FROST & SULLIVAN

Satellite Phone Comparison Iridium and Inmarsat

A Frost & Sullivan White Paper

PROJECT INTRODUCTION

This white paper is Frost & Sullivan's fourth round of testing of satellite phones using quantitative and qualitative analysis. The focus of this specific research is to compare Inmarsat's new satellite phone, the IsatPhone Pro and corresponding service, against the market leader and industry standard, Iridium's 9555. Satellite phone testing was conducted in Anchorage, Alaska, Fort Lauderdale, Florida, and Fort McMurray, Canada, to compare and contrast Iridium and Inmarsat's satellite phone offering and corresponding service network.

About Inmarsat: Inmarsat is the leading provider of mobile satellite services to the maritime industry. They also offer Broadband Global Area Network (BGAN), which is a satellite Internet network that also enables telephony with laptop sized terminals. Inmarsat has over 268,000 subscribers and operates 11 geostationary orbit satellites.

About Iridium: Iridium is the only mobile satellite service company offering coverage over the entire globe. The Iridium constellation of 66 low-Earth orbiting cross-linked satellites provides critical voice and data services for areas not served by terrestrial communication networks. Iridium voice services are provided via various handsets that provide voice and data communications onboard ships, aircraft, land-based vehicles as well as mobile users on land. Iridium has over 383,000 subscribers and serves commercial markets through a worldwide network of distributors. Iridium also provides services to the U.S. Department of Defense and other U.S. and international government agencies.

EXECUTIVE SUMMARY

In Frost & Sullivan's testing of the two devices and services, our overall findings, in most areas and metrics, found the Iridium phone and service to be superior to Inmarsat. Iridium has been operating satellite phones and service since 1998 whereas this is Inmarsat's first year of offering a device on the Inmarsat I–4 network. Previously, Inmarsat offered a regional handset service based on the acquisition of the ACeS network with limited success.

Frost & Sullivan found the Iridium device to be superior to the Inmarsat phone in most measurable areas. The Iridium device is smaller, lighter, and much easier to fit in a pocket than the Inmarsat phone. The raised keypad of the Iridium phone is much easier to use and provides greater tactile feedback when you are wearing gloves—a typical usage scenario for satellite phone end-users in the military, maritime, and oil and gas markets. The Iridium keypad was found to have greater sensitivity and the amount of numbers entered per second was higher with the Iridium phone. The Inmarsat phone has a color screen, primarily configured in blue and white, which is more attractive than the LCD screen of the Iridium phone, but the Isatphone Pro screen was very hard to see in bright sunlight. While turning up the display brightness helped somewhat, it had to be done every time the device was powered on. The Inmarsat phone also discharged its battery faster than the Iridium device during actual use. This was observed by the battery meter that went down faster on the IsatPhone Pro than the Iridium 9555. Increased battery consumption may be due to the higher power required to look for and access a signal from Inmarsat's constellation of three satellites in geostationary orbit, 20,000 miles farther away than Iridium's 66 low-Earth orbiting satellites. Also, in order to better see the Inmarsat screen in sunlight, we set the

screen brightness setting to the maximum level. In wet conditions, the exterior of the Inmarsat phone made it more slippery and harder to hold than the Iridium phone.

In Fort Lauderdale, Florida, both devices worked but the Iridium device was faster to operate, would work with the antenna down, and, overall, provided a higher level of voice quality. In Fort McMurray, Canada, the results were similar except that the Inmarsat phone would lose its satellite connection if it was set down for a second or two in between calls and would need to re-register with its satellite, causing a minute or two of device downtime. It also would not receive an incoming call unless the device was held up with the antenna pointed towards the south. In Anchorage, Alaska, the Inmarsat device was unable to make or receive a call despite dozens of attempts and was only able to briefly find a satellite. The Iridium phone and service performed better than Inmarsat in nearly every test and comparison, and it appeared that the farther north you went the worse the IsatPhone Pro phone and service was by comparison.

