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April 27, 1999

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Automated Collision Notification:

Help is on the way!

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What% an Automated **Collision** Notification (A **CN**) Sys tern?

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- . An ACN System consists of an In-Vehicle System that connects via Wireless Communications Systems to an Emergency Services Dispatch Location to:
 - **Notify Emergency Response Personnel of Crash**
 - **Provide Vehicle Location & Information on Crash Severity**
- . Goal is Reducing Response Time for Medical Assistance
- . Activation May be:
 - **Crash Sensor, Air Bag Deployment, or other means**

Why Do We Need ACN Capability?

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- . Time of Crash to EMS Notification (1996)
 - USA average:
 - 7 minutes rural
 - 4 minutes urban
 - Differs greatly from state-to-state
 - North Dakota - 17 minutes
 - Maryland - 2.2 minutes

ACN *Targeted Crashes*

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• **Rural, single vehicle crashes:**

- Longer notification times
- ▶ Few potential "Good Samaritans"
- ▶ Poor location references

Example ACN System

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Emergency Services Dispatch

- . Data Modem
- . Graphic Display of Crash Location & Information
- . Voice Contact w/Vehicle



EMS Notification

- . Location
- . Crash Severity

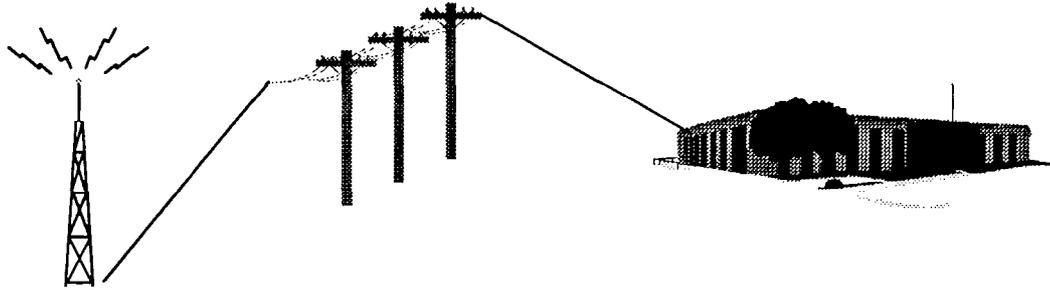
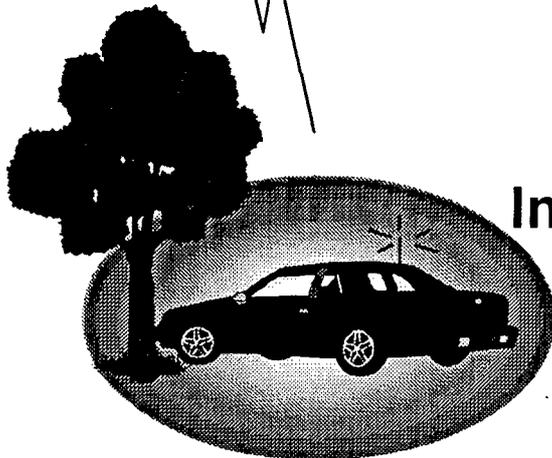


