

# **GIS @ NTSB : The Next Steps**

**Dr. David J. Cowen**

**Chair, National Geospatial Advisory  
Committee**

# Outline

- Role of GIS data and technologies in transportation safety.
- Institutional Issues - FGDC and NGAC
  - FGDC Mission
  - The Transportation Theme
    - Role of DOT (GAO Report)
  - NGAC initiatives
  - Potential linkage to NTSB
- Data accessibility, standard, and interoperability
  - Streets and Addresses
- Long Term impacts of driverless vehicles

# 1. Role of GIS data and technologies in transportation safety.

# Typical NTSB Highway Accident Report Non – GIS

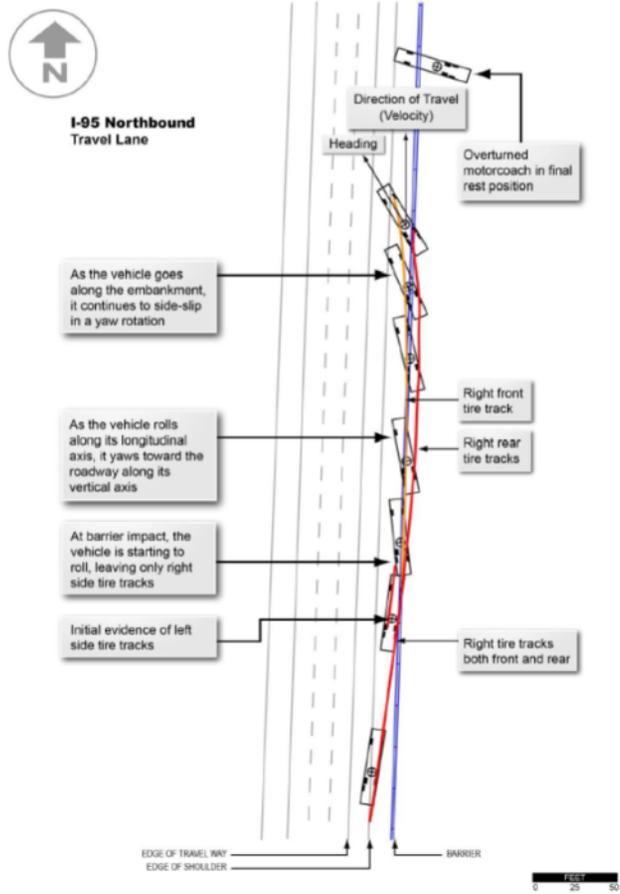


Figure 2. Accident scene diagram.



Figure 3. Map showing the motorcoach's travel area and the accident location.

# Safety Oriented GIS Events

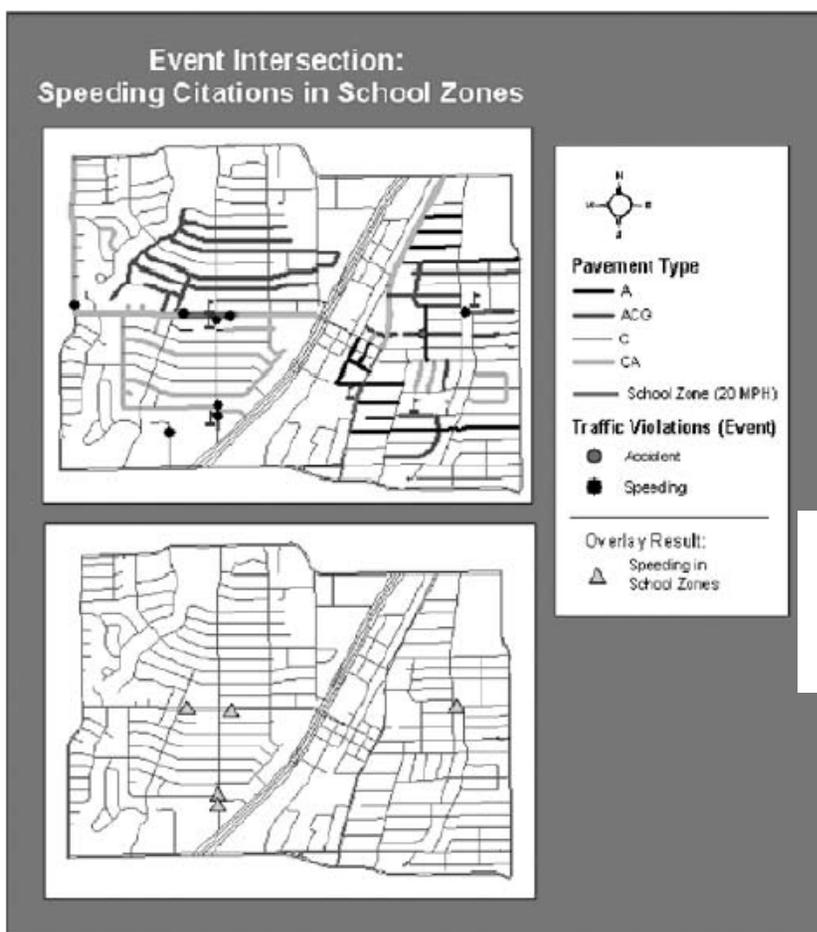


Figure 9. Intersection of linear and point events

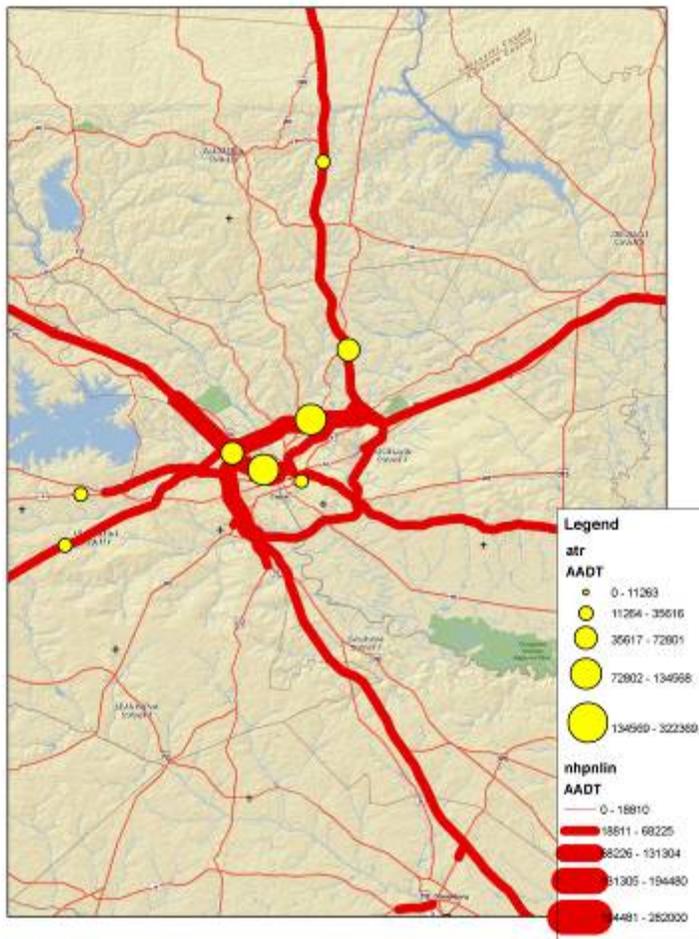
## A Comprehensive Process for Linear Referencing

