NASA plans to evolve an interplanetary internet, linking earth and space. Toby Howard reports.

Into the outernet

Illustration courtesy of NASA/JPL/Caltech

▲ONE DAY, 'INTERPLANET' COULD UNIFY SPACE AND TERRESTRIAL COMMUNICATIONS

It is 20 years since Vint Cerf co-invented TCP/IP, the standard data code which made the modern internet possible. Having seen the net grow to today's world-circling web, Cerf now has a bigger idea. He plans to take cyberspace into outer space. Cerf has just been appointed Distinguished Visiting Scientist at NASA's Jet Propulsion Laboratory. Together with Adrian Hooke, manager of NASA's Space Mission Operation and Standardization Program, Cerf's brief is to find a way to merge the work of the space communications and internet communities.

Just as the web provides an integrated interface to the data moving across the net, Cerf envisions a solar system-wide web, unifying space and terrestrial communications. NASA sees this interplanetary internet, or "InterPlaNet", as the future of space communications. Currently, space comms technology encodes data in different ways to suit particular mission requirements. There are no multimedia standards, as on the internet; no point-and-click interfaces; no standard mechanisms to upload new programs to control spacecraft or planetary landers. "It took 20 years for the internet to take off here on Earth," Cerf said recently. "It is my guess that in the next 20 years we will want to interact with systems and people visiting the Moon, Mars and possibly other celestial bodies."

NASA is already convinced. It wants to employ the Interplanetary Internet in its forthcoming Mars missions, and has plans to leave special satellites in orbit as a first step to creating internet servers in space. But Cerf's vision is as technically demanding as it is fascinating. Just as the terrestrial internet brings together smaller networks in cities and countries, the goal of the Interplanetary Internet is to link together nets on different planets and their moons. Special interplanetary gateways will convert the Interplanetary Internet data protocols to conventional TCP/IP, connecting (in NASA-speak) "dirt-side to space-side".

The Interplanetary Internet will need a robust data transmission protocol. Traditional TCP/IP won't do because transferring data across space has its own problems. First there's interference. As far as man-made radio waves are concerned, empty space is a noisy place. As well as the natural radio emissions from stars and planets, cosmic rays cause unpredictable distortions in spacecraft transmissions. A more serious problem is the time-lag which results from the vast distances involved and nature's unbreakable limit of the speed of light. A radio signal, transmitted from Mars, say, takes several minutes to reach Earth, and the transfer time varies constantly. But Cerf is confident that the technical problems are soluble. "The time has come to think beyond the Earth," he says.

Some people worry about taking the web into space, fearing that we might be exposing ourselves a little too much to scrutiny by extra-terrestrials. It's not quite as daft as it sounds. Suppose aliens spot our planet and want to eavesdrop on us. The web is a perfect resource

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for them, far better than fiddly radio and TV transmissions which bubble out in spheres of ever-decreasing intensity: the web just sits there with its data intact, accessible to any alien with the latest quantum snooping gear. Take the web into space, and we really start advertising our presence. One day, ET will surely say hello. Let's hope the email is friendly.

Ian Robson reviews the startling developments in the presentation of holographic videos in 3D.

Altered perceptions

▲Fig 1 The Philips 14.5in Colour 3D-LCD evaluation kit

Sci-Fi films would have you believe that a holographic video is a 3D real-time video display projected into thin air. In reality, there is no way of producing such a display without the use of a capturing medium; thin air is not one of them. But other methods are producing startling results. Philips Research Laboratories has developed the Auto-

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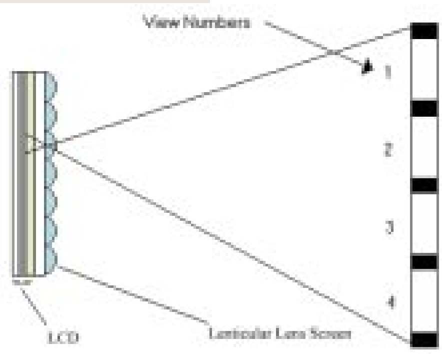
Stereoscopic 3D-LCD, combining its lenticular lens screen and LCD technologies to produce effective holographic video displays which appear to be as deep as they are wide. The lenticular lens screen sits on top of a normal LCD screen and is made up of vertical arrays of small cylindrical lenses which split the image into a number of views. The resulting image is horizontal parallax only (you see it only in the horizontal plane).

To get an idea of how these views work, hold an orange in front of your face. Close each eye in turn and you will see a slightly different view of the orange but they will both be in the same horizontal plane. A two-view lenticular lens does the same thing, projecting left and right views from two columns of pixels on the LCD screen, so the resulting image is perceived by the viewer as three dimensional. The fact that the viewer needs no special glasses is a major contributing factor to the "natural experience" but this two-view set-up means you can only see the image from one fixed point in front of the screen. To enhance the natural experience, the developers split the view into four, so each lenticular lens covers four columns of pixels on the LCD. This gives a wider viewing angle but reduces the horizontal resolution by half, compared to a two-view lens.

▼Fig 2 Diagram of a four-view 3D-LCD



A four-view system is shown in Fig 2, with an enlarged portion of the LCD and attached lenticular lens screen on the left. The black line between each projected view is caused by the LCD's opaque black mask which runs between each pixel of the display and prevents light leakage from areas of the liquid crystal that are not modulated by any voltage. When the viewer moves his head horizontally across the display it appears as a "now you see it, now you don't" effect. Blurring the boundaries between the four views created by each lens spreads out the black mask image, softening the transition between one view and the next. This encourages the viewer to perceive "solid objects" rather than being distracted by the black lines.

Progress in this field has been rapid, driven by interest from such diverse parties as medical institutions to home entertainment companies. Ultimately, though, the LCDs will have to improve before the technology can progress. An LCD with a horizontal resolution of 1,920 liquid crystal elements will have just 640 pixels. As it takes four pixels to create one four-view, a four-view 3D-LCD display will therefore have a resolution of just 160. Philips has developed a 14.5in 3D-LCD screen [Fig 1] which should be available soon to help developers create new applications. Games developers may jump at the chance.

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For further information: **www.research.philips.com/generalinfo/special/3dlcd**
If you're interested in another approach to holographic video, try **http://spi.www.media.mit.edu/groups/spi/**