Technology Implementation Group

Charles Brown, PE, PLS
State Location & Surveys Engineer
North Carolina DOT

Speaking for
Len Sanderson, PE
Highway Administrator
North Carolina DOT
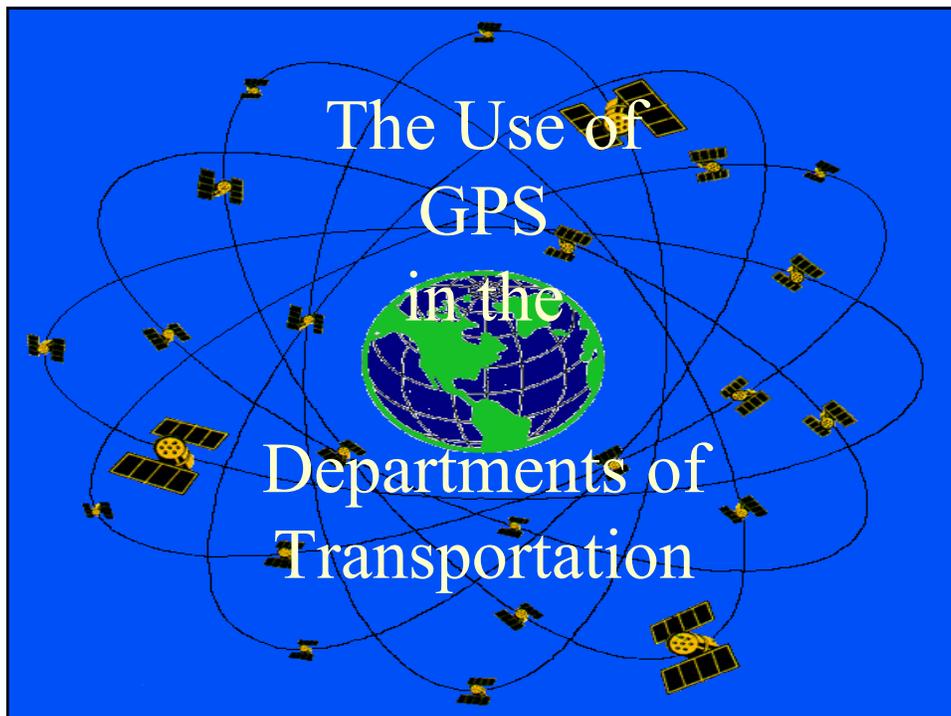
The Use of
GPS
in the

Departments of
Transportation

GPS - A New Tool

- What Is GPS?
- GPS Applications in DOTs
- Types of GPS Networks
- What Can GPS Do For You?
- What Can TIG Do For GPS?
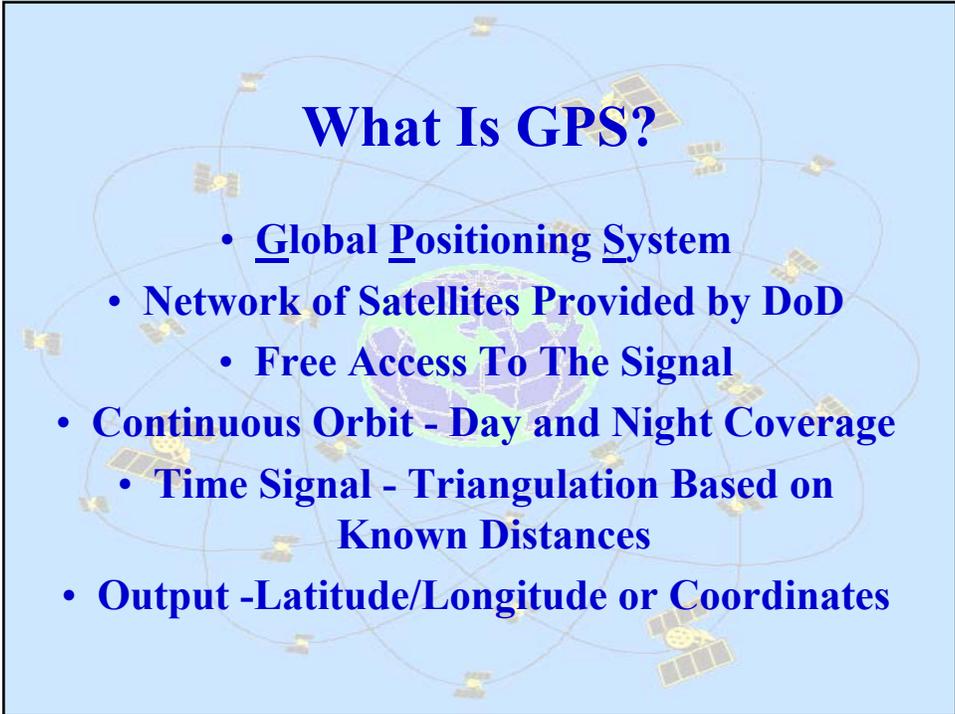
What Is GPS?

