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OFFICE OF THE SECRETARY

September 29, 2000

(VIA HAND DELIVERY)

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ORIGINAL

Ms. Magalie R. Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: *Ex Parte* Presentation of US GPS Industry Council
ET Docket 98-153

Dear Ms. Salas:

Pursuant to Section 1.206 of the Commission's Rules, 47 CFR Sec. 1.1206, this letter serves as notice that on September 28, 2000, Dr. Charles Trimble and Ms. Ann Ciganer, representing the US GPS Industry Council ("Council"), Dr. Terrence Barrett, technical consultant to the Council, Dr. Ivan A. Sommers representing the Aerospace States Association, and the undersigned, met with the members of the staff of the Office of Engineering and Technology copied below, to discuss Comments filed and related issues concerning the referenced docket. A copy of a slide presentation used during this meeting is enclosed, as well a copy of a resolution of the Aerospace States Association, and a video tape that was provided to the staff.

An original and one copy of this letter and its enclosures are being submitted for inclusion in the record of the subject proceeding.

Respectfully submitted,

Raul R. Rodriguez
For the US GPS Industry Council

RRR/rjc

Enclosures

cc (w/o encl.): Dr. Julius P. Knapp
Mr. John A. Reed
Ms. Karen Rackley

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Presentation to

FCC Office of Engineering and Technology

on ET Docket 98-153

By Representatives of

The U.S. GPS Industry Council

September 28, 2000

Communications Act

Directs FCC to maximize access to and efficient use of radio frequency spectrum

- To maximize access the FCC is encouraged to speed the process of adopting new technologies and services.
- To maximize efficient use, the FCC must insure the preservation of equities of all licensed and allowed services both old and new.

Balancing Competing Goals

- All other things being equal, priority should be given to services and technologies which are efficient in terms of use of the spectrum, particularly those relating to the nation's IT engine.
- In the case of UWB, however, things are not equal
  - Technical issues
  - Regulatory issues
  - Risk to public safety, security, and IT infrastructure

UWB in Military

- Used for
  - Clandestine communications
  - Radar
  - Intrusion detection
- Under Circumstances Where
  - There is low density of use
  - Spectrum efficiency is not a top priority
  - There is a closed system environment

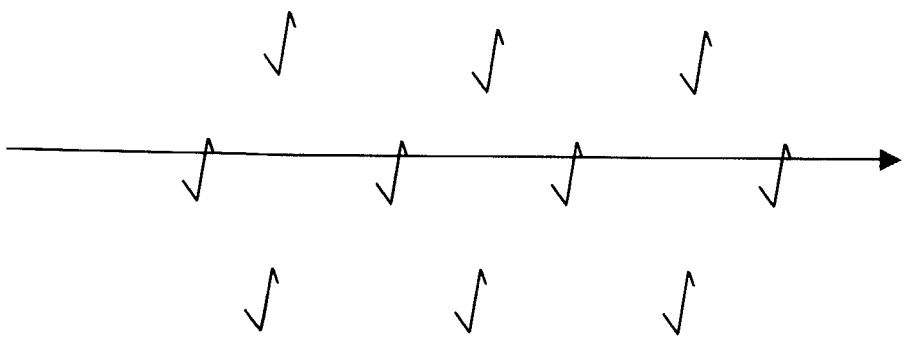
Spectrum Drives IT Engine

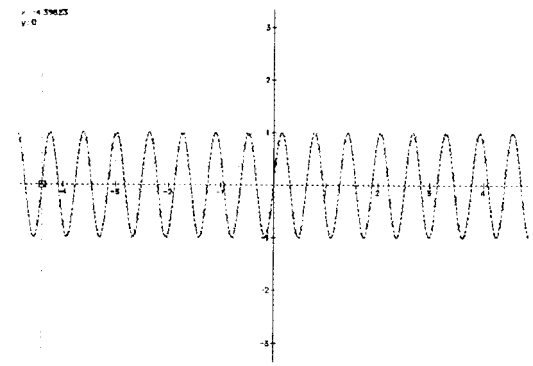
- High density use
- Maximum frequency efficiency (data rate/bandwidth)
- Open environment (no control of who operates where)
- Grandfathering of existing services
- Majority of users and services below 3 GHz

UWB History

- Original Marconi spark-gap radio was UWB
  - One of the last commercial marine uses of spark gap radio was on the Titanic
- 1927 Radio Act divided frequency-spectrum into 80 channels to allow multiple users in the same geographic area – END of use of UWB technology for many decades
- Modern UWB technology developed for US military
  - Proposed as a technology for sharing the frequency spectrum below the noise floor

Frequency versus Time Domain





Pulses of energy across wide spectrum instead of waves confined to narrow spectrum

[If a pulse goes out earlier than the time prescribed by codes known to a correlating receiver, that's can be communicated as a "1" -- a precise time later would be a "0".]

