

FROST & SULLIVAN'S
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SATELLITE
TELEPHONE QUALITY
OF SERVICE
COMPARISON

A Frost & Sullivan White Paper

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IRIDIUM AND GLOBALSTAR: A LEO SATELLITE TELEPHONE QUALITY OF SERVICE COMPARISON

Introduction

Frost & Sullivan's satellite and telecommunications practice has now completed its second LEO Satellite Telephone Quality of Service Comparison. Results from this evaluation found that calls through the Iridium system are nearly three times more likely to be successfully connected and completed, without being dropped, than calls placed through the Globalstar network.

In today's post-Katrina world, the demand for highly mobile and reliable communications solutions help place MSS providers in the top rank of suppliers for areas with limited or disrupted infrastructure. In 2005, revenues from the handheld MSS market totaled approximately \$669.4 million, with revenues forecast to reach \$1.9 billion by 2012. Military operations in the Middle East, disaster recovery, and first-responder solutions, along with steady demand from the traditional MSS sectors such as maritime, oil and gas, and construction have all been contributing to the sector's double-digit growth.

Nevertheless, with a growing market comes greater competition, and with that, increasing demand for a reliable and high-quality service. Frost conducted its first LEO Satellite Telephone Quality of Service Comparison in July of 2002 and because the MSS market has experienced strong growth since that time it now seems appropriate to revisit the subject.

In addition, there has been a growing diversity of LEO MSS services, however, voice service remains a vital aspect of its value proposition. As a result, Frost & Sullivan has revisited the issue of LEO MSS voice service quality. This project is intended to provide an independent, third party comparison of both Iridium and Globalstar's quality of service (QoS) and provide baseline information for potential satellite users and providers.

Scope of the Evaluation

There are many relevant metrics that might be used to measure the QoS of satellite communications services depending on the intended application. For this test, Frost & Sullivan has chosen the most basic measure of QoS: voice call completion and termination. Other possible metrics are discussed in the Conclusions and Future Testing Recommendations section at the conclusion of this white paper. This test did not attempt to determine the quality of data service or any other possible application beyond basic voice service.

Two types of satellite phones were used in these tests. The first, and most important, was a fixed unit (one each, Iridium and Globalstar), supplemented by an Iridium and Globalstar handheld unit. Each fixed unit was operated for 24 hours successively from the same

location. In addition to the auto-dialer tests, 25 calls were attempted on a handheld unit from each location with each satellite service in order to validate the auto-dialer findings.

Iridium’s call success rate was measured to be 98.1 percent in Northern California and 94.7 percent in Central Texas. This is compared to Globalstar whose call success rate was 36.2 percent in Northern California and 31.8 percent in Central Texas. Call success was defined as a call connection on first attempt and avoidance of being dropped for a period of three minutes.

Figure 1, below, describes the various fixed and handheld units used throughout the evaluation.

Figure 1

Overview of Mobile Handsets and Fixed Units Used in Testing

<u>Iridium</u>	<u>Globalstar</u>
Mobile Handset Model:	Mobile Handset Model:
<i>Iridium 9505A</i>	<i>Qualcomm GSP-1700</i>
Handset Software Version:	Handset Software Version:
<i>ISO5004</i>	<i>WDC: R7.1.0.4.1</i>
Fixed Unit Model:	Fixed Unit Model:
<i>CTX 1147M</i>	<i>Qualcomm GSP-2400</i>
Fixed Unit Software Version:	Fixed Unit Software Version:
	<i>REV:A 603 10-81390-18</i>

Source: Frost & Sullivan

Data Collection

In total, over 1,500 phone calls were made with Iridium and Globalstar fixed and handheld units at two geographically dispersed test sites, one in Central Texas and another in Northern California. In order to assure comparable results between services, tests at each site were conducted from exactly the same locations, under similar environmental conditions. Test sites in each location were chosen in order to minimize obstructions, 15 degrees above the horizon, and to avoid interference from external signal sources such as industrial parks, airports, etc.

The auto-dialer equipped fixed units were run continuously for a period of 24 hours to ensure that a full cycle of the constellation was witnessed. In total, the Frost & Sullivan testing team conducted 96 hours of auto-dialer testing (24 hours each, Iridium and Globalstar, in two geographically diverse locations). With three-minute calls and a one-minute buffer between calls (to allow the equipment to recycle after call termination) this resulted in approximately 359 calls per 24-hour period.

