All Electric Satellites: Revolution or Evolution?

The manufacture of new satellites is a critical part of the overall ecosystem for satellite communications. With "all-electric propulsion" the term on everyone's lips, we examine whether these types of satellites will lead to a step change in the way satellites are manufactured.

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Jay Gullish, director of Space & Telecommunications at Futron, vividly recalls his reaction last year when Boeing made its groundbreaking announcement about launching two satellites with all-electric propulsion for two different customers – Satmex and ABS – in the same slot, on the same rocket.

"Innovation and satellite manufacturing are not always words that end up in the same sentence," says Gullish. "Due to the expensive nature, risk aversion and technical complexity, innovation has been fairly slow in satellite communications."

One year later, the industry is still optimistic for innovation, but reality has entered the scene. Electric propulsion has a long and successful history regarding station keeping, or keeping the satellite in its position on orbit, but not with orbit raising, when satellites use their own propulsion system to reach orbit after separating from the rocket. Traditionally, more powerful chemical propulsion engines are used to quickly move satellites through Earth's hazardous radiation belt. All-electric propulsion offers other challenges, too, that can jeopardize missions. Boeing's grand news has prompted some companies to adopt a wait-and-see attitude while developing or adding hybrid options to their product line.

The main focus of Boeing's deal has been on the technology. However, Gullish believes the company's application of joint procurement was a "clear business innovation." By offering a dual launch configuration, the financial cost and risk is cut in half for operators, which lowers barrier-to-entry into the space market for small providers and entrepreneurs.

Although Boeing's idea won't necessarily open the door to other technologies, Gullish says it will provide satellite operators with more economical options. "Presuming that the electric propulsion system actually works well and is cheaper over time, more companies will offer this type of technology," he says. "You will see it ramp up as people get comfortable with it … Five years from now, we'll probably be at that cusp, where the industry accepts this type of technology as the norm."

According to Dionisio Tun, vice president, engineering and satellite operations at Satmex, his company decided to use an all-electric satellite because it will improve capital investment efficiencies and is likely to expand business opportunities.

"Maybe more companies will use electric propulsion," he says. "But because you are using one or the other system doesn't mean you will need to choose one application. We can still address the same opportunities … maintain our business plan … and look for new opportunities to use it."

But, all-electric satellites carry a trade-off. "The only disadvantage is that since the thrust of such systems is lower than chemical propulsion systems, it will take satellites up to six months longer to reach their final orbit," says Tun.

While orbit raising may be an issue for some operators, he says his company plans on offsetting the longer time frame with a shorter production cycle. Besides, the advantages are too strong to be ignored. Consider the lower mass of its all-electric satellite, he says, which allows Satmex to have a dual launch on a SpaceX Falcon 9 rocket, optimizing the use of capacity of this launcher.

"Once the satellite is in orbit, during the execution of a maneuver in the stationary orbit, you will have a better pointing accuracy toward the Earth," says Tun, explaining that signal variations will be reduced. "Instead of doing one maneuver every two weeks, you'll be doing

one maneuver every day."

All-electric satellites can also carry larger payloads. Because of the efficiencies of electric propulsion, larger payloads can fit on a smaller platform, adds Jim Simpson, VP, business development, at Boeing Space and Intelligence Systems.

"Our 702SP (small platform) satellite has a capability of 7.5 kilowatts of payload but the mass of the satellite is effectively half of what a traditional chemical propulsion satellite system would be," explains Simpson. "It also utilizes fuel very efficiently. A bi-propellant system may weigh four metric tons to do the same type of activity that a two metric ton electric propulsion would do."

So far, Boeing is on schedule to deploy its all-electric satellites in early 2015. While they are a new part of the company's 702 product line, all-electric satellites are not the only change. Boeing also redesigned its 702HP (high power), which uses both electric and bipropellant fuel to provide a configuration compatible with the Falcon 9, and introduced the 702MP (medium power) in 2009, which uses bipropellant but was designed to also accommodate other, more efficient electric propulsion.

Although Simpson says the 702SP is attracting much interest, Boeing's strategy is to provide a portfolio of satellites, enabling customers to pick the most appropriate technology for their economics and mission planning. The company is currently in contract talks with several manufacturers. Simpson explains that all-electric satellites enable traditional and regional satellite providers to increase their capability with less risk more than ever before.

He says this new application also offers additional antenna coverages. Two small satellites operating together would be equipped with eight to 10 antennas while larger satellites usually offer between four and five antennas.

Another aspect to consider is that the U.S. government, specifically the U.S. Air Force, plans on procuring "off-the-production-line" buses, rather than tailored buses for their unique payloads. This allows the Air Force to avoid carrying obsolescence and extra costs of a USAF-unique bus.

"The bus would not necessarily be unique but the payloads could be tailored to some of the needs of the warfighter," Simpson says, adding that the 702SP is well-suited for a production line and aligns with a more disaggregated architecture of satellites, which is the architectural future vision being considered by the government. "So the economics, the flexibility and the fit relative to a disaggregated space, or more robust space architecture, seem suited for the 702SP in our product line," he says.

The move to a 702SP was also a reaction to a diminishing government satellite market. Boeing purposely shifted its portfolio, developing a balanced commercial and government product line. Since then, he says the company's commercial business jumped from roughly 9 percent to nearly 35 percent. "This has been part of our strategy starting around 2007 but was really put into play by adding the 702MP and 702SP into our product line," says Simpson.

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