Low-Cost Epoch-by-Epoch™ Network-Centric Positioning Unit (ENPU) for FCS Testing

23rd Annual National Test & Evaluation Conference

Hilton Head Island, SC

March 12-15, 2007

Presented by:

Dr. Jeff Fayman

Geodetics Incorporated

About Geodetics

Geodetics, Inc. is a Woman Owned Small Business (WOSB) based in San Diego, California.

Geodetics specializes in high-precision, real-time position and navigation solutions based on its proprietary **Epoch-by-Epoch™** technology.

Geodetics offers a full range of GPS based products and services.

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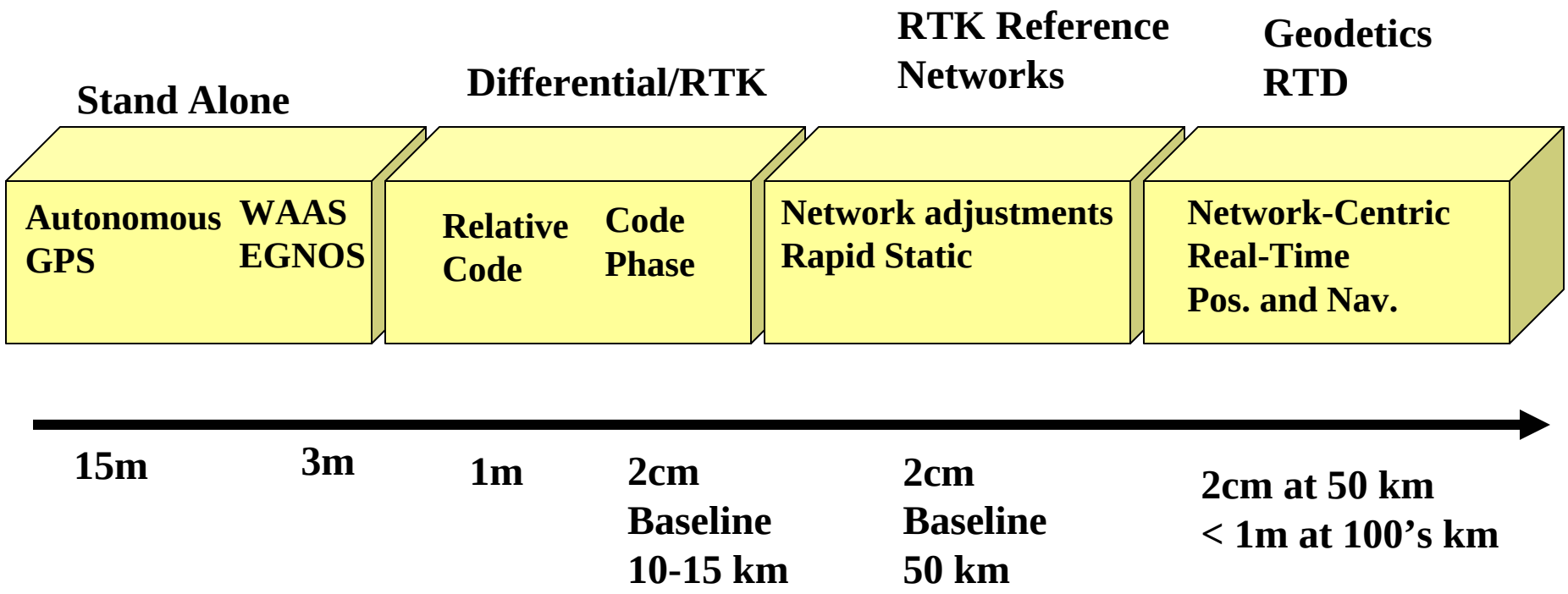
Real-Time Dynamic (RTD) Technology



Geodetics is Introducing Real-Time GPS Reference Network Technology to the Army at Ft. Bliss and Ft. Hood. And the Navy at SPAWAR.

This Technology has been Deployed in many Civilian Applications World-Wide

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California Real-Time Network (CRTN)

