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February 17, 2000

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th St., S.W.
Washington, DC 20554

Re: ***Ex Parte* Notification**
ET Docket No. 98-153
Ultra-Wideband

Dear Ms. Salas:

This is to note that on February 16, 2000, Ralph Petroff and Rachel Reinhardt of Time Domain Corporation, Jeffrey Ross of Patton Boggs and I made an *ex parte* presentation to Mr. John Reed, Senior Engineer in the Technical Rules Branch of the Office of Engineering and Technology, in which we provided the enclosed paper summarizing a testing effort that Time Domain has engaged in to examine the interaction between its time modulated ultra-wideband signals and GPS reception. The information shown to Mr. Reed is included in the enclosed attachment.

Should any questions arise concerning this matter, please contact me.

Respectfully,

David E. Hilliard

David E. Hilliard
Counsel for Time Domain Corporation

cc: Mr. Reed (w/enclosure)

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UWB vs. GPS Testing

Time Domain Corporation -- February, 2000

Testing Summary

- TDC testing at NASA's Marshall Space Flight Center strongly suggests Prof. Enge's preliminary "parking lot" experiment greatly overstates impact of UWB on GPS
- Testing concurrent with NPRM will force timely testing

Part 15 - Background

- Part 15.109 & 15.209 defined acceptable emission over a decade ago
  - Billions of "Unintentional" UWB emitting devices certified in accordance with these rules
  - Devices include: computers, televisions, VCR, camcorder, audio equipment, printers, PDA's, ...
- TDC testing has witnessed GPS interference from some Part 15 devices
  - Palm Pilot
  - Motorola Walkie-Talkie
  - Computers
  - Office Pagers

Time Domain Testing

- Testing conducted by personnel from
  - RF Group, Marshall Space Flight Center, NASA
  - Engineering Systems & Planning, Inc. (NASA/DOD contractor)
  - Time Domain
- Utilized NASA's GPS system simulator
  - Tests are not official NASA tests
- Tested
  - 4 different GPS receivers (3 consumer & 1 military)
    - Only consumer grade results available (military results classified)
  - No aviation grade receivers were tested
  - 12 different UWB operating modes

Harsh Conditions Assumed

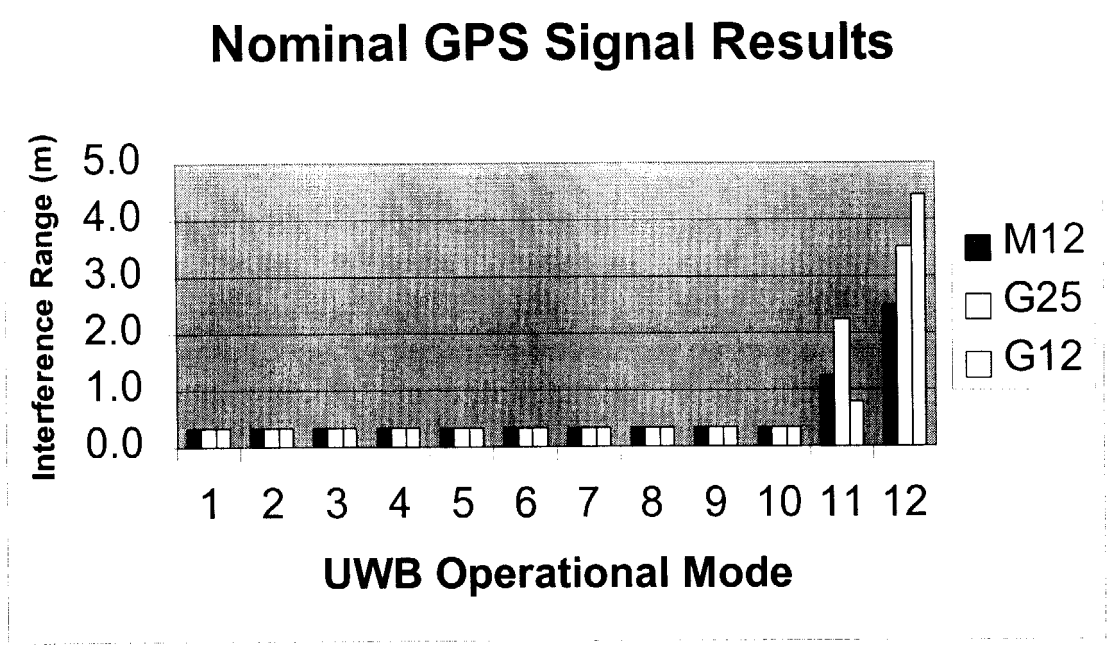
- UWB signal in main lobe of GPS
- GPS antenna in main lobe of UWB antenna
- UWB polarization matched to GPS antenna's polarization
- Operating at maximum certifiable Part 15 field strength in the GPS band
- Free Space losses

