Terrain Impact on GPS Availability and Accuracy

David Craig
14 Oct 2010
314-676-1407/9140

Problem Statement

- Problem
  - User is experiencing adverse impacts due to loss or degradation of GPS in rugged terrain areas

- Current State
  - Full constellation - 31 GPS satellites
  - Positioning and navigation with GPS is assumed to be good
  - Some applications that characterize accuracy do not consider terrain
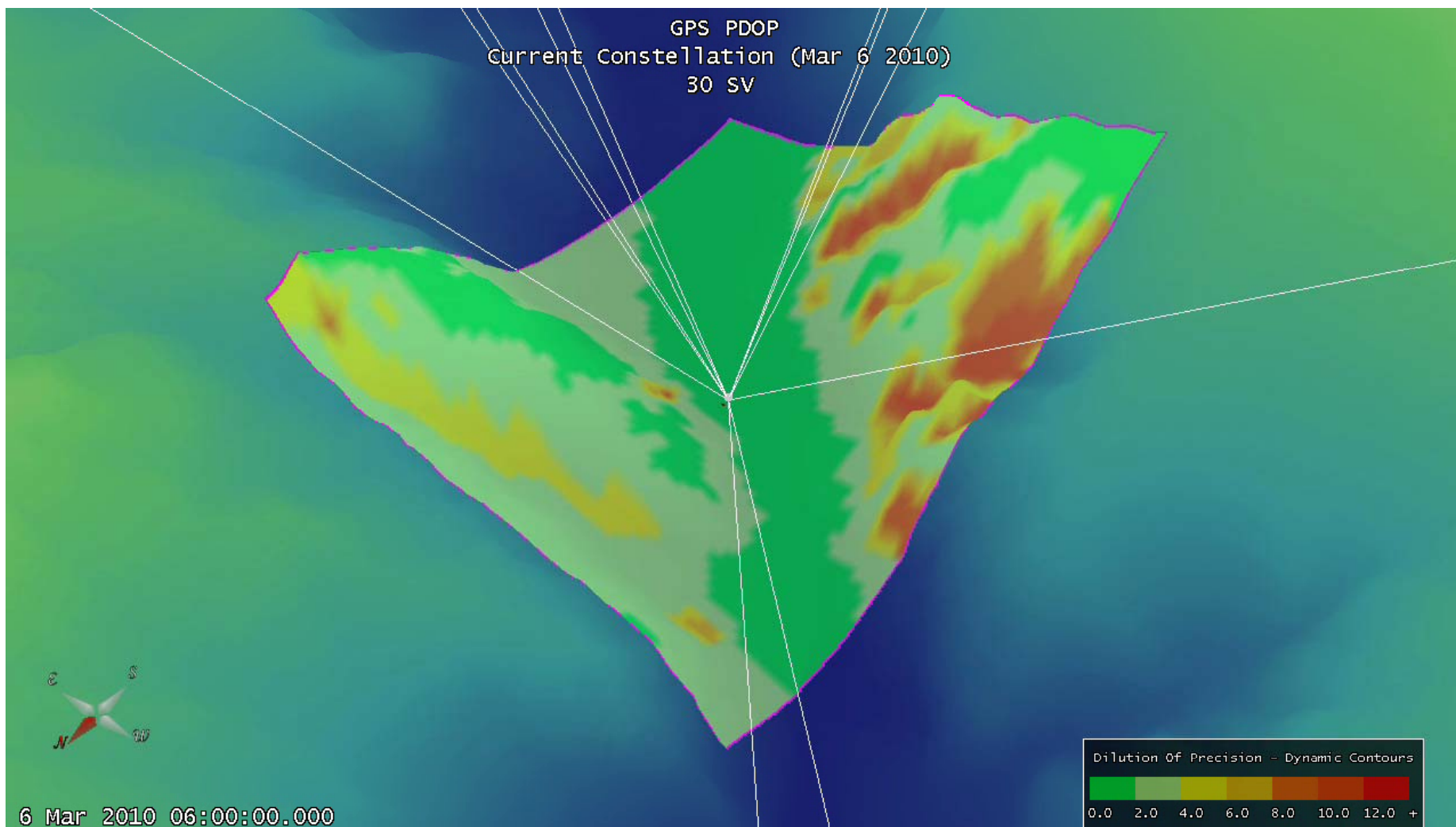
Analysis

