ITS Tools and Facilities

Advanced Antenna Testbed

The advanced antenna testbed (ATB) is a multi-channel test facility based on ITS digital sampling channel probe technology (see "Advanced Antenna Testbed," pp. 50-51). The system can simultaneously characterize eight wideband radio channels (expandable to 16 with multiplexing). The received signals are digitized for flexible post processing. The table below summarizes the range of permissible values for the ITS channel sounding system, as well as giving an example of a measurement system configured for 2.3 GHz and 10 Mb/s operation.

Configurable Testbed Parameters

Parameter	3G Example	ITS System
Receiver Channels	8	1-8 (expandable to 16)
Carrier Frequency	2.3 GHz	.45 – 6 GHz
Bit Rate	10 Mb/s	.1 – 50 Mb/s
Resolution	100 ns	20 ns – 10 µs
Code Type	Maximal Length	Programmable
Code Length	511 bits	Programmable
Acquisition Mode	Burst	Continuous or Burst
Positioning	GPS/Dead Reckoning	GPS/Dead Reckoning
Transmitters	16	Multiple
Data Processing	Post	Post or Real Time

The ATB provides common reference sites for evaluating next-generation antenna systems. Data from multiple channels can be used to test the diversity gain resulting from various signal combining algorithms. Digital beam forming and multiple input, multiple output (MIMO) techniques may also be examined by simultaneous digitization of signals from multiple antenna elements. Sites in Boulder and Denver, Colorado, serve as known environments for evaluating 3G components and systems. Alternately, the ATB system may be van-mounted for site mapping studies at any required location.

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Audio-Visual Laboratories

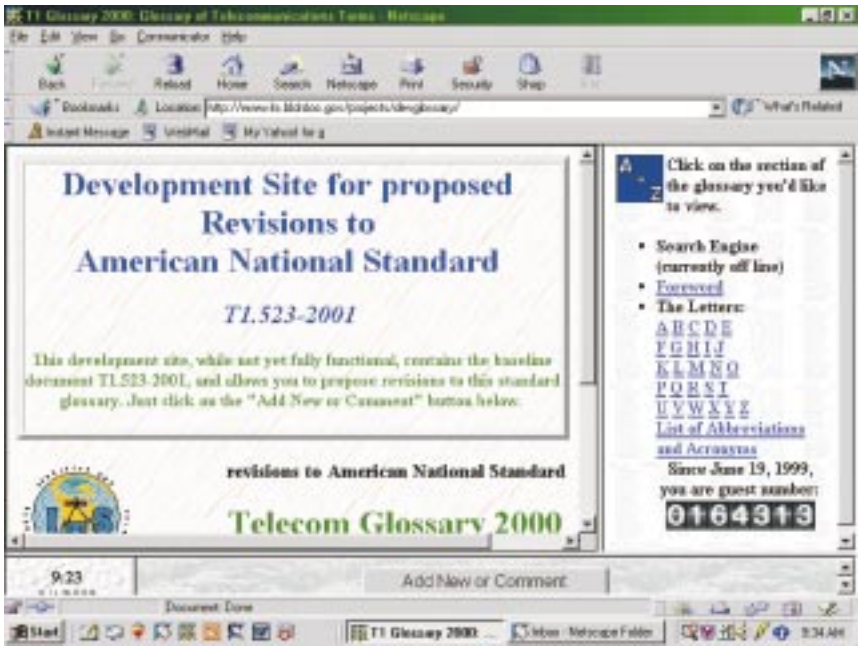
The ITS Audio-Visual Laboratories offer a wide range of audio and video recording, storage, processing, reproduction, objective quality assessment, and subjective testing capabilities. These capabilities in turn support the development and verification of new quality estimation techniques for compressed digital audio and video, the development of novel subjective testing techniques for audio and video signals, and the development of new coding algorithms.

