SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION: QUESTIONS FOR THE RECORD

HEARING ON REOPENING THE AMERICAN FRONTIER: PROMOTING PARTNERSHIPS BETWEEN COMMERCIAL SPACE AND THE U.S. GOVERNMENT TO ADVANCE EXPLORATION AND SETTLEMENT
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Written Questions Submitted to Mr. Tim Ellis, Co-Founder and CEO, Relativity

Submitted by Senator Dan Sullivan

Challenges Hindering DOD-Commercial Partnerships

Question 1. Earlier this year, in response to a provision that I included in the FY2017 National Defense Authorization Act (NDAA), the Department of Defense (DOD) released an Arctic strategy that among other points, highlights severe challenges caused by the limited satellite and terrestrial communications above 65 degrees north. When the DOD needs to quickly address gaps in capabilities, commercial partnerships can—where appropriate—play a key role in filling these needs. What are the primary challenges that have hindered or prevented you from working with the U.S. government to fill critical gaps in U.S. space capabilities, like the domain awareness and communications gaps in the Arctic?

Relativity is a new launch services provider for payloads following the "small satellite" form factor of less than 1,000 kg. Satellites in this weight class can potentially be a primary solution to communication gaps in remote locations, such as the Arctic areas described.

Primary challenges include open access to a launch site capable of satisfying the commonly used polar or sun synchronous orbits used by these satellite communication systems. Geography dictates that in the United States, a West Coast launch location is ideal to reach high inclination orbits without prohibitively flying over land or using a costly "dog leg" flight maneuver, such as from Wallops Island. The Pacific Spaceport Complex on Kodiak Island, Alaska is one such potential commercially-usable site, as well as Vandenberg Airforce Base in California. Both sites would need modification to be ideally capable of launching cryogenic liquid fueled orbital rockets optimized for small satellite launches. Some of these modifications include shipping, receiving, and ground transport infrastructure for rocket vehicles, cryogenic propellant loading and ground handling equipment, and expanded support for Autonomous Flight Termination Systems. We are beginning conversations with both sites to assess applicability to Relativity's needs, and would be happy to follow up with any other roadblocks or challenges we find.

A potential Hawaiian island located site, or drone and barge ship launch platform, could also help solve the challenge of U.S. based launch sites open to smaller orbital rockets performing on a commercial basis. Streamlining procurement by the government through expanded use of Other Transaction Agreements (OTA) would incentivize emerging companies and startups with the most cutting-edge technologies to work with the government earlier in their lifecycles. This

is due to the lower overhead requirements and streamlined procurement process agreements such as OTA's provide, which reduce the burden on personnel-strapped startups and allow transactions to happen more quickly for both parties.

Internet Access in Rural Areas

Question 2. In Alaska, many places do not have any connectivity and many times are not even connected by road. It is costly to deploy telecommunications infrastructure, and while these communities are extremely innovative, a lack of connectivity hinders business growth and increased economic activity.

Commercial space provides the possibility of increased communications, including satellite based broadband internet, at a reduced cost. Especially if the cost of launches continues to decline, this could provide real benefits to consumers in extremely rural places like Alaska. How can recent advances in commercial space help provide broadband-level internet to the most rural areas?

Relativity believes we are at the beginning of a huge growth phase in satellite internet and connectivity capabilities. Several major, well-funded constellations of distributed "small satellites" are being developed that would greatly aid in solving the issue of rapidly deployable, low cost, high bandwidth access to remote areas such as in Alaska.

As mentioned above, this future is possible "especially if the cost of launches continues to decline". Relativity and several other private, commercial space launch companies are emerging to fill the needs of the emerging small satellite sector. Currently, none of the proposed and in-development Low Earth Orbit (LEO) satellite constellations are in full operating service. There is great promise, with significant funding going to both satellite companies and the launchers that will serve them. However, for the space ecosystem to capitalize on this opportunity requires an ROI incentive for continued private funding, advanced technology development, infrastructure buildup, and successful relationships with regulators and the U.S. Government.

Question 3. Is latency still an issue?

Yes. For streaming internet, video and voice communications, and applications with high inout bandwidth needs, latency at traditional Geosynchronous Earth Orbits (GEO) high above the Earth will always inhibit these systems from serving these low latency applications. This is a fundamental physical limit to the speed of signals traveling through a long, fixed distance through space. Medium Earth Orbits (MEO) and Low Earth Orbits (LEO) increasingly improve latency by locating satellites at lower and lower altitudes, and thus shorter transmission distances and times to the surface of the Earth. However, using MEO and especially LEO satellite constellations necessitates much larger numbers of satellites to provide continuous, effective coverage due to the orbital periods and ground tracks they require. The future of distributed LEO satellite constellations promises latency and bandwidth that is comparable to terrestrial coaxial cable and fiber internet, however none of these constellations are currently fully operational and are in various development phases.