In-Vehicle System

- . Crash Sensor
- . GPS Receiver
- . Cellular Phone



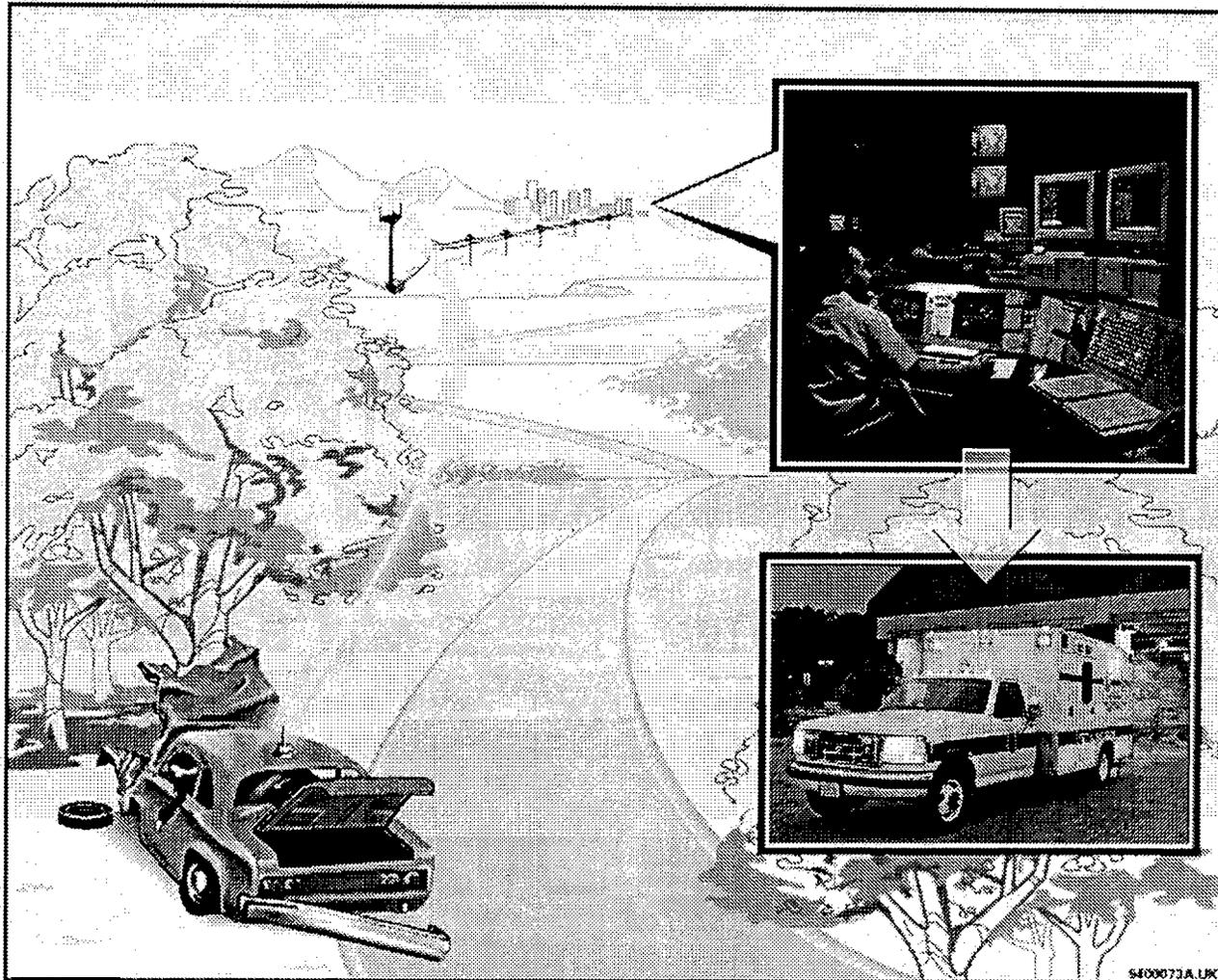
**Crash
Notification
Message**



ACN Flow

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NHTSA Vision

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Improve victim care following a crash by addressing the full spectrum of the emergency services through a seamless nationwide emergency communications network, using the most advanced technology.

NHTSA Goals

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- . Improve emergency access and response
 - ▶ The “Post-Crash” problem
- . Address total “Post-Crash” problem
 - “Field-to-Facility” or “End-to-End” system
- . Health care improvement

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- **Addresses full range of issues**
 - Organization
 - Procedures
 - Technology
- **Emphasis on process**

NHTSA's ACN Deployment Strategy

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- Precursor Technology Assessment
 - ▶ Define system requirements
 - ▶ Assess technology from a theoretical & laboratory perspective
 - ▶ Conduct technology testing in a field I operational environment
- Conduct large scale Field Operational Test (FOT) using results of technology assessment for guidance

