Leadership Talks — Global SBAS

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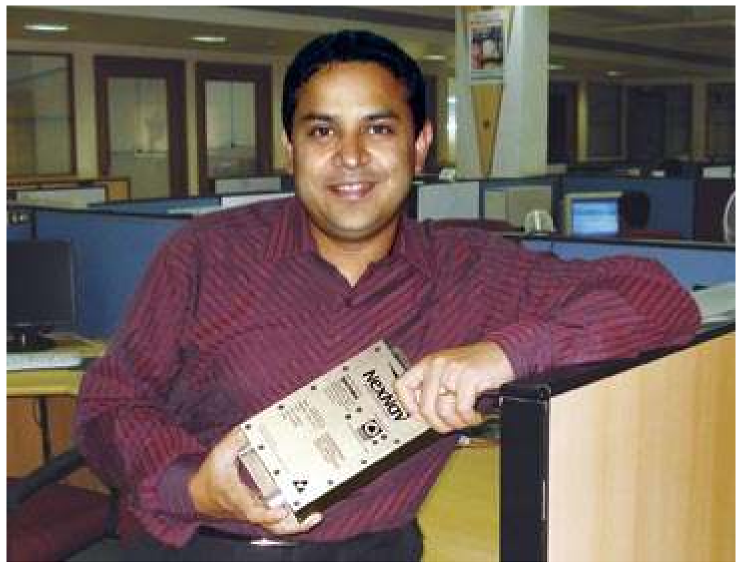

Jayanta Ray (JR) received his Ph.D. from the University of Calgary in 2000. He has worked in the GPS field since 1992, and is group manager at Accord Software and Systems in Bangalore, India.

Alan Cameron: Tell us about Accord's new GPS-SBAS (satellite-based augmentation systems) receiver.

JR: The development of the aerospace GPS-SBAS receiver called NexNav is complete, and it was approved by the Federal Aviation Administration (FAA) on November 1. This receiver can be used in a civilian aircraft as a primary means of navigation during en-route, terminal, approach, and landing. This is the first and so far only certified aerospace GPS-SBAS receiver of its class conforming to the latest FAA standards.

An aerospace GPS receiver is characterized by extreme reliability, high accuracy, and very good availability. Of these, reliability is the most important factor. That is achieved by creating a very reliable hardware and software.

The hardware reliability has to be very good to the extent that misleading information is less probable than 10–7 during the approach, where the aircraft is very close to the runway; that is, about 200–250 feet altitude from the runway. This is done through extensive failure mode and effect analysis, fault tree analysis of the hardware, and real-time hardware failure monitoring.

To create very reliable software, the GPS receiver software and programmable logic device (PLD) software should should be developed conforming to FAA design assurance standards DO-178B and DO-254. This requires an enormous amount of effort and a large team of avionics experts.

As we know, GPS guarantees a certain level of accuracy with say 95 percent probability. But there is no assurance of accuracy for the remaining 5 percent of the time. With SBAS, the error is bounded to a great extent. An aerospace GPS receiver takes advantage of SBAS to provide error bounds up to 99.99999 percent confidence level during approach. The receiver should also provide the highest level of integrity when there is no SBAS, through a comprehensive fault detection and fault exclusion algorithm (FD/FDE). An aerospace receiver should be able to detect and exclude any satellite failure either through SBAS integrity monitoring or through autonomous FD/FDE within time-to-alert.

These and many more requirements related to accuracy, integrity, and interference are specified in RTCA document DO-229D. The FAA gets involved in the development process life cycle right from the planning stage until completion. Throughout the process, the FAA-designated engineering representatives monitor the program and ensure conformance to FAA development standards.

In the case of Accord, we have two centers of excellence — one is the GPS and the other is the avionics software. Therefore it was synergistically appropriate for us to develop an aerospace GPS-SBAS receiver. We took more than three years from planning to the completion of the FAA-certified GPS-SBAS receiver.

AC: Does such a rigorous procedure mean the receiver is qualified for use elsewhere beside the United States?

JR: All the FAA-approved standards for the aerospace GPS receiver are exactly the same for Europe. A GPS receiver approved by the FAA is generally accepted by the European Aviation Safety Agency (EASA). Currently our NexNav receiver is primarily for the U.S. general aviation market, for more than 200,000 aircraft. We already have an airframe and two avionics OEM manufactures as our customers. But it can also be used elsewhere. NexNav receiver is flying in Europe, Australia, and in New Zealand as well.

AC: What about other products?

JR: We have built GPS receivers for the last 15 years, primarily for the land transportation segment in Latin America, Southeast Asia, and parts of Europe. In this market we partnered with Analog Devices (ADI) of the United States.

We have also developed a GPS L2C receiver prototype and were able to acquire and track the L2C signal within three days of the first IIR-M satellite beaming the L2C signal, December 16, 2005. This was published in the Innovation section of *GPS World* [May 2006].

We have also developed a 24-channel GPS/GLONASS receiver to support domestic market needs. On the indoor GPS front, in partnership with ADI we have created a new chipset, which will be available in mid-2008. We have benchmarked the performance of our solution with the best in the industry and are confident about its success. It is an autonomous GPS and its variant uses assisted GPS protocols using GSM, GPRS, or CDMA networks.

AC: Tell us about GAGAN project.

JR: GPS-Aided Geo-Augmented Navigation System (GAGAN) is the Indian SBAS. We are not directly working with the GAGAN program yet, though we have used NexNav to track the GAGAN satellite. We look forward to working in the initial experimental phase. We have been working with the Indian Space Research Organizatin (ISRO) since 1999. ISRO has used our GPS-based satellite positioning systems for all their LEO missions for the past eight years.

AC: How will GAGAN affect the international GNSS marketplace?

JR: WAAS in the United States and MSAS in Japan are now operational. EGNOS will be ready soon in Europe. However, there is a gap between EGNOS and MSAS which will be filled in effectively by GAGAN, so that one can have seamless travel from Europe to the Asia-Pacific region.

Another very important aspect is that the problem of large ionospheric scintillation in the Indian region will have to be solved before GAGAN can be declared operational. The ionosphere is very turbulent in equatorial and tropical regions. It's a big challenge to model the ionosphere well enough to get required GPS performance for aircraft navigation and landing. A lot of countries are waiting to see how this problem gets solved in India. Once solved here, it can be used elsewhere; the single-shell model used in WAAS and other regions is not really applicable for India. Once GAGAN becomes operational, similar systems can come up in countries such as Brazil.

The International Civil Aviation Organization (ICAO) has a mandate that eventually aircraft navigation should primarily use satellite-based systems such as GPS, GLONASS, or Galileo along with SBAS and/or ground-based augmentation systems (GBAS). So it is all but certain that eventually the world will adopt GAGAN or WAAS-like systems. GAGAN is expected be operational around 2010 or 2011. c