# 'Super laser' revolutionises data communications in space

28 November 2014

It takes almost three days to fly the 36,000 kilometres from Berlin to Wellington and back. On 28 November 2014, a laser beam covered a comparable distance in outer space for the first time – with the difference that it only took a few seconds to dispatch satellite images to Earth via a relay satellite.

The two satellites that used a new laser technology to exchange this data and transport it to Earth were the European communication satellite Alphasat I-XL, in geostationary orbit at an altitude of 36,000 kilometres since July 2013, and the European Earth observation satellite Sentinel 1A, which has been in a near-Earth polar orbit at an altitude of around 700 kilometres since April 2014.

The technology used for this groundbreaking data link came from Germany. The Laser Communications Terminal (LCT) was developed by Tesat-Spacecom GmbH under the auspices of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) Space Administration with funds from the German Federal Ministry for Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie; BMWi).

"What we are showing here is truly state-of-the-art technology made in Germany. It is an immense success. I personally consider this data transfer to be an important milestone for EDRS, the European Data Relay System, a kind of express highway. Laser beams are used to transmit large amounts of data from one satellite to another, and then back to Earth. Its data rate is 30 times higher than current standards," says Gerd Gruppe, Member of the DLR Executive Board responsible for the Space Administration. "With this demonstration, we have taken a big step closer to completing and using the world's most powerful data relay system."

In future, LCT technology will be used to transmit substantially greater quantities of data around the clock and in real time. The aim is to make storing large amounts of data on board satellites redundant and allow users faster access to the data. "This is relevant, for example, for a large number of environmental and security monitoring systems, among them the European Copernicus Programme," explains Rolf Meyer, Project Manager at DLR.

EDRS (European Data Relay System, see background information below) is a programme within the European Space Agency (ESA) that also uses the laser communications technology. A prototype was installed on Alphasat I-XL; the ESA Earth observation satellite Sentinel-1 acts as the 'partner station'. The LCTs on Alphasat and Sentinel 1A can transmit data at up to 1.8 gigabits per second across a distance of 45,000 kilometres. "This is equivalent to about 180 DVDs per hour," explains Meyer. "Compared with the first laser link between a geostationary satellite and a near-Earth partner, established in 2001, LCT technology permits a data rate that is 30 times higher. Yet this system weighs only a third as much and requires a telescope half the size," says the Project Manager. Alphasat I-XL remains 'parked' in geostationary orbit and is able to send data continuously to its ground station at DLR's Oberpfaffenhofen facility. Crossing both poles as it orbits Earth, Sentinel 1A is only able to use its current systems to transmit data when it passes over one of its ground stations. The LCT data link means that the Sentinel data can be dispatched to a ground station via Alphasat almost in real time.

The ground station at the DLR German Remote Sensing Data Center in Oberpfaffenhofen acts as a bridgehead for the geostationary relay satellite. While communication between the satellites is based on LCT technology, Alphasat I-XL sends its data to the ground station by microwave link. "This also involves the use of new technologies. The antenna installed for this purpose operates in the Ka band, at a frequency of 26 gigahertz – a substantially higher frequency than is usual for this form of communication," says Erhard Diedrich, responsible for the Alphasat ground station at DLR. It is important to note that Earth's atmosphere disturbs microwaves very little, hence permitting trouble-free reception regardless of weather conditions.

**The European Data Relay System – EDRS**

EDRS will initially consist of two geostationary communication satellites with data relay stations. These geostationary satellites will receive data from smaller, near-Earth satellites – for instance the Sentinels – and will proceed to transmit this data round-the-clock to the EDRS ground stations. At the moment, satellites in near-Earth orbit are only able to send observation data to their ground stations when the satellite passes over one of these stations. Until then, the Earth observation satellites have to store the data, meaning it is not available to users for analysis. EDRS is also known as the European 'data highway in space'.

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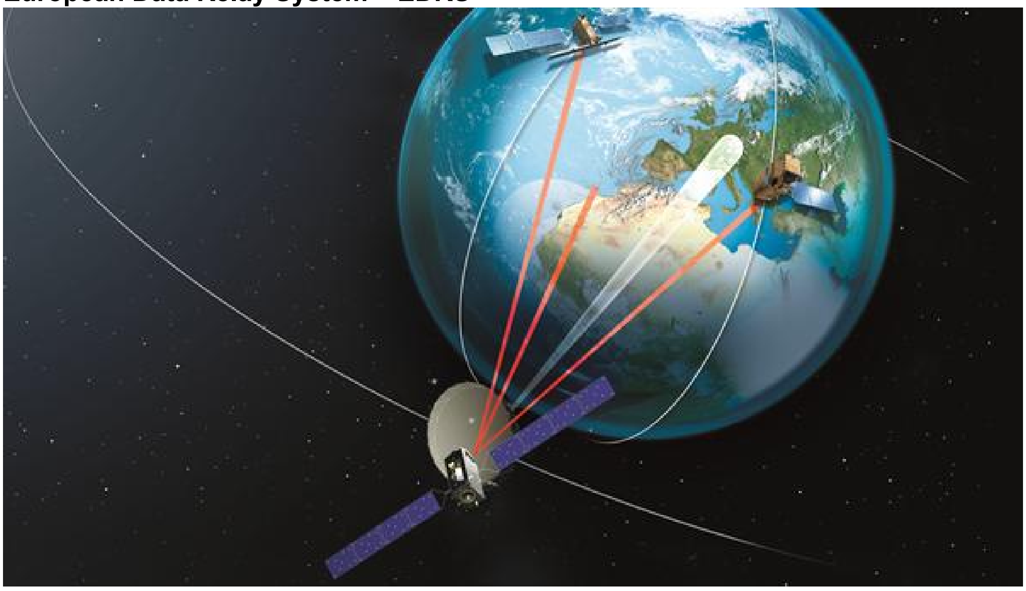
## European Data Relay System – EDRS



EDRS is an ESA programme for an independent European satellite data relay system. It is designed to significantly reduce the time delay in the transmission of large amounts of data.

Credit: ESA.

**Sentinel 1A**

The European Earth observation satellite Sentinel 1A has been in a near-Earth polar orbit since April 2014.

Credit: ESA.

**The laser communication terminal (LCT)**

The LCT is one of four ESA technology demonstration payloads on Alphasat. It was developed by Tesat-Spacecom GmbH with funding from DLR.

Credit: ESA.

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