Review of Researches in Controller Area Networks Evolution and Applications

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Outline

• Introduction
  – Controller Area Network (CAN)
  – CAN Protocol Overview

• Application of CAN
  – Automobile application
  – Home automation application

• Proposed WCAN

• Conclusion
Controller Area Network (CAN)

- bus standard designed to allow microcontrollers and devices to communicate with each other without a host computer.
- distributed network with no central unit
- CSMA/CA for medium access control
- Messages are broadcasted to all other nodes
- message contains no information relating to the destination and source addresses but contains identifier.
CAN Protocol Overview

- 2 standards: standard CAN and Extended CAN
- Difference in identifier
CAN Protocol Overview

- Collision resolved through bit-wise arbitration
- Lower identifier value = highest priority
- 0 as dominant bit and 1 as recessive bit
Application of CAN

Various CAN control modules in Jaguar's sports car, the XK8
Application of CAN

CAN based fire detection system
Wireless CAN

- Adaptation of its wired cousin
- No definite standard proposed yet
- Previous proposed scheme:
  - S. Dridi et. al [1]: RTS / CTS scheme with priority
  - Kutlu et. al [2]: Remote Frame MAC (RFMAC) and Wireless MAC (WMAC)
Wireless Token Ring Protocol (WTRP)

- Follows two analogous characteristics of wired token ring
  - Token passing protocol
  - Ring topology network
- Developed with contention in solving latency and reserved bandwidth problem
Proposed Wireless CAN Protocol

- Frame control (FC) - a SOF, 29-bit message identifier, a RTR, and a reserved bit
- the ring address (RA)
- destination address (DA)
- the source address (SA)
- sequence number - to build an ordered list of stations
- generation sequence - incremented at every rotation of the token by the creator of the token
Operation of WCAN

- Capture the passing token and place message identifier.
- Passing nodes examine the token.
- Higher priority nodes have first access to the token.
- Messages are distributed to all nodes in the network.
Joining a network

- Dynamic manner
- Condition of rotation time does not increase too much
Leaving the network
Performance Evaluation

Two parameters to evaluate:
- Token Rotation Time (TRT)
- Throughput (S/R)
Token Rotation Time

\[ TRT = n \times T_m + N \times (T_t + DIFS) \]

- \( T_m \) = transmission time of data packets
- \( T_t \) = transmission time of token
- \( n \) = active nodes
- \( N \) = total nodes
- \( DIFS \) = DCF interframe space – period of time when channel is available
Performance Evaluation

Throughput

\[ S/R = \frac{(n \times T_m)}{TRT} \]

Transmission delay, \( D \) – time required for data packet to wait for the token to successfully transmitted.

Average, \( D = \frac{TRT}{2} \)

\[ S/R = \frac{(n \times T_m)}{2D} \]
Performance Evaluation

Throughput vs. Delay

- $n = 1$
- $n = 5$
- $n = 10$
Conclusion

• New approach in CAN automation
• Utilizing WTRP as its MAC protocol
  – Flexibility
  – Versatile design
  – Lowering number of retransmission
• Infant stages
• Future works:
  – Simulation environment
  – Delay and performance


THE END