Road traffic injuries is a huge public health problem
- Killing nearly 1.2 million people a year
- Disables 20 – 50 million more

Road traffic crash problem can be corrected

Traffic exposure and crash probability results in crash risk

Accurate data are essential to monitor trends and develop intervention strategies

Smart vehicles and new technologies are opening new opportunities for road safety.

Extracted from:
World Report on road traffic injury prevention, Geneva 2004
The Crash Epidemic

Total Crashes: 15,200,000
Property Damage Crashes: 4,365,000*
Injury Crashes: 1,925,000*
Unreported Crashes: 8,900,000
Fatal Crashes: 38,252

Societal Cost: $230.6 Billion

Fatalities: 42,643

*Police-Reported
Crashes of all Severities, 2000 GES

- Road-Departure: 21.0%
- Rear-End: 29.0%
- Intersection: 26.0%
- Lane Change and Merge: 9.0%
- Pedalcyclist: 1.0%
- Pedestrian: 1.0%
- Animal: 4.0%
- Other: 4.0%
- Opposite Direction: 3.0%
- Backing: 2.0%
Safety Belt Use Rates 1983 - 2004

1983-1990 from 19 city surveys
1991-1997 from State surveys
1998-2002 from NOPUS/mini NOPUS surveys
2004 State Observational Surveys

2004 Rate 82%
Drivers Involved In Fatal Crashes with Positive BACs (BAC>0), 2003

Number of Drivers

BAC (g/dl)

Legal Limit In 50 States

Median, 2003 .16

Source: FARS 2003
Vehicles and Fatalities by Collision Type 2003

Passenger Vehicles in Crashes

Approx. 10.6 million vehicles involved

- Rollover: 1%
- Front: 22%
- Side: 28%
- Rear: 3%
- Other: 3%

Passenger Vehicle Occupant Fatalities

31,904 total occupants killed

- Rollover: 4%
- Front: 23%
- Side: 38%
- Rear: 2%
- Other: 33%
Lives Saved by Safety Technologies, '60 - '02 : 328,551

- 168,524 Lives Saved by Safety Belts Alone
- 160,027 Lives Saved by All Other Safety Features

<table>
<thead>
<tr>
<th></th>
<th>Cost (2002 Dollars)</th>
<th>Weight (Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers Cars</td>
<td>$839.13</td>
<td>125.44</td>
</tr>
<tr>
<td>LTVs</td>
<td>$710.86</td>
<td>86.18</td>
</tr>
</tbody>
</table>

Source: NHTSA
Highway Safety Priorities

- Increase safety belt use
- Reduce impaired driving
- Improve data
- Reduce rollovers
- Improve vehicle compatibility
Advanced Car seating
Restraint Systems
Alcohol Screening Systems

- System needs to be totally unobtrusive
- Nearly 100 percent accuracy essential
- Multiple sensing assures reliability

- Passive system that “sniffs” ambient air
- Applications include testing for alcohol in exhaled breath, vehicles, and other enclosed spaces

**Tru touch skin biometric sensor**

**Siemens sensor technology to detect gases and smells**
Data Collection

Why do we need EDRs?

- New technologies
  - Stability control systems
  - Advanced air bags
  - Other devices that do not leave evidence
- Better pre-crash data
- Better crash severity parameter estimates
- Better crash reconstruction
- Automated collision notification
The Naturalistic “100 Car” Study: Database Statistics

- **42,300 hours of driving data collected**

- **82 Crashes and collisions**
  - Defined as any contact between the subject vehicle and another vehicle, fixed object, pedestrian, bicyclist, animal.

- **761 Near crashes**
  - Defined as a conflict situation requiring a rapid, severe evasive maneuver to avoid a crash.

