**Iridium Satellite Constellation**

From Wikipedia, the free encyclopedia



An Iridium satellite

The **Iridium satellite constellation** is owned and operated by Iridium Satellite LLC. It is used to provide voice and data coverage to satellite phones, pagers and integrated transceiver units.

The constellation requires 66 active satellites in orbit to complete its constellation, with spare satellites in-orbit to serve in case of failure. Satellites are in low Earth orbit at a height of approximately 485 miles (780 km) and inclination of 86.4°. Orbital velocity of the satellites is approximately 17,000 mph (27,000 km/h). Satellites communicate with neighboring satellites via Ka band intersatellite links. Each satellite can have four intersatellite links: two to neighbors fore and aft in the same orbital plane, and two to satellites in neighboring planes to either side. The satellites orbit from pole to pole with an orbit of roughly 100 minutes. This design means that there is excellent satellite visibility and service coverage at the North and South poles, where there are few customers. The over-the-pole orbital design produces a "seam" where satellites in counter-rotating planes next to one another are travelling in opposite directions. Cross-seam intersatellite-link handoffs would have to happen very rapidly and cope with large Doppler shifts; therefore, Iridium supports intersatellite links only between satellites orbiting in the same direction.

**Satellites**

The satellites each contain seven Motorola/Freescale PowerPC 603E processors running at roughly 200 MHz. Processors are connected by a custom backplane network. One processor is dedicated to each cross-link antenna ("HVARC"), and two processors ("SVARC"s) are dedicated to satellite control, one being a spare. Late in the project an extra processor ("SAC") was added to perform resource management and phone call processing.

The cellular look down antenna has 48 spot beams arranged as 16 beams in three sectors. The four inter-satellite cross links on each satellite operate at 10 Mbit/s. The inventors of the system had previously worked on a government study in the late 1980s that showed that microwave cross links were simpler and had fewer risks than optical cross links. Although optical links could have supported a much greater bandwidth and a more aggressive growth path, microwave cross links were favored because the bandwidth was more than sufficient for the desired system. Nevertheless, a parallel optical cross link option was carried through a critical design review, and ended when the microwave cross links were shown to support the size, weight and power requirements allocated within the individual satellite's budget. In recent press releases, Iridium Satellite LLC has stated that their second generation satellites would also use microwave, not optical, inter-satellite communications links. Such cross-links are unique in the satellite telephone industry, as other providers do not relay data between satellites.

The original design envisioned a completely static 1960s "dumb satellite" with a set of control messages and time-triggers for an entire orbit that would be uploaded as the satellite passed over the poles. It was found that this design did not have enough bandwidth in the space-based backhaul to upload each satellite quickly and reliably over the poles. Therefore, the design was scrapped in favor of a design that performed dynamic control of routing and channel selection late in the project, resulting in a one year delay in system delivery.

Each satellite can support up to 1100 concurrent phone calls and weighs about 1,500 pounds (700 kg).

**In-orbit spares**

Spare satellites are usually held in a 667 kilometers (410 mi) storage orbit. These will be boosted to the correct altitude and put into service in case of a satellite failure. After the Iridium company emerged from bankruptcy the new owners decided to launch seven new spares which would have ensured two spare satellites were available in each plane. As of 2009[update] not every plane has a spare satellite however the satellites can be moved to a different plane if required. This moving process can take several weeks.

**Next-generation constellation**

Iridium is currently engaged in studies to build and launch a second generation of satellites, consisting of 66 satellites and six spares. These satellites will incorporate features such as data transmission which were not emphasized in the original design. The current plan is to begin launching new satellites in 2014.

The existing constellation of satellites is expected to remain operational until at least 2014, with many satellites expected to remain in service until the 2020s. Iridium is planning a new generation of satellites with improved bandwidth to be operational by 2016. This system will be backward compatible with the current system. In August 2008, Iridium selected two companies — Lockheed Martin and Thales Alenia Space — to participate in the final phase of the procurement of the next generation satellite constellation, with the winner to be announced in mid-2009.

**Patents and manufacturing**

The main patents on the Iridium system, U.S. Patents 5,410,728 and 5,604,920, are in the field of satellite communications, and the manufacturer generated several hundred patents protecting the technology in the system. Satellite manufacturing initiatives were also instrumental in the technical success of the system. Motorola made a key hire of the engineer who set up the automated factory for Apple's Macintosh. He created the technology necessary to mass-produce satellites on a gimbal, taking weeks instead of months or years and at a record low construction cost of only US$5 million per satellite. At its peak during the launch campaign in 1997 and 1998, Motorola produced a new satellite every 4.3 days, with the throughput time of a single satellite being 21 days.

**Launch campaign**

Motorola used launch vehicles from three companies from three different countries — the Delta II from McDonnell Douglas; the Proton K from Krunichev in Russia; and the Long March IIC from China Aerospace Science and Technology Corporation. The original constellation of 66 satellites, plus six spares, was launched in 12 months and 12 days, between May 5, 1997, and May 17, 1998, with an astounding success rate of 15 out of 15 successful launches and all 72 satellites put into the intended orbits. In one 13-day period (late-March to early-April 1998) they successfully put 14 satellites into orbit.

The most recent launches took place in 2002 when a total of seven spare satellites were launched.

**Defunct satellites**

Over the years several Iridium satellites have ceased to work and tumbled out of control, some have reentered the atmosphere while other partially functional satellites have remained in orbit. However these satellites are not in active service.

Iridium 28 failed in July 2008 and has been replaced with the in-orbit spare Iridium 95.

According to a Feb. 11 [2009] e-mail alert issued by NASA, Russia's 1,984-pound (900-kg) Cosmos 2251 -launched in 1993 but out of service since 1995 - collided with the 1,234-pound (560-kg) Iridium craft at 11:55 a.m. EST at an altitude of 490 miles (790 km). Bethesda, Md.-based Iridium Satellite LLC alerted the U.S. Air Force after losing contact with the **Iridium 33**.

**Collision**

Wikinews has news coverage of the 2009 satellite collision

* Russian and US satellites collide
* Burning debris from satellites spotted over several US cities:

*Main article: 2009 satellite collision*

At 16:56 UTC on February 10, 2009 *Iridium 33* collided with the defunct Russian satellite, Kosmos-2251.

Iridium plans to move one of its in-orbit spares into the network to replace the destroyed satellite within 30 days of the collision. This is the first time two intact satellites have collided. Iridium 33 was in active service when the accident took place but was one of the oldest satellites in the constellation, having been launched in 1997.