SOPAC

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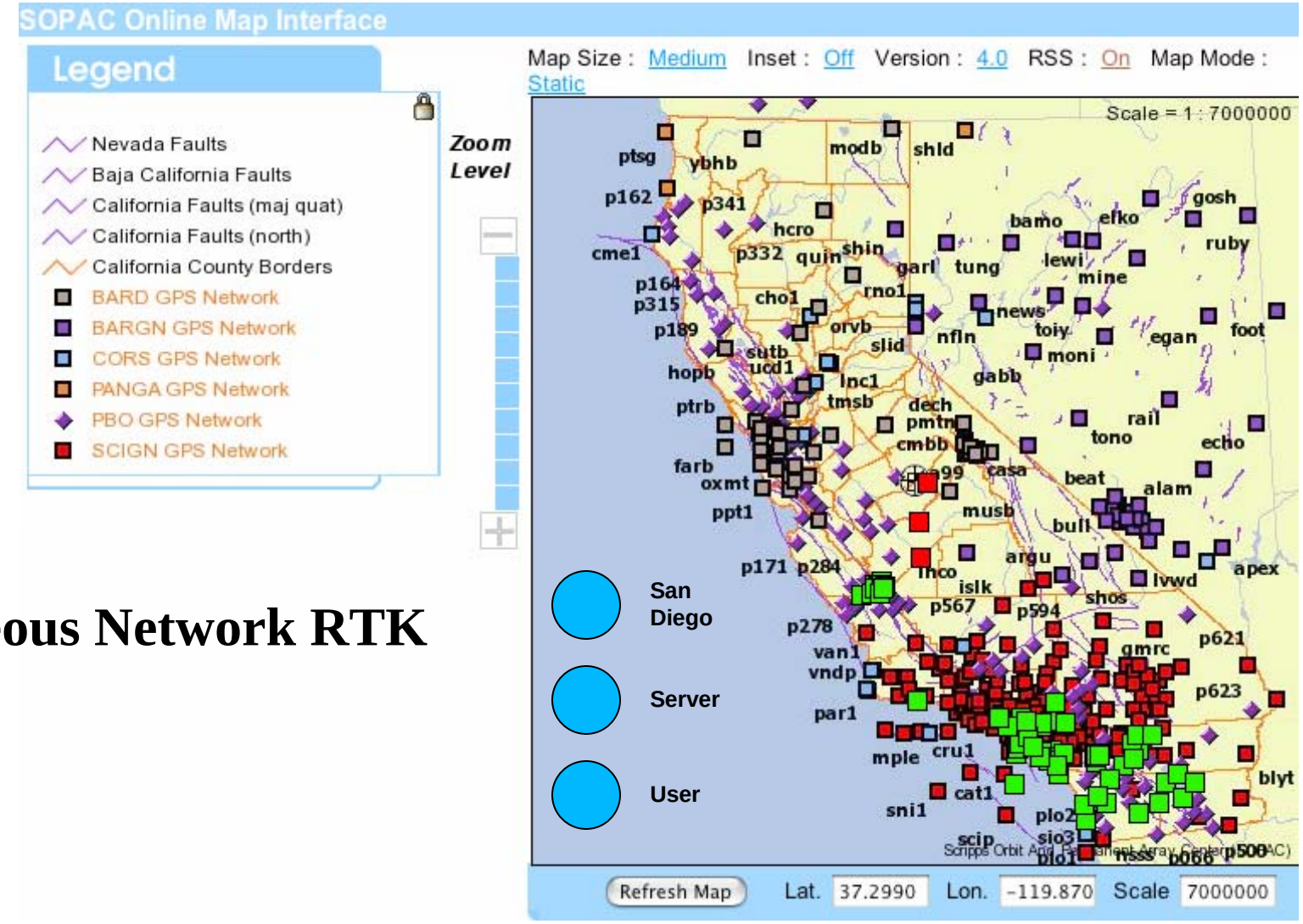

