IRIDIUM BACKGROUNDER

System Description:

Iridium is a worldwide digital, satellite-based, cellular personal communications system primarily intended to provide commercial, rural, mobile service via either handheld mobile or transportable user units, employing low-profile antennas, to millions of individual users throughout the world. The system includes a constellation of 77 small, smart satellites in low-earth orbit which are networked together as a switched digital communications system utilizing the principles of cellular diversity to provide continuous line-of-sight coverage from and to any point on the earth's surface, as well as all points within an altitude of about 100 miles. The system also includes space-to-earth gateways which interface into the public switched telephone network (PSTN). Service will be available on a country-by-country switched basis as negotiated with the individual governments and/or the individual telephone companies. Unlike the terrestrial cellular telephone system, Iridium is best suited for areas where the traffic density is low -- sparsely populated areas, the oceans, and areas where personal communications is just emerging. In these emerging markets, Iridium can be used as a primer for the eventual terrestrial system.

Voice:

The system is designed as an entirely digital communications system with 8KHz bandwidth available for each voice channel. Vocoders operating at 4.8 kilobits per second are employed in the user units to recreate the audio signals and in the gateways to couple to the analog PSTNs.

Data:

The system is designed to allow a user to substitute a data link in lieu of a voice link which would operate at a rate of 2400 baud.

Modulation:

The user links use PSK modulation with a multiplexing scheme that will be compatible with digital terrestrial cellular systems.

Spectrum:

The system is designed to operate in the 1 to 2 GHz region with a capability of up to 29 MHz for the uplink and 29 MHz for the downlink with the expectation that spectrum allocation may grow as the system demand grows. Gateways and crosslinks will operate at approximately 20 GHz.

Subscriber Unit:

The system is designed to operate with a subscriber unit similar to the Motorola Dyna-Tac.

Constellation:

The constellation of 77 satellites at a height of 413 nautical miles was chosen to assure that every point on the earth's surface is continuously in line of sight of one or more of the satellites. The constellation includes 7 planes of 11 satellites each in circular polar orbits. The satellites all "travel in the same direction," meaning that the seven planes of satellites co-rotate towards the

north pole on one side of the earth and "cross over" the pole, traveling down to the south pole on the other side of the earth. The 11 satellites in each plane are equally spaced around their planar orbit, with the satellites in planes 1, 3, 5 and 7 in phase with one another, and those in planes 2, 4, and 6 in phase with each other and halfway out of phase with 1, 3, 5 and 7. (In order to prevent the satellites from colliding at the poles, a tolerance on the term "in phase," as used above, is employed and a minimum miss distance is maintained.) Each of the seven co-rotating planes are separated by slightly more than 27 degrees, and the "seam" between planes 1 and 7, which represents plane 1 satellites going up on one side of the earth and plane 7 satellites coming down in the adjacent plane, is separated by slightly more than 17 degrees.

Cells:

Each Iridium satellite has the capacity to operate 37 cells which are projected onto the earth's surface. These separate cells allow for higher gain antenna beams and for spectral efficiency in the system since different cells are able to reuse frequencies and service different customers with the same channel. These cells are spatially separated by the main mission antenna on board each satellite.

The 37 cells are created in a contiguous hexagonal pattern with one center cell surrounded by three rings of smaller cells. The three rings consist of 6, 12, and 18 cells respectively, and each of the 37 cells are created such that each is of approximately the same shape and size. The cells are approximately 360 nautical miles in diameter, and the ensemble of cells covers the earth's surface. In operation, cells will be turned on and off to singly cover all points within which operation is desired, as well as all necessary gateways, and to conserve energy on board the satellites.

The constellation of satellites and its projection of cells is somewhat analogous to a cellular telephone system. In the case of cellular telephones, a static set of cells serves a large number of mobile users; in the case of Iridium, the users move at a relatively slow pace relative to the spacecraft, which move at about 7,400 meters per second, so the users appear static and the cells move. The advantage for Iridium, given this situation, is that the handoffs required as a call migrates from cell to cell are more deterministic in that, with the spacecraft's high velocity, handoffs are largely in one direction and the potential handoff is not to one of six adjacent cells but more commonly to one of two.

