USERS' CONFERENCE

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GPS Signal Simulation & Visualization

Oct 11, 2005

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Spirent Federal Systems

About Spirent Federal Systems…

- North America's leading supplier of high performance broadband, network and ***GPS RF*** test equipment
- Headquarters: Yorba Linda, CA
- Core expertise: Satisfying customers' unique needs for wireless, network and ***GPS*** receiver test and evaluation!

What is GPS?

- **The *Global Positioning System* is owned and operated by the US government**
- **Constellation of orbiting satellites (~26,560 km altitude) and ground facilities**
- **First Block 1 developmental satellite launched 1978**
- **GPS provides 24-hour, all-weather navigation and timing capability to terrestrial, airborne and spaceborne users**
- **Funded purely through US federal taxes– signals available "free of charge"**

Enormous public value:

Recreation
Aviation
Defense
Electric utilities
Internet timing

Surveying
Agriculture
Financial
Precise Timing
Scientific Research

Factors affecting GPS performance

Satellite factors

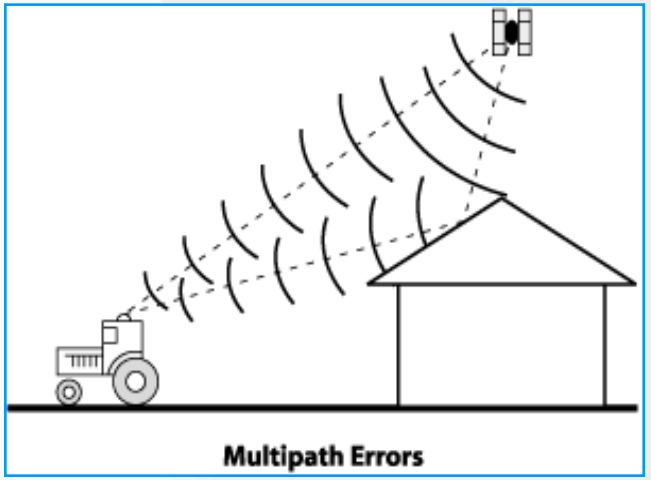
- Broadcast ephemeris
- Clock errors
- Constellation geometry
- SV anomalies and periodic maintenance

Atmospheric factors

- Ionosphere effects
- Troposphere (weather)

User factors

- Sky visibility
- User motion
- User environment (urban, heavy foliage, etc.)
- Signal reflections (multipath)
- Interference (unintentional or otherwise)
- Receiver design
  (noise figure, sensitivity, software bugs, design limitations, etc.)



Why simulate GPS signals?

- **Controllable** — Specific tests are created for unique conditions
- **Flexible** — Enormous variability of GPS signal conditions can be modeled
- **Precise** — Every aspect of the GPS signal and environment is specified by user
- **Repeatable** — GPS receiver responses to various stimuli are observed repetitively
- **Inexpensive** — Platform motion is simulated, reducing need for expensive field testing
- **Safe** — Tests are conducted in a lab

Spirent GPS Simulation Lab

Get from here to here…

Quickly & with confidence!

