

A. Applicant's Qualifications

Although only 38 years old, the University of California, San Diego (UCSD) ranks tenth in the USA in the excellence of its graduate programs and the quality of its faculty, according to the most highly-regarded ranking of universities, released in 1995 by the National Research Council. In a recent objective study of academic strengths among U.S. research universities conducted by Johns Hopkins' researchers, UCSD's faculty ranked tops in the nation among public institutions in science. When the private and public science rankings are merged, UCSD is fourth in the nation behind Caltech, Stanford, and MIT. UCSD ranks third in the nation and first in the University of California system according to the amount of federal research dollars the campus spends on research and development. Last year UCSD received \$351 million in research funding. UCSD is home to the San Diego Supercomputer Center and the Scripps Institute of Oceanography.

B. Qualcomm's CDMA Cellular System

UCSD wishes to establish and operate a private experimental campuswide High Data Rate (HDR) wireless data network using Qualcomm's HDR technology and equipment. This system is discussed in detail in UCSD's Exhibit 2, which is a copy of Qualcomm's FCC Form 442 Exhibit 1.

C. The Proposed Experiment

UCSD is seeking authority to determine the feasibility of applying Qualcomm's HDR technology in a research oriented campus university environment. The radio transmitting facilities, operating in the 1850-1990 frequency band will be used to provide wireless Internet-based services to UCSD's Faculty, Staff and Students as well as researchers based at the San Diego Supercomputer Center and the Scripps Institute of Oceanography

The system will be initially deployed using one base station and up to 100 mobile stations. Operational characteristics learned from this phase will be used to plan and deploy the second phase, which may reach five base stations and 1000 mobile units. During the large-scale deployment of phase two, production mode operational processes and procedures will be developed.

D. Conclusions

Grant of this application will permit UCSD to explore thoroughly the possible application of Qualcomm's High Data Rate wireless data network technology in a research oriented campus university environment.

QUALCOMM, Inc., founded in 1985, is a rapidly growing, privately held company specializing in the design, development, manufacture, and service of advanced telecommunications systems for a wide range of consumer, government and industrial applications. QUALCOMM has its headquarters in San Diego, California, one of the fastest growing new technology areas in the United States.

A. Applicant's Qualifications

QUALCOMM is a current FCC licensee and the Commission is aware of QUALCOMM's qualifications to hold this license. QUALCOMM has been a pioneer in the area of mobile communications as well as other high technology fields. It has developed a wide range of innovative communications systems and products including fixed and mobile satellite communications systems, government telecommunications systems and services and VLSI components. QUALCOMM pioneered OmniTRACS®, the first two-way mobile satellite communications system designed for trucking, marine rail and other industries. OmniTRACS® uses hybrid spread spectrum techniques based on frequency hopping and direct sequence CDMA in one of the largest commercial applications of spread spectrum technology, to date. QUALCOMM is providing OmniTRACS® service to approximately 20,000 trucks in the United States today. The Defense Advanced Research Projects Agency (DARPA) awarded QUALCOMM a contract for the development of High Definition Television (HDTV) compression and signal processing systems.

Over the last several years QUALCOMM has developed an advanced digital cellular system using spread spectrum technology. Out of a staff of over 700 employees, QUALCOMM has over 150 employees, including over 100 engineers, directly involved with the development of Code Division Multiple Access (CDMA) technology and resulting products. QUALCOMM has committed major resources to developing CDMA as a next generation digital cellular system. It is also investigating wireless local loop and PCN applications of its technology.

B. QUALCOMM's CDMA Cellular System

QUALCOMM's CDMA has the following capabilities:

- **High Capacity:** up to 40 simultaneous calls per antenna sector in a single 1.25 MHz channel based on using a variable rate vocoder-this translates to up to 20 times the capacity of the analog AMPS system;
- **Expandable:** the system can increase capacity by using additional 1.25 MHz channels or by partitioning the system's antennas into sets;
- **High Speech Quality:** near toll quality vocoded digital voice with a consistent signal level based on tight power control, no background static, even under heavy load;
- **High Link Quality:** very resistant to multipath and interference;
- **Flexibility of Installation;** frequency reuse planning and management is highly simplified and overlapping coverage of antennas is desirable, not a problem as in other systems;
- **Mobility:** all 40 active calls can be in an area covered by a single antenna providing for pedestrian (low speed) and vehicular (high speed) communications with handoff capabilities;
- **Soft Handoff;** totally transparent handoff of calls to different coverage areas within system;
- **Interface:** simple interface to ISDN, PBX, and PSTN;
- **Digital features:** data communications, facsimile, position location, alpha numeric messaging, paging, etc.;
- **Broad range of Applications:** a common subscriber instrument can access private wireless PBXs, residential cordless and public digital cordless, PCN and cellular system;
- **Cost:** CDMA system costs, both in terms of network equipment costs and subscriber equipment costs, would provide significant cost advantages in large production volumes.