Crosslinks:

Each satellite operates crosslinks as a medium used to support internetting. These operate at approximately 20 GHz and include both forward and backward looking links to the two adjacent satellites in the same orbital plane. These are nominally at a fixed distance and angle 2,173 nautical miles away. Up to 6 interplane crosslinks are also maintained and these links vary in angle and distance from the satellite with a maximum distance of 2,500 nautical miles.

Gateways:

Each satellite has the capacity to interlink (via the crosslink network) to earth-based gateways that employ high-gain antennas. The initial system will use 20 gateways. Gateways employ

standard cellular switches and interface both to the various local PSTNs and to the local billing offices.

Delay:

Unlike geostationary satellite communications systems, interconnect distances in the Iridium system are on the order of the wireless telephone and echo effects are minimized.

Spacecraft Life:

The Iridium spacecraft are designed for a 5 year mean mission duration (MMD) with expandables sized for 8 years. A small expandable launch vehicle, such as Pegasus, will service the Iridium constellation, which, in its steady-state mode (after initial deployment), will replace satellites on a routine basis and emergency replacements within 36 hours.

Growth:

With such a dynamic constellation, constantly being refurbished, the system design takes on a unique freshness in its baseline. High reliability is designed into the system to assure the 5 year MMD, but redundancy, per se, is avoided wherever possible. The initial system is sized to handle the system capacity expected, with some margin, for the first 8 years -- the system design, however, incorporates all the necessary "hooks" to allow for capacity growth in subsequent "blocks" of satellites. Technological improvements in power available on board spacecraft, launch, weights, antenna technology, electronic technology and other areas will allow for system growth within the overall system design. This will provide for a natural evolution as Iridium matures.

MOTOROLA UNVEILS NEW CONCEPT FOR GLOBAL PERSONAL COMMUNICATIONS; BASE IS CONSTELLATION OF LOW-ORBIT SATELLITES

In a move that heralds a new era in personal communications, Motorola, Inc., Schaumburg, Ill., announced a global communications system that will allow people to communicate by telephone anywhere on earth -- whether on land, at sea or in the air -- via portable radiotelephones operating as part of a satellite-based system.

Callers using the new system will not need to know the location of the person being called; they will simply dial that person's number to be connected instantly.

Motorola calls the new system Iridium and has established a satellite communications business unit to develop it. The heart of Iridium is a "constellation" of 77 satellites in low-earth orbit, working together as a digital switched communications network in space. The system will be able to handle both voice and data.

"Iridium brings personal communications to the world -- it represents the potential for any person on the planet to communicate with any other," said John F. Mitchell, vice chairman of Motorola Inc. "For this reason, Iridium marks the next major milestone in global communications."

"It is an ambitious concept, which will bring us significantly closer to 'the global village' As such, Iridium boldly extends the Motorola tradition of innovation in personal communications recognized through our leadership in cellular telecommunications, private two-way radio and radio paging."

IRIDIUM ADVANTAGES:

Motorola's Iridium system provides several key improvements over the geosynchronous satellites currently used for international communications. The low altitude of Iridium satellites allows easy radio links with portable radiotelephones on earth, using small antennas rather than satellite dishes. It also supports reuse of radio frequencies, in a similar fashion to land-based cellular systems.

In addition, the system solves the problem of low-orbit satellites "disappearing over the horizon" by combining a large number of satellites in a space-based, inter-satellite switching system.

Although Iridium uses cellular communications principles, it is designed to complement, not compete with, land-based cellular systems. Land-based cellular will remain the most efficient way to serve high-density areas, whereas Iridium will bring communications to remote or sparsely populated areas that lack communications. Iridium and terrestrial cellular will work together to eventually provide a seamless communications service for the entire world.

SMALL SATELLITES:

The satellites are small (approximately one meter in diameter and two meters tall) and lightweight (approximately 315 kilograms, or 700 pounds). They are considered "smart" because they can switch and route calls in space.

