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ORIGINAL

January 23, 1997

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**VIA HAND DELIVERY**

William F. Caton, Acting Secretary
Federal Communications Commission
Experimental Licensing Branch
2000 M Street, NW
Suite 230, MS 1300E1
Washington, D.C. 20554

Re: Spike Technologies, Inc.
Experimental Station WA2XCV
Nashua, New Hampshire
**Progress Report**

Dear Mr. Caton:

Submitted herewith on behalf of Spike Technologies, Inc. ("Spike"), licensee of the above-captioned experimental facility, is an original and one copy the station's 6-month progress report pursuant to Section 5.204(a) of the Commission's Rules.

As the attached report demonstrates, Spike has utilized the first six months of its experimental license to conduct a variety of tests which address important technical and service-oriented issues. These tests have shed considerable light on the feasibility and limitations of two-way digital communications systems using MDS channels, and have contributed significantly to the refinement of Spike's proprietary equipment.

Please contact undersigned counsel if there are any questions.

Very truly yours,

E. Lawrence Zolt

cc: H. Franklin Wright, OET

Enclosures
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FAX

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| Pages: | 7 |
| Re: | Spike progress report |

Ed - please call me at 972 758 7325 with any comments. I can modify and refax. Thanks

# Progress Report

## Introduction

Spike Technologies is a microwave equipment provider with technical facilities in Nashua, New Hampshire. Spike's technical strengths include a proprietary sectored antenna system that creates a multitude of narrow, individually-focused beams, resulting in greatly increased capacity through frequency reuse, two-way capabilities, and the ability to reduce interference to and from the system by positioning the beams accordingly.

In late 1995, Spike began developing equipment for bi-directional delivery of digital services such as Internet, data connectivity, videoconferencing and telephony over MMDS channels. These services will enable the wireless cable operator to more effectively compete against the traditional cable operator.

In July 1996 Spike was granted an experimental license to test its systems using MMDS spectrum in the vicinity of the Company's Nashua, New Hampshire technical facility. The license specifies that Spike is required to submit semi-annual reports of its progress to the Commission. This is the first of such reports, and contains details of Spike's accomplishments to date in both technical and market development issues.

## System Basics

Spike's communications system consists of a PRISM Base Station, which contains proprietary sectored smart antenna technology, and numerous user stations in locations that have line-of-sight with the base station. In Nashua, the base station contains a 20 sector antenna system and a transceiver for each sector. Users use mesh parabolic antennas and similar transceivers. Modulation is of the packet-based digital variety, allowing multiple users within a sector to establish two-way communications with the base station. Our current configuration provides peak data rates of 10 Mbps within a given sector, using a single 6 MHz channel pair. Although we currently have the capability to provide much higher degrees of sectoring, and higher data rates, the purpose of this initiative is to tackle system-level issues, which are quite challenging, and the current configuration provides an aggregate data rate of 400 Mbps using only one channel pair. This is clearly a quantum leap in microwave communications systems.

## Progress to Date

### *Technical Issues*

Initial tests were done with prototype transceivers containing limited diagnostic capabilities, and were therefore suitable for only small-scale deployment. We have explored issues such as:

## Serving multiple users within a single beam

We were successful at connecting multiple users in a single beam. Our multiple-access technology was able to conduct orderly packet-based data transmission, even though all the users in the beam were operating at the same frequency. This told us that our vision of serving a very large number of users from a single base station is realistic. We identified certain limitations of our multiple-access configuration, but were unable to quantify these limitations exactly without a larger-scale evaluation.

## Maximum loading within a single beam

Using full-motion packet-based digital videoconferencing signals, we loaded a single beam to capacity. We were able to reliably transfer enough separate, simultaneous video signals through the same beam to establish the feasibility of heavily loading a single sector. We were quite satisfied with the system's ability to support high-bit-rate video under such loading, suggesting that our aspirations of providing large-scale videoconferencing are realistic. We have begun providing the local government with vidoeconferencing, but need to add a larger number of users to effectively model a true videoconferencing community. It is not within our focus to deliver broadcast TV programming because we emphasize two-way communications over MMDS spectrum.

