

GPS and DOT

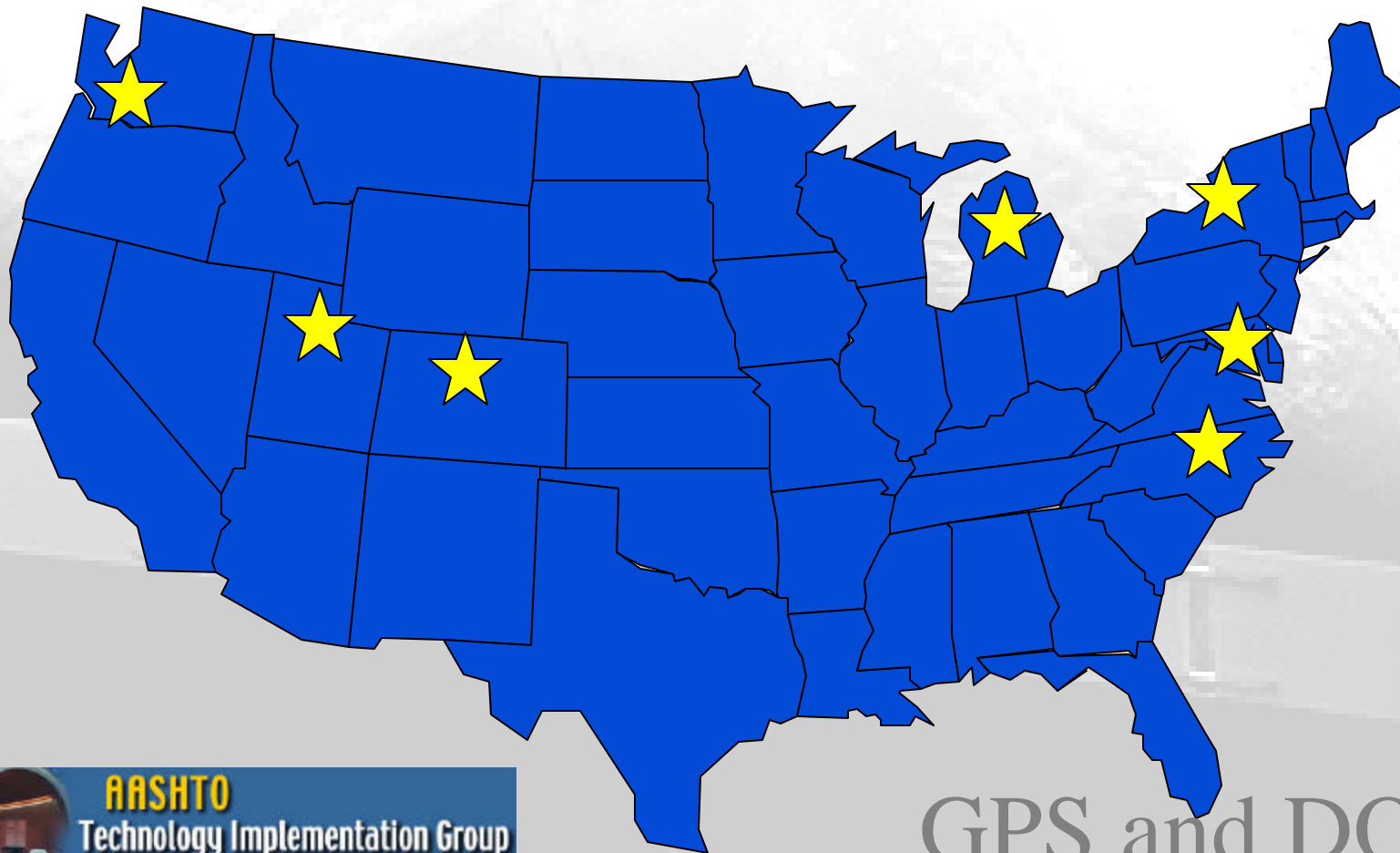
The Circle of Usage Or Who's Doing What Where and Why

Presented By Charles W. Brown, PE, PLS

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Technology Implementation Group GPS Implementation Committee



Technology Implementation Group GPS Implementation Committee

Len Sanderson, PE	NCDOT, Chair
Alan Blair - Central Fed Lands Hwy Div (FLHD)	
Charlie Brown	NCDOT
Leo Dario	Eastern FLHD
Brian Dolman-Jersey	MDOT (Mich)
Sean Fernandez	UDOT
Larry Goble	Western FLHD
John McCracken	FHWA R&D
Jeff Place	Western FLHD
Dan Streett	NYDOT

Technology Implementation Group Two-Fold Implementation Plan

GPS Workshop - Today

Nationwide Workshops - Locally if Possible

At GPS Users' Requests

For Survey Grade Users

Who Is Using GPS For What

Contacts

Technology Implementation Group Two-Fold Implementation Plan

Multiple Uses of GPS in DOTs

AASHTO Regional Meetings

For Upper Management

Who Is Using GPS For What

What Benefits

What Shortcomings

What this workshop is not:

A Sales Pitch for any particular Vendor

A Training Session in GPS

A Solution to All of Your GPS Woes

What this workshop is:

**A Brief Discussion of GPS Applications in
DOT/FHWA Operations**

Concentration on Design and Construction

Discussion of What To Do

and What Not To Do

**A Starting Point for a National Discussion on
GPS Standards in Highway Planning, Design,
Construction**

TIG Nationwide Survey

Fall, 2003

Utah DOT Website

<http://www.udot.utah.gov/ets/GPS/default.htm>

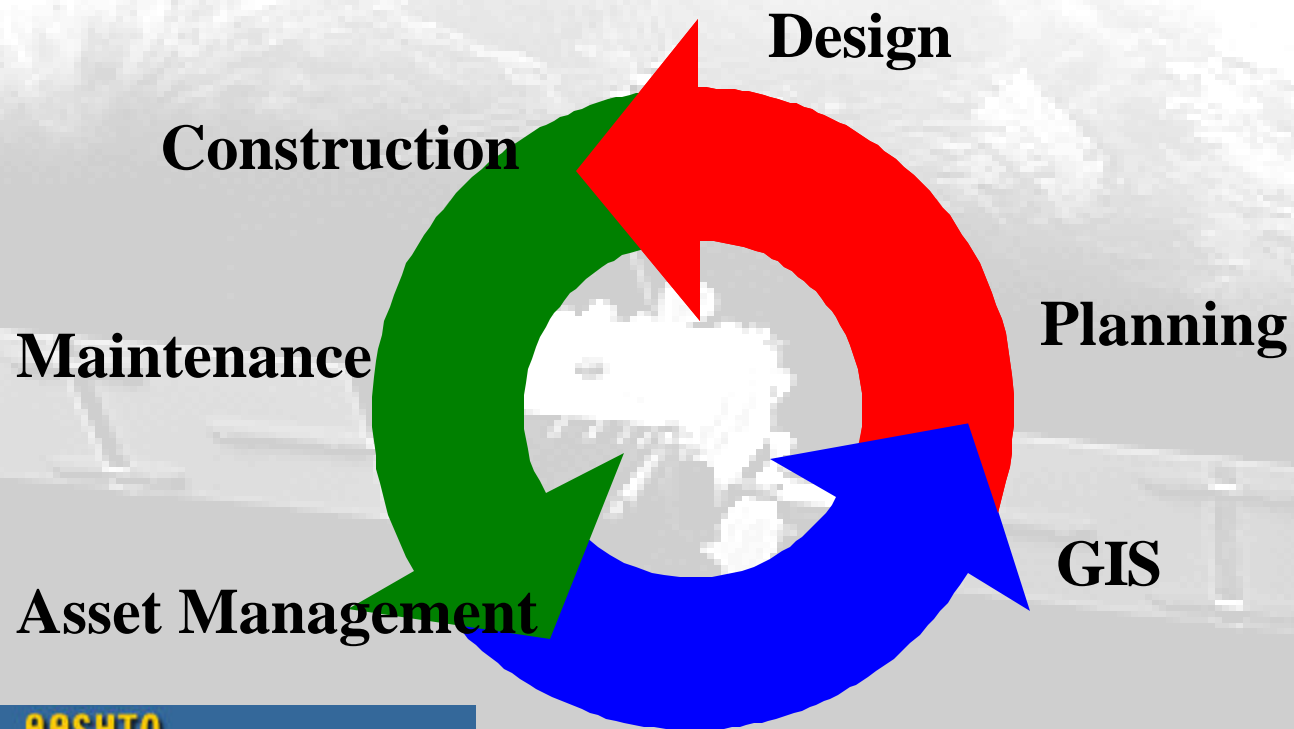
32 States and Federal Lands - Highways responded

**Individual results can be accessed thru TIG website
www.aashtotig.org**

TIG

Nationwide Survey

Different Applications of GPS:



Planning the Project - Corridor Studies



Natural Environment Mapping

Wetland Boundaries/PETS Habitat

Historic Property Locations

**Archaeological Sites - Points or
Boundaries**

Major Utility Locations

Things To Avoid

Planning the Project - Corridor Studies



**Mapping or Recreational Grade GPS
Accuracy Relative to Need for
Feasibility Studies/ Initial Cost Estimates
Planning Purposes
Fast and Inexpensive
More Data with Fewer Personnel
Common Coordinate System
(Usually State Plane or Similar)**

Planning the Project - Corridor Studies



Mapping or Recreational Grade GPS

Accuracy Only Relative to Need

Uneducated Users Unfamiliar with:

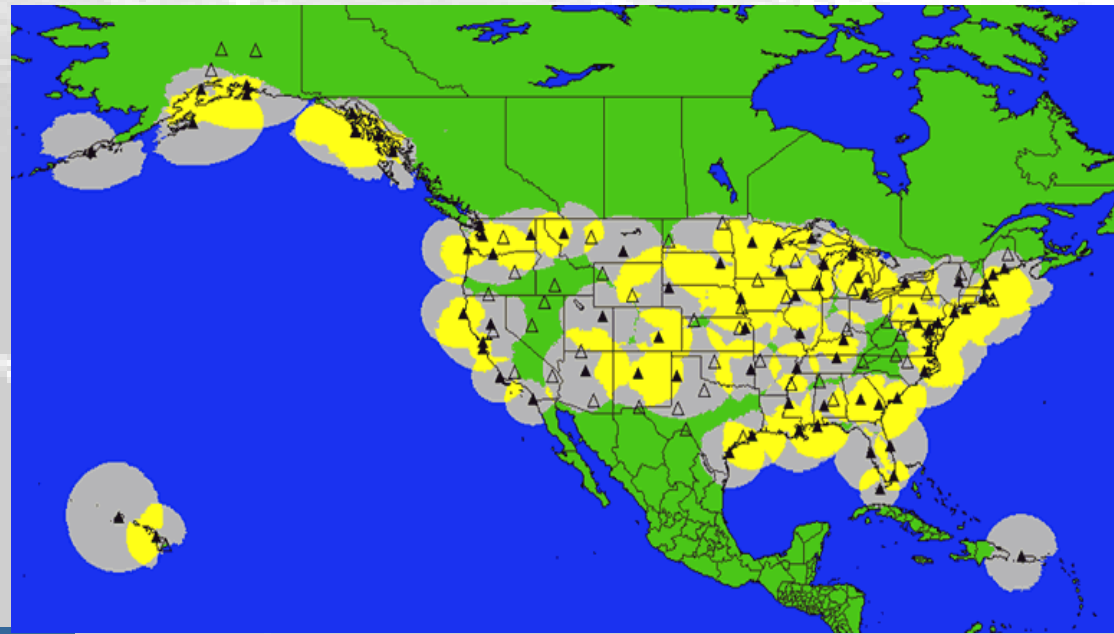
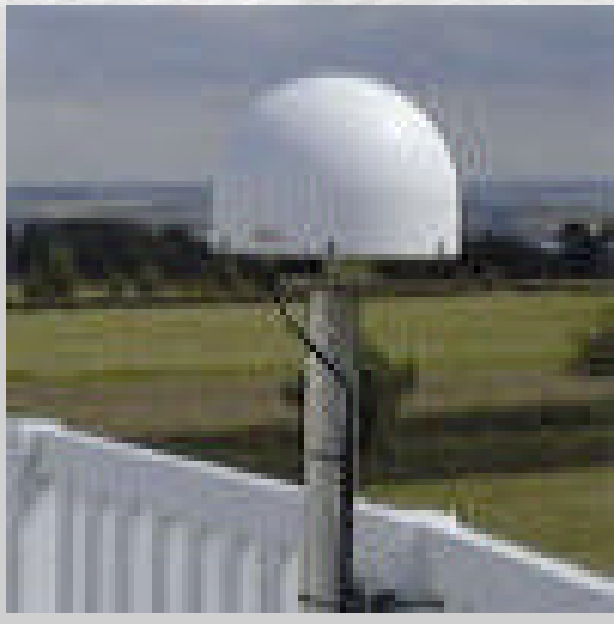
Coordinate Systems

Accuracy of Different Types of GPS

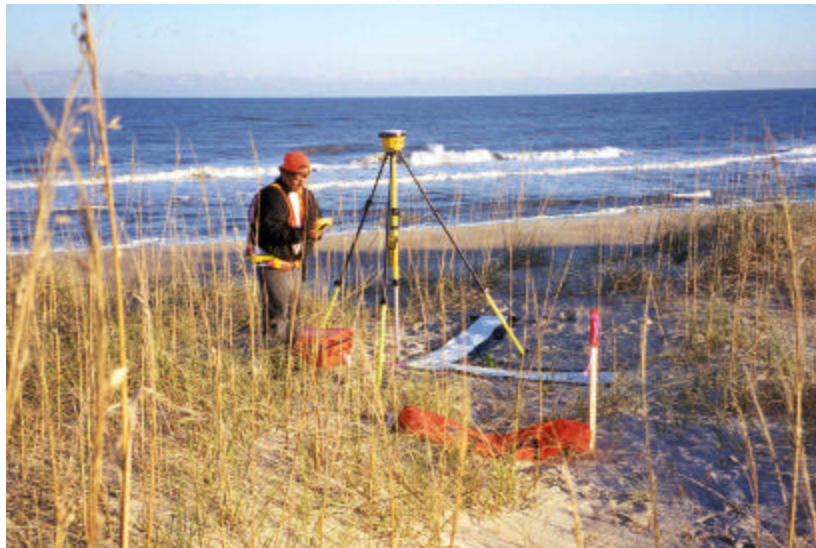
**Application of Mapping Grade (or
Recreational) to Actual Design Needs**

Controlling the Project - NDGPS Networks

12/03- All contiguous 48 states receive the signal from at least two transmitting sites.



