Xytrans, Inc.
Orlando, FL
407-345-8008
www.xytrans.com

| CREATED BY: Gavin Clark | DATE: 02DEC04 | CHECKER: | DATE: | **XYTRANS, INC.** | ORLANDO, FL 407-345-8008 www.xytrans.com |
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# Table of Contents

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## 1. Introduction

Xytrans intends to perform roof-top testing of its Out Door Units (ODU's) at its Orlando, Florida, facility to gather information regarding the ODU performance when exposed to typical climatic conditions for extended periods. The FCC requires the issuance of an Experimental Radio Service License (see FCC Form 442) prior to commencement of such testing. This document provides detail of the proposed testing as part of that application. Xytrans currently plans to test its 15 GHz, 18 GHz, and 23 GHz point-to-point ODU's with each radio outputting 1W or less power and mounted to commercially available antennas. These directional antennas will be mounted on the roof-top of Xytrans' existing facility.

## 2. Physical description of testing

Each test setup will consist of 2 ODU's mounted individually on commercially available, directional, antennas. The current plan calls for 2 ft diameter antennas, mounted to commercially available, 3"-4" diameter aluminum poles on mounting platforms installed per local codes for roof-top equipment. These antenna/ODU systems will be mounted on the roof-top of Xytrans' existing facility and aimed towards each other. Their placement will vary, but will be approximately on opposite sides of the roof-top. All antennas will be installed such that they transmit/receive in the horizontal direction (i.e. transmit/receive direction is parallel to roof-top). The antenna width of beam at the half power point is as follows: 15 GHz = 2.4°, 18 GHz = 1.9°, 23 GHz = 1.6°. Cabling will be routed through an access port in the rooftop and into a lab for attachment to various test equipment per local code. See **Figure 1** for a sketch of a typical setup.

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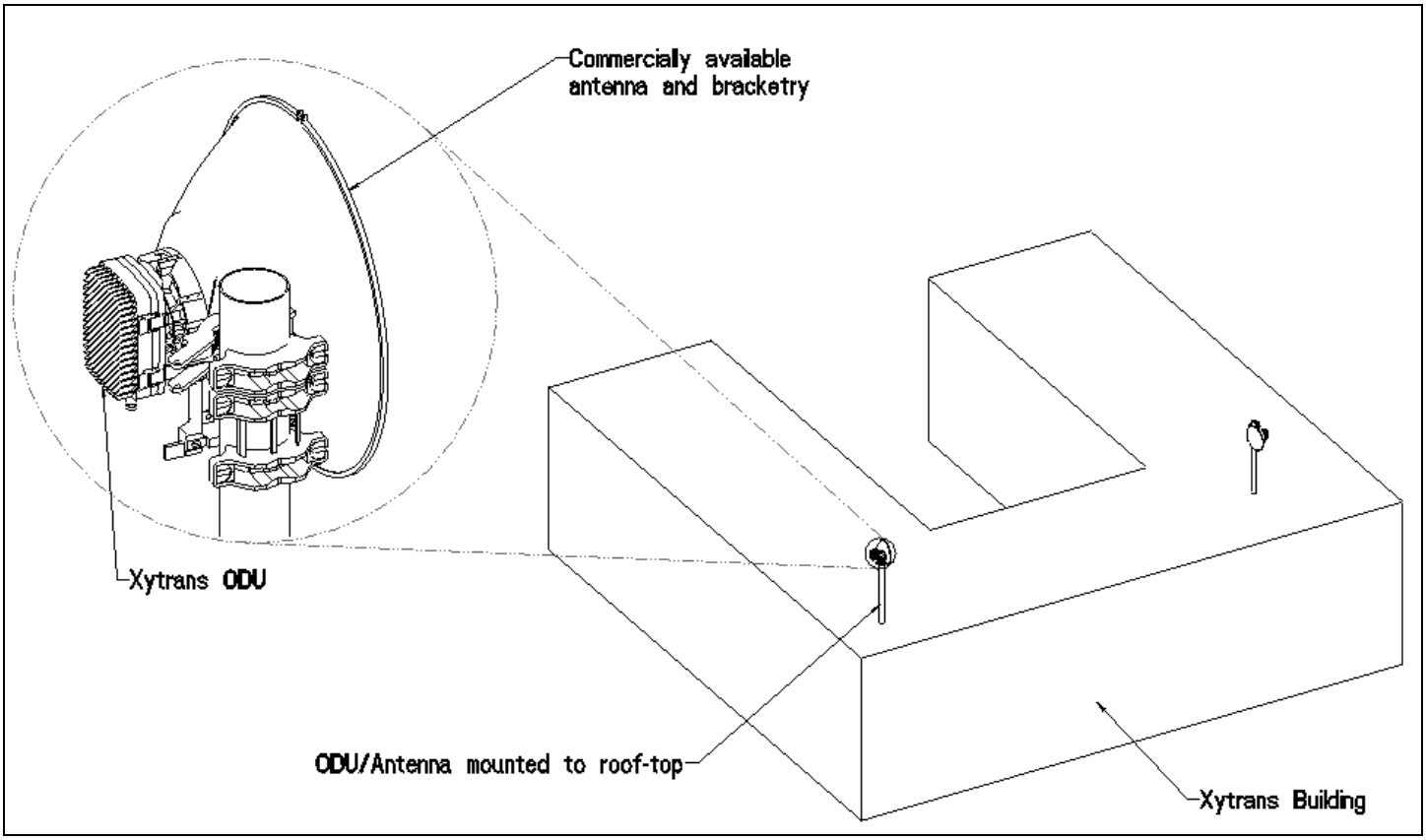


Figure 1. Typical Roof-top installation (not to scale).

