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FEDERAL COMMUNICATIONS COMMISSION
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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Systems, including Third Generation Wireless Systems	)	ET Docket No. 00-258
	)	
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
	)	
Amendment of the U.S. Table of Frequency Allocations to Designate the 2500-2520/2670-2690 MHz Frequency Bands for the Mobile-Satellite Service	)	RM-9911

COMMENTS OF THE TELECOMMUNICATIONS INDUSTRY ASSOCIATION IN RESPONSE TO THE NOTICE OF PROPOSED RULEMAKING

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COMMENTS OF THE TELECOMMUNICATIONS INDUSTRY ASSOCIATION

The Telecommunications Industry Association (TIA),[1] pursuant to Sections 1.415 and 1.419 of the Commission's Rules,[2] hereby submits its comments in response to the Notice of Proposed Rulemaking ("NPRM")[3] in the above-captioned proceeding. As it has

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[1] TIA is the leading trade association servicing the communications and information technology industry, with more than 1,100 member companies that manufacture or supply the products and services used in global communications. TIA represents the communications sector of the Electronic Industries Alliance.

[2] *See* 47 C.F.R. § 1.415, 1.419.

[3] Notice of Proposed Rulemaking, FCC 00-455 (released January 5, 2001)(hereinafter "NPRM").

stated in the past,[4] TIA believes that the Commission must move expeditiously to make available additional suitable spectrum that can be used for advanced wireless communications services, including third-generation (3G) wireless systems. In these comments, TIA offers the manufacturers' perspective on many of the difficult questions posed by the Commission in the NPRM.

I. INTRODUCTION

As the Commission is fully aware, the demand for wireless services continues to explode. Moreover, the emergence of new advanced wireless applications and services, such as those enabled by 3G wireless systems, means that the wireless revolution really is just getting started. The Internet continues to go mobile, as consumers demand access to it anytime, anywhere.

With its spectrum management responsibilities, the Commission is in a position to help foster the ability of American consumers to reap the full benefits of emerging advanced wireless services. Additional spectrum must be made available that is suitable for advanced communications services, such as 3G mobile systems. At last year's ITU World Radio Conference (WRC-2000), administrations from around the world agreed that "on the order of" 160 MHz of additional spectrum will be needed in order to meet the

[4] *See* TIA Reply Comments, RM-9920 (filed Sept. 12, 2000).

projected requirements of IMT-2000[5] in those areas where the traffic is the highest by 2010.[6] WRC-2000 identified a number of frequency bands that provide the greatest potential for meeting the predicted demand in a globally harmonized manner, including 1710-1885 MHz and 2500-2690 MHz.

It is now time for the Commission to allocate additional spectrum for IMT-2000 services in the United States. In fact, the future competitiveness of U.S. industry is very much at stake, as other nations already have begun the licensing process for advanced 3G services. The national administrations represented at WRC-2000 also recognized the importance of achieving a globally harmonized spectrum plan so as to achieve global roaming, maximize economies of scale, lower costs, and secure an early implementation of 3G services.[7] Harmonized spectrum coordination around the world can enable more effective, economical and competitive wireless communications. The U.S. must now make its own spectrum management decisions at the national level in light of the global framework adopted at WRC-2000, and make available on an expedited basis the spectrum needed for 3G services. In making its decisions in this proceeding, to the

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[5] IMT-2000 is the International Telecommunication Union (ITU)-led initiative to develop global standards for third-generation (3G) wireless systems capable of broadband and multimedia applications, including voice, video, and data. Since January 1999, TIA has served as the secretariat for the Third-Generation Partnership Project 2 (3GPP2), which was created to support IMT-2000. To that end, TIA's contributions to IMT-2000 help form the backbone of the ITU's radio interface recommendation.

[6] *See Provisional Final Acts of the World Radiocommunications Conference* (*Istanbul, WRC*-2000), Resolution 223 ("Additional *frequency bands identified for IMT-2000*").

[7] *Id.*

greatest extent possible, the Commission should seek solutions that will realize the benefits of harmonizing domestic spectrum use with regional and global allocations.