- Global Positioning System
- Network of Satellites Provided by DoD
- Free Access To The Signal
- Continuous Orbit - Day and Night Coverage
- Time Signal - Triangulation Based on Known Distances
- Output -Latitude/Longitude or Coordinates

Global Positioning System (GPS)

- Department of Defense (DoD) Creation
- 27 Satellites in orbit
- Transmitting Precise Time Signal to Earth
- Ground-Based Receivers measure Time for Signal to travel from Satellite to Receiver
- Distance = Speed of Signal x Time Difference
- GPS accurate within 10 meters

Presidential Decision Directive March, 1996
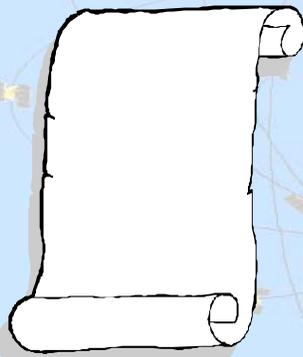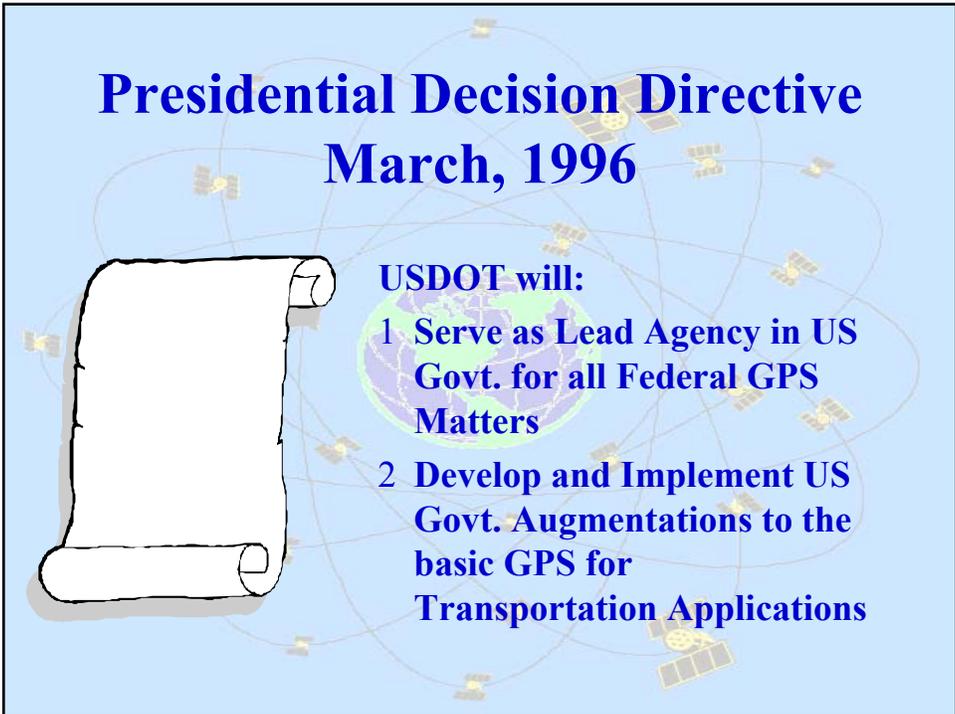
USDOT will:

1 Serve as Lead Agency in US Govt. for all Federal GPS Matters

2 Develop and Implement US Govt. Augmentations to the basic GPS for Transportation Applications

Presidential Decision Directive March, 1996
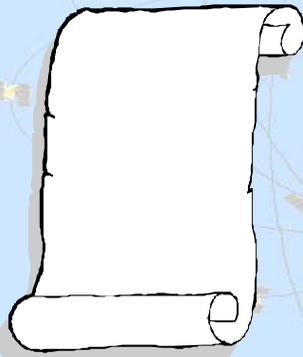
With DoD, State, and Commerce, USDOT will:

3 Promote Commercial Applications of GPS and Acceptance of US Govt. Augmentations as Standard

4 Coordinate US Govt.-provided GPS Civil Augmentation Systems to minimize Cost and Duplication

Some Acronyms

- RTK - Real Time Kinematic Surveys
- HARN - High Accuracy Reference Network
- NDGPS - National Differential GPS
- NSRS - National Spatial Reference System
- CORS - Continuously Operating Reference Station
- OPUS - On-line Positioning User Service
- VRS - Virtual Reference System

DOT Applications
Planning and Environmental Mapping

Mapping
- Wetlands
- PETS Habitats
- Historic/Critical Properties
- Utilities

DOT Applications
Design Mapping

Mapping
- Photo Controls
- Surveys
- Aerial Photography
- Utilities
- Property
- Other Topography

DOT Applications
Photogrammetry

Vehicle Guidance
Better Definitions of
Flight Plans

Airborne GPS -
Photo Control with
Less Ground Surveys

DOT Applications
Construction Stake-Out

RTK Staking
• Project Controls
• Alignments
• Slope Stakes
• Utility Locations
• Drainage Locations

DOT Applications
Construction Stake-Out

Even in Difficult Locations

Structure Stakeout

DOT Applications
Construction Vehicle Guidance

DOT Applications
Other Vehicle Guidance

The stolen car's navigation system sent signals to at least three global positioning system satellites. By measuring the time it takes for the signal to reach each satellite, location is plotted by triangulation.

Vehicle Tracking -
Location
Theft Prevention
OnStar

Vehicle Guidance -
Snow Plows

DOT Applications
Ferry /Rail Operations

Vehicle Guidance

Vehicle Tracking

Piedmont
Trains 73, 74

Greensboro   Burlington
High Point   Durham
                          Raleigh
Salisbury
                    Cary
Kannapolis
Charlotte

The Piedmont is sponsored by the NC Department of Transportation and is operated by Amtrak.

DOT Applications
Incident/Congestion Management

Traffic Accident Locations
Immediately to GIS

DOT Applications
Incident/Congestion Management

Congestion Points Easily Added To
GIS Congestion Management Database

DOT Applications
Inventory Tracking
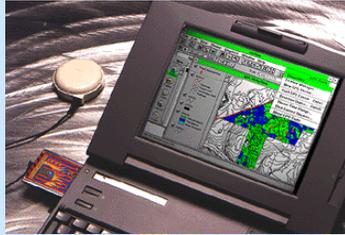
Road
Inventories

DOT Applications
Inventory Tracking

Asset Inventories
•**Pipes & Culverts**
•**Outdoor Advertising**
•**Landscape Seeding**
Measurements
•**Utility Locations**

Different Types of
Base Station Networks

**The Base Station provides the correction
factor for accurate GPS locations**

- •Individual Bases Stations
- •VRS
- •CORS
- •NDGPS
- •OPUS

Different Types of
Base Station Networks

The Project-Specific Base
- •Local Control Possible
- • Provides Local Coverage
- •Limited Area
- •Requires Base and
Transmitter/Receiver
- •Easy Set-up and Operation
- •Mobile
- •Inexpensive

Different Types of
# Base Station Networks

VRS Network
- **Private or Govt. owned**
- **Area-Wide**
- **HARN**
- **Several Bases in System**
- **Cell-Phone Signal**
- **Greater Distance from Base to Rover**
- **Survey Grade Accuracies in Real-Time**

Different Types of
Base Station Networks

CORS
- **Govt. Owned -**
- **State or Federal**
- **HARN**
- **Post-Processing Required**
- **Highly Accurate**
- **Wide Range**
- **User Requires Roving Units Only**

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Different Types of Base Station Networks
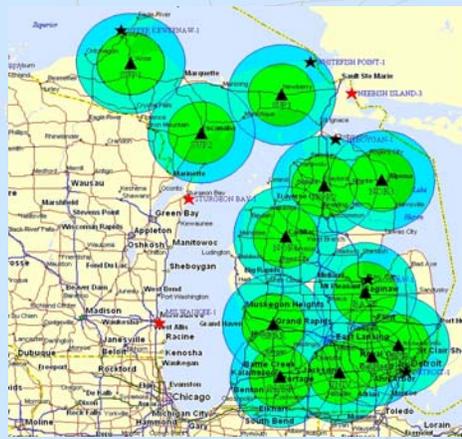
Michigan DOT CORS Network
- **12 Base Stations**
- **Statewide**
- **Room for Growth**

Different Types of Base Station Networks

**The Nationwide Differential Global Positioning System Program (NDGPS)**
- **Joint Project**
- **Federal Railroad Administration (FRA),**
- **US Coast Guard (USCG),**
- **Federal Highway Administration (FHA),**
- **Office of the Secretary of Transportation (OST),**
- **Expansion of the US Coast Guard's Maritime Differential GPS Service (DGPS) network**
- **Mapping Grade Accuracy**

Different Types of
Base Station Networks

12/02 - Approximately 85% the contiguous 48 states receive correction signal from at least one NDGPS transmitting site; 12/03- All contiguous 48 states expected to receive the signal from at least two transmitting sites.

