GARDNER, CARTON & DOUGL

1301 K STREET, N.W.

SUITE 900, EAST TOWER

WASHINGTON, D.C. 20005

(202) 408-7100

FAX: (202) 289-1504

INTERNET: gcdlawdc@gcd.com

CHICAGO, ILLINOIS

MEMBER

WORLD LAW GROUP

A GLOBAL NETWORK OF INDEPENDENT FIRMS LOCATED IN 30 COUNTRIES

WRITER'S DIRECT DIAL NUMBER

FRANCIS E. FLETCHER, JR.
(202) 408-7111
ffletcher@gcd.com

February 22, 2001

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

Re: ET Docket No. 00-258

Dear Ms. Salas:

Transmitted herewith, on behalf of Illinois Institute of Technology, are an original and four (4) copies of its comments filed in response to the Notice of Proposed Rulemaking, FCC 00-455, released January 5, 2001 in the above-referenced proceeding. A copy of these comments is also submitted herewith on a 3.5 inch diskette in Word 97 format.

Should any questions arise in connection with this filing, kindly contact the undersigned.

Sincerely,

Francis E. Fletcher, Jr.

DC01/355413.1

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	ET Docket No. 00-258
Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems	)	
	)	
Petition for Rulemaking of the Cellular Telecommunications Industry Association Concerning Implementation of WRC-2000: Review of Spectrum and Regulatory Requirements for IMT-2000	)	RM-9920
	)	RM-9911
Amendment of the U.S. Table of Frequency Allocations to Designate the 2500-2520/2670-2690 MHz Frequency Bands for the Mobile-Satellite Service	)	

To: The Commission

COMMENTS OF ILLINOIS INSTITUTE OF TECHNOLOGY

Thomas J. Dougherty, Jr.
Laura C. Mow
Francis E. Fletcher, Jr.

Gardner, Carton & Douglas
1301 K Street, N.W., Suite 900 East
Washington, D.C. 20005
(202) 408-7100

FEBRUARY 22, 2001

ITS ATTORNEYS

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Summary

IIT, a non-profit technological university, offers distance learning advanced degree and certificate programs through 139 courses in science and engineering to more than 1,000 students at nearly 60 receive sites in the Chicago, Illinois, metropolitan area via ITFS facilities operating on the E and G Channels. Due to ubiquitous use of the ITFS frequencies by educators and their wireless cable partners throughout virtually the entire country, sharing of the 2500-2690 MHz band between ITFS and 3G services is not practical or feasible absent abandonment or drastic curtailment in use of this band by IIT and other educational institutions. Relocation of ITFS to higher frequency spectrum would be highly disruptive and expensive, and provide ineffective coverage and throughput. IIT and other non-profit schools and universities cannot afford such expense. Even if costs were compensated, the disruption caused by relocation would effectively doom many, if not most, long distance learning programs. No frequency allocations above 3 GHz can readily support the requirements of ITFS.

Two important public interest objectives would be thwarted by reallocation of the ITFS frequencies. The first is education. The importance to the nation of education, a key concern of the Administration and of Congress, is obvious. The second is the imminent rollout of advanced fixed broadband service over these facilities by Worldcom, Sprint and others. Any sharing or reallocation of ITFS spectrum will threaten the billions of dollars invested by these companies in fixed broadband, and the delivery of the powerful multimedia learning opportunities, interactivity and quality and speed of communications promised by this technology could be sacrificed. The Commission's role is not to favor one technology over another. It should not reallocate spectrum to one technology (3G) where the demand for mobile broadband services is

speculative at best, by taking it away from another technology (fixed wireless) where demand is clear and provision of service imminent.

Assuming allocation of any spectrum beyond that currently allocated to cellular, PCS and SMR is justified, the Commission should select additional candidate spectrum that best satisfies the needs of consumers of communications services here in the U.S. without regard to allocation plans in Europe, Asia and far flung regions of the world. The Commission has rightly recognized that a single global band for 3G is unlikely. While some European countries may allocate the 2500-2690 MHz band for 3G, others may not. In the Americas, the direction is clear. The United States' neighbors and biggest trading partners, Canada and Mexico, will not be using the 2500-2690 MHz band for 3G. Therefore, harmonization objectives would be better served by not reallocating the 2500-2690 MHz band in this country. This is especially true in light of the strong demand for Internet access and other fixed broadband services that will be met by the ITFS licensees and their partners using the 2500-2690 MHz band.

Finally, because it operates at the highest frequencies among the "additional candidate spectrum" being considered by the Commission for reallocation, the 2500-2690 MHz band also is technically the least desirable choice for 3G. Problems associated with building penetration and seamless coverage common to 2GHz PCS systems will only be worse at 2.5 GHz. Consequently, the desired capabilities of 3G service -- (i) the support of circuit and packet data at bit rates of 2 Mb/s or higher within buildings; (ii) the capability to determine geographic location of mobiles and to report mobile unit location to both the network and the mobile terminal; and, (iii) the overarching mobile service goal, universal coverage -- will not be realized in the 2500-2690 MHz band.

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To: The Commission

COMMENTS OF ILLINOIS INSTITUTE OF TECHNOLOGY

Illinois Institute of Technology ("IIT"), by its attorneys, hereby submits its comments in response to the *Notice of Proposed Rulemaking,* FCC 00-455 (the "*Advanced Services NPRM*") in the above-captioned matter.[1/] The *Advanced Services NPRM* considers whether to reallocate or otherwise provide spectrum for advanced services, including "third generation" ("3G") wireless services or IMT-2000 services. In addition to considering reallocation of approximately 210 megahertz of spectrum currently used for cellular, broadband Personal Communications

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1/ ET Docket No. 00-258, RM-9920; RM-9911, released on January 5, 2001 (FCC 00-455). The NPRM was released in the *Federal Register* on January 23, 2001, thus establishing February 22, 2001 as the filing deadline for these Comments. 66 FED. REG. 7438 (Jan. 23, 2000).

Service ("PCS"), and Specialized Mobile Radio Services ("SMRS"), the Commission seeks comment on reallocation of "additional candidate spectrum" in the 1710-1755 MHz, 1755-1850 MHz, 2110-2150 MHz, 2160-2165 MHz and 2500-2690 MHz bands.[2/] IIT holds licenses in 2500-2690 MHz band for use in the Instructional Television Fixed Service ("ITFS") and, for the reasons stated herein, opposes reallocation of that band for 3G services.

DISCUSSION

I. IIT's Educational Mission And Commitment To Its Professional Students Depends Upon Continued Availability And Uninterrupted Use Of Its ITFS Facilities.

IIT, a non-profit technological university, provides distance learning opportunities including advanced degree and certificate programs to working professionals in the Chicago, Illinois area. IIT relies upon its FCC-licensed ITFS facilities (channels E1-E4 (WBM648) and G1-G4 (WHG 269)) to achieve its mission of providing accessible and convenient quality education to the professions.

