**ORBCOMM Application Note #12**

**Date: 1/25/2006**
**Subject: Test Setup & Performance of ORBCOMM Antennas**

## Summary

The purpose of this note is to describe the test set up used to generate ORBCOMM performance data for specific antennas and provide test results. From this data, one can determine whether the antenna under test meets the requirements of a given application.

## Discussion

The ORBCOMM System is a world-wide, two-way, data communications system. There are two basic data structures that are used to send data from the Subscriber Communicator to the back office. These are REPORTs and MESSAGEs. The difference between the two is the size of the data that can be transmitted in each structure. REPORTs can carry up to 6 bytes of user data while MESSAGEs can carry up to several thousand bytes of data.

The signals transmitted from the satellite to the Subscriber Communicator contain a synchronization segment that occurs every second.

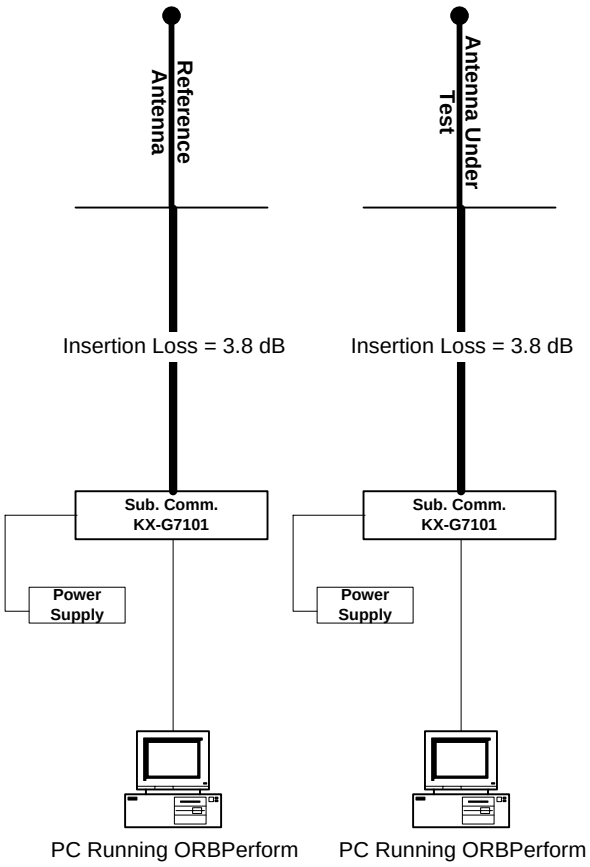
REPORTs, MESSAGEs and synchronization segments allow one to characterize the performance of an antenna. That is, one could say that the antenna under test was able to send x messages per hour. From this data, one can determine the latency associated with each antenna type.

ORBCOMM latency is measured from the time that the REPORT or MESSAGE is generated until the time the data is delivered to the Internet. This time would include the innate latency of the network, satellite acquisition, retransmission of data due to interference or packets received with errors, and the time to get a positive acknowledgement indicating the message was received by the ORBCOMM System.

## Setup

The following is a block diagram of the test set up used. The Reference antenna is a Cushcraft ½ wave whip antenna tuned to 144 MHz. The reference and test antennas are normally tested under a 4' x 4' ground plane. Some antennas are specifically designed to operate without a ground plane and are tested in this mode. The antenna under test is compared to the ½ wave whip antenna running at the same time and at the same location.

Panasonic KX-G7101 communicators are used for testing. The test software used is called ORBPerform and is available to customers and antenna manufacturers. The software is set up to recognize and process debug information from the Panasonic communicator; this is important to note when running the Sync Segment or downlink portion of the test. REPORT and MESSAGE Tests can be run with any communicator that is ORBCOMM Serial Interface Specification compliant.



## Performance/Test Results

The test set is run for approximately 3 days. This duration allows the antennas to 'see' approximately 90% of all look angles to the satellites for a given location. This duration also allows a good data pool to be generated from which statistically meaningful observations can be drawn.

