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Evaluation of the SPOT Satellite Messenger

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Introduction

The Forest Service Chief Information Office (CIO) requested the Technology and Development Program (T&D) to evaluate the SPOT Satellite Messenger for potential use by Forest Service employees. The CIO received requests for technical approval to purchase the SPOT device to be used as an auxiliary safety device for field employees. The small, rugged global positioning system (GPS) device (figure 1) from SPOT Inc., a subsidiary of Globalstar Inc., allows users to send an "OK" (check-in), HELP, or Alert 911 distress message with their current GPS location to designated employees, family members, or friends. Messages are delivered using the Globalstar satellite constellation either by e-mail or by a short message service (SMS) text message to a mobile phone. The CIO wanted an evaluation of the reliability of this new device to transmit messages under a variety of canopy types and in different types of terrain.

Highlights...

- Forest Service field employees aren't always able to establish communications using cell phones, satellite phones, or Forest Service radios.
- The SPOT Satellite Messenger can reliably send emergency messages, even under a forest canopy.
- The device's primary disadvantage is that it can only send messages but cannot receive them.
- Field employees might find the device useful as a backup for emergency communications.

Figure 1—The SPOT Satellite Messenger is a small, rugged device that allows users to send distress or check-in messages that include their GPS location using the Globalstar satellite constellation.

This report describes the results of T&D's evaluation. The device was tested under open, medium, and heavy canopy types at three GPS test courses in western Montana and northern Idaho. The devices also were tested by field employees around the country to determine such things as reliability, ease of use, and transmission capabilities, and to gather the employees' overall impressions.

SPOT Satellite Messenger

The SPOT is a small, rugged, satellite-based personal messenger and GPS tracking device. It contains a GPS receiver and internal antenna and transmitter. The SPOT enables users to send its GPS location and a preconfigured message using the Globalstar satellite system's simplex data network to designated recipients. Recipients will receive an e-mail message and/or a text message on a mobile phone. Delivery options, e-mail addresses, and mobile phone numbers are configured on the user's account at the SPOT Web site (*http://www.findmespot.com*). Each message contains the GPS location with a link to Google Maps displaying the location (figure 2).

The SPOT device provides one-way communication only. Messages are sent from the device to user accounts. The device cannot receive messages. Additionally, there is no way to know for certain that messages have been successfully transmitted. The device sends redundant messages to improve the likelihood that messages are sent successfully.

The SPOT device is waterproof, rugged, and self-contained. It is 4.38 inches long by 2.75 inches wide by 1.75 inches thick and weighs about 8 ounces. It runs off two AA 1.5-volt lithium batteries for about 14 days when it is in the tracking mode or it can send about 1,900 check-in messages.

The SPOT device uses the simplex (or one-way) frequency of the Globalstar network to transmit messages. The duplex (two-way) frequency used by Globalstar's phone/data service has experienced problems over the past few years because some of the electronics in the satellites have degraded. This problem has not affected the simplex frequency.

