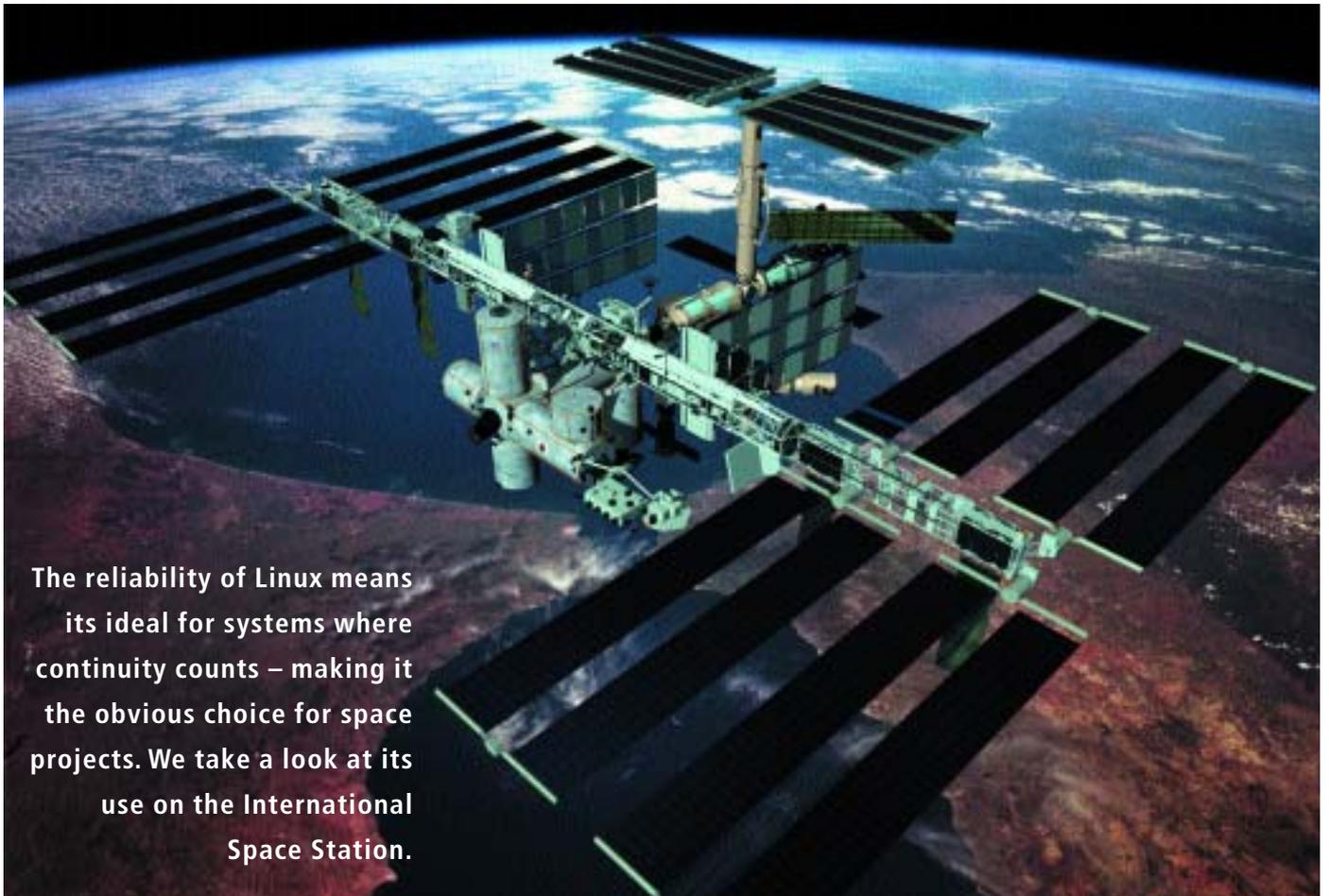


Linux on the International Space Station

BEAM ME UP, TUX

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The reliability of Linux means its ideal for systems where continuity counts – making it the obvious choice for space projects. We take a look at its use on the International Space Station.

The International Space Station (ISS) is about three times the size of the space station Mir that crashed into the Pacific a few months ago. With good visibility it can be seen from Earth. This sort of high-tech project depends on stability, reliability and performance, so it's no surprise that the European Space Agency (ESA) has chosen Linux for one of its projects.

