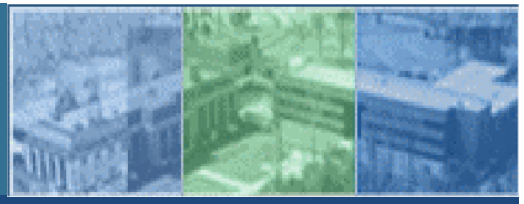
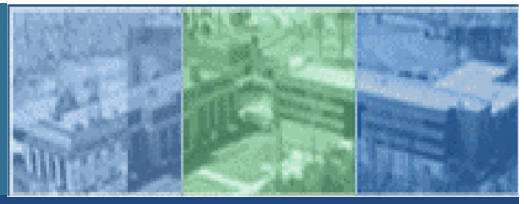


FHWA Activities in Navigation

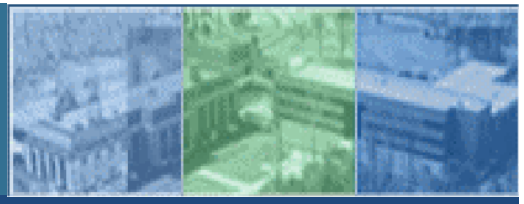
Jim Arnold

Turner Fairbank Highway Research Center



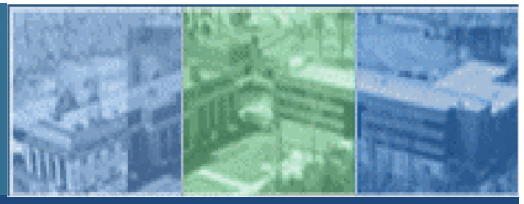
Outline

- HA-NDGPS
- Compression
- Timing
- Fast Integer Resolution – Long Range/Multiple Baseline
- Signal Phase & Timing



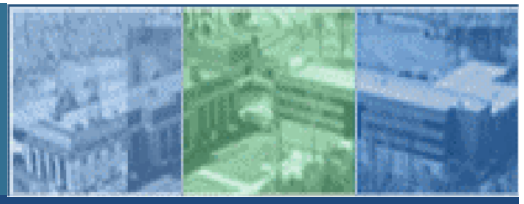
HA-NDGPS

- Continue Research using
  - Hagerstown
  - Hawk Run
  - Pueblo
- Documentation Development for Additional Test Sites Complete



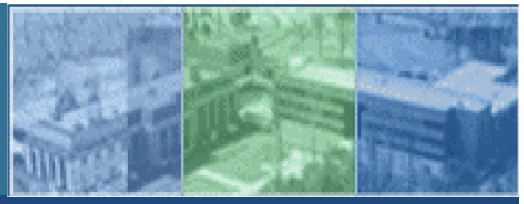
New Compression Algorithm

- Goal – Develop a compression algorithm to ensure delivery of GNSS Observables over multiple data services
- Small Business Innovative Research – SBIR
  - Awarded September 2010
  - Completed March 2011
- Output
  - Non-proprietary compression algorithm
    - Can achieve 1000 bps
    - Includes iono and tropo models
    - Integrity Included!
  - Exceeded Expectations – details to follow
- Phase II – Awaiting Contract Award