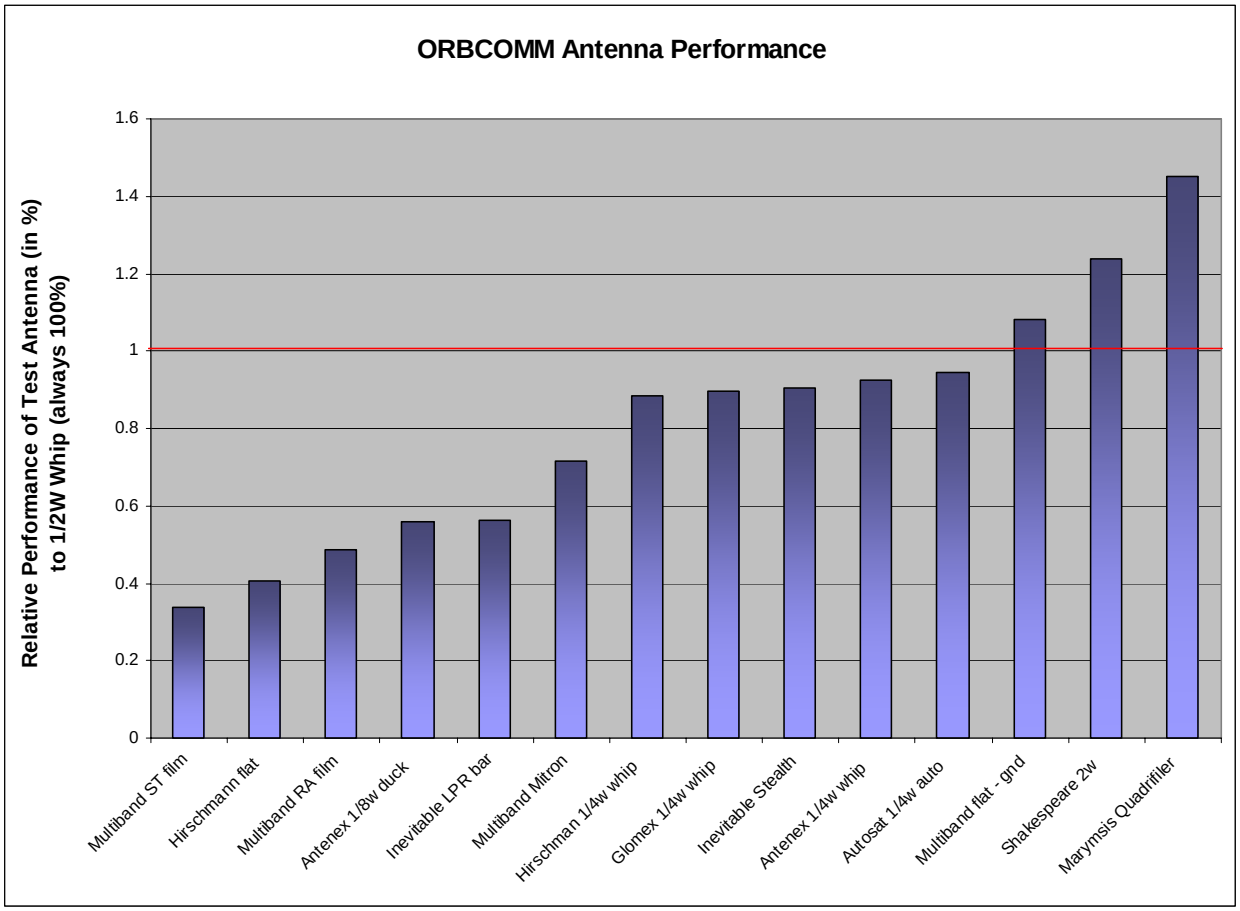
The results are provided as:

- number of reports/hour(Normalized)
- number of messages/hour(Normalized)
- number of synchronization segments per hour

These are done for both the reference antenna and the antenna under test. The variations in satellite constellation configuration are therefore factored out when the results are normalized to the ½ wave whip antenna. For example:

> The whip antenna system sends 100 reports per hour and the antenna under test sends 45. So the normalized result = (100 – 45)/100 or .45.