Planning the Project - Corridor Studies



**Ground Control for
Photogrammetry Over
Multiple Corridor Area**

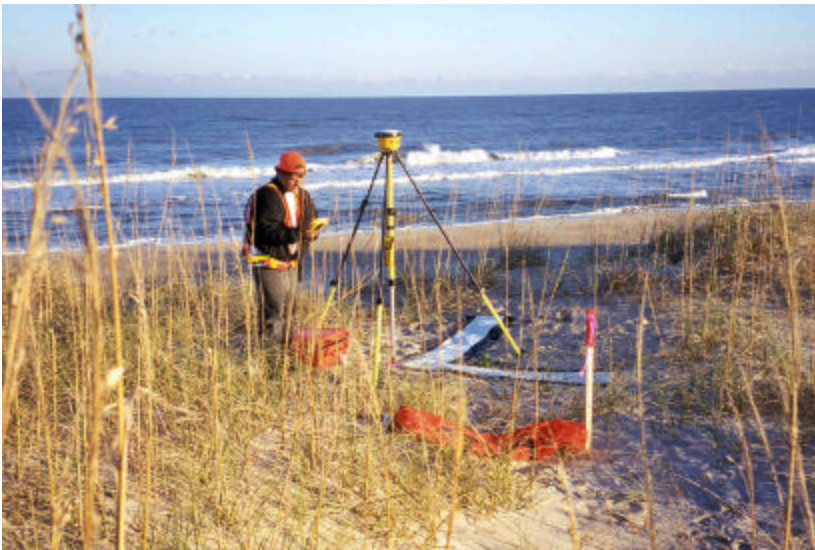
**GPS-IMU for Aerial
Photography**

Mapping For Preliminary

Roadway Alignments and Grades

**GPS Combined with LIDAR for Preliminary
Earthwork Quantities**

Planning the Project - Corridor Studies



Survey Grade GPS

Post Processed or RTK

Highly Accurate Control

Utilized Throughout Project

Better Data / Fewer Personnel

**Accuracy Determined by Photogrammetric Process
(Altitude of Plane Usually)**

Knowledgeable Users

Designing the Project - Route/Property Location



**Recreational/Mapping Grade
Locating Known Coordinates**

Lost Control Corners

Property Reconnaissance

Low Cost = Low Accuracy

Easy Use

Designing the Project - Route/Property Location



Survey Grade GPS

Post Processed or RTK

**Highly Accurate Control -
Photogrammetry or Ground Surveys**

Property Corner Locations

Utilities

DTM Collection

Hydraulic Data - Rivers, Lakes, Bays

Designing the Project - Route/Property Location

Faster Data Collection

More Accurate Data

Fewer Personnel

Knowledgeable Users - Usually

Limited Usage

Staking Right of Way

Setting Known Points



Designing the Project - Route/Property Location



Canopy A Problem

Urban Canyons

Equipment Costs

Coordinate Issues - Different Datums

Tying Grid To Ground

Who's On The Right Point?

How Do We Know What's Right?

Controlling the Project - NDGPS Networks



Post Processing

**Common Points - Common
Coordinates**

Multiple Users - Multiple Benefits

Numerous State DOTs

Maintaining NDGPS Networks

**Cost Included in Operational
Budget or Thru Projects (FHWA)**

Building the Project - Construction Estimate for Bid



**Paper Plans and Electronic
Alignment on a Mapping Grade
GPS Receiver**

OR

**Electronic Plans on a Mapping
Grade GPS Receiver**

**No Need to Stake the Project for
Estimation Purposes**

So - You've Got Good Data

Typical Construction Phasing:

Electronic Plans Printed and Provided to Contractor

Construction Surveyor Computes Coordinates

Construction Surveyor Establishes Project Control

Construction Surveyor Stakes Project

Grader Tears Up Stakes

Construction Surveyor Stakes Project

Grader Tears Up Stakes

Construction Surveyor Stakes Project...

Building the Project - Construction Stakeout

Canopy - What Canopy?

**Should Use Existing GPS Control
Network**

**Plans Should Contain GPS Data
Electronic Data Sent To Construction
Surveyor**

Reduces Error/Increases Time

Reduces Cost



Building the Project - Construction Stakeout



**Stakeout Error Not As Critical In
Construction As In Right Of Way**

**Smaller Survey Parties - More Crews in
Different Directions**

**One Base On Project Can Serve Several
Different Surveyors**

**Reduces Need For Multiple Project
Controls**

So - You've Got Great Data and It's Really Staked Well

Still Typical Construction Phasing:

Construction Surveyor Computes Coordinates

Construction Surveyor Establishes Project Control

Construction Surveyor Stakes Project

Grader Tears Up Stakes

Construction Surveyor Stakes Project

Grader Tears Up Stakes

Construction Surveyor Stakes Project...

Solution - Put GPS On The Grader!



Building the Project - Vehicle Guidance



**Tied To Electronic DTM File
Provides Cut/Fill As The
Grader Moves Dirt
Tied To Project Control
Thru Base Station
In Most Cases, Good Down
(or Up) to Near Final Grade**

Building the Project - Vehicle Guidance



**Reduces Repetitive Need For
Construction Stakeout**

Reduces Time

Reduces Cost

**Operators Are Already
Visualizing - This Gives
Them Something To See**

Building the Project - Vehicle Guidance



**Western Mining Operations
Have Been Using GPS
Vehicle Guidance For Years
Contractors Are Using GPS
Vehicle Guidance on DOT
Projects In Several States**



What Controls Are In Place To Put The Bridge In The Right Place?