For the purposes of this test, successful calls were considered to be those in which the satellite phones connected with the satellite, the call went through to the intended recipient and remained connected for a period of three minutes. Calls that did not connect were considered failures, while calls that connected but were not maintained for the requisite three minutes were described as dropped. The key metrics that were recorded for all voice calls were as follows:

- Attempt number
- Call completion (did the call connect after dialing)
- Call drop (does the call terminate unexpectedly before the 3 minute set time limit)
- Call duration (in minutes and seconds)

Each auto-dialer test was validated by a series of 25 calls made on the corresponding handset. Unlike the auto-dialer calls, in which attempts did not require the acquisition of a satellite signal, the handset attempts were only made after acquiring a satellite signal (although in some cases this signal was lost before the call was completed). Although 25 handset calls are not, in and of themselves, sufficient to judge QoS, they served to validate the larger patterns seen in the auto-dialer results. It should be noted that results are not fully comparable between test sites due to the impossibility of perfectly replicating test conditions.

TEST RESULTS

Northern California

Figures 2 and 3, shown below, display the data collected in Northern California using the Iridium Fixed Unit.

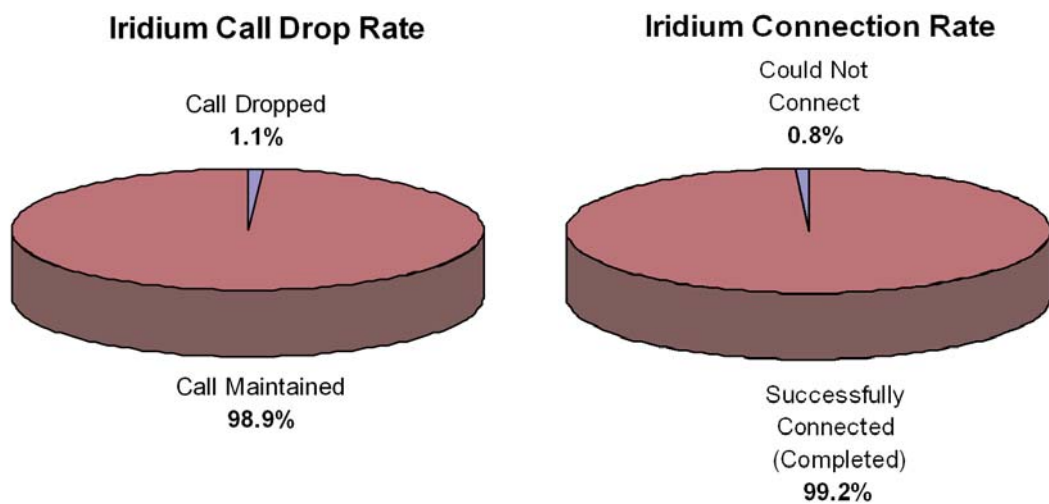
Figure 2

Iridium Fixed Unit (with Autodialer) Results – N. California	Value	(%)
Number of Calls Attempted:	359	N/A
Number of Calls Successfully Connected (Completed):	356	99.2
Number of Attempted Calls Not Connected (Completed):	3	0.8
Number of Connected Calls that Drop Prior to 3 Minutes:	4	1.1*
Number of Connected Calls that Maintain for 3 Minutes:	352	98.9*
Total Number of Successful Calls (Connected and Lasted 3 Mins):	352	98.1

*Percentage of connected calls not total calls attempted

Source: Frost & Sullivan

Figure 3: Comparison of Iridium Call Drop and Call Connection Data for N. California



Source: Frost & Sullivan

Figures 4 and 5, shown below, display the data collected in Northern California using the Globalstar Fixed Unit.

