

Technology Transfer to Industry and Academia

Outputs

- Cooperative research and development agreements with private companies and universities to perform telecommunications research and/or to use the Table Mountain field site for telecommunications-related research.
- Licenses to companies, universities, and individuals to use the patented Video Quality Metric (VQM) software.

Technology transfer is the process by which existing knowledge, facilities, or capabilities developed under Federal research and development (R&D) funding are utilized to fulfill public and private needs. This definition was developed by the Federal Laboratory Consortium for Technology Transfer (FLC), a network of over 700 Federal laboratories including ITS, and the only government-wide forum for technology transfer. Organized in 1974, the FLC promotes and facilitates technical cooperation among Federal laboratories, industry, academia, and State and local governments.

ITS participates in technology transfer and commercialization efforts in a number of ways: through fostering cooperative telecommunications research with industry where benefits can directly facilitate U.S. competitiveness and market opportunities, through making the Table Mountain field site available for research by industry and academia, and also through distribution of our patented software.

The Federal Technology Transfer Act of 1986 (FTTA), as amended, allows Federal laboratories to enter into cooperative research agreements with private industry, universities, and other interested parties. Under this Act, an agency can implement a cooperative research and development agreement (CRADA) that protects proprietary information, grants patent rights, and provides for user licenses to corporations, while allowing Government expertise and facilities to be applied to interests in the private sector.

ITS has participated for a number of years in CRADAs with private sector organizations to design, develop, test, and evaluate advanced telecommunication concepts. Research has been conducted under agreements with the following organizations:

- American Automobile Manufacturers Association
- ARINC
- AudioLogic, Inc.
- Bell Atlantic Mobile Systems
- Bell South Enterprises
- Lockheed Martin/Coherent Technologies
- East Carolina University's Brody School of Medicine
- Eton Corporation
- FirstRF Corporation
- General Electric Company
- GTE Laboratories Inc.
- Hewlett-Packard Company (HP)
- Integrator Corporation
- Intel Corporation
- Johnson's Jobs
- Lehman Chambers
- Lucent Digital Radio
- Lucent Technologies
- Motorola/Freescale Inc.
- Netrix Corporation
- RF Metrics Corporation
- Savi Technologies
- Spectrum Mapping LLC
- Telesis Technology Laboratories
- University of Colorado
- University of Pennsylvania
- US WEST Advanced Technologies
- US WEST New Vector Group

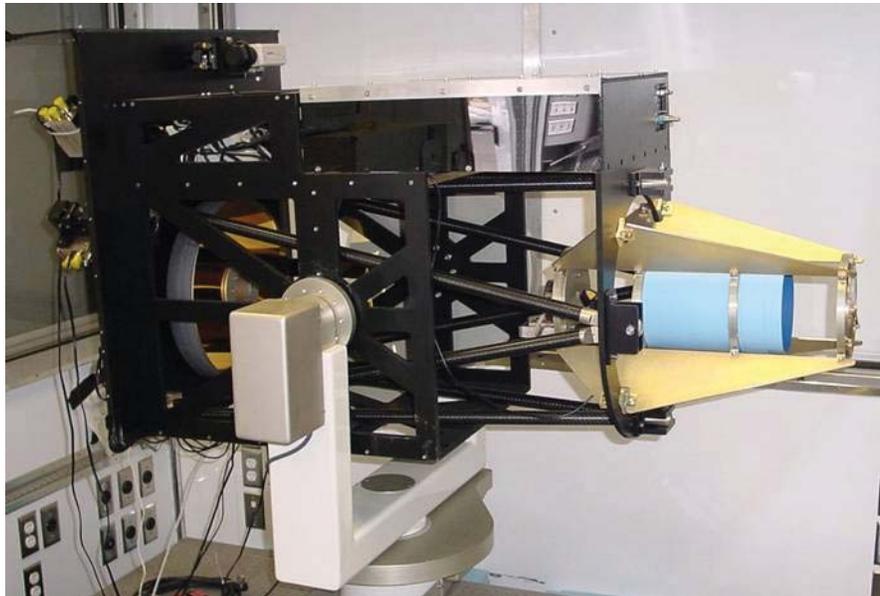
Not only does the private sector partner benefit, but the Institute is able to undertake research in commercially important areas that it would not otherwise be able to do.

While ITS often participates in technology transfer through CRADAs that involve performing measurements for a private company (thus transferring the Institute's knowledge and expertise), another very common form of technology transfer utilized by ITS is to make the Table Mountain field site available for telecommunications-related research. Federal facilities such as Table Mountain often contain resources (or, as in this case, *are* resources) otherwise unavailable to the general public. Active Table Mountain CRADAs in FY 2007 and publications resulting from them are described on pp. 10-11.