AASHTO
Technology Implementation Group

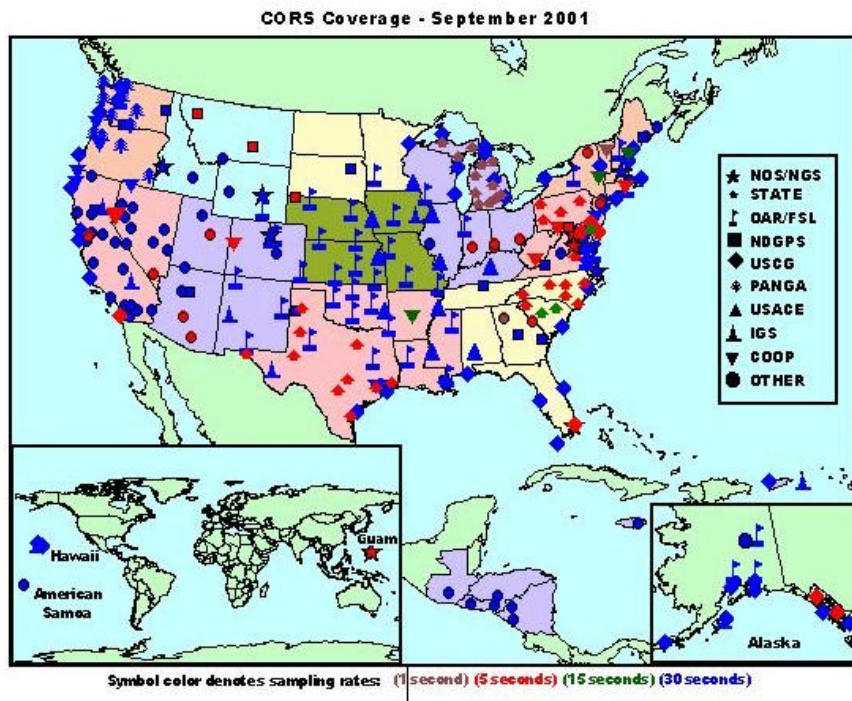
GPS and DOT

Solution

Common Coordinate System

- **Predetermined Base Station Network**
- **Project Control as Part of Plans**
- **Any Required Adjustment Factors**
- **OPUS**
- **Network RTK**
- **Local Base Stations**

Controlling the Project - OPUS Networks



On-line Positioning User
Service

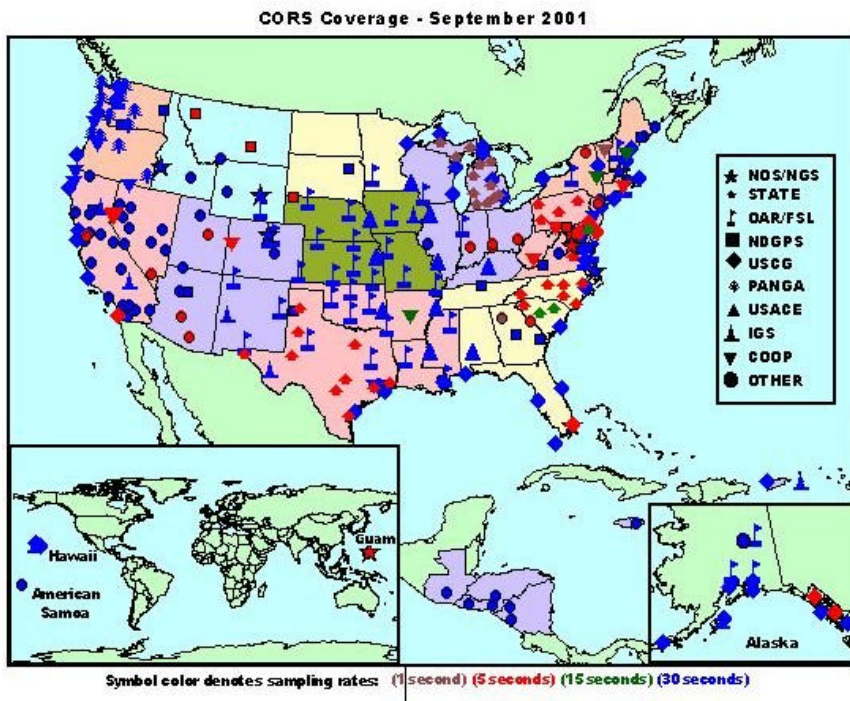
Product of NGS/NOAA

Utilizes NCORS

NGS Home Page

(<http://www.ngs.noaa.gov>)