*Kevin M. Curtin, Greta Nicoara, and Rumana Reaz Arifin*

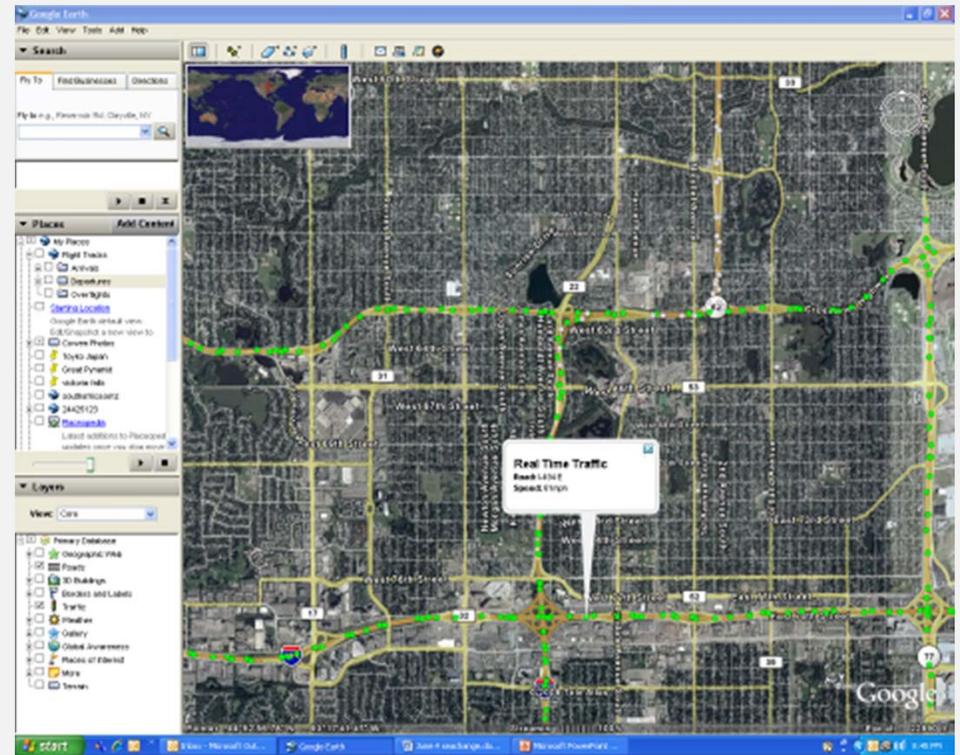
# GIS Context

Static

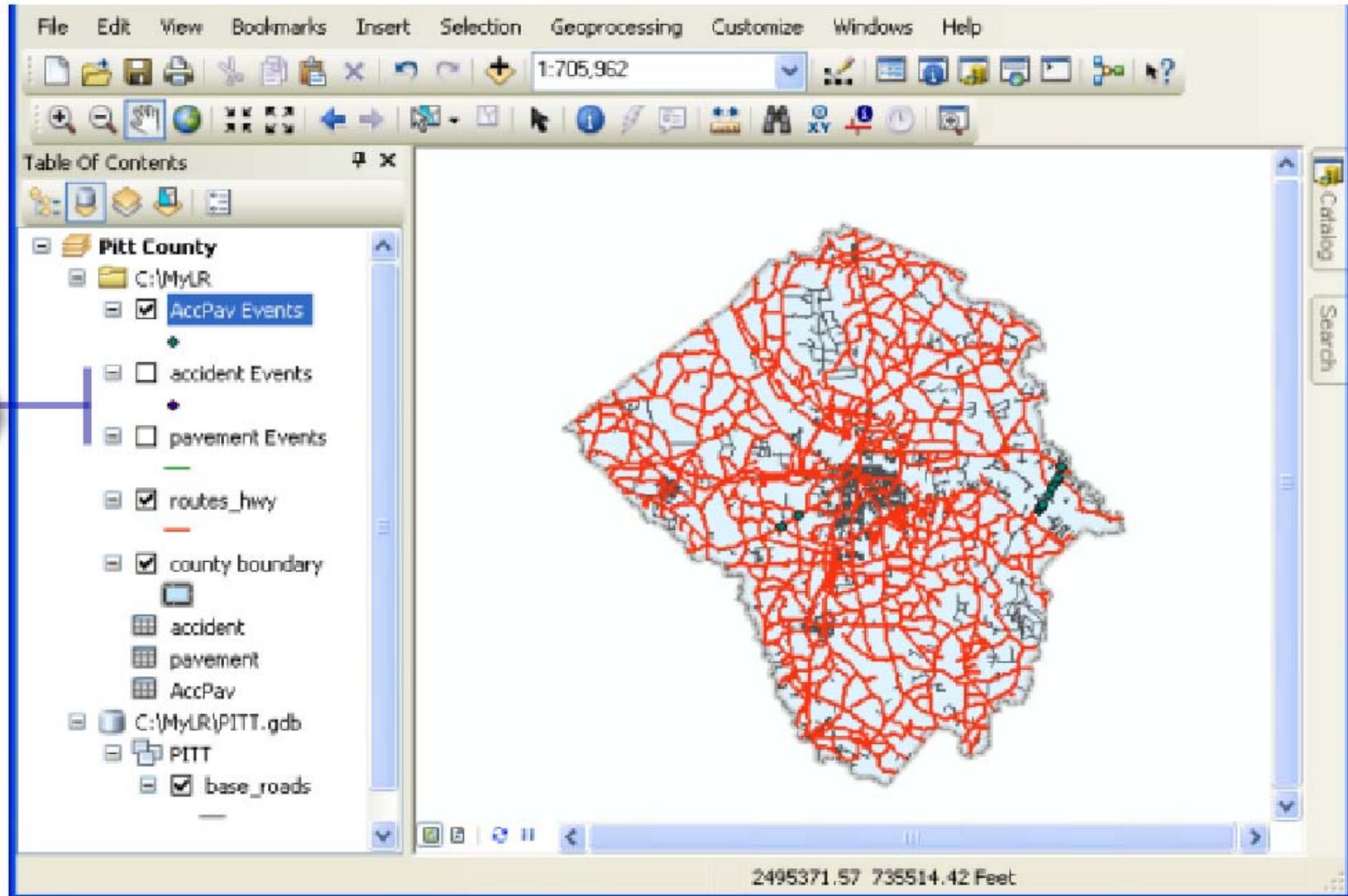
BTS GIS Data



Real Time

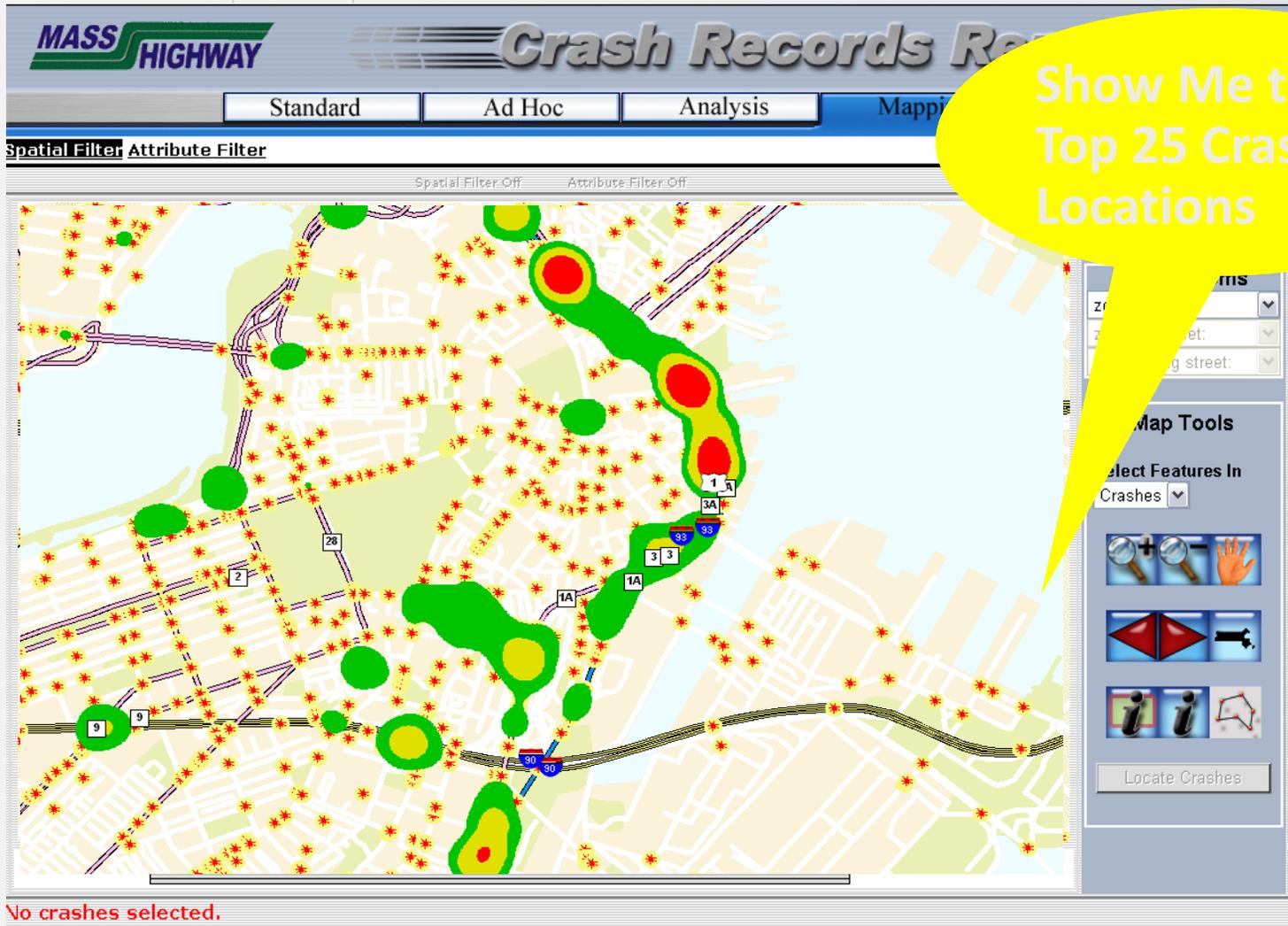


# GIS - Point and Linear Events





# Custom GIS Server Analysis



© 2005 MHD Last revision: 07.19.2005

Polygon - Click to start line. Click again to add vectors. Press Ctrl key while clicking, or double-click to add last vector and finish polygon.  
 Polyline - Click to start line. Click again to add vectors. Press Ctrl key while clicking, or double-click to add last vector and finish line.

# Infrastructure: GIS is needed! - \$1.6 Trillion

36 United States

Economist

Infrastructure

## The cracks are showing

CHICAGO AND NEW YORK

**America's tradition of bold national projects has dwindled. With the country's infrastructure crumbling, it is time to revive it**

America has a grand tradition of national planning, from Thomas Jefferson's vision for roads and canals in 1808, which influenced policy for the next century (and led to America's first transcontinental railway) to Dwight Eisenhower's Federal Highway-Aid Act of 1956, which created the interstate system. Such plans stand in stark contrast to the federal government's strategy today. America invests a mere 2.4% of GDP in infrastructure, compared with 5% in Europe and 9% in China. America's ageing water infrastructure is sorely underfunded: the Environmental Protection Agency forecasts an \$11 billion annual gap in meeting costs over the next 20 years.

