

BROUGHT TO YOU BY:



FIRST RESPONDER'S GUIDE TO SATELLITE COMMUNICATIONS

SATELLITES AS PART OF THE SOLUTION

**WHEN TERRESTRIAL COMMUNICATIONS
INFRASTRUCTURE IS DAMAGED,
DESTROYED, OR OVERLOADED,
SATELLITES = OPERABILITY**

For more information and an electronic version of the guide, please visit www.sia.org
and click on the link *FIRST RESPONDER'S GUIDE TO SATELLITE COMMUNICATIONS*.

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SATELLITE INDUSTRY ASSOCIATION WELCOME LETTER



Following the 2005 hurricane season, the Asian Tsunami, the earthquake in Pakistan, and the 9/11 terrorist attacks, satellite communications immediately stepped in to fill the communications and command and control gap created by the devastation of the terrestrial network. The lack of operable, terrestrial communications infrastructure resulting from these disasters severely impeded command and control functions, situational awareness, and therefore, the disaster relief and recovery efforts of first responders.

When the telephone and broadcast networks went down, satellites remained on the job. Satellites connected emergency personnel and other first responders. Satellites reunited families. Satellites reconnected communities. Satellites enabled the world to witness the devastation of these disasters and also the many acts of heroism.

In many of the affected areas, satellites provided the **ONLY** source of communications in the hours, days, and weeks following these events. Satellites provided the basic 'operability' that terrestrial networks could not provide following those disasters.

The Satellite Industry Association (SIA) and its member companies thank you for reading the *First Responder's Guide to Satellite Communications*. We hope the information in this guide provides users in public safety, homeland security, and emergency preparedness with the basic fundamental information needed to effectively incorporate satellite communications into the preparations for the next natural or man-made disaster. 🚀

SIA is a U.S.-based trade association providing worldwide representation of the leading satellite operators, service providers, manufacturers, launch services providers, and ground equipment suppliers. SIA is the unified voice of the U.S. satellite industry on policy, regulatory, and legislative issues affecting the satellite business. Additional information can be found at www.sia.org.

SIA Executive Members include: Artel Inc.; The Boeing Company; The DirecTV Group; Globalstar LLC; Hughes Network Systems LLC.; ICO Global Communications; Integral Systems, Inc.; Intelsat, Ltd.; Iridium Satellite LLC; Lockheed Martin Corp.; Loral Space & Communications Ltd.; Mobile Satellite Ventures LP; Northrop Grumman Corporation; PanAmSat Corporation; SES Americom, Inc.; and TerreStar Networks Inc.; and Associate Members; ATK Inc.; EMC Inc.; Eutelsat Inc.; Inmarsat Ltd.; IOT Systems; Marshall Communications Corp.; New Skies Satellites Inc.; Spacecom Corp.; Stratos Global Corp.

LETTER FROM THE ASSOCIATION OF PUBLIC-SAFETY COMMUNICATIONS OFFICIALS



Dear Colleagues:

The Association of Public-Safety Communications Officials

(APCO) International is pleased to work with the Satellite Industry Association in order to provide a better understanding of the unique resource satellite communications brings to the field of public safety communications. While no single technology can fully support all of public safety's communications' requirements, the features of a non-terrestrial based platform provide a unique and important method for public safety to plan around the hazards of earth-based infrastructures that can be susceptible to all manners of natural and manmade catastrophes.

Public safety has been deeply impacted by the 2005 hurricane season. The lessons learned have forced agencies to look outside of their comfort zone and truly assess the requirements to provide for the continuity of operations that must occur when the rest of our infrastructure is in a state of failure. As a result, the satellite industry has responded quickly and effectively to the recent natural disasters.

Communications is ultimately responsible for providing sense and order to chaotic events. All agencies should review their state of preparedness and evaluate their entire communications requirements for events of epic proportions. Our first responders must be able to communicate with each other as well as within their chain of command in order to effectively respond. Public safety managers must be able to manage and control their field resources and be able to communicate their needs and response to the rest of the world. This requires a complete tool kit of communications resources.