The distance learning program provided through IIT's ITFS facilities has been very successful. Presently, IIT is celebrating its 25th year of offering programs and courses via ITFS. Each semester, over 1,000 students enroll in IIT's ITFS courses covering more than a dozen subject areas.[3/] Many of IIT's programs are unique, and it is only through ITFS that students in engineering and the sciences can access these programs. As IIT's distance learning program has

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[2/] *Advanced Services NPRM*, ¶ 1. The Commission also has proposed three different pairing options for the provision of 3G services combining parts of these five bands. The first option proposes pairing three noncontiguous bands, 1710-1755 MHz, 2210-2150 MHz and 2160-2165 MHz ("Option 1"), which yields 90 MHz for 3G uses. The second option proposes the pairing of the 1710-1755 MHz and 1755-1850 MHz bands ("Option 2"), which yields 140 MHz for 3G uses. The final option proposes to pair either the 2210-2150 and 2160-2165 MHz bands, or the 1710-1755 MHz band with the 2500-2690 MHz band (Option 3"), which would yield 230 MHz for 3G uses. *Advanced Services NPRM*, ¶¶ 66-69.

[3/] IIT's Broadcast Course Schedule for the Spring 2001 semester is attached as Appendix I.

expanded steadily over the years, the number of ITFS receive sites has grown significantly. In the forthcoming Spring 2001 semester, IIT's network will support some 58 receive sites serving 1200 student enrollments in 139 ITFS courses.[4/]

ITT is committed to ensuring that its distance learning program provides a quality "virtual classroom" experience. Courier services are provided for class materials, and exams are proctored at the remote sites. In addition to the telecast presentation of the instructor, class materials are transmitted through whiteboards, document cameras, PCs and other technologies. The success of this system demonstrates IIT's commitment to making learning at a distance via ITFS as close to a "live" campus experience as possible, but with the convenience and associated cost savings of being close to work or home.

IIT's experience proves that video programming is an extremely powerful, highly effective and efficient method for distance learning. Travel in and around Chicago is often difficult, and students and their employers continually express gratitude for the convenience of having university courses available locally through IIT's ITFS network. Given many students' work and family commitments, most simply would be unable to take these courses absent remote access through ITFS facilities. The convenience of distance learning is absolutely essential to those IIT students that are working, remote professionals. IIT has committed to these students that the programs of study for which they, and in many cases their employers, are paying tuition dollars, will be available on a continuing, uninterrupted basis via ITFS.

Consistent with the central educational theme of the new Bush Administration and of the Congress, IIT's distance learning program focuses on science and engineering, and the expanded

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[4/] A map depicting the receive site locations in the Chicagoland area served by IIT's ITFS system as of August 31, 2000, is attached as Appendix II.

provision of educational resources to underserved populations. As an institution of higher education offering 19 full masters programs and 33 certificate programs via ITFS, IIT is not just an incumbent ITFS licensee, but a long-time, proficient and committed user of microwave instructional television for distance learning.[5/] Accordingly, IIT has a direct and vital interest in this proceeding. Because it would severely affect IIT's ability to continue to operate its distance learning programs, IIT is strongly opposed to reallocating, sharing or segmenting the 2500-2690 MHz band.

II. Spectrum Reallocation Should Be Considered Only If A Clear Need For Additional Spectrum For 3G Services Is First Established.

No one questions the fact that spectrum is a limited resource for which demand is growing. It is therefore important to carefully consider the threshold question of how much, if any, spectrum reallocation actually is justified for 3G services. Such considerations should not, and must not, be glossed over or buried in the discussion of the various frequency bands mentioned in the *Advanced Services NPRM* as possible candidates for reallocation.

The Commission has asked for comment on a number of questions in order to assess the ability of existing 1G and 2G systems to transition to advanced systems *without* additional spectrum allocations.[6/] Proponents of spectrum reallocation must first satisfactorily answer these

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[5/] The masters programs include the following subject areas: chemical engineering, telecommunications and software engineering, environmental engineering, and computer science. A complete list of IIT's Programs and Certificates available via ITFS is attached as Appendix III.

[6/] These include: Do service providers currently have capacity on their networks that could be used to provide advanced services? Does the amount of capacity, if any, differ by market size? How are capacity demands changing as service providers offer new data services? Are needs for more capacity being met by introducing new technology (i.e., advances in technology rather than the acquisition of additional spectrum)? Do current providers (e.g., cellular and PCS licensees) have sufficient excess capacity to offer advanced wireless services on their current networks? If so, which services can be provided? What migration paths to advanced wireless services are being considered? What can be done to facilitate the evolution of existing systems to advanced wireless systems? How does the type of

questions, and make a far more persuasive case than they have to date for the need for additional frequency allocations for 3G services. Before any precipitate action is taken to disrupt existing spectrum allocations, careful analysis of the projected nature and extent of demand for 3G services is called for, and due consideration should be given to the extent to which projected demand for Internet and other broadband access by users here in the U.S. will be met by other, existing broadband technologies including, in particular, the new fixed wireless broadband technologies emerging in the 2500 MHz to 2690 MHz band.[7/]

To date, there is no evidence that a need for 3G systems has been established. Recognizing the fact that quantifiable demand for advanced wireless services has not been ascertained, ITU-R charged Working Party 8F with studying demand for advanced wireless services. This study is not expected to be complete until 2003.[8/] Further, the FCC's *Interim Report* focuses on characteristics of candidate spectrum for reallocation without any consideration as to whether the demand for 3G services might require additional spectrum.[9/] And while the FCC at last has sought comment on the basic "3G need" issue in this proceeding, its simultaneous consideration of potential spectrum for reallocation fails to give the baseline inquiry its just due.

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technology currently used by a system provider influence their transition plans? *Advanced Wireless NPRM*, ¶23.

[7/] Other existing broadband technologies that could serve this need include DSL, cable modems and satellite.

[8/] ITU Working Party 8F has been charged with studying advanced wireless demand over the next 3 years in response to ITU Resolution 223. *See* Spectrum Study of the 2500 to 2690 MHz Band, the Potential for Accommodating Third Generation Mobile Systems (Interim Report, Nov. 15, 2000), at 13 ("*Interim Report*").

[9/] Increasingly, questions are being raised as to the cost and complexity of bringing about 3G services and whether advances in 2G systems obviate the need for 3G. *"Next Generation of Cellphones Becomes Murky,"* The Wall Street Journal, February 21, 2001.

Implementing specific frequency reallocations before completing the process of establishing the demand for advanced wireless services and evaluating whether that demand can be met by the introduction of new technologies (and, therefore, whether there is even a need for additional spectrum allocations), would only result in a premature and wasteful encumbrance of scarce spectrum resources. The Commission should defer any reallocation decision, therefore, until such time as these threshold issues have been thoroughly considered and resolved.

III. If The Commission Concludes That A Clear Need Has Been Established For Reallocation of Spectrum For 3G, The Commission Should In No Event Reallocate The 2500 MHz to 2690 MHz Band.

A. The 2500 MHz to 2690 MHz Band Is Heavily Encumbered And Reallocation Through Sharing Or Segmentation Would Be Highly Problematic At Best.

The FCC staff's *Interim Report* documents the fact that the 2500 MHz to 2690 MHz band is already heavily encumbered and provides ample evidence that it will become more so as imminent use of the band for Internet and other broadband access takes off.

