User Driven Benefit in a World of Multiple GNSS

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Overview

- Trimble Overview
- Product Evolution
- Solutions
- The Future

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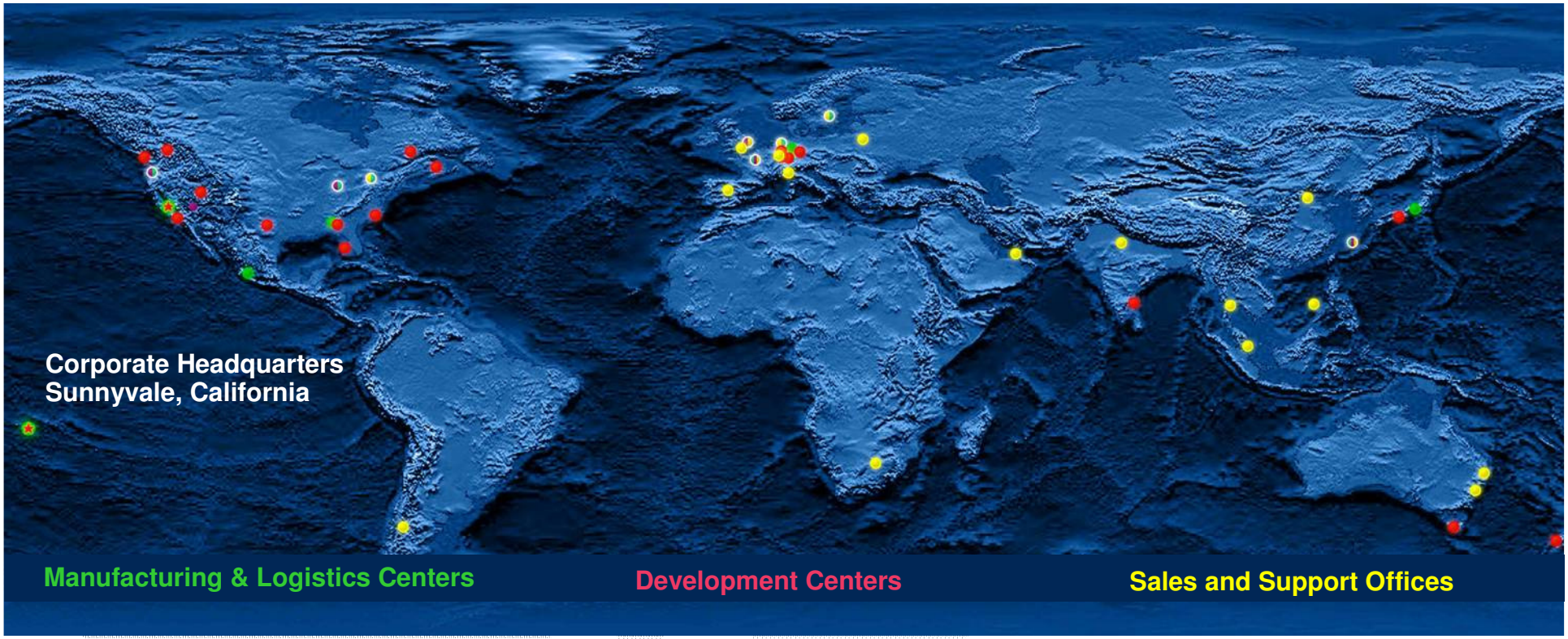
Trimble: Transforming the World's Work

3,600 Employees Worldwide



Trimble History

1978 – Company founded

1990 – Initial Public Offering (IPO)

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Our Strategy is…

Commercial solutions that transform the work process to enhance user economics and capabilities:

- Labor and machine productivity
- Rework
- Process optimization
- Quality
- Input costs

CONNECTED SITE FOR CONSTRUCTION

PRECISION AGRICULTURE

MOBILE & FIELD WORKER

ADVANCED DEVICES

Product Evolution (high precision)

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The Survey Line of GPS Receivers