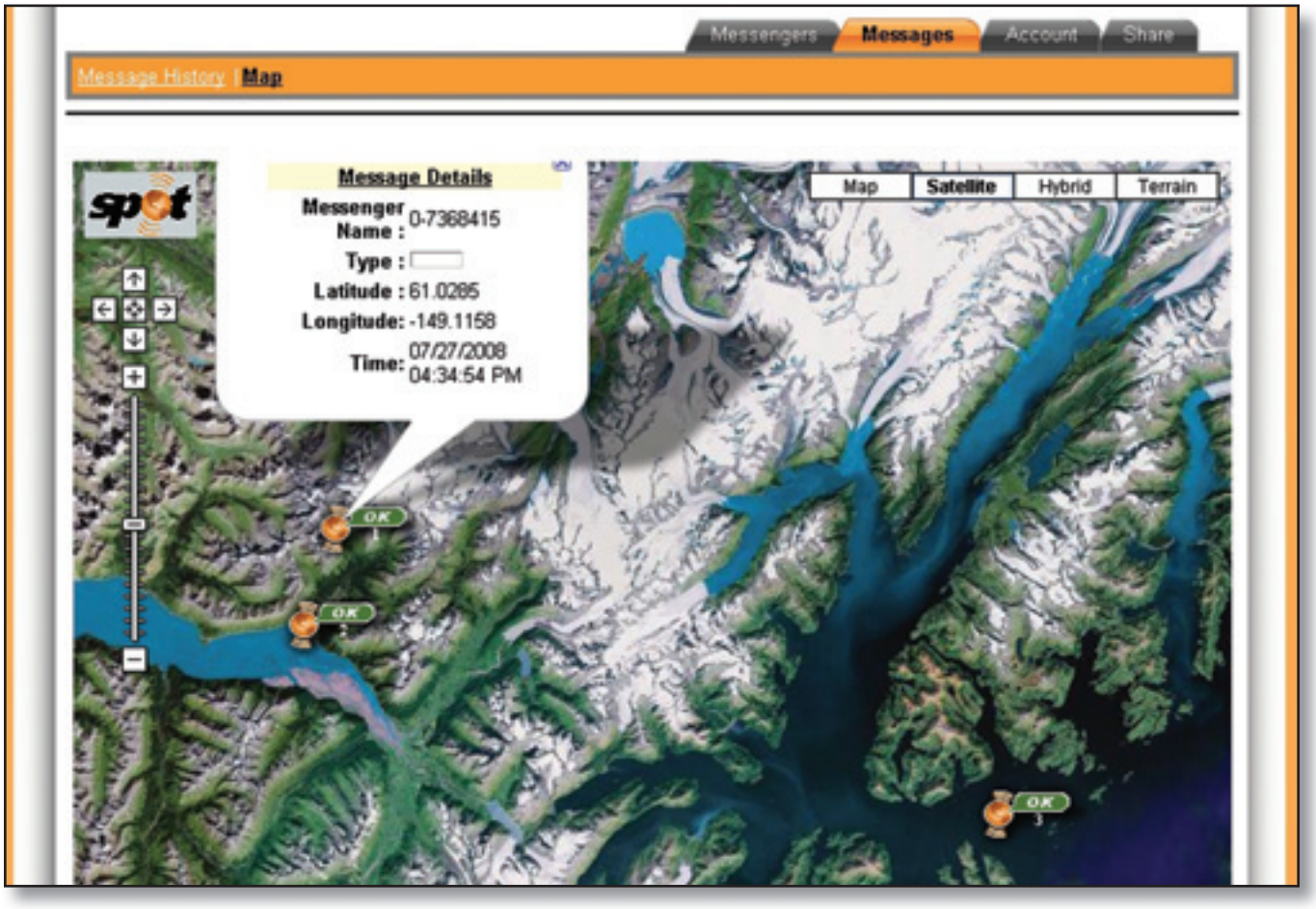

Figure 2—Anyone with access to a user's account can see where the user is on a Google map. Accounts can also be set up to send e-mail or text messages that include a link to Google Maps.

The SPOT device has four reporting methods:

- Alert 911—When the Alert 911 feature is activated during emergencies, the device will determine its location and send the coordinates along with an Alert 911 distress message every 5 minutes to the GEOS International Emergency Response Center. The center notifies local emergency responders based on the user's coordinates and personal information stored in the user's account. The center also notifies user-defined emergency contacts that it has received a distress signal. The user must press and hold the 911 button for 2 seconds to activate the Alert 911 feature. This requirement helps prevent accidental activations. The device keeps sending Alert 911 distress messages until the unit is powered off, the battery is depleted, or the Alert 911 distress message is canceled. An indicator light blinks green every 3 seconds when the Alert 911 feature has been activated and stays green for 5 seconds when a message is being sent. The Alert 911 distress message can be canceled by holding the 911 button for 3 seconds. The indicator light blinks red, then stays red for 5 seconds while the cancel message is being sent.
- HELP—The HELP feature can be used when help is needed but the situation is not life threatening (figure 3). When the HELP feature is activated, the device determines its location and sends the coordinates along with a preconfigured message to a list of contacts. Messages are received by e-mail and/or a simple message system text message on a mobile phone. Up to 10 different e-mail accounts or mobile phones can be configured to receive the HELP message. E-mail and mobile phone accounts are configured in the user's account on the SPOT