- Use Satellite Tool Kit (AGI Software) to analyze impact of terrain on GPS availability over 24 hr period in high terrain test area
- Test Area
  - ~2x2 km ground area
  - 24 hr time period
  - 30 m elevation data
  - 100 m grid spacing
- For each grid point
  - Compute Satellites in View
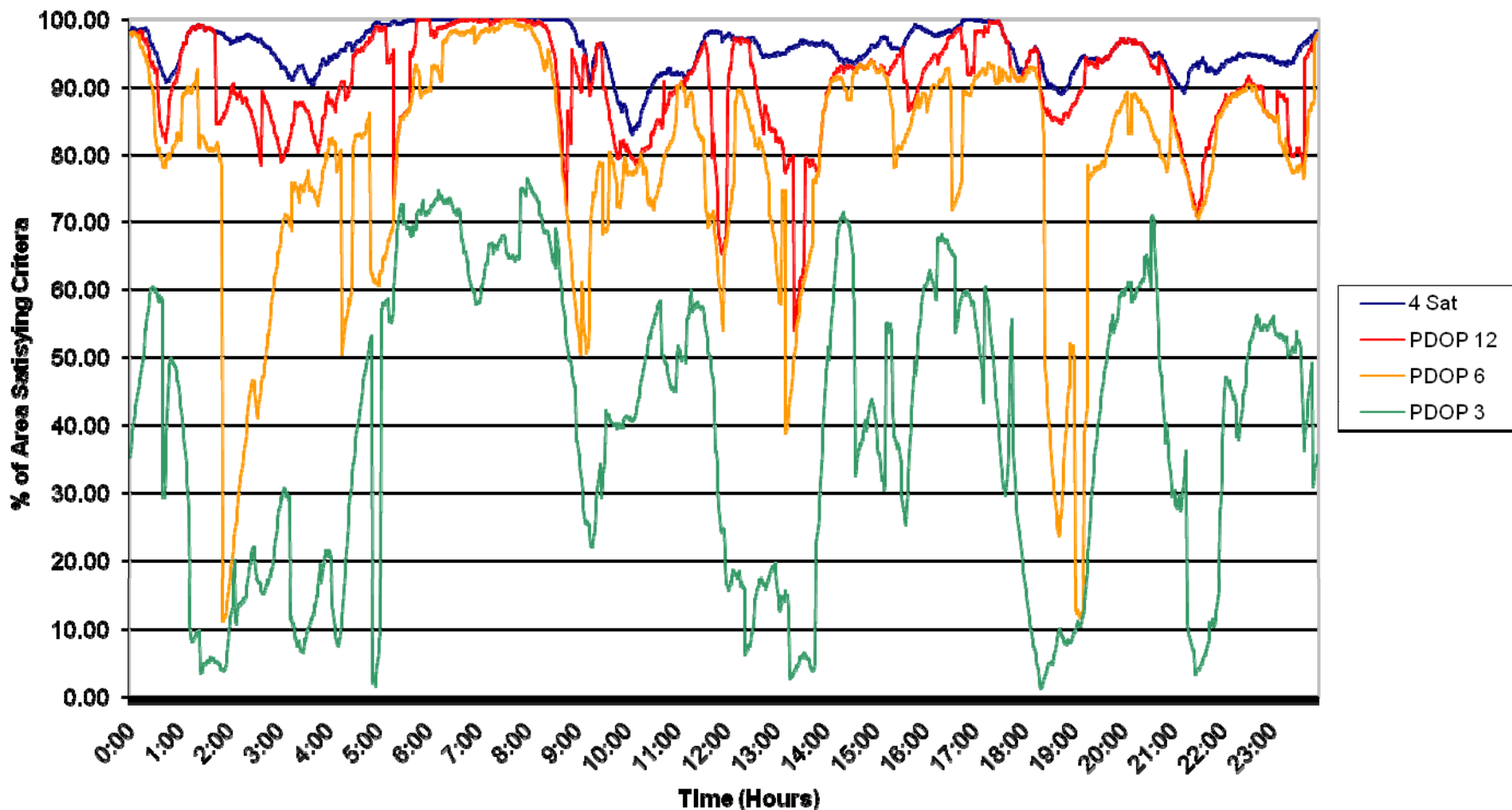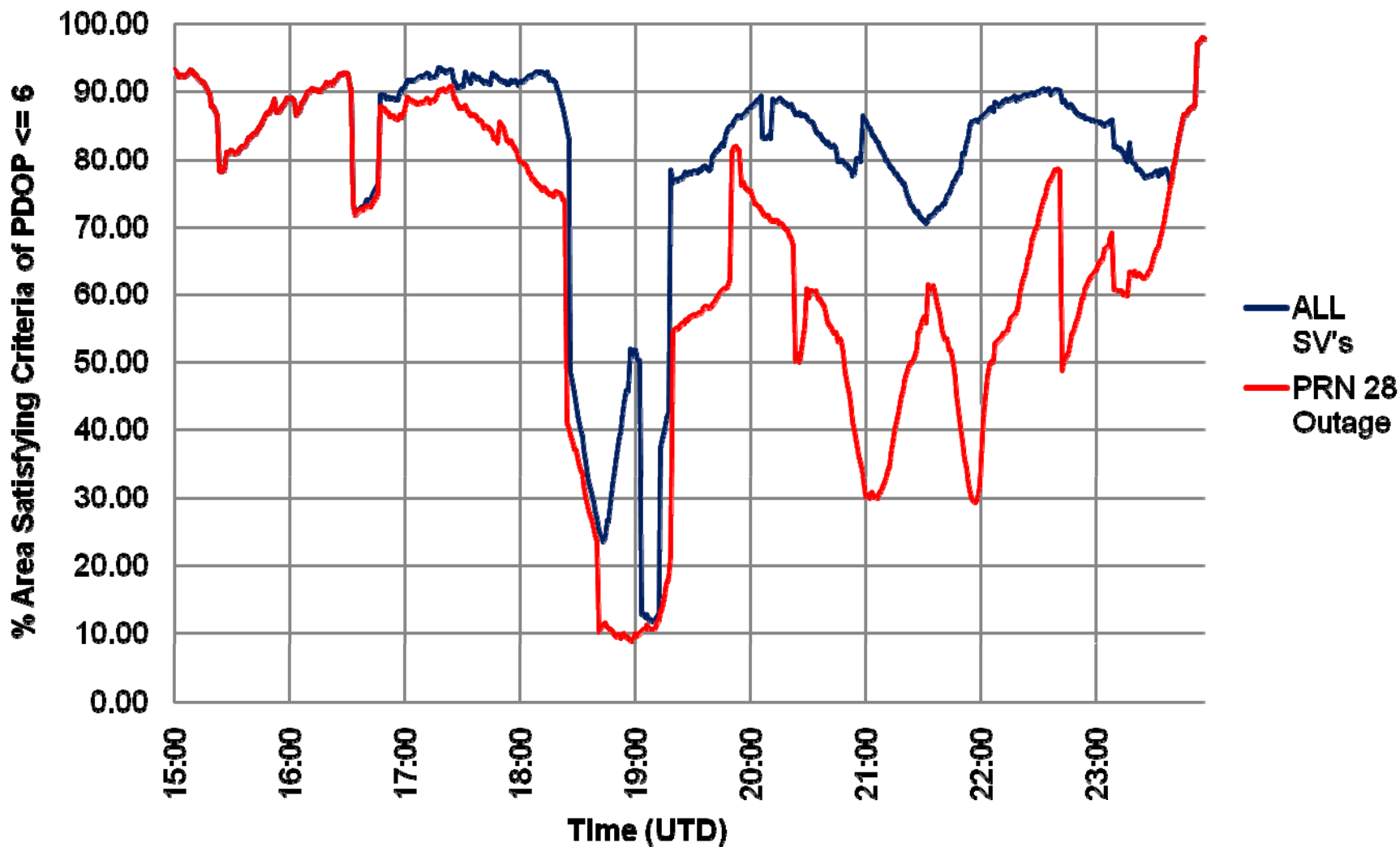 - Dilution of Precision (DOP)

