Project Crossroads
Vehicular Ad-Hoc Network for Collision Warning

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Outline

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- Motivation
- Proposed Solution/Theory of Operation
- Design Constraints
- Block Diagrams
- Time Scenario
- Field Testing
- Realized System
- Conclusion
Introduction Scenario
In the United States of America
- 45% of all collisions occur at intersections
- 21% of these are fatal (9213 Total in 2003)
- More than one person per hour

Result: Lost Lives, Money, and Time
- Considered High Priority by DOT
- Currently No Adequate Solution
- Easily Adaptable to Other Scenarios
Proposed Solution

Roadside-to-Vehicle Communication
Roadside Equipment (RSE)

- RSE broadcasts environment variables
  - Stop light conditions
  - Stop line coordinates
  - Intersection ID

Vehicle-to-Vehicle Communication
Onboard Equipment (OBE)

- OBE
  - Obtains speed, location from GPS
  - Obtains intersection info from RSE
  - Calculates warning possibility
Design Constraints

- **Strict Timing Constraints**
  - Safety Critical
  - Consideration toward Human Reaction
- **Budget**
- **GPS Accuracy (within 1.5 meters)**
- **Debug Interface for Testing**
- **Non-Invasive User Interface**
- **Modular Design for Future Adaption**
  - Interface with OBD-II
  - Future Transportation Applications
OBE Block Diagram
Timing Scenario

Assumptions:
- Constant 35 MPH
- Accurate GPS data
- Adequate distance = 45-50 m

- \( T_{RSU} = 192.14 \text{ns (5.9 GHz)} \)
- \( T_{A-B} = 192.14 \text{ns (5.9 GHz)} \)
- \( T_{Eth} = 52 \text{us (10 Mbps)} \)
- \( T_{SPI} = 65 \text{us (8 MHz)} \)
- \( T_{Code} = 31.25 \text{us (16 MHz)} \)

31.28 Meters

300us
Field Testing

- Conducted at UMass Football Stadium
- Utilized the RSE for Virtual Traffic Scenarios
UMass Amherst
Realized System
Concluding Remarks

- Functional Testing
- Restrictions with DSRC
- Inaccuracies of GPS
- Full Scale Implementation
  - RSE Integration
  - OBE Integration
- Future Adaptability