Two-Minute Tech: How radiation impacts satellites

Alex Miller 2 minutes

Technology

Satellites in lower orbits are more likely to be affected by solar radiation, while those in higher orbits must account for cosmic radiation from outer space.

While satellites are remarkably good at providing communications in places terrestrial networks cannot, they all must be designed to handle the harsh environment of space. The potentially harmful effect of radiation is one of the main things satellite architects must plan for.

The types and severity of radiation vary greatly depending on the orbit of the spacecraft. Satellites in low Earth orbit (LEO — 160-1,200 km) are much less exposed to radiation than those in medium Earth orbit (MEO — 5,000-12,000 km), while those in geostationary orbit (GEO — 35,786 km) are much more likely to encounter high-energy cosmic radiation from outer space.

Since satellites in GEO tend to be quite large, they are able to support a fair amount of shielding against radiation.

In LEO and MEO, the primary source of radiation is from the sun, which emits protons, electrons and other charged particles. Satellites gain a fair amount of protection from the Earth's magnetic field — typically the lower the orbit, the more protection gained.

Jake Peery, lead electrical engineer at E-Space, was recently part of a team that successfully tested a number of payload avionics components for the company's upcoming LEO constellation. The testing focus, he says, was on proton radiation.

"In LEO, the radiation effects aren't as severe as they are in higher orbits, but they're still a factor," Peery says. "At minimum, radiation can degrade the characteristics of the electronics over time — like switches stop functioning or a processor can have its data corrupted or thrown into a fault."

At worst, he says, radiation can destroy transistors or cause permanent damage — things that can't be mitigated from the ground. That's why it's so important to test the components long before they are ever launched into space.

Radiation can also impact the silicon in chipsets in various ways, he says.

"Again, it's not usually as big of a risk in LEO compared to say, interplanetary space, but there are places even in this orbit that can be problematic — such as the South Atlantic Anomaly where the Earth's magnetosphere is weaker, allowing an increased flow of protons and electrons."

Radiation impacts on spacecraft are grouped into two main categories: Single-event upsets (SEUs) that can lead to temporary or permanent issues; and Total Ionizing Dose (TID) — the cumulative effect of radiation over time. Solving for them could include a simple replacement or adding fault protection and recovery features into the electronics.

Other radiation effects on satellites could include thermal stress from high-energy particles, solar cell degradation and impacts to communications systems.

Alex Miller

Alex Miller leads editorial at E-Space. Based in Denver, he's a longtime journalist who's been involved with the satellite industry for over a decade.

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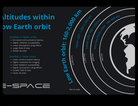

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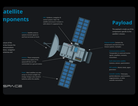

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