collision.
A collision may occur when two or more nodes in the network are attempting to access the bus at virtually the same time, which may result in unwelcome effects, such as bus access delays or even destruction/damage of messages.
There are various methods of collision avoidance between the various fieldbus systems and in most cases the collision avoidance is actually a collision "repair", which requires an unspecified bus recovery time, therefore taking up valuable bandwidth, and usually results in the destruction of the message.
CAN averts message/data collisions by using the message ID of the node, i.e. the message with the highest priority (= lowest message ID) will gain access to the bus, while all other nodes (with lower priority message IDs) switch to a "listening" mode.

Principle of Bus Arbitration



CAN Arbitration Field

The picture to the left provides a closer look into the arbitration field of a CAN message, in this case a CAN message with an 11 Bit identifier.
The arbitration field follows right after the SOF (Start of Frame) bit and it contains of the message ID and the RTR (Remote Transmission Request) bit.
Per definition, CAN nodes are not concerned with information about the system configuration (e.g. node address), hence CAN does not support node IDs. CAN data transmissions are distinguished by a unique message identifier (11/29 bit), which also represents the message priority. A low message ID represents a high priority. High priority messages will gain bus access within shortest time even when the bus load is high caused by lower priority messages.
At a baud rate of 1 MBit/sec this would translate into 12 microseconds of actual bus arbitration. Naturally, the bus arbitration time varies with baud rate and the message identifier length, 11 or 29 Bit.
Main Rules of Arbitration
The main rules of bus arbitration are:

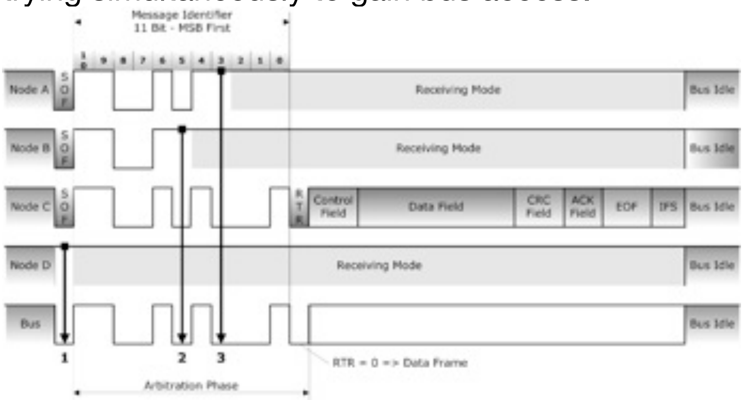
- Bit wise arbitration across the Arbitration Field

Zero Bit = Dominant Bus Level, One Bit = Recessive Bus Level, dominant bit overrides recessive bit

The CAN bus level will be dominant in case any number of nodes in the network output a dominant level. The CAN bus level will only be recessive when all nodes in the network output a recessive level.

- Bus is considered idle, i.e. free for access, after end of the completely transmitted message followed by the Intermission Field.
- Node that transmits message with lowest message ID, i.e. highest priority, wins the arbitration and continues to transmit. Competing nodes switch to receiving mode (listening mode).
- Nodes that lost arbitration will start a new arbitration as soon as the bus is free for access (idle) again. Thus CAN provides a non-destructive bus arbitration.

Bus Arbitration Example
The following example is based on a four node CAN network, where three nodes are trying simultaneously to gain bus access.



CAN Bus Arbitration Example

The nodes in this example have the following message IDs:
A   1100101100 = 32C hex
B   1100110000 = 330 hex
C   1100101000 = 328 hex
The message ID of node D is of no significance, since it is not requesting bus access. According to this example and the CAN specification (lowest message ID represents highest message priority) node C must gain the bus access.
The sequence of the bus arbitration process in this example is as follows:

Nodes A, B and C request bus access at the same time by putting a dominant level to the bus (SOF = Start of Frame). Node D, not requesting bus access, will switch immediately to receiving mode.• Nodes A, B and C output their message ID bits starting with the most significant bit (MSB).

Between the transmission of bit 10 and bit 6 of the message ID there is no difference in signal level.• After transmission of bit 5 node B loses the bus arbitration, since nodes A and C are posting a dominant level and node B posts a recessive level. Node B switches to receiving mode.

After transmission of bit 3 node A loses the bus arbitration, since it posts a recessive level to the bus, which is overridden by a dominant level from node C.• Node C gains the bus access and continues with the transmission of the remainder of the message.