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SCANNED



Date: Aug. 16, 1999

Experimental Licensing Branch
Federal Communications Commission
445 12th St SW
Washington, D.C. 20554

Re: Progress Report On Lucent Technologies Use of Experimental License WA2XQM
For April 14, 1998 to August 16, 1999

To FCC Reviewer(s):

Attached is the first progress report on Lucent Technologies' use of Experimental License WA2XQM (File No. 5937-EX-PL-97) issued on April 14, 1998 and expiring on April 1, 2000.

Due to an oversight on Lucent's part, the previous two, 6 month interval, reports that should have been provided to the FCC in October, 1998 and April, 1999 in order to comply with Special Condition 3 listed on our license were not generated. In a telephone conversation with Doug Young of the FCC OET on August 13, 1999, when the above oversight was noted by Lucent, he indicated that Lucent should submit a progress report covering the April, 1998 to the present time period as soon as possible to be in compliance with the stated special conditions. This report is being submitted to comply with that directive.

Any questions concerning this report should be forwarded to:

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Yours Truly,


Joseph W. Knapp

Attachment: Progress Report for WA2XQM
Experimental License -
April 14, 1998 to August 16, 1999



Lucent Technologies
Bell Labs Innovations

Date: Aug. 16, 1999

Progress Report On Lucent Technologies Use of Experimental License WA2XQM During April 14, 1998 to August 16, 1999 Time Period

Introduction

Testing to date has essentially followed the test plan outlined in the "Overview of Experimentation and Description of Products to Be Tested" document that was filed as Attachment 1 with our request for the above license. However, it is important to note that since filing for that license, Lucent has created a Wireless Broadband Networks Division (WBND) which is headquartered in Milpitas California and is now responsible for overseeing all of the experimentation associated with wireless products operating in the millimeter wave bands associated with the above FCC license. The N. Andover, Massachusetts broadband wireless group, which initiated the original license request and did most of the testing to date, is now a part of that division but is still located in N. Andover.

With the creation of the WBND, a second test bed for evaluating millimeter wave radio products was initiated at the Milpitas location. That test bed, which in the future will become the primary test bed, is now fully operational. As a result, some of the Over-The-Air (OTA) and on-bench testing goals described in the above Attachment 1 and originally scheduled to be done at the N. Andover site were rescheduled for the Milpitas site. For OTA testing at that site, Milpitas will operate under the "Nationwide Area of Operation" umbrella authorized by our WA2XQM license for all testing on systems using the covered frequency bands. The test bed at N. Andover is still in use, and will continue to be used in the foreseeable future to support the Milpitas WBND Integration and Test group.

As stated in Lucent's license request, the primary goal of the experimentation to be done under this license was to perform the evaluations necessary to enable a selection of one or more non-Lucent or OEM supplied millimeter wave band Point-To-Multipoint (PMP) and Point-To-Point (PTP) radio products for inclusion in its overall broadband wireless product portfolio. In accord with this goal, limited OTA testing of PMP and more extensive on-bench testing of both PMP and PTP systems from multiple suppliers was done at the N. Andover site during time period under consideration. Testing at the Milpitas site has been, to date, limited to OTA and on-bench testing of multiple versions of a PMP product from a single supplier and has been performed under the OEM supplier's experimental license since it operates at 26 GHz and is therefore not covered by our existing license.

Since all PTP testing at N. Andover has, to date, been done on a bench test basis using waveguide simulated air paths, no OTA testing of PTP product has been done. Therefore, this report does not address any of the results of the PTP testing. It should be noted, however, that some of the PTP products tested involve the same frequency bands used by the PMP products and were evaluated for potential use in hub-to-hub trunking and/or providing extremely broadband service to selected customers in PMP networks. Extensive on-bench testing of the PMP products evaluated was also done during this time interval and, unless they had an impact on the OTA testing, are not reported on here. Similarly, the 26 GHz testing done at Milpitas will not be covered since it was done under a different license. This report is dedicated solely to describing the evaluation progress made via the OTA experimentation performed on the OEM based PMP products at the N. Andover test site for the period from April 14, 1998 to the present.

Products Tested

During the stated time period, PMP radio systems from several suppliers were tested and evaluated on an OTA basis at the N. Andover test bed site. Most of the products tested were either in the prototype or pre-release/ limited availability category and included PMP radio systems operating in the 24, 26 and 38 GHz frequency bands. The 24 and 38 GHz systems were operated under our assigned WA2XQM experimental license. The 26 GHz system, which was simply an updated version of an initial 24 GHz system from the same supplier¹, was done under an STA furnished by the supplier of the initial 24 GHz PMP product. For that reason, the results obtained with that 26 GHz version have been used in generating this report.