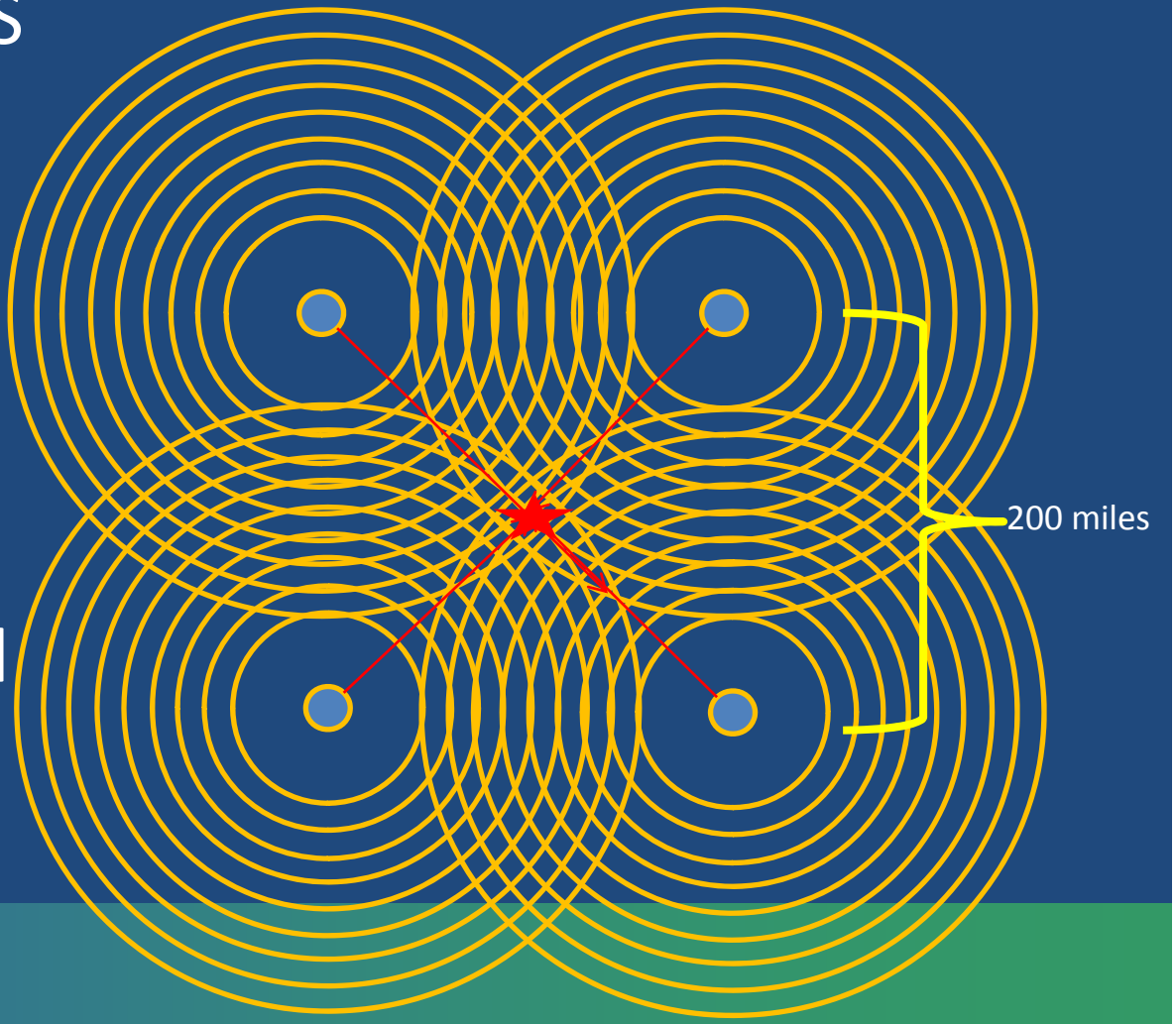
Timing

- In the event of a GPS failure, are there timing backups?
- Why?
  - Telecom
  - Traffic Signals
  - Network Control
- Options
  - Procedural
  - High end clocks
  - NDGPS/HA-NDGPS
- Working with DHS
  - Proposed Network Solution
  - Need Last Mile



