

The legend of Goonhilly

For those readers in the UK who watched the Apollo 11 landing on the Moon live in 1969, the transmission that they were watching was beamed into their home by the Goonhilly Earth Station in Cornwall, writes **Carolyn Kennett**.



In the depths of the Cornish countryside, on the remote Lizard peninsula, is a satellite communications site called Goonhilly Earth Station. Situated on a high plateau, the iconic dishes act as a landmark that can be seen from far across the Cornish landscape. This summer sees worldwide celebrations commemorating the fiftieth anniversary of the Apollo 11 lunar landing. Goonhilly Earth Station played a pivotal role when one of its radio dishes, named 'Arthur', shot to fame by beaming the images of the lunar landing into millions of homes across the UK. This event was perhaps the pinnacle of early live television, and it is fascinating to consider that broadcasting an event such as this had not been possible just a decade before. In 1945, Arthur C. Clarke, member of the British Interplanetary Society and an RAF electronics officer, wrote an article in *Wireless World* outlining the possibilities of geostationary satellites being able to bring television direct to people's homes. This article was an excellent prediction of the future, though at the time it seemed to have little impact since Clarke felt the need to republish it in his 1951 book *The Exploration of Space*. Less than ten years later the idea of 24-hour telecommunications satellites was becoming a reality, and NASA started to experiment with two passive communications satellites called Echo 1 and Echo 2. This created a need for ground stations that could receive the signal transmitted from space, and Earth stations such as Goonhilly started to be built around the world.

Arthur was built in 1962, and was the first dish in the UK to transmit television pictures from the USA to the UK via the Telstar 1 satellite. The first transatlantic broadcast was made via Pleumeur-Bodou Ground Station in north-western France a matter of hours earlier, on 11 July 1962. A reverse of this broadcast was achieved on 16 July 1962 when General Post Office Engineers at Goonhilly transmitted a colour-television signal to Telstar, which was then received at the American ground station in Andover, Maine. Reports confirmed that the received picture was excellent and the colour quality good. On the Lizard there is little complaint about missing the first transatlantic television signal, because sixty years earlier and within five miles of Goonhilly, the first transatlantic radio signal had been made by Guglielmo Marconi on 12 December 1901, consolidating the Lizard's importance as a historic site of communications technology.

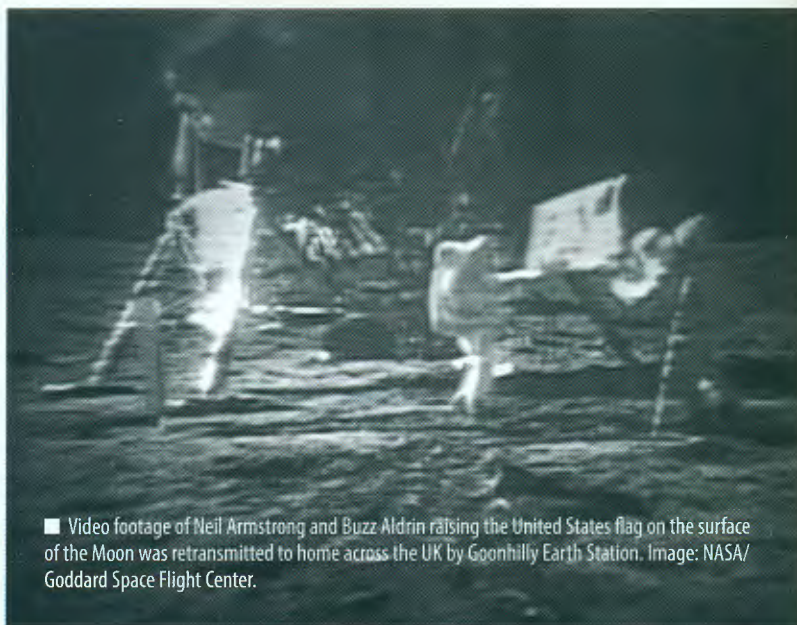
Live from the Moon

Late on the evening of 20 July 1969, people in the UK gathered around their television sets to follow the Apollo 11 lunar module, named *Eagle*, down to the surface of the Moon, and then watch the first images of astronauts walking on the lunar surface. Commander Neil Armstrong took the first human steps on the Moon in the early hours of 21 July, at 3.56am BST, and all three British television channels

■ An overview of the Goonhilly site, which is home to over 60 radio dishes, 25 of which are still in use. Image: Goonhilly Earth Station Ltd.