Controlling the Project - Networks

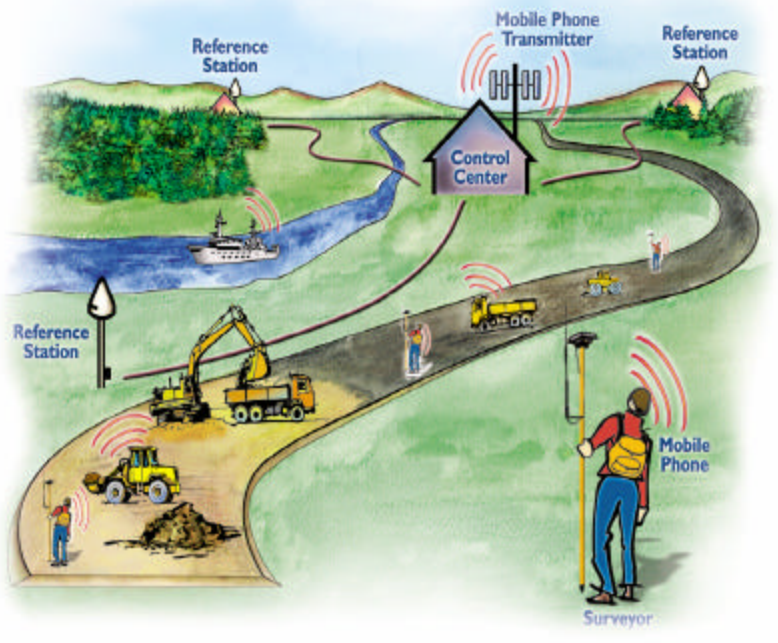


**OPUS - Reduces Time for
Establishing Controls
Cuts Occupation and Travel
Time**

**Good For Stand-Alone
Projects - Accurate Within
Itself**

Free from NGS

Controlling the Project - VRS* Networks



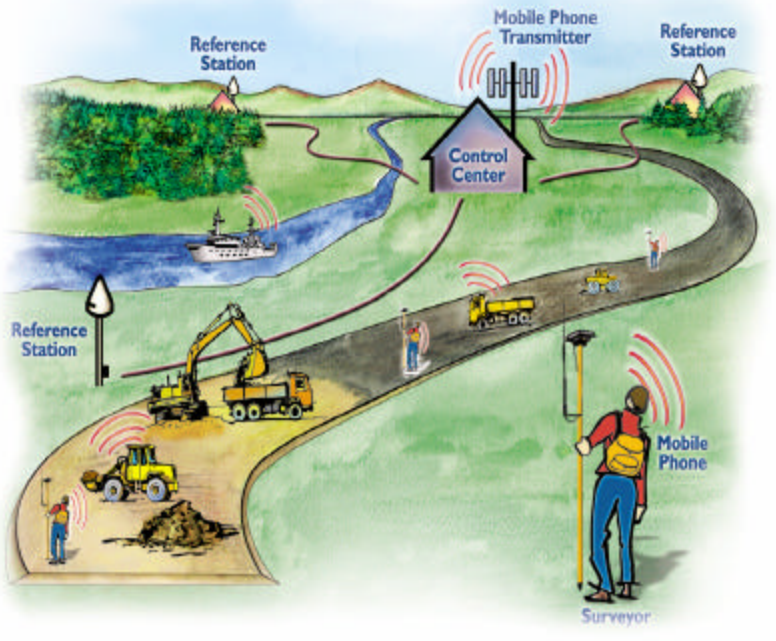
**Virtual Reference System
(Trimble)**

**RTK Network Using Multiple
Base Stations**

**Transmits One Correction
Factor to Multiple Rovers**

Utilizes Cell Phone Technology

Controlling the Project - VRS* Networks



**Reduces/Removes Need For
Individual Bases**

As Accurate As Individual Bases

No Set-Up Time

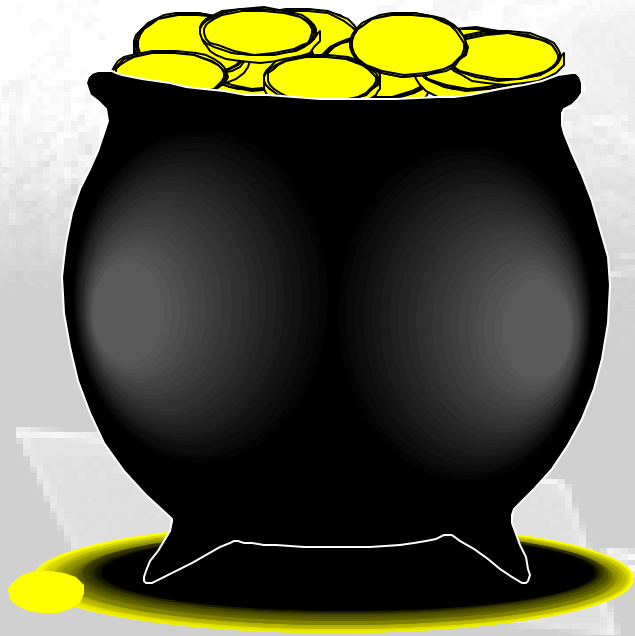
No Additional Equipment

Not Inexpensive

Limited to 50 Users Per License

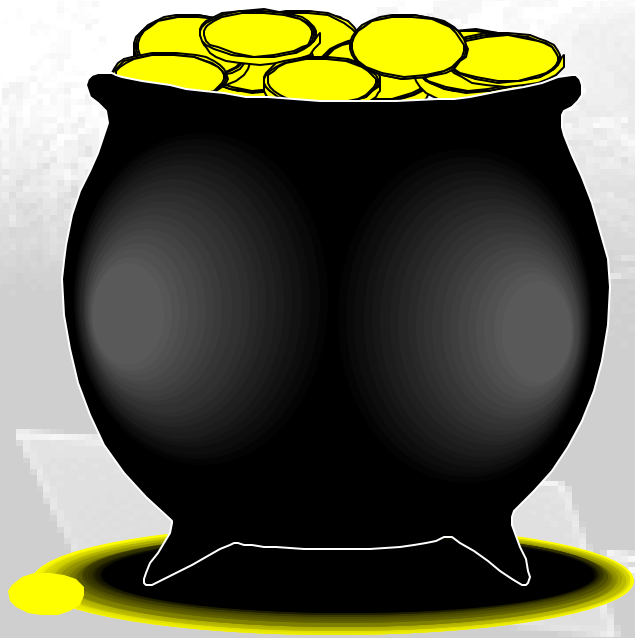
Cost v Benefits?