APCO International hopes that this "First Responder's Guide to Satellite Communications," a joint educational effort, will be the first step for the first-responder community towards a better understanding of the resources available to them. By understanding the wide range of technical capabilities and limitations of the technology, the public safety community will be better prepared for the next disaster. ♣

Sincerely,

Wanda McCarley
President
APCO International

SATELLITE =

→ SATELLITE COMMUNICATIONS ARE:

- » Highly **Survivable** (Physical Survivability and Robustness)
- » **Independent** of Terrestrial Infrastructure
- » Able to Provide The Load Sharing and **Surge Capacity Solution** for Larger Sites
- » Best for Redundancy: They add a Layer of **Path Diversity** and **Link Availability**

→ SATELLITE SYSTEMS PERFORM EFFECTIVELY WHEN:

- » **Terrestrial** infrastructure is damaged, destroyed, or overloaded
- » **Interconnecting** widely distributed networks
- » Providing **interoperability** between disparate systems and networks
- » Providing **broadcasting** services over very wide areas such as a country, region, or entire hemisphere
- » Providing connectivity for the **“last mile”** in cases where fiber networks are simply not available
- » Providing **mobile/transportable** wideband and narrow-band communications
- » Natural disasters or terrorist attacks occur. Satellites are the best and most reliable platform for communications in such situations — fiber networks or even terrestrial wireless can be disrupted by tsunamis, earthquakes, or hurricanes. Satellites are **instant infrastructure**.

OPERABILITY

SATELLITES = UBIQUITY + RELIABILITY + OPERABILITY

→ BENEFITS OF USING SATELLITE:

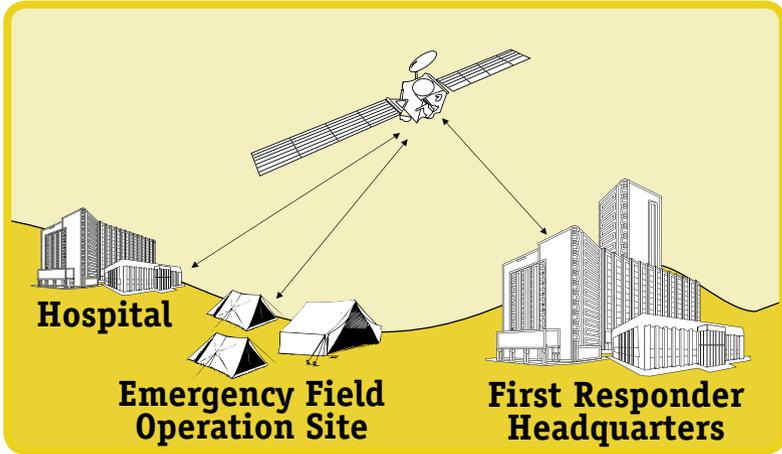
- » **Ubiquitous Coverage:** A group of satellites can cover virtually all of the Earth's surface.
- » **Instant Infrastructure:** Satellite service can be offered in areas where there is no terrestrial infrastructure and the costs of deploying a fiber or microwave network are prohibitive. It can also support services in areas where existing infrastructure is outdated, insufficient, or damaged.
- » **Independent Of Terrestrial Infrastructure:** Satellite service can provide additional bandwidth to divert traffic from congested areas, provide overflow during peak usage periods, and provide redundancy in the case of terrestrial network outages.
- » **Temporary Network Solutions:** For applications such as news gathering, homeland security, or military activities, satellite can often provide the only practical, short-term solution for getting necessary information in and out.
- » **Rapid Provisioning Of Services:** Since satellite solutions can be set up quickly, communications networks and new services can be quickly recovered and reconfigured. In addition, you can expand services electronically without traditional terrestrial networks. As a result, you can achieve a high level of communications rapidly without high budget expenditures.