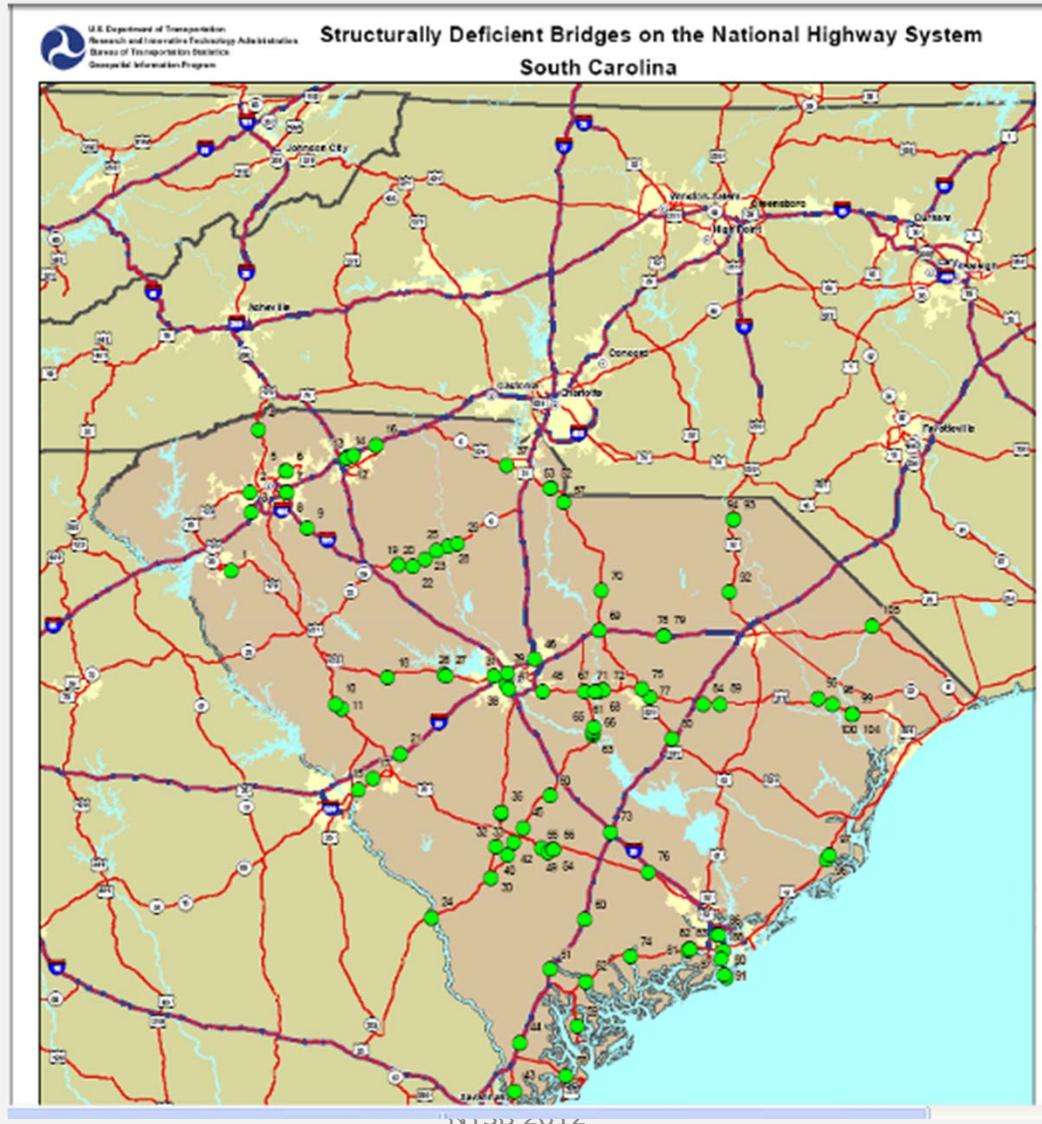
The country's transport network is similarly dysfunctional, says a recent Urban Land Institute report. Important gateways, such as the ports in Los Angeles and New York, are choked. Flight delays cost at least \$15 billion each year in lost productivity. Commutes are more dismal than ever. Congestion on roads costs \$78 billion annually in the form of 4.2 billion lost hours and 2.9 billion gallons of wasted petrol, ac-

last summer. In 2005 the American Society of Civil Engineers estimated that \$1.6 trillion was needed over five years to bring just the existing infrastructure into good repair. This does not account for future needs. By 2020 freight volumes are projected to be 70% greater than in 1998. By 2050 America's population is expected to reach 420m, 50% more than in 2000. Much of this growth will take place in metropolitan areas, where the infrastructure is already run down.



No little plan needed

# Measure, Map, Monitor & Manage Structurally Deficient Bridges



## 2. Institutional Issues - FGDC and NGAC

- FGDC Mission
- The Transportation Theme
  - Role of DOT (GAO Report)
- NGAC initiatives
- Potential linkage to NTSB

# FGDC - Mission / Authority

The Federal Geographic Data Committee (FGDC) is an interagency committee that promotes the ***coordinated development, use, sharing, and dissemination*** of geospatial data on a national basis.

“...advance the goals of the National Information Infrastructure; and to avoid wasteful duplication of effort and promote effective and economical management of resources by Federal, State, local, and tribal governments...” (Clinton Executive Order 12906 )

**Authority:** The Office of Management & Budget (OMB) established the FGDC in 1990, and re-chartered the committee in its August 2002 revision of Circular A-16, “Coordination of Geographic Information and Related Spatial Data Activities.” Executive Order 12906 assigns NSDI implementation responsibility to the FGDC.