Another major technology transfer mechanism is the use of intellectual property resulting from R&D activities at Federal laboratories. In the past, ITS has made its patented Video Quality Metric (VQM) software available to the public through royalty-based licenses. In an effort to make the software more widely available, in FY 2007 ITS decided to begin distributing the VQM software royalty free. Plans are now underway to put the VQM software into the public domain and thus achieve even wider distribution of this very popular software. Further details about VQM can be found on pp. 56-57.

Cooperative research with private industry has helped ITS accomplish its mission to support industry's productivity and competitiveness by providing insight into industry needs. This has led to adjustments in the focus and direction of other Institute programs to improve their effectiveness and value.

ITS is interested in assisting private industry in all areas of telecommunications. The pages of this technical progress report reveal many technological capabilities that may be of value to various private sector organizations. Such organizations are encouraged to contact ITS if they believe that ITS may have technology useful to them. Because of the great commercial importance of many new and emerging telecommunication technologies, including third generation wireless (3G), wireless local area networks, digital broadcasting, and intelligent transportation systems, ITS will continue to vigorously pursue technology transfer to the private sector through CRADAs and thereby contribute to the rapid commercialization of these new technologies. ITS also plans to commit substantial laboratory resources to the development and standardization of new telecommunication technologies.



Lidar system used in the CRADA between Lockheed Martin/Coherent Technologies and ITS (photographs courtesy of LM/CT). LM/CT performed field-testing and characterization of components, subsystems, and systems for eyesafe coherent laser radar at the Table Mountain field site in FY 2007.

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SUPPORT TO PRIVATE SECTOR TELECOMMUNICATIONS ACTIVITIES:

ITU-R Standards Activities

Outputs

- Technical support to the U.S. Administration in ITU-R Working Party 8B, the Radar Correspondence Group, and Joint Rapporteurs Group 1A-1C-8B, as well as Study Group 3 (see pp. 42-43).
- Measurements to determine the emission spectrum of an HF ocean-surveillance radar to support the U.S. Administration's position on tightening radar emission criteria for better spectrum efficiency.
- Measurements performed on the effects of interference from signals of radionavigation satellite systems (RNSS) on a long-range air surveillance radar.
- Presentations on the effects of interference in radar receivers for the International Symposium on Advanced Radio Technologies (ISART) in Boulder, Colorado; the Tri-Service Radar Symposium in Orlando, Florida; and the Defense Department Emerging Spectrum Technologies (EST) workshop in Herndon, Virginia.

Success in worldwide telecommunication markets, as well as effective and compatible use of telecommunications technologies both domestically and abroad, is critical to the long-term health of the United States, both economically and otherwise. To achieve these goals, the U.S. Administration actively participates in the single most important worldwide telecommunications standards and regulatory body, the International Telecommunication Union — Radiocommunication Sector (ITU-R), to further its objectives with regard to all forms of wireless communication on a worldwide basis. ITS in turn provides important, ongoing technical support to the U.S. Administration in ITU-R Study Groups 3 and 8; Working Party 8B; the Radar Correspondence Group (RCG), and Joint Rapporteurs Group (JRG) 1A-1C-8B. Current areas of interest include (but are not limited to): potential reallocation of radar spectrum; effects on radars of interference from communication systems; dynamic frequency selection technology proposed for 5-GHz spectrum sharing between communication systems and radars; development of radar emission spectrum measurement techniques; and development of more efficient radar spectrum emission criteria.



Figure 1. Working Party 8B meeting in Geneva, June 2007 (photograph by F.H. Sanders).

Proposals have been made by non-U.S. Administrations in ITU-R to introduce communication systems into bands that have heretofore been allocated for radars on a primary basis. An area of current debate is the introduction of WiMax systems into radar bands on a worldwide basis. Another area of technical interest is the impact of radionavigation satellite system (RNSS) signals on the performance of long-range air surveillance radars that use the same band.

Since the U.S. Administration has made an enormous investment in the development and deployment of both military and civilian radars, it is essential that new systems proposed for spectrum sharing with radars be examined for electromagnetic compatibility with existing and future radars. To this end, ITS engineers in FY 2007 were leaders in an extensive, multi-agency effort to measure the effects of RNSS signals on a long-range air surveillance radar. Interference signals were injected into the radar receiver while targets were observed. At a variety of interference levels, the effects on target detection were observed. The results of that work have been prepared for submission to ITU-R Working Party 8B (recently re-designated 5B). More generally, interference test results have been used for U.S. Contributions in WP-8B, the Tri-Service Radar Symposium, the International Symposium on Advanced Radio Technologies (ISART), the Defense Department's Emerging Spectrum Technologies (EST) workshop, and NTIA Reports and Technical Memoranda.