Signals are acquired with high-quality microphones and cameras. Recording and playback devices include studio-quality analog and digital video tape recorders with two to four audio channels, digital audio tape machines, CD players, and analog audio cassette machines. These systems are augmented with several computer-based digital audio and video systems and a set of high quality Analog-to-Digital and Digital-to-Analog converters. One laboratory system offers the ability to record and playback video streams that conform with International Telecommunication Union, Radiocommunication Sector (ITU-R) Recommendation BT.601 and synchronized digital audio streams to and from a high-speed workstation with over 1 TB of hard disk storage. Video processing is performed in the digital environment using several high-performance video workstations. These workstations are supported by storage peripherals that include a 12-GB 4mm tape drive, an 8-GB 8mm tape drive, and a 40-GB digital linear tape drive. Analog audio mixing, filtering, and equalizing equipment is available, and the most intensive audio processing is done in the digital domain on PC platforms. An array of digital audio and video encoders and decoders are available as well. Analog and digital audio and video routing switches and patch-panels allow for nearly arbitrary interconnections between the various pieces of equipment in these laboratories.

Reproduced signals are presented through studio-quality video monitors, monitor loudspeakers, headphones, or handsets. Two separate rooms with controlled acoustic and visual environments are available for the subjective testing of audio and video signals. These environments are specified in International Telecommunication Union, Telecommunication Standardization Sector (ITU-T) Recommendation P.800 and ITU-R Recommendation BT.500 respectively. These specifications address background noise levels, wall colors, light levels, room dimensions, and other properties. Finally, the labs feature an array of audio and video signal generators and analyzers to support laboratory

measurement and calibration activities.

Lab activities include objective estimation of audio and video quality, and subjective testing of audio and video quality. Random access digital audio-video playback systems coupled with discrete-time and continuous-time electronic data entry systems greatly facilitate many of the subjective testing activities. Because two separate subjective testing rooms are available, the laboratory can support conversation, teleconferencing, and video teleconferencing tests as well as viewing and listening tests.



Opening page of the Development Web Site for Proposed Revisions to ANS T1.523-2001, Telecom Glossary 2000.

Objective video quality estimation software, written in C++, processes video signals in accordance with American National Standards Institute (ANSI) T1.801.03-1996 and other more recently developed metrics, resulting in estimates of video quality that show good correlation with subjective test results. Several different objective speech and audio quality estimation algorithms are available, including those defined in ANSI T1.518, ITU-T Recommendation P.862, and ITU-R Recommendation BS.1387. The labs support both batch-mode and real-time objective quality estimation.

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Development Site for Proposed Revisions to *Telecom Glossary 2000*

Telecom Glossary 2000 is an American National Standard, ANS T1.523-2001, and is available free to the public on the ATIS/T1 website http://www.atis.org/tg2k

In cooperation with ATIS/T1, ITS maintains a web page that serves as the Development Site for Proposed Revisions to *Telecom Glossary 2000*: http://www.its.bldrdoc.gov/projects/devglossary

This website contains the baseline document, *Telecom Glossary 2000,* as well as features that allow viewers to submit proposed glossary additions and revisions for the revision committee's consideration.

Telecom Glossary 2000 — for which proposed revisions are being solicited — contains approximately 8000 definitions in the disciplines of fiber optics communications, telephony, National Security/ Emergency Preparedness (NS/EP), National Information Infrastructure (NII), spectrum sharing, radar, radio communications, television (UHF, VHF, cable, high definition television), high-frequency automatic link establishment, radio, facsimile, networks (intelligent networks, next-generation Internet, open network architecture, ISDN, broadband ISDN, and network management), communications security, data processing, premises wiring, grounding and bonding, telegraphy, and video. Recently added disciplines include web terminology, T1 Standards, information assurance/security, and photonics.

The glossary is presented in hypertext with clickable graphics and 69,000 hyperlinks to defined terms. The website contains an ITS-developed search engine with easy-to-follow, menu-driven instructions, to allow a more organized and thorough review of the entire glossary. The advantages of the search engine include tailored, rapid access to the text of all definitions, ranking of results, and hyperlinks to all search engine results.

The Development Site for Glossary Revisions automatically generates e-mail to the glossary's editors whenever anyone submits a proposed revision (addition, deletion, or change of text) by clicking the selected buttons on the Development Site web page. That e-mail is collected automatically in a bin and reviewed for future forwarding to the Revision Committee.