In the sections that follow, TIA offers its views on many of the technical considerations that will impact the Commission's decisions in this proceeding. TIA also recommends that the Commission take into account the report of the industry association group on identification of spectrum for 3G services,[8] which is being submitted into the record of this proceeding.[9]

II. DISCUSSION

A. IMT-2000 Standards are Sufficiently Robust to Enable the Provision of Advanced Wireless Services and Will Continue to Evolve; Their Evolution, However, Does Not Diminish the Need for the Commission to Thoughtfully Allocate Additional Spectrum.

In the NPRM, the Commission asks whether the IMT-2000 radio interface standards are sufficient for planning advanced wireless system spectrum requirements.[10] It also asks whether any significant developments in the standards context are anticipated that might affect its spectrum allocation decisions.[11]

IMT-2000 standards were developed in a global effort to be sufficient for the

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8 *See* Report of the Industry Association Group on Identification of Spectrum for 3G Services (Feb. 22, 2001) (hereafter "Industry Association Report").

9 See CTIA/TIA/PCIA Joint Comments in this proceeding (filed Feb. 22, 2001).

10 NPRM at ¶ 21.

advanced mobile wireless services projected to be required over the next decade. They offer spectrum efficiency and capabilities superior to second-generation (2G) technologies, *e.g.* higher data rates in different mobility scenarios, support for packet-based data services and support for asymmetric services. While these standards are not static and will continue to evolve over time to support higher data rates and to be more spectrally efficient, such advances do not eliminate the need for additional spectrum allocation.

Standards for 3G systems have been developed over the past few years, consistent with the requirements for IMT-2000 as set forth by the ITU.[12] The standards describe technical parameters for several air interface technologies and, therefore, afford operators the flexibility to select systems consistent with their present and future needs. The standards are well developed and, in some cases, are already in commercial operation or are being tested.

Additional effort is already underway in standards bodies to update the IMT-2000 radio interface specifications to provide additional or enhanced capabilities, as well as to define the mechanisms to support intersystem and global roaming. Further, work is beginning to identify parameters that will define systems beyond 3G. Moreover, in some cases, updates to regional standards have already been published.

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[11] *Id.*

[12] *See* "Detailed Specifications of the Radio Interfaces of IMT-2000," Recommendation ITU-R M.1457 (2000), International Telecommunications Union.

The IMT-2000 standards include the carrier spacing required for each of the air interfaces and describe the emission bandwidth permitted. Accordingly, they are sufficient for planning the allocation of spectrum for advanced wireless systems. However, it should be anticipated that market demand will grow, requirements will change, technology will continue to advance, and the radio systems deployed in the new spectrum allocated for advanced wireless services will evolve. Therefore, it is most important that the Commission maintain its current policy of technology-neutrality and thereby provide operators with the maximum flexibility to determine the optimal use of the available spectrum. While thus supporting its policy of technology neutrality, TIA does recommend that the FCC organize the bands with sufficient certainty to prevent interference between licensees.

Work is already underway to develop enhanced standards. These standards generally support more spectrally efficient use of bandwidth. However, the rapidity with which standards bodies are moving ahead with this effort is an indication of the increasing demand for wireless services and the need for yet additional spectrum.

It is anticipated that wireless systems based upon future standards developments will be implemented in the cellular and PCS bands currently licensed for Commercial Mobile Radio Service (CMRS), as well as in new spectrum that may be allocated as a result of this proceeding. Standards development in the wireless industry is performed in response to the market requirements put forward by wireless service providers. For the

most part, wireless standards development is focused on extending the utility of the existing networks.

TIA does not foresee the possibility of new wireless standards being developed that would make any proposed spectrum allocation obsolete. Rather, it is expected that future standards developments will provide greater flexibility in terms of the applications to which the proposed allocations may be put. As long as the spectrum is allocated in a technology-neutral manner, the risk of standards developments negatively impacting its employment is limited.

B. All of the IMT-2000 3G Technologies are Designed to be Capable of Providing Asymmetric User Services and Both Circuit and Packet Data Services Over a Wide Range of Data Rates.

