



STIC Note

Starlink Maritime



BACKGROUND

Starlink is a Low Earth Orbit (LEO) satellite constellation that has been developed by the SpaceX corporation, with the goal of providing low latency (~25 milliseconds), worldwide broadband internet coverage, at throughput speeds of 200 Mbps or more. In 2021, the Research & Development Center (RDC) worked with the Air Force Research Laboratory (AFRL) to obtain an early developmental terminal to conduct research and testing of this technology in the high latitudes as part of the RDC High Latitude Underway Connectivity project. In late September of 2022, the Science and Technology Innovation Center (STIC) was made aware of a new Starlink service that was marketed by the company as providing global coverage optimized for maritime customers called “Starlink Maritime”. The STIC immediately began working with contacts at the United States Special Operations Command (USSOCOM), the CG’s C5I Service Center (C5ISC) and SpaceX to purchase multiple systems for evaluation. Following many discussions with SpaceX and equipment vendors, an order was placed in December of 2022 for one system. The Starlink Maritime equipment was fully delivered in early 2023.

The purpose of this evaluation was to demonstrate the capabilities of the Starlink Maritime system on various Coast Guard assets performing multiple missions, and to determine the systems usefulness in the CG.

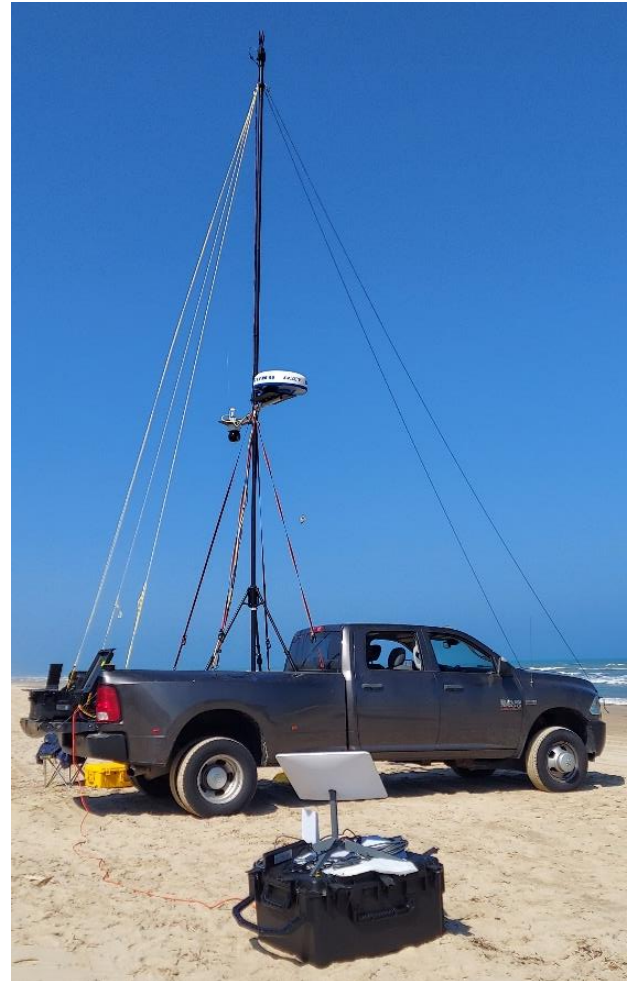


Figure 1. Starlink in the Foreground for a RDC MDA Test Event in Boca Chica TX (Source: U.S. Coast Guard).

EVALUATION

The STIC was able to purchase the system via the Defense Logistics Agency’s (DLA) Tailored Logistics Support Program (TLSP). The hardware cost for the system – which included the transceiver dish, power supply, Wi-Fi router, and various cables – was \$2750. The service plan was

\$59,500 for 12 months of “Global Access for Government.” This plan includes at least 5TB of data per month, with either a reduction in service, or a loss of service once the data cap is exceeded. In addition, approximately \$400 was spent on proprietary cables, ethernet adapters and mounting options that were purchased directly through the Starlink web store.