> The 2500–2690 MHz band is in a state of rapid evolution by incumbent ITFS and MDS licensees. The MDS industry has invested several billion dollars to develop broadband fixed wireless data systems in this band, including high-speed access to the Internet. These systems offer a significant opportunity for further competition with cable and digital subscriber line (DSL) services in the provision of broadband services in urban and rural areas. The band is used currently to provide video services for education and training in schools, health care centers and a wide variety of other institutions, as well as for the provision of a commercial video distribution service known as wireless cable. This spectrum is heavily licensed throughout the country and is ramping up for full operational use in the very near term.[10/]

[10/] *Interim Report*, at ii. The *Interim Report* notes that a Final Report, to be released by March 1, 2001, will include the remainder of the study requirements, including information on other bands, a description of alternate bands and relocation studies, and cost/benefit analyses of system sharing, segmentation and relocation options identified. *Interim Report*, at 2. Given that the Final Report will not be released until next month, after the February 22, 2001 deadline for filing comments in this proceeding, the Commission should provide for the filing of supplemental comments within a reasonable time after the release of the Final Report.

The *Interim Report* makes clear, moreover, that efforts to reallocate this band for advanced mobile wireless through sharing or segmentation would be a complicated and delicate task. The FCC's studies show, generally, that large (100-mile, or beyond-the-horizon) co-channel separation distances are needed between 3G systems and ITFS/MDS systems to avoid causing harmful interference to ITFS/MDS systems, and that protected service areas currently exist in all but the very thinly populated areas of the country.[11/] The Interim Report further concludes that:

> Based on the assumptions used for this initial analysis, sharing between 3G systems and ITFS/MDS operations is extremely problematic. At this point, there does not appear to be enough spectrum in the 2500-2690 MHz band in the populated areas to support a viable 3G service.[12/]
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> * * *
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> Aside from the issues of finding suitable spectrum on which to move these systems and the economic costs involved in such an endeavor, the flexible nature of this band makes it extremely difficult to assess the actual impact that this segmentation option would have on currently deployed systems. Such an analysis would entail an examination of the complex interaction of stations in any given geographic area, including the way station operation is influenced by various lease arrangements and channel swaps.[13/]

The *Interim Report* also makes clear that sharing or segmenting the 2500-2690 MHz band will have a significant detrimental impact on ITFS/MDS service providers and coverage areas, and that the complex licensing scheme in the 2500-2690 MHz band would require difficult market-by-market analyses:

[11/] *Interim Report,* at 42, 47.

[12/] *Interim Report,* at 53. The Interim Report concludes that "voluntary partitioning" between incumbent users and 3G operators could offer some promise of sharing, but only as an "interim measure."

[13/] *Interim Report,* at 57.

> Any segmentation option that may be pursued should account for the flexible service configurations and offerings that incumbent and geographic licensees are currently implementing. Further, no segmentation option appears to be significantly better than another in terms of number of licensees affected. That is, regardless of any option that is considered a substantial number of licensees would need to be accommodated. Also, if segmentation is pursued, ITFS/MDS service providers may need to reduce their service areas and their ability to provide service to customers in outlying areas or add more transmitter sites may be affected. Finally, because of the complex licensing scheme present in this band due to the mix of auction winners, incumbent ITFS and MDS licensees and the channel swaps and lease agreements that have been implemented, blanket statements as to the effect of segmentation on any specific market area cannot be made. To fully understand the implications of any segmentation plan on the ITFS/MDS service, each geographic area would need to be analyzed individually.[14/]

In short, the already heavy and soon to intensify fixed wireless usage of the 2500-2690 MHz band, the complex leasing and channel swapping arrangements common to ITFS/MDS, and the sharing, segmenting and reallocation problems detailed in the *Interim Report* are in and of themselves sufficient reasons to remove the 2500 MHz to 2690 MHz frequency block from serious reallocation consideration.

The FCC should look instead to the more than adequate spectrum found in other bands discussed in the *Advanced Services NRPM*, including in particular the approximately 210 megahertz of spectrum already allocated in the 806-960 MHz and the 1850-1910/1930-1990 MHz bands. As between the four segments of potential "additional candidate spectrum" (1710-1755 MHz, 1755-1850 MHz, 2110-2150MHz/2160-2165 MHz, and 2500-2690MHz) the MMDS/ITFS frequencies appear to be the most problematic candidates for reallocation.[15/]

[14/] *Interim Report,* at 63. The feasibility of pairing some portion of the 2500-2690 MHz band with other bands to provide 3G services, as discussed under "Option 3" at paragraph 69 of the *Advanced Services NRPM*, was deemed to not be clear by the staff and was therefore not studied. *Interim Report* at 37.

[15/] While reallocation of frequencies in the 1755-1850 MHz band also would have to consider incumbent usage, it will be far easier to resolve sharing, segmentation and relocation issues dealing with a

B. The Current Uses Of The 2500 MHz to 2690 MHz Band Serves Important Public Interest Objectives That Would Be Thwarted By Reallocation.

If the technical/interference problems identified by the *Interim Report* with regard to sharing or segmenting the 2500-2690 MHz band are not sufficient to eliminate this band from reallocation consideration, especially when considered in the light of alternative available spectrum, preservation of the tangible and very significant public interest objectives served by existing and projected fixed wireless uses of this band surely tip the balance against reallocation. It is not just that reallocating this band would be complex and difficult, it would sacrifice two primary public interest goals -- fostering higher education and promoting more widely available broadband access, particularly in rural areas.

1. Invading the ITFS frequencies for advanced mobile wireless will adversely affect higher educational services and the capabilities of the U.S. workforce.

Education is a key concern of the Bush Administration, as it was of the Clinton Administration. As the Commission is aware, the ITFS spectrum serves a fundamental educational purpose. Used as an educational radio service since 1964, the ITFS spectrum can be licensed only to non-profit educational organizations and must be used in significant part for educational purposes.[16/] To date, approximately 1,275 entities hold over 2,175 ITFS licenses in urban and rural locations throughout the United States.[17/] Over 70,000 locations serve as registered receive sites.[18/]

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single incumbent entity, the Department of Defense, than with the 1,275 entities holding ITFS/MDS licenses that operate under complex channel leasing and swapping arrangements with each other and with wireless cable and broadband access service providers.

16/ 47 C.F.R. §§ 74.932 & 74.931.

17/ *Interim Report*, at 17-18.

Any Commission decision to invade the ITFS spectrum for advanced services would likely decimate this radio service, sacrificing the significant and broad based use of ITFS as an educational tool, and cutting short future prospects for broadband two-way use. The educational benefits of ITFS are well documented in the *Interim Report*.

> ITFS stations traditionally have been utilized for a wide variety of services, including the provision of formal telecourses (on the K-12, secondary, and post-secondary levels) to schools, hospitals, workplaces and other places of learning; transmission of other educationally valuable programming (including news, public affairs and similar material) into schools; provision of professional and worker training (such as for teachers, health professionals and public safety officers); and transmission of teleconferences for educational, training and administrative purposes. Distance learning via ITFS takes students beyond the school walls by giving them access to experiences and instructions in locations anywhere in the world. Videoconferencing allows students and teachers to interact with presenters and ask questions by telephone and e-mail. ITFS has become a crucial part of the curriculum of many educators. ITFS licensees are permitted to lease excess channel capacity to MDS licensees, with the income from those leases typically helping to underwrite the cost of providing the ITFS service. (Footnote Omitted).[19/]

> The introduction of two-way service will allow many educational users to develop broadband access to support education throughout the nation and MDS entities to develop a commercial wireless broadband alternative. . . . . Under the flexibility allowed by the *Two-Way Order*, ITFS licensees can devise systems that provide educational users with broadband access for a variety of video and data applications, thereby establishing ITFS as an integral educational tool for school districts across the country.[20/]

IIT believes that reallocation of ITFS spectrum would severely disrupt, if not destroy, the educational infrastructure it has spent 25 years and untold resources developing. In addition to considering future adverse effects on the nation's educational goals, the Commission must take

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18/ *Id.*

19/ *Interim Report*, at 19.