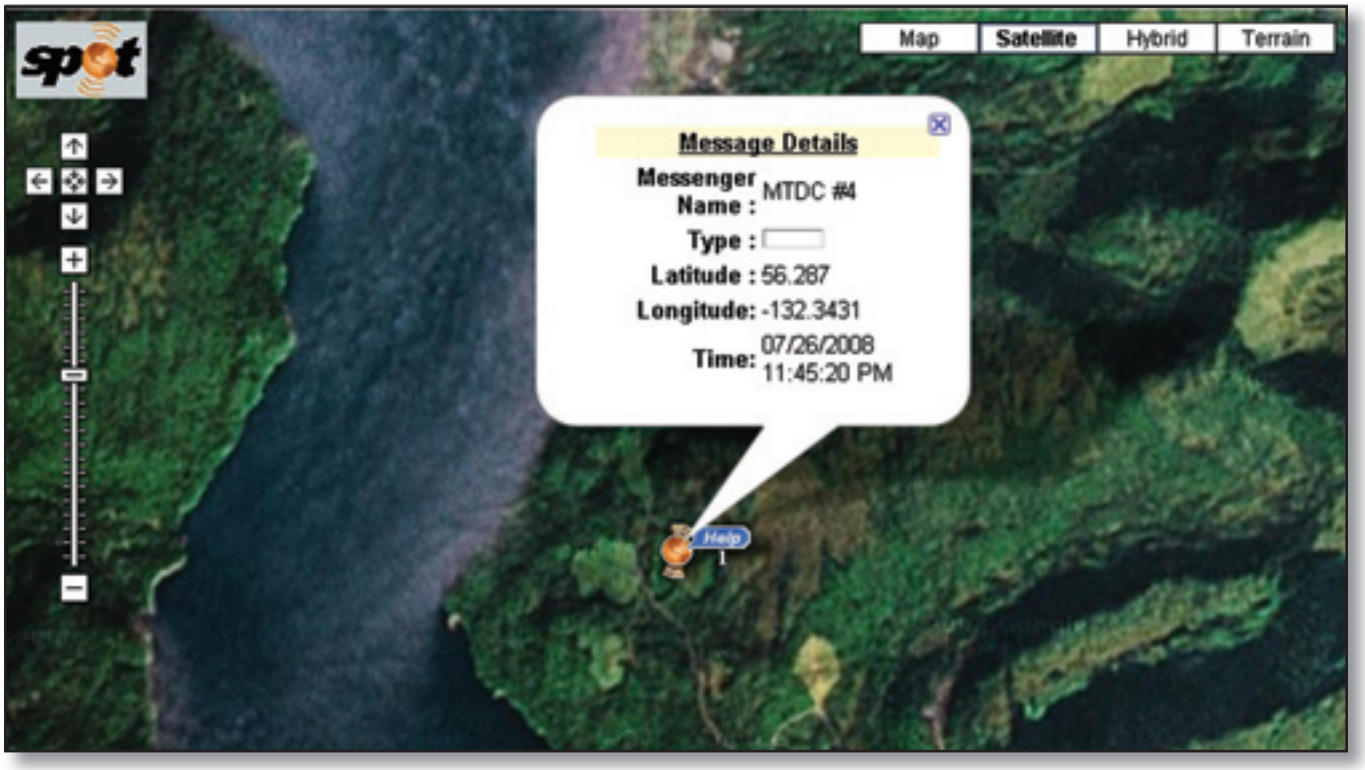

Figure 3—In this case, field employees were testing the HELP feature in Alaska. When the HELP feature is initiated, messages are sent every 5 minutes for 1 hour.

Web site. The device will send the HELP message and location every 5 minutes for 1 hour. The user must press and hold the HELP button for 2 seconds to activate the HELP feature. This requirement helps prevent accidental activations (figure 3).

- Check-In—The check-in feature is used to notify user contacts that all is well. When activated, the device will acquire its GPS location and send the location and a preconfigured message to a list of contacts (figure 3). The contact receives an e-mail message or a text message on a mobile phone. Up to 10 different e-mail or mobile phone accounts can be set up to receive the message. The SPOT device will send three redundant messages to help ensure that a message is received by the satellite and transmitted. Only one of the messages will be sent to the e-mail addresses or mobile phones.
- Tracking—When the tracking feature is activated, the SPOT device sends its coordinates to the user's account every 10 minutes. Anyone with access to the account can view the route and progress on Google Maps (figure 4).