C. The Proposed Experiment

QUALCOMM is seeking authority to conduct experiments to determine the feasibility of applying the technology it has developed for digital cellular to

the proposed personal communications services (PCS) in the 1850-1990 MHz band. QUALCOMM plans to conduct its experiment in three phases.

Phase 1 QUALCOMM designed the first phase of the experiment to test the basic coverage and transmission parameters of its CDMA cellular system in the 1850-1990 MHz band. As the Commission noted in its PCS Notice of Inquiry, there is interest in Europe in using this frequency band for personal communications networks.¹ In addition, many experimental applications filed with the Commission have proposed operations at these frequencies.²

QUALCOMM is now conducting validation tests of its CDMA technology in the cellular band in San Diego. Some tests are designed to test the coverage of the QUALCOMM CDMA system. The system includes a "rake receiver" that combines the multipath signals, which are present in the mobile environment, to enhance system performance. While the ongoing tests will demonstrate the performance of the system in the cellular band, there is no similar data available in the 1800 MHz band. QUALCOMM designed its Phase 1 experiment to test coverage in areas shadowed by both natural and man made obstructions as well as in buildings and in unobstructed locations.

Besides the propagation measurements, QUALCOMM intends to demonstrate that the unique dynamic power control and soft handoff features of its CDMA system will work as well at 1800 MHz as they do at 900 MHz.

Phase 2 The Commission has received reports from the grantees of experimental licenses suggesting there are large amounts of unused spectrum in the 1850-1990 MHz band.³ However, as the Commission stated in its recent Policy Statement on PCS, "serious issues may exist for the incumbents in this band and we intend to reallocate the spectrum needed for PCS with minimum disruption to existing users."⁴ QUALCOMM believes that its CDMA technology is unique in its ability to exploit the unused spectrum in this band. As noted above, QUALCOMM's CDMA system uses a narrowband (1.25 MHz) spread spectrum signal. The QUALCOMM cellular system is

¹ *Amendment of the Commission's Rules to Establish New Personal Communications Services*, Notice of Inquiry in GEN Docket No. 90-314, 5 FCC Rcd 3995, 3995 (1990) [hereinafter *NOI*].

² According to the Commission, 56 applicants have proposed experiments in this band. FCC office of Engineering and Technology Memorandum to CCIR TG8/1 (October 24, 1991).

³ See, *American Personal Communications*, Fourth Progress Report, Station KC2XDM, FCC File No. 1447-EX-PL-90 (July 29, 1991) and Telesis Technology Laboratory, Progress Report on Experimental Licenses KF2XFD, KF2XFE, KF2XFH, KF2XFJ, and KF2XFK, all File Number 1658-EX-PL-90.(August 20, 1991).

⁴ *Amendment of the Commission's Rules to Establish New Personal Communications Services*, Policy Statement and Order, GEN Docket No. 90-314, FCC No. 91-338, (October 25, 1991).

designed to operate in any one of 20 channels in the cellular allocation. QUALCOMM intends to reconfigure its system so that it can operate on any vacant 1.25 MHz channel in the 1850-1900 MHz band. In Phase 2 of its experiment, QUALCOMM will investigate methods of locating and assigning vacant spectrum in the subject band. Once a vacant channel is located, QUALCOMM will conduct a series of validation tests similar to those it is now conducting in the cellular band. Channels with light interference can be used at reduced capacity. The pilot channels used in the CDMA system will permit channel interference evaluation. QUALCOMM believes that it can demonstrate that the system attributes listed earlier can be made available in this band using its CDMA technology. In addition, QUALCOMM intends to demonstrate that it can achieve intense frequency reuse inside buildings using its unique distributed antenna system.

Phase 3 In Phase 3 of its experiment, QUALCOMM intends to investigate how closely it can locate its CDMA cells to existing cochannel and adjacent channel users of the band. In any band sharing solution, the Commission will need to establish well defined interference criteria. QUALCOMM will conduct experiments to determine how close to an existing station it can locate a cell. It also will conduct experiments to determine how close a mobile unit can approach an existing cochannel or adjacent channel user of the band without experiencing or causing interference. This information will assist the Commission in crafting rules that will allow the maximum sharing of this valuable spectrum resource.

D. Conclusions

The public benefits of proposed PCS/PCN systems have been well documented before the Commission. Grant of this application will permit QUALCOMM to explore thoroughly the possible application of its CDMA cellular system to the emerging PCS field.