Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

In the Matter of	)	
	)	
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	)))))	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 2500-2520/2670-2690 MHz Frequency Bands for the Mobile Satellite Service	))))	RM-9911

REPLY COMMENTS OF ARRAYCOMM, INC.

ArrayComm, Inc. (hereinafter "ArrayComm") is pleased to submit the following comments in the above-entitled matter.

ArrayComm is pleased that the concept of technical neutrality seems to be acceptable to virtually all the parties who addressed this aspect of the Commission's Notice. We are particularly gratified that a number of the filings recognize a) the suitability of TDD to deliver 3G services, and b) the spectral efficiency benefits of adaptive antennas for all of the technologies likely to be deployed in the bands under consideration. The comments of Qwest, Siemens, and Dr. William Lee on behalf of LinkAir Communications are particularly noteworthy.

Certain other comments contain statements regarding adaptive antennas or TDD which ArrayComm believes to be either misleading or simply incorrect. To assure that the record in this proceeding is accurate, ArrayComm wishes to respond.

The joint CTIA/TIA/PCIA filing contends on page 4:

> "Technological advances will not solve spectrum scarcity. The wireless industry continues to actively research and develop advances in technology that will promote greater spectral efficiency. We encourage the U.S. Government to establish policies that facilitate the use of various technologies, including Software Defined Radios or adaptive antennae that will assist the industry in this area. However, such technologies will not alleviate the need for additional spectrum in the short to medium term."

There is an implication in this statement that the benefits of adaptive antennas lie in the future and, therefore, offer no immediate help to alleviate spectrum inadequacy. While we agree that technological advances will not completely solve spectrum scarcity, adaptive antennas can and do, today, significantly increase the information carrying capacity in the spectrum that is currently available and which is suitable for portable/mobile applications. The limited amount of spectrum coupled with an ever-proliferating number of uses demands that spectrally efficient technologies be employed. ArrayComm alone has furnished 65,000 base stations world-wide with its adaptive antenna technology. Depending on the application, spectral efficiency increases range from a factor of seven to as much as forty.

Looking forward, ArrayComm's customer list includes providers of 2.5G and 3G infrastructure equipment, such as Marconi and Airnet, guaranteeing that spectrally efficient products will be available for the spectrum under consideration in this proceeding. Many other 3G infrastructure providers are either creating similar technology in-house or are partnering to obtain it.

It is a reasonable observation that the adoption of adaptive antenna technology industry-wide is outpacing the development and deployment of other components of 3G technology. Contrary to the CTIA/TIA/PCIA statement quoted above, ArrayComm is convinced that adaptive antenna technology can provide significant benefits to 3G deployments, essentially from their outset, thereby improving spectrum management.

The CTIA/TIA/PCIA filing referenced a report entitled "Characteristics of International Mobile Telecommunications (IMT) 2000 Technology" which provides an overview of UTRA-TDD, an IMT2000 TDD air interface. ArrayComm participated in the joint government/industry task forces that created this report.

A few comments raised questions about TDD and its role in 3G services. Because the filing of Lucent Technologies, Inc. ("Lucent") covers virtually all the issues raised in these comments, ArrayComm will focus its efforts below on an in-depth response to that company.

Before addressing Lucent's filing, however, we would call attention to the fact that the only system providing wide-area third-generation services today is the Personal Handyphone System (PHS) which employs TDD technology. This system is deployed extensively in Asia, providing indoor and ubiquitous outdoor coverage; it offers data rates today of 64 kbps, with 128 kbps services due to be rolled out by some operators later this year. This level of service exceeds that anticipated from initial 3G deployments. PHS had nine million subscribers at the end of 2000; more than thirty-seven million are forecast by the end of 2002.

Put in context: if the only system that provides wide-area third-generation services today anywhere in the world is TDD, and if initial deployments of FDD IMT2000 technologies are expected to be unable to match TDD's data rates, it is disingenuous or just plain inaccurate to label TDD as unsuitable for wide-area delivery of third-generation services.

On page 6 of its comments, Lucent states:

> "FDD systems have typically been used in high mobility, large scale deployments, while TDD systems are generally used in low power...applications."

Without adaptive antennas, ArrayComm concedes that FDD is better suited to extremely long range applications where power amplifier outputs are many tens of Watts. This occurs because it is much easier with an FDD duplexing structure to realize the requisite transmit/receive isolation at these high powers.

However, this is irrelevant to an analysis of how to provide 3G services for two reasons: First, as seen in the air interface characteristics tables appearing in Attachment I of the Report attached to the CTIA/TIA/PCIA filing, anticipated base station power amplifier levels for all of the air interfaces are no more than 10 W, and peak user terminal power amplifier levels are no more than 1 W with 100 mW being typical. The requisite transmit/receive isolation and switching/settling times for TDD are readily achieved at these power levels.