20/ *Interim Report*, at 20.

into consideration the enormous investment in ITFS made by IIT and other educational institutions to date, as well as the potential cost to the nation's distance learning infrastructure, before initiating steps toward reallocating ITFS frequencies. Incumbent users must be treated equitably. No reallocation should be permitted to adversely affect this important educational resource.

As noted earlier, year by year IIT has expanded upon its commitment to provide quality programs of interest to working professionals in the Chicago area. This growing commitment has involved investment both in infrastructure as well as faculty support. During the past six years, the number of broadcast-capable classrooms at IIT increased from 9 to 24. That number will be doubling over the next two years. The university is in its third year of design and implementation of the renovated Wishnick Building, which is planned to host 20 broadcast-capable facilities. Construction also is underway on the university's McCormick Tribune Campus Center, designed by Rem Koolhaus, planned to support about 12 broadcast facilities.

The number of IIT remote sites has increased dramatically over the past several years as well, from about 20 to 58 today. Included are corporate sites at multiple Motorola locations, Fermi Lab, Tellabs, Inc. and Caterpillar, Inc., among others. Several more are in the installation stage at present, and the number of remote sites is projected to continue to grow. The university has full-time staff working to implement potential new receive sites, in both the corporate and public access sectors, where educational needs for engineering, science, and specialized programs of study have been identified. The university provides the antenna, downconverter, and set-top boxes for all remote sites. Over 300 hundred set-top boxes are programmed to these channels. This substantial investment, dedicated to the public interest objective of furthering education, deserves protection.

IIT's expanding commitment to distance learning has been premised entirely upon its legitimate expectation of enjoying continued, uninterrupted access to the full channel capacity allotted to IIT through the end of its current ITFS license terms expiring in 2009 (E Group) and 2018 (G Group). Reallocation of the ITFS spectrum would place in jeopardy all of this investment. Attempting to preserve a comprehensive ITFS-based distance learning program in the face of reallocation would necessitate an order of magnitude of additional investment, expense and technical support that most educational institutions, including IIT, could not readily marshal. At the very least, substantial dislocation and interruption of IIT's distance learning program would be certain to accompany a reallocation of ITFS frequencies. Such interruptions would present an obvious detriment to the overall program, as well as wreak havoc on the curricula of thousands of IIT students.

Embarking upon an advanced degree or certificate program requires a substantial commitment by the student. Normally made in conjunction with an academic advisor, it implies a commitment on the part of the institution as well to offer the courses necessary to complete the selected program. In the distance learning environment, the university's commitment is to a continuous, non-interrupted set of courses offered via ITFS and established remote locations.

Reallocation of the ITFS spectrum will seriously disrupt the educational process. Considerable equipment will need to be refitted, reprogrammed or replaced. There is no possibility that this could be completed during a semester break period. Rather, the students' programs of study would have to be interrupted for at least a semester for the changes to be made and tested. The university's reputation would surely suffer, as would the plans and expectations of students.

Worse, if ITFS is relocated to a higher frequency band, some remote sites may lose service altogether, causing schools to breach contractual obligations with site owners, forcing students to travel to more distant locations, and perhaps, leading some students to discontinue their education. Even if it were possible to salvage existing sites through installation of repeaters, licenses would have to be obtained and sites determined, installed, and maintained. Apart from covering the costs involved in such an undertaking, the university does not have adequate staff to assume these tasks.

Direct spectrum reallocation costs to the university for refitting or replacing equipment are estimated by IIT to exceed $1 million. As compared to a large corporation, institutions of higher learning operate on tight budgets with only the full-time staffing necessary to maintain and operate, and to achieve planned growth on a continual basis. Expenses necessary to effect spectrum reallocation are not budgeted, nor would it be possible to maintain the required support for reallocation costs while continuing to pursue IIT's already committed expansion plans, including additional new receive sites, digitization of additional channels, and tests of two-way service.

Costs in loss of tuition dollars as a result of reallocation and interrupted programs of study will be more sizable. Only a 10% drop in enrollment of students mid-way through their programs of study would equate to $2,500,000 of lost tuition from existing students alone. In addition, enrollment of new students would surely suffer from the loss to the university's reputation and curtailment of remote sites, resulting in prospective revenue losses that cannot be readily estimated but would be significant and ongoing.

The Commission must consider the tremendous financial and human resource capital that has been invested in ITFS by IIT and other non-profit educational institutions before disturbing

the existing frequency allocations devoted to this service. As noted in the *Interim Report*, among the five guiding principles established in the Presidential Memorandum on 3G spectrum is the mandate that "incumbent users of spectrum must be treated equitably."[21/] It would be hard to find spectrum incumbents more deserving of equitable treatment than the non-profit educational institutions that serve the nation's distance learning needs via ITFS. Destroying their investment in ITFS would hardly be equitable.

2. Reallocation of the MDS/ITFS band to 3G services will greatly delay, if not completely thwart, the plans to use this spectrum for broadband fixed wireless services.

It would be ironic indeed if the Commission were to reallocate the current MDS/ITFS spectral home to promote the availability of broadband wireless services at the very moment MDS/ITFS systems are poised to offer broadband fixed-wireless services nationwide. The MDS/ITFS community has already begun the process of transitioning the 2.5 to 2.69 GHz band to two-way broadband use. At this stage, and after two very complex Commission rule making proceedings, MDS and ITFS interests have filed thousands of applications for two-way authorizations which will start to be granted in a couple of months. Quite aside from the billions of dollars spent by Sprint and Worldcom to acquire rights to this spectrum, millions of dollars have been spent to plan and apply for these complex broadband systems. In the wake of the Commission's authorization of two-way service, MDS equipment manufacturers have begun developing, and Worldcom, Sprint and Nucentrix have begun testing, two-way equipment and new ways of using available MDS/IFTS spectrum more efficiently, such as sectored antennas

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21/ *Interim Report*, at 1.

and advanced modulation techniques.[22/] It is expected that Sprint, Worldcom, Nucentrix and other broadband MDS and ITFS fixed service operators will commence these valuable services this year. If the Commission in any way threatens reallocation of MDS/ITFS spectrum, the mammoth effort expended to date by these parties and by the FCC to promote fixed wireless broadband access might be wasted.

Any threat to the development of broadband capability over ITFS is of particular concern to IIT. IIT has concluded that reallocation of ITFS frequencies will thwart its relationships and goals shared with its wireless cable partners, including plans for initiation of two-way services. Operating in good faith, IIT has been working with wireless cable providers since 1993 to make use of available airtime. Initially, wireless cable use consisted only of analog video downstream. Following the FCC's approval of digital transmission, IIT channels E1 and E2 were digitized to 5:1. Digitization of IIT's E3, E4 and G1 channels are soon to follow, and IIT's August 2000 application for two-way operations on channels G2-4 attests to IIT's firm commitment to new and better technologies to advance its distance learning program by providing such features as supplemental video with two-way email, videoconferencing, and other Internet-based activities.