# FGDC Structure

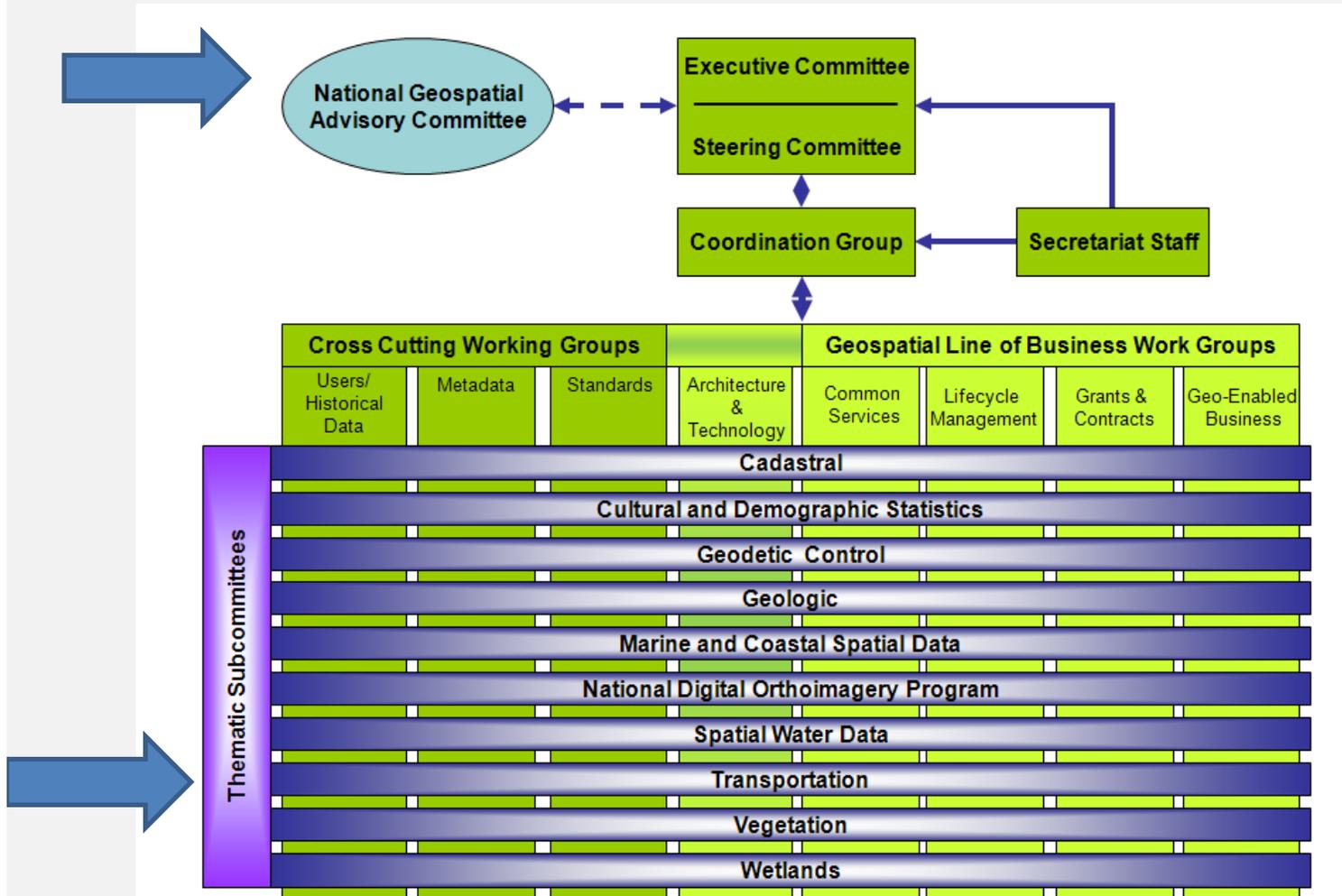
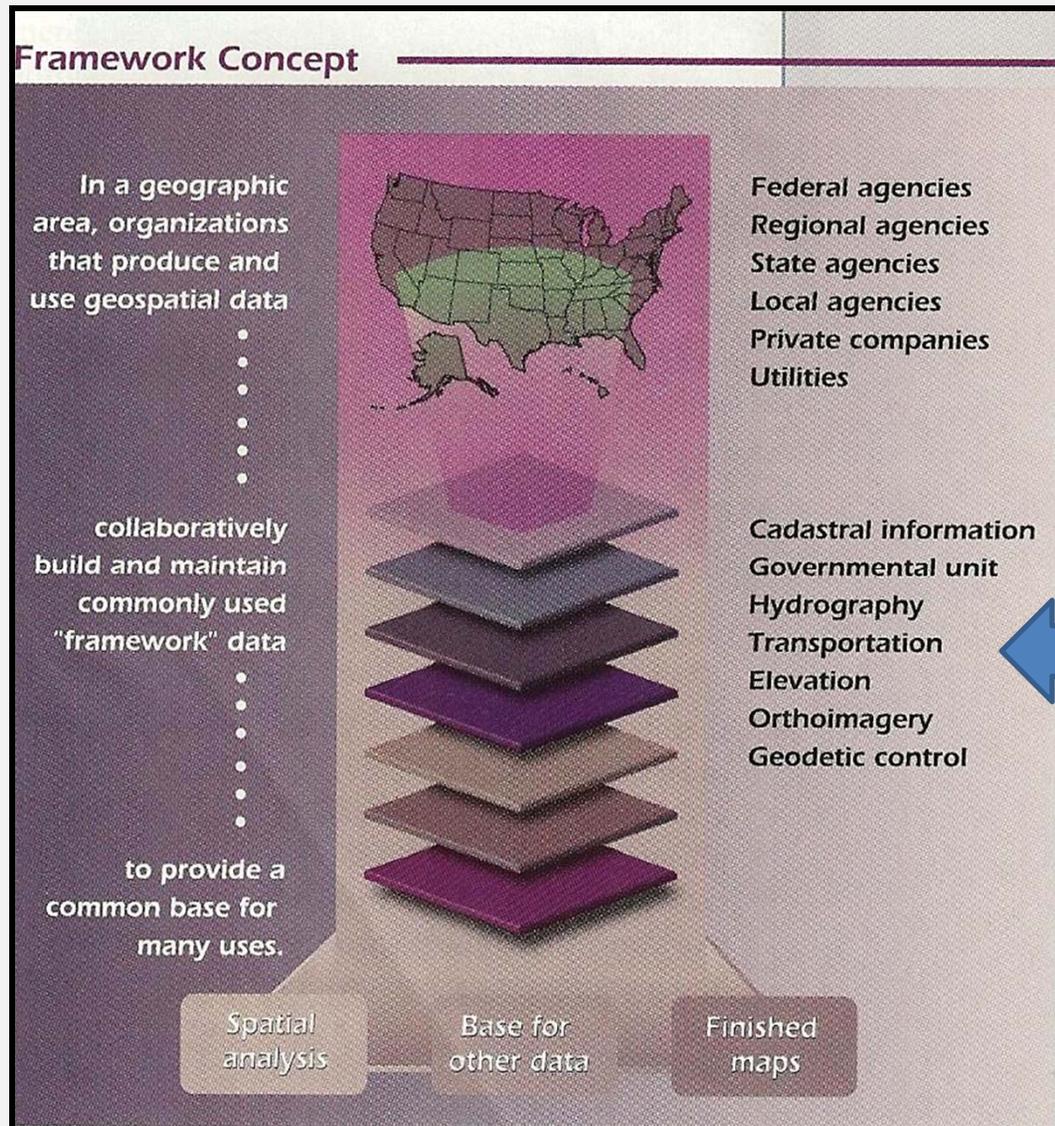


Figure: Overview of the structure of the various components of the FGDC

# Transportation is a Framework Dataset



**Framework Data:** Seven themes of geospatial data that are used by most GIS applications. These data include an encoding of the geographic extent of the features and a minimal number of attributes needed to identify and describe the features.

