

# Moving the UK to the leading edge of research in space networking

## Nomination for the Achievement in Space Research award, Sir Arthur Clarke Awards 2011

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The United Kingdom now holds an enviable lead in researching computer networking for space use, as a result of taking the Internet and advanced network communication into space.

Surrey Satellite Technology Ltd (SSTL) is a satellite manufacturer that was established at the University of Surrey in Guildford. SSTL adopted the Internet Protocol and IP networking for its Disaster Monitoring Constellation (DMC) remote-sensing satellites, as part of its philosophy of reusing well-engineered terrestrial technologies for the space environment.

Using IP networking onboard operational satellites led to an opportunity for in-the-field research on networking in space to be carried out. This opportunity was taken advantage of with the launch to low Earth orbit of an Internet router as a payload onboard the UK-DMC satellite,<sup>1</sup> with experiments in seamless mobile networking and the first tests from space of the new Internet Protocol, IPv6.<sup>2</sup> The Bundle Protocol, developed for Delay-Tolerant Networking and expected to be used to relay data between NASA's future 'Interplanetary Internet' of space probes, was first tested from space using the UK-DMC satellite.<sup>3</sup>

Lloyd Wood, who collaborated with colleagues at SSTL, NASA Glenn Research Center, and Cisco Systems in this work, was instrumental in making these research firsts happen.<sup>4</sup> Lloyd coordinated the successful tests of the router in orbit, proposed using it to test IPv6 and IP security, and then continued the established collaboration to gain in-space experience of implementing the 'Interplanetary Internet' and using DTN.<sup>5</sup> This has led to evaluation of the strengths and weaknesses of the Bundle Protocol's design, and of its applicability to deep-space and terrestrial ad-hoc networking scenarios.<sup>6</sup> Improvements to that communications protocol have been proposed as a result of this work.<sup>7</sup>

The success of this research has led to a later Internet router that is currently being tested on the Intelsat-14 satellite in geostationary orbit, and to a spinoff in developing a high-speed data delivery protocol, *Saratoga*.<sup>8</sup> That protocol was originally used for rapid download of large Earth images from the DMC satellites. It is now being implemented for use in future radio astronomy networks on Earth, such as the planned Square Kilometre Array. Lloyd is now working with CSIRO in Australia on *Saratoga* for astronomy data delivery.<sup>9</sup>

These team research efforts have been tested in orbit and led from the UK. This work is having an effect on satellite networking and how the future Interplanetary Internet will be built. It is also influencing how we approach terrestrial networking under extreme conditions: for challenged delay-tolerant and mobile ad-hoc networks, and for fixed, high-speed, astronomy sensor arrays, which are demanding in very different ways. Further information on this research, including papers, presentations, and press articles, is available from:  
<http://sat-net.com/L.Wood/dtn>

*Lloyd Wood is a Chartered Engineer and a fellow of the Royal Astronomical Society. He holds a PhD in satellite networking from the University of Surrey, where he does research, teaches, and supervises students. More information about Lloyd is available at: <http://uk.linkedin.com/in/lloydwood>*

## UK space networking research nomination - supporting references

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