The glossary and the Development-tools web sites are accessible and free to anyone with web access. Typical users include Federal purchasing agents, NS/EP implementors, NII planners, Standards writers and users, R&D workers, O&M workers, technical writers, telecom instructors, and telecom vendors.

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Digital Sampling Channel Probe

The digital sampling channel probe (DSCP), designed and patented at ITS, is used to characterize the wideband propagation characteristics of the radio communication channel. The probe, consisting of a transmitter, receiver, and data acquisition system, is used to make complex impulse response measurements. Unlike traditional analog sliding correlators, the DSCP digitizes a received pseudo-noise signal at an intermediate frequency (IF) and then post processes the data. Relative to the sliding correlator, the time over which the impulse is generated is less, and therefore, the probe can characterize the communication channel over a shorter period of time. Historically the DSCP has been employed extensively for channel characterization of cellular and personal communications services (PCS). ITS has recently expanded the probe to 8 channels capable of mobile phased array or multiple input, multiple output (MIMO) measurements. Also available is a wide-bandwidth, high-frequency probe, particularly suited for high resolution requirements such as wireless local area network (LAN) applications up to 30 GHz. For a more detailed description of the measurement systems and applications, see the following website: http://flattop.its.bldrdoc.gov/rcirms/

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Interoperability Research Laboratory

The Institute's Interoperability Research Laboratory (IRL) was developed during fiscal year 2002 to respond to the needs of the Justice/Public Safety/ Homeland Security community. It was established to confront both wireless telecommunications interoperability problems and difficulties associated with information sharing between local, state, and Federal government systems using different information technologies (and implementations). As a result, it is designed to accommodate a wide variety of uses.

The IRL is being used for basic wireless interoperability testing, e.g., between Project 25 radios produced by different manufacturers. It is also used to investigate current or emerging information systems and networking technologies, such as eXtensible Markup Language (XML) implementation approaches and intrusion detection systems. In addition, hybrid (wireline/wireless) communication products and services are assessed, e.g., radio frequency/ Internet Protocol repeaters.

The IRL works closely with other ITS laboratories to ensure that appropriate performance standards and testing techniques are chosen and properly applied for specialized engineering areas. For example, audio experts are consulted for voice quality tests.

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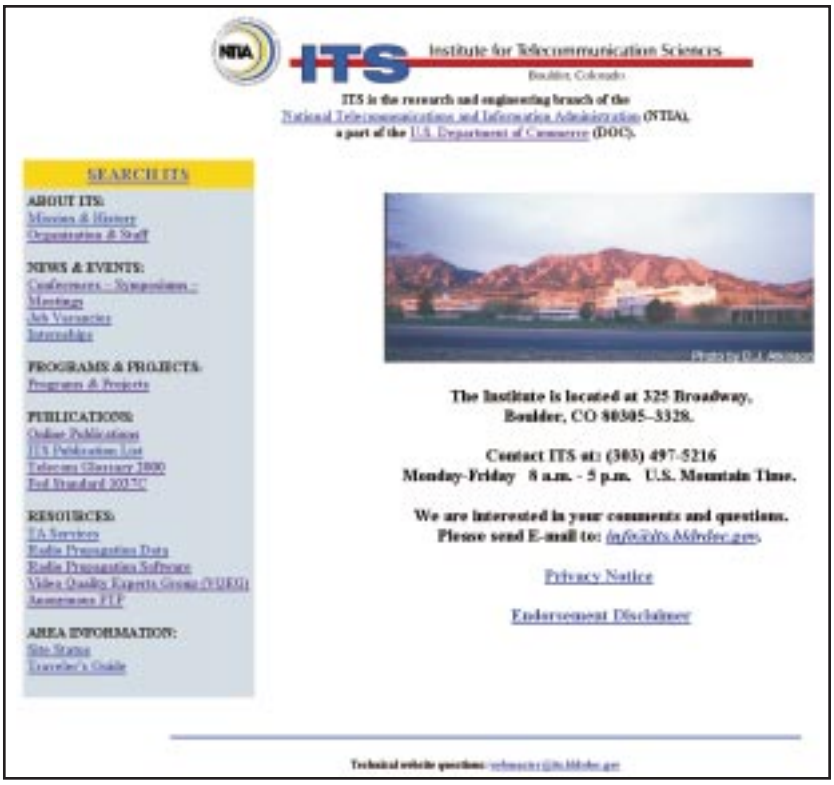
ITS Internet Services