Source:  
Framework Data Survey: Preliminary Report ,  
NSGIC & FGDC , 1999

## OMB – A-16

- **Transportation:** Department of Transportation, Bureau of Transportation Statistics

*Transportation data are used to model the geographic locations, interconnectedness, and characteristics of the transportation system within the United States. The transportation system includes **both physical and non-physical components representing all modes of travel** that allow the movement of goods and people between locations.*

- **Transportation (Marine):** USACE

# Proposed New Data Themes -

## Status of Theme Lead Agencies and Theme Leads

Theme	Lead Agency	Theme Lead	Contact Name
Biota	DOI/USGS	Theme Lead Candidate**	Marcia McNiff
Cadastre	DOI/BLM	Point of Contact***	Don Buhler
Climate and Weather	Commerce/NOAA	Theme Lead Candidate	Anne Ball
Cultural Resources	DOI/NPS	Theme Lead Candidate	Deidre McCarthy
Elevation	DOI/USGS Commerce/NOAA	Theme Lead Candidate Theme Lead Candidate	Tracy Fuller Jeff Ferguson
Geodetic Control	Commerce/NOAA	Theme Lead Candidate	Juliana Blackwell
Geology	DOI/USGS DOI/BOEM	Theme Lead Candidate Theme Lead Candidate	Dave Soller George.Dellagiarino
Governmental Units, and Administrative and Statistical Boundaries	Commerce/NOAA	Theme Lead Candidate	Lynda Liptrap
Imagery	DOI/USGS USDA/FSA	Theme Lead Candidate Theme Lead Candidate	Dick Vraga Shirley Hall
Land-Use Land Cover	DOI/USGS USDA/FS	Theme Lead Candidate Theme Lead Candidate	Jonathan Smith Ken Brewer
Real Property	GSA	Theme Lead Candidate	John Sullivan
Soils	USDA/NRCS	Theme Lead Candidate	David Hoover
Transportation	DOT	Theme Lead Candidate	Raquel Hunt
Utilities	BSEE DOE (TBD)*	Theme Lead Candidate	Warren Williamson
Water-Inland	DOI/USGS DOI/FWS	Theme Lead Candidate Theme Lead Candidate	Steve Aichele Bill Wiilen
Water Oceans Coasts	Commerce/NOAA	Theme Lead Candidate	Tony LaVoi

\* Conversations about a specific Agency Theme Lead resource are underway

\*\* The nominated Theme Lead will be listed as a "Theme Lead Candidate" until the nominee is approved by the Theme Lead Agency SAOGI and Executive Theme Champion

\*\*\* An agency contact is listed as "point of contact" if they indicated they are not yet ready to appoint a Theme Lead

\*\*\*\* An Agency contact is listed as FDGC Coordination Group Member when there has been no nomination of a Theme Lead or a point of contact other than the FGDC CG member



# Proposed Transportation Datasets

<b>Dataset Name</b>	<b>Theme</b>	<b>Agency</b>
Census Address Range-Feature Name Relationship File	Transportation	DOC-Census
Census Address Ranges Relationship File	Transportation	DOC-Census
Census All Roads Dataset	Transportation	DOC-Census
Inland Electronic Navigation Charts (IENC)	Transportation	DOD-USACE
National Transportation Dataset - National Map	Transportation	DOI-USGS
National Transportation Atlas DataBase-Airports Dataset	Transportation	DOT-BTS
National Transportation Atlas DataBase-Rails Dataset	Transportation	DOT-BTS
National Transportation Atlas DataBase-TransitLines Dataset	Transportation	DOT-BTS
National Transportation Atlas DataBase-TransitStation Dataset	Transportation	DOT-BTS
Census Rails Dataset	Transportation	DOC-Census
Traffic Analysis Zone (Census 2000)	Transportation	DOC-Census

# GAO Report - November 26 , 2012

## Need to reduce duplication

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**GAO**

United States Government Accountability Office

Report to the Committee on Homeland  
Security and Governmental Affairs,  
U.S. Senate

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November 2012

### **GEOSPATIAL INFORMATION**

**OMB and Agencies  
Need to Make  
Coordination a  
Priority to Reduce  
Duplication**

# GAO Recommendations to DOT

Secretary designate a **senior agency official** who has department wide responsibility, accountability, and authority for geospatial information issues.

## Specific recommendations

- Prepare, maintain, publish, and implement a **strategy** for advancing geographic information and related geospatial data activities appropriate to its mission.
- Develop a **policy** that requires the department to make its geospatial metadata available on the clearinghouse.
- Develop and implement internal **procedures** to ensure that it accesses the NSDI clearinghouse before it expends funds to collect or produce new geospatial data to determine
  - (1) whether the information has already been collected by others and
  - (2) whether cooperative efforts to obtain the data are possible.

# GAO Recommendations Continued

- We further recommend that the Secretary of Transportation direct the transportation ***theme point of contact*** to take the following three actions.
  - • Prepare goals relating to all datasets within the transportation theme that support the NSDI, and as needed, collect and analyze information from ***user needs*** and include those needs in the theme-related goals.
  - • Develop and implement a plan for the nationwide population of the transportation theme that addresses all datasets within the theme; and that includes
    - (1) the development of ***partnership programs*** with states, tribes, academia, the private sector, other federal agencies, and localities that meet the needs of users;
    - (2) human and financial resource needs;
    - (3) standards, metadata, and the clearinghouse needs; and
    - (4) a timetable for the development for the theme.
  - Create and implement a plan to develop and implement transportation theme standards.

# Standards

- The FGDC has adopted the United States ***Thoroughfare, Landmark, and Postal Address*** Data Standard (FGDC-STD-016-2011).



# Overview of Draft Street Address Standard

## Address Standards Working Group

### Co-Chairs:

Martha Lombard  
Spatial Focus, Inc.

Ed Wells  
DC OCTO

Hilary Perkins  
Jacobs Civil, Inc.

Sara Yurman  
Spatial Focus, Inc.

Carl Anderson  
Fulton County, GA



# Thoroughfare Classes

*A thoroughfare address specifies a location by reference to a thoroughfare.*

*A thoroughfare in this context is a road or other access route (for example, a walkway, railroad or river) by which the addressed feature can be reached.*

- **Site: 1230A North Main Street Extended**
- **Landmark-Site: City Hall, 410 Main Street**
- **Intersection: Seventh Street and D Street**
- **Two-number Range: 110-126 Main Street**
- **Four-number Range (TIGER format):**
  - **100-130, 101-135 Main Street**
- **Unnumbered Thoroughfare: Fagaima Road**



## Part 3: Street Address Data Quality

- Goal: Define quality control for addresses (not redefine principles of spatial quality)
- Existing standards and documents describing spatial data quality
  - Content Standard for Digital Geospatial Metadata (CSDGM)
  - Topic 11: OpenGIS Metadata (ISO/TC 211 DIS 19115)
  - Supporting ISO Geographic Information standards
    - 19113: Quality principles
    - 19114: Quality evaluation procedures
  - Spatial Data Transfer Standard (SDTS)
- All the standards describe spatial data quality in similar terms

# NGAC Initiatives

# NGAC – Geospatial Information Services for the Nation

- Overarching recommendation: The FGDC responsibilities for leadership, management and coordination of geospatial information and services across government, including continuing management of the Geospatial Platform and its supporting data, ***must assume a central role in the policy, budgetary, and procurement process related to geospatial programs.***
- Outcome: FGDC has ***greater authority, a more comprehensive funding strategy, and permanent staffing*** to implement a more robust, efficient, reliable, cost effective level of Geospatial Information Services for the Nation to support decision making.