Past and Present

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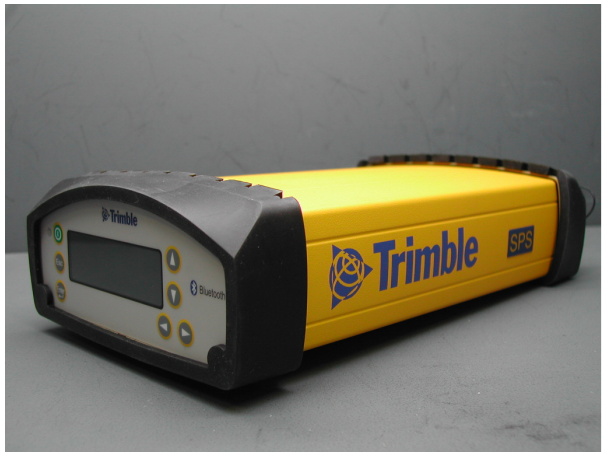
Shipping GNSS Technology [1]

- GPS
  - L1 C/A
  - L2C & L2 Enhanced Cross-correlation
    - L2C first shipped Q3 2003
  - L5
    - First shipped Q4 2005
- GLONASS
  - L1/L2 C/A & P
    - First shipped Q1 2006
- SBAS
  - DO-229C Compliant systems
  - WAAS/EGNOS/MSAS
- Commercial SBAS
  - OmniSTAR-HP/XP/VBS
  - L-band satellite link



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Shipping GNSS Technology [2]

- Integrated Communications
  - 2.4GHz, 450MHz, 900MHz, Cellular …
- Integrated TCP/IP Stack
  - Web Server for configuration / status
  - FTP (server & client)
  - Data Streaming / Corrections
  - NTrip
  - Firmware upgrade
- Bluetooth for local communication
- Serial / USB / CAN / Ethernet
- Open & Proprietary Data Formats
- Internal observable & position logging & streaming

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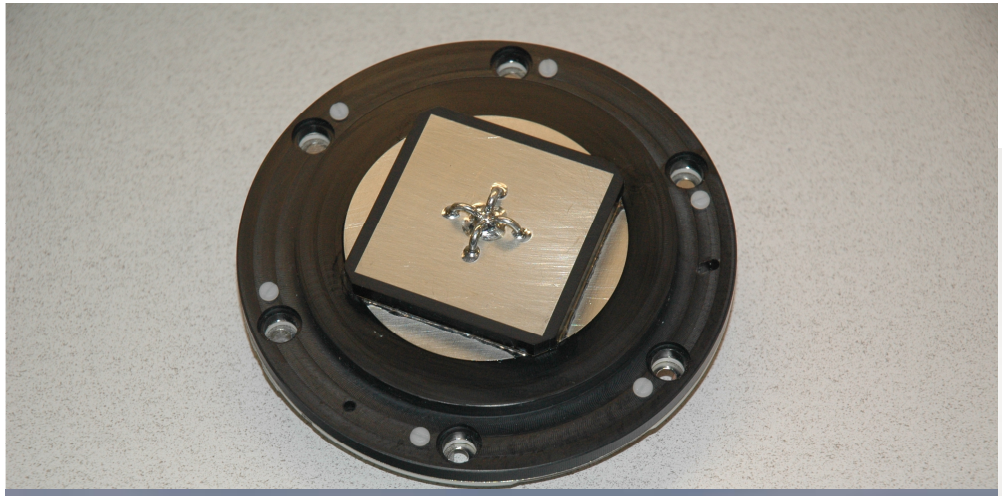
Multi-frequency/Multi-System Antenna