The Commission in the NPRM solicits comment on the advantages and disadvantages of various methods of accommodating asymmetric traffic relating to the use of spectrum for "advanced wireless services, including third generation wireless systems."[13]

All of the IMT-2000 3G technologies are designed to be capable of providing asymmetric user services and both circuit and packet data services over a wide range of data rates up to 2 Mbps. The traffic mix will differ, depending on types of active users in a network and their uptake of different applications, and will vary with time, location and

[13] NPRM at ¶ 21.

network. The overall traffic asymmetry in 3G networks, therefore, cannot be predicted in any detail. A mix of symmetric, downlink oriented and uplink oriented applications using different data rates can be expected. It generally is assumed that traffic volume will be greater in the downlink than the uplink once 3G services become widespread.

In time division duplex (TDD) systems, asymmetric services are achieved by allocating different numbers of time slots for the uplink and downlink. For TDD systems to function properly, a cell must generally avoid having a DL/UL configuration different from co-channel or adjacent channel cells. Otherwise, severe BS-BS and MS-MS interference may occur.

As a consequence, operators within line of site (LOS) or near line of site (NLOS) of each other must synchronize their networks and agree on the exact DL/UL configuration in all cells. This implies that the operators must agree on the overall DL/UL capacity asymmetry, a potentially difficult proposition since the operators may have different business plans and foresee different traffic behavior in their networks. In practice, therefore, the capacity allocation between uplink and downlink cannot be changed on a short-term basis and only with difficulty on a long-term basis. A further problem is that an asymmetric capacity allocation, typically involving more downlink slots than up-link slots, immediately implies reduced service capabilities (lower data rates) for all users in the uplink. Moreover, since cells in the same network, and even overlapping cells using adjacent carriers, need the same degree of asymmetry in order to avoid interference, the up-link data rate for all users is limited. This limitation does not

exist in frequency division duplex (FDD) systems.

Unlike TDD-based systems, FDD systems do not limit the service range in one link when allocating more resources in the other link to achieve asymmetric capacity. The operators do not need to coordinate their networks and thus may have different degrees of asymmetry in order to support different business plans.

TDD systems generally require synchronization and coordination between competing operators in order to avoid severe interference. For TDD, high capacity in one direction means low user data rates in the other direction for all users on that carrier's system. Since neighboring cells in the operator's own network and even in adjacent carriers' networks generally need the same slot configuration, the user data rates will be limited for these as well. FDD-based systems do not suffer from these problems and limitations.

Asymmetric TDD therefore is not the most suitable solution when considering multi-operator cellular systems where a wide range of requirements on applications, high data rates in both directions, and asymmetry can be expected.

FDD based systems do not have *any* of the drawbacks of TDD systems. Downlink and uplink usages are independent for the user, the cell, the network, and between networks. FDD-based systems can accommodate all service combinations that a TDD system supports. Taking into account the possibility for asymmetric spectrum allocation, FDD systems are well suited for support of asymmetric capacity. For each

individual user the overall use of symmetric or asymmetric resources is completely transparent from a service point of view. TDD thus offers no inherent advantage over a FDD system in terms of asymmetric capacity support.

Several factors should be considered in determining how to address asymmetric traffic demand and whether it is appropriate to license symmetric or asymmetric band pairs to support asymmetric traffic demand. At present, no sound basis exists for determining the degree of asymmetry (ratio of uplink to downlink traffic demand) that will occur in a wireless service provider's network. As such, the most robust allocation option would be to allocate symmetrical paired bands to support FDD allocations. It is anticipated that data traffic, particularly traffic created by wireless Internet access, will be increasingly more asymmetric, with additional downlink capacity required. However, other potential advanced wireless data services likely will require symmetric operation. Consider, for example, video conferencing or public safety/medical applications where imaging information may be transmitted from the terminal location. Moreover, voice traffic may comprise a large percentage of the network traffic, and voice traffic is essentially symmetrical. The degree of overall traffic asymmetry will depend on the asymmetric nature of each of the specific applications supported in an operator's network and the relative mix of traffic from the various applications supported, including voice traffic. Hence, overall traffic asymmetry is uncertain, likely to vary over time (including as a function of the time of day), and may differ from network to network, licensee to licensee, and market to market.