Pulses are Different than Waves

- Peak power can be dramatically higher than average power
  - 1 joule/sec = 1 watt
  - 1 joule/nanosec = 1 gigawatt, but measuring over 1 second would only see 1 watt of average power
- Total spectral energy density depends on specific UWB waveform
  - one size doesn't fit all
- Receiver vulnerability can depend on individual harmonic responses

That UWB Puts Out No More RFI Than A Hairdryer Is A Red Herring

- Hair dryers are not on most of the time.
- Hair dryers are rarely used outdoors.
- Hair dryers are not connected to an antenna.
- Hair dryers are not networked.
- Hair dryers cannot be changed into GPS jammers.

Prerequisites for UWB Sharing

- Quantifiable level of known interference to existing services.
- Proof of ability to limit interference to acceptable levels.
- Ability to control composite interference in safety-of-life bands.

Qualification of Levels of UWB Interference

1. Develop operational scenarios for UWB and existing services.
2. Characterize interference susceptibility of existing services.
3. Characterize interference characteristics of the proposed UWB applications.
4. Test devices against existing operational services.

Status of Current Testing

- NTIA is collecting operational scenarios.
- By using UWB simulators, GPS sensitivity is being studied by DoT/Stanford, University of Texas and NTIA.
- Some time domain and frequency domain measurements of representative UWB waveforms have been collected to establish link budgets for "tolerable interference."

Current Test Approach Will Not Lead To An Understanding of How To Regulate UWB Waveforms

- **Without a fundamental theoretical science understanding, an experimental approach must be be used in the testing.**
  - There is no generic UWB signal or waveform.
- **Each UWB waveform must be tested independently.**
  - Uniqueness of UWB waveforms precludes generalization of test results.
- **This means that the number of tests needed to be run and therefore the amount of time and money involved to arrive at a reliable answer, is large and unknown.**

Current Test Approach Will Not Lead To An Understanding of How To Regulate UWB Waveforms (Continued)

- Initial testing indicates that the GPS receivers are highly sensitive to the fine spectral line structure caused by the UWB waveforms tested to date.

- Unfortunately, initial testing indicates that UWB waveforms tested to date are strongly affected by the antenna and external loading of the antenna.

Current Test Approach Will Not Lead To An Understanding of How To Regulate UWB Waveforms (Continued)

- There is a recipe on how to convert a UWB device into a GPS jammer on the FCC website.
- It appears that mere proximity of the UWB antenna to human and inanimate objects will alter the UWB waveform and this invalidates any link budget analysis that has been done to protect existing services because the fine UWB spectral line structure changes depending on proximity of objects.

Current Test Approach Will Not Lead To An Understanding of How To Regulate UWB Waveforms (Continued)

- Limiting power, either peak or average, on a device basis does not limit the power of a network.
- The precise aggregation effect of large networks of UWB communications devices is unknown, but it is clear that the total radiated power per unit area cannot be controlled in the case of unlicensed devices.

Summary

- Radiated UWB waveforms are unstable due to variation in antenna loading and therefore their effect on current services cannot be predicted.
- Use of UWB devices for network applications means that the total interference cannot be easily measured, predicted or controlled.
- The instability and aggregation issues pose major obstacles to the development of a rational regulatory environment.