Two basic types of PMP systems were, or are, currently being evaluated at the N. Andover test site. These two system types included:

Type 1 – 24GHz (completed) and 38 GHz (ongoing) systems using:

- sectorized and broadcast TDM type transmission in the HUB to End User (EU) or downstream direction
- narrow beam, point-to-point, multiple frequency (different frequency for each EU) FDMA type of transmission in the upstream (EU to HUB) direction
- 4, 16 and 64 QAM modulation formats
- asymmetric downstream/upstream over-the-air CBR type data at rates capable of delivering one or more T1 rate payloads to the individual EUs

¹ Development of the 24 GHz version of this supplier's product was shifted to 26GHz because of increased market demand. As a result of the need for design changes in the product and some of the problems encountered during the testing of the initial 24 GHz version, an upgraded version operating at 26 GHz was substituted in the N. Andover test bed in order to expedite Lucent's evaluation testing. Since this supplier is using a "platform" approach where all their PMP radio products would essentially be identical except for the RF frequency used, the substitution of the 26 GHz version did not jeopardize our evaluation relative to the intended 24, 28/31 and 38 GHz products. An STA license provided by the supplier was used for the OTA testing in this case, since Lucent's license did not include the 26 GHz frequency.

Type 2 – 24/26¹GHz (completed) systems using:

- sectorized and broadcast TDM type of transmission in the (HUB to EU) or downstream direction
- narrow beam, point-to-point, single frequency (one frequency for multiple EUs) TDMA type transmission in the EU to HUB or upstream direction.
- 4QAM modulation format
- symmetric downstream/upstream over-the-air packetized, ATM type data at rates capable of delivering up to 4 structured or unstructured T1/E1 rate signals, plus a 10 BaseT Ethernet signal to the individual EUs.

N. Andover, MA. OTA Test Configuration

For the OTA PMP system testing at N.Andover, a cell consisting of a two-sector antenna Node or HUB site which had line of sight paths to up to 3 remote End User (EU) antenna sites was used. The HUB and all of the EU antenna sites were located on the roofs of buildings within Lucent's property boundaries. The air path lengths between the HUB and EU sites ranged from 760 to 1110 feet. Testing to determine the impact of the longer more typical paths on performance and functionality was to be transferred to Milpitas test bed.

At the EU locations, the outdoor antenna mounting structures, were designed to accommodate single or multiple antennas and thus allow for the connection and simulation of more EUs communicating with the HUB. As was typical of all of the PMP products evaluated at N. Andover, the PMP radio system equipment consisted of an outdoor radio transmitter/receiver/antenna unit (ODU) which was connected via single or multiple transmission and control to an indoor unit (IDU) at both the HUB and EU sites. The IDU at the HUB site provides for the network interface and the IDU at the EU sites provides the customer access interface ports. Various voice, video and data based digital signals provided via test sets were used at both the HUB and EU sites to simulate the payload signals. Where packetized data was involved, ATM switches working off of T1/E1 data sets provided the necessary ATM based network side interfaces to the PMP HUB equipment and at EU T1/E1 interfaces. Loopbacks were also used at EU sites to reduce the number of data sets necessary to drive the upstream direction. At the HUB indoor site, the network side of the HUB was connected to various Lucent network products to evaluate interoperability.

Summary of Results and Discoveries During Testing on N. Andover Test Bed

During the course of testing these PMP products, multiple problems related to performance, administrative and interoperability functionality were discovered with each of the products tested. Problems stemming from such issues as:

- network timing,
- payload signal jitter
- network interoperability
- transmission delay due to signal processing,
- recovery time following signal interruptions due to propagation events and other signal interruptions,
- adjacent channel interference,
- erroneous alarm and status reporting,
- set-up and operating software anomalies,
- outage induced by the accumulation of wet snow on antenna radomes,
- maintainability and trouble shooting diagnostics

as well as other interoperability and operational problems were encountered and normally addressed with the supplier as they occurred during the testing of these early release products.

Except for some quick experiments showing how significant outages due to the accumulation of wet snow on antenna radomes can and do occur, no formal data recording or testing was done at the N. Andover test bed to study and validate the expected impact of rain attenuation on radio system outage during this time period. Such a study would have required the planned expansion of the cell size beyond the Lucent properties and thus was put on hold when the decision was made to implement a more typical test cell at the primary Milpitas site. There was also some indications that reflections off of parked and/or moving cars in the parking lot or possibly nearby buildings over and near which some of the paths at the N. Andover sight passed could also pose problems under some conditions. Testing techniques and/or analysis to validate how serious these snow accumulation and reflection effects might be are now under consideration.