Instantaneous Network RTK

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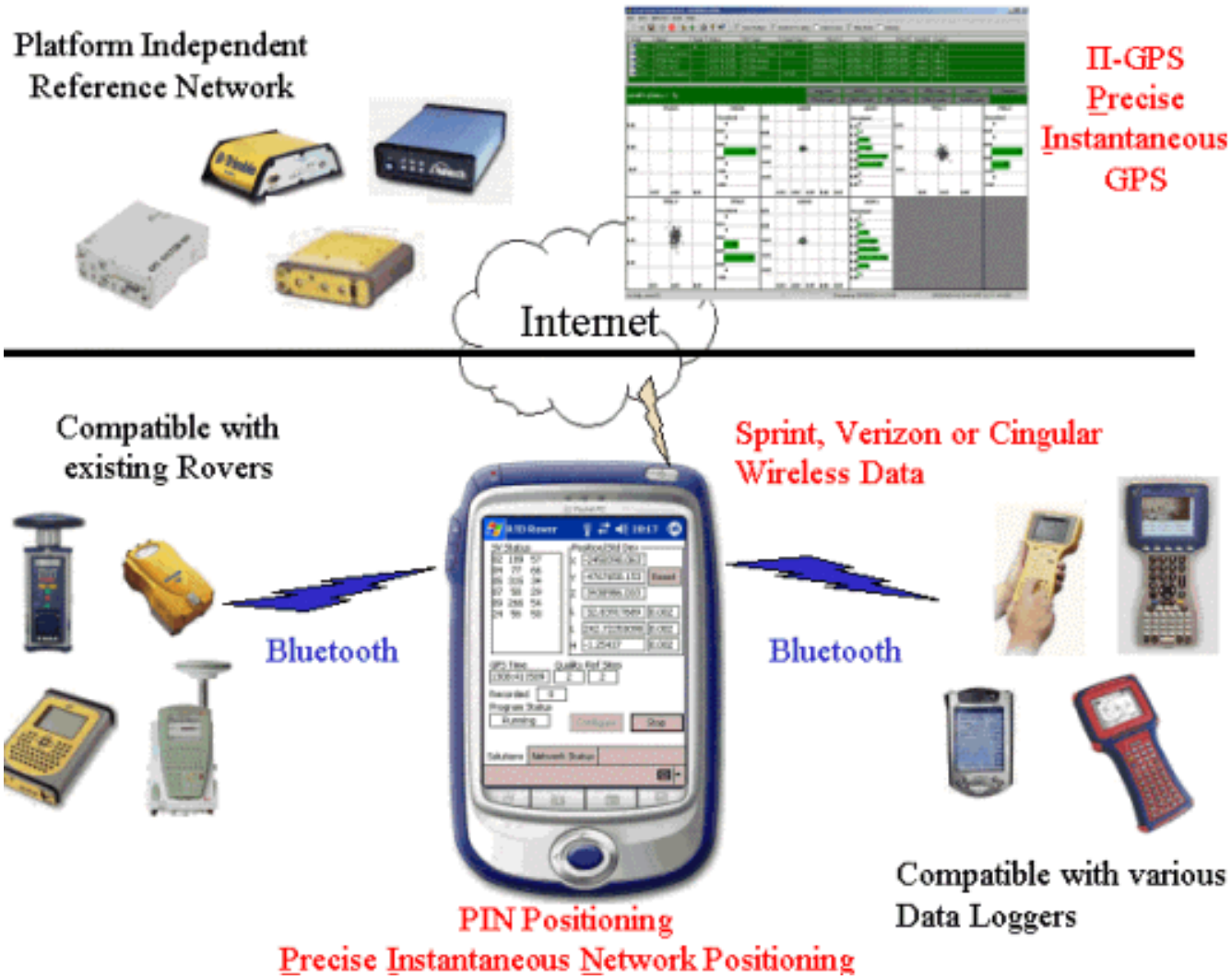
Geodetics Total Solution (Civilian)



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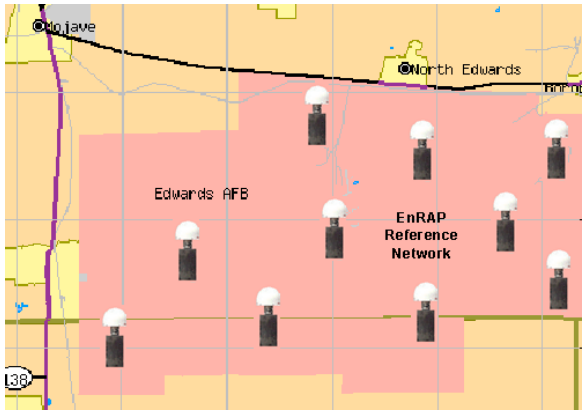
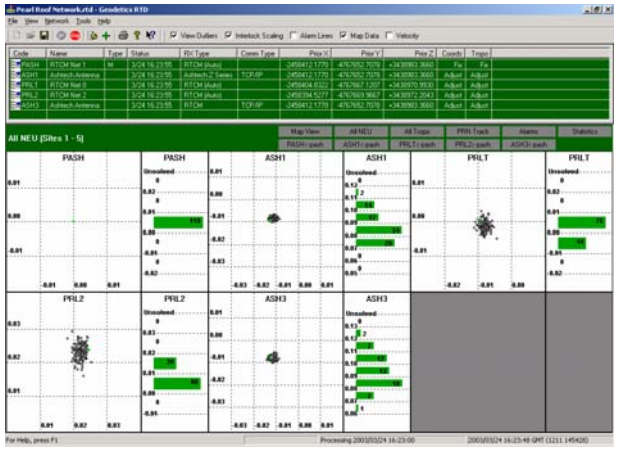
Real-Time GPS Reference Network

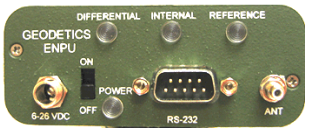


Reference Network



Reference Network Management System

Data-Link



Epoch-by-Epoch™ Network-Centric Positioning Unit (ENPU) for Dismounted Soldier and Low-Dynamic Vehicles