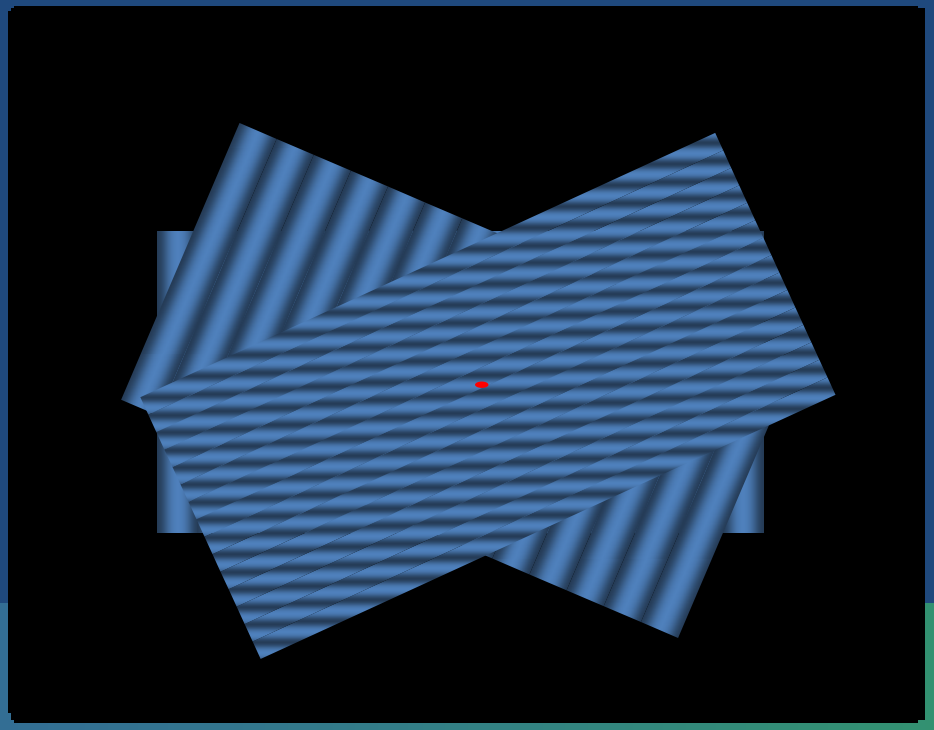
Fast Integer Resolution

- User receives GNSS Observables from multiple reference stations
- Reference station baselines may exceed 200 miles
- Discussion focused on 3 epoch solution

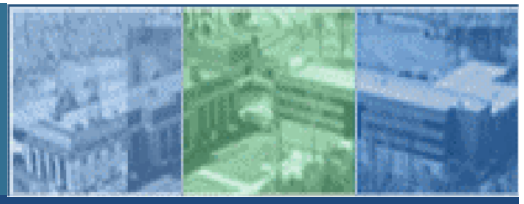


Fast Integer Resolution

- Initial Code Solution
- Minimizes Search Area
- Each second changes satellite Geometry



Note: Diagram is conceptual.



Signal Phase and Timing (SPaT)

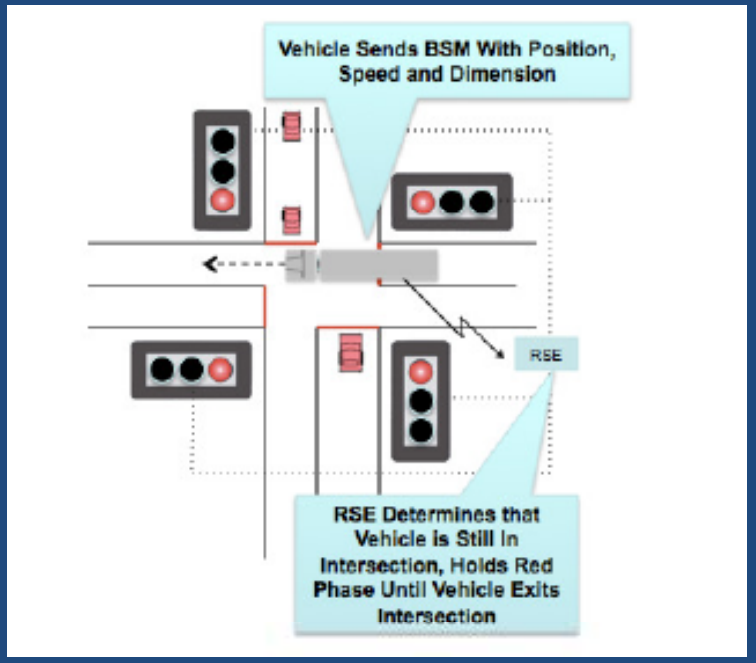
Preliminary Requirements → Examine Technology → Implement

