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April 21, 2000

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

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

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

Dear Ms. Salas:

This is to note that on April 20, 2000, Rachel Reinhardt of Time Domain Corporation, Karen Kincaid of this firm, and I met with Ms. Charlene Lagerwerff and Mr. David Furth of the Wireless Telecommunications Bureau to discuss ultra-wideband (UWB). Ms. Reinhardt provided a technical summary of UWB principles. She also discussed testing that Time Domain has performed at the Marshall Space Flight Center examining the compatibility of Time Domain's UWB equipment with GPS and further noted that Time Domain was examining the compatibility of UWB with other wireless communications systems. Copies of the slides she used in this discussion are attached.

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

Respectfully,

David E. Hilliard

David E. Hilliard
Counsel for Time Domain Corporation

Enclosure: GPS Testing Slides
cc: Ms. Lagerwerff and Mr. Furth (with enclosure)

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TIME DOMAIN℠

THE NEW WIRELESS MEDIUM℠

GPS-UWB Interference Issue

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TDC's Extensive Test Program

- Many of TDC's customers need integration of two capabilities
  - 1997 Program to integrate UWB & GPS
    - Validated ability to transmit UWB signals with co-located GPS receiver
  - 1999 – 2000 Consumer grade GPS receiver testing
  - 2000 – More extensive testing to include aviation grade receivers

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Consumer Grade GPS Tests

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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 (1 not yet completed)
  - No aviation grade receivers were tested
  - 12 different UWB operating modes

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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

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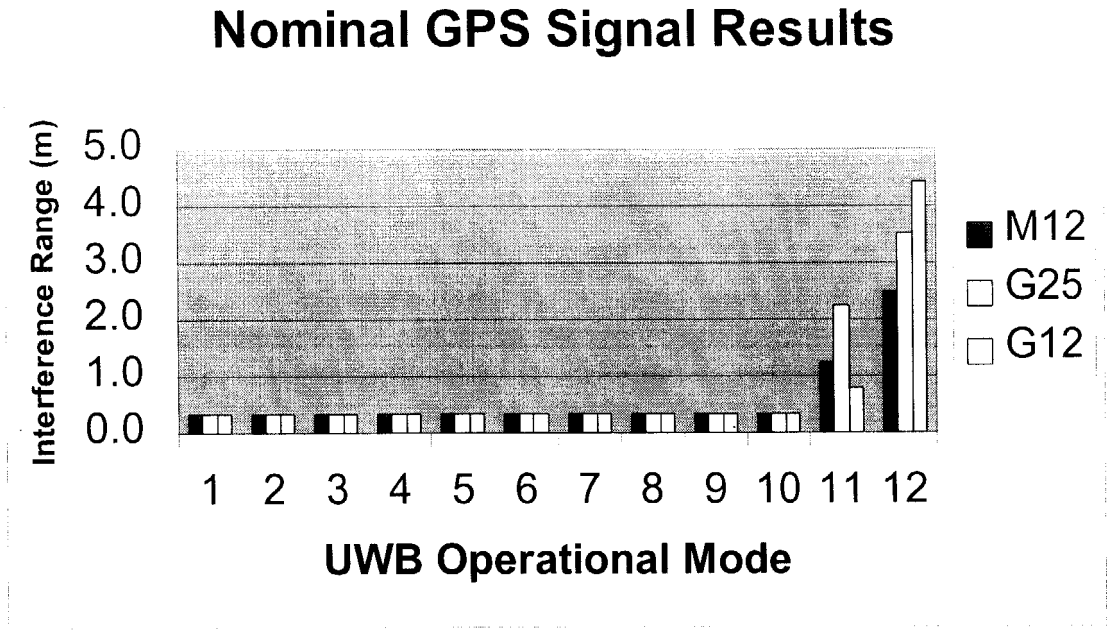
UWB Operational Modes

- 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.