Participants

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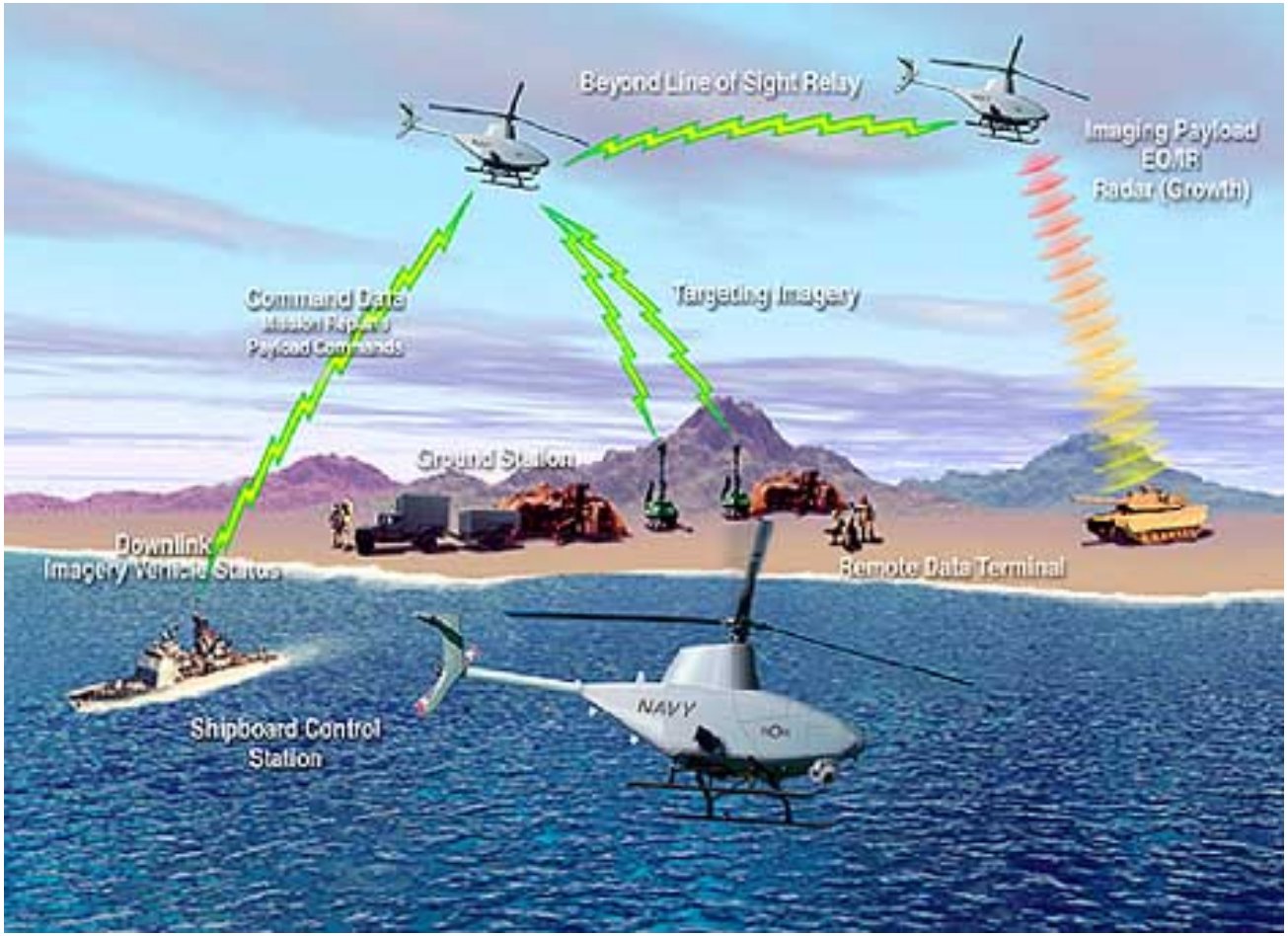
Real-Time, High-Accuracy Network-Centric Positioning for Mobile Force

Epoch-by-Epoch™ technology embedded in rovers offers real-time centimeter level relative and absolute positioning of many players.

The reference network enables extended range operations of the players and centralized command and control through Geodetics RTD server.