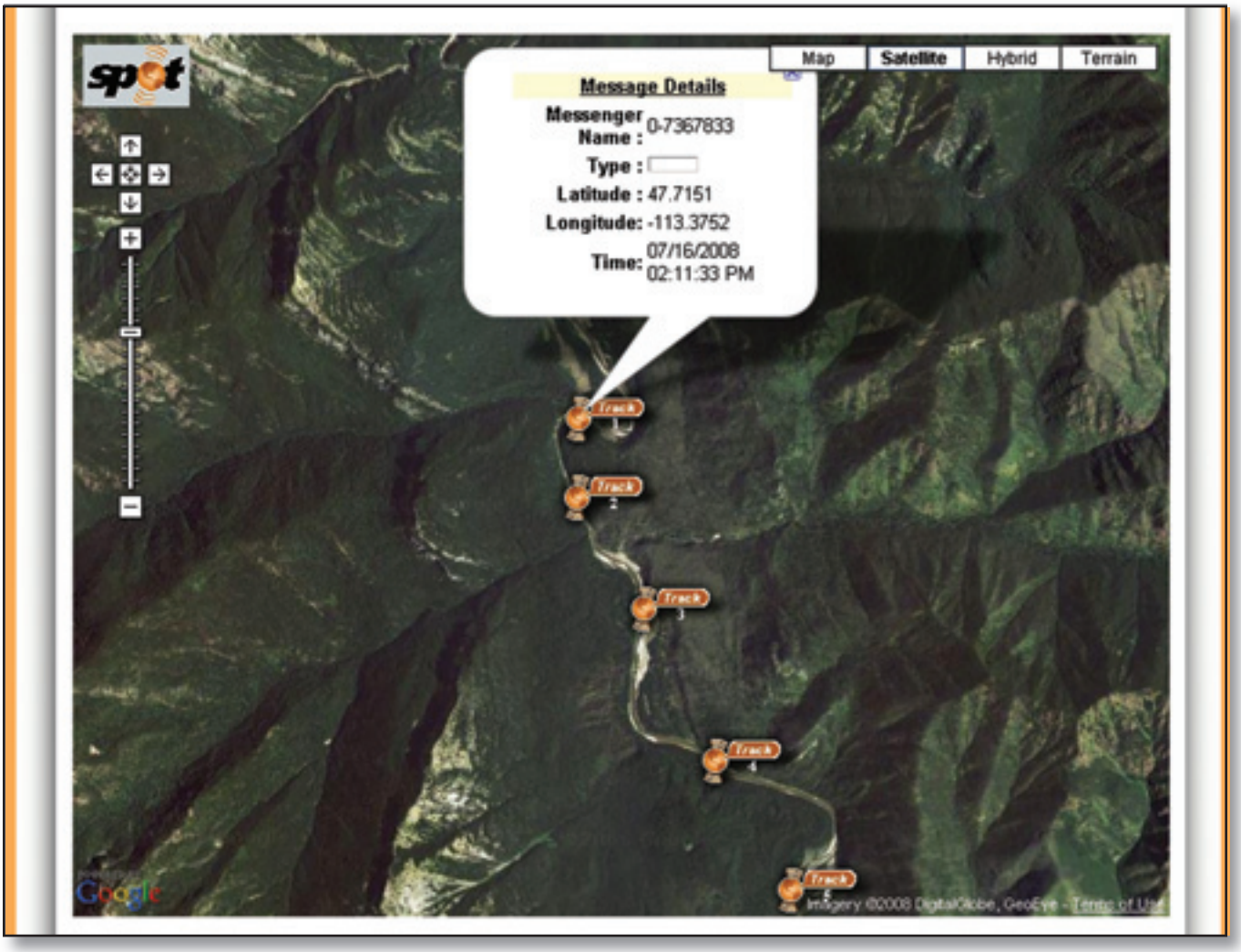

Figure 4—When the tracking feature is initiated, the SPOT will send its GPS location every 10 minutes. Anyone with access to the account can track the progress of the unit.