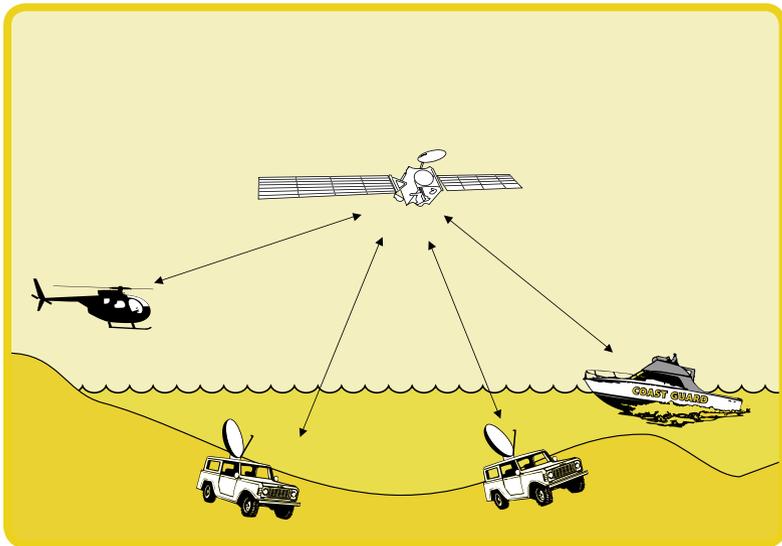
In times of disaster recovery, solutions provided via satellite are more reliable than communications utilizing land-based connections.

CAPABILITIES

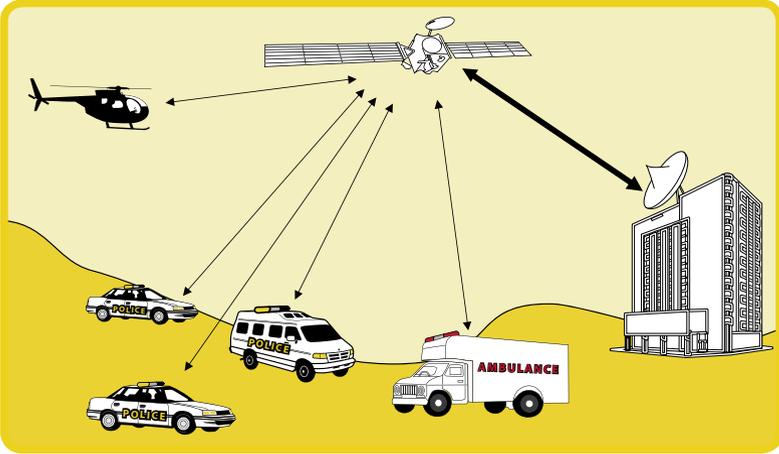
FIXED-TO-FIXED



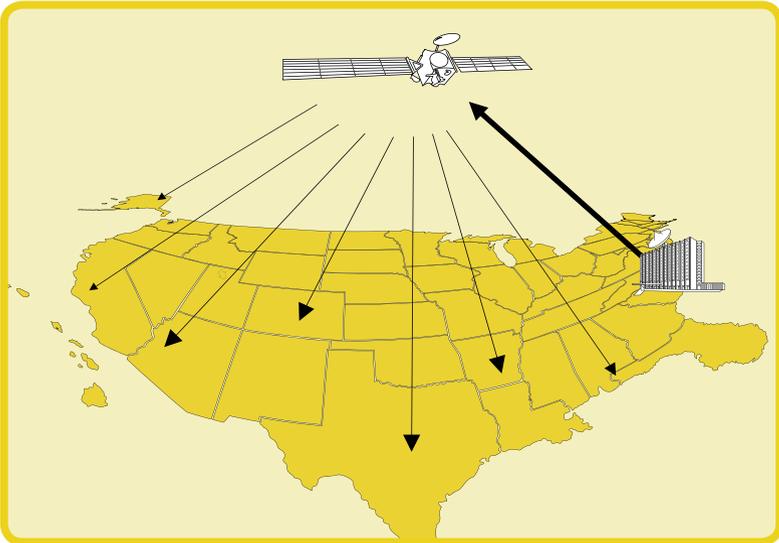
MOBILE-TO-MOBILE



FIXED-TO-MOBILE



POINT-TO-MULTIPOINT



INTEROPERABILITY

>> Satellite communications can interconnect with any other communications solution (i.e. LMR, Cellular, WiFi, etc.) via generic crossbanding equipment.