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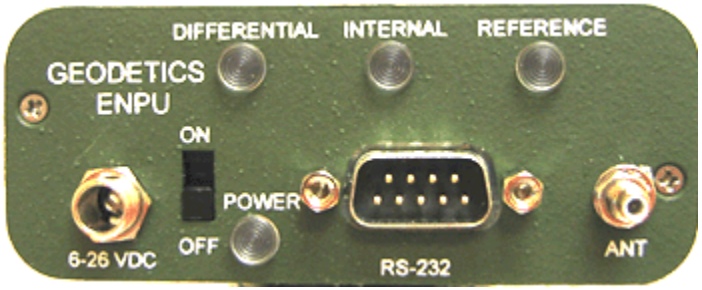
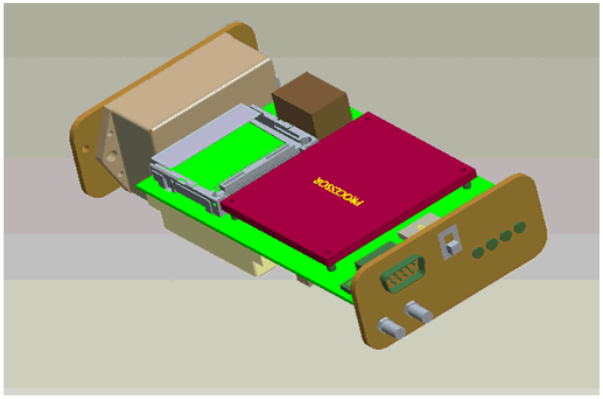
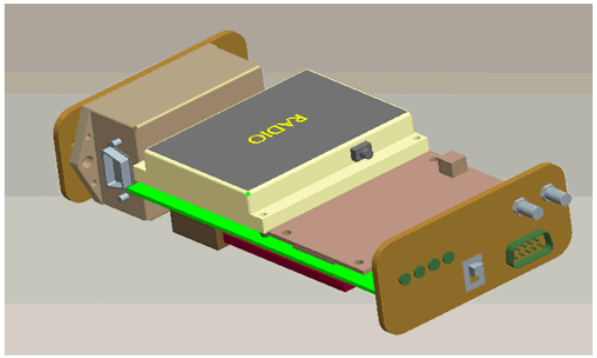
Epoch-by-Epoch™ Network-Centric Positioning Unit (ENPU)







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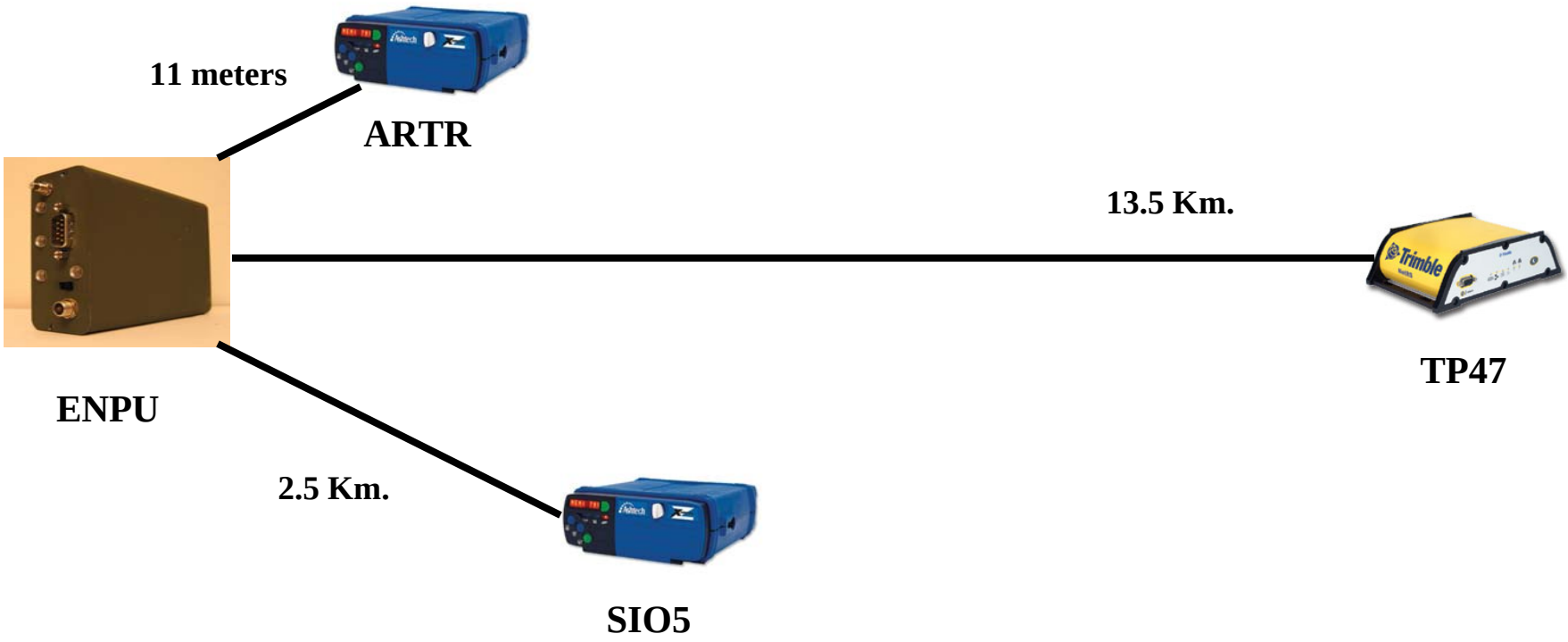
ENPU Accuracy Testing



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ENPU Accuracy Testing (cont.)