Given the uncertainty of how asymmetric traffic will develop, the issue of asymmetric versus symmetric spectrum allocations should be revisited in the longer term, as more information regarding asymmetric traffic becomes available. At that point, the Commission might consider whether any asymmetric traffic needs should be addressed by adding additional spectrum capacity or through future technological developments.

The FCC's allocation of new spectrum for "advanced wireless services, including third generation" is generally understood to allow for the implementation of IMT-2000 systems. All of the IMT-2000 standards that use FDD currently require symmetric paired spectrum bands. It should be anticipated that, initially, most of the new licensees will deploy systems based on one of these standards using symmetric, FDD band pairings.

C. Equipment, Such as Multi-Band Devices, Will Greatly Increase in Cost and Expense if Spectrum Allocations are not Harmonized, to the Greatest Extent Possible, with Allocations Around the World.

The Commission asks in the NPRM how much more expensive multi-band devices are than single-band devices and how many different frequency bands can be supported by current equipment?[14]

The cost penalty for multi-band or multi-mode devices is greatly dependent on the economies of scale achieved in each combination. A multi-band/mode device addressing

[14] *Id.* at ¶ 24.

a large global market may have cost parity with a less complex device serving a much smaller national or regional market. In general, adding frequency bands to be covered and modes to be handled increases development costs and manufacturing costs, as well as complexity, size, weight and power consumption.

This added complexity is largely associated with the need to incorporate the necessary filtering and to support multiple transmitters and receivers. Accommodating these needs is likely to be most burdensome in mobile terminals. Additional costs are associated with the capital and human resources that are necessary to develop and deploy systems that can operate in many different bands; this additional development can also contribute to delays in time to market for products developed for less widely available band plans. Multiplying the various categories of terminals (*i.e.* business, leisure, fashion, etc.) by the potential number of frequency bands and modes also demonstrates why it is imperative to keep the number of frequency bands to an absolute minimum.

Multi-band and multi-mode equipment exists today and in fact will be necessary to accommodate support for 2G and 2.5G modes[15] in 3G devices. Although such devices therefore can be manufactured as the market demands, complexity and costs are mitigated with the need to accommodate fewer spectrum allocations. Indeed, the success of the U.S. wireless industry in the development and the deployment of wireless systems may be enhanced if the U.S. frequency allocations were to align with the current and future

[15] In general, "2.5G" is a term used to describe certain technologies that afford operators an incremental approach to upgrading their systems to support higher-speed data services.

allocations around the world. This alignment will enable vendors and operators to realize the economies of scale afforded by a global market and to bring the benefits to U.S. consumers.

Accordingly, to better align the U.S. allocations with the rest of the world, the FCC should, to the greatest extent possible, identify spectrum that harmonizes with allocations already in place in other regions.

D. New Equipment for 3G Services Likely Will Become Available Earlier in Markets Without Unique Spectrum Allocations.

The Commission in the NPRM asks whether new equipment would have to be designed and when such equipment would be available.[16]

New equipment will need to be designed and deployed for all 3G technologies. However, in general, equipment may be available earlier in particular markets where manufacturers can draw upon the resources of an existing product line. Conversely, equipment availability may be delayed if the attributes of a new allocation require new technology development, standards, and manufacturing. Cost complexity in effect becomes a barrier to entry. In short, manufacturers will address the largest available market with common engineering resources. As a result, markets with unique allocations will be a smaller target for manufacturers and likely will see a less competitive supply of

[16] NPRM at ¶ 24.

mobile devices and equipment.

E. Allocation of Spectrum Suitable for 3G Wireless Systems Should be in Paired Increments of 5 MHz.

The Commission, in the NPRM, solicits comment on the appropriate size of spectrum blocks needed to implement 3G wireless systems, including the minimum size needed.[17]

In accordance with the 3G Characteristics Table,[18] to accommodate any of the IMT-2000 radio interfaces, the minimum size spectrum block that should be allocated for advanced wireless systems, including 3G services, is 5 MHz. The allocation should be in paired increments of 5 MHz, resulting in licenses of 2x5*n* MHz. Larger assignments (e.g., 2x10 MHz or 2x15 MHz) are desirable, as they can accommodate future, higher data rates, and provide the operators with additional capacity and, importantly, with greater flexibility. This kind of allocation would achieve the Commission's goal of technology neutrality, by allowing the operator maximum flexibility in the selection of technology.