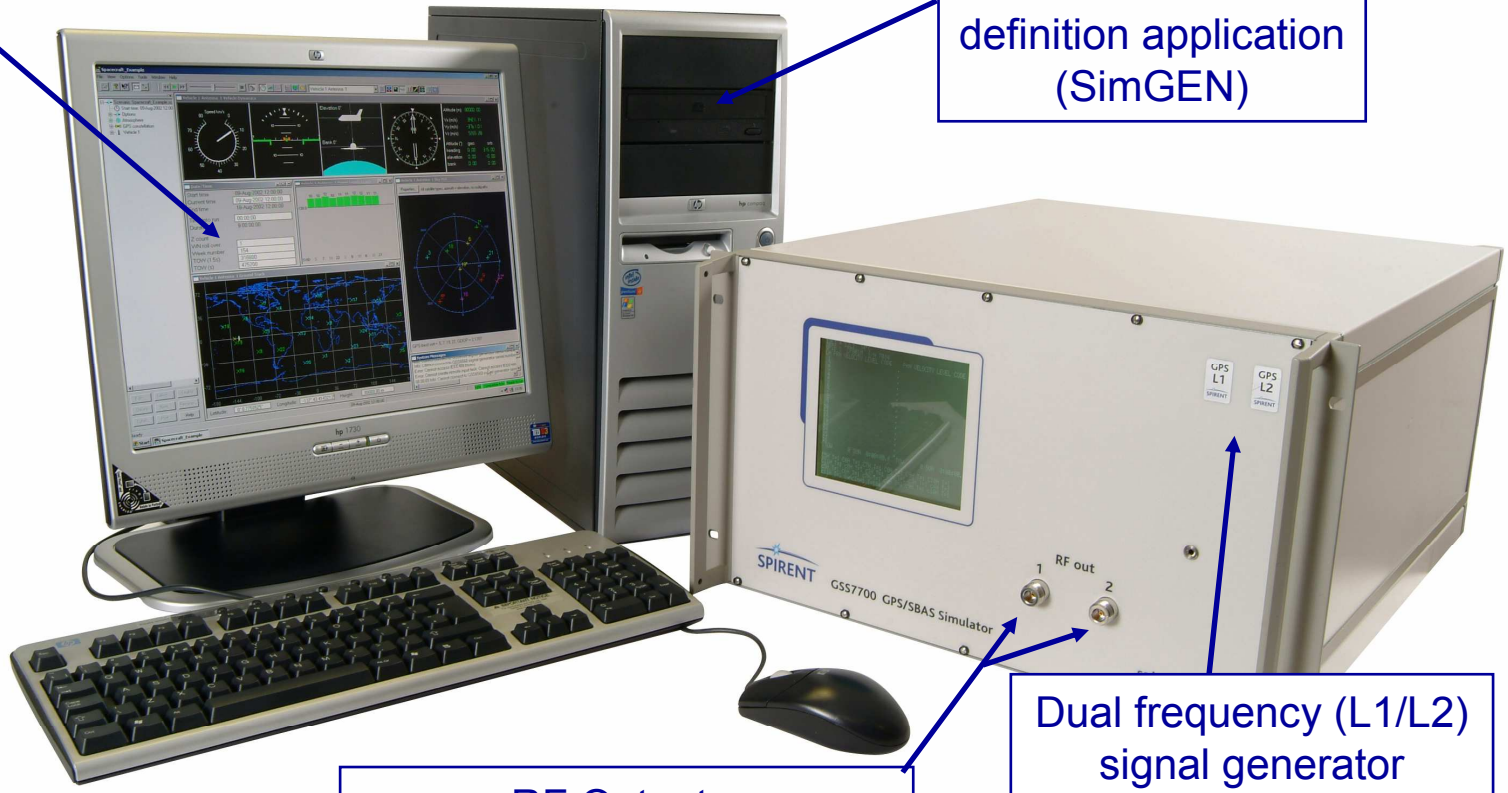
GPS-Guided Munition Test

Spirent's GPS Signal Simulator

SimGEN GUI
(for real-time scenario monitoring & control)

GSS7700

PC with scenario definition application (SimGEN)



RF Outputs
(to GPS receiver under test)

Dual frequency (L1/L2) signal generator "Constellation in a Box" (also available for L5)

Special GPS simulation applications

- High platform dynamics
  - Spinning antennas
  - High delta-V/delta-A trajectories
- GPS reception under jamming
- Combined GPS/INS navigation
- "Urban canyon" navigation
  - Heavy multipath & obscura
- Spaceborne navigation
  - Orbit & attitude determination
- Marine navigation
- Indoor navigation (AGPS)
- Space Based Augmentation
  - (WAAS, LAAS, EGNOS, MSAS)
- Classified signal simulation
  - (SAASM, M-Code)
  - *Authorized users only*

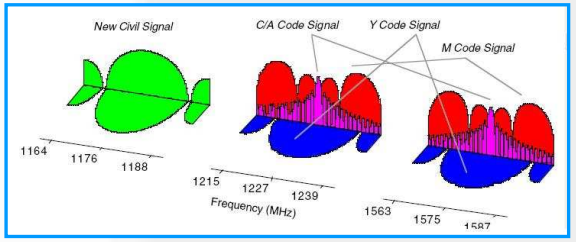
Spirent supports all of these applications… and many more!

Who are Spirent's GPS simulator customers?

- Government
- Defense
  - Army
  - Air Force
  - Navy
- Universities
- Automotive Industry
- Wireless Industry
- GPS Receiver Manufacturers and OEMs
  - Commercial & Government

GPS changes on the horizon…

- First modernized "IIR-M" satellite launched 25 Sep
  - M-Code (improved military code on L1 & L2 frequencies)
  - L2C (new civil signal on L2 frequency)
  - Modernized GPS payloads to be launched over next several years
- Third civil frequency (L5) planned for GPS "Block IIF" satellites
  - Further reduces GPS range measurement error
  - Centered at 1176.45 MHz
  - Projected 2007 first launch



- European Galileo system
  - EU effort to develop navigation satellite system similar to GPS
  - First launch TBD

Spirent has developed simulation capabilities for ALL of these signals. These test systems are available to authorized users today.