ITS provides public Internet access to NTIA/ITS publications, program information, meeting information, and on-line Telecommunications Analysis Services used by other Federal agencies, research partners, and private industry. Restricted-access services including electronic mail lists are used to facilitate communications with project sponsors and partners, and to support ANSI T1 standards committees. Some highlights of ITS Internet Services include:

- Information about ITS programs and projects. Available at http://www.its.bldrdoc.gov/home/projects.html
- An ITS organization chart and a complete listing of ITS staff with contact information. Available at http://www.its.bldrdoc.gov/home/organization.html
- Recent ITS publications including NTIA Reports, special publications, and journal articles. Available at http://www.its.bldrdoc.gov/pub/pubs.html



ITS home page: http://www.its.bldrdoc.gov

- Telecommunications Analysis Services. Available at http://www.its.bldrdoc.gov/tas/
- Radio propagation data. Available at http://www.its.bldrdoc.gov/home/data/radio_propagation_data/
- Radio propagation software. Available at http://www.its.bldrdoc.gov/home/software/
- Information about ITS-sponsored events such as ISART. Available at http://www.its.bldrdoc.gov/home/conferences/
- Anonymous FTP distribution of some ITS developed software programs. Available at ftp.its.bldrdoc.gov

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ITS Local Area Network

ITS maintains a highly flexible local area network (LAN) to support intranetworking services and laboratory interconnection. A structured cabling system interconnects all offices and laboratories with both optical fiber and Category 5 twisted-pair cabling to support high-bandwidth communications on demand. Over 200 devices are supported on 10Base-T and 100Base-TX Ethernet segments. Connections can also be made to laboratory test beds featuring synchronous optical network/asynchronous transfer mode (SONET/ATM). This provides ITS with great flexibility and rapid reconfiguration capability for new programmatic needs.

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ITS SIPRNET Capability

ITS maintains a connection to the Secret Internet Protocol Routable Network (SIPRNET). This connection allows ITS sponsors and Department of Defense users direct access to ITS tools and facilities in a secure environment, improving the quality of support that the Institute can give organizations with classified needs.

Since many of the planning and associated support activities of the military require a classified channel for discussions and data transfer, the need exists for a secure environment within which project planning and support can be carried on without interruption. ITS maintains several computer systems of diverse types with a variety of software capabilities in order to support propagation planning and modeling, as well as emerging technologies research.

The secure facilities of ITS allow users to import data from many military facilities and support organizations into propagation models and other management software. A complete end-to-end propagation planning capability in a secure environment is available for current and future classified needs. Various research studies that ITS conducts (that are determined as classified information) can also reside on the SIPRNET, allowing access by agencies on a need to know basis.

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Mobile Radio Communication Performance Measurements

ITS maintains a test capability for determining the performance of land-mobile radio systems that comply with the Telecommunications Industry Association's TIA-102 and TIA-603 series of specifications.

The measurement capabilities include the usual TIA-603 type of measurements for analog systems, such as receiver sensitivity, adjacent-channel, and cochannel interference. In addition, with TIA-102 (Project 25) capable test equipment, various aspects of the link control format information, such as network access code, talk group identification, emergency bit, and message opcode, can be viewed. Demodulated speech samples can also be collected for an assessment of audio clarity by ITS' audio laboratory.

The primary use for this capability is interoperability testing between TIA-102 radios of different manufacture and backward-compatibility testing between TIA-102 radios and legacy analog FM systems. Other applications may be possible, for example, routine performance measurements. This capability is available on a first-come, first-served basis by both NTIA and other agencies.