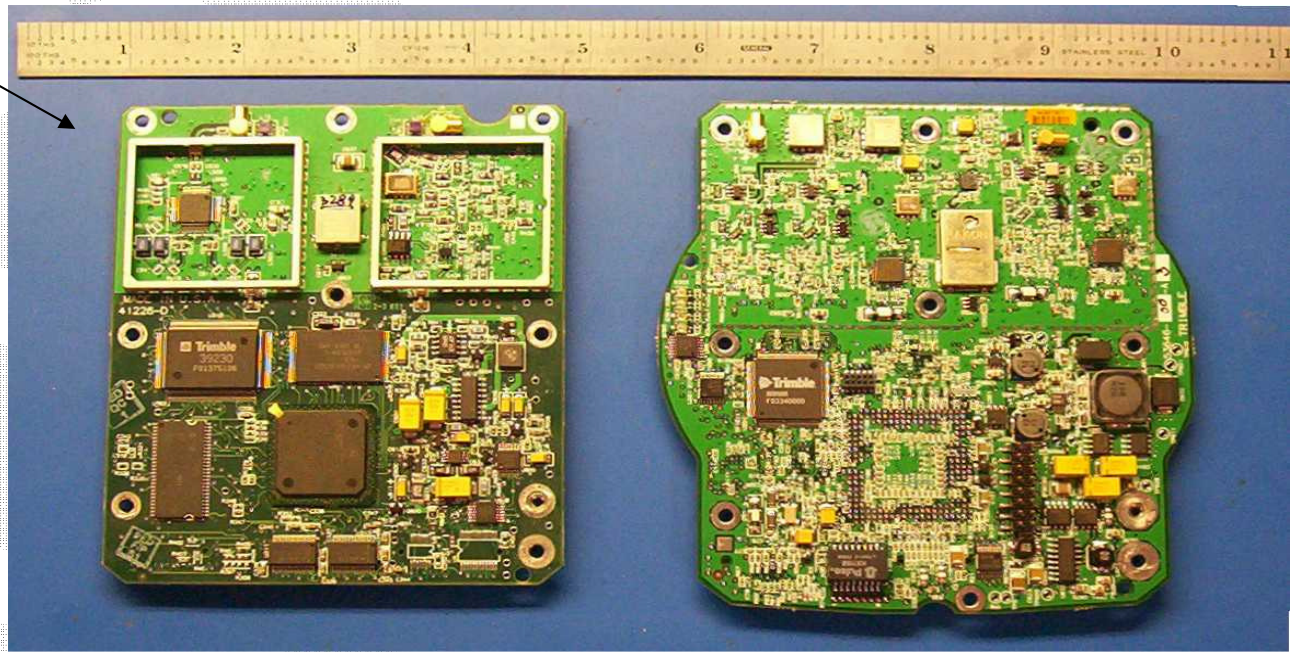
- GPS, GLONASS, Galileo Ready – shipping since Q4 2005



Increased Integration

L1/L2 RF Bands

G1/G2/L1/L2/L5 RF Bands



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Solutions

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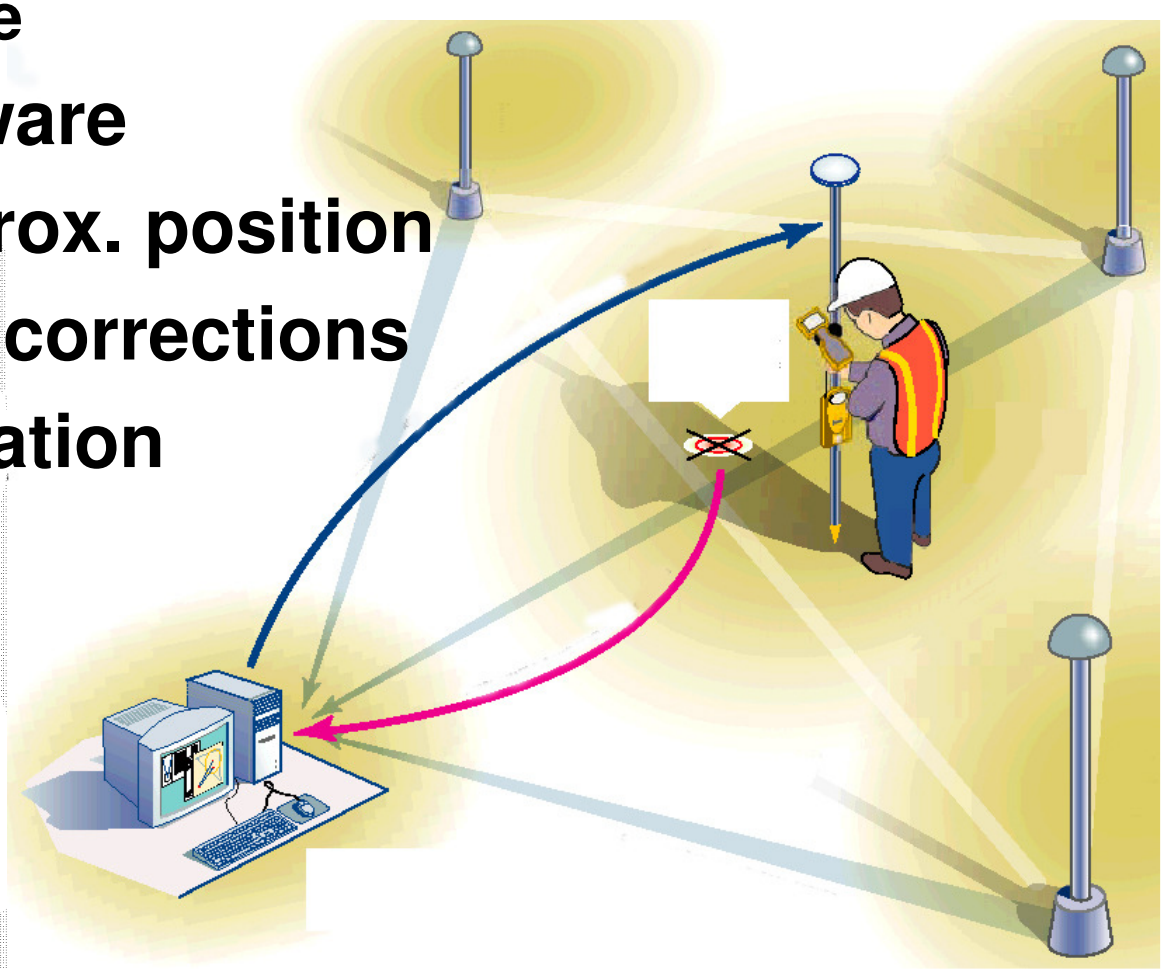
VRS Solution Example