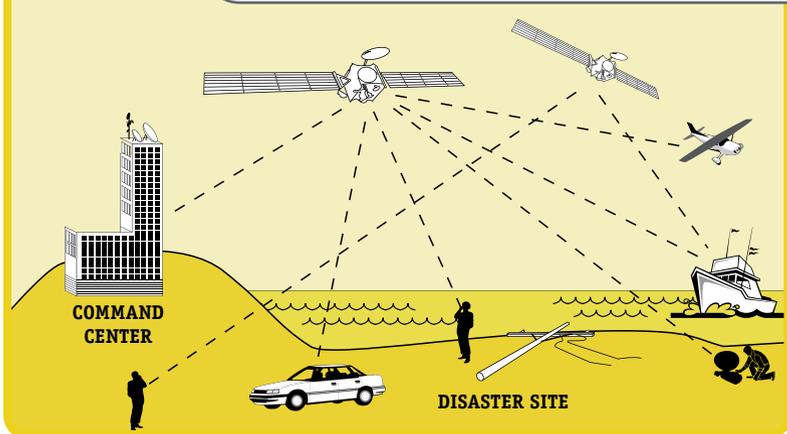


VOICE

VOICE

MSS

Mobile Satellite Service (MSS) uses portable satellite phones and terminals. MSS terminals may be mounted on a ship, an airplane, truck, or an automobile. MSS terminals may even be carried by an individual. The most promising applications are portable satellite telephones and broadband terminals that enable global service. In addition, emerging mobile communication networks will also offer voice, video and data services via "smart" chips inserted in handheld devices (i.e. cell phones, LMR's, PDA's, laptops, etc.) that integrate cellular and satellite technology.



→ MSS APPLICATIONS:

Mobile Telephony

Push to Talk Radio

Emergency Response Coordination

Dispatch Coordination

Communications On The Move

Asset Tracking

Data Transfer

Lone Worker Protection

Environmental Monitoring

Event Reporting

Messaging

Mobile Telephony

→ QUICK FACTS Mobile Telephony

- Water, shock & dust resistant for rugged environments
- One-touch dialing
- Use phone to transmit and receive data
- Headset/hands-free capability
- Provides up to 30 hours of standby time
- Provides up to 3.6 hours of talk time
- Call forwarding capability
- Two-way SMS capability



4 EASY STEPS TO CONNECT

STEP 1: MEASURING BATTERY LIFE

→ Most satellite phones display the battery level on the main menu. Read the battery life specifications provided by the phone manufacturer. Be aware that the battery life will vary depending on the use. Talk time ranges from 2 to 3.5 hours on average; stand-by time ranges from 20 to 40 hours depending on the phone.

STEP 2: FINDING A CLEAR LINE-OF-SIGHT TO THE SATELLITE

→ You need to be outside when using a satellite phone. Make sure you have a clear view of the sky and that you are away from buildings and obstacles. Rotate and extend the antenna, and point it straight up to the sky. Talk with the antenna above your head and vertical to the ground.

STEP 3: PLACING A CALL

→ Some satellite phones require that you dial 00 before the country code; others require you to dial a "1" before the area code if you are dialing inside the United States; or that you dial a particular code before calling to another satellite phone on the same service. Make sure to carefully read the instructions given by your service provider.

STEP 4: SENDING A 911 CALL

→ Most satellite phones can make 911 calls.

Mobile Voice/Data

ABOUT

Broadband Global Area Network

- Capable of e-mail, Internet, VPN, and telephone applications
- Offers broadband data up to 492kbps
- Offers streaming data rates on demand up to 256kbps
- Responders can speak to off-site leadership, while sending a live video update
- No technical expertise required
- Easily carried in a backpack for quick mobility
- Coverage available across U.S., Central and Eastern Canada
- Encrypted Air Interface
- Communications-on-the-move terminals are available for vehicles



→ QUICK FACTS Satellite Two-Way Radio/Telephone

→ **Seamless Coverage:** Satellites act as one big radio tower for all of North America. Users don't have to worry about service interruptions associated with roaming, because it is all one network.

→ **Interoperability:** Talk groups can be configured to allow for interagency communications between local, regional, and national emergency response organizations, including terrestrial-based two-way radio systems and two-way cellular networks.

→ **Network Flexibility:** Two-way radios can be interfaced with existing terrestrial fleet communications infrastructures or make a telephone call.