Frost & Sullivan found Iridium's service to deliver better performance and we were able to access Iridium's network in every test location and on nearly every attempt to make or receive a call. The Iridium phone worked even when the antenna was not deployed, although with reduced call quality, whereas the Inmarsat phone would not receive a call unless its antenna was deployed, and, in some locations, would not receive a call unless the antenna was deployed and the device pointed towards the satellite. In testing in North America, the Iridium phone delivered a constant high level of service at all test locations. The Inmarsat phone worked acceptably in Fort Lauderdale, Florida, which is located at approximate latitude of 26 degrees, however, its performance was found to degrade the farther north it was tested. In Fort McMurray, Canada, latitude of 56 degrees, the Inmarsat phone could make outgoing calls, but it took considerably longer than the Iridium phones and had lower call quality. As for receiving calls in Fort McMurray, the Iridium phone was able to successfully receive incoming calls whether the antenna was up or down, even if the phone was in a holster attached to a tester's hip and not aimed directly towards the sky. In testing, the Inmarsat phone only received calls in Fort McMurray with the antenna deployed and the phone aimed towards the satellite. In fact, when the phone was set down in between calls, even for only a few seconds, the phone would lose connection with the satellite and would take a minute or two to re-register before calls could be made or received. Farther north in Anchorage, Alaska, with latitude of 61 degrees, the Iridium phone worked well with very few problems in registering with the network and making/receiving incoming calls. After several hours of testing in Anchorage, the Inmarsat phone only briefly indicated satellite service twice, but, in each instance, it was unable to retain the connection long enough to make or receive a call. Anchorage was also close to the edge of the I–4 Americas satellite reported coverage in terms of both latitude and longitude but resides within the stated service area for this satellite. Our test results are consistent with a quote from Inmarsat's website concerning the new IsatPhone Pro coverage, "*The availability of service at the edge of coverage areas may require more directional pointing of the antenna and a clear line of sight to the satellite*."—Inmarsat website comment under coverage map for IsatPhone Pro. However, in Fort McMurray, Canada, which is well within the Inmarsat's I–4 Americas coverage zone, the device required an open view of the south and constant alignment of the antenna southward for it to function. Then in Anchorage, Alaska, which is near the edge, but still within the stated service coverage, the Inmarsat IsatPhone Pro would not

function even with a clear line of sight to the satellite and extensive attempts at directional antenna pointing.

Figure 1, provides an overall comparison of the two satellite phones and their service.

Figure 1

Satellite Phone Quality of Service Comparison: Overall Comparison of Inmarsat IsatPhone Pro and Iridium 9555 Satellite Phones and Service Networks (North America), 2010

Phone and/or Service Metric	Iridium 9555	Inmarsat IsatPhone Pro
Smallest in Size	X	
Sturdiest in Feel	X	
Best Overall Phone Design	X	
Could be charged with Cell Phone Micro USB Charger		X
Lowest Priced Handset		X
Consistently Good Performance in All Three Test Locations	X	
Received Calls with Antenna Down	X	
Fastest to Acquire Network	X	
Fastest to Make a Call	X	
Can be Utilized as a Modem Allowing Internet Access and Applications for Remote Computers	X	
Best Call Quality	X	
Best Network Performance	X	
Lowest Priced Service Plan		X

Source: Frost & Sullivan

In our testing and analysis, the Iridium 9555 satellite phone was found to be a superior device to the Inmarsat IsatPhone Pro. Iridium's satellite network also offered better coverage, including the ability to use a satellite phone in Anchorage, Alaska, which the Inmarsat phone was unable to do. The Iridium phone provided better call quality and was faster to find the satellite network and make a call. The Iridium phone also offered the ability to receive an incoming call with the antenna down—something the Inmarsat phone could not do. The Iridium phone also offered the ability to use the phone as a modem for a laptop for email or Web access. The Inmarsat IsatPhone Pro was less expensive than the Iridium 9555 and also had lower per minute usage charges. We believe that Iridium is a proven and reliable service that works well in various locations and, therefore, justifies the added premium for the hardware and service.