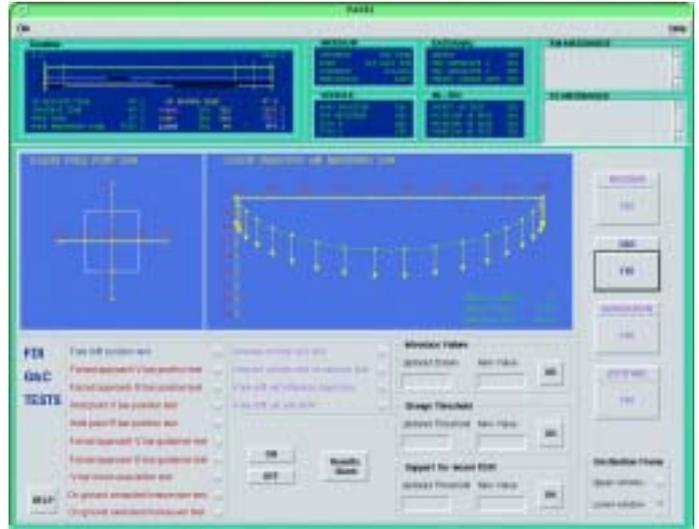
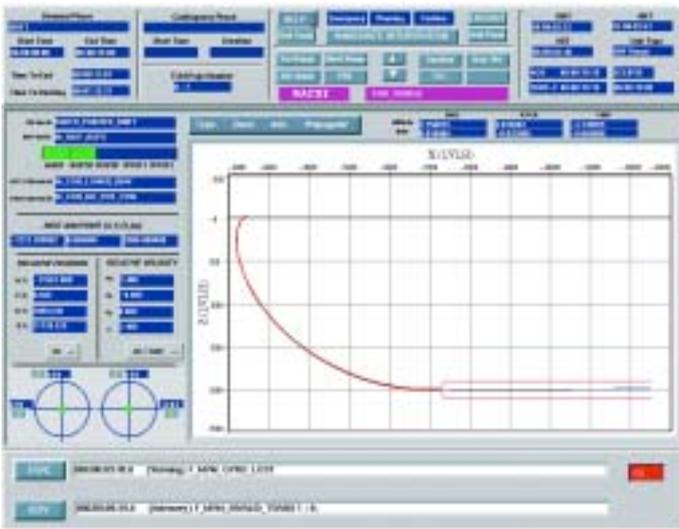
The Automatic Transfer Vehicle (ATV), realised by ESA, is an unmanned space craft that supplies the ISS with fuel and goods. To get the ATV's cargo onto the ISS requires a docking manoeuvre between the two spaceships. The difficulty lies in the different speed of the two ships. The whole rendezvous begins about 20 kilometres behind the

ISS. The ATV is initially faster; it follows the ISS, reaches it and adjusts its speed. Docking with the ISS must be accurate to the last millimetre. Then the cargo can be unloaded.

Even though most of the docking operations are automated in the unmanned ATV spaceship, the ISS crew and the ground staff are able to intervene in the manoeuvre. ESA has developed two Linux programs for this purpose – RASCI and GOAS.

Remote control

RASCI stands for Remote ATV Control at the International Space Station and runs on an IBM Thinkpad. The ISS crew will use it to monitor the



docking manoeuvre. The application requires X-Window (X11R6) with Fwmm as window manager and is currently running on Slackware 3.0 with kernel 2.0.30.

The relevant telemetric data is stored on the Linux file system. RASCI has a modular structure, there is a telemetry handler, which receives the telemetric data from the ATV, processes and saves it and, if necessary, transmits it to clients like the status monitors. Another module deals with error recognition during the docking manoeuvre. If an error occurs, the astronaut on the ISS is able to terminate the docking manoeuvre completely, pass control to the ground crew or start evasion manoeuvres if there is a danger of collision.

Future versions of RASCI are intended to also provide the astronaut with video data of the manoeuvre, which will be displayed in real time, in addition to the telemetric data.

Ground crew

The "Ground Operator Assistant System" (GOAS) was originally developed for Sun Workstations (Ultra-Sparc 5, 64MB RAM, 300MB HDD). The Linux version is derived from this. Linux-GOAS requires at least a 233MHz Pentium with 48MB RAM and uses X11R6 and Open Look as window manager. The GOAS GUI was developed in C++, the actual application in ANSI C.

GOAS is capable of addressing several monitors to provide as much status data as possible at one glance. The software allows the ground crew to intervene in the control of the docking manoeuvre in any situation imaginable. For example, the ATV's steering jets can be addressed directly to avoid a collision with the ISS. In contrast to RASCI, using GOAS, the ground crew can re-plan the entire docking manoeuvre – fully automated, semi-automatic or manually.

Although individual modules of the ATV project have been tested in several Shuttle missions (STS-80, STS-84, STS-86), the first deployment of an ATV for

the Ariane-5 mission is not planned until February 2003 – so Tux has got a little bit of time left.

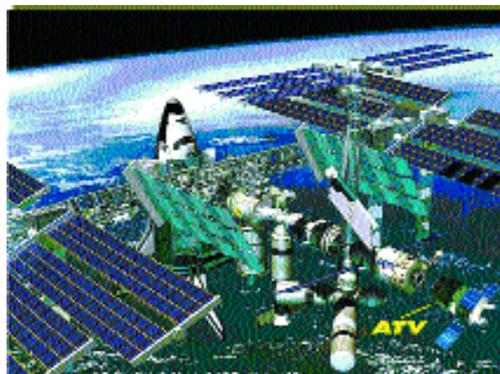
Other Linux space projects

Apart from the ATV project initiated by ESA the American space agency NASA is also looking into the use of Linux in space. The Flight Linux Project, originating in an initiative by NASA engineer Pat Stakem, is working on the Blue Cat-based distribution Flight Linux. According to its initiator, it is intended to maintain the course on board unmanned space ships and take over monitoring functions.

Another Linux project is the Linux-Equipped Astronauts Project (LEAP), the aim of which is to replace the Windows programs currently used by the astronauts with Linux programs. However, at the moment these lofty goals are still awaiting realisation, there is a lack of support from officials at NASA and ESA.

[left] Trajectory and control displays with RASCI

[right] GOAS gives control to the ground crew



Linux controls space rendezvous

Info

ESA ATV project: <http://www.estec.esa.nl/wawww/IESCI>

NASA Flight Linux: <http://flightlinux.gsfc.nasa.gov>

LEAP: <http://www.cantrip.org/leap.html>

<http://www.shelfug.co.uk/featuresoft.htm>

Space station computers crash: <http://www.theregister.co.uk/content/2/18526.html>