Precursor Technology Assessment

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- . Undertaken by The Johns Hopkins University Applied Physics Laboratory
- . Problem assessment
- . Problem decomposition:
 - Crash sensing
 - ▶ Vehicle location
 - ▶ Communications
- . Evaluate emerging technologies for applicability

● Conclusions:

- ▶ Recommend the most promising, existing technologies:
 - Solid state accelerometers for crash sensing
 - Global Positioning Systems (GPS) for vehicle location
 - Cellular telephone for communications
- Need for baseline data
- ▶ Need for geo-location uncertainty parameter
- Potential for success of a FOT of ACN is high

Conduct Large Scale Field Operational Test (FOT)

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- . The purpose of this FOT is to evaluate improvements offered by an Automated Collision Notification (ACN) system.
- . This FOT serves as a bridge between the research and development and deployment of commercial ACN systems.

FOT Objectives

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- . Demonstrate end-to-end system feasibility
- . Demonstrate reliability of ACN In-Vehicle Equipment
- . Measure the survivability & performance of the sensors & instrumentation
- . Demonstrate measurable improvement in efficiency of emergency medical services
 - **Quantify reduction in EMS response times**
- . Evaluate user (drivers, dispatchers, etc.) acceptance & system costs
- . Identify institutional issues with deployment

- . Independent Evaluator (**JHU/APL**)
 - **Not part of the test team**
 - **Not a product manufacturer or consumer service provider**
 - **Technical expert**
- . Employ a systems engineering approach:
 - **Clearly define quantifiable goals & objectives**
 - **Identify MOE's & MOP's**
 - **Ensure appropriate data collected**
 - **Perform data analysis**
- . Focus on evaluation of system benefits & deployment issues

Cooperative Agreement Award

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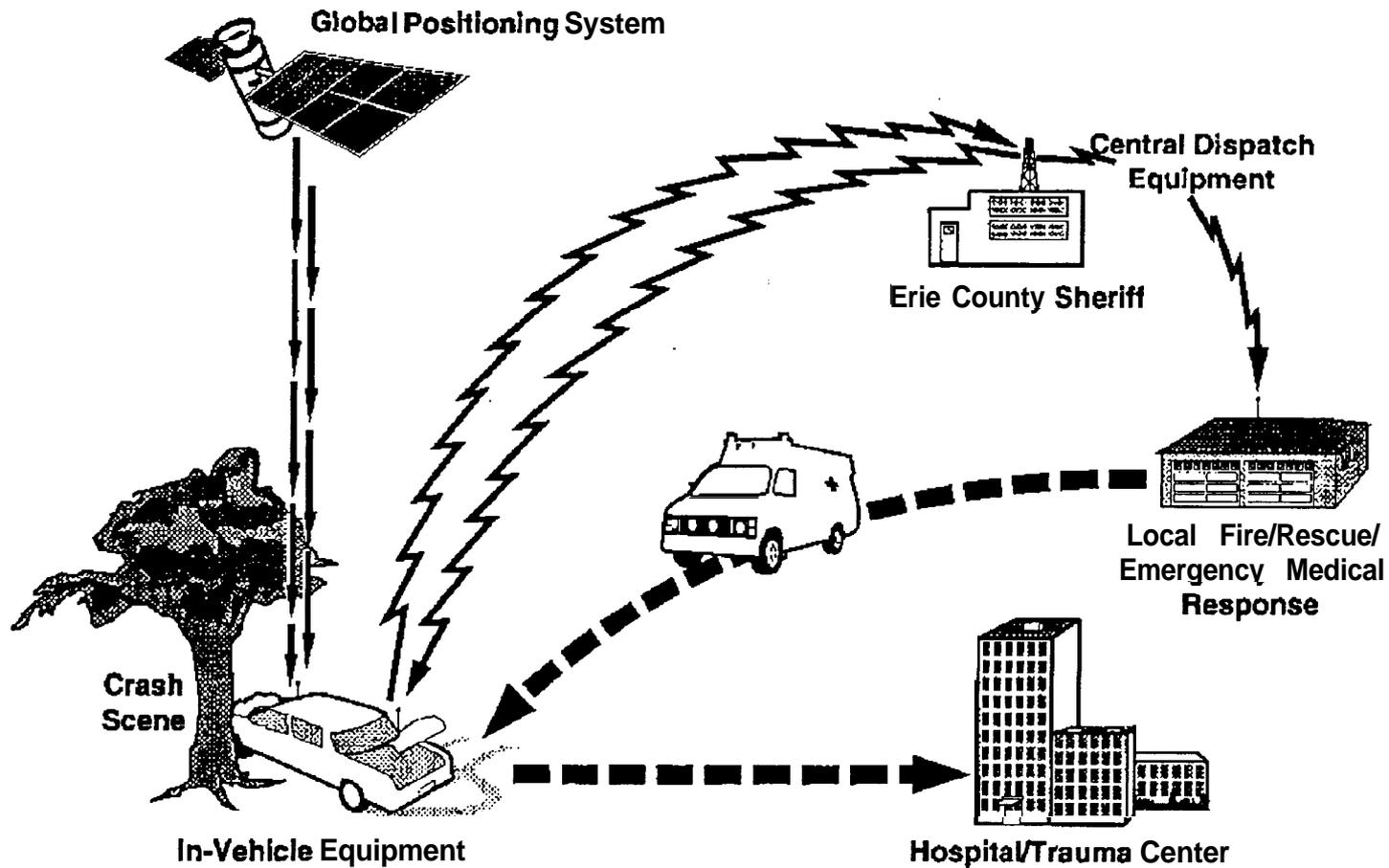
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- **Project Title: Field Operational Test for Automated Collision Notification**
- **NHTSA cooperative agreement No: DTNH22-95-H-07429**
- **Grantee: Calspan Operations of the Veridian Corporation**
- **Estimated total project cost: ~\$5M**
- **Award date: September 30, 1995**
- **Completion date: September 1999**