FCC Is In An Impossible Position

The FCC is under strong pressure to approve adoption of a technology

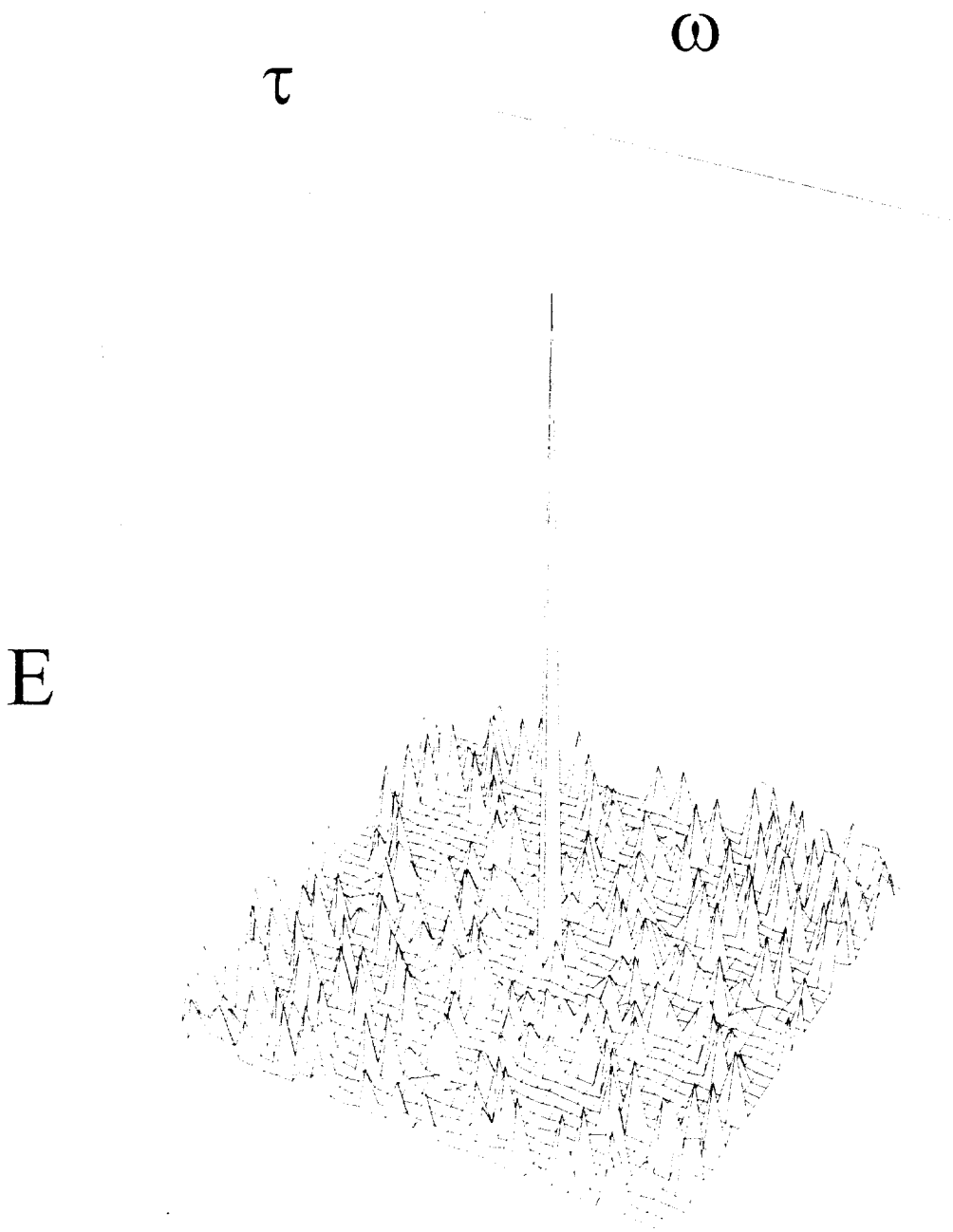
- Before the basic science of the interference with the Nation's IT engine is understood
- In the face of initial tests indicating unpredictable spectral characteristics of UWB waveforms and the inability to limit the total noise power of a network of UWB devices
- Given a documented example of UWB interference with broadcast television
- Given a documented example of how to build a GPS jammer from a UWB emitter

Solution: Perform a Strategic Experiment

- Use conventional band-segmentation to run a strategic experiment.
- Choose a 3 GHz-wide band above 3 GHz that does not contain a safety-of-life service and designate it as a band to use for UWB devices on a non-interfering basis.
- Use the experience gained to develop a regulatory environment for UWB devices.