Second, in the absence of adaptive antennas and unlimited spectrum, systems that provide true third generation services – mobility and high bandwidth – at meaningful subscriber penetrations will be composed of micro-or pico-cells and therefore operate with relatively low uplink and downlink powers. The reason is simply one of information density, that is, bits/H_z/km. 2G systems are widely accepted to operate at a spectral efficiency of 0.1 bits/s/H_z/cell including the effects of frequency reuse or code reuse. The CDMA Development Group estimates that for at least one IMT-2000 technology, CDMA2000, the spectral efficiency will have improved to 0.16 – 0.2 bits/s/Hz/cell.[1] Even with this spectral efficiency improvement, the data rate requirements of third-generation services will rapidly deplete spectral resources at a base station. This exhaustion of resources at each base

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[1] http://www.cdg.org/features/CDMASeminar/Viterbi/sld044.htm

station is a function of the number of active subscribers. This will occur in base station coverage areas of even modest size.

To illustrate, suppose an operator has a 2x10 MHz allocation. In each direction, the base station throughput will be 0.2 bits/s/Hz/cell x 10 MHz or 2 Mbps. If, as Lucent states on page 4, videoconferencing is one of the "high bit rate advanced wireless services" to be ultimately provided by third generation systems, and it is provided at 256 kbps which results in acceptable, but not outstanding videoconference quality, then no more than 7 such sessions can be supported per base station in a 2x10 MHz allocation. In contrast, for 2G voice services at 13 kbps/user/direction and at an efficiency of 0.1 bits/s/Hz/cell, the same 2x10 MHz allocation can support (10 MHz x 0.1 bits/s/Hz/cell ÷ 13 kbps/user) 76 simultaneous voice connections. With comparable service penetration, the combination of 3G air interface technology and third-generation services necessarily results in substantially smaller cells than for the voice-oriented services of 2G systems. And smaller cells require lower EIRPs (even accounting for the elevated S/NR requirements of the high rate data services.

Also, on page 6 of its filing, Lucent suggests:

> "It would appear more efficient, therefore, to allocate paired spectrum and permit the licensee the flexibility to deploy TDD systems if they [sic] desired."

This proposal not only advantages FDD equipment vendors, but also it is biased against would-be TDD operators who would, in effect, have to bid on twice the spectrum they need for their systems. They would, then, have to find another party or another use for the half of the pair they are not using.

ArrayComm recognizes that an allocation that is totally unpaired would discriminate unfairly against FDD operators. One equitable solution, suggested by Qwest (see page 5) would be to create separate blocks of paired and unpaired spectrum with appropriate out-of-band emission limits to permit these disparate technologies to co-exist.

Siemens in its Executive Summary has offered an alternative, suggesting different bands for FDD (1710-1755 MHz/1805-1850 MHz) and TDD (2110-2150 MHz plus 2160-2165 MHz).

Motorola on page 21 offers 1780-1800 MHz for TDD with the caveat: if it can be made available.

This band would be analogous to the 1910-1930 MHz band which lies between the PCS uplink and downlink bands. This band is an unlicensed, low powered band, restricted to indoor or inplant applications.

Motorola's proposal would create another such band at 1780-1800 MHz. Surrounded again by FDD uplinks and downlinks, the band would hardly represent technical neutrality. Motorola categorizes TDD as an in-building, low powered technology and, in effect, says: "This is all TDD needs."

As ArrayComm's recent filing in Docket ET No. 00-221 amply demonstrates, this depiction of TDD is a canard, a mischaracterization. TDD deserves, and should have, parity with FDD in access to spectrum to provide 3G services.

Finally, ArrayComm would point out that whenever FDD and TDD operate on adjacent channels, guardbands will be needed.

On page 7 of its comments, Lucent states:

> "Furthermore, interference between TDD systems can also be problematic as the time synchronization required for intersystem coordination between TDD systems is complex."

Many TDD systems synchronize by having base stations synchronize with their neighbor's frame structure at boot time. GPS receivers at the base stations are also used in some systems to provide a network-wide clock. The point is that these approaches work intra- and inter-operator when all are employing an identical technology. When different TDD technologies are used, for which the frame period or intra-frame structure differ, there is greater complexity. A meaningful set of out-of-band emissions rules is coupled with cooperation among operators is the basis for a solution here. Lucent has identified a problem but it is one that is manageable.

As we stated in our comments, the Commission has embarked on a meaningful, albeit multi-faceted, proceeding to provide advance mobile communications. We believe that TDD will and should have an important role. As long as the Commission adheres to a policy of technological neutrality, we are confident that TDD will be given proper recognition.

Respectfully submitted,

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