ACN FOT Flow

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● *Project Overview?! Infrastructure*

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- The ACN system utilizes the current Emergency Messaging Infrastructure:
 - ▶ **As is the case with current 9-1-1 Cellular Phone calls, all ACN Messages will be received by the Erie County Sheriff**
 - ▶ **Calls will then be routed to the appropriate Public Safety Answering Points (PSAP) to dispatch emergency services**
 - ▶ **Emergency medical dispatchers at the Erie County Emergency Communications Center will be alerted to provide instructions to vehicle occupants.**

Project Overview?! ACN Concept

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- . ACN Concept:
 - ▶ **Automatically notifies local EMS in event of a crash:**
 - **Crash sensing: On-board 3 axes, solid state accelerometers**
 - **Vehicle location: via GPS**
 - **Digital Signal Processor to implement crash severity estimation algorithm & format message**
 - **Cellular phone to transmit data message to Emergency Dispatcher & open voice line to vehicle occupants**
- . Operational test is located in Erie County, NY
- . Targets single-vehicle rural crashes to reduce EMS notification time
- . A Goal of 1,000 Vehicles will be installed with ACN system

ACN In-Vehicle Module (IVM)

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The **Calspan** ACN System vehicle system consists of

- **IVM containing central processor unit, crash sensors, cellular phone modem, & Global Positioning System (GPS) receiver**
- **Cellular phone handset & antenna**
- **GPS antenna**

The IVM performs the following functions

- **Determines that a crash has taken place & estimates its severity**
- **Automatically dials the Erie County Sheriff's Department & transmits a digital message with the crash information including vehicle position**
- **Switches the cellular phone to voice mode allowing the dispatcher to maintain contact with the vehicle's occupants**