The SPOT device costs about $150. SPOT Inc. provides a two-tiered subscription for airtime. The first tier, which is mandatory, provides the Alert 911, HELP, and unlimited check-in message features for $100 per year. The tracking feature can be added for $50.

SPOT Web site—Users set up their accounts, configure messages, and view messages and GPS location data on the SPOT Web site (http://www.findmespot.com). Users must set up an account name and password to enter this section of the Web site.

The Web site has four main tabs:

- Messengers Tab—The messengers tab displays the messengers registered in your account. It also displays the message profile assigned to each messenger. The message profile contains the e-mail addresses, mobile phone numbers, and emergency contact information for each SPOT device in your account.
- Message Tab—The message tab allows you to see your message history for all messengers in your account. The date and time of messages, the type of message, and location (where applicable) are included. You can view selected messages on Google Maps within the message tab. User can also export messages in GPS exchange (GPX), comma separated value (CSV), or Keyhole Markup Language (KML) formats.
- Account Tab—The account tab contains the customer identification, login information, billing information, and other preferences.
- Share Tab—The share tab allows users to show their messages and locations to others by creating a SPOT shared page. Anyone with the link to the shared page can see selected messages online. The shared page can be public or password protected. The account manager can create and delete pages and select information that is shown. Up to 10 different SPOT shared pages can be created, showing different information to different people.

Test Procedures

T&D employees tested the SPOT device during the summer of 2008 under three different canopy types at designated GPS test courses in western Montana and northern Idaho. The device was also tested in the Northern, Intermountain, Pacific Southwest, and Alaska Regions by field employees to determine such things as reliability, ease of use, transmission capabilities, and to gather users' overall impressions.

Four different tests were conducted at each site to determine how many messages were transmitted successfully.

- **Check-in Tests**—The check-in feature was tested at each survey marker on each test course. The check-in feature was initiated and the device was left at each marker for 20 minutes to give it time to send three messages. The face of the device was pointed toward the sky during these tests to simulate a person holding the device.
- **HELP Tests**—The HELP feature was initiated at one survey marker at each site and the device was left for 1 hour. The SPOT sends a HELP message every 5 minutes for 1 hour. To be considered successful, only one message needs to be successfully transmitted. The device was positioned horizontally, facing up.
- **24-Hour Tracking Tests (Horizontal)**—The tracking feature was initiated at one survey marker at each site and left for 24 hours with the device positioned horizontally, facing up. The device sends a position message every 10 minutes for 24 hours.

The device's transmitter is on the face of the unit, making the faceup position optimal for transmissions. This test determines the percentage of messages that are transmitted and allows results to be compared to the same test using a transmitter in a vertical position. This test helps determine whether users should orient the device facing up in a pack or clipped vertically on their belt.

- **24-Hour Tracking Tests (Vertical)**—The tracking feature was initiated at one survey marker at each site and the device was left for 24 hours, positioned vertically. The device sends a position message every 10 minutes for 24 hours.

Test Locations

Tests were conducted at three GPS test courses in western Montana and northern Idaho.

Open Canopy Test

Open canopy tests were conducted at the Missoula Technology and Development Center (MTDC) facility near the Missoula airport, where there are no trees or obstructions of the sky. The check-in and HELP tests were conducted at a known survey marker. The check-in test was repeated nine times. The 24-hour tests were conducted on MTDC's roof where the device was secure.

Medium Canopy Test

Medium canopy tests were conducted at the GPS test course in the Lubrecht Experimental Forest northeast of Missoula. The test course is in a stand of lodgepole pine trees. Figures 5 and 6 show views of the canopy and the site.

Figure 5—This photo shows the view of the canopy from one of the test points within the Lubrecht GPS test course.

Figure 6—The SPOT device was tested under a medium canopy at the GPS test course on the Lubrecht Experimental Forest near Missoula, MT. The site is in a lodgepole pine stand.

Heavy Canopy Test

Heavy canopy tests were conducted at the GPS test course near Powell, ID, southwest of Missoula. The test course is in a stand of old-growth cedar and Douglas-fir trees. Figures 7, 8, and 9 show the site and views of the canopy.