- **8295 Critical incidents**
  - Conflict requiring an evasive maneuver, but of less magnitude than a near crash.
Understanding normal driving performance is important.
Safety Impact of Incompatibility

Risk of Casualty

Aggressivity Metric

Vehicle Characteristics

Acceptable Risk & Incompatibility

Developed by: Joseph N. Kaniathra
Haddon Matrix

<table>
<thead>
<tr>
<th>Human</th>
<th>Vehicle</th>
<th>Environment</th>
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<tbody>
<tr>
<td>Pre-Event</td>
<td></td>
<td></td>
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<tr>
<td>Post-Event</td>
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</tbody>
</table>
Crash Time Line

Prevention

Severity Reduction

Injury Mitigation

Medical Attention

Crash may not be prevented—but Severity can be Reduced

0

100 m.sec.

1 hr

Developed by: Joseph N. Kaniantha
Why Advanced Technologies?

- Technologies often bring new opportunities
- Potential for total safety benefits
- Save lives, prevent injuries and reduce the economic costs
- How do we know if these systems, and others, improve or degrade safety?
The Challenge

How do we know if these systems, and others, improve or degrade safety?
Two prerequisites

- Objective tests that are related to relevant types of crash
- Computational foundation for incorporating test results and other data sources into a credible estimate of safety impact
Total Safety Cycle

Analysis of Safety Problem

Estimate Real World Benefits

Test Evaluation Procedure Development

Identify Technologies

Developed by: Joseph N. Kanianthra
Crash Time Line

Prevention

Severity Reduction

Injury Mitigation

Medical Attention

Crash may not be prevented—but Severity can be Reduced

Developed by: Joseph N. Kanianthra
Technology Opportunities

- New High Definition Maps and GPS
- Short Range Radar Sensor
- Camera Based Lane Detection
- Long Range Radar Sensor
- Short Range Radar Sensor
- Integrated Human System Interface
Longer Term
New ITS Safety Initiatives

- Integrated Vehicle-Based Safety Systems (IVBSS)
- Intersection Crash Prevention Systems (CICAS)
- Vehicle-Infrastructure Integration (VII)
- Next generation 911
Cooperative Intersection Collision Avoidance Systems (CICAS)

- Every year at intersections:
  - 9100 Fatalities
  - 1,500,000 Injuries
  - 3,000,000 Crashes

- To develop and demonstrate cooperative intersection collision avoidance systems

- To assess the value and acceptance of collision avoidance systems that utilize cooperative communication
Intersection Collision Avoidance
Vehicle Infrastructure Integration (VII)

- Facilitates implementation of FCC allocation of frequency at 5.9 GHz for safety communication
- Creating an “enabling communication infrastructure”
- Emphasis on safety applications
Safety Benefits Estimation of Crash Avoidance Systems Based on Experimental Data

No. of Crashes = No. Police-Reported Crashes
Safety Benefits Estimation of ACAS Based on Field Operational Test Data

System can potentially prevent up to 26% of rear-end crashes

No. Rear-End Crashes

- 4,000,000
- 3,500,000
- 3,000,000
- 2,500,000
- 2,000,000
- 1,500,000
- 1,000,000
- 500,000
- 0

Lower Bound  Upper Bound

Crashes Avoided  Remaining Crashes

95% Confidence Level

No. of Crashes = No. Police-Reported + Non-Reported Crashes
Driver Vehicle Safety Research

- Safety Impacting & Safety Critical In-Vehicle Technology Evaluation
- Countermeasure Development
- User Acceptance
- System Integration for Optimum Performance
- Driver Workload Management
- Driver Training
- Aggressive Driver Research
- Behavior Modification Research
- Demographic & Social Factors Research
- Information Processing Research
- Physical & Mental Capacity Assessment
- Driving Task Demands
- Cognitive & Attention Demand

Situation Awareness Capacity

Developed by: Joseph N. Kaniantha
Total Safety

- Electronic Detection
- Driver/Occupant Warnings
- Prevention
- Occupant Readiness
- Injury Mitigation
- Limited Driver Control
- Anticipatory Driving Assistance

Developed by: Joseph N. Kanianthra
Conclusions

Safety Needs Novel Approaches

- Use market forces
- Innovative regulatory approaches
- Consumer information and education
- Closer cooperation between Government and Industry