● *ACN Data Collected? Reported*

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- 3 axis Acceleration Collected:
 - ▶ Data Reported:
 - Computed (estimated) Delta Velocity (Δv)
 - Computed Principal Direction of Force (PDOF)
 - Final Resting Position (roll-over indication)
- Geo-location (latitude/longitude) Collected via GPS:
 - ▶ Data Reported:
 - "Street Address" : Dispatcher software converts lat/long via a Geographical Information System
 - Position error
- Date and Time

ACN 9-1-1 Dispatcher Screen

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NHTSA/Calspan Automated Collision Notification System

File View Agencies Locate Incident Help

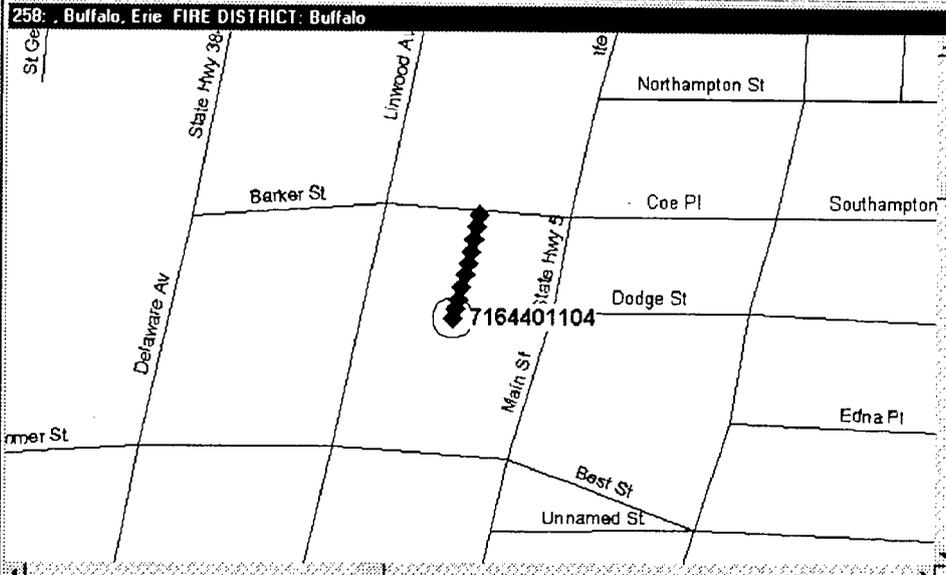
258

258: Buffalo, Erie FIRE DISTRICT: Buffalo

Time of Crash:
 Crash Date: 2/18/98
 Crash Time: 1:48:55 PM
 Elapsed Time: 12 days 19:30:24

Impact Details:
 Lat/Long: N 42.54 20.38° W 78.52 7.43°
 Position Error: 4.19 m
 Final Resting Position: Upright
 Change in Velocity = 14 mph



Vehicle	Fax	Voice	Call status	Hold	Preoc	Vehicle	Owner	Likely Occupants
Dispatcher						Make:		
Buffalo City Police						Model:		
Buffalo City Fire						Color:		
EDMC						Year:		
						Plate:		

Manual Dial:

Manual Dial:

Incident 258

Tuesday March 3 1998, 9:19:19 AM

● *Project Overview.?* *CET Concept*

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. CET (Crash Event Timer): Inexpensive Crash Detector & Timer:

- ▶ Will provide accurate time-of-crash measure, i.e., establish a reliable baseline for time between crash & EMS notification
- ▶ Address poor accuracy of crash times from police reports
- ▶ Goal: Installation in ~4,000 privately owned vehicles
- ▶ CET data will be:
 - Compared to ACN notification times
 - Used to corroborate existing databases of EMS Response Times (Police, PSAP, & Ambulance Reports)

● *Project Overview,..?*
CET

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- . Single axis mechanical switch
- . **3-week** countdown timer
- . **Calspan** crash investigation team reads timer using laptop
- . Small size, inexpensive, driver installed