In anticipation of using its ITFS system for broadband two-way services, IIT is currently supplementing its ITFS programming with streamed-video and synchronized slides of classroom materials over its university Internet connection in 62 courses having almost 500 student enrollments this Spring 2001 semester. These valuable two-way features are available to ITFS remote students to supplement the televised course, allowing them to review video sections again and again, and more closely duplicate a live classroom environment. IIT's experience to date

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22/ *See Interim Report,* at 33-34.

shows that students and faculty greatly appreciate the live interaction and call-in questions and answers permitted by this technology. IIT's ability to use its ITFS channels for two-way service is dependent upon ongoing collaboration with its cable partner. Any reallocation will, in all probability, end this cooperative endeavor and prevent IIT's students from realizing the benefits of an interactive ITFS experience.

C. Global "Harmonization" Should Not Drive The U.S. Allocation Decision And, In Any Event, Would Not Justify Reallocation Of The 2500 MHz to 2690 MHz Band.

The Commission has requested comment on reallocation of the 2500 MHz to 2690 MHz band as one of several bands identified at WRC-2000 for possible terrestrial IMT-2000 use. Although the international community's designation of potential frequency bands for IMT-2000 reallocation aims in part at promoting global frequency "harmonization," the Commission has recognized that "it appears very unlikely that a single band plan can be adopted on a global basis . . . [and has concluded that] . . . global roaming could be facilitated by the adoption of a limited number of common frequency bands that could be included in multi-band phones." *Advanced Services NPRM*, fn. 47. The Commission's reasoning is sound. Assuming the need for frequency reallocation to support 3G is established in the record of this proceeding, the Commission's primary objective should be to choose frequencies that are best for 3G use in the United States. International roaming harmonization objectives can be achieved by use of multi-band mobile units and new technologies such as software defined radio.

In fact, while the ITU appears to view advanced wireless service harmonization as a generalized ideal, as a practical matter, it has taken steps to provide for international advanced wireless spectrum diversity. Thus, the 2.5 to 2.69 GHz band is only one of several advanced wireless homes identified by the ITU. As noted in the *Advanced Services NPRM*, WRC-2000

identified the 806-960 MHz and 1710-1885 MHz bands for possible terrestrial IMT-2000 use while, previously, the World Administrative Radio Conferences ("WARC-92") had identified the 1885-2025 MHz and 2110-2200 MHz bands for possible advanced wireless system use. Additionally, WRC-2000 adopted a resolution stating that some countries may implement IMT-2000 in the 698-806 MHz and 2300-2400 MHz bands.[23/] Thus, the ITU has identified a total of 857 megahertz in various bands as alternative homes for advanced wireless spectrum.

Acknowledging the need for diversity, the WRC-2000 also adopted resolutions stating that a country may use any of the bands identified for IMT-2000, that IMT-2000 bands may also be used by other services that have allocations in those bands, and that IMT-2000 services do not have priority over other allocated services.[24/] In short, the international community has decided not to promote uniform worldwide advanced wireless spectrum harmony but, indeed, has taken steps that have the effect of encouraging worldwide spectrum diversity. Accepting the diversity premise, the ITU has decided to look into means to promote global roaming in a frequency divergent environment.

It is significant that the United States actively sponsored and supported this frequency diversity concept. As Commission Staff has reported:

> [t]he United States wanted the ITU to identify more than one band pair for IMT-2000 use. The rationale for a multi-band approach was that not all countries in the world require equal amounts of spectrum to support future wireless services. Identifying more than one band pair for IMT-2000 would allow countries to tailor their domestic band plans to their economic development and domestic priorities. Moreover, identifying a single band pair for IMT-2000 use would fail to consider the possibility that some nations already might have

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[23/] *Advanced Services NPRM*, ¶4.

[24/] *Id.*

encumbered the identified bands with equally vital services that could not be displaced or relocated without significant strategic or economic hardship.[25/]

Certainly, some benefits might be expected from having uniform band plans around the world.[26/] To the extent achievable, those benefits may include economies of scale in equipment manufacture and may include a greater ease of international roaming. Since, as noted by the Commission, "it appears very unlikely that a single band plan can be adopted on a global basis,"[27/] any Commission goal that may be adopted in favor of uniformity should seek harmonization of frequency use on a more regional basis.

If indeed international frequency harmonization creates significant economies of scale in manufacturing or significant international roaming benefits for United States users of advanced wireless services, then it would make sense to harmonize United States advanced wireless allocations with those administrations who are our largest trading partners and who will account for the greatest volume of roaming traffic by United States citizens. Our two largest trading partners are Canada and Mexico, the only countries that share a border with the United States. Canada/Mexico trade with the United States accounts for 52% of United States trade with its top ten trading partners.[28/] Neither Canada nor Mexico intends to use the 2500-2690 MHz band for

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[25/] *Interim Report,* at 10.

[26/] Economies of scale in equipment manufacturing have been cited. However, as the United States has argued in seeking to convince ITU members to allow nations to choose freely among several, equally valid bands for IMT-2000 use, "[w]hile global roaming might be improved by elevating a single band pair as the preferred band for IMT-2000 use, such a mandatory harmonization effort would just as likely stifle competition and technological development." *Interim Report*, at 10. Further, the U.S. market alone is sufficient to generate economies of scale.

[27/] *Advanced Services NPRM*, at n.47.

[28/] *See* Bureau of the Census web site, under "Foreign Trade Statistics," "Top Trading Partners." Statistics are based upon the latest trade information made available by the Bureau of the Census, and covers the eleven months ended November 2000. Only three European countries are within the top ten

advanced wireless services. Accordingly, if the United States sees significant economic or roaming-ease benefits from frequency harmonization, it must reach the conclusion that the 2.5 to 2.69 GHz band is not the preferred band for advanced wireless services.[29/]

There is no public interest reason for frequency harmonization to be the controlling objective in considering possible reallocation schemes. As noted in the *Interim Report*, the October 13, 2000 Presidential Memorandum established five guiding principles the Executive Agencies are required, and the FCC is encouraged, to use in selecting spectrum for 3G wireless systems. Only one of the five principles is that the federal government support industry efforts to harmonize spectrum allocations regionally and internationally, and then only "as far as practicable and based on market demand and national considerations."[30/] Two of the other five principles mandate:

(i) that incumbent users of spectrum identified for reallocation or sharing must be treated equitably; and,

(ii) the federal government be technology-neutral in spectrum allocation and licensing decisions.

Even assuming that some benefit in terms of harmonization would be derived from reallocating the 2500-2690 MHz band for 3G, it is clear that the two equally important objectives noted above would be ill served by such a reallocation. It has already been shown that IIT and

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trading partners – United Kingdom, France and Germany – and they account for only 13% of the trade between the United States and its top ten trading partners.

[29/] Certainly, many European administrations intend to use that band for advanced wireless services, but many do not. Further, the importance of frequency harmonization is much greater as between European countries, where crossing international borders is more a part of daily life and where economic integration has led to a single currency and an ever-increasing movement toward a single economy.

[30/] *Interim Report*, at 1.

other schools and universities who have invested heavily in ITFS would suffer tremendously, and be treated inequitably, by reallocation of the 2500-2690 MHz band.