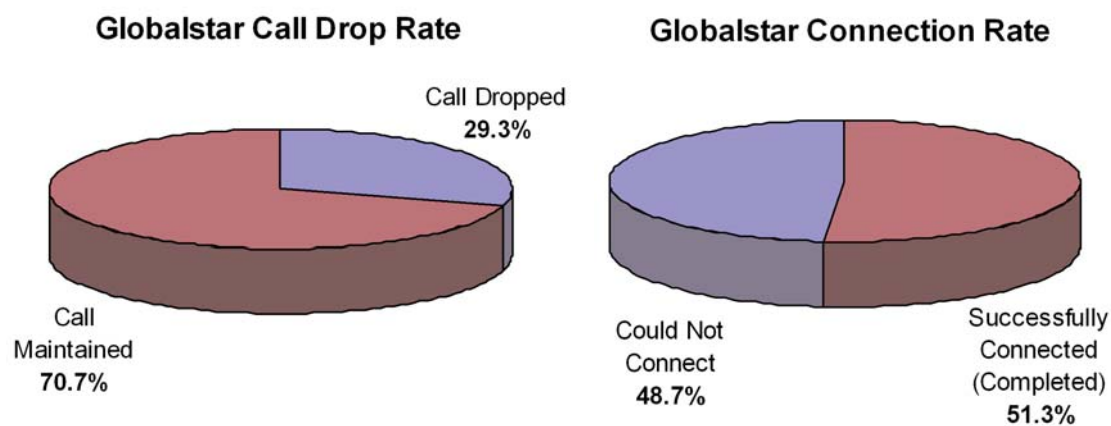
Figure 4

Globalstar Fixed Unit (with Autodialer) Results – N. California	Value	(%)
Number of Calls Attempted:	359	N/A
Number of Calls Successfully Connected (Completed):	184	51.3
Number of Attempted Calls Not Connected (Completed):	175	48.7
Number of Connected Calls that Drop Prior to 3 Minutes:	54	29.3*
Number of Connected Calls that Maintain for 3 Minutes:	130	70.7*
Total Number of Successful Calls (Connected and Lasted 3 Mins):	130	36.2

*Percentage of connected calls not total calls attempted

Source: Frost & Sullivan

Figure 5: Comparison of Globalstar Call Drop and Call Connection Data for N. California



Source: Frost & Sullivan

Central Texas

Figures 6 and 7, shown below, display the data collected in Central Texas using the Iridium Fixed Unit.

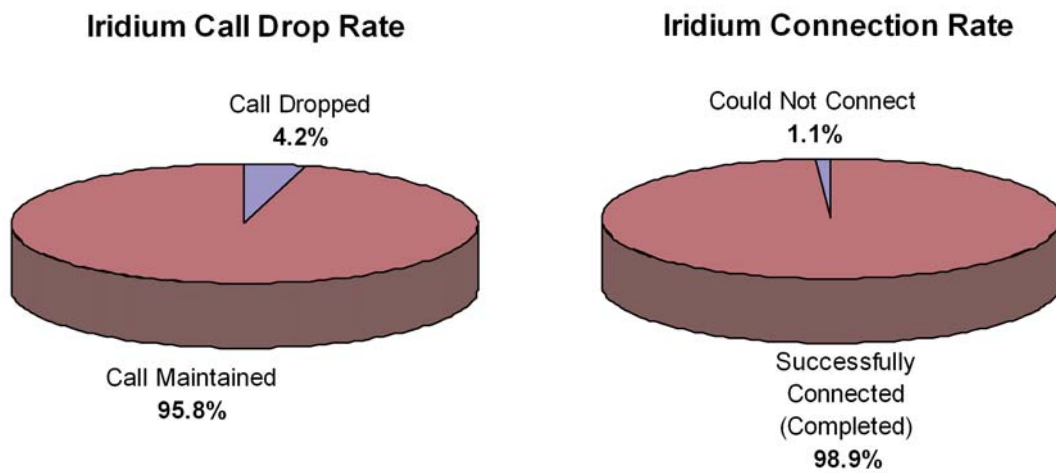
Figure 6

Iridium Fixed Unit (with Autodialer) Results – Central Texas	Value	(%)
Number of Calls Attempted:	359	N/A
Number of Calls Successfully Connected (Completed):	355	98.9
Number of Attempted Calls Not Connected (Completed):	4	1.1
Number of Connected Calls that Drop Prior to 3 Minutes:	15	4.2*
Number of Connected Calls that Maintain for 3 Minutes:	340	95.8*
Total Number of Successful Calls (Connected and Lasted 3 Mins):	340	94.7

*Percentage of connected calls not total calls attempted

Source: Frost & Sullivan

Figure 7: Comparison of Iridium Call Drop and Call Connection Data for Central Texas



Source: Frost & Sullivan

Figures 8 and 9, shown below, display the data collected in Central Texas using the Globalstar Fixed Unit.