● **ACN Program Stat&** *(1 April 199)*

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- **Engineering, Design, & Manufacturing Phases Completed**
- **Emergency Message Reception, Display, & Routing Operational**
- **Field Operational Test is Underway:**
 - **Equipment Installed: 677 ACN / 2,930 CET**
 - Days-in-the-Field: ACN: 218,000 CET: 1,782,000
 - ▶ **Data Collection: 8 ACN / 22 CET “Crash Events”**
 - “Incidents”: ACN: 25 CET: 34
 - “Out-of-Area”: ACN: 1 CET: 3
 - ▶ **Supplemental additional testing is being performed**

Summary

Representative ACN Crash

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- **Crash occurred at a Four-Leg Urban Intersection in Buffalo on February 18, 1998 at 1:50pm**
- **Two vehicles were involved**
 - ▾ **1993 Ford Taurus**
 - ACN equipped
 - Airbag Equipped but not deployed
 - Sustained damage to right side fender & right quarter panel
 - Single Passenger - Transported to Hospital (AIS 2)
 - ▾ **1998 Pontiac Sunfire**
 - Airbags deployed
 - Single Passenger - Injuries unknown at this time

ACN Crash Summary: Continued

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- . ACN reported crash message:
 - ▶ Crash Delta Velocity: 14 MPH
 - ▶ Principal Direction of Force: 2 O'clock
- . Three Reports received by 9-1-1 :
 - ▶ ACN (First)
 - ▶ 1 land line 9-1-1
 - ▶ 1 cell phone 9-1-1

Damage to Taurus

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Injury Probability: Estimation Algorithm

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Post Crash Algorithm: Injury Probability

File Data Help

Vehicle / Crash Data

Clear Data RollOver: No

Crash Delta V (mph): 14

Side Damage, Passenger Compartment: Yes

Rear Damage: No

Curb Weight (lbs): 3200

Incident ID: 258

Estimate of Injury Probability

100%

50%

0%

5%

Occupant Data

Clear Data Seat Belt Used: Yes

Age: 40

Gender: Female

Entrapment: No

Complete Ejection: No

Read IVM Data

Override IVM

Exit

What have we learned so far?

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- **High level of interest in ACN systems:**
 - **EMS Service Providers (ER & Trauma Physicians), Law Enforcement, Driving Public, Major Vehicle Suppliers**
- **Automated Emergency Messaging Creates New Issues for EMS Dispatchers & Services Providers:**
 - **New Procedures & Protocols need to be Developed**
- **Identification of Legal & Institutional issues:**
 - **Ownership of ACN data**
 - **EMS procedures must be modified to accommodate ACN:**
- **ACN system design feasibility**

Status of ACN Systems

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- . Public-private partnerships have conducted operational tests addressing deployment issues
- . First commercial systems have been introduced:
 - ▶ **GM OnStar, Ford Rescu, etc.**
- . Additional architectural, deployment, & performance issues need to be addressed
- . Interactions with the public safety dispatch infrastructure need to be defined
- . System standards are under development

Relationship to National ITS Goals

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- **IMPROVE SAFETY**
- Increase efficiency and capacity
- Reduce energy/environment cost
- Enhance productivity
- Enhance personal mobility
- Create an environment in which ITS can flourish

Program Impact

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- Model for developing & implementing capabilities
- Element of National ITS Architecture development
- Basis for standards development for ACN systems
- Accelerate deployment of a nationwide ACN