GPS PDOP

≥≥ **THE UNITED STATES OF AMERICA**

% of Area Satisfying Criteria at Time X
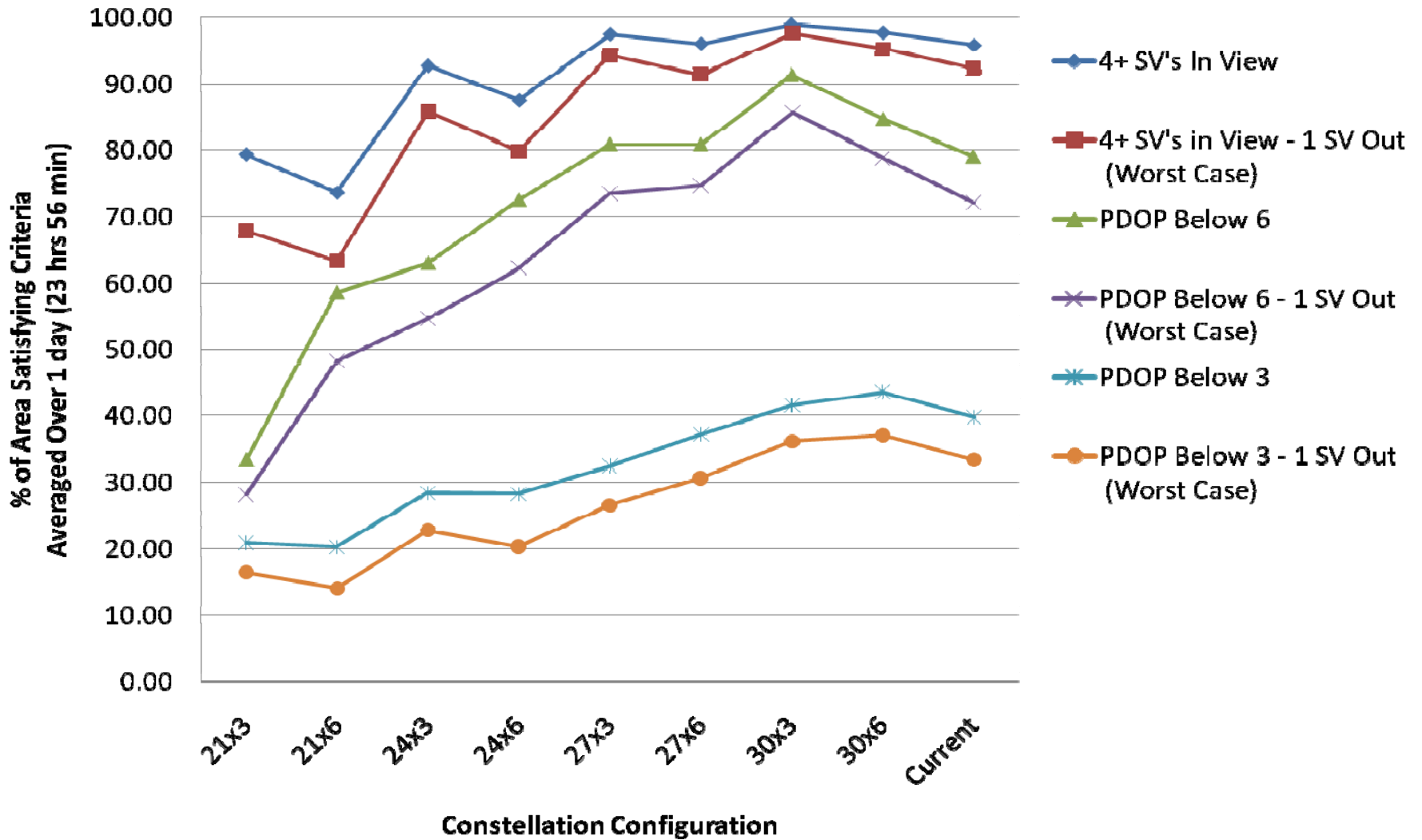23:56 hr Timespan
GPS Constellation
(as of Mar 6, 2010)

Impact of 1 SV Outage on PDOP
Current GPS Constellation

Comparison of SV's In View and PDOP Between Different Constellation Configurations

Solution: "GAPS"
GPS Availability Prediction Service

- Use GPS and Terrain Data to provide web based tool that lets mission planners assess GPS availability and accuracy over area of ground operations for near-term (next 72 + hours).
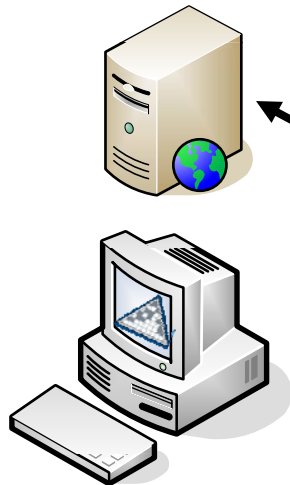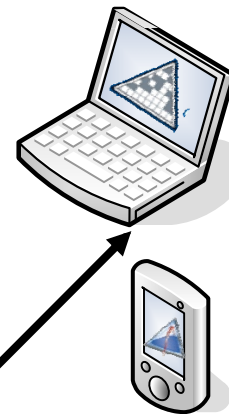
"GAPS" System Architecture

Data Servers

- GPS Data
- Terrain Data
- GPS Outage Files

Users requests

- Point over time
- POI analysis
- Route analysis
- Region analysis

GPS Support

- 24/7 Ops Monitoring
- Software updates

"GAPS" Web-service - Netcentric

- Computes GPS Availability
  - N-Asset – number of satellites in view
  - DOPs – Geometry assessment / quality
  - NavAcc – Predicted error (CEP/SEP)

9

R&D - Issues for further research

– Field tests: Real-world data vs. simulated predictions

– Analyze limitations of end-user equipment

- Hardware
- Software
- Communication pipes.

– Impact of terrain accuracy

– Trade-offs

- Accuracy vs Computation Time
    – Terrain and grid spacing detail vs Timeliness of product

– How much processing power and bandwidth is needed to provide user with acceptable results?

≥≥ THE UNITED STATES OF AMERICA

www.nga.mil

THE UNITED STATES OF AMERICA