- Network of Receivers
  - Vs single baseline
- VRS Server Software
- Rover sends approx. position
- Server optimizes corrections
- 2-way communication
  - E.g. GPRS



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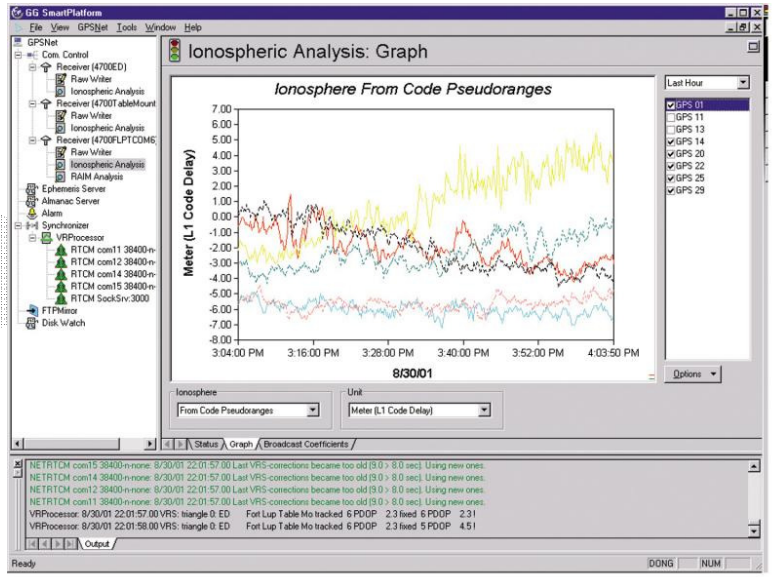
VRS GNSS

- Trimble provide end-to-end solution
  - TCP/IP enabled reference stations
  - VRS server software
    - In some regions Trimble operate a VRS Service
  - RTK GNSS Rovers with various communication options
  - Field rugged data collectors
  - Data collection software
  - GNSS Office Software Suite
  - Reduces customer investment
  - Increases productivity



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Construction Example [1]

- **High precision position of Bulldozer blade**
  - **Also Excavator, Graders etc**
- **Provides a significant productivity gain**
- **Requires satellite availability / precision**
  - **Currently GPS+GLONASS**

Single GNSS with tilt sensor

Construction Example [2]

- **Trimble provide**
  - **Office software / Machine software & display**
  - **GNSS & Communications**