Indeed, the allocations in those countries where 3G spectrum already has been assigned typically provide between 2x10 MHz and 2x20 MHz for each licensee. In fact, it may be a reasonable conclusion that a viable business case for a commercial

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[17] *Id.* at ¶ 28.

[18] See CTIA/TIA/PCIA Joint Comments (Attachment I to the Industry Association Report).

operator may require a minimum spectrum allocation of 2x15 MHz. An operator needs to provide service to many different customers at any one time in an economical manner. This is achieved by configuring different network layers within each network cell. Restricting an operator to one 5 MHz channel in a wide-band FDD system would mean occupying the complete cell capacity if the highest data rate were to be delivered to a customer at a specific time. To serve other customers at the same instant would require additional channels.

F. The Commission Should Allocate Paired Spectrum, Which Would Afford the Licensee the Flexibility to Consider a Mix of FDD and TDD systems, Dependent Upon Traffic Density, the Services Demanded, and the Relative Costs.

In the NPRM, the Commission solicits comment on the relative merits of FDD and TDD for advanced wireless systems (*e.g.*, spectral efficiency, backward compatibility, capacity limitations, cost to deploy).[19] It also solicits input on the frequency separation between bands needed to enable FDD operation, and the feasibility of operating TDD in the region between the FDD forward and reverse links.[20]

FDD systems typically have been used in high-mobility, large-scale deployments. TDD systems generally are used in low power, lower mobility applications, often within unlicensed spectrum. TDD applications might include alternative access for telephony and/or the provision of higher data rates in a densely populated area, where the desired

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[19] NPRM at ¶ 29.

[20] *Id.*

area of coverage is small. Operators might therefore consider a mix of FDD and TDD systems, dependent upon traffic density, the services demanded, and the relative costs.

Although licenses for 3G services in some European countries include unpaired spectrum together with paired spectrum, such allocations may result in spectrum that remains unused if the licensee has no plans for the use of TDD systems. It would appear more efficient, therefore, to allocate paired spectrum and permit the licensee the flexibility to deploy TDD systems, if so desired. In theory, the recipient of a license for paired spectrum could deploy TDD systems in its licensed spectrum consistent with requirements for out of band energy (OOBE) and interference. Interference between TDD and FDD systems can be problematic, as TDD transmit into FDD receive and FDD transmit into TDD receive must be considered. Compliance with OOBE requirements may, therefore, demand that a TDD operator implement guard bands of significant size within their licensed spectrum, adjacent to the boundary with FDD systems, or require a reduction in the TDD transmitter power.

Generally, FDD systems need a significant gap between uplink and downlink bands, in order to reduce interference. One design parameter affected by the duplex gap for FDD systems is the physical size of duplex filters. (Duplex gap = frequency gap between highest transmit frequency and lowest receive frequency in an allocation). For example, a reduction in the duplex gap from 80 MHz to 40 MHz would increase the volume of the necessary duplex filter by a factor of four. Ideally, duplex spacing should be about 10% of the frequency range in which the allocation is located. Existing

allocations (*e.g.*, PCS), however, typically provide considerably less duplex spacing than might be desired. The reduced duplex spacing is accommodated through more complex and costly filter designs.

Significant geographical separation distances are needed between TDD and FDD base stations operating in adjacent spectrum bands, in order to reduce signal degradation to acceptable levels. For carrier frequency separations of 5 MHz, required separation distances are in the range of 6-10 km, while for 15 MHz carrier distances they are reduced to 2-3 km.

G. In Allocating Additional Spectrum for Advanced Wireless Services, the Commission Should Seek to Adopt a Band Plan that Continues to Support the Use of the PCS Band for 2G and 3G Services and Promotes a Harmonized Regional and Global Approach.

The Commission in the NPRM solicits comment on the impact of using currently allocated spectrum and new spectrum bands on global roaming, harmonization and economies of scale.[21]

Harmonization of currently allocated spectrum for use by 3G systems is not possible on a global scale and, consequently, global roaming and the associated economies of scale cannot be achieved in that spectrum. For new spectrum bands being considered, the opportunity for harmonization exists and should be exploited.