■ The dish known as GHY-6, previously known as Merlin, is directed towards the stars. Image: Goonhilly Earth Station Ltd.



■ Video footage of Neil Armstrong and Buzz Aldrin raising the United States flag on the surface of the Moon was retransmitted to home across the UK by Goonhilly Earth Station. Image: NASA/Goddard Space Flight Center.

◀ The first radio dish to be built at Goonhilly – GHY-1, also known as ‘Arthur’ – broadcast the signals relayed from the Apollo 11 lunar landing. Image: Goonhilly Earth Station Ltd.

of the time (BBC1, BBC2 and ITV) broadcast extensive coverage. This was the first time that British TV had broadcast throughout the night. James Burke, Patrick Moore and Cliff Michelmore led the high-toned BBC coverage, while a young David Frost hosted a ‘Moon Party’ on ITV. The pictures received from the Moon were black and white and upside down. The initial moments were particularly grainy as the signal was relayed through Goldstone in California to Goonhilly. By the time Buzz Aldrin stepped onto the Moon nineteen minutes later, the picture quality had improved significantly, as Moonrise had occurred in Australia and the images were being relayed via the larger Parkes Radio Telescope, which in turn was relaying the signal from Australia’s smaller Honeysuckle Creek Tracking Station (as seen in the film, *The Dish*). Once the signal was received at Goonhilly, Arthur (which was its largest dish at that time) beamed the images into television sets in people’s homes. An estimated 530 million people around the world watched the grainy images, which were repeated extensively throughout the following days.

Upgrades

The original dishes at Goonhilly were fondly named after Arthurian characters, including Merlin and Guinevere. Other than the historic and protected Arthur dish, they were almost all torn down to make way for a wind farm

Once the signal was received at Goonhilly, Arthur beamed the images from Apollo 11 into television sets in people’s homes

when Goonhilly’s owner, British Telecom, decided to move their telecommunications operations to Hertfordshire and close down their operational use of the site. The site was rescued at the last moment by Goonhilly Earth Station Ltd and its forward-thinking CEO Ian Jones, who visualised a future market in commercial space satellite communications and radio astronomy. Goonhilly station is now undergoing a huge programme of upgrades and a rebranding in readiness to position itself at the forefront of commercial spaceflight communications.

Goonhilly has over 60 dishes on site, of which 25 are currently in use. The biggest of them all is GHY-6 (Goonhilly 6), which was built in 1985 and was once known as ‘Merlin’. This is a 32-metre dish that is famous for broadcasting Live Aid around the world in 1985. This dish is now undergoing a large upgrade that will allow Goonhilly to provide satellite communications and deep-space tracking on a commercial basis. The upgrade is expected to be completed by 2020 and involves stripping out much of the antiquated computer equipment that sits in the base building and replacing it with modern technology that will enable it to communicate with missions as far away as Mars.

As space exploration moves into a commercial realm, the need for commercial tracking and communications systems has never been greater, and Goonhilly is in a perfect position to provide this. “We already have a great deal of interest in using the upgraded antenna from our international customer base,” says Ian Jones. “This includes space agencies such as ESA, as well as some of the new private space exploration companies.”

Goonhilly sights the Moon

In 2018 the European Space Agency (ESA), Surrey Satellite Technology Ltd (SSTL) and Goonhilly Earth Station signed a commercial partnership agreement called 'Lunar Pathfinder', which will involve a mission to the Moon. The aim of the mission is to develop infrastructure in European lunar telecommunications as well as navigation. Jones sees this as a real opportunity for Goonhilly. "This partnership opens a new chapter on the development of international exploration of the Moon and beyond. We are excited about the potential of our new partnership with SSTL and ESA to make the commercial lunar economy a reality." Lunar Pathfinder has a launch date of about 2022–23 and will deliver its payload of small CubeSats into lunar orbit. The CubeSats, which are made of units 10 centimetres cubed, are being offered to paying customers who have the opportunity to place science experiments on them up to a weight of 60 kilograms. Each CubeSat will have onboard a CCSDS (Consultative Committee for Space Data Systems) compliant radio communications card (to allow interoperability between communications and data systems from the different space agencies and private spacecraft) that will be able to communicate with Pathfinder and future spacecraft launched by SSTL, relaying their communications to Goonhilly. The CubeSats will be released from the main Lunar Pathfinder spacecraft, placing them into a polar orbit around the Moon, from where they could even land on the lunar surface. There is also the option for the CubeSats to remain onboard the main Pathfinder spacecraft, which will enter a highly elliptical orbit around the Moon. This is perfect for long-term