High Precision Dual GNSS

Large Scale Scientific Applications

- **PBO**
  - **Analysis of Earth movement in Western US**
  - **Trimble provide NetRS receivers**

The Future

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Current Solutions

- GPS + GLONASS for position
- Various communication options
- Field/Office Software
- Next Generation Solutions Require:
  - Improved communications
  - Integration (size, weight, power)
  - Improved GNSS availability & accuracy

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Satellite Availability is Key

- Require cm operation in obstructed areas

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The Future

- Customers demand high precision in increasingly difficult environments (e.g. satellite masking)
- Integrating new systems requires investment hence new GNSS must:
  - Open access to signals and technology
  - Free signal availability
  - Predictable policies
  - Freedom to experiment with new applications
  - Level playing field for robust competition
  - Market-driven equipment standards
- Markets drive application development
  - Productivity is key
    - Customers don't care whether it is GPS or GNSS
    - New systems will be adopted if they provide a productivity increase
    - ROI

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Next Generation GNSS

- Galileo
  - Trimble active in Galileo development
    - First demonstrated Giove-A tracking at Intergeo Oct 2006
    - Demonstrated Giove-A & Giove-B (E1, E5A, E5B & E5AltBOC) at various conferences & trade shows
  - Public ICD
  - License / IPR unclear
    - User fees?
- QZSS
  - Well aligned with GPS III
  - Public ICD available
  - No fees
  - Regional
- Compass
  - Test satellite in space
  - Technical details yet publicly available

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Galileo Test Receiver

SN: GALILEO000

- Receiver Status
- Satellites
  - General
  - Tracking (Table)
  - Tracking (Graph)
  - Tracking (SkyPlot)
  - GPS Enable/Disable
  - GLN Enable/Disable
  - SBAS Enable/Disable
  - Satellite Almanacs
  - Predicted Elevation
  - Predicted Constellation
  - Current Constellation
  - Ground Track
  - Satellite Data
- Data Logging
- Receiver Configuration
- I/O Configuration
- Network Configuration
- Security
- Firmware
- Help

Trimble - Galileo Development Platform

SV	Type	Elev. [Deg]	Azim. [Deg]	L1-C/No [dBHz]	L1	L2-C/No [dBHz]	L2	L5-C/No [dBHz]	L5	IODE	URA [m]	Type
GIOVE-A	GALILEO	18.70	183.56	39.8	BOC	-	-	37.8/37.9/43.4	A/B/Alt	-	-	-
1	GLONASS	58.11	338.51	47.3/45.4	CA/P	46.3	P	-	-	223	-	-
8	GLONASS	30.94	45.90	42.4/42.1	CA/P	42.3	P	-	-	95	-	-
9	GLONASS	4.85	21.02	39.2/38.4	CA/P	35.6	P	-	-	95	N/A	M
10	GLONASS	22.06	67.98	43.6/41.0	CA/P	35.8	P	-	-	95	N/A	M
11	GLONASS	14.47	121.87	45.0/42.0	CA/P	34.3	P	-	-	95	N/A	M
17	GLONASS	24.45	326.32	44.5/42.3	CA/P	40.1	P	-	-	95	N/A	M
23	GLONASS	32.66	188.67	47.3/44.3	CA/P	36.4	P	-	-	95	N/A	M
24	GLONASS	59.10	274.97	53.5/50.7	CA/P	44.0	P	-	-	95	N/A	M
3	GPS	45.32	260.60	47.8	CA	38.5	E	-	-	43	2.8	IIA
6	GPS	22.95	181.77	42.7	CA	26.9	E	-	-	98	2	IIA
9	GPS	19.83	74.03	41.7	CA	26.7	E	-	-	52	2.8	IIA
14	GPS	57.96	184.82	49.8	CA	41.4	E	-	-	45	2	IIR
18	GPS	42.30	53.33	48.1	CA	36.8	E	-	-	88	2	IIR
19	GPS	36.13	302.31	45.8	CA	35.7	E	-	-	58	2	IIR
21	GPS	33.22	114.60	49.1	CA	33.7	E	-	-	56	2	IIR
22	GPS	71.08	345.87	53.5	CA	44.7	E	-	-	15	2	IIR
32	GPS	42.00	271.26	50.3	CA	36.2	E	-	-	41	2	IIA

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