## Isolation among sectors

We needed to know that users can communicate with the base station on one beam while many other users do the same on other beams. We were concerned that interference among sectors might be a problem, since each sector uses the same spectrum. We knew of no other deployable antenna systems to date that could provide this type of isolation. We were quite pleased that our proprietary antenna technology performed well, providing more than adequate isolation among sectors, making the highly-sectored concept a reality. We plan to test these isolation parameters with a more densely sectored antenna system as our system evolves.

## ENVIRONMENTAL CONCERNS

As with any new technology that is deployed outdoors, we were concerned about the impact of weather on our antenna system and our transceivers. We examined the effects of heavy rain, wind, snow and ice, and have made certain adjustments to our transceiver and antenna designs. Foliage is a major concern for all MMDS applications. We began testing during the summer of 1996, when foliage was present, but the early tests consisted mostly of short-range transmissions. Longer-range tests began during the late fall of 1996, after the leaves had fallen. All of our user stations are currently within a six mile radius. We plan to extend our reach to thirty miles but may require higher power levels. The 30 mile goal will enable us to study the effects of wooded hills and valleys, as well as to examine the effects of precipitation over larger distances.

## Transceiver performance criteria

We needed to know how robust our transceivers must be to successfully serve the user. We learned that our frequency stability, power output and consumption, and linearity were all acceptable, but we determined that additional diagnostic capabilities would be needed for the next generation of transceiver design. Also, frequency agility and dynamic power level compensation were important features for the next round of testing, to properly assess loading issues. Overall, we learned that we could design transceivers that are cost-effective enough to market to large numbers of users, while delivering the performance necessary for a successful system deployment.

## Multiple Dwelling Units and Office Buildings

Many potential users are located in multiple-dwelling units (MDUs) or office buildings. It is not feasible to mount rooftop equipment for each user in this scenario, so user stations must be capable of serving multiple users within a building. This brings up numerous data connectivity issues, such as security, bandwidth limitations and wiring topologies. We learned that our user stations can serve multiple users in a building, and that security should be more than adequate. We still need to learn more about the burst data rate requirements versus the average data rate requirements for these users, and this can only be determined through a larger-scale real-world test.

## Modem Issues

Our base stations and user stations contain RF modems that have certain performance limitations. We needed to determine how they would perform with our transceivers and antenna systems, and to what degree we could increase the data rates and under what circumstances. Also, we needed to determine if there were tradeoffs between modem data rates and the degree of sectoring. We learned that our 10 Mbps modems (using QPSK modulation) performed easily in our signal environment, and that faster modems (using QAM modulation) should also work in this scenario.

Currently, bidirectional modems using QAM are only available as prototypes. Full availability of some models is projected for Q2 of 1997. Pricing and robustness issues for QAM modems are unclear so we have been evaluating the tradeoffs of using QPSK modems in a highly sectored system design. We have found that a tremendous increase in system capacity can be achieved using this approach versus using QAM in a system with less sectors. We are anxious to deploy QAM solutions, but are also concerned about robustness in harsh signal environments. Clearly, QAM is much more sensitive to noise and interference the QPSK.

We expect to incorporate QAM prototype modems into our Nashua System during February and March, and during April and May to install CDMA-based modems. We plan to examine the effects of using different modulation schemes in different sectors, hoping to assess the potential of hybrid modems that can switch among modulation schemes to adapt to the signal environment.

## User Antenna Design

It was important to design a user antenna that would be environmentally pleasing while delivering adequate performance. We tested several designs, and decided to settle on two types, each for a different situation. We are currently using a mesh parabolic antenna, as well as a flat panel antenna for some applications. During our ongoing market development, we will gather statistical data on the reliability of each user antenna design.