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Harmful Interference Criteria

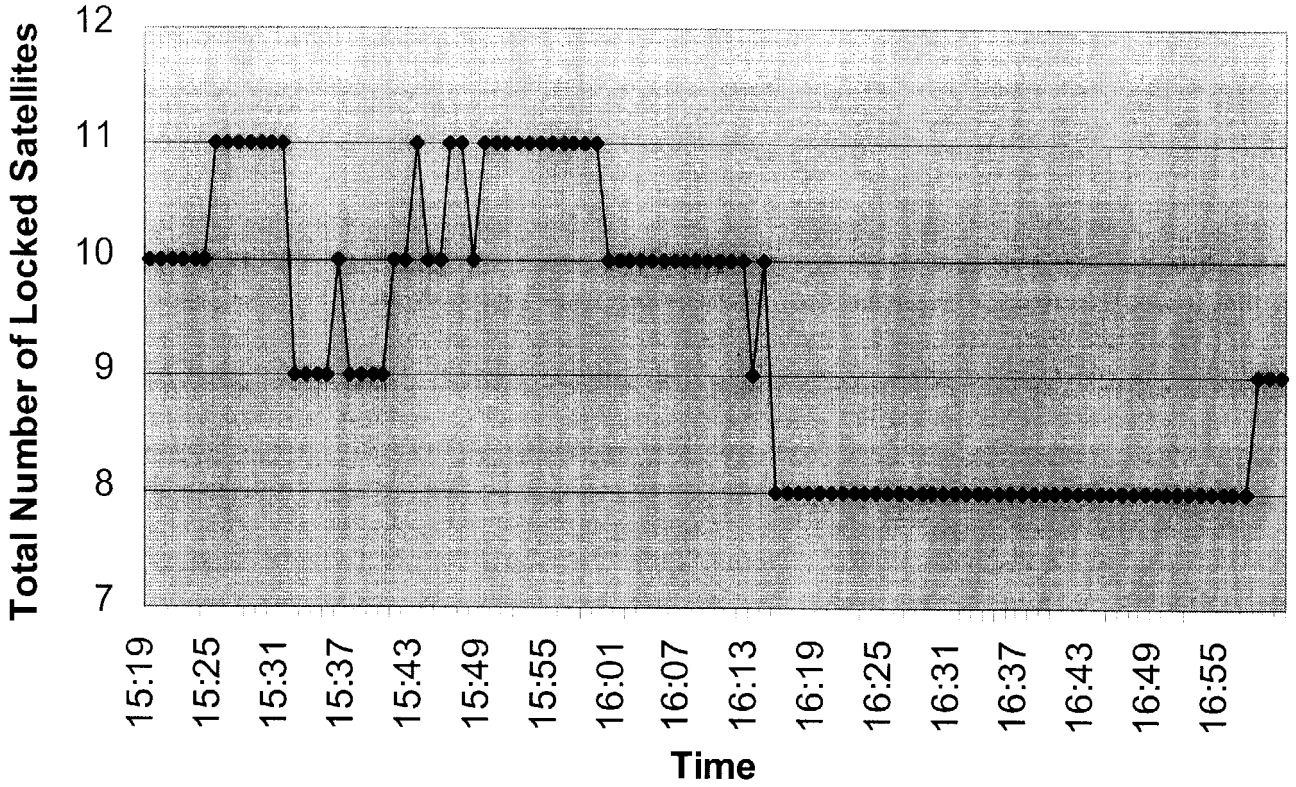
- Harmful interference assumed to have occurred when fewer than 5 satellites tracked in this study
- Just considered consumer applications
- Aviation GPS testing will need much more stringent criteria
- Current Test Program is investigating more appropriate harmful interference criteria

Contrast with Prof. Enge's Tests

- TDC testing suggests Enge's preliminary tests overstate interference potential
- 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
- 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

