VP's Design Service Capabilities in CAN-based System & Component Design/Prototyping

Info@vptinc.com
VP Technologies, Inc.
A Georgia ATDC Company.
www.vptinc.com
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Overview of the CAN Protocol

- The CAN protocol is an ISO standard (ISO 11898) for serial data communication. It is for shared bus protocol.
- The CAN standard includes a physical layer and a data-link layer. The physical layer typically uses differential transmission on a twisted pair wire.
- CAN defines a few different message types, arbitration rules for bus access and methods for fault detection and fault confinement.
- Any node can start transmitting whenever the bus is free. If a conflict is detected during the transmission, arbitration will be performed. A non-destructive bit-wise arbitration is used to control access to the bus. Lower priority will transmit later.
- The messages are small (at most eight data bytes) and are protected by a checksum. If errors are still there then there will be retransmission.

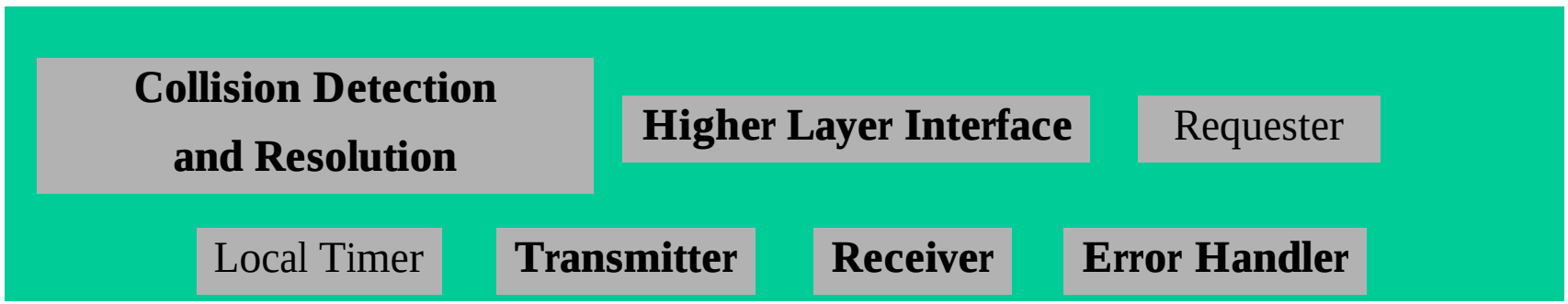
Overview of CAN (Contd.)

- There is no explicit address in the message, instead, each message carries a numeric value which controls its priority on the bus, and may also serve as an identification of the *contents* of the message. Thus, requires some higher layer protocols to take these issues into account. (Application - HLP (Higher Layer Protocol) - CAN)
- There are effective means for isolating faults and removing faulty nodes from the bus. Each node keeps count of the transmitted errors and received errors, since any node detecting error will send error frame. As the counter goes up the node will shut down. (Thus detecting its own fault.)
- CAN is an event based protocol, there is no notion of global time though higher layers can introduce these features.

VP's Customization of the CAN Model Components

VP Technologies has developed a proprietary architecture for CAN-based systems - one that can be quickly customized for various objective functions for different customers.

