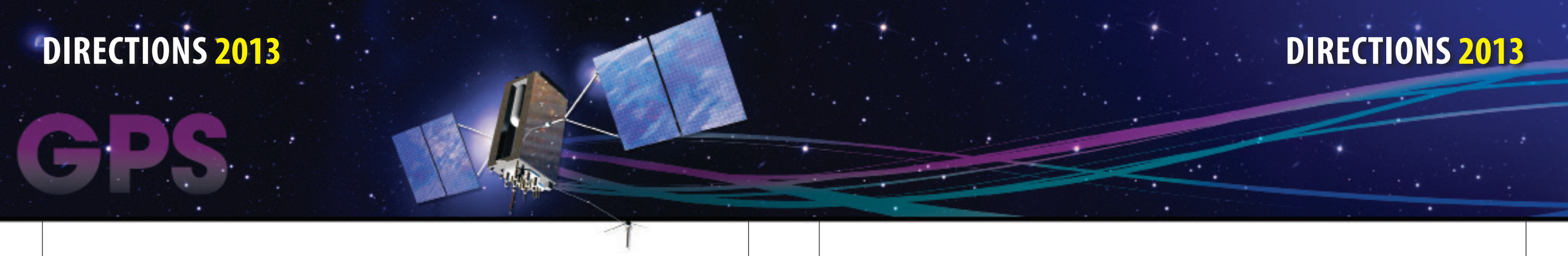

DIRECTIONS 2013

Dealing with Interference

A Proactive Approach for More Efficient Spectrum Use

In my vision of the future of GNSS, I see a pressing need to manage radio-frequency spectrum more efficiently. This will drive the creation of official standards for GNSS receivers, and better design of those receivers with better filters at lower cost, to preotect against out-of-band and near-band interference. This in turn will enable user to undertake widespread monitoring and reporting of in-band interference, and create the freedom for many technologies to explore wider and more productive use of all bands of the radio-frequency spectrum.

With the tools embedded in our receivers, everyone can easily see that widespread interference already exists in most places.

— Javad Ashjaee

Spectrum Management

As a consequence of unprecedented technological development on all fronts and in many fields, the radio-frequency spectrum is very congested. All countries, and the United States in particular, must find ways to use this spectrum more efficiently. Licenses for spectrum bands are very expensive, and special interest groups do all they can to secure ownership of any part of the spectrum and to prevent others from competing with them. There is an intense struggle going on, both behind the scenes and in the public arena; it has been called "the spectrum wars." These involve big companies, very high stakes, politicians, and special interest groups. The Federal Communications Commission (FCC) seems caught, powerless, in the crossfire between these powerhouses.

GNSS Interference

GNSS interference exists everywhere and comes from many different sources, identified and unidentified, intentional or unintentional. The 1-dB effect on GNSS of the proposed LightSquared signal is negligible compared to what already exists. The reason that the LightSquared plan encountered so much opposition was not because of its effect on GNSS. It was because of its effect on the competing business models of large companies and special interest groups.

With the tools that we have created and embedded in our receivers, everyone can easily see that widespread interference already exists in most places, especially in cities, and that interferences can easily be monitored and automatically reported. It seems no organization has ownership of regularly monitoring interferences on these bands and taking corrective actions. This is partly because the tools to easily monitor and report interferences did not exist earlier.

GNSS Receivers

Current GNSS receivers on the market and in use around the world rely on inadequate designs. The technology does in fact exist to overcome out-of-band interference problems such as LightSquared and many others commonly encountered in today's congested radio-frequency environment. There is no reason to prohibit others from using bands near GNSS; this just makes spectrum use inefficient. Continued shipping of inadequate, inefficient receivers by current manufacturers only increases and compounds the problems encountered by users.

There are standards for manufacturing countless industrial goods — for example, something as ordinary as car tires or — but there is no standard for building GNSS receivers that will be used in critical applications.

So far, the FCC has been silent on this topic, and has not established guidelines for GNSS receivers that are used in critical applications. The civilian users of GNSS, such as the U.S. National Geodetic Survey, the U.S. Geological Survey, the Federal Aviation Administration, and so on, have criteria for all sorts of little equipment, but there is no criteria for GNSS receivers that they claim are so important for their job.

Instead of taking the proactive and productive approach of putting filters into the receivers that they use, these organizations advocate keeping spectrum bands adjacent to GNSS off-limits to other users. Manufacturers do not see any reason to make better receivers while such a powerful lobby protects them.

Interference monitoring and reporting is strongly desirable for places such as GNSS reference stations, or for users to see the interferences before they start a jog that they are tracking on their GPS-enabled personal training device — just as pilots check the weather before they take off.

Special Interest Groups, Politics, and Blind Followers

The problem that LightSquared encountered was that its proposal impacted the business models of special interest groups. Although we — that is, JAVAD GNSS in presentations before the FCC in Washington DC — showed that other interferences exist in cities, the FCC did not care, and GNSS magazine editors did not care. They just blindly followed what the special interest groups had planned for them.

Brad Parkinson, in his article "PNT for the Nation: Three Key Attributes and Nine Druthers" in the October issue of *GPS World*, did not even hint at guidelines for building GNSS receivers. This is similar to formulating guideline on how to build and clean the roads while having no guidelines on how to build tires that are going to ride on the roads.

In Parkinson's long list of recommendations, there was no mention at all that we need to build better GNSS receivers and be able to monitor interferences. There are guidelines and standards for how build every little item, but none for GNSS receivers that are claimed to be so essential for our security and prosperity.

Military GPS receivers do not have protection against even one particular type of interference such as that posed by LightSquared — and the suggested approach was to bomb such interferences, which most admit that of course cannot be done. This is a bad attitude. The cost of a filter in a receiver is almost nothing. A precision bomb costs millions if you factor in development costs, and deployment and delivery puts the full cost even higher.

The case is similar for GNSS receivers used in commercial airplanes. Instead of pushing for a better GNSS receiver design, the FAA simply hopes that interference does not happen.

Conclusion

These are my predictions — and my strongest possible recommendations — for the future of GNSS.

- The FCC will create standards for GNSS receivers.
- GNSS manufacturers will be forced to build better receivers.
- GNSS users will benefit from better receivers at a lower cost.
- Interference monitoring and reporting will become a desirable feature of GNSS receivers.
- Bands near the GNSS spectrum will be freed for more efficient use by all types of productive technology.

I am proud to be a part of the efforts to make these happen, against all odds.

JAVAD ASHJAEE Javad Ashjaee received his Ph.D. in electrical engineering from the University of Iowa. He was chairman of the Computer Engineering Department, Tehran University of Technology, 1976-1981. He began his GPS engineering career at Trimble Navigation, 1981–1986. Founder and president of Ashtech Inc., 1986–1995, the company that produced the first integrated GPS-GLONASS receivers; founder and CEO of Javad Positioning Systems, 1996–2000, which he sold to Topcon Corporation. He founded JAVAD GNSS in 2007, and is currently president and CEO. In 2010, the company introduced the integrated geodetic receiver TRIUMPH-VS, with a GNSS Interference Analyzer, capable of tracking current and next-generation signals of GPS, GLONASS, QZSS, and Galileo signals. In 2011, the company introduced a LightSquared-compatible GNSS receiver.