Outdoor Environment – Open Sky

Indoor Environment

Note: Testing for GPS only capabilities i.e. no IMU, no smoothing etc.

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ENPU Accuracy Testing (cont.)

				STAND-ALONE PERFORMANCE			
NPU Outdoor Performance			Note: All values are in meters				
	Test Date	North StdDev	East StdDev	Up StdDev			
	4/30/2006	4.55727	3.30303	9.56708			86399 solutions with 1511 outliers (1.7%) (0 non-solutions)
NPU Indoor Performance			Note: All values are in meters				
	Test Date	North StdDev	East StdDev	Up StdDev			
	5/29/2006	6.92149	4.53512	14.18528			84961 solutions with 1101 outliers (1.3%) (65 non-solutions)
				DIFFERENTIAL PERFORMANCE			
NPU Outdoor Performance			Note: All values are in meters				
	Test Date	Reference	Baseline	North StdDev	East StdDev	Up StdDev	Solutions
1	4/30/2006	ARTR	11.08218	0.6937	0.59169	1.79606	86362 solutions with 117 outliers (0.1%) (37 non-solutions)
	4/30/2006	SIO5	2514.32131	0.64314	0.56589	1.55919	86399 solutions with 113 outliers (0.1%) (0 non-solutions)
	4/30/2006	P472	13538.93553	0.67077	0.58248	1.62057	86399 solutions with 130 outliers (0.2%) (0 non-solutions)
NPU Indoor Performance			Note: All values are in meters				
	Test Date	Reference	Baseline	North StdDev	East StdDev	Up StdDev	Solutions
2	5/29/2006	ARTR	10.92737	3.45577	2.8116	7.13446	83560 solutions with 1056 outliers (1.3%) (2839 non-solutions)
	5/29/2006	SIO5	2514.92052	3.42554	2.79797	7.0174	83897 solutions with 1082 outliers (1.3%) (2502 non-solutions)
	5/29/2006	P472	13537.00244	3.41271	2.80889	7.06108	83846 solutions with 1017 outliers (1.2%) (2553 non-solutions)

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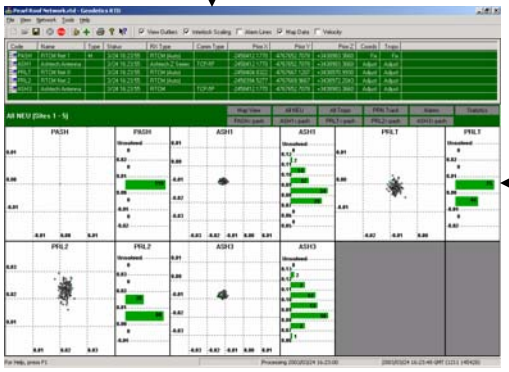
ENPU Accuracy Testing at Ft. Bliss for FCS Testing

Topcon Odyssey dual-frequency rover



RTD Server

Ft. Bliss RF Telemetry Link

Leica Geosystems RS500 Reference Receiver

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ENPU Accuracy Testing at Ft. Bliss

Ft. Bliss Test Site

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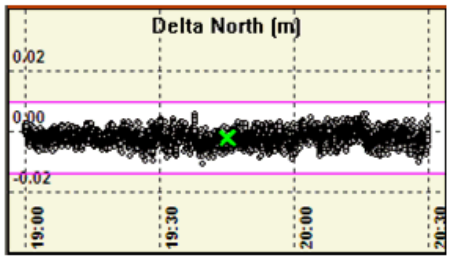
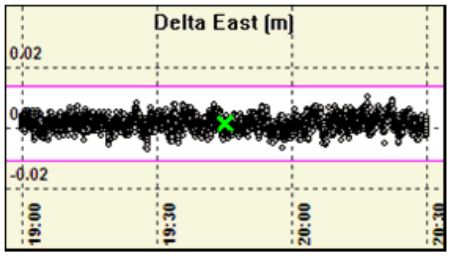
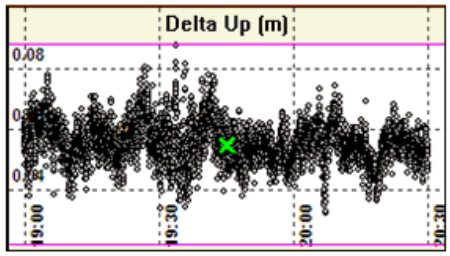
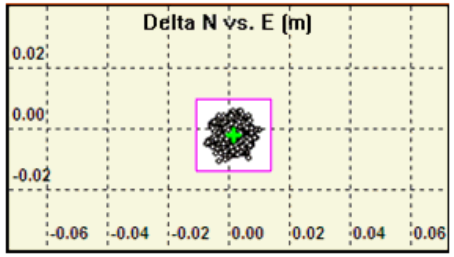
ENPU Accuracy Testing at Ft. Bliss