→ **Secure Communications:** The network employs the IMBE (Improved Multi-Band Excitation) voice codec compatible with Project 25 digital voice coder. Digital coding and scrambling prevents casual eavesdropping or monitoring of calls.

→ **Satellite Two-Way Radios** can be installed in a fixed location or can be used in mobile environment while driving.



VIDEO/DATA

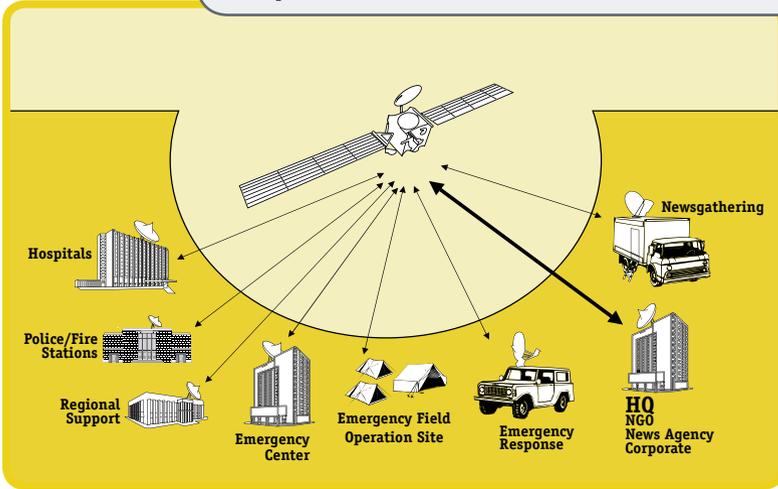


SOURCE: HUGHES NETWORK SYSTEMS, GETTY IMAGES.

VIDEO/DATA

FSS

Fixed Satellite Service (FSS) has traditionally referred to a satellite service that uses terrestrial terminals communicating with satellites in geosynchronous orbit. New technologies allow FSS to communicate with mobile platforms.



→ FSS APPLICATIONS:

Cellular Restoration

Wi-Fi Restoral

Emergency Phone Bank

Communications On The Move

PSTN Backhaul

Voice-over-IP

Broadband Internet Access

Live Video

Telemedicine

Video Conferencing

Broadband Connectivity

→ SATELLITE VSAT NETWORKS:

- » A satellite Very Small Aperture Terminal (VSAT) network consists of a pre-positioned, fixed, or transportable VSAT that connects to a hub station to provide broadband communications to hospitals, command posts, emergency field operations and other sites.
- » VSAT(s) are low-cost, 2 to 4 foot antennas equipped with a fixed mount that can be made survivable to over 100 mph winds. There are also variants of VSATs that are transportable which can be on-the-air within 30 minutes and require no special tools or test equipment for installation.
- » Remote FSS VSAT equipment requires standard AC power for operation, but comes equipped with lightweight, 1 and 2KW, highly efficient, and self-contained power generator equipment for continuous operation, regardless of local power availability.
- » Turnkey FSS communications packages can be provided with satellite bandwidth and ground equipment fully integrated.
- » Internet access and Internet applications (i.e. VoIP) are supported through the remote VSAT back through the FSS provider teleport location which is connected to the PSTN and/or the Internet.
- » A typical VSAT used by a first responder may have full two-way connectivity up to several Mbps for any desired combination of voice, data, video, and Internet service capability.
- » VSATs are also capable of supporting higher bandwidth requirements of up to 4 Mbps outbound and up to 10+ Mbps inbound.
- » The FSS network topology consists of remote point-to-multi-point and two-way satellite IP connectivity.
- » Delivered bandwidth can support a substantial number of phone lines (i.e. phone bank).

Transportable FSS VSATs providing high-speed Internet, data, voice, and/or video access with automatic set-up and simple operation.



VIDEO/DATA

Network Restoration

→ TERRESTRIAL BROADBAND, LMR, CELLULAR, OR WIMAX AND WIFI INFRASTRUCTURE RESTORATION:

- » VSAT networks are able to provide high-speed, two-way emergency communications restoration in the wake of a natural or man-made disaster when all other forms of high-speed communication are unavailable.
- » VSAT networks provide connectivity for restoral and contingency communications, providing for higher volume VoIP telephony, data, video and Internet access, thereby connecting remote locations to the rest of the world in a time of crisis.

