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Statement of Dr. Irwin M. Jacobs
Chairman and Chief Executive Officer
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Good morning. My name is Irwin Jacobs. I am the Chairman and Chief Executive Officer of QUALCOMM Incorporated. I would like to thank the Commission for giving me the opportunity to participate in this panel discussion of the PCS spectrum technical issues.

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Key questions for the Commission to address in reconsidering its PCS allocation decision are the location and size of the total spectrum to be auctioned, the division of the spectrum into various size blocks, the choice of license areas, and a range of policy and economic issues. I will limit my response to common technical issues including system capacity, service quality, and standards.

As the Commission is aware, QUALCOMM has developed a complete digital PCS system allowing a single technology portable phone to deliver a variety of services equally well in large macro cells with high speed handoffs and distributed in-building microcells with dense usage and heavy frequency reuse. This system is based on QUALCOMM's pioneering work in the application of code division multiple access (CDMA) technology to the mobile communications channel. I will describe briefly QUALCOMM's CDMA system and explain the implications of the technology for the issues the Commission will be addressing in the reconsideration proceeding.

The fundamental concept of a true CDMA system is that all users of a communications channel use common spectrum at the same time, with channelization provided by the assignment of a unique code to each user. The receiver applies advanced digital signal processing techniques to separate the desired user from the others simultaneously received. The use of a common frequency by a large number of users allows all cells in a multicell system to share the same slice of spectrum. This factor alone gives a true CDMA system a capacity several times that of other multiple access methods. Other technical features of the QUALCOMM PCS system, several of which are unique to CDMA, support demonstrated capacity gains of 10 to 20 times (and more) that of existing analog cellular systems. QUALCOMM has demonstrated such capacity in the extensive testing of its PCS system that it has carried out over the past several years.

It should be noted that the existing cellular systems service perhaps 6% of the United States population, and the CDMA capacity improvement would support an increase to nearly 100%, without additional spectrum, at the current level of usage. However, with the new PCS services and the enhanced competitive environment fostered by the auction of additional spectrum, one can expect usage to go up and approach or exceed that of the wired access network.

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To support expanded use, the QUALCOMM CDMA system provides significant inherent quality advantages over other systems. The use of a single frequency in multiple cells allows "soft handoff" between cells. In a soft handoff system, an active mobile is connected to a new base station before it is released from the originating base station. This "make before break" capability expands the useful radius of a cell, reduces dropped calls and facilitates the provision of data services that are much less tolerant of errors than voice service. The QUALCOMM PCS system also features a unique RAKE receiver that mitigates the harmful effects of multipath and fading common to all mobile radio systems. Finally, the precise closed loop power control, which is required to maximize system capacity, also causes each mobile to transmit the minimum power at each instant required to provide a desired quality of service. This feature increases mobile talktime, facilitates spectrum sharing with existing spectrum users, and reduces safety and electromagnetic interference concerns. It also operates with lower radiated power from base stations, such that a limit similar to that proposed by the Commission is feasible, except that it should be modified to specify a power density scaling the effective power radiated from an antenna to signal bandwidth.

Let me now address some of the specific questions raised by Dr. Stanley. First, consider the size of the spectrum block. As noted above, QUALCOMM has demonstrated that its system provides greater than 10 times the capacity of AMPS. This means that a 20 MHz block, which is 80% of the existing 800 MHz cellular authorization, could provide more than 8 times the capacity of a current cellular system. Similarly, a 10 MHz allocation will support more than 4 times the capacity of an existing cellular system, assuming the same number of base stations and 3-sectored cells. The capacity is further increased by increasing the number of sectors and/or reducing the average vocoder rate. This, of course, assumes clear spectrum. The number of existing microwave users can severely limit the capacity in the short term. However, a new PCS licensee will not need all the capacity of its system on day one. The PCS licensee, if it offers a competitive service, will very likely be able to relocate existing microwave users as its capacity needs increase. For these reasons, I believe that a PCS licensee could use any of the proposed block sizes, 10, 20, 30, or even 40 MHz, to provide viable PCS service. The Commission therefore must look to other non-technical issues such as the appropriate number of competitors and the need to provide spectrum for designated entities to determine block size.