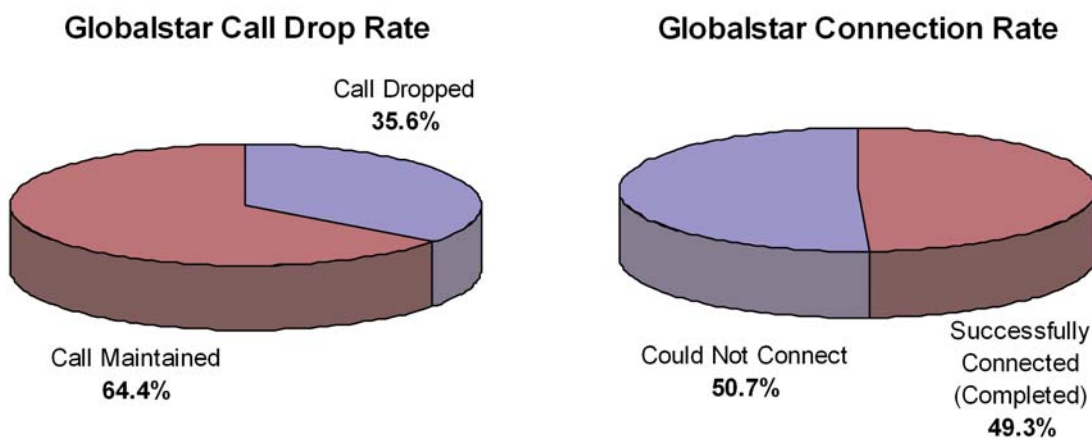
Figure 8

Globalstar Fixed Unit (with Autodialer) Results – Central Texas	Value	(%)
Number of Calls Attempted:	359	N/A
Number of Calls Successfully Connected (Completed):	177	49.3
Number of Attempted Calls Not Connected (Completed):	182	50.7
Number of Connected Calls that Drop Prior to 3 Minutes:	63	35.6*
Number of Connected Calls that Maintain for 3 Minutes:	114	64.4*
Total Number of Successful Calls (Connected and Lasted 3 Mins):	114	31.8

*Percentage of connected calls not total calls attempted

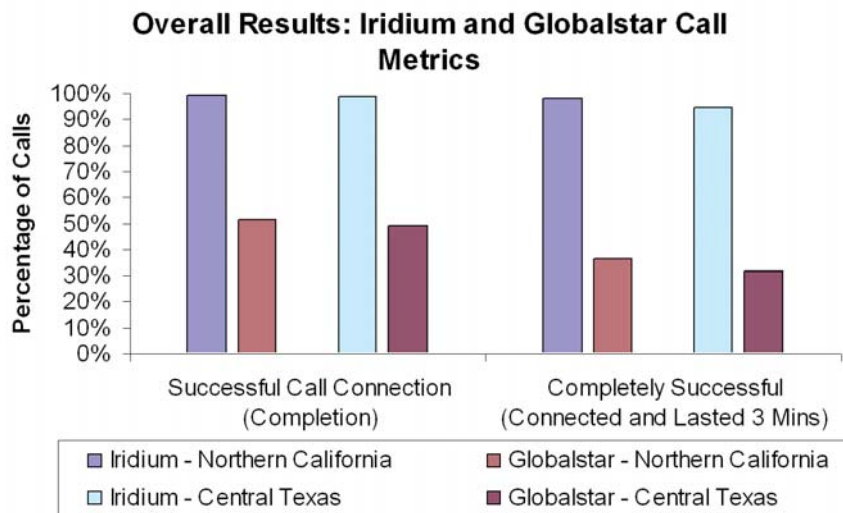
Source: Frost & Sullivan

Figure 9: Comparison of Globalstar Call Drop and Call Connection Data for Central Texas



Source: Frost & Sullivan

Figure 10: Overall Results: Iridium and Globalstar Call Metrics



Source: Frost & Sullivan

CONCLUSIONS AND FUTURE TESTING RECOMMENDATIONS

Frost & Sullivan’s testing shows that the quality of satellite telephone service has improved in the period since Frost’s 2002 quality assessment. In 2002 the percentage of Globalstar calls that connected and did not drop throughout the call (defined as call success) was 97.4 percent, while in 2007 Iridium’s percentage was 98.1 percent. In this year’s testing Iridium demonstrated a superior call success rate with 98.1 percent in Northern California and 94.7 percent in Central Texas. Globalstar’s call success rate in Northern California was 36.2 percent and 31.8 percent in Central Texas. These test results have revealed that calls through the Iridium system are nearly three times more likely to be successfully connected and completed, without being dropped, than calls placed through the Globalstar network.

Many factors play a role in QoS and these factors change over time as technology improves, satellites age, and replacement systems are deployed. It is also important to remember that QoS is measured differently according to the application in question and the value placed on different attributes by different users. In general, however, availability of service is the most basic requirement for any application and although Frost & Sullivan has chosen a three-minute call connection as its metric for this study there are a number of other metrics that might be considered in future evaluations.

Some future testing recommendations include:

- Additional diversity in regional test sites
- Increased duration of calls
- Non-ideal test locations (such as urban canyon or various foliage coverage)
- Data service quality (SMS, web usage, and data downloads)
- Audio quality

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