- Identify high-Level Preliminary Requirements
  - Final Requirements – NO!
  - First high-level cut at requirements
  - Further work under Systems Engineering Study
- Examine Available Technology
  - What can it do?
  - Technology holes
  - Target further research?
- Implement at TFHRC
  - Create Test Bed
  - Test applications in safe environment

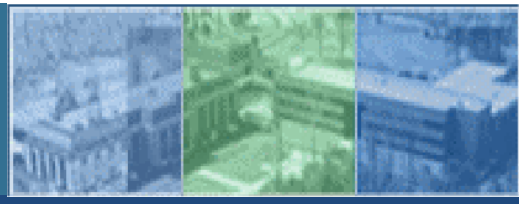
Signal Phase and Timing (SPaT)

- Goal – Build something that works!!
  - Vehicle Positioning
  - Mapping
  - Telecommunications
  - Traffic Controller Interfce

- Final Requirements – NO!
  - First high-level cut at requirements
  - Further work under Systems Engineering



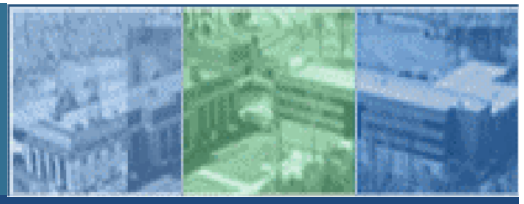
Red Light Extension



Application Requirements
- SAMPLE -

Application	Rationale	Basic Positioning Requirements						Higher Order Position Related Parameter Requirements					
		Position (m)	Confidence (%)*	Location Reference Required?	Time Error (sec)	Integrity?	Availability Indication?	Logical Directionality?	Dimension	Velocity	Acceleration	Yaw	Slip
Hazards, Information, and Traffic Control													
Intersection Collision Avoidance - Red Extension		0.5	99.9	YES	<100 msec	TBD	Yes	Yes	Yes	Yes	No	No	No

*The confidence associated with the error radius represents the tolerable frequency with which the application may make a false positive or false negative error. It is also possible to bias the application in favor of either false positive or false negative errors, although biasing in one direction increases the occurrence of errors in the other direction.



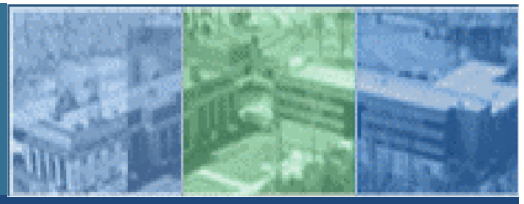
Summary

- Longer Range, Faster, High Resolution Mapping
- Timing Backup
- Goal of Improved Vehicle Positioning
- Understanding Our Needs

New Apps + New Accuracies + New Systems

=

NEW OPPORTUNITIES



Questions?