See the figure below for test results of some antennas tested with this method.



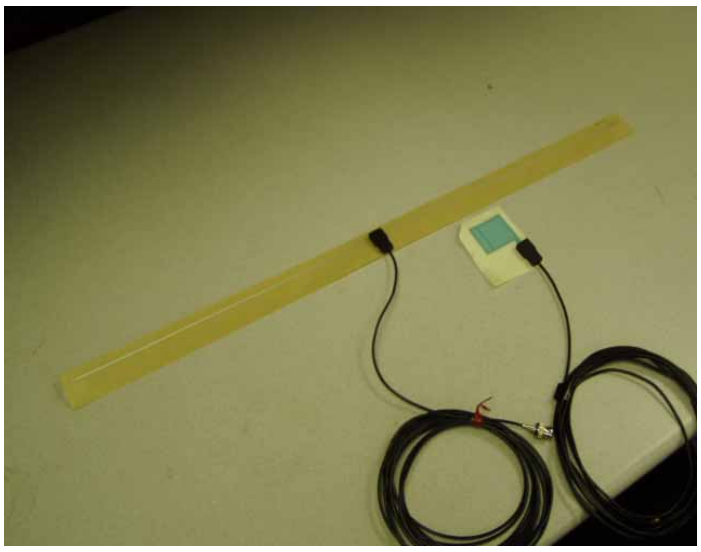
An antenna that performs better than a the reference antenna would have a normalized value greater that 1.00. Extensive testing has shown a close correlation between the synchronization segment statistics and REPORTs and MESSAGEs statistics. The synchronization segment and message tests are not run for every antenna.

## Antenna Specifcations

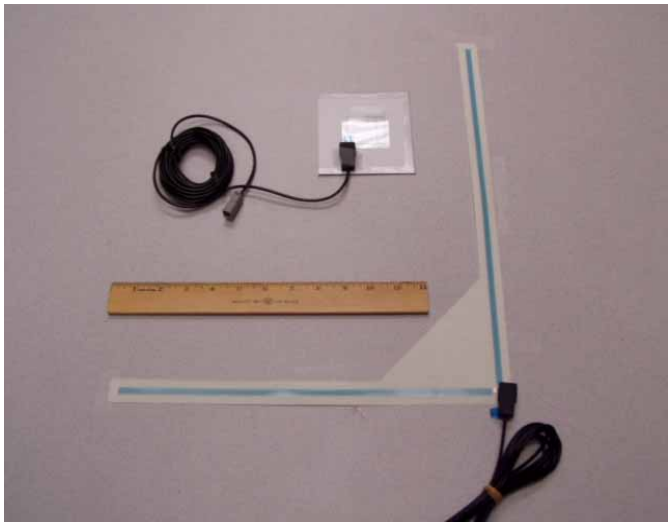
| ANTENNA | | | |
|---|---|---|---|
| **Name** | Rugged Bar | | |
| **Manufacturer** | Multiband Antennas | | |
| **Model #** | LPR2 | | |
| **Dimensions** | 21” x 3.25” x 2” (533mm x 83mm x 50mm) | | |
| **Retail Price** | $100 | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 57 | Reference Antenna Avg.: | 101 |
| **Messages/Hour** | 14.4 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Injected with closed cell foam which prevents water penetrating the radome should it become cracked. The antenna will meet or exceed J1455 requirements. GPS antenna included in radome. | | |
| **Applications** | Typically used for container, trailer, and heavy equipment industries. Typical installation is on the leading edge of a trailer with the long side parallel with the ground. It can also be mounted on the roof of a container/trailer. | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Glomex ¼ Wave | | |
| **Manufacturer** | Glomex | | |
| **Model #** | ¼ Wave | | |
| **Dimensions** | 20” H | | |
| **Retail Price** | Contact Vendor | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 56.4 | Reference Antenna Avg.: | 63 |
| **Messages/Hour (135 Byte)** | 25.6 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Weatherproof Fiberglass | | |
| **Applications** | Boats, Fixed sites | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Straight Film | | |
| **Manufacturer** | Multiband (Harada) | | |
| **Model #** | Straight Film | | |
| **Dimensions** | 30” L x .1” W x .05” H | | |
| **Retail Price** | $30 | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Automotive Glass | | |
| **Reports/Hour** | 25.9 | Reference Antenna Avg.: | 76.9 |
| **Messages/Hour (135 Byte)** | 11.8 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Thin film metalized antenna. GPS film antenna also available. Needs to be 2” away from any metal. Can be mounted on fiberglass with proper tuning. | | |
| **Applications** | Cars, Trucks, Fiberglass Boats | | |