Bus Access Architectural Template for CAN



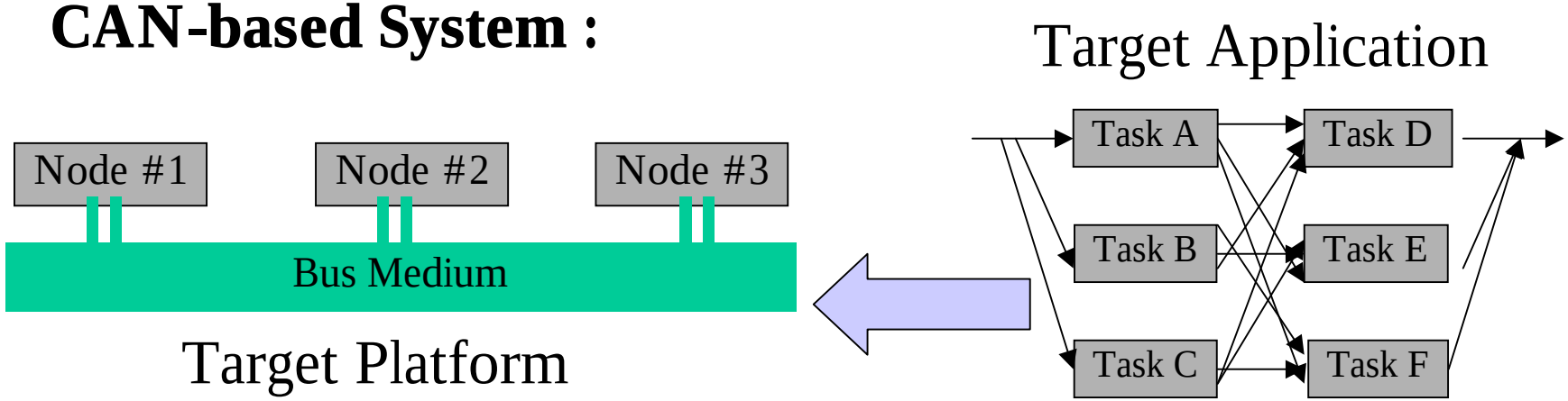
Bus Medium Template for the CAN Protocol

CAN-based Design Flow

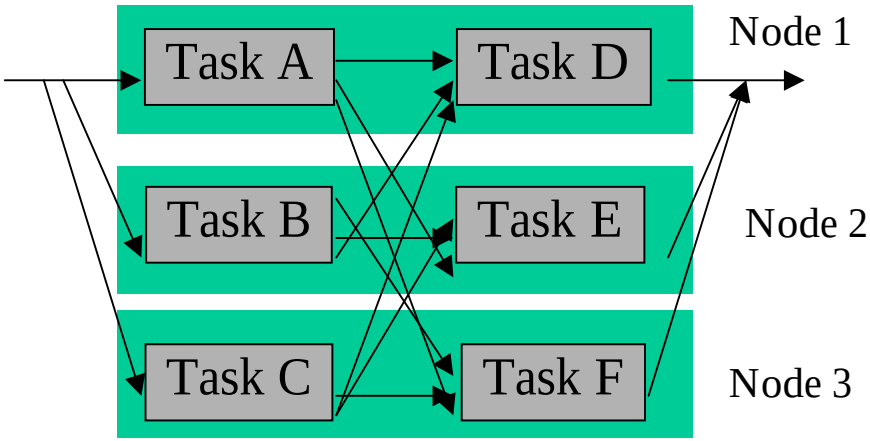
Template Configuration

Our architecture allows us to model and synthesize system-level and component level CAN-based boards.

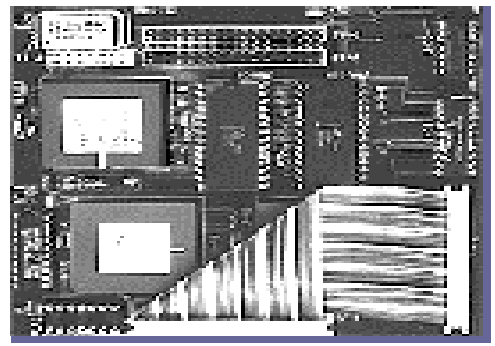
CAN-based System :