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[21] *Id.* at ¶ 34.

A goal of the allocation of additional spectrum for advanced wireless services should be to adopt a band plan that continues to support the use of the PCS band for 2G and 3G services and promotes a harmonized regional and global approach. The Commission should seek to achieve an allocation that is harmonized, to the extent possible, with allocations throughout the world. An allocation that provides commonality of 3G spectrum in the U.S. with other parts of the world will enhance global roaming and facilitate the realization of economies of scale.

H. All of the IMT-2000 Technologies Provide an Evolutionary Path for Existing Mobile Systems and U.S. Mobile Network Operators Enjoy the Necessary Regulatory Flexibility to Utilize Currently Licensed Spectrum.

In the NPRM, the Commission seeks information regarding the ability of existing 1G and 2G systems to use currently licensed spectrum to provide advanced services.[22]

In many countries, including the U.S., operators of mobile networks have the flexibility to evolve their existing infrastructure to provide 3G capabilities. Many U.S. cellular operators still support both analog and 2G handsets throughout their networks. Most U.S. operators are planning to evolve their networks to provide advanced services, and some likely will have 1G, 2G and 3G systems coexisting in their networks.

The IMT-2000 radio interfaces were designed to be deployable on currently

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[22] *Id.* at ¶ 22.

operating systems and within their existing licenses. All of the IMT-2000 technologies provide an evolutionary path to 3G. cdma2000 provides an evolution path for ANSI-95 (cdmaOne) networks to introduce advanced 3G services in their existing spectrum, while TDMA and GSM operators can deploy GPRS/EDGE/W-CDMA to provide advanced 3G services in their existing spectrum. Equally important, operators must have the flexibility to evolve their 3G capabilities within their currently assigned spectrum, thus providing the opportunity to deploy new capabilities consistent with market demand.

Under the FCC's existing rules, operators currently have the flexibility, and the standards necessary, to deploy systems to meet their customers' needs. No additional rules are required to support this capability.

I. The Commission Can Help Facilitate Widespread Global Roaming by Allocating Spectrum Suitable for 3G Services That is Common to Most Parts of the World.

The Commission in the NPRM solicits comment on steps it can or should take to facilitate global or regional roaming.[23]

The ability of the mobile industry to offer global roaming capability for 3G services will benefit consumers and the industry alike. For consumers, it means an increased ability to use their mobile devices around the world, along with a wider array of products to choose from due to increased competition among vendors.

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[23] *Id.* at ¶ 24.

It is of course clear that the allocation of spectrum that is common to most parts of the world is an important step in the widespread implementation of global roaming. As noted earlier in these comments,[24] harmonized spectrum allocations maximize economies of scales for equipment manufacturers, providing the industry with an opportunity to produce a wider array of products at less cost. Global demand for wireless products and services continues to explode. This demand will continue to increase dramatically as Internet access is enabled on a multitude of wireless devices. Manufacturers will have a difficult enough time meeting this level of demand even without being required to build country-specific technologies and solutions. Globally aligned spectrum allocations and technical standards will provide the necessary economies of scale and maximize the ability of manufacturers to bring innovative products to market in a timely fashion.

The Commission has proposed a number of candidate spectrum plans to achieve its multiple goals. Spectrum harmonization and global roaming are very important goals. Achieving them, however, requires each national administration to consider, in the context of its domestic allocation proceedings, the availability of spectrum and its planned use in other countries.

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[24] *See* section II.D, *supra*.

III. CONCLUSION

TIA urges the Commission to take into consideration the comments herein as it continues the important task of making available suitable additional spectrum for advanced wireless services, including 3G. The Commission should make every effort to maintain a goal of allocating spectrum in the U.S. consistent with global and regional allocations, to the greatest extent possible. The benefits of such action will accrue to consumers, as communications equipment manufacturers will have the opportunity to roll out new equipment and products in a timely fashion, and continue making available an increasingly wide array of advanced mobile devices with expanded roaming capability.

Respectfully submitted,

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