The first significant test of the system was in March of 2023 and consisted of using it as a data link for Maritime Domain Awareness (MDA) sensors distributed near Station South Padre Island. The system was used for one week in a semi-mobile capacity (Figure 1) to transmit radar and camera data back to a centralized command center. The system was used mostly at night and was moved and/or restarted at least once every 24 hours.

The second significant test of the system occurred in August of 2023 and consisted of installing the system on a Fast Response Cutter (FRC) in Florida (Figure 2).



Figure 2. Starlink installed on the USCG ROBERT YERED (Source: U.S. Coast Guard).

During this testing the Starlink system was used as a data pipe to stream live Uncrewed Aerial System (UAS) video and other data back to a

shore-based command center. Streaming occurred over Microsoft Teams and other applications while the Cutter was approximately 30 miles offshore. Testing occurred over several days with the Cutter operating at various speeds and sea states.

The third and final test event occurred over a week in September of 2023 and consisted of mounting the system on the RDC’s 25 foot Response Boat-Small (RB-S) (Figure 3) and running the boat at various speeds in a seaway, while constantly gathering latency and throughput data.

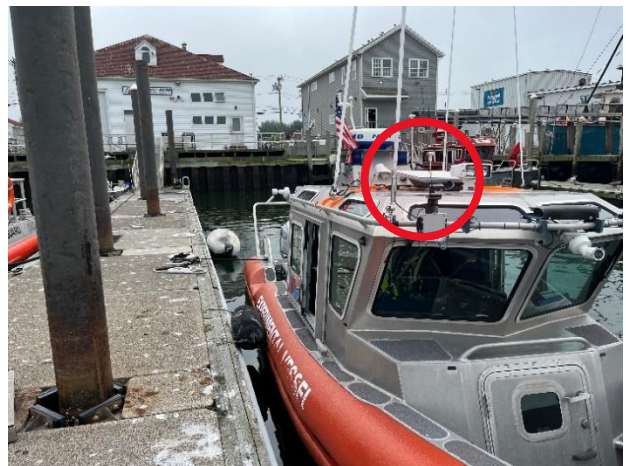


Figure 3. Starlink antenna installed on the RDC’s RB-S (Source: U.S. Coast Guard).

CONCLUSIONS

Overall, the system worked very well in all three major test events. There are countless CG missions that could benefit from the highly mobile, low latency, high throughput global internet coverage that Starlink provides.

Boot-up and establishing a stable connection took approximately five minutes each time the system was turned on, the connection was very stable, throughput was generally in the 150-200 Mbps range, and latency was approximately 30-50 ms in most use cases.

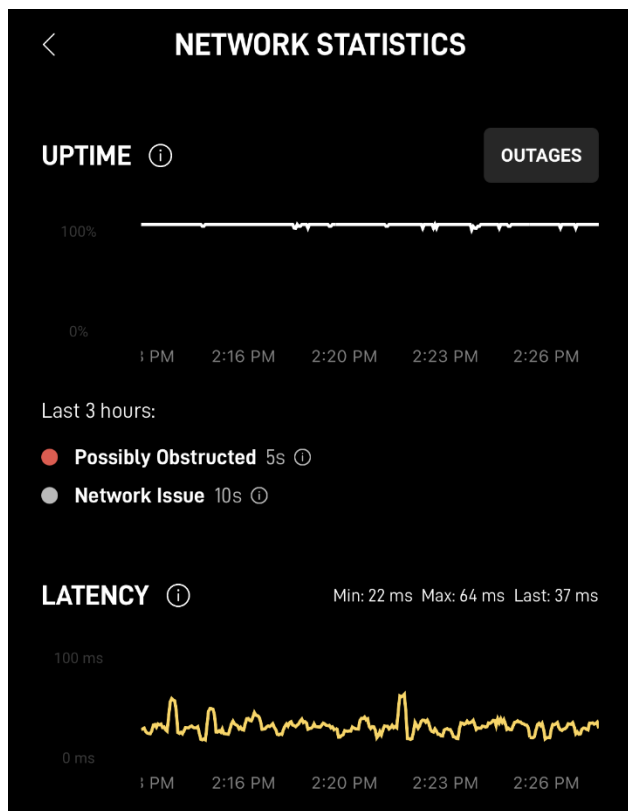


Figure 4. Uptime and Latency Data from 11 September 2023 (Source: U.S. Coast Guard).