STRATEGIC RECOMMENDATIONS

It is Frost & Sullivan's recommendation that heavy users of satellite phones, and first responders who rely on satellite phones for emergency communications, select the Iridium

phone and service. We believe that Iridium is a proven and reliable service that works well in various locations and, therefore, justifies the added premium for the hardware and service. For first responders, remote workers, and others who rely on satellite communications for safety-of-life and emergency communications, the Iridium 9555 handset and service is the obvious choice. While testing in multiple locations in North America, Frost & Sullivan was always able to make a call in less than sixty seconds, experienced a high degree of call quality, and were able to receive incoming phone calls in all locations, whether or not the antenna was deployed. These findings were not typical for the Inmarsat phone, however. The IsatPhone Pro could not receive incoming calls at any location with the antenna down, was unable to make or receive any calls in Alaska, and, in Fort McMurray, it could only receive calls while the phone and antenna were aimed precisely towards the satellite. The Iridium phone was also found to make calls quickly, even after being put down to complete a task—a scenario in which the Inmarsat device would lose registration and would require a minute or two to re-register on the satellite. The need for the Inmarsat phone to constantly re-register between uses and not be ready to receive an incoming call could slow the progress of remote workers and could be a liability for government or emergency personnel in high-intensity environments.

For emergency communications and for those who use satellite phones where their lives or their livelihoods are on the line, the Iridium phone is the clear choice due to its high level of call quality and its repeatedly tested reliability. The Iridium device appears to be more rugged than the Inmarsat phone and was found to have better battery life based on our display settings and observations of the battery meters, two qualities that could make the difference between a phone working or not in harsh conditions, far away from a power grid or conventional telephone networks. The Inmarsat phone was found to be best suited for casual or leisure communications in those geographic areas where IsatPhone Pro coverage has been confirmed but, to reiterate, should not be relied upon for emergency communications in leisure environments. In this testing, it was found that inside the 30 degree contour of the Inmarsat satellite over North America the device and service worked the best, however, it was still not as quick, reliable, or maintained the call quality of the Iridium 9555 phone and solution. Inside the 20 degree contour, which included our testing site in Fort McMurray, Canada, the Inmarsat solution functioned but not at the level of the 30 degree test site that we conducted in Fort Lauderdale, Florida. Finally, testing in Anchorage, Alaska, which is outside the 20 degree contour for the Inmarsat I–4 Americas Satellite but is still within Inmarsat's published service map, showed that the device and service would not function.

This research also concluded that, while Inmarsat shows geographical coverage maps where service for their IsatPhone Pro is depicted to be available in Anchorage, Alaska, Frost & Sullivan found this not to be the case. In Inmarsat's defense, their service offering is very new and has only been on the market a few months so it is possible it could be improved to work out to the edges of their current coverage map. However, until they improve their geographical coverage to be on par with their sales brochure diagrams, we strongly recommend that they update their coverage maps so that prospective customers know exactly where their devices will and will not work. Satellite phones are often used in emergencies as well as life and death situations and Inmarsat could potentially be exposing themselves to litigation risk if their coverage diagrams exceed their service limitations.

PROJECT OVERVIEW

In the summer of 2010, Inmarsat commercially launched its first satellite phone, the IsatPhone Pro, to operate on Inmarsat's I-4 network. The product was introduced with a suggested retail price of $699 and retail service pricing around $19.95 per month for basic access. Comparatively, Iridium's retail pricing is around $1,295 for the 9555 satellite phone and service pricing of around $39.95 for basic access. This study was commissioned in order to evaluate the design and performance of the new IsatPhone Pro in comparison to Iridium, who has offered satellite phones since 1998 and is a premium provider in the market.

This whitepaper and the research therein were developed with end users of satellite phones in mind. Emergency first responders, maritime users, remote oil and gas workers, disaster recovery personnel, military and government agents, and countless other types of people routinely require global 24x7 access to communications even when a wireless network or a wireline phone isn't available. This research was designed to provide those users with information on two of the satellite phones currently available in the market and provide independent evaluation of their service quality. The goal of this research was to identify any differences between satellite phone devices and services and to detail those in this research paper. Our intent is to aid those decision makers responsible for purchasing, deploying, or using personal satellite communications devices.