I also believe that any of the proposed block sizes can be used to support a highly attractive set of new digital data services to meet anticipated market demand, although a 10 MHz licensee certainly would have less flexibility in meeting market demand.

Regarding the relative usefulness of the upper and lower bands, although QUALCOMM has not yet produced equipment in the upper bands there is no technical impediment if there is sufficient demand for such equipment and therefore for quantities of the required new RF components. Our system,

which uses a 1.25 MHz bandwidth with extensions to 5 MHz, is compatible with the 10 MHz and larger allocations with appropriate constraints on energy spillage from adjacent blocks and adjacent regions. We are pursuing dual mode/dual band equipment that will operate in both the 800 MHz cellular band and one or both PCS bands. Multi-band equipment (and equipment that accommodates different separations between up and down links) does impose weight, size, and cost penalties.

As you know QUALCOMM and Loral have formed a joint venture to build and operate a big LEO satellite system known as Globalstar. The Globalstar application is one of the big LEO applications that is pending before the Commission. We have worked very hard with the other big LEO applicants to find a way to accommodate all the proposed systems in the existing RDSS allocation and we believe that when the commission grants our application, we will be able to operate a profitable business in that band. However, we also believe that as the Globalstar system goes on line and the public begins to recognize the benefits of satellite delivered mobile services, Globalstar and other mobile service providers will need additional spectrum. When the Commission made its initial PCS spectrum allocation it took 20 MHz of the spectrum that the 1992 WARC allocated for mobile satellite service at the recommendation of the United States. QUALCOMM believes that this was a mistake that the Commission should rectify on reconsideration. We believe that the public interest would be better served by eliminating or finding other spectrum for the four ten MHz blocks and reserving this valuable spectrum at this time for mobile satellite service.

I will conclude my remarks with a few observations on standards. I believe the Commission has a role to play in the standards process. It should not set standards. However, it should ensure that the equipment used to provide service conforms to an industry approved standard. It can do this by requiring as a condition for type acceptance that all mobile and base station equipment conform to a standard issued by an ANSI approved standards setting organization such as the Telecommunications Industry Association. Such an action by the Commission would allow the industry to develop multiple standards and would encourage equipment vendors to develop conforming equipment.



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Irwin Mark Jacobs

Education:

Irwin Mark Jacobs received the B.E.E. degree in 1956 from Cornell University and the M.S. and Sc.D. degree in Electrical Engineering from the Massachusetts Institute of Technology in 1957 and in 1959, respectively.

Experience:

On July 1, 1985, Dr. Jacobs became a founder and the Chairman and CEO of QUALCOMM Incorporated. He has lead QUALCOMM into international activities in mobile satellite communications and digital wireless telephony.

Previously, as Co-Founder, President, Chief Executive Officer, and Chairman, Dr. Jacobs guided the growth of LINKABIT from a few part-time employees in 1969 to over 1,4000 employees in 1985 located in San Diego, Boston, and Washington D.C. Linkabit merged with M/A-COM in August 1980.

From 1959 to 1966, Dr. Jacobs was an Assistant/Associate Professor of Electrical Engineering at Massachusetts Institute of Technology, and from 1966-1972 a Professor of Information and Computer Science at the University of California, San Diego (UCSD). He is coauthor of "Principles of Communication Engineering," 1965, the first comprehensive text book on digital communications.

He is a member of the National Academy of Engineering and a Fellow of the IEEE. In June 1992, he was awarded the Entrepreneur of the Year Award for achievement in San Diego's High Technology industry category. In 1980, he was joint recipient, with Dr. Andrew J. Viterbi, of the American Institute of Aeronautics and Astronautics (AIAA) biannual awards "for outstanding contribution to aerospace communications." In 1993, he received the American Electronics Association (AEA) "Inventing America's Future" award for his contributions to the electronic and information technology industry.

He is active in community affairs, currently serving on the Boards of the San Diego Symphony Orchestra, UCSD Green Foundation for Earth Sciences, UCSD Cancer Center, and San Diego Repertory Theater (advisory).