To support the U.S. Administration's spectrum efficiency goals in FY 2007, ITS and OSM engineers measured emission spectra from an FM-pulse (chirped) HF ocean surveillance radar and submitted the results to Working Party 8B. Additional work in the ITU-R has been devoted to chairmanship of the Radar Correspondence Group by an ITS engineer, as well as ongoing support and written Contributions for JRG 1A-1C-8B on the topic of future development of radar spectrum emission criteria.



Figure 2. Test team with a radar that was used in RNSS interference testing in support of the U.S. Administration in ITU-R WP8B (photograph courtesy of Lockheed Martin).

Recent Publications

B. Bedford and F. Sanders, "Spectrum sharing and potential interference to radars," in "Proceedings of the International Symposium on Advanced Radio Technologies, Feb. 26-28, 2007," P. Raush and K. Davis, NTIA Special Publication SP-06-445, Feb. 2007.

F.H. Sanders, R.L. Sole, B.L. Bedford, D. Franc, and T. Pawlowitz, "Effects of interference on radar receivers," NTIA Report TR-06-444, Sep. 2006.

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ITU-T & Related U.S. Standards Development

Outputs

- Leadership of ITU-T and related U.S. telecommunications standards committees.
- Technical contributions presenting U.S. standards proposals and ITS research results.
- Proposed ITU-T Recommendations and associated U.S. industry standards.

The Institute has a long history of leadership, technical contributions, and advocacy of U.S. Government and industry proposals in the International Telecommunication Union's Telecommunication Standardization Sector (ITU-T) and related U.S. standards organizations. ITU-T is a specialized agency of the United Nations, responsible for developing the international standards (Recommendations) that providers use to plan, interconnect, and operate public telecommunication networks and services worldwide. ITU-T Recommendations strongly impact both the evolution of U.S. telecommunication infrastructures and the competitiveness of U.S. telecommunication products in international trade.

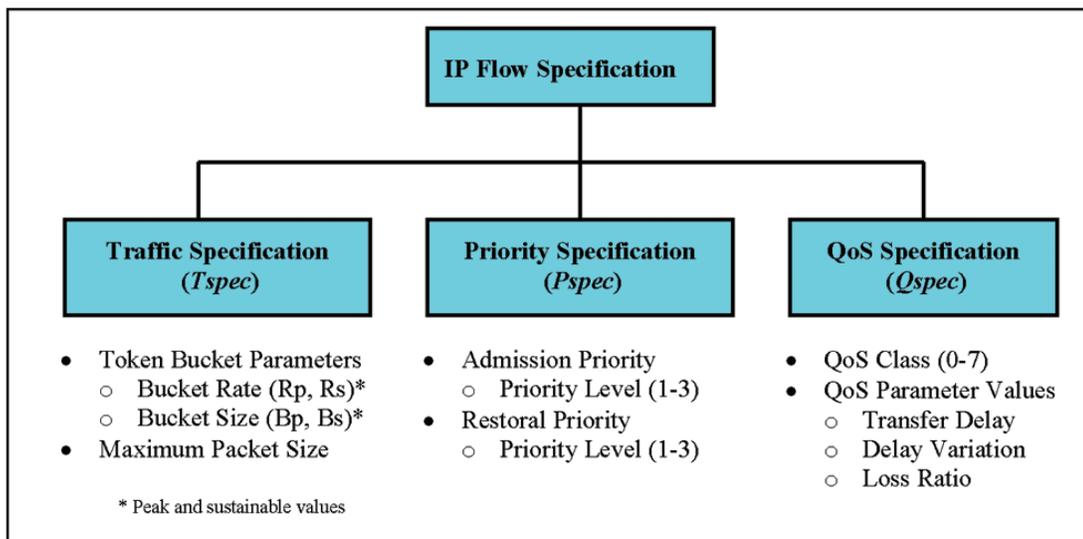
The Institute's long-term goal in ITU-T (and related national standards work) is to motivate the standardization of user-oriented, technology-independent measures of telecommunication service quality, and to relate those measures with the technology-specific performance metrics and mechanisms providers use to provision and operate networks. This work promotes fair competition and technology innovation in the telecommunications industry, facilitates interworking among independently-operated networks and dissimilar technologies, and helps users define their telecommunication needs and select products and services that meet them.