PROJECT METHODOLOGY

In this research paper, we compared the Iridium 9555 satellite phone with the new-to-the-market Inmarsat IsatPhone Pro. Frost & Sullivan also compared Iridium's network of 66 low-Earth orbit satellites to that of Inmarsat's constellation of three geosynchronous orbit satellites. Both qualitative and quantitative analysis was conducted.

For the qualitative portion of this analysis, we evaluated each phone's:

1. Size and weight
2. Keyboard
3. Display
4. Antenna
5. Battery use and charge life
6. Battery charger
7. Construction and overall feel

For the quantitative section of the analysis, test locations were selected in order to understand the variations in performance referenced in the FAQ section on an Inmarsat reseller website. These locations included:

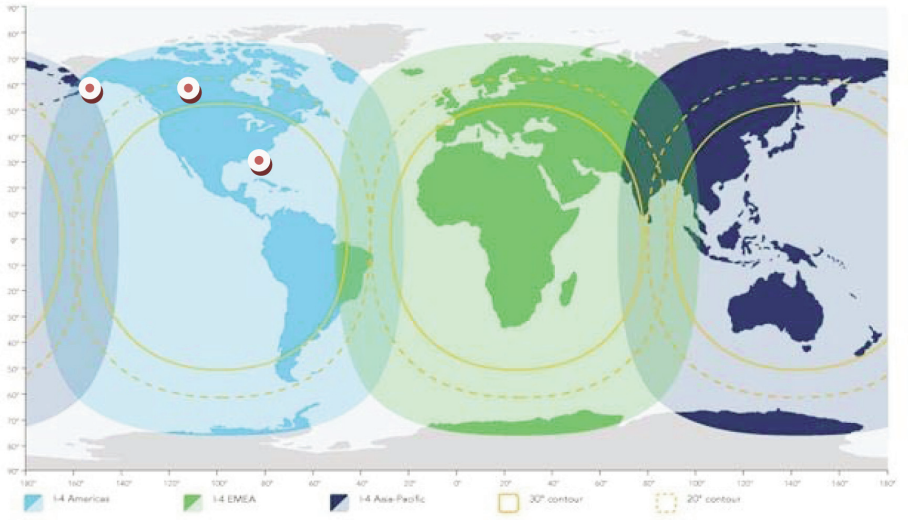
- **Fort Lauderdale, Florida**—Inside the Inmarsat I–4 Americas 30 degree contour: Major staging ground for emergency first responders for hurricanes in south Florida.
- **Fort McMurray, Canada**—Inside the Inmarsat I–4 Americas 20 degree contour: Only major city near the Athabasca oil sands, one of the largest oil and gas reserves in the world.

- **Anchorage, Alaska**—Outside the Inmarsat I–4 Americas 20 degree contour: Largest city in the United States' largest and most rural state, which has the least wireline and wireless communications infrastructure.

Below is an illustration of the test locations, relative to Inmarsat's satellite contours, noted on an IsatPhone Pro Coverage map found on an Inmarsat reseller website:

Figure 2

Satellite Phone Quality of Service Comparison:
Inmarsat IsatPhone Pro Coverage Map (World), 2010



Fort Lauderdale, Florida, is a regular staging location for many emergency personnel responding to hurricanes hitting Miami or southern Florida. Fort McMurray, Canada, is the largest city near the Athabasca oil sands and is the only major city in the oil sand producing region. Anchorage, Alaska, is the largest city in the largest state and has strong maritime, oil and gas, and industries along with very little wireline or wireless infrastructure necessitating satellite phone use for communications.

For the quantitative testing we measured:

1. The length of time required for the phone to power on and register with the network
2. The length of time required to dial and connect a phone call
3. Ability to successfully initiate and complete a two minute phone call while stationary
4. Ability to successfully initiate and complete a two minute phone call while walking
5. The length of time required to receive an incoming call with phone in hand and antenna down
6. The length of time required to receive an incoming call with phone in hip holster and antenna down
7. The length of time required to receive an incoming call with phone in hand and antenna oriented with a satellite

For each location, a different researcher from Frost & Sullivan conducted the satellite phone tests and also contributed input for the qualitative portion of this testing.

