Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *The Deep Space Network.*

If you've ever seen a home satellite TV installation, you'll know you can pick up a signal from a satellite orbiting the Earth at 36,000 kilometres altitude (which is geostationary orbit) with just a 60 centimetre wide dish.

So how about picking up a signal from the Cassini spacecraft in orbit around Saturn which is about 1.3 billion kilometres away? Yep - you're going to need a bigger dish.

And it's not just a question of size. All our spacecraft out there exploring the solar system and beyond aren't in geostationary orbit – so not only do you need a bigger dish, you also need a steerable dish that you can point at different spots in the sky – and a dish that can track distant spacecraft, meaning that it's able to stay locked onto a faint radio source for a extended period of time even though the Earth is rotating beneath it.

And if you are tracking a multi-million dollar spacecraft like New Horizons that will do the first ever fly-by of Pluto on the 14^{th} of July 2015 at a speed of nearly 14 kilometres a second there's no way you are going to call it quits when Pluto sets below the horizon and just wait around until you can pick up the signal again in the morning.

For all these reasons there are a collection of big, steerable, tracking dishes operating in a coordinated 24-7 network – collectively known as the Deep Space Network.

The Deep Space Network dishes look just like radio telescopes and can be used as radio telescopes if there's an opportunity within their increasingly busy spacecraft tracking schedule. A number of dishes can even be arrayed to enable interferometry observations.

The DSN dishes also transmit enabling us to make alterations to mission plans in mid-flight by sending course corrections or instructing the spacecraft to take more images of some interesting feature we never knew about from Earth, like a volcano on Io or a water geyser on Enceladus.

The DSN's transmitting power has also been used for some puzzling NASA PR exercises, like blasting out a Beatles song at Polaris or sending a bunch of text messages to Gliese 581d.

The Network has been around in various forms since the sixties – ensuring round the clock monitoring of both manned and unmanned spacecraft, including the Apollo missions to the Moon and early interplanetary forays, such as the Pioneer and Mariner missions.

Its current configuration involves collections of large dishes up to 70 metres in diameter established in three approximately equidistant sites around Earth – being Goldstone in California, Madrid in Spain and Canberra in Australia. This ensures at least one site can receive data from any spacecraft in the ecliptic plane (where the sun and the planets are) throughout a twenty four hour day – and at least for lengthy periods of a day for spacecraft in any other place in the sky.

The DSN is managed by NASA's JPL, which is the arm of NASA with prime responsibility for the design, construction and in-flight tracking of US robotic spacecraft. And increasingly, it helps missions run by other international bodies, notably the European Space Agency, the Japanese Aerospace Exploration Agency and the Indian Space Research Organisation.

The DSN currently plays almost no role in manned space missions –since we haven't left low earth orbit since 1972. Fortunately though – our robots have continued doing a fine job of exploring the solar system without us.

Some of these robotic spacecraft out there exploring the solar system and beyond are in low to medium Earth orbit, like the Hubble Space telescope, so would rarely if ever need dishes the size of DSN's to transmit data back to Earth.

For robots visiting the Moon, which is over 380,000 kilometres from Earth, it starts becoming more important to have those big sensitive DSN ears available. Indeed, it's anywhere from the Moon's orbit and outwards that we technically call Deep Space.

The Lunar Reconnaissance Orbiter, a NASA spacecraft currently searching for potential lunar landing sites returns its data via the Deep Space Network. India's Chandrayaan 1 and Japan's Kaguya have also used the DSN.

Beyond the Moon's orbit, Lagrange points 1 and 2 are a popular location for other spacecraft. L1 which is a point on the edge of Earth's gravity well directly between the Sun and the Earth is about 1.5 million kilometres away and an ideal place to park a spacecraft to observe the Sun – like SOHO the solar and heliospheric observatory – or to look back at Earth to observe the effects of the Sun on Earth, like, say, the Wind spacecraft does.

Conversely L2 the point on the edge of Earth's gravity well farthest from the Sun, is an ideal place to park a spacecraft to observe the rest of the universe, since that spacecraft will stay permanently in Earth's shadow, blocking out the Sun. The Spitzer infrared space telescope is parked there – as is the WMAP spacecraft, still measuring the tiny variations in the average 2.7 Kelvin cosmic microwave background radiation.

And then of course there's all those planetary missions. Around Mars, there's the Mars Odyssey, Mars Reconnaissance Orbiter and the European Mars Express – not to mention Spirit and Opportunity down on the surface. Then there's Cassini at Saturn, New Horizons on its way to Pluto – and going back the other way there's Venus Express at Venus and Messenger, which is due to enter Mercury's orbit in 2011.

And way, way out there are the two venerable 32 year old Voyager spacecraft that really drove the DSN to extend to its current capacity, ensuring we got every bit of data we could from the Voyager fly-bys of Jupiter, Saturn, Uranus and Neptune between 1979 and 1989.

Since then, both spacecraft have just kept going and now travel in different directions way off the ecliptic, but they still manage to transmit back to the DSN on a regular basis providing valuable data about the edge of the solar system – representing the first hesitant dip of our collective toe in the new frontier of interstellar space. Both spacecraft have about ten more years of active duty before their plutonium-based power sources finally run out.

Voyager 1 is the currently most distant human constructed object in the universe, at nearly 16.5 billion kilometres from Earth – which is just over 15 light hours away. It's moving at about 40 kilometres a second and at this rate it will achieve a distance of one whole light year from Earth in about 18,000 years.

Did someone mention this stuff is far?

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website where you don't have dig deep to dig space. No ads, no profit, just good science. Bye.