Figure 7—The SPOT device was tested under a heavy canopy on a GPS test course at Powell, ID. This view is from the parking lot. The first survey marker is about 100 feet inside the stand.

Figure 8—One of the test points inside the test course at Powell, ID—the SPOT device is shown in the center. The check-in message was successfully sent, even though the unit was surrounded by large cedars.

Figure 9—This photo shows the SPOT device's view of the canopy from the test point.

Test Results

The following table shows the results from the three test locations. Nearly all the check-in messages were successfully sent at all the test points.

Under the open canopy, all check-in and HELP messages were sent successfully (table 1). Even when tracking messages were sent with the SPOT device positioned vertically, 80 percent were sent successfully .

Under the medium canopy, 89 percent of the check-in messages were sent successfully, 46 percent (6 of 13) of the HELP messages were sent successfully, as were 81 percent of the tracking messages sent with the device positioned horizontally and 54 percent of the tracking messages sent with the device positioned vertically.

Under heavy canopy, 91 percent of the check-in messages were sent successfully, as were 31 percent of the HELP messages and half of the tracking messages sent with the device positioned horizontally. Only 14 percent of the tracking messages sent with the device positioned vertically were sent successfully.

Table 1—The percent of SPOT messages sent successfully during tests at the three GPS courses in western Montana and northern Idaho.

Test	Percent of Messages Sent Successfully		
	Open Canopy (MTDC)	**Medium Canopy (Lubrecht)**	**Heavy Canopy (Powell)**
Check-in Feature	100 (9 of 9)	89 (8 of 9)	91 (10 of 11)
HELP Feature	100 (13 of 13)	46 (6 of 13)	31 (4 of 13)
24-Hour Tracking (Horizontal)	97 (140 of 145)	81 (110 of 136)	49 (71 of 145)
24-Hour Tracking (Vertical)	80 (115 of 144)	54 (78 of 145)	14 (21 of 145)

Regional Field Tests

Field employees tested the SPOT device in the Northern, Intermountain, Pacific Southwest, and Alaska regions. These tests evaluated how well the device performed in field conditions. Volunteers were asked to use the SPOT while recording the frequency and type of transmissions they made and to offer any observations they had about their experiences using the device.

We received limited data from the field testers on the success and failure of different types of transmissions. The problem was that users did not download or compare the data from the Web site before the data were purged. The Web site only allows users to download the past 30 days of data. The results in this section are from the comments users provided of their experiences with the device.

Field employees provided written evaluations of their experiences using the SPOT device. These comments were analyzed to determine major concerns users had and to better understand users' evaluation of the usefulness of the device for their location.

Users' comments focused on four major topics: the effectiveness of emergency communication, the reliability of transmission and reception of messages, the usefulness of the Web tracking service, and overall impressions of the usefulness of the device for field applications.

Emergency Communications

Field employees reported that the SPOT device seemed to be useful as a backup for emergency communication.

> ***"I have fairly good confidence that it would be possible to send a message out if needed even if the person had to find an opening in the canopy. It should not be used as the primary communication device, but could be an effective alternative."***

Reliability of Transmission and Reception

The issue of reliable transmission and reception of messages in a variety of conditions was a primary focus of the comments we received from field employees. They discussed how the SPOT device functioned under a forest canopy and in a variety of other conditions. Some evaluators compared their experiences using the device to their experiences using a satellite phone.

Users reported that a forest canopy reduced the reliability of transmission and reception.

> ***"The SPOT device was limited greatly by canopy cover, especially in the tracking mode. Seemed to work a little better for check-ins."***

> ***"Initial SPOT test. Activated from deck of my residence. With a clear view of the sky on a relatively clear day, SPOT HELP and check-in features appeared to be very successful."***

> ***"SPOT placed near forest road to test HELP/check-in feature. When activated in HELP/check-in mode, SPOT was successful in sending out the alert message the majority of the time from what I could tell. Delays in receiving the message were detected at times."***

Comments also addressed how well the SPOT device functioned when placed in different locations.