In FY 2007, the Institute provided leadership in two key ITU-T groups: Study Group (SG) 13 and SG 9's Working Group on Quality Assessment. Institute staff also provided leadership in the ANSI-accredited Performance, Reliability, and Quality of Service Committee (PRQC). SG 13 is developing international standards for Internet Protocol (IP) based Next Generation Networks (NGNs) that will offer integrated voice, video, data, and multimedia

services — and innovative new services like IP television (IPTV) — with assured quality levels. An ITS staff member serves as Vice Chair of ITU-T SG 13 and chairs SG 13's Working Party (WP) 4, which develops NGN standards on Quality of Service (QoS) and Operation, Administration, and Maintenance (OAM). An ITS staff member chairs SG 9's Working Group on Quality Assessment, which defines quality objectives for integrated broadband cable networks and television and sound transmission. In that group, ITS chairs Question 14/9 (Objective and Subjective Methods for Evaluating Audiovisual Quality in Multimedia Services). ITS also leads and contributes to the ITU-affiliated Video Quality Experts Group (VQEG), which works with SG 9, SG 12, and ITU-R WP 6Q (Broadcasting Services — Performance Assessment and Quality Control) to develop objective, computer implementable, perception-based video quality metrics that emulate the human visual system. In related work, ITS leads the Joint Rapporteur Group on Multimedia Quality Assessment (JRG-MMQA), a cross-cutting ITU-T standards body that unites the video quality expertise of SG 9 with the audio quality expertise of SG 12 in an effort to develop objective, perception-based metrics for combined audio and video signals in mobile and PC environments. ATIS PRQC develops national standards and contributes strongly to ITU-T standardization in all of these technology areas. Institute staff members lead PRQC's QoS and Security Task Forces.

In FY 2007, Institute leaders contributed strongly to management of the Next Generation Network Global Standards Initiative (NGN-GSI), a SG 13-based standards development program that coordinates and accelerates NGN standardization across many ITU-T Study Groups. SG 13's NGN-GSI activities collectively involved over 1200 delegates and produced 21 new ITU-T Recommendations during FY 2007.

The Institute's PRQC leaders organized and managed six PRQC meetings during FY 2007. Among other outputs, the group produced a new American National Standard on availability metrics for transaction-based IP network services, a new ATIS Technical Report (TR) that describes how Emergency Telecommunications Service (ETS) will be given priority treatment in NGNs, a new TR that



IP flow specification parameters.

defines a method of estimating the overall availability of an IP network based on selected point-to-point availability samples, and the text for a new ITU-T Recommendation that defines service prioritization requirements for NGNs. PRQC also produced a new Draft Standard for Trial Use that specifies an algorithm for calibrating (aligning) transmitted and received video streams, enabling them to be accurately compared by objective video quality assessment methods. This calibration technique, which was developed at ITS under the Video Quality Research project (pp. 56-57), will be valuable to video service providers and equipment manufacturers in developing and implementing objective video quality measurements.

ITS has co-chaired the ITU Video Quality Experts Group since its formation in 1997. VQEG enables video experts from many countries to collaborate in developing and evaluating video quality metrics (VQMs), and its results strongly impact the standardization of VQMs in both ITU-T and ITU-R. The group works primarily via an e-mail reflector, publicly accessible at <http://www.VQEG.org>. During FY 2007 the number of participants subscribed to this reflector grew to 600. ITS chaired two physical VQEG meetings in FY 2007. ITS also contributed to VQEG's Reduced Reference-No Reference (RR-NR) TV, HDTV, and Multimedia video test plans and provided key video source material during FY 2007. ITS is spearheading new ITU-T work on multimedia quality assessment through its leadership in VQEG and the JRG-MMQA.

ITS submitted two technical contributions to ITU-T SG 12 during FY 2007. The first provided complete text for a new Recommendation that defines speed, accuracy, and dependability parameters for call setup in NGNs that employ the session initiation protocol (SIP) in establishing and terminating media sessions ("calls") between users. The second provided the core text for a new Recommendation that will define IP flow specification parameters (identified in the accompanying figure) and associated decision rules to coordinate NGN admission control, policing, and resources assignment in situations where independently-operated networks must cooperate in providing NGN services.

During FY 2007, the Institute's ITU-T leaders also contributed to the planning and conduct of an ITU-T/IEEE Joint Workshop on Carrier Class Ethernet. An ITS staff member organized and chaired a key workshop session (Ethernet QoS, Timing, and Synchronization) and arranged for the session results to be published in a forthcoming special issue of *IEEE Communications Magazine*. This initiative contributed to mutual understanding and cooperative action among standards groups based in IEEE 802.1 and 802.3 (Higher-layer LAN Protocols, Ethernet) and ITU-T SG 15 (Optical and Other Transport Network Infrastructures).

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