### 3. Electrical/performance description of testing

Xytrans' program consists of creating point-to-point microwave links in order to evaluate the performance of its commercial radios in realistic outdoor environments. Currently, Xytrans does laboratory qualification within its facility to verify that the equipment it manufactures meets internal, customer, and regulatory requirements prior to shipping products. While the company is able to simulate many real-life conditions, this approach does not provide insight into radio performance when the units are connected to feeder equipment, antenna equipment, and subjected to weather and other physical conditions that will be common when deployed. In addition, many new modem technologies are being developed that are relatively new to wireless communications systems at very high frequencies that will benefit from a comprehensive evaluation program.

The Xytrans unit, commonly referred to in industry parlance as an outdoor unit, or ODU, performs as follows. On the indoor side of the ODU input, it receives a modulated RF signal carrying information encoded digitally.

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For test purposes, it is likely to be carrying a known sequence of encoded digital information for purposes of diagnostic testing. The ODU then converts this signal from the UHF band, typically 350 MHz, to a much higher frequency. This frequency is transmitted at the ODU output. The frequencies, as well as the output signal itself, will be chosen to be in compliance with regulatory guidelines for the relevant licensed bands in the region. Table-1 shows the frequencies which may be tested at the Xytrans facility. Within the ODU itself, the process consists of frequency mixing, amplification, and spectrum filtering. The design implements multiple stages of each based on performance requirements. The ODU also generates its own oscillator frequencies that create the output digital carrier necessary.

**Table-1. Frequency Bands to be Tested**

| Frequency Band Designation (GHz) | Actual Frequency Range (GHz) |
|---|---|
| 15 | 14.4 – 15.4 |
| 18 | 17.7 – 19.7 |
| 23 | 21.2 – 23.6 |

The ODU also has an outside facing input to perform the complementary receive function. In this case, the high frequency input is converted to a lower frequency output in the UHF band, where it is delivered to data processing equipment. This processing equipment acts as diagnostic equipment to understand the performance of the ODU and its impacts on digital modulated signals sent across point to point radio links. The topology and functions in the ODU on the receive side looks very similar to the transmit side – frequency mixing, amplification, and filtering.

## 4. Objectives

The objectives sought by Xytrans are to thoroughly understand the performance of its microwave radios in environments that represent realistic use, and to observe how this performance changes over time and conditions. The objectives sought are common to ODU suppliers throughout the industry. There has been rapid evolution of system approaches and equipment mix in actual systems, and there is still important information to

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be gleaned about radio performance by creating the most realistic test systems possible. This includes, but is not limited to:

- Robustness of housing weatherproofing
- Heat dissipation capability
- Integrity of RF transmitted data link
- Long-term reliability
- Integrity of data-stream between ODU and lab-based electronics via cabling
- Microphonic monitoring
- Phase hit monitoring
- Modulation scheme verification

It is anticipated that there will be continual, long-term, testing of the Xytrans ODU product line to ensure that our products meet the performance specifications expected by our customers. This will require us to sample ODU's from our production line, mount them on the roof-top test antennas, and monitor various aspects of their operation over extended periods of time.

**5. Contributions to radio technology**

The cellular infrastructure industry is evolving rapidly in backhaul radio technology. Important new developments in digital communications are rapidly maturing and being deployed, such as high order Quadrature Amplitude Modulations (QAM), Trellis-Coded modulation (TCM), Reed-Solomon and turbo coding, fast equalization, and interference mitigation. Each of these tools allows operators to make the most efficient use of licensed bandwidth, increasing the total system capacity and ultimately providing for more bandwidth per end user, which is both consumers and businesses.

However, there is only limited history with the advanced technologies in microwave radio applications, where modulation formats and real-time processing sophistication were kept relatively simple due to the complexity of the channel. The challenges of the radio channel historically have resulted in a need to pursue simple system designs to ensure robustness. With the advances in RF integration, mixed signal application specific integrated

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circuit (ASIC) design, very large scale integration (VLSI), and digital signal processing (DSP), allowing practical implementation of new technologies, many of these constraints have been lifted.

In parallel to the technology developments worthy of investigation, the industry is moving towards a new business approach that involves system components from multiple suppliers. The result is a need to specify individual components to create the complete system. This process is evolving between manufacturers and system suppliers. There is an ongoing effort to understand the implications of this new approach to system development and the impact of the new technologies available in RF and digital communications. Xytrans is part of this evolution, and this system testing is part of these important investigations. It will lead to the proper subsystem specifications for microwave radios. It will enable developing accurate requirements for the ODUs, and represent important new parameters to guide radio designers in general who are interested in supporting robust advanced digital communications.

## 6. Conclusion

As stated earlier, the objectives sought by Xytrans are to thoroughly understand the performance of its microwave radios in environments that represent realistic use, and to observe how this performance changes over time and exposure to environmental conditions. We anticipate testing our ODU's on a continual basis as part of our product development cycle and to ensure that our customers are receiving radio devices which are compliant will all applicable regulations. Part of this testing will consist of ODU's operating on our rooftop. Some units will be setup for long-term testing (i.e. several months) and others will only be operational for a few hours to verify performance. This paper has discussed the test setup and objectives as part of Xytrans' application to the FCC for an Experimental License under FCC Form 442.

The technical point of contact for this activity is:

Gavin Clark
Mechanical Engineering Manager
Xytrans, Inc. *(FRN 0011-8204-46)*
5422 Carrier Dr. Suite 201
Orlando, FL 32819
407-345-8057 ph
gavin@xytrans.com