Minor testing and re-testing of results was also conducted at Frost & Sullivan's offices in San Antonio, Texas.

PROJECT RESULTS

In the qualitative comparison of the two phones, we found the Iridium phone to be smaller and to have a more solid feel. Figure 3 is a table comparing the two phones in terms of size and weight:

Figure 3

Satellite Phone Quality of Service Comparison: Device Comparison of Iridium 9555 and Inmarsat IsatPhone Pro (North America), 2010

Phone Metric	Iridium 9555	Inmarsat IsatPhone Pro	Difference
Length (mm)	143	170	18.9%
Width (mm)	55	54	-1.8%
Depth (mm)	30	39	30.0%
Volume (cm)	236	358	51.7%
Weight (g)	266	279	4.9%

Source: Frost & Sullivan

The Iridium 9555 felt considerably sturdier, which should not be surprising as the IsatPhone Pro is 50 percent larger than the Iridium device but only five percent heavier. The IsatPhone Pro is 19 percent longer, 2 percent narrower and 30 percent deeper. It almost felt like the IsatPhone Pro was made to float in water as it was much larger in size than the Iridium phone and only a tad bit heavier in weight. Both phones felt good against your ear when in use. The Inmarsat phone, although bulkier, did not feel that way in use because the large antenna swings out making the phone narrower and easier to hold with the antenna up. This was the case when either hand was used. The Iridium 9555 went into a large pants pocket with less trouble than the Inmarsat IsatPhone Pro and bounced around less when walking. Size-wise the Iridium phone was considerably smaller and, since they are about the same weight, felt sturdier.

IsatPhone Pro has a port for charging by a conventional micro USB charger as well as the proprietary charger it came with. Frost & Sullivan views this as a positive feature that the Iridium 9555 didn't have. Being able to use a typical wireless phone charger on your satellite phone increases the utility of the device, and for users packing for long excursions, having to take only one charger for two or more phones or electronic devices would lessen required gear.

For the quantitative portion of the study, 140 tests were conducted in each location and results are outlined herein.

Upon using the two different satellite phones and service offerings, several differences were noticed. One small difference is that, with the IsatPhone Pro, you must dial 001 to make a call, whereas, with the Iridium device, you can just dial 1 if you are calling an American phone number since the international access number is automatically added. This can save a second or two off call times but would be mostly important to U.S. users or people who primarily call U.S. numbers. The Iridium phone had fewer dropped calls and less instances of call break-up or inaudible sound. In the hundreds of calls made for the study, we had one call by the IsatPhone Pro in which the conversation could not be heard by the call recipient. There were no such instances with the Iridium 9555.

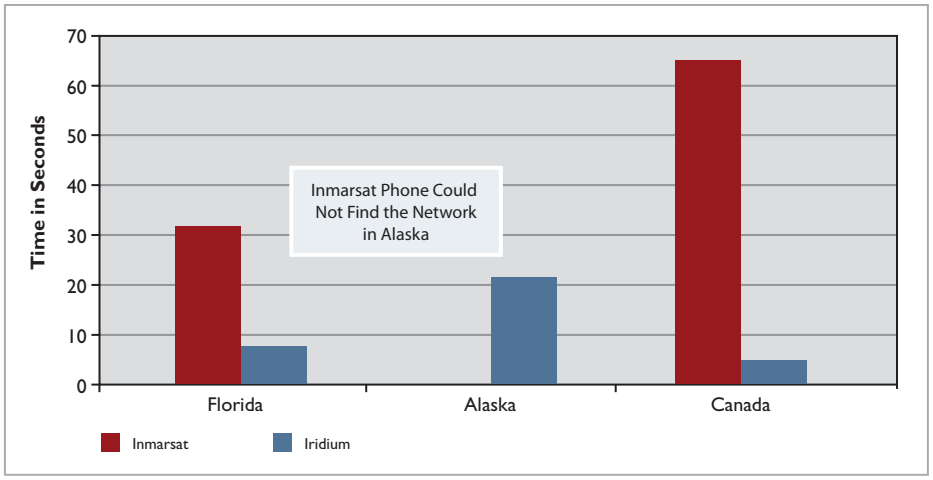
The battery life meter went down noticeably faster on the IsatPhone Pro, which was contrary to our expectations as Inmarsat's brochure lists a longer talk and stand-by time than the Iridium 9555. This could be due to a faulty battery meter or to the IsatPhone Pro using much more battery life out in the field as opposed to much more conservative consumption in a test lab. We set the display brightness higher to compensate for the glare on the display in sunlight so this could have been a contributing factor.