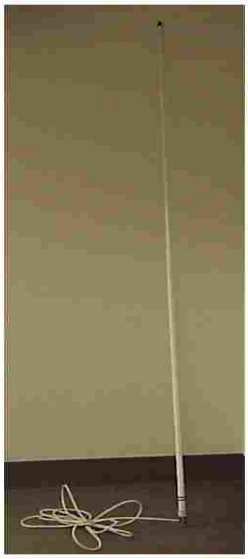


| ANTENNA | | | | |
|---|---|---|---|---|
| **Name** | Right Angle Film | | | |
| **Manufacturer** | Multiband (Harada) | | | |
| **Model #** | Right Angle Film | | | |
| **Dimensions** | 15” L(per leg) x .1” W x .05” H | | | |
| **Retail Price** | $30 | | | |
| **PERFORMANCE** | | | | |
| **Test Installation** | On Automotive Glass | | | |
| **Reports/Hour** | 42.6 | Reference Antenna Avg.: | 87.6 | |
| **Messages/Hour (135 Byte)** | 12.6 | Reference Antenna Avg.: | 30.5 | |
| **Syncs/Hour** | Not Tested | | | |
| **Comments** | Thin film metalized antenna. GPS film antenna also available. Needs to be 2” away from any metal. Can be mounted on fiberglass with proper tuning. | | | |
| **Applications** | Cars, Trucks, Fiberglass Boats | | | |



| ANTENNA | | | |
|---|---|---|---|
| **Name** | AutoSat ¼ Wave | | |
| **Manufacturer** | AutoSat | | |
| **Model #** | ¼ Wave | | |
| **Dimensions** | 19” H | | |
| **Retail Price** | Contact Vendor | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 78.1 | Reference Antenna Avg.: | 82.7 |
| **Messages/Hour (135 Byte)** | 15.1 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Flexible ¼ Wave, 45 degree mounting | | |
| **Applications** | Cars, Trucks | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Shakespeare Pole | | |
| **Manufacturer** | Shakespeare | | |
| **Model #** | 5225X | | |
| **Dimensions** | 6.5’ H | | |
| **Retail Price** | Contact Vendor | | |
| **PERFORMANCE** | | | |
| **Test Installation** | Without Ground | | |
| **Reports/Hour** | 109.5 | Reference Antenna Avg.: | 88.5 |
| **Messages/Hour (135 Byte)** | 38.3 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Fiberglass construction. Saltwater protected. | | |
| **Applications** | Boats, Fixed sites | | |