> ***"Seemed to transmit as well through a pack as on the outside of a pack."***

> ***"SPOT attached to ballistic vest carrier in tracking mode while hiking. Tracking was initiated with SPOT in this position on my vest and while in the top of my pack. Results appeared to be better from inside my pack, possibly due to better positioning of GPS antenna."***

"SPOT messenger placed in front window and or passenger seat of patrol SUV to test tracking function. Tracking did not appear to be very successful with the test conditions. Tracking was successful at times, but appeared to require a very clear view of the sky and/or a slower moving platform to get a steady breadcrumb type trail established."

Web Tracking Service

The field users reported dissatisfaction with the SPOT tracking Web site.

"SPOT messenger Web page leaves room for improvement. On this attempt to view the Web page, it was down for improvement. Hopefully, they are improving on the overall ease of use and layout. I found it difficult to navigate the pages to find the information I was seeking. I resorted to using the help/instructions page, which turned out to be only somewhat helpful. Additionally, I was very disappointed to find that results of SPOT messenger use were only available for the past 30-day period. On multiple occasions, I wished to see tracking histories from prior use and was unable to do so because of the 30-day max history."

"Definitely are limitations on the Web-based tracking part of it. The e-mail and text messaging seemed to work well."

The evaluators also criticized the usability of the SPOT Web site.

Overall Impressions

Overall, field employees are interested in the SPOT's potential as a backup device for emergency communications, but feel usability needs to be improved. There was a sense that some of the features duplicated current communication and GPS capabilities.

"All and all, I think it will be a useful tool, but as we have talked, it definitely has limitations. For the price though, not a bad deal."

"Forest Inventory and Analysis (FIA) crews currently have a cell phone, satellite phone, GPS, aerial photos, and maps. Is a SPOT also needed? Possibly have a few SPOTS available for crewmembers, if they desire?"

"Overall opinion, I would say SPOT messenger has some real potential to fill a void left between the use of USFS radios, SAT phone, cell phone, and emergency location transmitters (ELT)/emergency position indicating response beacons (EPIRBs). While conducting patrols I depend on a USFS radio (communications with USFS dispatch), a police department radio (police communications), my work cell phone (communications to all), my personal cell phone (it gets better service in places than the work cell), a SAT phone at times when I request it (for patrols in areas/times where there isn't USFS or police radio coverage and ELT (emergency situations only)."

Conclusions

Based on the results of the T&D tests, the SPOT personal satellite messenger is effective in transmitting messages, even under heavy tree canopies. Users can be confident that messages will be sent successfully, especially if they are able to send messages in any type of clearing. It is important to follow the manufacturer's recommendations and instructions to increase the likelihood of the message will be sent successfully. For example, it is important to leave the device in the open for 20 minutes when sending a check-in message. This allows the unit to send three redundant messages.

The tracking feature was affected both by tree canopy and the orientation of the device. Whenever possible, the SPOT device should be oriented so the face is pointing to the sky. This places the antenna in the best orientation.

The SPOT has some significant limitations that should preclude the device from being a primary check-in/check-out device. These include:

- The device provides one-way communication only. No one can contact the SPOT user. This limitation is the main reason why the cost of the unit and the satellite service can be so low.
- The SPOT device provides no feedback that would allow users to know that their messages were sent and received successfully.
- The Web site is not designed for large numbers of devices or for corporate users. Security and privacy concerns (contact information) are key problems. SPOT is developing a solution for corporate users that should address these concerns.
- The device can be confusing to use. For instance, the user has to push and hold the OK button for 5 seconds to enable the tracking feature. This command won't work if the unit is still trying to send another message. In such a case, the user must turn the unit off and back on to cancel the message.

Overall, the SPOT device worked fairly well. However, field units should consider the device as a backup or enhancement for normal communications. The primary limitation is its inability to provide two-way communication.

About the Authors

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Theron Miller received his Ph.D. in forestry from the University of Montana in 1997 with an emphasis in natural resources social science. He worked as a research and teaching professor at the University of Montana, focusing on applied social sciences directly related to the management of natural resources on public lands. Theron joined MTDC in 2006 and works as a project leader in the safety and health, recreation, and fire and aviation management programs.

Library Card

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Keywords: communications, data communications, emergencies, GPS, Internet, safety at work, satellites, simplex, telecommunications

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