In conducting the test phone calls, some considerable trends were noticed. The most obvious finding was that the Inmarsat IsatPhone Pro would not work at all in Anchorage, Alaska. It received a very weak signal from the satellite and was unable to ever get a GPS fix and make or receive a call before the signal was lost again. The Inmarsat IsatPhone Pro also would not take an incoming call at all if it did not have the antenna deployed. In Fort McMurray, Canada, to receive a call, the antenna needed to be out and the device needed to be pointed towards the satellite. The Inmarsat phone's display was also harder to see in bright sunlight. This could be negated somewhat by upping the brightness setting on the phone, but this had to be done every time the phone was used or turned on. The Iridium 9555 phone worked well even with obstructions such as trees and during overcast conditions in one of the test locations. Meanwhile, the Inmarsat phone had more trouble with obstructions and would not take or receive calls unless it had a clear view of the southern sky in Fort Lauderdale, Florida, and in Fort McMurray Canada. In between calls, one could set the Iridium phone down on the ground or on a table and it was ready to dial out at a moment's notice, or receive a call in that position, with or without the antenna extended. The Inmarsat IsatPhone Pro would lose its network registration if the device was set down, so it could not make or receive a call until you re-registered it with the satellite. The Inmarsat phone took longer to make outgoing calls.

Figure 4 chart shows the time it took, on average, to find the satellite network and to prepare a phone to make or receive a call.

Figure 4

Satellite Phone Quality of Service Comparison: Elapsed Time in Seconds to Power Satellite Phone on and Orient with Network (North America), 2010



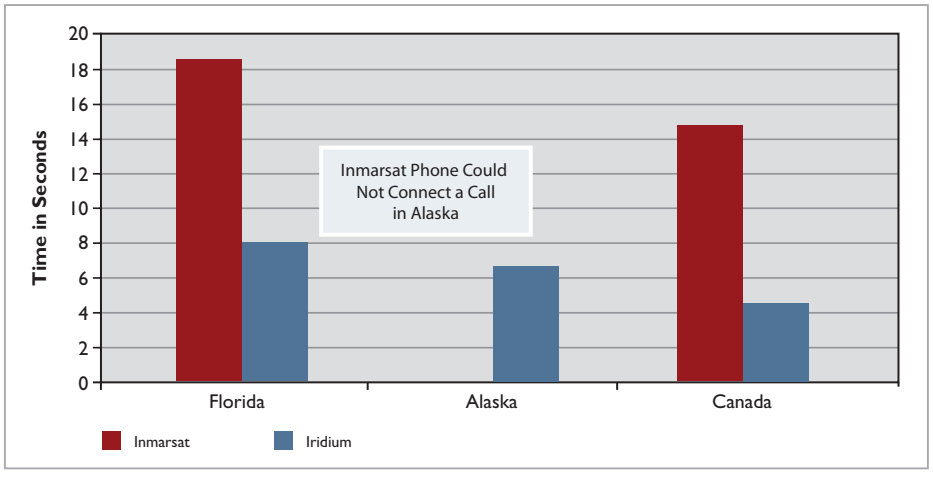
Source: Frost & Sullivan

This chart illustrates the average time to power on and find the satellite network. The Inmarsat phone was unable to connect to the satellite in Anchorage, Alaska, and is not included in this chart. At each location, the satellite phone was turned on and timed for finding the satellite network and the average of five attempts was recorded in this chart. Since Frost & Sullivan was unable to get a satellite signal in Anchorage, Alaska, with the Inmarsat IsatPhone Pro, that test is not included in Figure 3.

The next figure, Figure 5, shows the time it took on average to connect a call dialed out with each satellite phone.