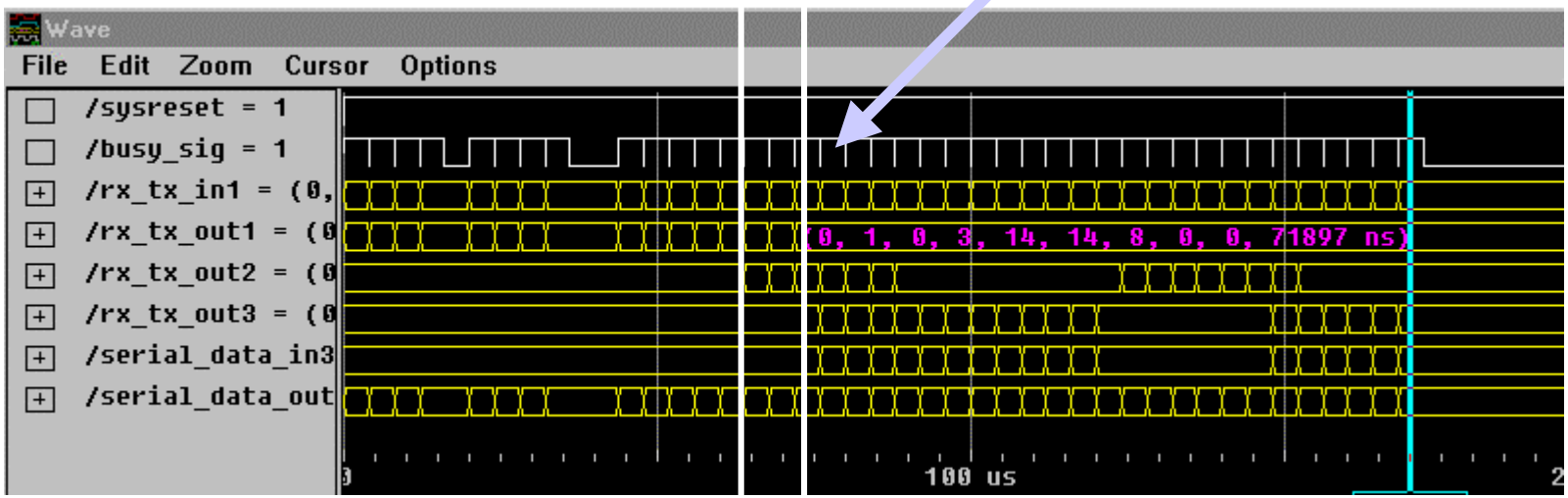
Exemplary Results of Mapping Application onto a CAN-based System using VP's approach.



Task Mapping on the Nodes



Bus Busy / Bus Idle



Collision Between Two Nodes

Interpretation View of Results

Debugging the CAN-based System Results

Collision and Back-off

Collision and Not Back-off

No Collision

Time Line of a CAN Node

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Starting LOOP at 20
COMPUTE TASK Starts :  40030
COMPUTE TASK Finished :  43830
NON BLOCK SEND Starts : 63840
Current BUFF_LENGTH :  32    63840
NON BLOCK SEND for Data Size 32 With Message id 6 Finished : 0
BLOCK RECV for Data Size 32 With Message id 3
 BLOCK RECV Starts : 63840
Attempting for BUS :      COLLISION BUT RECESSIVE
Attempting for BUS :      COLLISION BUT RECESSIVE
Attempting for BUS :      COLLISION BUT RECESSIVE
Attempting for BUS :      COLLISION BUT DOMINANT
Current BUFF_LENGTH:  24    79919
Attempting for BUS :      COLLISION BUT DOMINANT
Current BUFF_LENGTH:  16    83930
Attempting for BUS :      COLLISION BUT DOMINANT
Current BUFF_LENGTH:  8    87941
Attempting for BUS :      COLLISION BUT DOMINANT
Current BUFF_LENGTH:  0    91952
BLOCK RECV for Data Size 32 With Message id 3 Finished : 60010
NON BLOCK SEND Starts : 123850
Current BUFF_LENGTH :  32    123850
NON BLOCK SEND for Data Size 32 With Message id 2 Finished : 0
COMPUTE TASK Starts :  123850
Attempting for BUS :      NO COLLISION
Current BUFF_LENGTH:  24    128051
COMPUTE TASK Finished :  127650
PROGRAM IS OVER : 157650
Communication Overhead: 150030
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Summary

VP Technologies has developed extensive experience with CAN-based systems through the use of proprietary virtual prototyping technologies based on multi-level models.

The current capability includes preliminary and detailed CAN design capabilities for modeling timing behavior at the event level and the clock-edge level.

Current capabilities are exploring the impact of higher level protocol layers on performance, stability and fault-tolerance.

Transition to synthesizable versions of the system can be made with confidence due to reduced risk (schedule & cost) to the customer via VP's virtual prototyping.

We can provide design services to primes in all the above areas.