Funding - Equipment or Networks



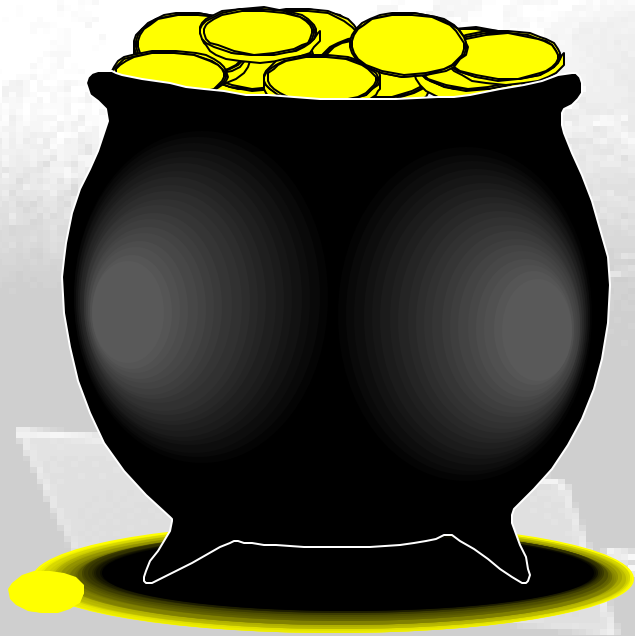
Different Sources of Funds - NC
Charge Equipment & Partial
Funding of Network RTK via
Federal Projects - FHWA
Approval of Shared Funds
Additional Funding from
NCDENR and User Fees

Funding - Equipment or Networks



**Different Sources of Funds - NY
Leasing CORS Base Stations on
6 year interval, through IT
Budget, with option for 2nd 6
year interval renewal or re-bid
Not a Lease-To-Own**

Funding - Equipment or Networks



**Different Sources of Funds -
TN - State DOT Equipment
Budget**

**FL - Legislative Funds approved
over Multi-Year plan**

Maintaining the Project - Asset Management



Pavement Analysis Mapped With GPS

Roads Mapped For GIS

Structures Located

Highway Assets :

Signs

Utilities

Pipes



Maintaining the Project - Asset Management



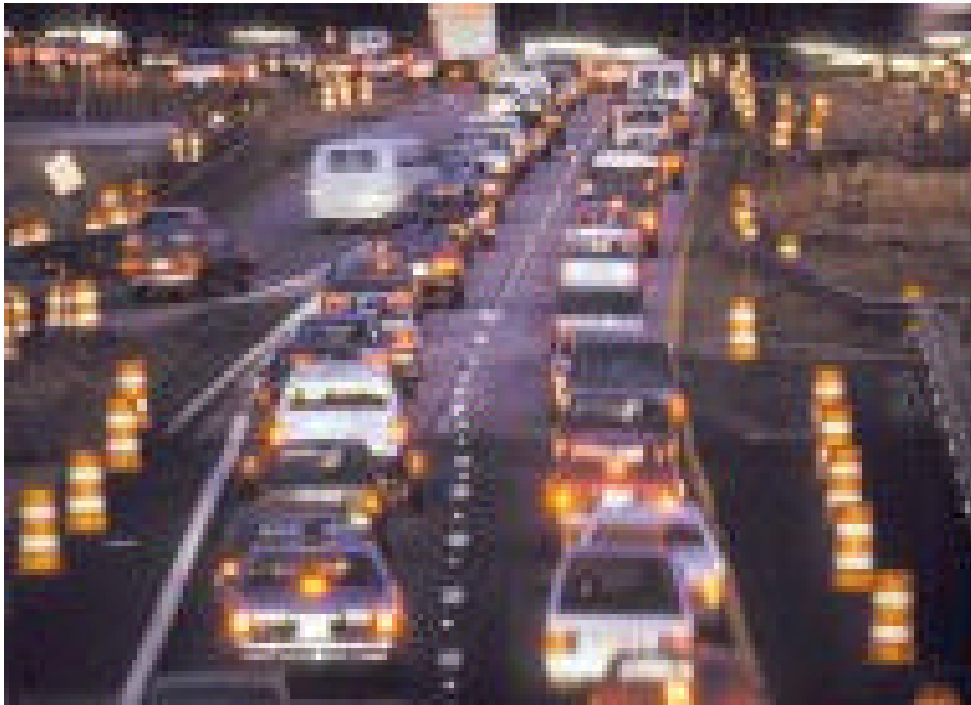
**GPS Used To Monitor
Bridge Deflections in FL
Dam Deformation in TN
Earth Movement in CA
Subsidence in Houston, TX**