The ensuing Lucent/supplier interactions stimulated by the discovery of these problems during testing helped to generate an understanding of how to better design and deploy such PMP product, for both Lucent and the several vendors involved. In many cases, suppliers provided "fixes" while their equipment was still in the Lucent test bed or delivered new, upgraded, equipment during the test interval covered by this report for additional testing after they made corrective changes. This ongoing, interactive type of cooperation with potential suppliers continues to benefit all parties involved and should help to create better broadband wireless PMP products.

At present the N. Andover evaluation group is testing a newer version of one of its potential supplier's 38 GHz Type 1 products and is in the process of selecting other OEM supplier's PMP products of similar and different types to test. Testing on the current 26 GHz Type 2 product at N. Andover has terminated since the completion of this evaluation is to be done at the Milpitas site. Expansion of the the N. Andover test bed cell to include more typical EU sites beyond its current Lucent property boundaries is also under consideration to provide more flexibility in the degree of testing support it can provide to the Milpitas Integration and Test Group.

Overview of Milpitas, CA. Test Plan and Test Site

As noted above, all testing at the Milpitas, CA. site has, up to this point, been done on a product from a single supplier. The product selected was a Type 2 PMP system as defined above. As noted in the earlier footnote, only a 26 GHz version of this product was available at the time the Milpitas site became available. As a result, a test bed based on that 26 GHz version was set up and, as pointed out, testing was started under the supplier's experimental license, since our license did not cover operation at 26 GHz. Testing at Milpitas is continuing on that basis but products at the frequencies covered by our license will soon be available and, except for RF frequency, will be identical to the 26 GHz version from a feature and function point of view. Since the 26 GHz product version tested at the Milpitas test bed has been, up to this point, identical to the one that was evaluated at N. Andover, no significant results beyond those already noted are available at this time. That system is currently being upgraded however and should reflect the improvements necessary to eliminate the problems discovered during the N. Andover tests. A future progress report will report on whether or not that is the case.

At this point it is significant to note the improvements in the test bed that are included in the Milpitas site for these future evaluations since they are indicative of Lucent's commitment to perform the degree of testing that will guarantee a successful evaluation and use of these new and evolving PMP radio products.

Milpitas Test Configuration

For wireless PMP product testing at Milpitas, a more typical cell consisting of a three-sector antenna Node or HUB site with 5 remote, EU antenna sites has been established. These HUB and EU antenna sites are located on buildings in the Milpitas area. Each EU antenna site, is equipped with multiple antennas (2 to 4) to allow for the use of more frequencies in a sector as well as the simulation of more EUs. A total of 16 EUs are currently equipped within the cell. The configuration of the sectors, the deployment of EUs within the sectors, and the frequency reuse scheme used are such that the typical situation of EUs with some overlapping coverage from adjacent sectors as well as typical adjacent channel and co-channel interference situations have been included. The 5 EU antenna sites, which were distributed throughout the 3 sectors, were located on line-of-site paths ranging from 0.8 miles to 5.9 miles in length and thus involved path lengths that are typical for the typical system availability objectives in this rain rate region. As in the case of the N. Andover test bed, the HUB has been connected to Lucent network equipment to permit interoperability testing

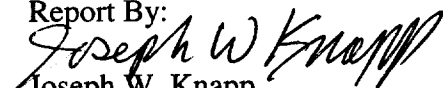
When the PMP product under test at Milpitas is upgraded, it will be possible to do a more comprehensive evaluation of that product. It will also make it possible to validate the expected impact of rain attenuation on system availability. As noted earlier, the N. Andover test site may also be expanded in cell size and complexity to assist with these more comprehensive evaluations.

Impact of Experimental Testing to Date

Based on the results that Lucent was able to achieve by having this experimental license, the following items beneficial to the art of wireless transmission at the millimeter wave frequencies have or are evolving:

- Lucent has announced it's OnDemand broadband wireless PMP access radio product which will soon be available for application in the 28/31 GHz (LMDS) and 37/39 GHz band in the US as well as at the international frequencies which are applicable (10, 26, and 42GHz for example). The 10 and 26 GHz International/ETSI based versions of this OnDemand product are available now.
- Lucent is in the process of running and deploying PMP field trials of it's OnDemand product with multiple service providers all over the world. The results of these field trials will further enhance the art of using these frequencies for broadband wireless access systems.
- Techniques for evaluating the performance of such PMP radio systems have been and are being created.
- Techniques for successfully deploying such PMP radio systems in voice and data networks have been and are being generated.
- Techniques for the successful deployment of broadband PMP radio systems capable of transmitting multimedia type voice, video and data are beginning to evolve.
- An appreciation for the cost effective applications for such PMP radio systems is evolving.

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