Test 1: Topcon at "L10"

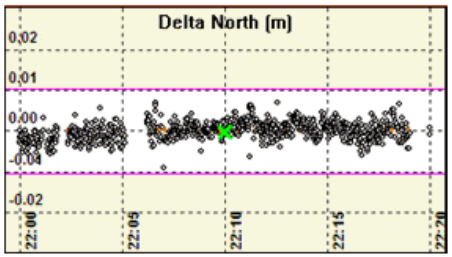


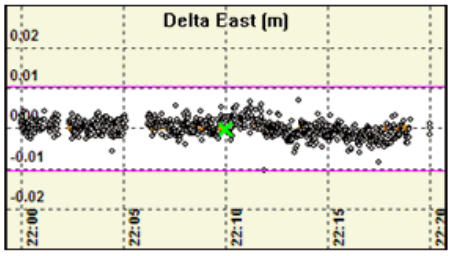


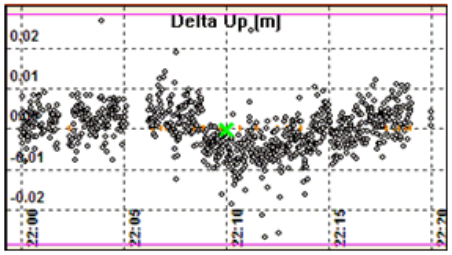


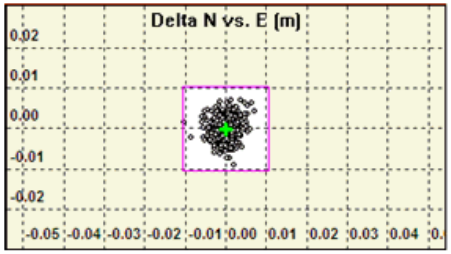


Test 4: Topcon at "L9"









Test 1: Topcon at "L10"

	North (meters)	East (meters)	Up (meters)
IQR	0.003	0.003	0.009

Test 4: Topcon at "L9"

	North (meters)	East (meters)	Up (meters)
IQR	0.003	0.003	0.0072

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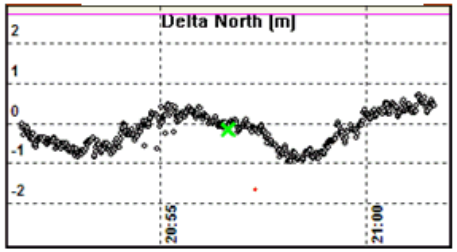
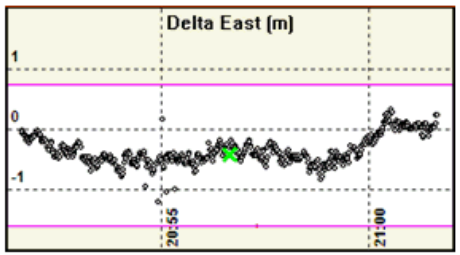
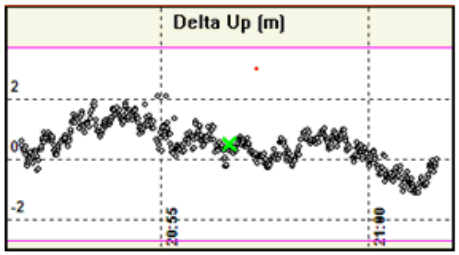
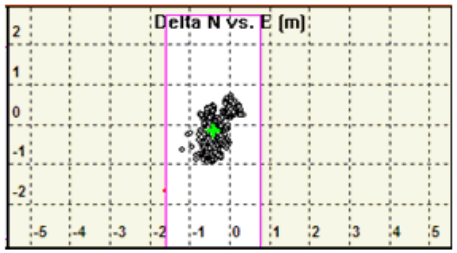
ENPU Accuracy Testing at Ft. Bliss

Test 2: SiRF at "L10"

