TTCAN

Time Triggered CAN

Benefits of CAN

- It is event triggered which means that each node can send whenever it needs to as long as the bus is free
- Since different nodes have different time cycles for their need to send this can give an effective sceduling on the bus

Limitations of CAN

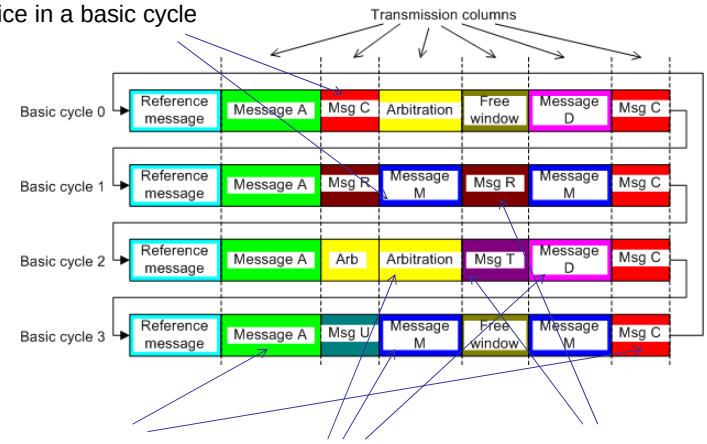
- If many nodes send frequently the utilisation of the bus is poor since many messages have to be retransmitted
- Some node(s) could choke the bus
- Because of the arbitration we don´t know the maximum delivery time for a message.
  In a real-time system this is often essential, particulary if the message is safety critical

TTCAN - the best of both worlds

- The timing on the bus is controlled by one master node
- The transmission sequence is set up as a schedule matrix
- The matrix is divided into basic cycles
- Each basic cycle starts with a reference message that sets the global time in the system
- Each basic cycle consists of a number of transmission columns
- The columns can be of three types
  1 - Reserved for one particular message
  2 - Free for arbitration, all nodes can compete for transmission
  3 - Free window, not used but reserved for further expansion
- Since the messages have to keep their time slots there is no retransmission of messages. The slots will have to wait until the next assigned time slot or an arbitration time slot

Schedule matrix

Some messages occur twice in a basic cycle



Some messages occur every basic cycle

Some messages occur every other basic cycle

Some messages occur more irregulary

Schedule matrix cont.

- The schedule matrix can consist of up to 64 basic cycles
- Each basic cycle can be up to 2^{16} = 65536 bits (clock cycles) long
- A transmission column has to be of the same size in every basic cycle so the size is governed by the longest message that is to be sent in that column
- A free window is not used but we can use it later on if we need to add more messages or send some message more frequently

Timing

- There are two levels of timing
  + Level 1

    Each node has a 16 bit clock that is retriggered each basic cycle by the one byte long reference message

    This is called the local time
  + Level 2

    Each node has a 19 bit clock that that runs at eight times the bit rate.

    The reference message is four bytes long and contains information on the time of the global clock held by the master.

    The nodes can correct their clock in a more detailed way by using the extra bits of their clocks and correct for different wire lengths ao

Backup masters

- Since the timing of the system is essential it must not fail
- To reasure this all nodes on the bus are potential masters
- The nodes have different priority given by the last three bits of the reference message
- If the current master node fails to release a reference message the other nodes will try to send a reference message after a short time-out period
- The node with the highest priority will win the arbitration and send its reference message