## Headend Digital Traffic Issues

Our base station must be capable of routing large amounts of data from many sectors. We need to know what configuration of LAN switches and routers will accomplish this. We were able to simulate a variety of traffic patterns in our lab, allowing us to arrive at a tentative base station digital layout. However, without larger-scale testing, we will not know the real-life traffic patterns that these systems will need to manage. Depending on the user mix (individual, corporate, schools, government), a variety of traffic patterns could occur. We will need to test under a number of different conditions to assess the feasibility of different designs under different conditions.

## Channel Sizes for Upstream and Downstream

There is a divergence of opinions in the MMDS industry as to whether symmetrical or asymmetrical usage of upstream/downstream bandwidth is better. Generally proponents of the asymmetrical approach tell of Internet traffic that is mostly downstream, consisting of very little upstream traffic, mainly mouse clicks and brief text entries. On the other hand, symmetrical proponents say that a true digital networking solution needs to have equal upstream capacity to enable users to upload data destined for other users. Based on the demand in Nashua, we lean more toward the symmetrical model. But we acknowledge that in some cases downstream may be more heavily loaded than upstream. For this reason, we think that dynamic allocation of channel sizes for upstream and downstream would be an attractive feature. Presently we are not aware of the availability of any such equipment, but would look forward to its manufacture.

## *APPLICATIONS*

Our technology is ideal for some digital applications, but others may overly burden the system. Within a given sector, the bandwidth of a single channel pair is shared among all users of that channel pair within the sector. When the channel is idle, a user has access to the entire 10 Mbps ("burst rate"), but when multiple users are transferring data at the same time, the bandwidth is shared among those users, resulting in a lower average data rate. Thus, the ideal user for this system is one who wants a high burst rate but does not transfer large volumes of data continuously. Each application has its own traffic usage patterns, and must be examined for suitability.

Certain types of data transfer typically load the system more than others. Performing data backups are common on computer networks, and are usually performed at night. These backups involve copying the entire contents of a file server to a remote location where it can be archived. We believe that our system is ideal for nightly backups, because other data traffic slows late at night. But companies who need to back up data during the day are not target users because they may load the system too heavily during peak hours. Although considerable effort can go into identifying users with ideal traffic patterns, there are other measures that can be taken to help avoid saturating sectors.

As part of our market development, we are examining the use of pricing strategies to encourage users to save large data transfers for off-peak hours. But pricing strategies must be accompanied by some type of active control on bandwidth usage. With ATM and other technologies, bandwidth allocation can be very flexible, making it possible to enforce certain traffic restrictions so that unruly users do not saturate the system. These technologies allow the operator to control the bandwidth available to each user at a given time, and to accurately monitor the amount of data transferred and the rate at which it is transferred. ATM and other technologies also enable the billing functionality to support a broad array of marketing strategies. We have also begun evaluating solutions that can give us this functionality.

## *SERVICES*

Digital services provided by the Nashua System fall into three general categories. Broadband Internet access, WAN connectivity and Videoconferencing all have their own traffic issues. The following table lists typical data transfer actions according to desirability for our system:

### High burst data rate/ low continuous average data rate

The following data transfer operations benefit from high burst data rates and exhibit low continuous average loads, so therefore are extremely desirable for our technology:

**Transaction processing:**

Credit card verification
ATM machine transactions
General account inquiries and transfers
File transfers (except for multiple files in large blocks)
World Wide Web page access
E-mail
Electronic Meter Reading

### Medium continuous average data rate

Applications that require medium continuous average data rates are desirable if they can be regulated to avoid overloading. These include:

Digital audio data (Telephony and Internet audio broadcasting)
Videoconferencing with compressed video data

Stock market, news and similar data feeds

**High continuous average data rate**

Generally, applications that require large amounts of data to be transferred continuously are less desirable for our system because they are "bandwidth hogs," using bandwidth that would otherwise be available to others. They include:

Data Storage Backup
Broadcast-Quality Video Transmission

## *Discussion*

### Transaction Processing

Businesses, schools, municipalities and non-profit institutions all have data transactions that are conducted from within their local area networks (LANs). In order to connect these LANs to distant computer systems, data lines are usually leased from the local telephone company. These data lines are very expensive and are often out of reach of many users. While some users can substitute standard telephone lines equipped with computer modems, many transactions require higher speed lines. But the irony is that although higher speed lines make the transactions occur more quickly, these lines often sit idle waiting for the next transaction. In this case the most desirable communications technology would transfer the data quickly but would make the unused bandwidth available to the other users. This is the nature of Spike's communications technology. For this reason, we are anxious to conduct market development using users with transactional processing requirements. We have entered into a preliminary agreement with the YMCA to provide wireless data services to their branch offices in our area. The alternative for them would be to lease T-1 lines from the phone company, but this is too expensive for them. We believe our technology will be more affordable, and hope to confirm this through our market test.

### File Transfers

In addition to transactional processing, many users need to transfer files among their branch offices. Presently, leased lines are used, but they operate more slowly than LANs. Ideally, users could interconnect their LANs using links that operate as quickly as the LANs themselves. Spike's wireless links operate at 10 Mbps, which is exactly the speed of traditional Ethernet LANs. For this reason, users can perform data transfers across the city with the same performance as if they were operating within the same building. Occasional file transfers do not place undue demands on the system, so adequate bandwidth is left for other users. Spike Technologies has begun testing with the City of Nashua, whereby City Hall is connected to other buildings within the city for LAN connectivity. The Mayor of Nashua has been very supportive of these efforts to upgrade the city's communications technology.

### World Wide Web Page Access

Internet users often experience long delays while downloading pages from the World Wide Web. This has been a major impediment to growth of the Internet, and is primarily due to the limited bandwidth of the telephone connections that are the primary means of connecting to the Internet. High-speed data lines can help reduce these delays but are also very expensive. Internet traffic is typically very bursty, benefiting from short bursts of data, but overall not requiring high continuous average data rates. Spike's technology is ideal for Internet access, and we have obtained a backbone connection to the Internet from MCI so that we may connect others to the Net with high speed links. We have entered into an agreement with Cyber Joe's Café in Nashua whereby they will be a participant in our market test. The café has six PCs that are available for use by customers. These users can browse the Web while enjoying a cup of coffee. Our wireless link connects the café to our base station, and thus to the Internet. Cyber Joe's opens for business on January 28, 1997.

## Videoconferencing

Businesses and schools have a variety of needs that can be solved by videoconferencing technology. Schools can conduct classes with participants in multiple locations, and businesses can save on travel expense by conducting meetings in a similar manner. Also, video can be added to telephone calls for the "face-to-face" aspect of the conversation. However growth in videoconferencing has been hindered by the expense of high-speed data lines. Our technology makes possible affordable videoconferencing, because all users are connected to our network operations center (NOC), and they can automatically arrange conferences on the fly. Also, videoconferencing hardware can usually operate at a variety of data rates, making it possible to adapt to different data traffic patterns. Spike Technologies has entered into an agreement with the Nashua District Court and several police stations to conduct video arraignment of suspects without having to transport them to the court. This saves money on travel and police overtime, and reduces the chance of escapes during the process.

## Data Storage Backup

Most LANs must have their storage archived on a daily basis. This usually involves copying the data onto magnetic tape late at night when activity is low. Ideally, businesses and municipalities would like to conduct their nightly backups from a single location automatically. As part of its market test, Spike Technologies is offering data warehousing services, whereby users' LANs are automatically archived through Spike's wireless links. Spike will maintain a data vault that protects this valuable data, relieving the users of this common data processing headache.

## *Conclusion*

We believe that our technology can revolutionize the use of MMDS spectrum. Clearly, our technical accomplishments have been most satisfying, and the initial indications of our market test are encouraging, but a lot remains to be done. We will continue to advance the nature of our test, and will update the Commission as is appropriate. We would like to thank the Commission for the opportunity to perform these tests. If any Commission member has questions, please feel free to contact Spike's President, Douglas Carey at (212) 924-5000.