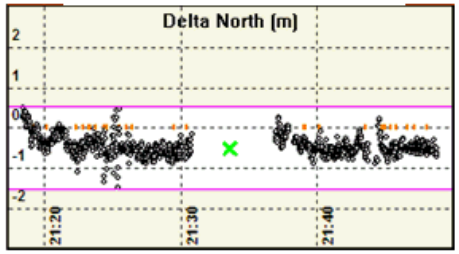


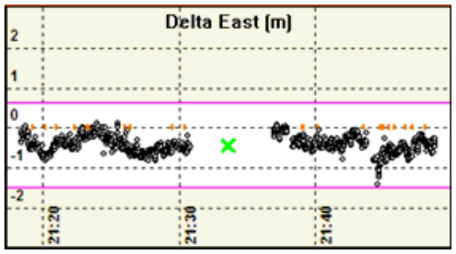


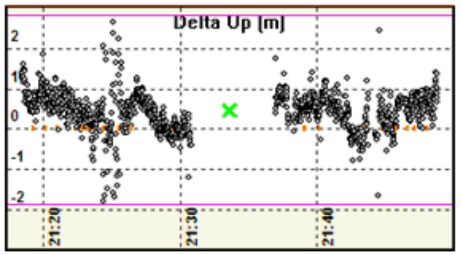


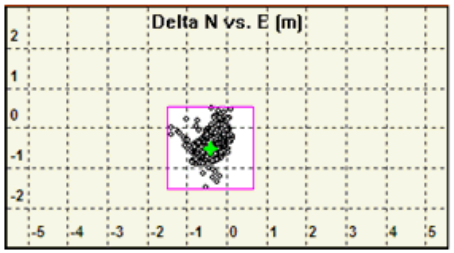


Test 3: SiRF at "L9"









Test 2: SiRF at "L10"

	North (meters)	East (meters)	Up (meters)
Mean Diff.	-0.153	-0.405	0.450
IQR	0.730	0.294	0.802

Test 3: SiRF at "L9"

	North (meters)	East (meters)	Up (meters)
Mean Diff.	-0.487	-0.425	0.467
IQR	0.260	0.268	0.587

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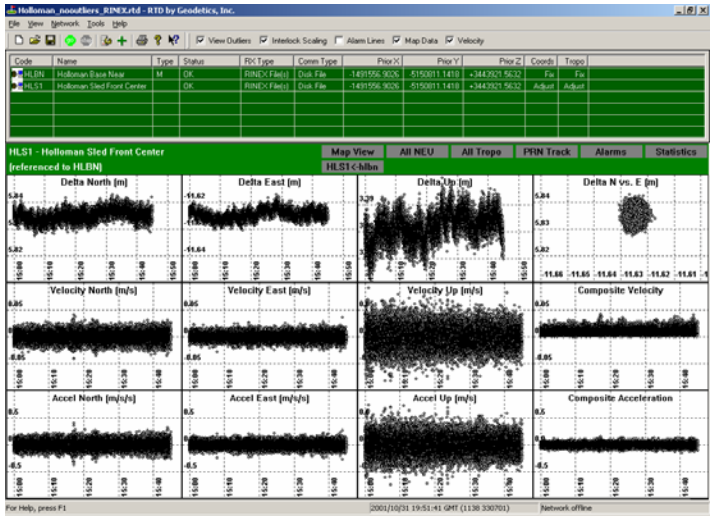
Epoch-by-Epoch™ Test Verification

- Geodetics technologies were extensively tested by DoD and are making their way into many projects in the Military
- The Central Test & Evaluation Investment Program (CTEIP) has funded a program to evaluate the performance of Epoch-by-Epoch™ (EBE) technology for test and evaluation instrumentation applications.
- EBE technology has undergone extensive testing in both live and simulated tests under strenuous environments, including:
  - Low Dynamics
  - High Dynamics
  - SAASM under High Dynamics
  - Attitude Determination



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ITEA Award

The preceding tests results were published in the October 2004 International Test and Evaluation Association Journal under the title:

"Epoch-by-EpochTM Real-Time GPS Positioning in High Dynamics and at Extended Ranges“

The paper was selected by the ITEA publications committee as the most important paper published in 2004.

Geodetics, together with its co-authors received the award at the annual ITEA International Symposium in September 2005

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Nunn-Perry Award

Geodetics and Lockheed Martin entered a three year DOD sponsored Mentor-Protégé (MP) agreement in August, 2005. The program was awarded by the OSD Office of Small Business Utilization through the U.S. Navy SPAWAR, San Diego, CA, Joint Robotics Program (JRP).

Under this program Lockheed Martin is mentoring Geodetics, in the manufacture of high-accuracy, real-time geo-location sensor systems based on GPS technology. This MP agreement enables Geodetics to deliver turn-key hardware/software solutions to the Government.

This year, the Geodetics/Lockheed Martin Team was selected as the top Mentor-Protégé team out of several hundred such DOD M/P teams.

The Geodetics/Lockheed Martin Team will receive the prestigious Nunn-Perry award in March recognizing the team as the best in the DOD.

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