Managing Risk and Reward from New Technologies

- The demand for commercial spectrum is intense
- The attraction of technological "silver bullets" is obvious, but
- The nation's IT engine (and other critical and restricted services) must not and need not be exposed to technical and regulatory "Russian roulette."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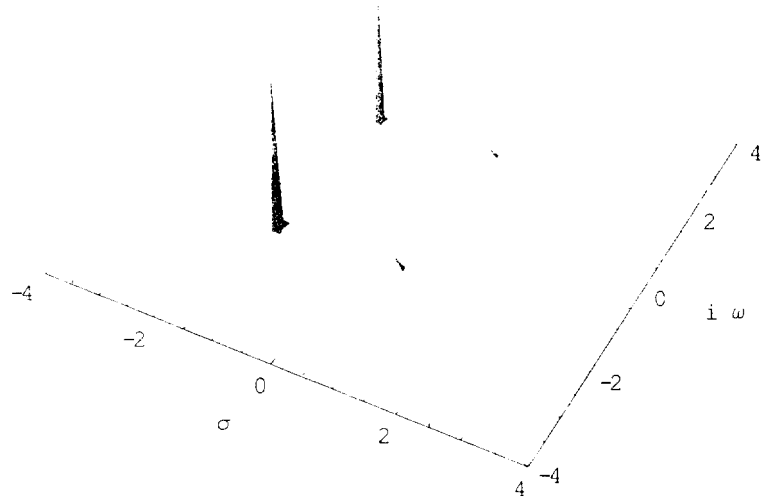
Laplace Transform UWB Pulse



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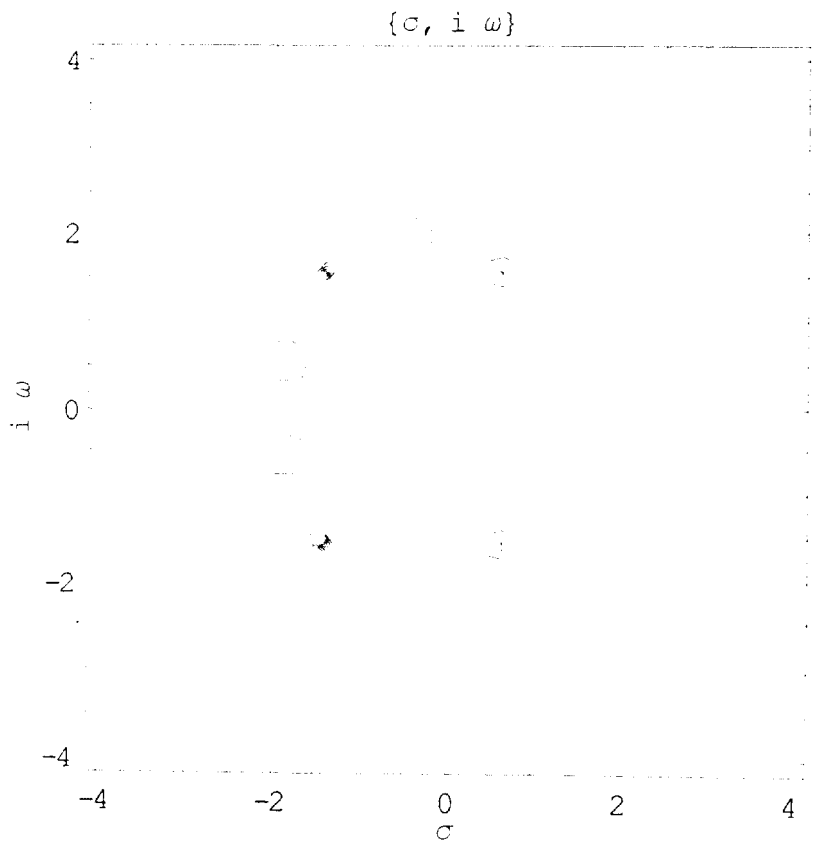

