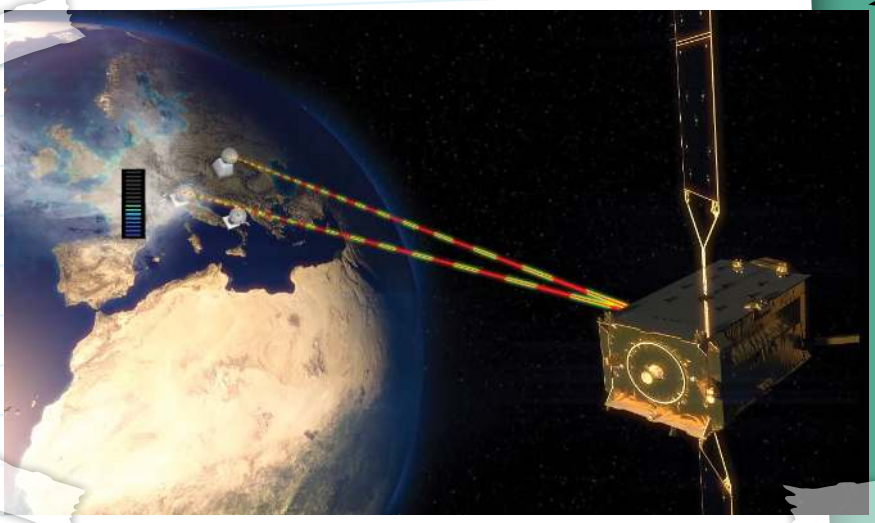
TEACHER RESOURCE

SCIENCE CONTENT/ CURRICULUM LINK
CONCEPTS OF DISTANCE AND TIME. LEARN ABOUT SPACE PROBES. ELECTROMAGNETIC SPECTRUM.

STARDOME OBSERVATORY & PLANETARIUM
FACTS, RESOURCES AND ACTIVITIES ON...

SPACE TEXTING



Alphasat's Aldo Paraboni (TDP 5) measures the impact of cloud coverage on its signal. Credit: ESA.

In 1945, science-fiction author Arthur C. Clarke published an article about the idea of communication equipment in space, titled Extra-Terrestrial Relays. Beginning with Sputnik in 1957, thousands of satellites have been launched to Low Earth Orbit (LEO) in an area nicknamed the 'Clarke Belt'. In the 1970's the Voyager missions were sent out of Earth's orbit, and have travelled farther than any other spacecraft. Their current mission is to be the first humanmade object to enter the interstellar medium beyond our star system. These missions are considered still active, because they still communicate with us. The most important part of a mission is ensuring that we can communicate with it. A mission is unsuccessful if we have no idea what happened to it once it leaves the launch pad.

In the 1970's the Arecibo Observatory sent a message to a globular cluster outside our own Milky Way Galaxy, and that message still has another 25,057 years before it will reach those stars.

The Deep Space Network (DSN) was developed to keep a continuous watch on spacecraft. The DSN is a series of antennas setup around the world; each site has one large 70m antenna, and then several 34m antennas combined into an array. Because of the distortion caused by Earth's atmosphere, there are satellites like the Hubble Space Telescope to get uninterrupted views of the cosmos. But with the use of atmospheric correction techniques, we now can gain the same views of space from here on Earth, eliminating the risk and cost of launching expensive equipment beyond Earth's atmosphere.

Ongoing research projects are testing data compression techniques, energy efficiency and the use of near-infrared (laser) technology to speed up the process 10–100 times.

The Disruption Tolerant Networking (DTN) is a new technology developed on the International Space Station (ISS) for Internet-like communication with spacecraft. Interplanetary communication comes with a high lag time, our current ability to transmit data is at the speed of light, so it can take anywhere from several hours to an entire day to receive transmissions because of the vast distance of the spacecraft.

Using current communication techniques there is years, to billions of years' lag time in interstellar communication. The Search for Extra Terrestrial Life (SETI) has been sending radio signals for decades to see if anyone is out there listening. Optical-laser communication is being developed to replace the low-frequency radio waves, but even lasers are restricted by the speed of light. Scientists are currently theorising the prospects of using neutrinos or gravitational waves rather than electromagnetic signals to transmit to other star systems.

Check out these other resources...

- https://scienceandtechnology.jpl.nasa.gov/research/research-topics-list/communications-computing-software/deep-space-communications
- https://www.space.com/23350-laser-space-communications-incredible-technology.html

DISCUSSION POINTS

What cutting edge technology has been developed to ensure the missions aren't outdated before they even arrive?

What are the details of some of these missions that have lost connectivity over the years?

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ACTIVITY

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SENDING SIGNALS

In this activity, students will explore the way satellites and spacecraft communicate to Earth and beyond through radio waves and light waves.

ACTIVITY ONE

RADIO WAVES

You'll need:
Battery
Wire
Compass

Instructions:
- Attach the wire to either end of the battery, then take a compass and place it on the wire. The magnetic field created by the moving electrons between the two terminals will cause the compass to change the direction is it pointing and align with the newly created magnetic field.
- To create a radio transmitter, you want to rapidly change the electric current in the wire. This creates a wave, and at this low of a frequency, you have essentially created a radio wave.

To pick up on a radio wave with such a low (and most likely inconsistent) frequency, would be a bit of a challenge! To overcome this challenge, we are going to switch from radio waves to visible light waves.

ACTIVITY TWO

LIGHT WAVES

You'll need:
Light
Cover

Instructions:
- Have students send messages across the room by having them uncover a light source in distinct intervals, like Morse code. In teams, see which students can send a secret message across the room the fastest.
- Now, give the students your own version of code, with all the letters and numbers mixed up, and see if the students can decode.

It is not worthwhile timewise to spend too long getting students to try and decode the messages. But it is a nice way to illustrate to students how hard it would be not only for countries who speak a different language, but for how difficult it might be for an alien race to receive and understand our messages. (Do these aliens have ears, or eyes, or even a language?)

Take a photo of your activity and send it to us. We'd love to see it! education@stardome.org.nz

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