→ APPLICATIONS SUPPORTED:

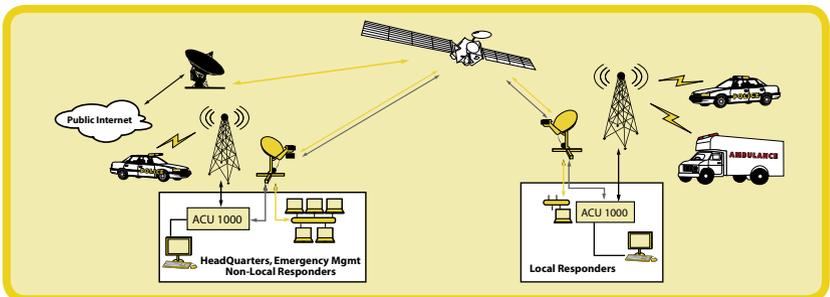
» Telco Terrestrial and WiMAX/WiFi Infrastructure Restoration

- VSAT networks provide for restoration of the Public Switched Telephone Network (PSTN) and Internet access to meet emergency communications demand, with high-speed connections that are independent of the local Telco ground system infrastructure to re-establish voice, data, and video connectivity.
- VSAT networks equally provide for restoration of wireless cellular nodes and WiMAX (Worldwide Interoperability for Microwave Access) WAN (Wide Area Network) networks to be re-established for private First Responder networks or to reconstitute local Telcos and Internet Service Providers (ISPs).

» Wireless Handheld Interoperability

FSS VSAT networks are fully compliant to support IP based Ethernet data to/from P25 wireless handheld radio systems.

- FSS VSAT networks may provide for IP phone signaling, acting as a redundant link between remote fire, rescue and other first responder's operations centers to support any radio system with IP connectivity, [i.e. 700 MHz].



Communications On The Move (COTM)

→ MOBILE COMMAND AND CONTROL COMMUNICATIONS:

FSS and MSS COTM solutions can provide fully mobile IP data and voice services to vehicles on the move up to 60 mph. The comprehensive FSS COTM offering includes the terminal, teleport, and satellite capacity to provide high performance COTM IP connectivity.

→ TYPICAL APPLICATIONS SUPPORTED:

- » Any vehicle can also serve as a mobile command post while in-route and as a fixed command access point for personnel upon arrival at the designated location when local Telco terrestrial and wireless infrastructure are not available.
- » A full 10 Mbps downlink channel is delivered via FSS to the vehicle and 512 Kbps uplink channel transmitted from the vehicle to the Internet using IP support for voice, video and data simultaneously.
- » Support for 802.11x wireless access allows vehicle to function as wireless hot spot access point for a First Responder convoy while in-route or a fixed hot spot for personnel upon arrival.



MSS Comm-on-the-Move Equipment

FSS Comm-on-the-Move Command Post



GLOSSARY

SATELLITE COMMUNICATIONS TECHNOLOGY TERMS AND DEFINITIONS

ANTENNA

A device for transmitting and receiving signals. An antenna is part of an Earth Station.

BACKHAUL

A terrestrial communications channel linking an earth station antenna to a local switching network or population center.

BANDWIDTH

A measure of spectrum (frequency) use or capacity. For instance, a voice transmission by telephone requires a bandwidth of about 3000 cycles per second (3KHz).

CHANNEL

A frequency band in which a specific broadcast signal is transmitted. Channel frequencies are specified in the United States by the Federal Communications Commission.

DOWNLINK

The link from the satellite down to the Earth Station.

EARTH STATION

The buildings, hardware, software and antennas used to communicate with a satellite.

FDMA

Frequency Division Multiple Access. A way of sharing a channel by assigning different frequencies to different users.

FOOTPRINT

The area of the Earth's surface from which an Earth Station can transmit to or receive from a particular satellite.

FREQUENCY BANDS

Internationally, frequencies are divided into well-defined bands. For satellites, the relevant bands are:

→ L-Band

As defined by IEEE std 521, the frequency range from 1 to 2 GHz. The L-band term is

also used to refer to the 950 to 1450MHz frequency range used for mobile communications. L-band is used for Mobile Satellite Services and offers good penetration through adverse weather conditions and foliage.