Natural Variability Can Make Single Satellite Criteria Misleading

Garmin 12XL



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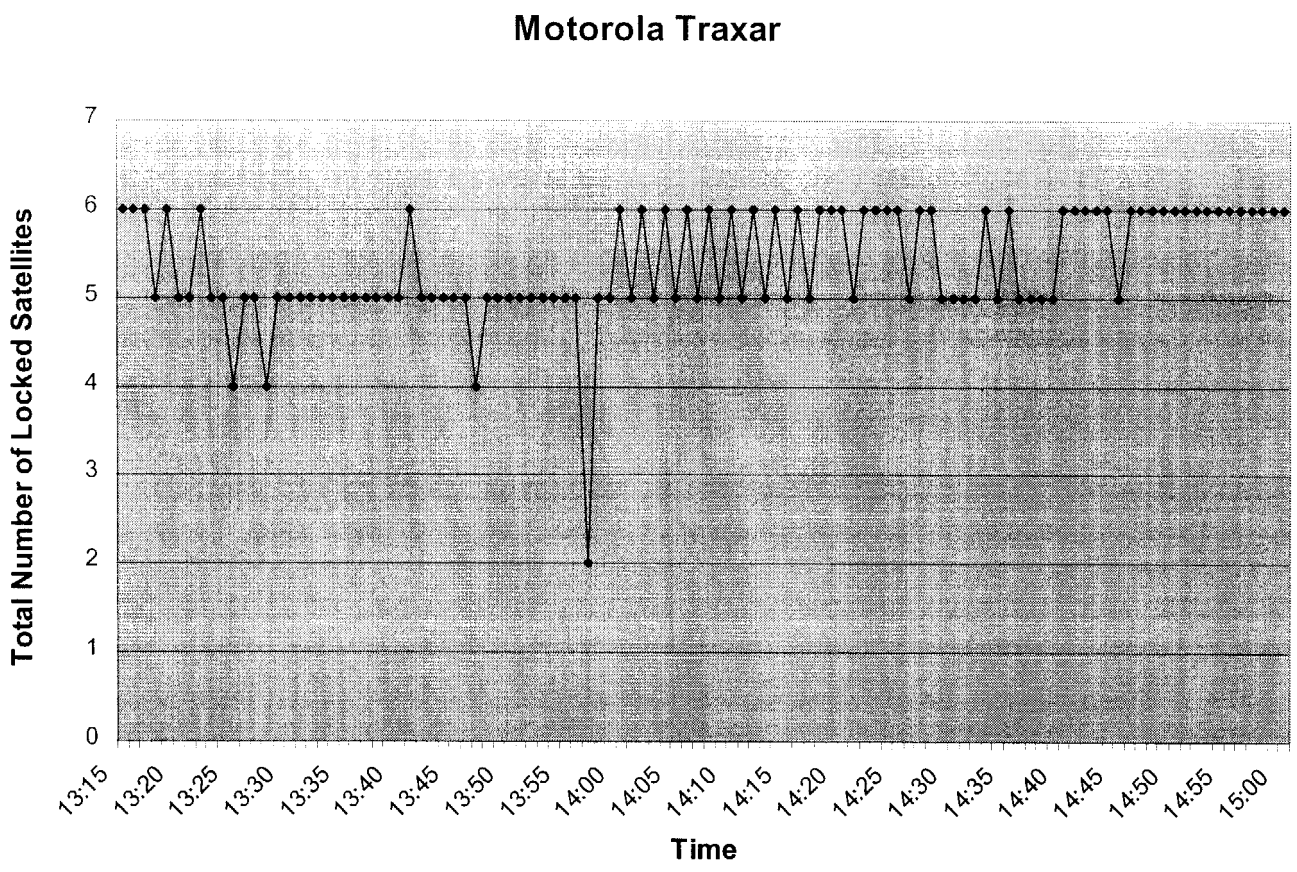
Natural Variability (cont'd)



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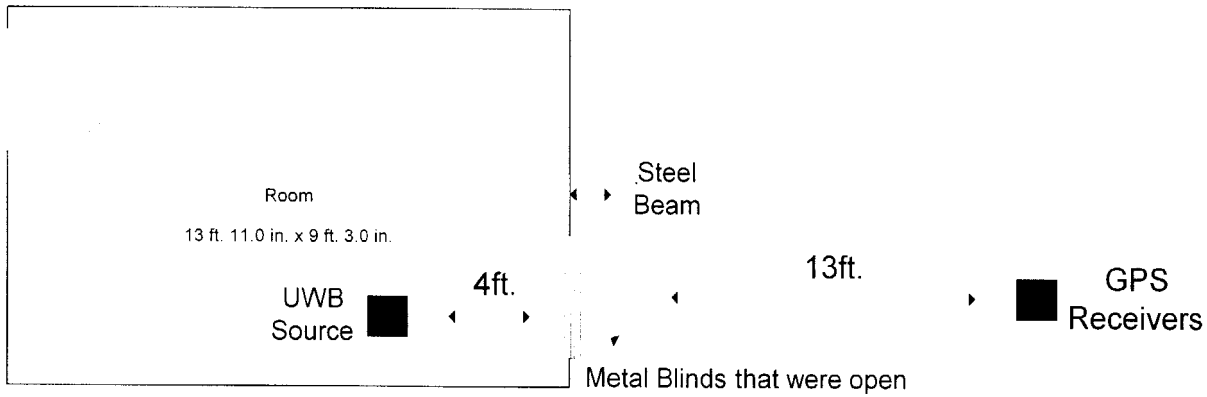
Walls Provide Additional Isolation

- 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.

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