# National Geospatial Strategy

- **Stimulating Economic Growth Through Geospatial Technology**
- **Using Geospatial Information To Control Costs and Save Taxpayer Dollars**
- **Applying Geospatial Tools To Ensure Public Safety and Decision-Support**

# Recommendations - Continued

- Fully Implement the Geospatial Platform and Geospatial Portfolio Management
- Implement Coordinated Multi-Agency, Intergovernmental Geospatial Data Initiatives
  - 3-D Elevation Program
  - ***Transportation for the Nation***
  - National Land Imaging
  - ***National Land Parcel Data***
  - ***National Address Data***
  - Imagery for the Nation
  - National Height Modernization System

# The Need for a National Address Database

- The NGAC proposes the following *Vision Statement* for a National Address Database.

*“The National Address Database is an authoritative and **publicly available resource** that provides accurate address location information to save lives, reduce costs, and improve service provision for public and private interests.”*

# National Address Database

USERS	PURPOSE
FEMA	Pinpoint disaster areas, provide relief
Emergency Response, E9-1-1	Emergency response by first responders (police, fire, ambulance, rescue)
Department of Homeland Security	Locate and protect critical infrastructure
Public Safety	Crime analysis and response, incident/citation tracking
Voter Registration	Precinct assignment
State Dept. of Revenue	Sales tax collection and distribution
USPS, UPS, FedEx	Mail and package delivery
Census Bureau	Mail census and survey forms, geocode responses; Census gathering and tracking; locate non-respondents
Health and Human Services Agency	Track medical benefits, disease, births/deaths, and vulnerable populations.
Call Before You Dig (8-1-1)	Infrastructure protections, development coordination
Department of Transportation	Locate traffic accidents, access to FHWA funds to improve dangerous non-state roads.
Utilities (public & private)	Hookup, service calls, billing
Map and address companies (e.g. MapQuest, Navteq and TomTom)	Repackage/reformat accurate data for insurance companies, location based service companies and utilities
Retail/Services (e.g., Sears, local plumber)	Delivery of goods and services, new site locations
Assessor/Taxation	Property and owner location
Planning & Zoning Office	Building permit, planning studies

# Data - Linkage to NTSB

- Place accidents and safety into geographic context
  - Quantitative and qualitative attributes to transportation features
- Measure, Map, Monitor and Manage transportation infrastructure to support safer movement of people and freight
- Identify patterns and associated causes for accidents
- Recommend preventative measures
  - Speed limits
  - Crossing hazards
  - Guard rails
  - Signage
  - Bridge maintenance

### 3. Data accessibility, standard, and interoperability

- Geospatial Platform
- Streets and Addresses

# Executive Support for a Common Platform



# Platform Provides Opportunity for NTSB

**GEOSPATIAL PLATFORM RESOURCE CENTER**

HOME ABOUT DOCUMENTS NEWS

## WELCOME TO THE GEOSPATIAL PLATFORM WEBSITE

The partner agencies of the Federal Geographic Data Committee (FGDC) are developing a Geospatial Platform to more effectively provide place-based products and services to the American public. The Geospatial Platform will be a managed portfolio of common geospatial data, services, and applications contributed and administered by authoritative sources and hosted on a shared infrastructure, for use by government agencies and partners to meet their mission needs and the broader needs of the Nation.

*Read the President's Call to Action that Launched the Geospatial Platform*

**New!** Read the new Geospatial Platform Value Proposition and let us know what you think.

**Learn More:** View the Geospatial Platform Conceptual Model, Technical Model, or Timeline.

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### COMMON DATA

Core geospatial data will be a key building block of the platform offering. Data sets are selected by the Managing Partner because they meet inclusion criteria outlined in the A-16 Supplemental Guidance and are used by two or more agencies/partners to meet their business needs.

### COMMON SERVICES

Common geospatial services will provide users with consistent capabilities for performing necessary geospatial functions. Examples of common services include geocoding, basemap services, requirements development and tracking tools, system computing cycles and file transfer protocol (FTP) services, acquisition services, data production services and training.

### COMMON APPLICATIONS

Key tools or capabilities that enable users to perform geospatial visualization or analysis, including software, online applications and geo-processing required by two or more agencies/partners/customers. This category of applications includes a broad spectrum of analytical support generated to facilitate the government's delivery of services to citizens.

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The FGDC is an interagency committee that promotes the coordinated development, use, sharing, and dissemination of geospatial data on a national basis.  
[See More](#)

Data.gov increases the ability of the public to easily find, download, and use datasets generated and held by the Federal Government.  
[See More](#)

# GAO Highlighted the Need to Coordinate National Highway Data Base

## **Duplication of Effort:**

Acquisition of nationwide road centerline data across federal agencies and other levels of government, resulting in millions of wasted taxpayer dollars.

- Census Bureau's (TIGER) system, which uses data procured from local sources for census enumeration and demographic applications.

The report identified several initiatives that are currently independently acquiring road centerline data:

- USGS's National Map website, which uses licensed data from a commercial provider to create viewable maps on the National Map. These data are managed by USGS.
- The Department of Defense's Homeland Security Infrastructure Program, which uses licensed commercial data procured by the National Geospatial-Intelligence Agency for emergency management.

# DOT – MAP 21

## A Unique Opportunity

- MAP-21 passed legislating the creation of a “Basemap” with the capability to ***attach Safety attributes***.
- Office of Management and Budget cleared HPMS to collect an All-Public dual carriageway Road Network ***from States DOT***
- Office of Planning authorized the use of State Planning and Research (SPR) funds for producing this Network with a ***waiver to the state Match requirement***
- HPMS issued a Memo that requests states to provide a network to include ***all paved and unpaved public roads in 2014***.