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Mobile Radio Propagation Measurement Facilities

ITS maintains a measurement vehicle capable of radio channel characterization over a wide frequency range. The vehicle is equipped with on-board power, a telescoping mast, azimuth and elevation controllers, and global positioning system (GPS) devices with dead-reckoning backup. A suite of measurement equipment is also available for use in this vehicle. This includes wideband systems for measuring radio channel impulse response from 450 MHz to 30 GHz. Impulse response measurement capability at 30 GHz with 2ns resolution has been enhanced with the addition of a digital wideband recording system. During the past year ITS increased its mobile channel measurement capability with the addition of an 8-channel receiver and an 8-channel 14-bit data acquisition system. Multi-channel synchronous acquisition can be used for antenna array measurements or multi-frequency broadband measurements. Mobile measurement capability allows space division multiple access (SDMA) algorithms to be studied using data collected in typical mobile environments. This data can then be used to simulate and model radio systems.

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Network Simulation System

Data communications networks, both wireline and wireless, continue to grow and evolve. Changes to a network configuration, such as additional users or the implementation of a new transfer protocol, can result in unforeseen problems and situations. Computer simulation of these communications networks, and the proposed changes to them, can help system planners to anticipate and eliminate potential problems. Large networks are so complex that it is only by modeling and simulation that telecommunication planners can hope to predict the effects of catastrophic failures in the infrastructure.

NTIA/ITS maintains a widely held network simulation software package. By using this highly flexible software, trained ITS staff can design, configure, and implement almost any type or size of data-communications network. ITS has several licenses to use the software, including access to the basic package, radio modules, and the traffic importation and analysis module.

ITS staff are successfully using this software in support of both internal and external projects to simulate existing and proposed data communications networks. For example, ITS has built reference network models for use in network survivability and restoral studies. ITS staff also used the simulation system to extract and analyze Voice over IP (VoIP) traffic using Session Initiation Protocol (SIP) in an Internet experiment between Washington, D.C. and Boulder, Colorado.

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Pulsed CW Radar Target Generator

The Pulsed Continuous Wave (CW) Radar Target Generator is an electronic tool that is used to produce targets on a radar screen. The generator produces signals that simulate the returns that would normally be seen by a radar from targets in the environment. The signals are injected into the radar's receiver at the normal frequency of operation.

Several parameters of the signals can be adjusted over a wide range to be compatible with several different models of radars. For the same model radar, the number of targets and the range to the targets can be adjusted. Other adjustments include the displayed bearing of the targets and whether the targets are stationary or moving along concentric circular paths. Compensation adjustments can be made for radars that have large tolerances in their operating specifications. The generator can be used to verify operation or troubleshoot the radar under test. ITS uses the generator to provide simulated desired signals in interference studies where interference is injected into the radar and the effect on the targets is recorded.

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QPSK/BPSK Generator

The QPSK/BPSK (quadrature/binary phase-shift keying) Generator is an electronic tool used to generate digital signals for testing purposes. The generator consists of software to generate a sampled version of the signal, an arbitrary waveform generator to create an analog version of the signal and a frequency conversion unit to shift the signal's frequency content to the desired output frequency. The ITS written software gives the user control over several parameters of the signal including the duration of the signal, the sample rate, the number of cycles per dibit (which can be an integer to place the bit transitions on zero crossings) and the signal amplitude. The frequency conversion unit mixes the signal to its final value through a frequency agile local oscillator. A bandpass filter removes the unwanted mixer products and an adjustable attenuator controls the output amplitude. The generator has been used to simulate interfering sources, within the reception range of a radar, to record any effects. Because of the frequency agility, detailed waveform parameter control, and amplitude control, this tool can be used in a large number of applications.

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Radio Noise Measurement System

The ITS radio noise measurement system hardware consists of an omnidirectional antenna mounted on a ground plane, preselector filter, low noise preamplifier, off-the-shelf spectrum analyzer, digitizer, and computer. Noise samples are digitized prior to spectrum analyzer detection just after spectrum analyzer log amplification. Spectrum analyzer demodulation circuits are used for aural noise identification during measurements. The measurement system noise figure is nominally 2 dB above the theoretical noise floor. Noise is measurable approximately 15 dB below and 60 dB above system noise. The noise measurement system uses custom data acquisition software written and maintained at ITS. The software graphical user interface allows the user to customize and notate each measurement. It also displays noise samples and their corresponding first-order statistics. The statistics are revealed through an amplitude probability distribution (APD). The APD is plotted on a Rayleigh graph where the Gaussian noise appears as a straight line with a negative slope. Non-Gaussian noise is easily identified during measurements as a deviation from the straight line or a change in slope. Non-Gaussian noise exists throughout the radio spectrum. ITS has used the noise measurement system to measure noise at 137.5 MHz, 402.5 MHz, and 761.0 MHz. The noise measurement system can also be used to measure noise at higher frequencies, e.g., at 2.4 GHz in spectrum occupied by unlicensed Part 15 low power communication devices such as wireless local area networks and Part 18 industrial, scientific, and medical (ISM) devices such as microwave ovens.