Figure 5

Satellite Phone Quality of Service Comparison: Elapsed Time in Seconds to Connect a Dialed Phone Call from a Satellite Phone (North America), 2010



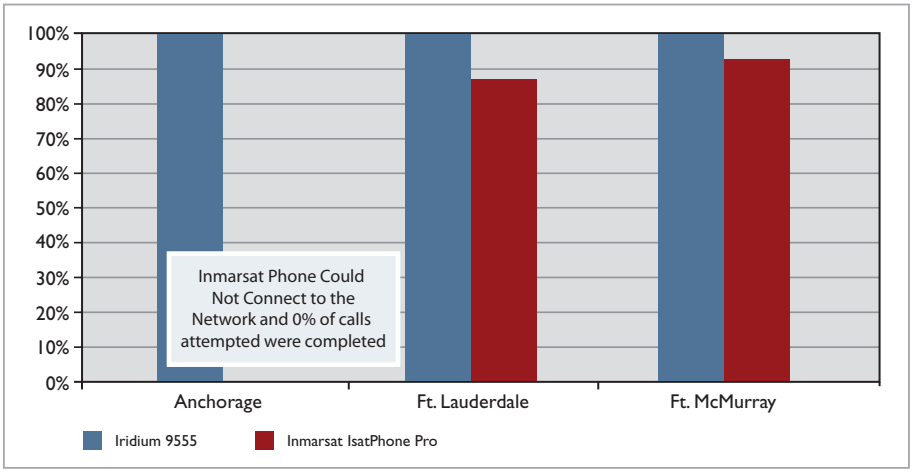
Source: Frost & Sullivan

This figure shows the average time to connect a call made by a satellite phone in the three test locations. The Inmarsat phone was unable to dial out in Anchorage, Alaska, and is not included in this chart. It took, on average, more than 16 seconds to make a call with the Inmarsat phone and around six seconds for the Iridium device in all three locations.

Figure 6 shows the call completion percentage for each test location. At each locale, 15 outgoing calls were attempted per phone.

Figure 6

Satellite Phone Quality of Service Comparison: Call Completion Percentage for Each Satellite Phone and Testing Location (North America), 2010



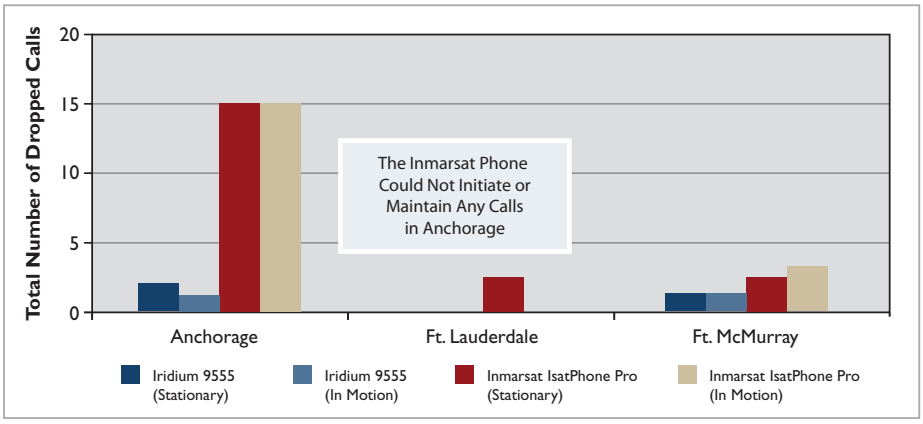
Source: Frost & Sullivan

The Iridium phone had 100% call completion for each of the three testing sites. Inmarsat did nearly as well in Fort Lauderdale and Fort McMurray, combining for a 90 percent call completion ratio of dialed calls. In Anchorage, Alaska, however, the Inmarsat IsatPhone Pro was unable to complete a dialed call at all and had a call completion percentage of zero percent.

Figure 7 shows the total number of dropped calls out of a total of 15 phone calls made with each device while standing stationary and while walking around.

