DATA TRANSMISSION IN SPACE

JOURNAL ENTRY 04

In August of 2012, NASA's Voyager 1 officially became the first man-made object to leave the solar system [1]. Launched in 1977, the Voyager missions 1 and 2 were designed to send images and research data from Jupiter, Uranus, Neptune and Saturn by taking advantage of a rare alignment of the outer planets in the solar system [1]. Over 43 years later, voyager has now travelled over 22.6 Billion kilometres away from Earth and still transmits scientific data to this day [2]. It takes data transmissions from Voyager 1 over 19 hours to reach earth at this distance, and about 20 minutes on average to communicate with a Mars Rover [3].

As humans begin travelling further and further out into space, more efficient methods of transmitting data will need to be developed to avoid the ever-increasing delay in data transmission. Alpha Centauri, the nearest star to earth is over 40 trillion kilometres away, and would take a radio signal over 4 years to reach earth [4].

Data validity retention is a major issue when transmitting over such vast distances. The further data has to travel, the chance that data is altered or lost due to interference and noise increases exponentially [4]. Then there is also the issue of power. The greater distance away the signal needs to be sent, the more power is required to transmit it. Already, Voyager 1 is expected to run out of power by 2025 [1].

There are many current theories as to how to improve the current data transmission technologies. An Italian Astronomer Claudio Maccone theorised using the sun as a 'gravitational lens' to communicate with greater distances, for example, to Alpha Centauri and back [5]. This technology uses the idea that the immense gravity of a star bends space around it, creating what is essentially a gravity lens around. This lens would act as an antenna, increasing the intensity of its signal due to deflection [5]. This technology seems promising for the future, however it expects the use of technology that has not been developed yet [4].

Another method would be to send probes out, that would return with large amounts of physical data. If you have a large amount of data, it is often faster to deliver that data by hand than it is to try to send the whole thing in one go. There are some space programs actively developing probes that theoretically could reach the nearest stars and back in about 40 years. While 40 years is a lot longer than the 4 year proposed travel time for a radio signal (which excludes the time it would take to actually send something out to retrieve data in the first place), it does mean more data can be collected (think multiple thousands of terabytes of data by the time this technology will be available), and there is much less chance of data being corrupted due to long transmission times (assuming the probe returns intact).

[1] E. Howell, 'Voyager 1: Earth's Farthest Spacecraft', *Space.com*, Mar. 01, 2018. https://www.space.com/17688-voyager-1.html (accessed Oct. 14, 2020).
[2] JPL, 'Voyager - Mission Status', *Jet Propulsion Laboratory*. https://voyager.jpl.nasa.gov/mission/status/ (accessed Oct. 14, 2020).
[3] M. Koren, 'When Will Voyager Stop Calling Home?', *The Atlantic*, Sep. 05, 2017. https://www.theatlantic.com/science/archive/2017/09/voyager-interstellar-space/538881/ (accessed Oct. 14, 2020).
[4] J. Batt, 'Solving the Data Transmission Challenge in Deep Space', *Data Makes Possible*, Jul. 23, 2019. https://datamakespossible.westerndigital.com/solving-deep-space-data-transmission-challenge-in-deep-space/ (accessed Oct. 14, 2020).
[5] C. Maccone, 'The Sun as a Gravitational Lens : A Target for Space Missions Reaching 550 AU to 1000 AU', Politecnico di Milano, Milano, Jul. 2008, [Online]. Available: http://kiss.caltech.edu/workshops/ism/presentations/Maccone%20FOCAL%20mission.pdf.