The noise measurement system can be run from a building or a measurement van. A direct current converter with noise suppressor is used to power the van mounted equipment if 120 V alternating current is not available. Calibration measurements in radio quiet zones have shown that noise contributed by the noise measurement system and power conversion equipment is negligible.

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Radio Spectrum Measurement Systems

ITS has designed, constructed, and currently operates a number of automated spectrum measurement systems. The third generation Radio Spectrum Measurement System (RSMS-3), ITS' primary sytem, is a vehicularly mounted, self-contained facility for measurements between 1 MHz and 24 GHz. A fourth generation RSMS (RSMS-4) has been designed and is currently being built. RSMS-4 capabilities will exceed those of RSMS-3, to better meet spectrum measurement challenges of the 21st Century. Development of hardware, software, and a

vehicular platform for RSMS-4 progressed substantially in FY 2002 and completion is expected in FY 2003.

ITS also has available a number of suitcase-deployable systems called Compact Radio Spectrum Measurement Systems (CRSMS's). In FY 2002, CRSMS's were used to couple interference into a variety of radars at locations across the U.S.

All RSMS and CRSMS facilities incorporate a combination of commercial off-the-shelf hardware, hardware custom-designed by ITS, and control software written by ITS. Both the RSMS-3 and the RSMS-4 are RF-shielded, and each incorporates multiple 30-ft masts; on-board power generators; air conditioners; a complement of full-height equipment racks; and storage space. CRSMS capabilities utilize the same software but typically include only as much hardware as is required for any given measurement task. Local arrangements are made for CRSMS shelter and power.

All RSMS and CRSMS measurements rely extensively upon computer control of measurements. These systems can be operated in fully automatic, semi-automatic, and fully manual modes. Mobile radios; fixed communication links; radars; personal communication systems; earth station uplinks; industrial, scientific, and medical devices; broadcast signals; and special-purpose transmitter system emissions can be measured. For a detailed description of the RSMS, go to ITS on-line publications (http://www.its.bldrdoc.gov/pub/pubs.html) and download applicable appendices from any RSMS measurement report (e.g., Appendix A of NTIA Report 97-334).

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RFIMS Laboratory

The Radio Frequency Interference Monitoring System (RFIMS) Laboratory is used to provide support to the Federal Aviation Administration's (FAA) RFIMS program. Under the RFIMS program, ITS personnel analyzed FAA requirements and developed an automated, custom-designed radio frequency measurement system; integrated and tested a prototype mobile system; and integrated, tested and delivered eleven mobile systems. The lab contains a measurement system that is identical to the measurement system found within RFIMS vehicles. The lab is capable of reproducing the same measurement scenarios that can be created with the mobile systems, including measurements of spectrum signature, radar prf, and spectragraph, among others. In the RFIMS lab, ITS engineers develop and test measurement concepts that will become part of the RFIMS. Newly created software is tested for both functionality and user friendliness. If trouble reports are received from the deployed systems, the lab is used to recreate the situation, analyze the causes, and implement a viable solution. The lab is available to ITS engineers, all nine FAA regions, FAA headquarters and the FAA Technical Center to support the use and future development of the RFIMS.

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Spectrum Compatibility Test and Measurement Sets

The introduction of new radio technologies in close physical and frequency proximity to older ones can result in electromagnetic compatibility (EMC) problems. Although theoretical models and simulations provide much useful information in guiding design decisions, the complexity of modern systems and the existing spectral environment often requires real world measurements of a proposed system's effects within its proposed operating environment to determine its impact on other users of the radio spectrum. Another problem is the production of a controlled interfering signal with known characteristics in environments where the suspected interferer may be unavailable for use. This includes situations such as laboratory tests using interference from ship or aircraft mounted radars or communications systems. In both situations a system is needed that simulates the spectral emissions of other devices with a wide range of latitude. An example of these needs is the requirement to determine the thresholds at which various types of interference are manifested as observable interference effects in a variety of radar receivers.

