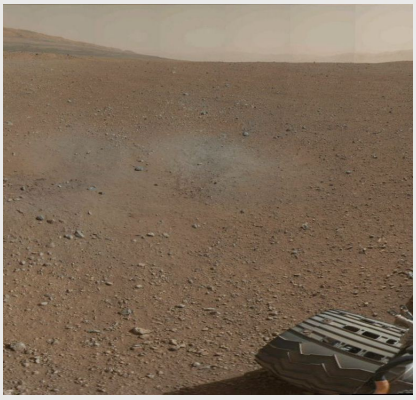

Postcards from Mars – but how did they get here?

Posted on AUG 15 2012 5:37AM

Panoramic image taken by NASA's Curiosity rover showing the Martian landscape

Image courtesy NASA/JPL-Caltech/MSSS.

This true-color photograph, taken by NASA's Curiosity rover, which landed on the surface of the Red Planet last week, shows the lower slopes of Mount Sharp rising away to the left on the dusty Martian surface. Images like these are, of course, just a small fraction of the information being sent back to Earth by the high-tech, nuclear-powered rover as it slowly traverses the Gale crater, but have

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you ever wondered how the data gathered by Curiosity - or the Mars Science Lab, to give it it's official NASA title - makes its way back to the computers of scientists here on Earth for analysis?

Curious about Curiosity's computer?

A dozen quick facts about the fastest computer on Mars:

- Curiosity actually has two computers on board
- While one computer is functioning, the other is kept in cold backup mode
- Each is based around a RAD750 computer
- Produced by BAE Systems Electronic Solutions in the UK
- Hardened, single-board design
- Processor based on PowerPC 750 design
- Has less processing power than an iPhone
- Draws approximately 10 watts of power
- Can withstand a 1,000 gray radiation dose
- Runs VxWorks operating system from Wind River
- Each computer has 256 KB of EEPROM and 256 MB of DRAM
- 2 GB of flash memory for temporary sensor and image storage

Here at iSGTW, we're used to computer networks dealing with large amounts of data, but despite Curiosity's array of state-of-the-art scientific equipment - including an alpha particle X-ray spectrometer, a neutron spectrometer, and an X-ray diffraction instrument - the amount of data sent back to Earth by the rover is actually relatively small. NASA mission plans call for the return of just 250 megabits of data per Martian day, which is known as a Sol and is roughly forty minutes longer than a day here on Earth.

Curiosity is capable of transmitting data directly back to Earth, via X-band (7 to 8 gigahertz), but

Curiosity
data
Deep Space Network
Earth
ESA
Gale crater
Mars
Mars Express
Mars Reconaissance Orbiter
memory
Mount Sharp
MSL
NASA
Odyssey
orbiters
processor
Red Planet
rovers
satellites
sending
spACE
transmission

this is only at a rate of up to a few kilobits per second. The rate of data transfer is so slow because of the rover's limited power and antenna size, as well as the long distance between Earth and Mars. Consequently, this will not be the primary method for returning data to Earth.

Instead, curiosity will transmit data via UHF (around 400 megahertz) to NASA's Mars-orbiting satellites, which will then relay the signal back to Earth. Curiosity can send data to the Odyssey satellite at a rate of 256 kilobits per second and can send data to the Mars Reconnaissance Orbiter at a rate of roughly 2 megabits per second. The European Space Agency's Mars Express also has the capability to serve as a backup for relaying the data. These orbiting satellites are capable of sending much more data back to Earth than the rover itself, not only because they are much more powerful and have bigger antennas, but also because they are in view of the Earth for much longer.

There is however, one major drawback of communicating this way. An orbiter is in the vicinity of the sky to communicate with the rover for just eight minutes each sol. Nevertheless, in these eight minutes between 100 and 250 megabits of data can be transmitted to an orbiter, which would take up to 20 hours for Curiosity to transmit directly to Earth via X-band.

Finally, back on Earth, the data signal is received by NASA's Deep Space Network (DSN), from where it is then sent to researchers around the world for

analysis. The DSN is a worldwide network of large antennas supporting interplanetary spacecraft missions, as well as performing radio and radar astronomy. Telescopes belonging to the network are located in Australia, Spain and California, so as to provide coverage for space missions around the clock. The Deep space Network has now received more than 130 terabytes of data - including more than 70,000 images - from the six science instruments on Mars Reconnaissance Orbiter during its first five years at Mars. Now that's more like it.

From left to right: (1) a mosaic image showing part of the left side of the Curiosity rover and two blast marks from the descent stage's rocket engines; (2) true-color image showing part of the wall of Gale Crater; (3) true-color image looking southwards toward Mount Sharp; (4) true-color image showing blast marks from the descent stage's rocket engines. Click through for larger versions. All images courtesy NASA/JPL-Caltech/MSSS.

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