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Research Results

SpaceX Starlink Satellite Broadband Communications for ITS Pilot

Providing broadband to rural ITS field equipment.

Rural

June 2026

Project Title: SpaceX Starlink Satellite Broadband Communications for ITS Pilot

Task Number: 4059

Start Date: August 15, 2022

Completion Date: June 30, 2025

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WHAT WAS THE NEED?

Reliable high-bandwidth rural communications are a significant challenge since early deployments of Intelligent Transportation Systems (ITS) at the California Department of Transportation (Caltrans). While there was an effort to install fiber-optic broadband services on select rural highways throughout the state, the effort would take years before it was usable, wouldn't be installed on every rural state highway, and would be located in areas highly susceptible to damage from wildfire, floods, and landslides. Reliable communications were critical to the perceived reliability of ITS Elements for the traveling public. ITS Elements ceased to function as intended when communications systems failed. This posed a problem in rural areas where ITS Elements were deployed to mitigate the effects of non-reoccurring congestion due to snow, fire, floods, and other major incidents. Caltrans needed to find an alternative reliable high-bandwidth wireless communications option that was less susceptible to weather-induced incidents.

WHAT WAS OUR GOAL?

To have provided reliable, cost-effective broadband communications solutions to field sites in the State's remote rural areas.

WHAT DID WE DO?

We procured, installed, operated, and evaluated four SpaceX Starlink satellite broadband communication systems for various ITS elements in District 2. The selected rural Caltrans field sites were impacted by the lack of available high-bandwidth communication options. These ITS sites included infrastructure such as changeable message signs, video sites, and roadside weather information systems. The project evaluated the procurement, construction, installation, integration, operation, and maintenance of the four selected sites in rural regions of

Caltrans

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the state.

WHAT WAS THE OUTCOME?

The evaluation of Starlink for Caltrans District 2 showed that the system is generally effective for rural communication needs, performing well under normal conditions but experiencing reduced performance during heavy snow or when obstructed by trees or high humidity. The Starlink High-Performance (HP) Kit with a flat antenna proved to be the most suitable hardware for field deployment due to its strong wind resistance.

Testing confirmed that 40 GB (Gigabytes) of priority data per month is sufficient, as non-priority data speeds were adequate for image and video transmission needs. More expensive Mobile Priority service is only necessary when frequent relocation or maximum mobility is required. Even when priority data is depleted, the system continues to function at lower speeds without extra costs unless optional add-on data is purchased.

Obstructions slightly increased ping drops rates at certain locations, but these did not lead to significant downtime. Additionally, researchers created a custom mount, outside the original project scope, to provide a more integrated and visually appealing installation option.

WHAT IS THE BENEFIT?

As heavy snow, wildfires, floods, and other major incidents continue to impact terrestrial infrastructure, having an alternative high-bandwidth communications option in rural areas is crucial. Satellite broadband services are linked to fixed low Earth orbit satellites. These satellite services do not rely on terrestrial infrastructure, providing immunity to the incidents described above. With throughputs of up to 20 Gbps (Gigabits per second), satellite broadband offers enough bandwidth for the most bandwidth-intensive Transportation Management Systems (TMS) applications.

IMAGES



Image 1: Starlink high-performance antenna (left side of image) after installation at the Redding Fiber Hub – Image Source – the Advanced Highway Maintenance and Construction Technology (AHMCT)

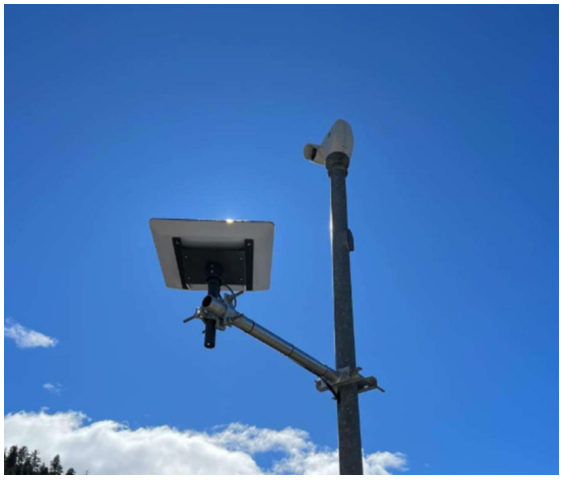


Image 2: Starlink high-performance flat antenna after installation – Image Source – AHMCT

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Image 3: Starlink high-performance flat antenna after installation – Image Source – AHMCT

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