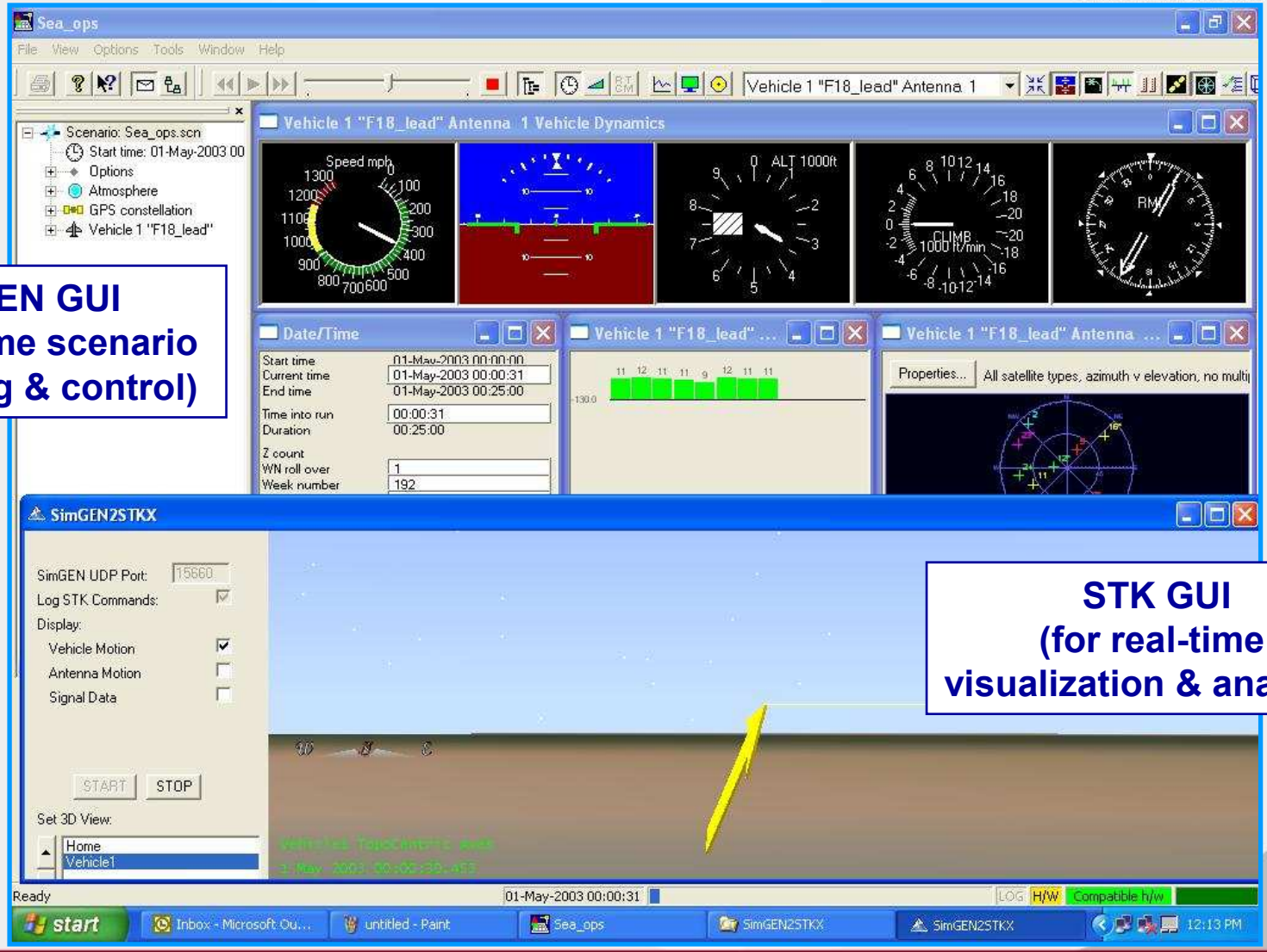
AGI & Spirent Collaboration

- AGI offers wealth of experience with spatial visualization and graphical analysis

- *Spirent GPS RF simulations can be enhanced by adding real-time (and post processing) visualization capabilities*
    - STK translates simulated trajectories into viewable motion
    - Eliminates level of abstraction

- Useful attributes of SimGEN-STK interface include:
    - Signal vectors to orbiting satellites
    - Jammer location visualization
    - 3D rendering of platform motion
    - Illustration of signal reception vs. antenna orientation

SimGEN2STKX Application



SimGEN GUI (for real-time scenario monitoring & control)

STK GUI (for real-time visualization & analysis)

QUESTIONS?