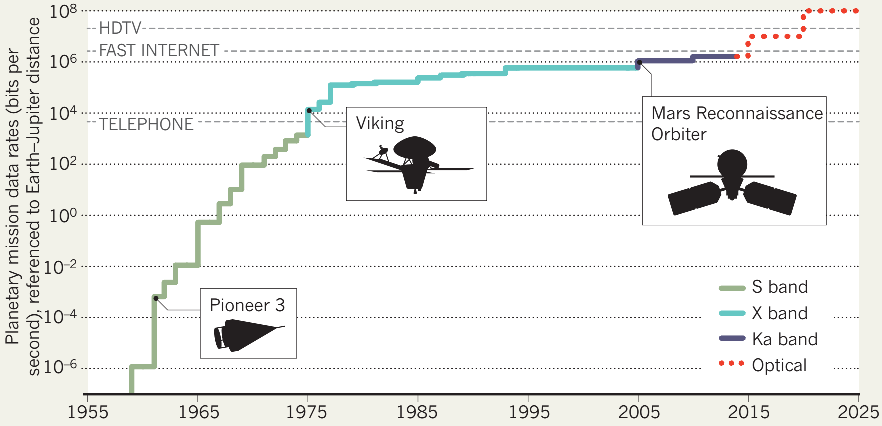
TUNED IN

Interplanetary data transmission rates have shot up 10 orders of magnitude in the past 50 years, thanks in part to higher frequency bands of radio waves. Optical transmissions with lasers promise to extend that pace, to the point at which high-definition television broadcasts from Jupiter might be possible.



SOURCE: NASA/JPL-CALTECH

a constant flow of data to its ground station — unlike low-Earth-orbit satellites, which can commuicate with the ground for only an hour or two each day as they race by overhead. "Other satellites will be able to buy time on our laser terminal," says Philippe Sivac, Alphasat's acting project manager.

One client will be another ESA mission due to launch this year: Sentinel-1, the first of several spacecraft to be sent up for Europe's new global environmental-monitoring programme Copernicus. It will beam weather data to Alphasat until the end of 2014. At that point, Europe plans to start deploying a network of dedicated laser-relay satellites that will ultimately handle 6 terabytes of images, surface-temperature measurements and other data collected every day by a fleet of Sentinel spacecraft.

But Europe's space lasers have a significant drawback. Although they can shuttle information between spacecraft, they have trouble talking to the ground — a task that must still be performed by radio waves. This is because these lasers encode information by slightly varying the frequency of light in a way analogous to modulating an FM radio station. A beam modulated in this way is protected from solar interference but is vulnerable to atmospheric turbulence.

The laser on NASA's upcoming LADEE mission will communicate directly with Earth using a different approach that is less susceptible to atmospheric interference. It encodes information AM-style by tweaking the amplitudes rather than the frequency of a light wave's peaks.

NASA hopes that the LADEE demonstration will extend laser communications beyond Earth's immediate vicinity, to the Moon and other planets. Deep-space missions currently rely on radio transmissions. But radio waves spread out when they travel long distances, weakening the signal and reducing the data-transfer rate.

Laser beams, by contrast, keep their focus, allowing them to shuttle the already greater quantities of information they encode over longer distances without using the extra power needed by radio transmitters. "Laser communication becomes more advantageous the farther out you go," says Donald Cornwell, mission manager for the Lunar Laser Communication Demonstration project on LADEE at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

In 1992, the Galileo probe, on its way to Jupiter, spotted laser pulses sent more than 6 million kilometres from Earth. A laser on Earth pinged the Mars Global Surveyor in 2005. Another struck the MESSENGER mission en route to Mercury, which responded with its own laser pulses. In January this year, the Lunar Reconnaissance Orbiter received the first primitive message sent by laser to the Moon — an image of the Mona Lisa that travelled pixel by pixel in a sort of Morse code.

LADEE carries NASA's first dedicated laser communications system. With a bandwidth of 622 megabits per second, more than six times what is possible with radio from the distance of the Moon, the system can broadcast high-definition television-quality video. But even though its AM optical system is good at penetrating Earth's turbulent atmosphere, it will still need a backup radio link for cloudy days when the laser is blocked. To minimize this problem, LADEE's primary ground station is in a largely cloudless desert in New Mexico, with alternative sites in two other sunny spots: California and the Canary Islands. ■ SEE EDITORIAL P.254

CORRECTION

The News story 'Teething troubles at huge telescope' (*Nature* **499,** 133–134; 2013) mistakenly gave Natural Resources Canada as the source for the graph instead of National Research Council Canada.