Different Types of
Base Station Networks
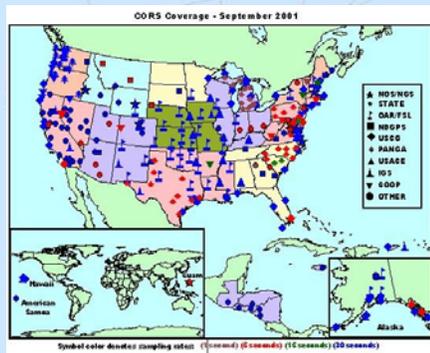
OPUS
- **Maint. By NGS**
- **Provides users easy access to the National Spatial Reference System (NSRS).**
- **The service is based on data from the NCORS.**
- **Survey Grade Accuracy**

What Can GPS Do for You?

Some More Acronyms

MAD - More Accurate Data

BUM - Better Utilization of Manpower

MEO - More Efficient Operations
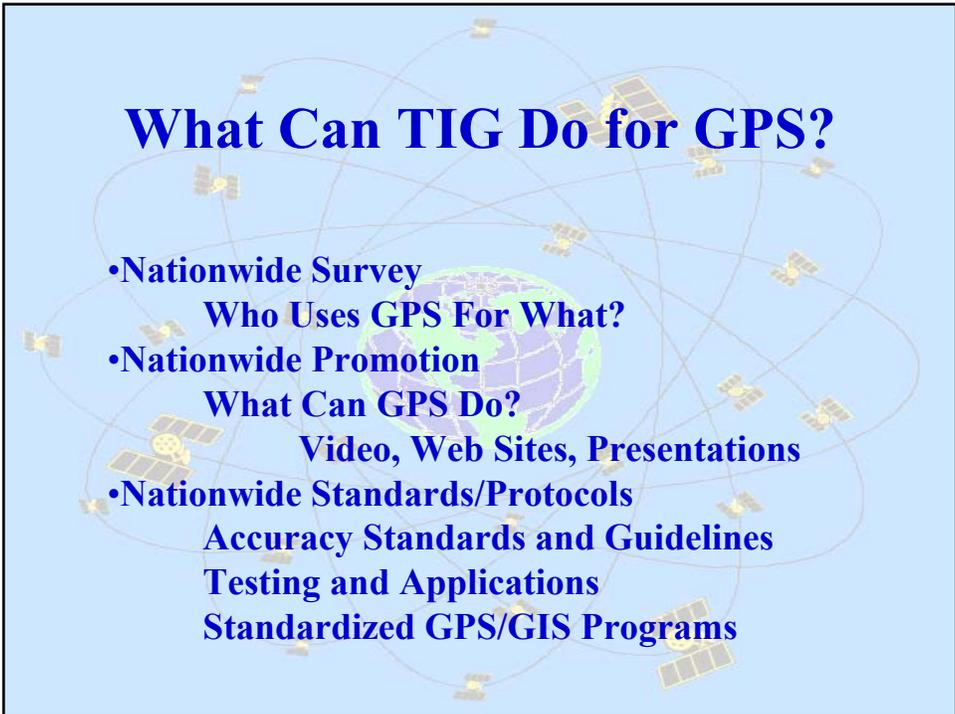
What Can TIG Do for GPS?

•**Nationwide Survey**
   Who Uses GPS For What?
•**Nationwide Promotion**
   What Can GPS Do?
      Video, Web Sites, Presentations
•**Nationwide Standards/Protocols**
   Accuracy Standards and Guidelines
   Testing and Applications
   Standardized GPS/GIS Programs

What Can TIG Do for GPS?

January -
- Preparation of Powerpoint program
- Create GPS Usage Survey

March -
- Presentation to TIG
- Request for Work Plan Approval
- Submit Budget Proposal for Approval

Future -
- GPS!

Questions?

DOT Applications
Construction Vehicle Guidance

Mapping
- **Wetlands**
- **PETS Habitats**
- **Historic/Critical Properties**
- **Utilities**

Different Types of
Base Station Networks