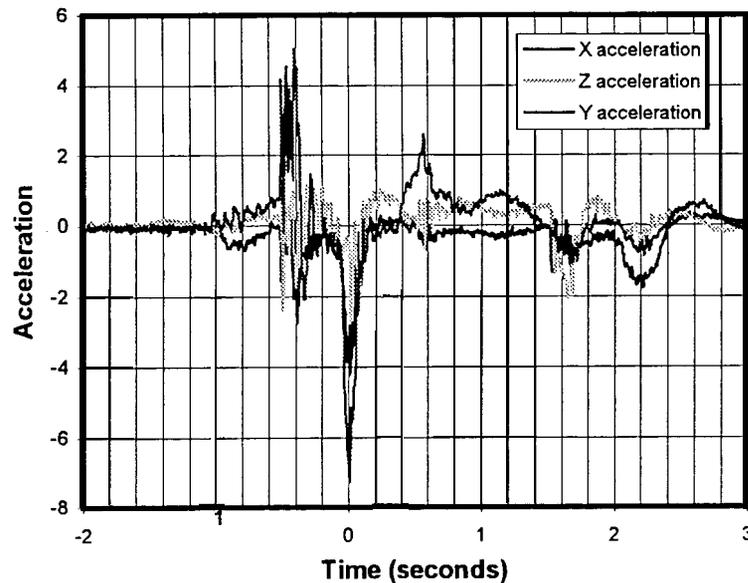
ACN Crash

January 31, 1999

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- Crash Time: 04:40 pm
- Notification Time: 04:41 pm
- Police Response Time: 04:45 pm
- EMS Response Time : 04:48 pm
- Delta Velocity (DV): 16 mph
- Principal Direction of Force: 2 o'clock
- Number Injured: 2
- Maximum AIS: 2



ACN Crash - Continued

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ACN Dispatcher Interface

NHTSA/Calspan Automated Collision Notice

File View Agencies Locate Incident Help

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Time of Crash
 Crash Date: 1/31/99
 Crash Time: 4:40:00 PM
 Elapsed Time: 0 days 00:03:53

Impact Details
 Lat/Long: N 42 52 3.97 W 78 44 32.93
 Position Error: 267 m
 Final Resting Position: Upright
 Change in Velocity = 15 mph

728 - Fire DISTRICT: Southline

Vehicle	For	Voice Call status	Hold	Priority	Vehicle	Owner	Likely Occupants
Dispatched					Make:		
Cheeklowaga Police					Model:		
Cheeklowaga Fire					Color:		
ECMC					Year:		
Manual Dial:					Plate:		
Manual Dial:							

Incident 728 Sunday January 31 1999 4:43:53 PM

ACN Crash - Continued

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Occupant #1

Post Crash Algorithm: Injury Probability

File Data Help

Vehicle / Crash Data

Clear Data RollOver: No
Crash Delta V (mph): 16
Side Damage, Passenger Compartment: Yes
Rear Damage: No
Curb Weight (lbs): 4012

Incident ID:

Estimate of Injury Probability

100%
50%
0%

10%

Read IVM Data
Override IVM
Exit

Occupant Data

Clear Data Seat Belt Used: Yes
Age: 68
Gender: Male
Entrapment: No
Complete Ejection: No

Actual Injury: Cervical Strain (AIS-1)
Transported and Released

Occupant #2

Post Crash Algorithm: Injury Probability

File Data Help

Vehicle / Crash Data

Clear Data RollOver: No
Crash Delta V (mph): 16
Side Damage, Passenger Compartment: Yes
Rear Damage: No
Curb Weight (lbs): 4012

Incident ID:

Estimate of Injury Probability

100%
50%
0%

25%

Read IVM Data
Override IVM
Exit

Occupant Data

Clear Data Seat Belt Used: No
Age: 67
Gender: Female
Entrapment: No
Complete Ejection: No

Actual Injury: Non-displaced compression fracture of the L1 vertebral body (AIS-2)
Transported and Hospitalized (2 days)

Next Step?

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. WIRELESS E-9-1-1

▶ **Architecture and Standards**

- Local / State / Regional / National
- PSAP / Vehicle Capability / Equipment
- Means of vehicle location:
 - example: GPS or triangulation
- Means of communications
 - example: Cellular or satellite

▶ **Stake holders (non-traditional roles / interactions)**

- ComCARE Alliance, AAA, NENA, Emergency Medical, Public Safety, Consumer groups, Wireless companies

▶ **FCC rule - federal legislation**

9-1-1 Critical Issues Forum

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- . Integrating Transportation, EMS, and 9-1-1 :
A Vision for the Future
- . May **20, 21**: Alexandria, VA
- . NENA, NHTSA, **ComCARE** Alliance, Wireless providers, CTIA, ITS America