Satellite Phones

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On March 7, 1876, the U.S. Patent Office granted Alexander Graham Bell Patent # 174,465 covering his &quotelectrical speech machine,&quot which Graham created to improve upon the telegraph. Graham imagined great uses for his invention, but could he have possibly perceived the telecommunications landscape we now see, almost 100 years later?
Even the most creative science fiction writers of Bell's time would probably have responded to the notion of satellite telecommunications like life on Mars, yet here we are with portable handsets that can be activated in the Arizona desert to talk to someone in the middle of the Atlantic Ocean.
Satellite phones aren't just for James Bond anymore. Thanks to advancements in satellite and communications technology, as well as the development of handheld phones only slightly larger than cellular handsets, satellite phones are becoming available for widespread use.
Until recently, the satellite phone was a heavy, expensive, lap-top sized machine used only by journalists covering stories in remote locations, military personnel conducting top-secret operations in the jungle or aid workers in remote parts of foreign countries. Now, satellite communications are being rapidly adopted by many industries and individuals for a variety of communications needs.
Technological advances in satellite transmission and the introduction of handheld devices have created a new category of satellite communications, called Global Mobile Personal Communications by Satellite (GMPCS). The benefits of GMPCS are turning the promise of global, mobile communications into reality by providing a universal dial tone that is accessible from virtually anywhere at anytime.
Who Uses These Things?
Satellite phones serve the needs of primarily three audiences:
&#149 *People who want cellular coverage but can't get it because they live in rural or remote areas not served by cellular, or in smaller communities with limited cellular coverage.* For example, the town of Fredericksburg, Texas, one of Texas' top tourist attractions with more than one million visitors per year, has a population of 7,500. But cellular coverage is limited and sketchy in this highly trafficked area. And the number of residents who live outside the city limits can't obtain cellular service at all. Satellite phone service is ideal for these individuals.
&#149 *Individuals living or working in urban areas served by cellular, but regularly traveling in and out of cellular &quotzones&quot for work or play.* This includes suburban dwellers, traveling salespeople, recreational vehicle owners, and weekend outdoor sports enthusiasts. Many areas right outside large cities have sketchy coverage &#151 even someone living 30 miles outside of the technology hotbed of San Francisco has trouble getting continuous cellular coverage. Also, cellular coverage is often absent on long highway stretches between cities. Satellite phones, which can be usually used in both cellular and satellite mode, are filling in

the gaps via satellite while offering the user the opportunity to use less-expensive cellular whenever possible.
&#149 *Companies with operations in remote areas &#151 the most avid users.*
Industries with operations in remote areas &#151 such as oil, forestry, construction and mining &#151 have found satellite phones to be one of their most important pieces of equipment, for voice communications now and for data transmission in the near future. The maritime industry has discovered the value of satellite phones, which can be used up to 200 miles off shore, as compared to the 30-mile off shore reach of cellular.
Satellite phones have also played a vital role in serious emergency situations. A sergeant from the Orange County search and rescue team recently put his phone to use while in a remote location. The sergeant was alerted about a man who had kidnapped his stepdaughter and was suspected of harming or even killing her. Time was critical. Clothing was found in the man's car, and its scent could be used to search for the girl. The sergeant quickly needed to get bloodhounds to the vehicle to pick up the scent, and then out to the search area, but could not reach the substation on his cellular phone and there were no landlines nearby. Using his satellite phone, the sergeant was able to contact the substation and immediately dispatch the bloodhounds to the scene without having to return to base and then back out into the field again.

Not the Same as Cellular

There is a common misconception that satellite telephony works &#151 or should work &#151 just like cellular phone service. But at the very basic level, there are differences. The wireless cellular call signal only travels a limited distance through the air to a nearby receiving tower. With earlier generation satellite systems, the call signal would travel much further: to a satellite in geostationary orbit, with all the resulting voice delay. This, along with the relatively high cost of satellite equipment, had until recently prevented mass adoption of traditional satellite services for telephony. But advances in satellite design and related technologies have made it now possible to reliably deliver satellite-based services on a wide scale.
Satellite and cellular also differ greatly with regards to one of the most important issues in telecommunications: coverage. Those using cellular service may not be able to get a signal if they travel outside their service area or beyond areas with roaming agreements. And cellular services are primarily concentrated in metropolitan areas. They are generally not offered in rural communities because it has been difficult to find investment capital for areas where some believe profitable returns cannot be achieved.

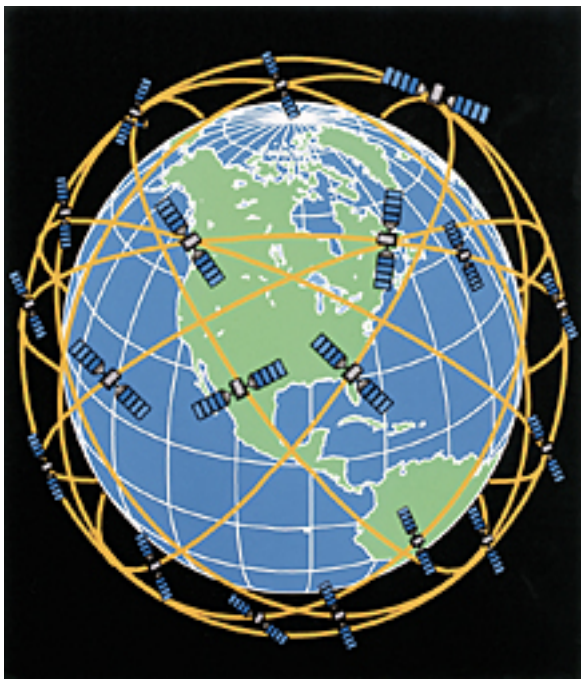

Figure 1. The Globalstar&#153 48-satellite low earth orbit (LEO) constellation provides wireless communication services including voice and data, paging and messaging to areas of the world under-served or unserved by existing terrestrial systems.