Each satellite antenna pattern will project 37 cells onto the earth's surface. Each cell will provide communications coverage for an area of the earth's surface roughly 350 nautical miles in diameter; people will communicate with the satellites using equipment operating at frequencies of 1.5/1.6 Gigahertz. In addition to voice, the digital system can transmit data at a rate of 2400 baud.

The Iridium satellites can be placed into orbit by a variety of launch vehicles. The U.S. Delta and Atlas rockets, and the European Ariane, could launch multiple satellites. The new Pegasus air-launched vehicle could launch individual satellites. Each satellite is expected to have a lifespan of five to six years.

Another key component of the system will be a network of "gateway" surface facilities in various countries that will link Iridium with the public switched telephone network. These gateways will store customer billing information and will constantly keep track of each user's location. An Iridium system control facility will maintain the satellite network and the overall operation of the system.

LIGHTWEIGHT, PORTABLE SUBSCRIBER UNITS:

Subscriber units for Iridium are similar to Motorola's original cellular radiotelephones and will offer additional features

such as latitude, longitude, altitude, and Greenwich Mean Time.

In addition to the lightweight portables, Iridium subscriber units will be available as mobiles or small fixed units.

ANTICIPATED USERS:

The Iridium system will support millions of users worldwide, with a total capacity more than 10 times greater than current geosynchronous satellite systems.

For low-density areas not economically feasible for cellular phone networks, Iridium will be an ideal alternative for mobile telephone service. In sparsely populated or underdeveloped areas lacking basic telephone service, Iridium can be a foundation for an eventual ground telephone system.

For ships and aircraft, Iridium will provide voice or data links and positioning information without the sophisticated on-board telecommunications hardware now required. Since Iridium is not dependent on land-based communications links, it also would play a crucial role in disaster-recovery efforts following earthquakes, hurricanes, or other natural calamities.

OPERATING PLAN:

Motorola envisions that the Iridium system will be operated by one or more international consortia whose members have the necessary licenses to operate in each country.

Motorola will serve as the supplier of the system itself. This will include the satellites, the communications links and all necessary support. Motorola's plan for an open architecture is expected to provide the opportunity for significant international participation in the development and manufacture of Iridium.

Plans call for two demonstration satellites to be placed into orbit in 1992. Implementation of the entire system is planned to begin in 1994, and full service will begin as early as 1996.

MOTOROLA SIGNS AGREEMENTS TO EXPLORE NEW SATELLITE-BASED PERSONAL COMMUNICATION SYSTEM

Motorola, Inc. has signed memoranda of understanding with three organizations -- the London-based International Maritime Satellite Organization (Inmarsat), the American Mobile Satellite Corporation (AMSC), based in Washington, D.C., and Telesat Mobile Inc. (TMI) of Canada -- to jointly explore the potential of Motorola's Iridium satellite communications system.

Iridium is a network of 77 small satellites in low-earth orbit that will allow people with portable radiotelephones to communicate anywhere on earth, whether on land, at sea, or in the air.

In each memorandum of understanding, the parties agree to cooperate in studying the potential of the Iridium satellite network, including an analysis of the technical and business issues involved.

"This system ushers in a new era of global personal communications," said John F. Mitchell, vice chairman of Motorola, Inc. "We're delighted that these organizations recognize the importance of Iridium to the future of worldwide telecommunications."

Inmarsat, organized in 1979 as an international consortium to provide satellite communications for ships at sea, now includes representatives of 59 nations and has expanded its services in several countries to include aviation and land-mobile communications.

AMSC is licensed to provide mobile communications via satellite for the United States, and TMI is licensed to provide a similar service for Canada.

Motorola is continuing discussions with other potential partners, including British Telecom in London and organizations in Australia, Hong Kong and Japan.

Motorola Inc. is one of the world's leading providers of electronic equipment, systems, components and services for worldwide markets. Products include two-way radios, pagers, cellular telephones and systems, semiconductors, defense and aerospace electronics, automotive and industrial electronics, computers, data communications and information processing and handling equipment. Motorola was a winner of the first annual Malcom Baldrige National Quality Award, in recognition of its superior company wide management of quality processes.