Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20544

In the matter of the Amended Application of

ORBITAL COMMUNICATIONS CORPORATION For Authority to Construct a Low-Orbit Mobile Satellite System.	))))	File No. 22-DSS-MP-90(20)

COMMENTS

1. Background

The Satellite Communications Group at Virginia Tech has been conducting research in satellite communications since 1971. The Group has received over $6 million in research contracts over a 20 year period, and is the major center for slant path propagation studies in the United States. Sponsors have included NASA (Goddard, Langley, Lewis Research Centers and Headquarters), Jet Propulsion Laboratory, DCA, Intelsat, Comsat, NSF, IBM, and the Virginia Center for Innovative Technology. The group has built earth stations to receive signals from the ATS-6, SIRIO, PBS, COMSTAR, INTELSAT V, and OLYMPUS satellites.

The Center for Commercial Space Communications was recently established within the Satellite Communications Group to conduct research on low earth orbit satellite (LEOSAT) systems and other new space communication technologies. Two earth stations for use with the UoSAT-3 satellite were built at Virginia Tech in 1990 and delivered to Volunteers in Technical Assistance for use in their demonstration LEOSAT system.

The Satellite Communications Group has been working with the Virginia Center for Innovative Technology (CIT) and Orbital Sciences Corporation for several years on the VASTAR project. This project will use the Orbcomm-X experimental satellite to test several new ideas in remote data collection and communications using LEOSATs. Specific projects include the monitoring of stress in bridges carrying roads and railroads over rivers, etc, monitoring of hazardous waste sites and dams for leakage, studies of traffic densities on rural roads, wildlife monitoring at remote locations, collection of rainfall data over mountainous catchment areas for water conservation and flood control purposes, and many other remote monitoring applications.

LEOSATs such as ORBCOMM-X are ideally suited to such applications because the earth terminals operate in the vhf band and can be procured at very low cost, typically well under $1000 each. This allows many such terminals to be placed in the field.

Comparable terminals which can communicate with geostationary satellites cost over $10,000.

The proposed ORBCOMM LEOSAT system will provide the public with many services other than remote data collection. In our view, the emergency rescue service that the commercial Orbcomm system will provide is perhaps the most valuable and cost effective. The vehicle equipment for comparable systems using geostationary satellites (GEOSAT) would cost the user twenty or thirty times as much. This is because the ORBCOMM system uses vhf band frequencies to take advantage of the lower path loss at lower frequencies, and the shorter path distance to a LEOSAT compared to a GEOSAT.

2. Comments

The Center for Commercial Space Communication at Virginia Tech urges the FCC to expedite the rule making and licensing processes so that construction of the Orbcomm system can proceed without delay. The system will provide the population of the United States, and other countries also, with communications services that are not currently available from any other provider, and which cannot be provided as effectively by any other means. These services will be available to everyone in the U.S., including rural areas which are presently poorly served by almost all other communications systems. The availability of communications with Orbcomm satellites anywhere in the world offers many possibilities for expanded foreign trade and the earning of valuable export dollars.

The system proposed by Orbcomm for a messaging service to and from mobiles is highly innovative and extremely cost effective. Although cellular telephones can provide similar services, they can do so only in those areas served by cellular base stations - primarily urban and suburban areas. Most of the land mass of the United State will never be served by terrestrial cellular telephone. The cost of the user equipment for the Orbcomm system is much lower than for cellular telephone, and the user fees for service are also much lower. While a minority of automobiles will be equipped with cellular telephones, there is good reason to believe that every automobile will eventually be equipped with an Orbcomm terminal.

The capability of Orbcomm's system to summon rescue services to the precise location of a stranded vehicle, or other emergency situations, is unique among proposed mobile communication systems. The potential for saving of life, reduction of crime, and benefit to users makes this aspect alone sufficient justification for the FCC to issue a license for the Orbcomm system.

The benefits of the Orbcomm mobile system can only be achieved if the terminal cost is low and can share the broadcast antenna already fitted to automobiles. The system must operate

in the vhf bands for this to be possible. That means that frequencies must be allocated in the vhf band for Orbcomm's services.

The Satellite Communications Group at Virginia Tech has undertaken research studies of many satellite communications systems over the years. These have included analysis of VSAT systems using geostationary satellites, position location systems using GEO and LEO satellites, communications links using GEO and LEO satellites and modulation and coding analyses for various satellite links. We have investigated spread spectrum systems for overlaying data on television transmissions via satellite, and direct sequence and frequency hopping CDMA for VSAT systems. We have also studied Orbcomm's proposals for demand assignment of uplink channels at vhf for the Orbcomm system.

In our view, the use of overlaid CDMA on satellite links poses a number of serious problems, especially when the processing gain is not high (<30 dB). The potential for interference is considerable, and although CDMA works well for the CDMA users, it poses an interference threat to the services it overlays. CDMA is, in effect, a form of electromagnetic pollution, since it spreads energy all over the spectrum. When several users transmit at the same time, pollution levels can rise considerably. For example, if processing gain is 20 dB and ten stations transmit at the same time, the effective interference level for every similar allocated channel is -10 dB. Under these conditions 100 primary users could be affected.

By comparison, Orbcomm's proposed demand assignment scheme allocates unused portions of the spectrum to uplinks as needed. If fewer slots are available at any instant than users requesting uplinks, the system can make some users wait until the channels are available. This ensures that interference with other users of the band will never occur - a major advantage over CDMA with low processing gain. Orbcomm's concept of their messaging service is that many users will possess the equipment but, at any given time, a small number will be actively transmitting. This is an efficient way to use the spectrum, since a large community of users can be served by a small number of channels in a restricted RF bandwidth.

The system proposed by Orbcomm has an excellent combination of low user equipment cost, flexible system performance for messaging services, and minimal impact on other users of the vhf spectrum. It will be easy to integrate the RF equipment into automobile radios to greatly enhance the utility of the communications equipment of the automobile.

3. Conclusion

Virginia Tech endorses Orbcomm's amended application for authority to construct a low orbit mobile satellite system. The system will provide a valuable service to drivers of automobiles and other vehicles which is currently not available. LEOSATs

offer the best way to implement messaging and rescue services for vehicles, at much lower cost than systems using GEOSATs.

The Orbcomm system must operate at vhf to be compatible with existing auto radios and antennas. We urge the FCC to license Orbcomm's system in the vhf band, as requested. The system should use demand assignment FDMA to achieve maximum spectral utilization with minimal interference for a large population of users.