Maintaining the Project - Incident Management



**GPS Used to locate
accidents for E-911 routing**

Maintaining the Project - Incident Management



**Congestion Points Easily
Added To GIS Congestion
Management Database**

Maintaining the Project - Incident Management

10 Accidents

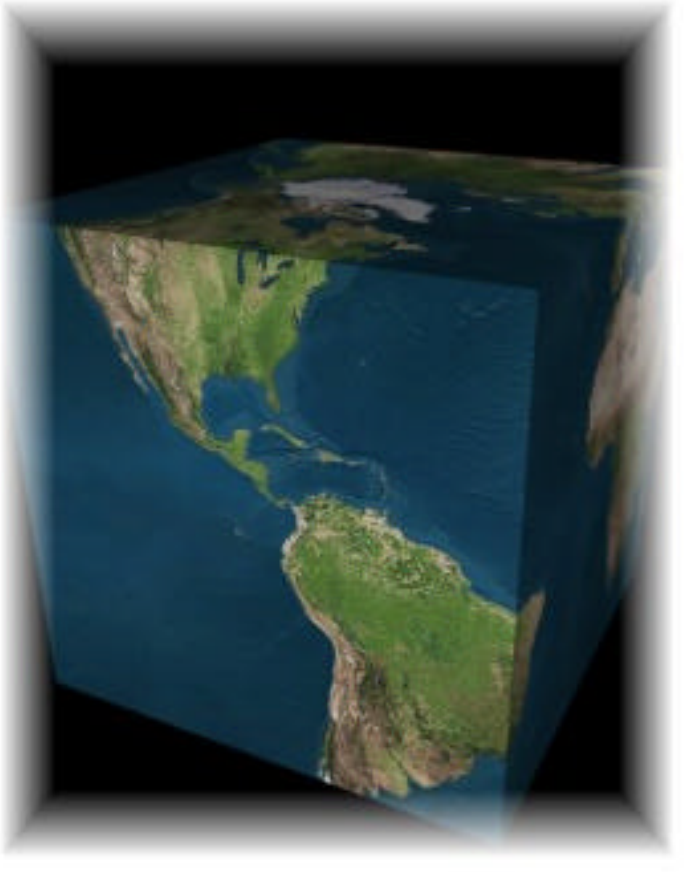
Vehicular Accident
Investigations and
Tracking

X

X

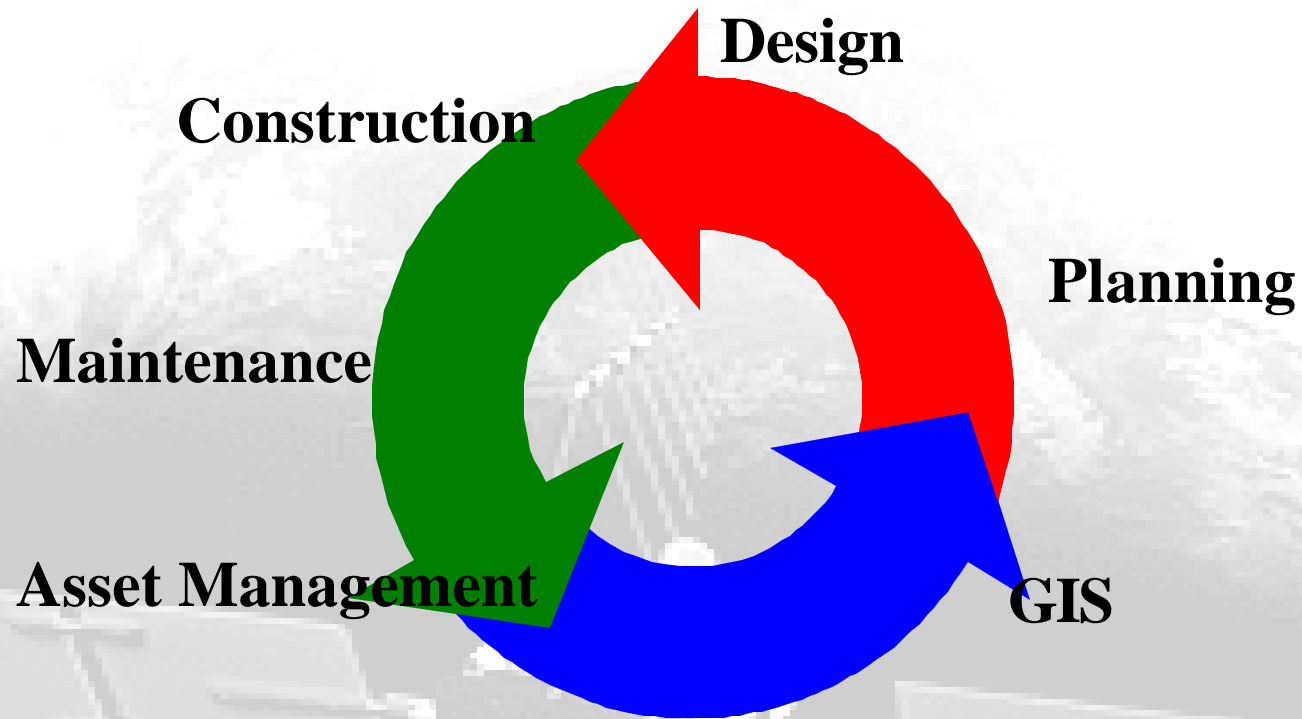
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Project Records GIS



**GPS Places GIS Data In The
Correct Location, Geographically
Where Are The Assets?
Where Are The Wetlands?
With A Well-Built GIS, Based on
Good Data, Planning For Future
Projects Becomes Easier**

We've Come Full Circle



What Now?

**After Lunch:
Panel Discussion**

- **Obstructions to GPS Implementation**
 - **Need for GPS Standards**
 - **How Much? What Type?**

**Begin A Nationwide Discussion on Data,
Metadata, and Methods of Collecting Data**

Thank You.