experiments as it will remain in this stable orbit for many years.

It is envisaged that the project will also pave the way for 'Lunar Mission Support Services' (LMSS) to evolve from this mission. This would see the development of an infrastructure to support future commercial lunar missions with communications between Earth and the Moon, navigation to the Moon and operational services for use at the Moon, both in orbit and on the surface. The idea behind these services is that the partnership will be opening up the opportunity for a wide sector of interested parties to launch their own private missions to the Moon. Goonhilly, in collaboration with SSTL satellites, will not only be able to relay communications from the far side of the Moon and the lunar polar regions, but will also enable continual direct communication with Earth. This

▲ Radio dishes fill the landscape at the Goonhilly Earth Station in Cornwall. Image: Goonhilly Earth Station Ltd.



◀ An artist's impression of the joint European Space Agency–SSTL–Goonhilly Lunar Pathfinder mission. The spacecraft will test technologies for acting as a relay between other satellites around the Moon, and Goonhilly on Earth. Image: SSTL.

Goonhilly is now undergoing a huge programme of upgrades and rebranding to position itself at the forefront of commercial spaceflight communications

will provide greater coverage for large areas of the lunar surface and orbital regions, extending the possibilities available to commercial lunar orbiters and landers.

As commercial space ventures become more frequent, there is an ever-increasing demand on existing communications networks, such as those provided by NASA and ESA. As these networks reach capacity, it is clear that there will be a need for additional private communications networks, and Goonhilly Earth Station is in a perfect position to provide this. Lunar Pathfinder will be just the start of this type of mission that Goonhilly will be involved with.

Arthur and e-MERLIN

Arthur has now been renamed GHY-1 (Goonhilly 1). A 25.9-metre-wide dish, it has been in almost continual use ever since it was built, and has undergone a makeover which enables it to work as an astronomical radio telescope. It is hoped that the dish can join a larger network, such as the e-MERLIN network that includes Jodrell Bank and Cambridge's Mullard Radio Astronomy Observatory. The

e-MERLIN network (which stands for Multi-Element Radio Linked Interferometry Network) is a powerful tool for radio astronomy, capable of observing a huge array of astronomical objects, including giant stars, supernova remnants, neutron stars and hydrogen gas in galaxies, enabling astronomers to answer questions about the composition and evolution of the Universe. Adding the GHY-1 dish to the network would be beneficial, as it would double e-MERLIN's baseline – i.e. its effective aperture – from 200 to 400 kilometres. GHY-1 'Arthur' can slew relatively quickly, at 120 degrees per minute on its giant turntable. A test run showed that it tracked objects with an accuracy of 0.6 arcminute over extended periods, but it is expected that once a measurement is being made, the tracking accuracy will be better than one-hundredth of a degree. Alongside GHY-1, the 29.6-metre GHY-3 dish is also being upgraded and will be utilised as a radio telescope.

There is much to celebrate this summer in the Cornish countryside. As Goonhilly reflects on its important role in the Apollo lunar landings with an event called Apollo 50, celebrating the fiftieth anniversary of Apollo-11 (see apollo50.co.uk for more details), it is clear that it has set its sights on a return to the Moon, as well as extending the horizons of what is possible in space communications with continued future development at the site.

Carolyn Kennett is the joint Editor of the *Society for the History of Astronomy Bulletin*.

▼ A rainbow seen arcing over Goonhilly Earth Station hints at the treasure that awaits it in the private space sector market. Image: Goonhilly Earth Station Ltd.