→ C-Band

The frequency range from 3.7 to 6.2 GHz. Transmissions are less affected by atmospheric conditions such as snow and rain. However, C-band transmissions have low power, so Earth Stations must be rather large to compensate dish size. Applications include public switched networks and Internet trunking.

→ X-Band

The frequency range from 8.0 – 12.0 GHz. The X-band frequency enables high power operations with very small terminals. Applications include COTM, manpacks, emergency communications and airborne and shipboard platforms. X-band is also less vulnerable to rain fade and adjacent satellite side lobe interference than other frequencies.

→ Ku-Band

The frequency range from 11.7 to 14.5 GHz. Ku-band has higher power than C-band allowing for smaller dishes to be used. However, the higher frequency of Ku-band makes it more susceptible to adverse weather conditions than C-band. Applications include VSAT, rural telephony, satellite news gathering, videoconferencing, and multimedia.

→ Ka-Band

The frequency range from 17.7 to 21.2 GHz. Has a higher power than Ku-band allowing for smaller dishes to be used and therefore, will be used for high-bandwidth interactive services such as high-speed Internet, videoconferencing, and multimedia applications. Ka-band transmissions are more sensitive to poor weather conditions than Ku-band.

HUB

The master station through which all communications, to, from and between terminals must flow.

KBPS

Kilobits per second. Refers to transmission speed of 1,000 bits per second.

KHZ

KiloHertz. One KiloHertz is the equivalent of one thousand Hertz, or one thousand cycles per second. Used to measure frequency and bandwidth.

LAN

Local Area Network. A geographically localized network.

MHZ

MegaHertz. One MegaHertz is equivalent of one million Hertz, or one million cycles per second. Used to measure frequency and bandwidth.

SPOT BEAM

A satellite beam with concentrated geographic coverage.

TDMA

Time Division Multiple Access. A way of sharing a channel by assigning different time slots to different users.

TERMINAL

One of the communications stations that receives, processes, and transmits signals between itself and a satellite.

TRANSPONDER

A device located on board the satellite which receives signals uplinked from an earth station and transmits them back to earth on a different frequency.

UPLINK

The link from the earth station up to the satellite.

VSAT

Very small aperture terminal. Refers to small earth stations, with antennas usually in the 1.2 to 2.4 meter range. Small aperture terminals under 0.5 meter are sometimes referred to Ultra Small Aperture Terminals (USAT's)

WIFI

Wireless Fidelity - A brand originally licensed by the Wi-Fi Alliance to describe the underlying technology of wireless local area networks based on the IEEE 802.11 specifications. A person with a Wi-Fi device, such as a computer, telephone, or personal digital assistant (PDA) can connect to the Internet when in proximity of an access point. The region covered by one or several access points is called a hotspot.

WIMAX

WiMAX is a wireless communications technology that provides high-throughput broadband connections for considerably longer distances than that offered via WiFi (Wireless Fidelity) LAN (Local Area Network). 🐘



FAQ

FREQUENTLY ASKED QUESTIONS

WHAT IS A COMMUNICATIONS SATELLITE?

A communications satellite is a device used to receive and transmit radio signals in space. The satellite has communications equipment including receive and transmit antennas, power, and electronic components which enable it to receive a signal from a satellite terminal/user and then transmit that same signal to another satellite terminal/user.

WHAT IS A SATELLITE TERMINAL?

A satellite terminal is anything you use to receive or transmit a signal via a satellite, such as a satellite phone, satellite radio, satellite dish/antenna or Very Small Aperture Terminal (VSAT).

DO SATELLITE PHONES WORK JUST LIKE CELL/WIRELESS PHONES?

Satellite phones offer many of the same characteristics as cellular phones including a similar user interface and design. Satellite phones are slightly larger in size than cellular phones because the antenna required to communicate on the satellite frequencies must be larger than a cellular phone antenna. Another fundamental difference between traditional wireless phones and satellite phones is that when the phone is in satellite mode, it must be within line-of-sight of the satellite in order to complete calls (i.e. you need to have a clear view of the sky). Therefore, a traditional satellite phone cannot be used indoors. However, some satellite phones will work indoors in cellular mode when the user is within a cellular-serviced area.