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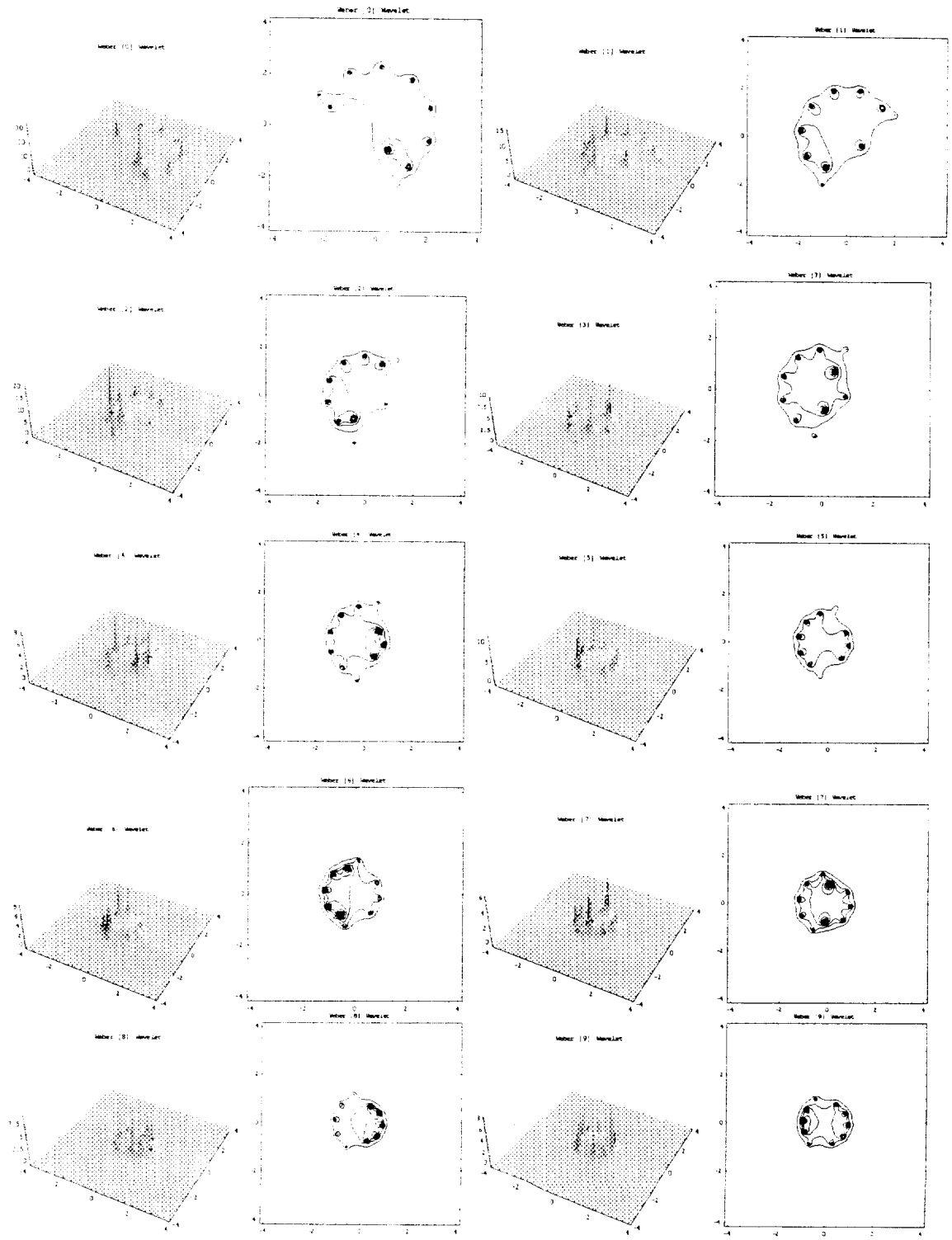
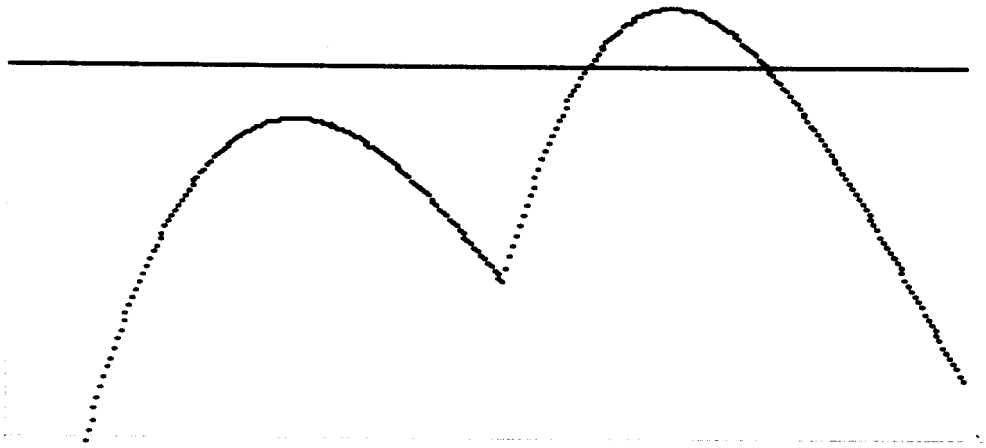


Fig 6.2.9 $H(z)$ pole locations for the Weber filters [0]-[9] using 10 taps. The unit circle (where $z = 1$, in radians) in the units shown is at axes crossing values of $\pm\sqrt{2\pi} = \pm 2.50663$. It can be seen that all the filters are within the unit circle and are therefore stable filters.