UWB Operational Modes

- These modes display a variety of realistic time-modulated UWB operating modes.
  - For example, mode 4 is the mode of operation for RadarVision1000.
- The different modes represent different burst on/off times.
- Mode 12 is the worst case since there is no off time - continuously on.

Test Results

Nominal GPS signal strength (-130 dBm), harsh UWB conditions, 12 operational TM-UWB modes, 3 different GPS receivers.



Only two operational modes show interference at short range.

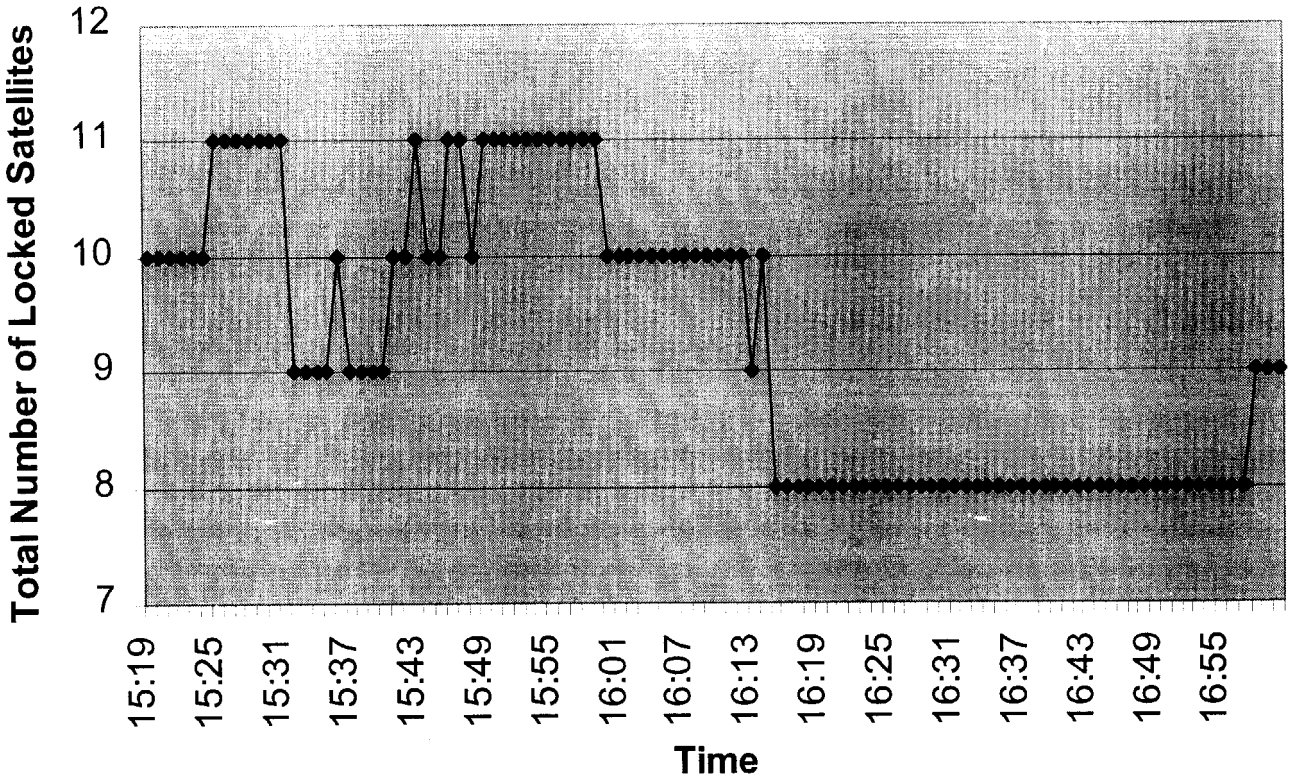
Note: Modes 11 & 12 assume extremely long UWB "dwell" times, not very practical in commercial applications.