On the other hand, GMPCS delivers near-universal coverage, from isolated villages to major metropolitan areas, mountaintops to skyscraper observation decks. With this kind of reach, satellites can not only keep international business travelers reliably connected while on the road, but also help quickly and affordably expand basic communications services into areas that do not have an existing or reliable land infrastructure. Advanced devices such as tri-mode handheld phones allow users to access satellite-based phone service, as well as the analog and digital terrestrial wireless networks &#151 the mode utilized primarily in urban areas.

Overcoming the Technological Challenges to Satellite Telecommunications

In order to provide global telecommunications coverage, GMPCS providers have tackled a number of challenges. For instance, uninterrupted satellite communications require a clear &quotline of sight&quot to the intended receiver, which means that the handsets can't be used in satellite mode in certain locations such as indoors. Signal blockage can also result from terrain or other natural features. Further, with every signal that is beamed down from space, satellite communications compete for a share of the radio frequency spectrum with mobile phones, LANs and microwaves.

Companies such as Globalstar have developed new technologies to respond to these and other technological hurdles. Three of these technologies: Multi-mode, Path Diversity and "Dynamic Load Balancing" help ensure reliable delivery of satellite services around the globe.

Multi-mode technology is the blueprint for a dual-mode system that allows calls to use either satellite or wireless mode from the same handset. It helps assure that calls are completed in the most efficient way possible, utilizing terrestrial networks where available, and using satellite mode when terrestrial service is not available.

Path Diversity is a system by which the power resource of each satellite is divided among the users who are on the system at any one time, ensuring balanced and optimal system performance. This system also allows the power source of the

satellite to be increased in areas where there is heavier usage and reduced in areas where usage is light, maximizing the capacity of each satellite.
Dynamic Load Balancing is the patented method of signal reception, which enables a call to be transmitted to several satellites at once, thereby minimizing the chance that a call is dropped. Path Diversity, combined with Code Division Multiple Access (CDMA) technology, enables Globalstar to use the limited radio spectrum more efficiently by allowing a large number of wireless users to simultaneously access a single radio frequency channel while reducing interference. This makes satellite communications more reliable, ensuring access when users need it and performance under the most rigorous conditions.
The CDMA concept can be compared to carrying on a conversation at a party, where everyone in the room is talking simultaneously. Imagine that the conversations around you are being held in different languages that you do not understand. They would all sound like noise to you. However, if you knew the "code," or in this case the appropriate language, you could filter out the unwanted conversations and listen only to the conversation directed to you. This is analogous to the technique used in CDMA.

Figure 2. QUALCOMM GPS1600/CDMA/AMPS Tri-Mode Phone.

Overcoming the International Issues Challenge to Satellite Telecommunications

The complex path that a satellite call must follow creates the second major hurdle that GMPCS providers have overcome: international regulatory issues and international marketing. In order to provide global coverage, GMPCS providers first had to provide global cooperation. In the International Telecommunication Union (ITU) Memorandum of Understanding (MoU) developed in February 1997, the GMPCS industry and many governments and regulators agreed on the need to reach regional, and preferably global, arrangements &#151 under the auspices of the ITU &#151 on issues related to facilitating the introduction of GMPCS services around the world. To that end, the participants agreed on the need to standardize regulations and work together to harmonize certain technologies, network components and frequency spectrums.
While the ITU overcame one major hurdle, Globalstar overcame another. Globalstar chose a decentralized business model between itself and its in-country (or in-region) international service providers. In this model, the in-country partner &#151 a

national and/or local service provider &#151 owns and manages the communications gateways as well as markets and distributes satellite services in their operating areas. Globalstar sells access to its system, or wholesale minutes, to its partners, typically in an 'exclusive rights' arrangement.
This model is a win-win for both the GMPCS provider and its partners. The national and local providers obtain all necessary regulatory approvals, and own and operate the gateways necessary to serve their respective markets. The satellite service provider is free to concentrate on its GMPCS core business, since its in-country partners have the knowledge and relationships required to resolve not only most of the regulatory issues associated with international telecommunications business, but most of the tariff issues as well. This approach is preferable to host countries because all calls that originate or terminate in the host country will pass through the local ground station and a percentage of the charges related to each call will go to the national network. This creates a revenue stream amenable to the host country.

Satellite Phones - What Will They Come Up With Next?

Alexander Graham Bell could not possibly have predicted the shape of today's telecommunications when he rang in the industry in 1876. Today's GMPCS providers can't possibly predict the shape of things 100 years from now. Already in the works for release in the very near future are data capabilities for satellite phones, allowing people to not only stay in voice communication virtually anywhere, but also stay connected to the information superhighway.
The only thing certain is change, and if the next 100 years are anything like the last, we'll probably be able to pick up a phone and call Mars &#151 or send them an email.

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