Nonlinearity: Temporal Summation



Resolution of the Aerospace States Association
Fall Quarterly Meeting - Pasadena, California
December 7, 1998

Resolution Advocating Preservation of Existing International Allocation for Radionavigation Satellites Services
(Resolution 99-01)

Findings

Radionavigation satellite services are a practical application of space technology that is resulting in benefits to people around the world, including:

Provides Public Sector Benefits (at local, state, and national levels):

- Increases the efficiency of the use of fixed infrastructure assets, such as ports and harbors, roadways, rail links and air routes;
- Improves the efficiency response time of emergency services, such as police, fire, and ambulance;
- Speeds disaster relief and is fundamental to search and rescue;
- Protects property and saves lives.

Improves Industrial Base Productivity and Economic Sectors:

- Agriculture, Aviation, Automotive, Banking, Commercial Space, Construction, Emergency Medical Response, Geographical Information Systems, Mining, Mineral Exploration, Natural Resource Management, Survey, Transportation (Space, Air, Land, Maritime), Telecommunications, Utilities.

Provides a Critical Information Infrastructure Technology Component:

- Time synchronization, including: Internet, power grids, mobile and paging communication cell sites, electronic banking, and stock transactions.

Consumers worldwide use Global Navigation Satellite Systems (GNSS) to increase their safety and security in their cars, boats, airplanes, and as tourists exploring the outdoors and new urban environments, e.g., both European and American reference guides include GNSS coordinates for tourist use. Soon GNSS will be an integral component of cellular telephones 911 services.

The United States and Russia currently operate GNSS composed of radionavigation satellites. The signals from these satellites are available free of direct user charges;

In addition to the GPS and GLONASS systems operated respectively by the United States and Russia, Europe and Japan are building space-based augmentation systems to improve the accuracy, availability, and integrity of GNSS signals for international aviation;

The signals from GNSS systems, and in particular GPS, are widely used for precise navigation, positioning, and timing by users on the Earth and increasingly in space;

GNSS signals are being used to navigate and control unmanned satellites individually and as part of emerging commercial communication networks;

GNSS signals are required for crew safety aboard the Space Shuttle and will be required by the International Space Station; and

GNSS is continuing to evolve and is expected to find new uses in space and on the Earth.

Noting

The International Telecommunications Union is the international organization responsible for spectrum allocations and the assignment of satellite slots in geosynchronous orbit;

Any reallocation of the radiospectrum set aside for GNSS signals (1559-1610 MHz) to communications use risks harmful and disruptive interference to operational GNSS services and the installed user base due to the incompatibility between two-way voice and data broadcast signals and receive only radiopositioning signals;

While GNSS signals are internationally protected at present in the Space-to-Earth direction, such signals are not protected in the Earth-to-Space and Space-to-Space directions;

The issue of protection for GNSS will be taken up at the next World Radiocommunications Conference (WRC-2000) in Istanbul, Turkey; and

The Aerospace States Association has as its primary interest the economic development and educational opportunities that derive from the nation's aerospace programs, and protection of GNSS is clearly in the best interest of our member states and their private and public sector entities.

Resolved

The existing international allocation for radionavigation satellites services should be preserved and protected in its entirety from harmful interference;

No portion of this band should be ceded at anytime to commercial two-way broadcast due to the evolutionary nature of GNSS which is driven by rapidly growing worldwide user demand;

Protection of radionavigation satellite services should also be extended to uses in the Earth-to-Space and Space-to-Space directions;

These additional protections are necessary for future space exploration, navigation, science, and, most importantly, crew safety; and safety of people worldwide;

The Aerospace States Association will communicate its views to appropriate representatives of the ITU, national spectrum authorities, space agencies, international municipal and regional public sector counterparts, and other affected parties in order to promote international understanding and cooperation for the protection of GNSS services.

Resolved and adopted by a unanimous/majority vote of the membership this 7th day of December 1998.

Joseph E. Kernan, Chair
Aerospace States Association

Attachment A

DOCUMENT OFF-LINE

This page has been substituted for one of the following:

o An oversize page or document (such as a map) which was too large to be scanned into the ECFS system.

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1 VideoTape