In addition, such a reallocation would not be technology neutral. Reallocating to another technology (3G) the MMDS/ITFS spectrum that is now on the verge of realizing the benefit of billions of dollars of investment to enable it to provide broadband Internet access through fixed wireless facilities, just so advanced wireless technology may provide broadband Internet access, would be nothing other than favoring one technology over another.[31/] Thus, by reallocating the 2500-2690 MHz band the Commission would violate both the fair treatment of incumbents and the technology-neutral mandates in pursuit of an unnecessarily global level of harmonization.

Finally, by its own terms, the Presidential Memorandum requires the federal government to support industry efforts to harmonize spectrum allocations only "as far as practicable and based on market demand and national considerations."[32/] The Commission cannot simply assume that a particular allocation of spectrum for 3G is required in the U.S. just because that may be the case in other parts of the world. For one thing, the demand for 3G can be expected to vary from country to country. As noted by the Commission's staff, "[t]he [ITU's] rationale for a multi-band approach [for ITU-2000 use] was that not all countries in the world require equal amounts of spectrum to support future wireless services."[33/] For example, countries having lower PC penetration levels and less adequate wireline infrastructures than the U.S. will be more likely to experience demand for mobile wireless Internet access, at least in the near term. Users

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31/ As has been noted earlier in this proceeding, "the Commission should take care not to advance next generation mobile services by undercutting the next-generation fixed wireless services that have just begun to realize their potential." Comments of Cisco Systems in RM-9920, p1.

32/ *Interim Report,* at 1.

33/ *Id.* at 10.

in the U.S., accustomed to viewing the Internet on 17-inch color monitors using widely available PCs in the home and office, may not generate the same demand for access to the Internet over advanced mobile devices as, perhaps, Internet users in Italy who are used to the limited capabilities and small screen of a hand-held access device.

In fact, given the relatively high use of PCs for Internet access in the U.S. both at home and at work (57.1% household penetration compared, for example, to 13.1% in Italy, 12% in Spain),[34/] the enhancements to *fixed* wireless Internet access in the 2500-2690 MHz band promised by Worldcom, Sprint and Nucentrix represent a more appropriate use of this spectrum than reallocation for 3G services. As detailed in the *Interim Report,* the demand here in the U.S. for fixed broadband access is expected to far outpace the ability of incumbent DSL and cable modem providers and, in rural or otherwise underserved markets of the country, ITFS/MDS may be the sole provider of broadband service.[35/] In the end, what is best for the U.S. must be the driver of any 3G allocation decision, not harmonization for harmonization's sake.

As the ITU has stated, "the identification of several bands for IMT-2000 allows administrations to choose the best band for their circumstances."[36/] Even if the Commission determined that the objectives of harmonization would be served by reallocating the 2500-2690 MHz band, the uncertain benefits derived from harmonization clearly pale by comparison to the serious harm reallocation would inflict on the incumbent licensees and users of MDS/ITFS frequencies.

[34/] *"Consumer Electronics: A World Survey"*, Euromonitor, July 2000. See Table attached as Appendix IV.

[35/] *Interim Report,* at 21-23. The underserved markets referred to in the *Interim Report* include not only rural areas but residential and small office/home office ("SOHO") customers.

[36/] See Resolution COM5/24.

D. Other Frequencies Available For Advanced Wireless Services Are Technically Superior To The 2.5-2.69 GHz Band For Advanced Wireless Use.

The ITU's vision of 3G services includes several capabilities that would be difficult to achieve at 2.5 to 2.69 GHz or, at least, would be more readily achieved at lower frequencies. These capabilities include: (i) the support of circuit and packet data at bit rates of 2 Mb/s or higher within buildings; (ii) the capability to determine geographic location of mobiles and to report mobile unit location to both the network and the mobile terminal; and, (iii) the overarching mobile service goal, universal coverage.[37]

Frequencies below 2.5 GHz are required to effectively provide such capabilities. To achieve building penetration, a 3G service using the 2.5 to 2.69 GHz band would require antennas mounted outside the premises to overcome line-of-sight and building absorption problems associated with these higher frequencies. It is common knowledge that Sprint's PCS service operating at even somewhat lower frequencies in the 1.8-2 GHz range works poorly, at best, within buildings. An advanced wireless system operating at 2.5 to 2.69 GHz can be expected to perform even more poorly within buildings.

Building penetration is again a problem with regard to geographic location capability. If an advanced services mobile unit within a building does not send a signal of sufficient strength to be received by the closest cell tower receiver array, no system can determine where the mobile unit is located within the building, or even if the mobile is within the service area of the mobile system.

As to seamless coverage, one need only consider the coverage problems Sprint PCS has encountered. Because PCS operates in a higher band, Sprint is required to build many more cell

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[37] *Advanced Services NPRM*, at 10.

towers to offer a geographically seamless PCS service than cellular carriers need to cover a comparable geographically seamless cellular service area. Sprint PCS experiences large coverage gaps even in populated areas due to difficulty in securing cell tower sites. It must be expected that such coverage problems would be magnified for an advanced wireless system using the still higher 2.5 to 2.69 GHz frequencies.

There is, moreover, a significant supply of more suitable spectrum already available, or soon to be made available, that might be used for advanced wireless services when and if market conditions dictate. This includes: existing PCS and cellular mobile radio spectrum; the 45 MHz of spectrum in the 1710-1755 MHz band which the Commission has proposed to reallocate for mobile and fixed services from Federal Government under two statutory directives, the 1993 Omnibus Budget Reconciliation Act ("OBRA-93") and the 1997 Balanced Budget Act ("BBA-97");[38/] the 45 MHz of spectrum in the 2110-2150 band and 2160-2165 MHz band that were identified for reallocation under the Commission's 1992 Emerging Technologies proceeding;[39/] and, the 30 MHz of spectrum at 747-762 MHz and 777-792 MHz, which will be auctioned in September of this year.[40/] All told, and not counting the cellular and PCS spectrum, this adds up to a total of 120 MHz of additional spectrum, all of which would be more suitable for advanced wireless services than the ITFS frequencies.

[38/] *See* Omnibus Budget Reconciliation Act of 1993 (OBRA-93), Pub. L. No. 103-66, 107 Stat. 312 (1993) and Balanced Budget Act of 1997 (BBA-97), Pub. L. No. 105-33, 111 Stat. 251 (1997).

[39/] *See* Redevelopment Of Spectrum To Encourage Innovation In The Use Of New Telecommunications Technologies, ET Docket No. 92-9, *Notice of Proposed Rule Making*, 7 FCC Rcd 1542 (1992).

[40/] *Public Notice*, No. AUC-01-31-a (Jan. 31, 2001).

CONCLUSION

Given (i) IIT's mission to distance learning and its commitment to working professionals seeking degrees via ITFS technology, (ii) the absence of any mandate for a particular type or level of advanced wireless services for the U.S., (iii) the acknowledged problems of reallocation, sharing or segmenting the 2500-2690 MHz band, (iv) the crucial educational and broadband access functions provided by the 2500-2690 MHz band's incumbents, (v) the availability of more suitable frequencies, and (vi) that demand for advanced wireless services in the U.S. is informed by nothing more reliable than speculation, there is no need to invade, nor justification for invading, the 2.5-2.69 GHz band for advanced wireless spectrum.

Respectfully submitted,

ILLINOIS INSTITUTE OF TECHNOLOGY

By: 

Thomas J. Dougherty, Jr.
Laura C. Mow
Francis E. Fletcher, Jr.