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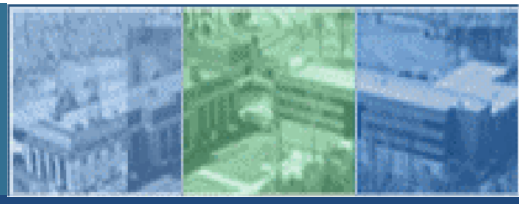
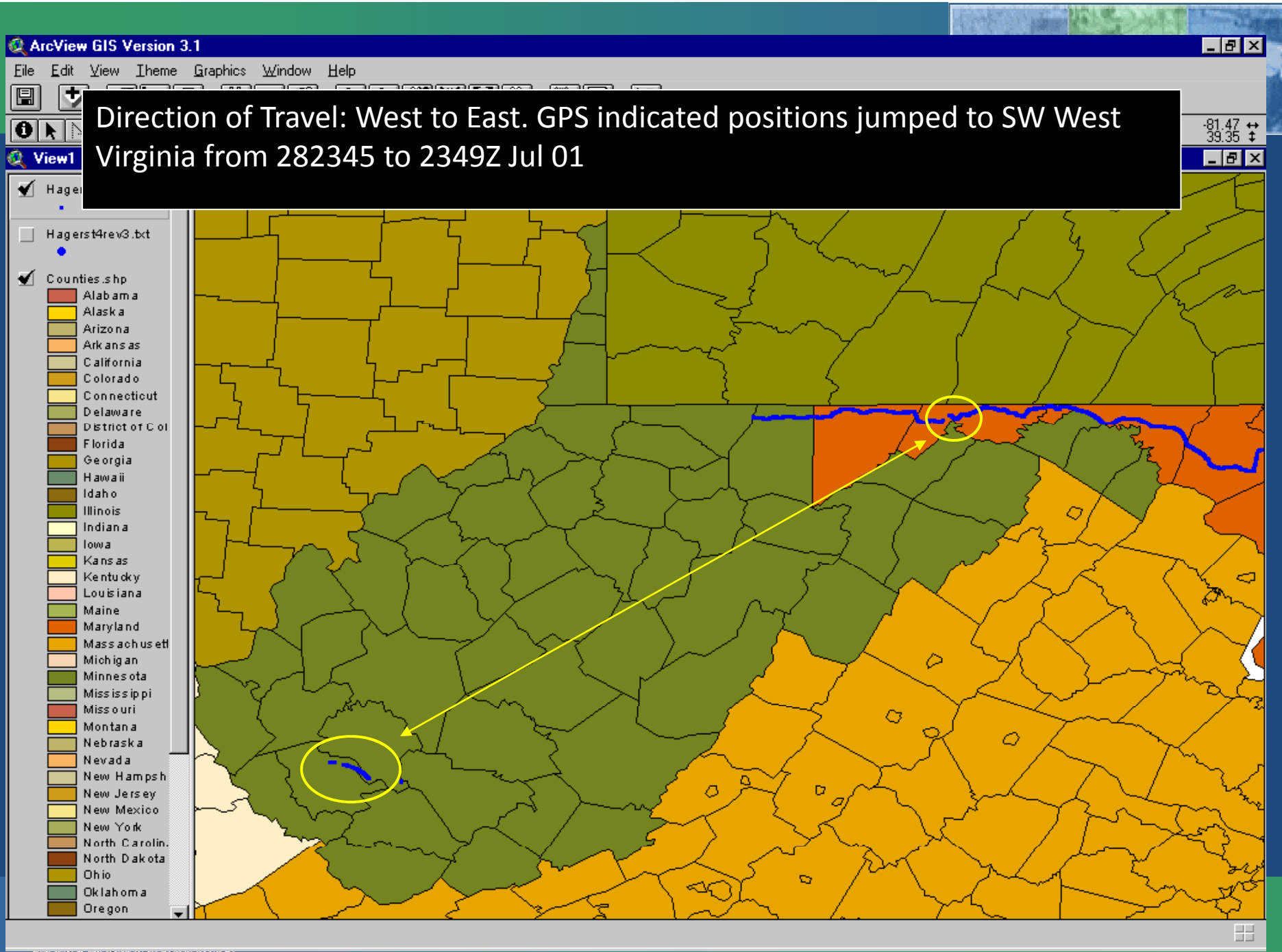
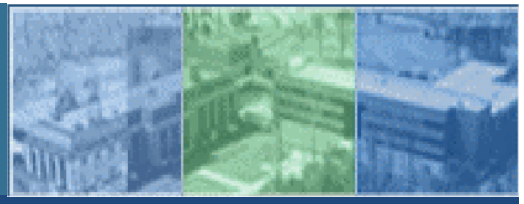
James.a.arnold@dot.gov



Backup Slides


ArcView GIS Version 3.1
File Edit View Theme Graphics Window Help
Direction of Travel: West to East. GPS indicated positions jumped to SW West Virginia from 282345 to 2349Z Jul 01
View1
Hagerst4rev3.txt
Counties.shp
Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Iowa
Kansas
Kentucky
Louisiana
Maine
Maryland
Michigan
Minnesota
Mississippi
Missouri
Montana
Nebraska
Nevada
New Mexico
New York
North Dakota
Ohio
Oklahoma
Oregon



Reality versus Measured

		Reality	
		Event Present	Event Not Present
Measurement	Event Present	True Positive	False Positive
	Event Not Present	False Negative	True Negative