To meet these needs, ITS engineers have developed two different types of interference generators. The first system is the Broadband Arbitrary Waveform Transmitter (BAWT) that is used to simulate the spectral output of a wide variety of radar and communication systems. These signals can be coupled directly into a system under test or they can be transmitted into a target system's antenna to more accurately gauge its response to a real interference situation.

In cases where ITS can gain access to the emissions from a particular transmitter, the transmitter's emissions can now be digitized using high-speed samplers. The digitized waveforms (in bandwidths up to 30 MHz and at frequencies as high as 26 GHz) are stored. The amplitudes, frequency components, and phase components of the signals are recorded for later playback by arbitrary waveform generators and selected RF signal generators. The advantage of this arrangement is that very complex waveforms may be replicated with complete confidence in the fidelity of the simulated signal and the original signal from which it was derived.

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Table Mountain Radio Quiet Zone

This unique facility (one of only two in the nation) is controlled by public law to keep the lowest possible levels of unwanted radio frequency energy within the test area. This allows research concerned with low signal levels, such as from deep space, extraterrestrial low-signal satellites, or very sensitive receiver techniques, to be conducted without the interference found in most areas of the nation. As the use of electronic systems (e.g., garage door openers, computers, citizen band radios, cellular telephones, arc welders, and microwave ovens), the number of radio and television stations, and new uses for the radio frequency spectrum increase, the average level of electromagnetic energy across the spectrum will also increase. This is important to companies that develop sensitive radio receivers and signal-processing equipment, since the equipment is often saturated by the background signal level. This facility is available for use by private parties on a reimbursable basis.

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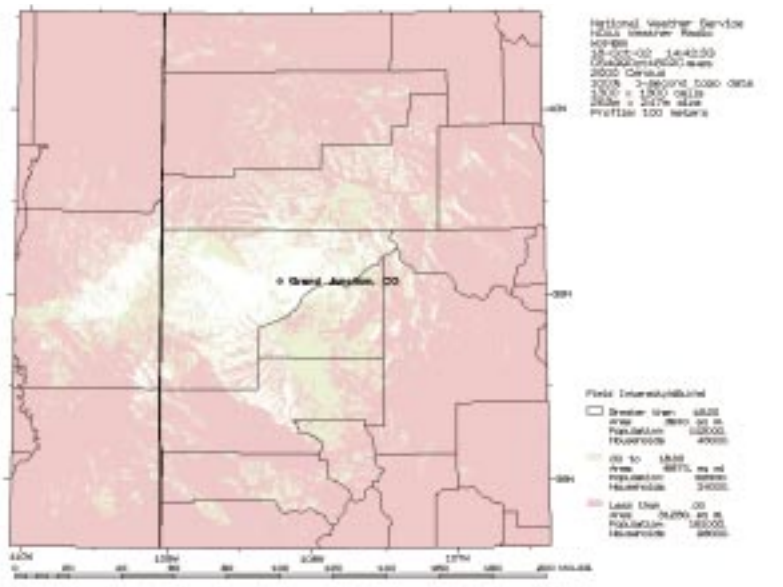
Telecommunications Analysis Services

Telecommunications Analysis Services (TA Services) provides the latest engineering models and research data developed by ITS to industry and other Government agencies via a web-based interface (http://flattop.its.bldrdoc.gov). Designed to be both user-friendly and efficient, it offers a broad range of programs that allow the user to design or analyze the performance of telecommunications systems. Currently available are: on-line terrain data with 1-arc-second (30 m) for CONUS and 3-arc-second (90 m) resolution for much of the world and GLOBE (Global Land One-km Base Elevation) data for the entire world; 2000 census data, 1990 census data (also 1997 updated); Federal Communications Commission (FCC) databases; and geographic information systems (GIS) databases (ARCINFO). TA Services has developed models which predict communication system coverage and interference for many broadcast applications. New models in the GIS environment for personal communications services (PCS) and Local Multipoint Distribution Services (LMDS) have been developed (see Telecommunications Analysis Services, pp. 42-43). The TA Services computer has about 210 GB of storage capacity. The following is a brief description of some programs available through TA Services.