Gardner, Carton & Douglas
1301 K Street, N.W., Suite 900 East
Washington, D.C. 20005
(202) 408-7100

Its Attorneys

February 22, 2001

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APPENDIX I

Spring 2001 Illinois Institute of Technology Broadcast Courses		
DEPARTMENT	**COURSE ID**	**COURSE TITLE**
BIOLOGY	BIOL 403-091	Biochemistry Lecture
	BIOL 514-092	Toxicology
	BIOL 515-092	Molecular Biology
	BIOL 560-092	Microbial Physiology
	BIOL 561-092	Microbial Genetics
COMPUTER ENGINEERING	CAE 534-092	Computational Tech. Finite Analysis
	CAE 577-092	Constr. Equip. Man.
CHEMICAL ENGINEERING	CHE 523-092	Fundamentals of catalysis
	CHE 525-092	Chemical Reaction Engineering
	CHE 530-092	Advanced Processing Control
	CHE 533-092	Stats Analysis/ Process data
	CHE 538-092	Polymerization Reaction
	CHE 543 / ENVE 544-092	Energy, Environment and Economics
	CHE 560-092	Stat. Quality and Process
	CHE 566-092	Fundamentals of electrochemistry
	CHE 577-092	Biochemical Engineering
CHEMISTRY	CHEM 500-092	Advanced Analytical Chemistry
	CHEM 501-092	Liquid Chromatography
	CHEM 508-091	Analytical Methods Developments
	CHEM 521-092	Structural Inorganic and Solid State Chemistry
	CHEM 530-092	Tactics of Organic Synthesis
	CHEM 542-092	Polymer Characterization
COMPUTER SCIENCE	CS 200-091	Introduction of C++ programming
	CS 330-091	Discrete Structures
	CS 331-091	Data Structure & Algorithm
	CS 401-092	Introduction to Advanced Studies I
	CS 401-397	Introduction to Advanced Studies I
	CS 402-092	Introduction to Advanced Studies II
	CS 411-092	Computer Graphics
	CS 425-091	Database Organization
	CS 425-092	Database Organization
	CS 425-094	Database Organization
	CS 430-091	Introduction to Algorithms
	CS 440-091	Programming Languages
	CS 445-092	Object -Oriented Design and Programming
	CS 450-091	Operating Systems I
	CS 450-397	Operating Systems I
	CS 451-092	UNIX Systems Programming
	CS 455-091	Data Communications
	CS 455-092	Data Communications
	CS 460-093	Fundamentals of Multimedia

Spring 2001 Illinois Institute of Technology Broadcast Courses		
DEPARTMENT	**COURSE ID**	**COURSE TITLE**
	CS 480-091	Artificial Intelligence
	CS 487-091	Software Engineering
	CS 487-397	Software Engineering
	CS 495-092	Java Primer
	CS 495-390	Java Primer
	CS 521-395/397	Object - Oriented Analysis and Design
	CS 525-092	Advanced Database Organization
	CS 527-092	Client Server Applications Development I
	CS 527-390	Client Server Applications Development I
	CS 528-390	Client Server Applications Development II
	CS 530-091	Formal Theory of Comp.
	CS 535-092	Analysis of Algorithms
	CS 536-091	Science of Programming
	CS 542-092	Principles of Computer Networks
	CS 542-390	Principles of Computer Networks
	CS 546-091	Parallel Processing
	CS 550-091	Computer Operating Systems
	CS 551-092	Operating Systems Design Implementation
	CS 555-092	Analytic Models and Simulations
	CS 586-092	Software systems Architecture
	CS 587-961	Software systems Architecture
	CS 588-091	Prog. Project Mang.
	CS 595-091	Cryptography and Network Security
	CS 595-092	Distributed Objects
	CS 695-091	Ph.D Seminar
	CS 761-591	Commercial topics in information systems
ELECTRICAL & COMPUTER ENGINEERING	ECE 242-091/098	Digital Computers and Computing
	ECE 309-091	Traveling Waves
	ECE 319-091/094/098	Fundamentals of Power Engineering
	ECE 407-395	Computer Communications Network
	ECE 407-397	Computer Communications Network
	ECE 411-092	Power Electronics
	ECE 421-092	Microwaves
	ECE 423-092	Microwave Circuits and Systems
	ECE 429-092	Introduction to VLSI Design
	ECE 429-094	Introduction to VLSI Design
	ECE 434-092	Control Systems with Laboratory
	ECE 434-093	Control Systems with Laboratory
	ECE 438-092	Control Systems
	ECE 449-092	Object Oriented Programming and Comp. Sim.
	ECE 470-390	Fiber optic Communications Systems
	ECE 504-091	Communication System Design
	ECE 504-098	Communication System Design
	ECE 511-092	Analysis of Random Signals

Spring 2001 Illinois Institute of Technology Broadcast Courses		
DEPARTMENT	**COURSE ID**	**COURSE TITLE**
	ECE 514-092	Digital Communication Principles
	ECE 519-092	Coding for Reliable Communications
	ECE 523-092	Electronic Circuit Theory
	ECE 530-092	VLSI Design
	ECE 531-092	Linear System Theory
	ECE 541-390	Perf. Eval. of Computer and Commun. Networks
	ECE 545-395	Comp. Communication Networks
	ECE 545-397	Comp. Communication Networks
	ECE 553-091	Power Systems Planning
	ECE 560-092	Power System Dynamics and Stability
	ECE 566-092	Statistical Pattern Recognition
	ECE 569-092	Digital Signal Processing II
	ECE 575-390	Electronic Devices
	ECE 585-098	Digital Computer Design
	ECE 585-395	Digital Computer Design
	ECE 585-397	Digital Computer Design
ECONOMICS	ECON 423-091	Economical Analysis of Capital Investments
ENGLISH	ENGL 530	Online Design
	ENGL 532	Rhetoric of Technology
ENVIRONMENTAL ENGINEERING	ENVE 506-092	Chemodynamics
	ENVE 513-092	Biotech Proc. Water
	ENVE 527-092	Analysis of Environ. Systems
	ENVE 544-092	Energy, Environment & Economics
FOOD PROCESSING	FPE 541-290	Principles of Food Packaging
	FPE 541-295	Principles of Food Packaging
MATHEMATICS	MATH 471-091	Numerical Analysis I
MECHANICAL & AEROSPACE ENGINEERING	MAE 402-091	Engineering Experiments
	MAE 413-092	Mechanical Vibrations
	MAE 461-092	System Analysis and control
	MAE 479-399	Materials Processing
MECHANICAL, MATERIALS & AEROSPACE ENGINEERING	MMAE 202-091	Mechanics of Solids
	MMAE 271-091	Engineering Materials and Design
	MMAE 303-091	Mechanics of Solids III
	MMAE 500-092	Engineering Analysis 1A
	MMAE 501-092	Engineering Analysis 1B
	MMAE 502-092	Engineering Analysis II
	MMAE 527-092	Heat Transfer: Convection and Radiation
	MMAE 531-091	Theory of Elasticity
	MMAE538-092	Computational Tech. Finite Analysis
	MMAE 543-092	Analog and Digital Control Systems
	MMAE 564-092	Dislocations and Strengthening Mechanisms
	MMAE 575-092	Ferrous Products
	MMAE 576-092	Materials Process and Selection
	MMAE 590-092	Reliability in Engineering II

Spring 2001 Illinois Institute of Technology Broadcast Courses		
DEPARTMENT	**COURSE ID**	**COURSE TITLE**
	MMAE 593-091	Departmental Seminar
MANUFACTURING TECHNOLOGY	MT 311-096	Production and Operations
	MT 315-395	Manufacturing Enterprises
	MT 321-395	Computer Integrated Manufacturing
	MT 412-096	Manufacturing Processes
	MT 426-395	Decision making and Risk Analysis
	MT 432-395	Vendor/Customer Relations
PHYSICS	PHYS 561-051	Radiation Biophysics
	PHYS 572-051	Health Physics II
	PHYS 575-051	Case Studies in Health Physics
TOTAL = 139 Courses		
Multiple offerings of same course by different instructors or at different broadcast times are listed separately.		