# Centerlines Versus Ramps and Carriageways

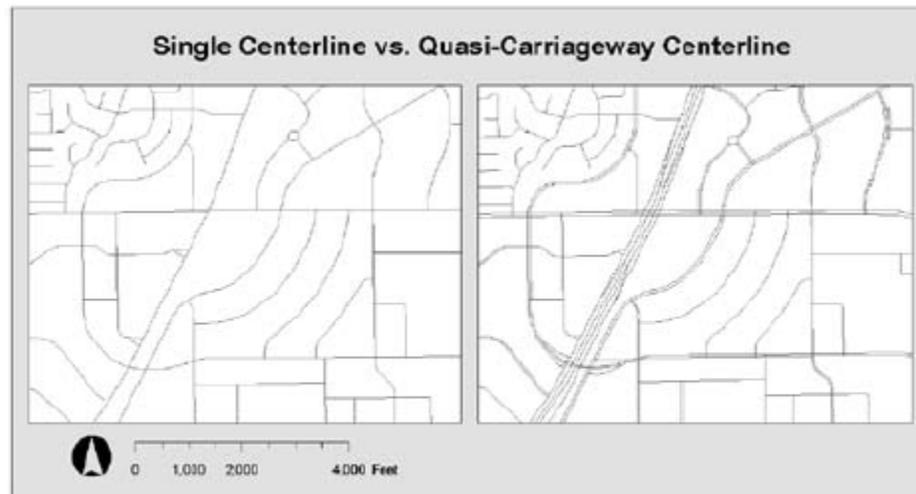


Figure 3. Simple centerline over quasi-carriageway

## A Comprehensive Process for Linear Referencing

*Kevin M. Curtin, Greta Nicoara, and Rumana Reaz Arifin*

# Comparison of TIGER and Local Roads Not Good for Navigation

## TIGER Roads Compared to Loudoun Centerlines

### Legend

- study area
- Tiger\_Roads
- Loudoun Centerlines



0 0.02 0.04 0.08 Miles



# 4. Long Term Societal impacts of driverless Vehicles

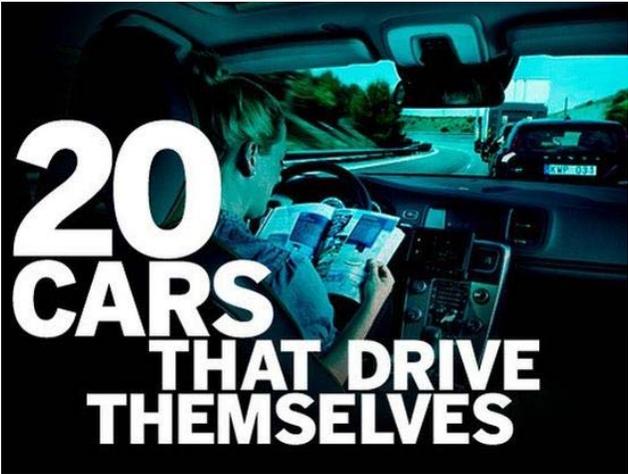
# This Doesn't Have to happen



# Already

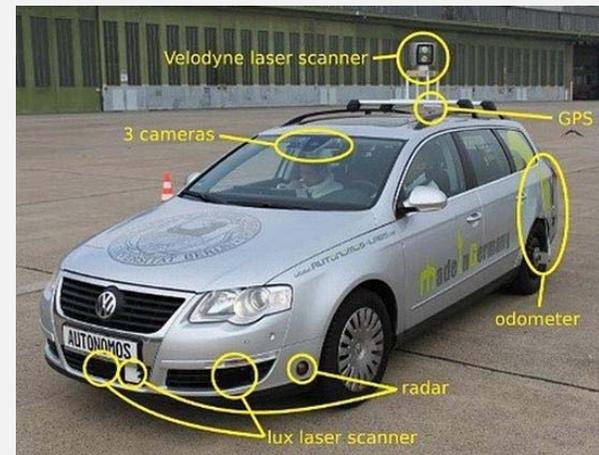
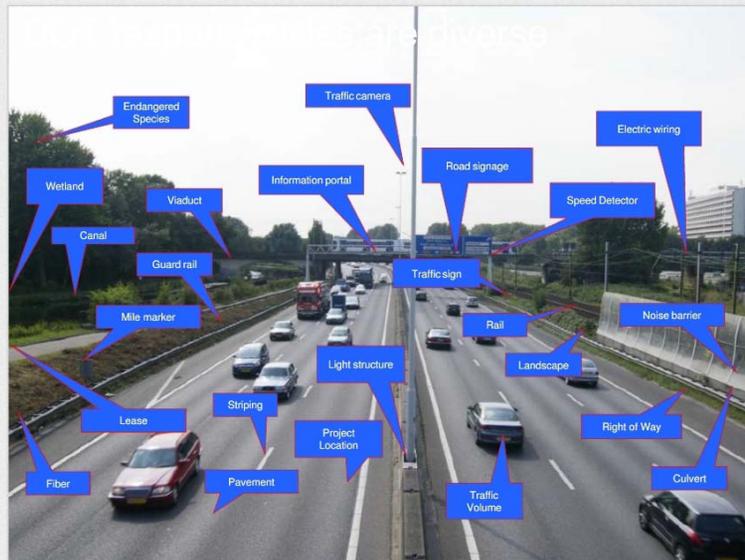
- Cruise on auto pilot
- Slot themselves into awkward parkign spaces
- Brake automatically
- Google experimental vehicle

# Examples



<http://slideshow.techworld.com/3405617/20-cars-that-drive-themselves/>

# Intelligent



**Esri Roads and Highways Solution Overview**  
Eric Floss – Transportation Practice Manager



# Potential Societal Changes Of Driverless Vehicles: The Economist (10/20/2012)

- Boost new car sales – feature rich
- Increased capacity of existing roads (nose to tail)
- New designs
  - No steering wheels, pedals
  - Lighter materials (don't have to resist crashes)
- Electronics Boost
  - Driver Oriented Entertainment –(don't have to watch road)
- Buses in convoys
- Travel at night and sleep > Fewer hotels
- Loss of jobs
  - Taxis, car rental could merge into one pick up a d drop off service
  - On demand vehicle rental Supermarkets, department stores , shopping centers – will send a vehicle

## Potential Societal Changes Of Driverless Vehicles: The Economist (10/20/2012)

- Obey all laws > Eliminate traffic tickets, traffic cops, meter maids
- Lower revenues – Fewer parking fees
- Eliminate the need for auto insurance
- 2 Million hospital visits / year
  - Less need for emergency rooms etc.
- Longer commutes possible (productive in transit, lower cost / mile) > Exurbs
- Free mothers from car pooling – join the work force

# Conclusions

- A robust GIS program will enable the NTSB to improve the way it monitors and manages its safety programs – it deals with fundamental geographic events
- NTSB should work closely with FGDC, DOT, and Census to ensure that the transportation features meet its needs
- NTSB should take advantage of the geospatial platform data and services to initiate its programs
- NTSB must help guide all the stakeholders associated with driverless vehicles and provide recommendations and regulations that ensure these developments are safe, economical and efficient.