ARE SATELLITE SERVICES AND EQUIPMENT RELIABLE?

Yes. Overall, satellite service and equipment are reliable. A significant portion, if not the majority, of the

problems encountered in the field with dropped service are traceable to “operator error” resulting from a lack of training/familiarity with the equipment.

AREN'T SATELLITE COMMUNICATIONS COST PROHIBITIVE FOR ANYONE EXCEPT DOD?

Today, satellite communications can be a sound economical option for any federal, state, or local first responder – especially when equipment and service plans are purchased in bulk and for an extended period of time. For instance, satellite phones can be purchased for hundreds of dollars with service rates available for less than a dollar a minute.

WHY ARE SATELLITES AN ESSENTIAL COMPONENT IN ALL CRITICAL TELECOM NETWORK PLANNING?

To enable rapid deployment and/or restoration and truly mobile communications, emergency personnel should incorporate satellite services and networks as a redundancy requirement in any communications network or architecture. Satellite systems should be emphasized and included in the early planning of these initiatives to ensure there is a back-up communications solution when the terrestrial network is damaged or destroyed. Without a satellite component to any future emergency response communications network, the emergency communications network will be rendered useless for First Responders when the terrestrial network next sustains damage in overloading. ❏

PROVIDERS

SATELLITES = UBIQUITY + RELIABILITY + OPERABILITY

SATELLITE SOLUTIONS PROVIDERS



Point of Contact: north_america@inmarsat.com
Telephone Number: (703) 647-4760
Website: www.inmarsat.com
Solutions: Mobile Satellite Services (MSS); Broadband Global Area Network (BGAN)



Point of Contact: Britt Lewis
Telephone Number: (301) 571-1210
Website: www.intelsatgeneral.com
Solutions: Ground infrastructure, mobile and fixed satellite systems, technical expertise, and secure communications network solutions.



Point of Contact: info. americom@americom-gs.com
Telephone Number: 703-610-0988
Website: www.americom-gs.com
Solutions: FSS fixed, deployable, and mobile Internet, voice and data broadband connectivity.



Point of Contact: John Schroeder
Telephone Number: (301) 571-6265
Website: www.iridium.com
Solutions: Mobile voice, data and tracking capabilities on an immediate basis.



Point of Contact: Larry Haughey
Telephone Number: (301) 590-7402
Website: www.xtarllc.com
Solutions: Fixed and COTM X-band communications services.



Point of Contact: Jim Frek
Telephone Number: (571) 921-4619
Website: www.terrestar.com
Solutions: Next generation mobile communications that seamlessly integrates cellular and satellite networks through customized IP-based applications.



Point of Contact: Amir Dehdashty
Telephone Number: (301) 601-2674
Website: www.hughes.com
Solutions: Broadband satellite networks, backup services, continuity of operations and other managed network services.



Point of Contact: info@msvlp.com
Telephone Number: (800)-216-6728
Website: www.msvlp.com
Solutions: Interoperable two-way radio, telephone, and mobile data solutions.



Point of Contact: Jennifer Brooks
Telephone Number: (301) 968-1972
Website: www.stratosglobal.com
Solutions: Multiple VSAT/MSS solutions for emergency and contingency communications.



Point of Contact: Robert W. Turner
Telephone Number: (202) 478-7121
Website: www.ses-newskies.com
Solutions: Fixed Satellite Services to include voice, data, video and Internet connectivity.



Point of Contact: Len Corasaniti
Telephone Number: (301) 361-0091
Website: www.globalstarusa.com/en/
Solutions: High quality, cost effective satellite voice and data communications to over 120 countries



Point of Contact: Sonny Marshall
Telephone Number: (571) 223-2010
Website: www.marshallcomm.com
Solutions: Secure content delivery, mobile VSAT, and custom turnkey communications solutions.



Point of Contact
info@eutelsatinc.com
Telephone Number: (202) 756-1460
Website: www.eutelsatinc.com
Solutions: Fixed satellite video applications, broadband IP connectivity, mobile data and telephony communications.

For more information and an electronic version of the guide, please visit www.sia.org and click on the link *FIRST RESPONDER'S GUIDE TO SATELLITE COMMUNICATIONS.*

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