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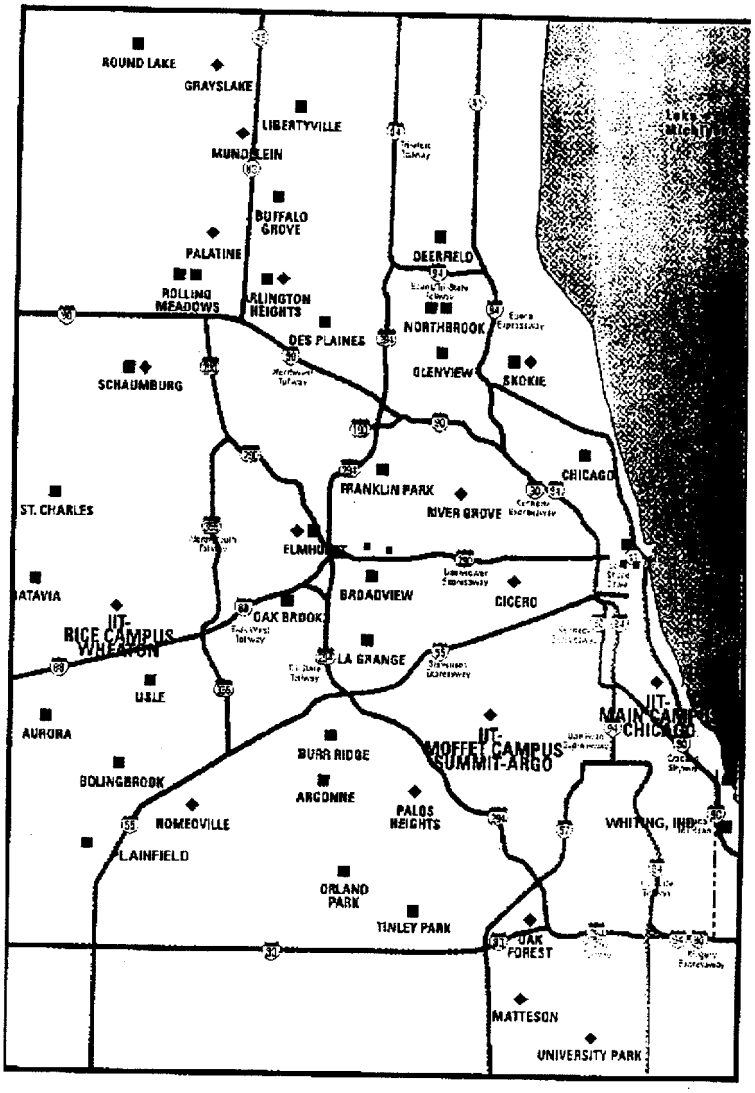
APPENDIX II

Map of Receive Sites as of 8-31-00
Illinois Institute of Technology



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APPENDIX III

Programs and Certificates Available Via ITFS
Illinois Institute of Technology

Entire Degree Programs:

Chemical Engineering, M.S., Master
Chemistry, M.S.,
Chemistry, Master
with specialization in:
Analytical Chemistry
Materials and Chemical Synthesis
Biochemistry/Biotechnology
Environmental Chemistry
Materials Chemistry
Polymer Chemistry
Computer Science, M.S.
with specialization in:
Intelligent Information Systems
Software Engineering
Computer Networking and Telecommunications
Computer Systems Engineering, M.S.
Construction Engineering & Mgmt., Master
Electrical Engineering, M.S.
Electrical and Computer Engineering, Master
Electricity Markets, Master
Environmental Engineering, Master
Geotechnical Engineering, Master
Geoenvironmental Engineering, Master
Manufacturing Engineering, Master
Mechanical and Aerospace Engineering, M.S., Master
Metallurgical and Materials Engineering, Master
Public Works, Master
Structural Engineering, Master
Telecommunications and Software Engineering, Master
Transportation Engineering, Master
Physics
Health Physics, Master

Master refers to a professional master's degree (non-thesis option) for working professionals.

Entire Certificate Programs:

BCPS (Biological, Chemical, and Physical Sciences)

Analytical Method Development – Pending
Analytical Spectroscopy – Pending
Analytical Chemistry – Pending
Characterization of Inorganic and Organic Materials
Chromotography – Pending
Synthesis and Characterization of Organic Materials
Synthesis and Characterization of Inorganic Materials

CAE (Civil and Architectural Engineering)

Construction Management

ChE/ENVE/FST (Chemical Engineering, Environmental Engineering, and Food Processing Engineering)

Hazardous Waste Engineering
Indoor Air Quality
Particle Processing
Pharmaceutical Processing
Physiology for Pharmaceutical Applications
Polymer Operations Management
Water and Wastewater Treatment

CS (Computer Science)

Internet
Intelligent Information Systems
Software Engineering
Telecommunications and Networking

ECE (Electrical Engineering)

Advanced Electronics
Applied Electromagnetics
Computer Engineering
Electricity Markets

Power Engineering
Signal Processing
Wireless Communications Engineering

Consumer Electronics: A World Survey - Introduction, Executive Summary, Key Market Drivers, Key Digital Technologies and Market Overview

From EUROMONITOR, July 2000

Table 19 Household Penetration Levels Of Personal Computers In Major Markets 1995-1999

Per 100 households

	1995	1996	1997	1998	1999	% growth 1995/1999
Australia	23.0	24.8	30.6	32.4	36.4	13.4
Brazil	12.5	15.2	16.9	19.2	22.2	9.7
Canada	28.8	32.1	36.4	38.14	1.8	13.0
China	5.0	6.2	7.8	10.1	12.8	7.8
France	31.5	31.8	31.9	32.0	34.1	2.6
Germany	24.5	27.9	28.2	29.8	30.7	6.2
India	0.6	0.7	0.7	0.7	0.7	0.1
Israel	31.1	32.6	33.0	33.0	33.7	2.6
Italy	10.6	11.0	11.6	12.2	13.1	2.5
Japan	15.1	17.3	22.1	23.5	27.3	12.2
Mexico	15.2	18.7	20.1	22.2	25.2	10.0
Poland	7.7	7.5	9.0	11.0	12.5	4.8
Russia	3.0	3.0	4.0	5.0	6.0	3.0
South Africa	4.0	4.5	5.0	5.5	6.1	2.1
South Korea	20.2	22.3	24.0	24.5	26.1	5.9
Spain	8.0	9.0	10.0	11.0	12.0	4.0
Taiwan	18.5	22.6	25.4	26.2	29.5	11.0
UK	25.8	26.7	27.4	28.7	30.9	5.1
US	33.5	38.8	44.0	50.0	57.1	23.6

Source: Euromonitor from official sources