Wideband Technology: Frequently Asked Questions

What is wideband terminal technology and how does it differ from other satellite communications (SATCOM) terminals?

Wideband means the ability to operate over a large band of the electromagnetic spectrum. For NASA, that covers the entire frequency range of commercial and government Ka-Band allocations, including 17.7 GHz to 23.55 GHz (Forward), and 27 GHz to 31 GHz (Return). The ability to communicate over a wide range of the electromagnetic spectrum could provide NASA with the flexibility to use multiple satellite constellations to support multiple NASA mission use cases. For example, typical use cases could include launch and early operations, low and high data rate transmission, high altitude terrestrial, and sustaining communications in various contingency situations.

Similar to cellphone roaming where cellular devices jump from network to network without interrupting service, a wideband terminal can "hop" or "roam" between government and SATCOM service providers. This form of interoperability could give spacecraft the ability to seamlessly connect to various communications networks, allowing for multi-access points of services, lower latency, and lower costs.

How could the use of wideband terminals benefit NASA missions?

Reliable communications systems are critical to every NASA mission. NASA has relied on its own Tracking and Data Relay Satellite (TDRS) system to provide communication links between the ground and satellites in low-Earth orbit for almost 40 years. However, the constellation is nearing retirement.

NASA will gracefully fly out TDRS, meaning that each spacecraft's retirement will be driven by health factors rather than arbitrary deadlines. As the capacity of the TDRS constellation decreases, new missions will be directed to alternative communication network resources. NASA's Space Communications and Navigation program, or SCaN, aims to have operational commercial space relay services in place and available for missions by 2031, with a brief period of access to TDRS as a backup if needed.

Interoperability between commercial and government owned networks could play a key role in NASA's transition towards acquiring commercial SATCOM services for spaceflight missions. Wideband terminal technology could also be designed to enable interoperability among multiple near-Earth network providers, reducing the risk of data loss and communication delays. Additionally, providing missions with a selection of network providers could also help avoid vendor lock-in and keep mission execution on schedule should unexpected circumstances arise.

How was wideband terminal technology developed?

With the growing robustness of the commercial satellite relay industry and NASA's pending transition to commercial SATCOM services, the agency sought to develop terminals that missions could use to adopt commercial services while reducing potential risk. Wideband user terminals designed for service interoperability, were originally developed and tested at NASA's Glenn Research Center in 2021. These ground tests demonstrated the ability to "roam" between commercial and government satellite networks for the first time.

Previously, NASA has demonstrated a software-defined radio testbed on the International Space Station and long-duration software testing on a ground-based testbed. Combined, these proof-of-concept efforts showed the feasibility of wideband terminal technology improving space communications.

How is NASA partnering with industry to test wideband technology?

NASA and the Johns Hopkins Applied Physics Laboratory are collaborating on a flight demonstration of wideband terminal technology, known as the Polylingual Experimental Terminal, or PExT. PExT will integrate on a York Space Systems S-class Bus and launch on a SpaceX Falcon 9 for a six-month flight demonstration of wideband terminal technology. Mission objectives include demonstrating interoperability through contact and link management, and forward and return link data flow, while roaming between NASA's existing TDRS network and at least two commercial relay networks.

What are some key features of PExT?

The primary feature enabling this demonstration is a software defined radio (SDR). SDRs are reprogrammable in orbit, allowing for improved reconfigurability. Utilizing a SDR will allow PExT to support both NASA and commercial waveforms, including DVB-S2 and CCSDS TDRSS - a key aspect of the capability demonstration. Combining SDR technology with wideband components could enable initial data transmission rates up to 90 Mbps Forward and 375 Mbps Return. The body-mounted 0.6-meter antennas are scalable for other missions. PExT has an Effective Isotropic Radiated Power (EIRP) 46.21 dBW minimum, and a gain-to-noise (G/T) ratio of approximately 6dB/K.

The PExT terminal aims to demonstrate various mission scenarios during its six-month testing period, including self-pointing capabilities, long-term schedule execution, intra-/inter-network link handoff, waveform adaptation and reloading, command stack protection (crypto), and link fault recovery.

Which commercial SATCOM signals will the PExT flight demonstration attempt to receive?

The PExT team has baselined with SES Satellites' O3b mPOWER and Inmarsat's Global Xpress networks. However, due to the wideband nature of the terminal, PExT demonstrations could be conducted with a variety of providers.

Interested commercial SATCOM providers are invited to contact NASA's Wideband Terminal Project about specific demonstration interests by emailing Marie Piasecki, marie.t.piasecki@nasa.gov.

When will the PExT demonstration take place?

PExT will launch on a SpaceX Falcon 9 flight, currently planned for April 2025. Once launched, the demonstration will last for a duration of six months.

For PExT media inquiries, please contact Brett Molina, brett.molina@jhuapl.edu.

How can interested NASA missions participate in extended operation experiments?

The Wideband Terminal Project is currently providing opportunities for the NASA mission user community to take part in extended operation experiments using wideband technology. For more information, please contact the Wideband Terminal Project by emailing Marie Piasecki, marie.t.piasecki@nasa.gov.

What will happen after the PExT demonstration?

PExT is focused on demonstrating capabilities enabled through the use of wideband terminals. Individual missions will likely have specific requirements. The PExT terminal is scalable, and the NASA Wideband Project plans to share NASA lessons learned from the capability portion of the wideband flight demonstration by engaging with commercial entities who may wish to build and sell these types of terminals. It is anticipated that a range of industry solutions will provide enough design flexibility to meet the future needs of many NASA missions.

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For more information on NASA's development of wideband technology, visit **https://go.nasa.gov/43dMQEX** or use your device to scan the QR code.