Figure 4 provides a snapshot of the system’s latency performance data collected over a 15-minute period during which the RDC’s RB-S was traveling at speeds between 10 and 30 kts in swells of five feet and wind driven waves of two

to three feet. During this time, the RB-S was experiencing slamming, heel angles of 25 degrees to port and starboard, and large amounts of pitch and yaw. The connection was very stable with throughputs consistently in the 140-150 Mbps range, and latency between 22 and 64 milliseconds. A Starlink provided outage report (Figure 5) shows the system’s connection stability over a seven-hour timeframe that includes the timeframe covered in Figure 4.

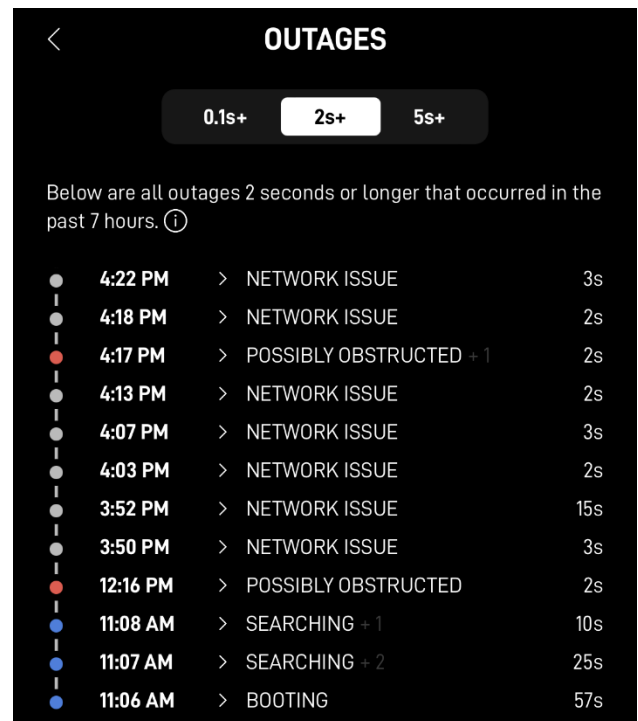


Figure 5. Outage report from 11 September 2023 (Source: U.S. Coast Guard).

There are some concerns with the ability of the Starlink transceiver dish, plug and mounting hardware to withstand the maritime environment. Starlink advertises the plug to be IP-56, which is “dust protected” and “protection against powerful waterjets” ([IP code - Wikipedia](#)). This is not considered sufficient in most military applications and doesn’t equate to a Mil-Standard. The mounting hardware is also made from structural grade aluminum (likely 6061) and powder coated and would not withstand

the maritime environment for very long. No issues were observed during the three one-week tests, but the STIC will continue to closely monitor the equipment.

FUTURE WORK

To date, the Coast Guard has installed approximately 20 systems on various assets and has a plan to have Starlink installed on remaining large cutters by end of next FY. The RDC will continue to use this Starlink Maritime system for various test events. In March of 2023 the RDC was briefed by SpaceX on their new Starshield service. According to SpaceX, “Starshield uses additional high-assurance cryptographic capability to host classified payloads and process data securely, meeting the most demanding government requirements.” It was stated that the STIC’s current service could be converted to a Starshield account by submitting a “Starshield Conversion Form.” This form was submitted in May of 2023. Once the STIC’s current service gets fully converted to Starshield, the STIC will create test events to quantify this additional capability. In addition, the STIC is working with third-party vendors to better “harden” the system for the harsh maritime environment.

The Science and Technology Innovation Center (STIC) is a DHS S&T and USCG collaboration.