Figure 7

Satellite Phone Quality of Service Comparison: Total Number of Dropped Calls for Two Minute Calls for Each Satellite Phone and Testing Location (North America), 2010



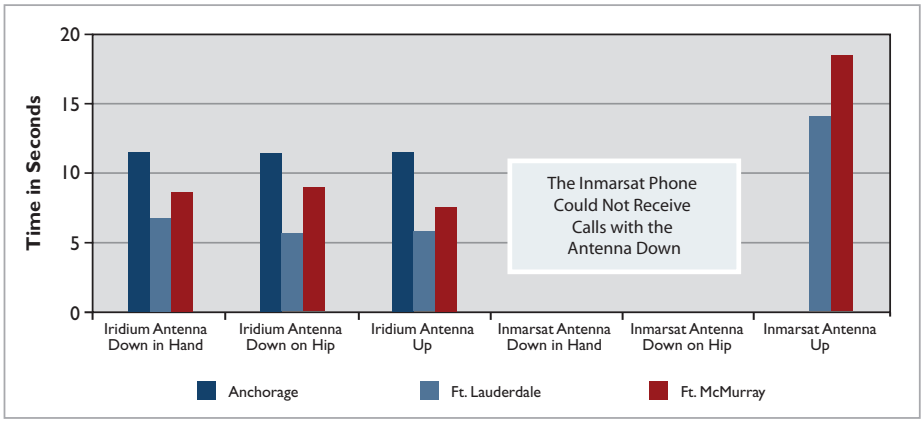
Source: Frost & Sullivan

All calls were for at least two minutes. If the call was lost or dropped before two minutes had elapsed, it was scored a dropped call. One qualitative difference noticed in this test was found at the Fort McMurray test location; that call quality dropped significantly on the Inmarsat IsatPhone Pro while in motion as compared to being stationary. If in motion and using the Inmarsat device in order to speak and be heard or listen to what is said from the other party, you needed to constantly orient the antenna towards the south or slow your movement rapidly.

Figure 8 shows the time it took at each testing location to receive an incoming call with the phones in three positions, in hand with the antenna down, on your hip with the antenna down, and with the antenna up.

Figure 8

Satellite Phone Quality of Service Comparison: Time in Seconds for the Satellite Phone to Receive an Incoming Call and Testing Location (North America), 2010



Source: Frost & Sullivan

For each phone, five incoming calls were scored for each position at each location. At all three locations, the Inmarsat phone would not receive an incoming call if its antenna was down, it could only receive incoming calls with the antenna deployed. In Fort McMurray, the Inmarsat phone would only receive an incoming call if the phone was held up at head level or higher while also pointing the antenna to the south.

PROJECT CONCLUSIONS

Satellite phone use is more popular than ever. Satellite phone use by maritime, oil and gas, and government employees continues to grow. New satellite phones are constantly coming into the marketplace, such as Inmarsat's IsatPhone Pro. Frost & Sullivan found it valuable to compare the latest industry model with the industry standard, the Iridium 9555 satellite phone.

Overall, the Iridium phone worked well and performed consistently and reliably in all three test locations. The IsatPhone did not work at all in Anchorage, Alaska, even though the coverage map provided by Inmarsat represented that coverage was available in that area. The IsatPhone Pro did work in Fort McMurray but offered only marginal service and call quality, which may be indicative of how similar areas may perform on the coverage map. In Fort Lauderdale, Florida, the Inmarsat phone was able to both send and receive calls when the antenna was up, but its call quality was worse than the Iridium phone. In addition, the time required to locate and register with the satellite network, and subsequently make a call, was significantly longer with the Inmarsat phone. A key limitation of the Inmarsat phone is that it cannot receive an incoming call unless its antenna is deployed whereas the Iridium phone can receive an incoming call even with the antenna stowed, albeit at a lower call quality until the antenna is extended. The Iridium phone is considerably smaller, lighter and appears to have a sturdier build. The Iridium 9555 also held a longer battery life in our testing, and its display was far easier to read in the direct sunlight.

It is Frost & Sullivan's recommendation that heavy users of satellite phones, and first responders who rely on satellite phones for emergency communications, select the Iridium phone and service. We believe that Iridium is a proven and reliable service that works well in various locations and therefore justifies the added premium for the hardware and service.

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