Harmful Interference Criteria

- Harmful interference assumed to have occurred when four or fewer satellites tracked in this study
- Enge assumed harmful interference occurs when single satellite is lost
  - Not a reliable criteria when testing conducted in parking lot
  - Natural variability causes frequent loss of satellites
  - Difference between this criteria and TDC criteria is typically only a few dB

Natural Variability Can Make Single Satellite Criteria Misleading

Garmin 12XL



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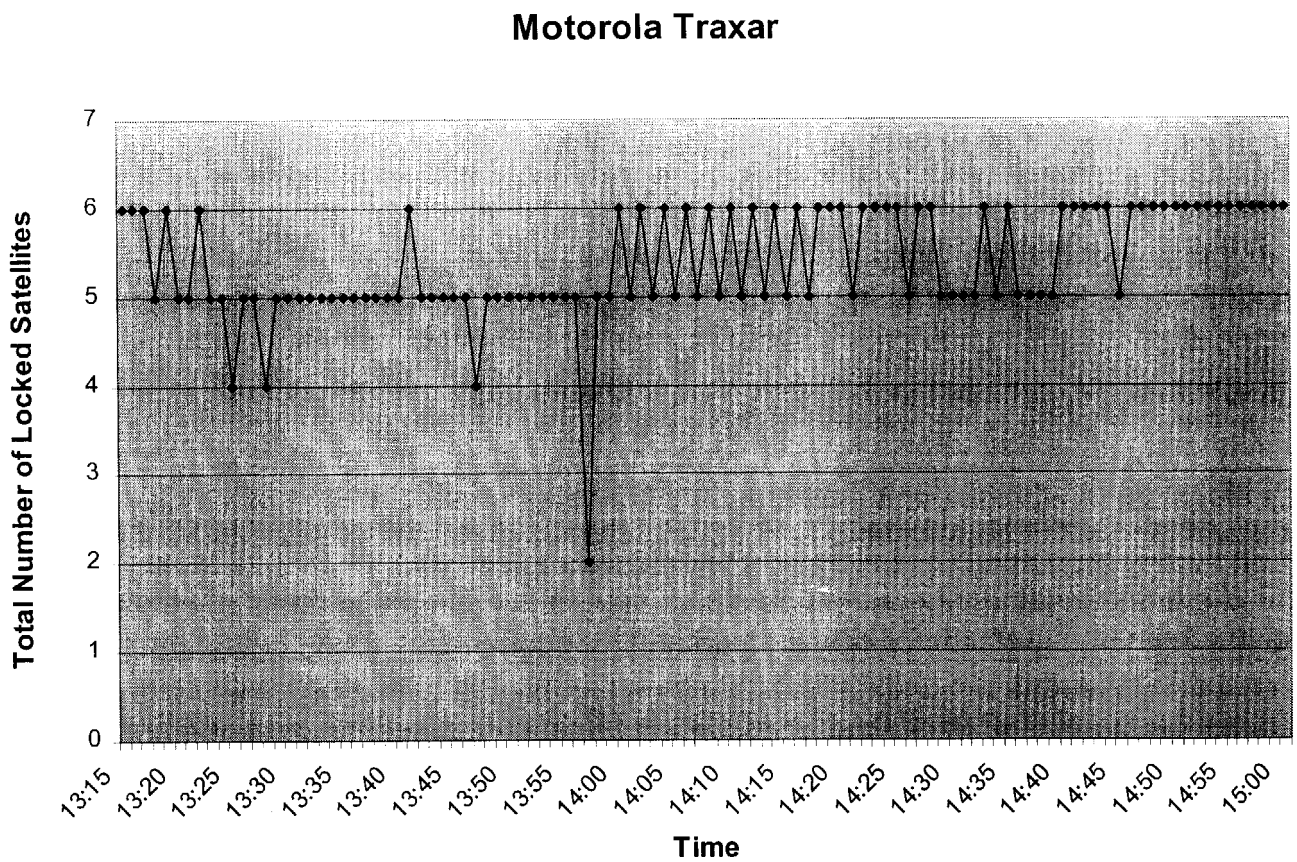
Natural Variability (cont'd)