| ANTENNA | | | |
|---|---|---|---|
| **Name** | Shakespeare 5/8 Wave | | |
| **Manufacturer** | Shakespeare | | |
| **Model #** | 5/8 Wave Fiberglass | | |
| **Dimensions** | 4’ H | | |
| **Retail Price** | Contact Vendor | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 36.8 | Reference Antenna Avg.: | 77.9 |
| **Messages/Hour (135 Byte)** | 16.1 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Fiberglass construction. Saltwater Proof. | | |
| **Applications** | Boats, Fixed sites | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Antennex ¼ Wave Whip | | |
| **Manufacturer** | Antennex | | |
| **Model #** | 1/4 Wave | | |
| **Dimensions** | 18” H | | |
| **Retail Price** | Contact Vendor | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 91.7 | Reference Antenna Avg.: | 99.1 |
| **Messages/Hour (135 Byte)** | 30.7 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Stainless steel whip, not flexible, spring at base. GPS antenna in base. | | |
| **Applications** | Cars, Trucks, Fixed sites | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Quadrifiler | | |
| **Manufacturer** | Marimsys | | |
| **Model #** | Quadrifiler | | |
| **Dimensions** | 36” H x 12” D | | |
| **Retail Price** | $100 | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 131.5 | Reference Antenna Avg.: | 90.7 |
| **Messages/Hour (135 Byte)** | 45.7 | Reference Antenna Avg.: | 30.5 |
| **Syncs/Hour** | Not Tested | | |
| **Comments** | Polarized, Enameled copper. Saltwater proof. GPS antenna can be mounted at the top. | | |
| **Applications** | Boats. Fixed Sites. | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Flat Panel | | |
| **Manufacturer** | Multiband Antennas | | |
| **Model #** | Flat Panel | | |
| **Dimensions** | 12” x 12” x .75” | | |
| **Retail Price** | | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 45.7 | Reference Antenna Avg.: | 42.2 |
| **Messages/Hour (135 Byte)** | | Reference Antenna Avg.: | |
| **Syncs/Hour** | | | |
| **Comments** | | | |
| **Applications** | | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | 1/8 Wave Duck | | |
| **Manufacturer** | Antenex | | |
| **Model #** | 1/8 Wave Duck | | |
| **Dimensions** | 8” H | | |
| **Retail Price** | | | |
| **PERFORMANCE** | | | |
| **Test Installation** | | | |
| **Reports/Hour** | 57 | Reference Antenna Avg.: | 101.9 |
| **Messages/Hour (135 Byte)** | | Reference Antenna Avg.: | |
| **Syncs/Hour** | | | |
| **Comments** | | | |
| **Applications** | | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Stealth | | |
| **Manufacturer** | Inevitable Technologies | | |
| **Model #** | | | |
| **Dimensions** | 24” x 2” x .75” | | |
| **Retail Price** | | | |
| **PERFORMANCE** | | | |
| **Test Installation** | No Ground Plane | | |
| **Reports/Hour** | 45.2 | Reference Antenna Avg.: | 50.2 |
| **Messages/Hour (135 Byte)** | | Reference Antenna Avg.: | |
| **Syncs/Hour** | | | |
| **Comments** | | | |
| **Applications** | | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | ½ Wave Helical | | |
| **Manufacturer** | Multiband Antennas | | |
| **Model #** | Mitron II | | |
| **Dimensions** | | | |
| **Retail Price** | | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 43 | Reference Antenna Avg.: | 60 |
| **Messages/Hour (135 Byte)** | | Reference Antenna Avg.: | |
| **Syncs/Hour** | | | |
| **Comments** | | | |
| **Applications** | | | |

| ANTENNA | | | |
|---|---|---|---|
| **Name** | Flat Panel | | |
| **Manufacturer** | Hirschman | | |
| **Model #** | Flat Panel | | |
| **Dimensions** | | | |
| **Retail Price** | | | |
| **PERFORMANCE** | | | |
| **Test Installation** | On Ground Plane | | |
| **Reports/Hour** | 30 | Reference Antenna Avg.: | 73.6 |
| **Messages/Hour (135 Byte)** | | Reference Antenna Avg.: | |
| **Syncs/Hour** | | | |
| **Comments** | | | |
| **Applications** | | | |