HAAT – Calculates Height Above Average Terrain for an antenna at a specified location.
PCS/LMDS – Allows the user to create or import surfaces which may include terrain, buildings, vegetation, and other obstructions in order to perform line of sight (LOS) and diffraction studies.
FCCFIND, FMFIND, TVFIND, AMFIND, and TOWERFIND – Allows the user to search the FCC database for particular stations or by search radius around a point of interest.
PROFILE – Extracts path profiles according to user-specified input parameters. After the data is extracted, either the individual elevations or an average elevation along the profile can be obtained. A user can also receive plots of the profiles adjusted for various K factors. For microwave links, Fresnel zone clearance can be determined so that poor paths can be eliminated from a planned circuit or network.
SHADOW – Plots the radio LOS regions around a specified location in the United States using digitized topographic data. The program shows areas that are LOS to the base of the antenna, areas that are LOS to the top of the antenna, and areas that are beyond LOS to the antenna.
TERRAIN – Plots terrain elevation contours from any of the terrain databases available (1-arc-second SDTS for CONUS, 3-arc-second USGS, and GLOBE for the whole world).
COVERAGE – Calculates the receive signal levels along radials that are spaced at user-defined intervals of bearing around the transmitter. The program lists the contours of signal coverage of the transmitter along each radial and lists distances to user-specified contours for each radial. Either the FCC broadcast rules or the ITS Irregular Terrain Model can be chosen

for calculations.

CSPM – Determines the system performance of mobile and broadcast systems in detailed output plots of signal intensity, as shown in the figure. Plotted outputs can be faxed to the user, plotted on clear plastic for overlaying on geopolitical maps, or downloaded to the user site (in HPGL, GIF, or TARGA format). This program uses the ITS Irregular Terrain Model in a point-to-point mode, or other user-chosen algorithms for path loss calculation.



Example of a CSPM output using highest resolution terrain data.

HDTV – Allows the user to analyze interference scenarios for proposed digital television (DTV) stations. The model contains current FCC and MSTV allotment tables and maintains the catalogs created by all users of the program. The user can create new stations by hand, or by importing station information directly from the FCC database. Analyses may be performed using the existing FCC database and allotment assignments, or the user can replace a station with one created and maintained in the user's catalog.

NWS – A specialized application to assist the National Weather Service in maintaining its catalog of weather radio stations (currently about 750).

PBS – An analysis model similar to the HDTV model, but specialized for Public Broadcasting Stations (PBS). Typical outputs may consist of composite plots showing Grade A and B coverage of several stations or "overlap" plots which show areas covered by more than one station.

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Wireless Networks Research Center (WNRC)

The Wireless Networks Research Center (WNRC) provides a common laboratory area for work in the areas of wireless networks and wireless network access technologies. The WNRC allows the Institute to consolidate efforts in several areas, such as the RF/network interface. This work uses RF link characterization correlated with low-level network management protocols to develop PCS-to-PCS interference models, wireless network propagation models, non-cooperative wireless measurement, and wireless network discovery. RF/network interface measurement devices are used to make detailed measurements of PCS and cellular networks. One device uses a series of PCS/cellular phones to extract low-level protocol messages, network management information, and RF signal quality parameters. Another device has the ability to perform provider-independent PN offset scans and cdma2000 level 3 message logging.

The WNRC contains an experimental IEEE 802.11b wireless local area network (WLAN). ITS has conducted a series of wireless Voice over IP (VoIP) tests utilizing this infrastructure. The WLAN resources include IP packet logging equipment that can be used in network measurements. ITS recently added a code domain analyzer (CDA) measurement capability to the WNRC. The CDA is used to collect both short and long term Walsh channel data for any target IS-95 base station. The CDA operates in both the cellular and PCS frequency bands and can be used in fixed or mobile environments.

The WNRC is used to conduct ITS work in the area of inter-PCS interference, in support of TIA TR-46.2. ITS also has the capability to simulate PCS interference using a series of ITS implemented interference models.

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