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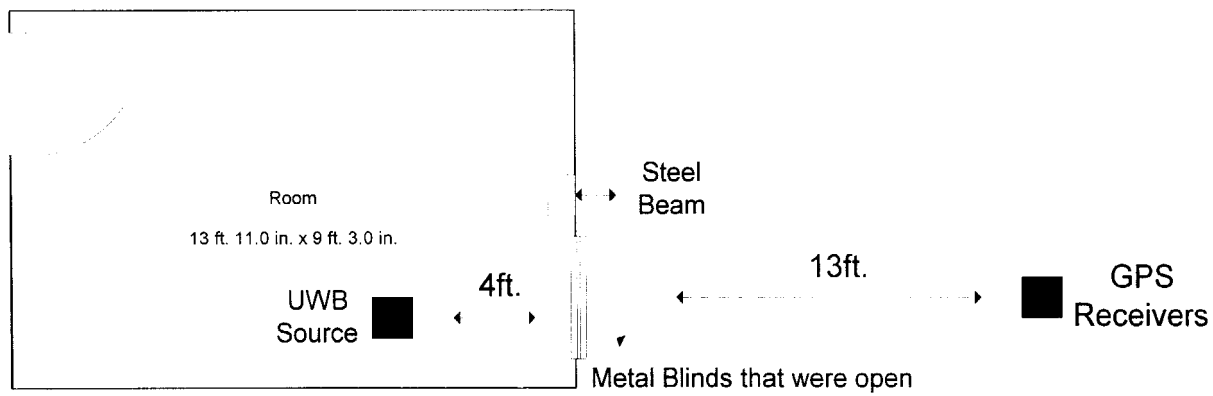
Contrast with Prof. Enge's Tests

- TDC testing suggests Enge's tests overstate interference potential
- TDC test utilized consumer grade receivers
  - **Enge's tests showed aviation grade GPS receiver emulator performed significantly better than consumer grade receivers**
- TDC utilized carefully controlled and reproducible testing protocol
  - High quality NASA GPS system simulator
  - Part 15 certifiable high performance TDC UWB transmitter
  - Significant expertise in UWB field strength measurement procedures

Walls Provide Additional Isolation

- Exterior building walls reduce signals by an average of 10 to 15 dB
- GPS receivers can't be operated effectively near buildings due to blockage



No measurable impact on GPS receivers from indoor UWB source.

Conclusions

- Many Part 15 certified devices interfere with GPS at very short ranges
- UWB devices exhibit the same characteristics as other Part 15 certified devices
- TDC's tests show insignificant GPS interference from UWB in 10 of 12 test modes
- Various engineering techniques can further mitigate interference potential
- Testing concurrent with NPRM can
  - Ensure no adverse impact on aviation safety applications of GPS
  - Ensure the testing is completed