

A One-Stop Web Application for the Mars Team

- **The Mars Exploration Rover Collaborative Information Portal (MERCIP) provides a window to all mission events**
- **It supports mission updates, data sharing, and collaboration**

In June and July of 2003, NASA launched its two Mars Exploration Rovers, Spirit and Opportunity, to explore separate sites on Mars. They will land on the planet in January, 2004. Their mission is to search for evidence that the sites might have had running water and could have supported life at some earlier time. Capable of moving about 40 meters per Martian day, Spirit and Opportunity could each travel several kilometers during their three-month mission on the planet, much further than Sojourner's 100 meters. Using images and measurements received daily from the rovers, scientists will command the vehicles to go to and examine geological targets of interest.

To support this mission, the CICT Program's Computing, Networking and Information Systems (CNIS) Project has funded the development of a new Web-based tool, called the Mars Exploration Rover Collaborative Information Portal (MERCIP).

Piyush Mehrotra, manager of the CNIS Project's Information Environment (IE)

subproject, says, "MERCIP is one of the innovations that we are funding to provide scientists and engineers with computer environments that explicitly support their domain and, if possible, their immediate task. Our goal is to help increase the performance and productivity of NASA missions. With MERCIP, lead investigator Joan Walton and her team have developed a customizable Web-based tool that can quickly and automatically inform the Rover team of changes to mission status and make it easier for them to collaborate on deciding new rover tasks."

Rapid and intuitive access to mission data

MERCIP is an information management and data integration system that uses Java™ desktop and enterprise technologies, along with Web services, to provide mission operations and science teams with rapid and intuitive access to a broad range of science data, as well as mission status and planning information. MERCIP assists the team in its daily collaborative process of deciding which geological targets the rovers will explore next.

"We talked with team members from the 1997 Mars Pathfinder mission as well as the current Mars Exploration Rover mission team," says Joan Walton, the CNIS Project's principal investigator and lead computer scientist for the Computational
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Technology Spotlight

Technology

Mars Exploration Rover Collaborative Information Portal (MERCIP)

Function

Provides a single Web application that automatically informs all 240 members of the Mars Exploration Rover team of changes to mission status, and enables them to find specific data quickly and to collaborate on future rover activities

Relevant Missions

- Mars Exploration Rover (MER)
- Exploration Systems Enterprise Missions
- Other collaborative tele-robotic missions

Features

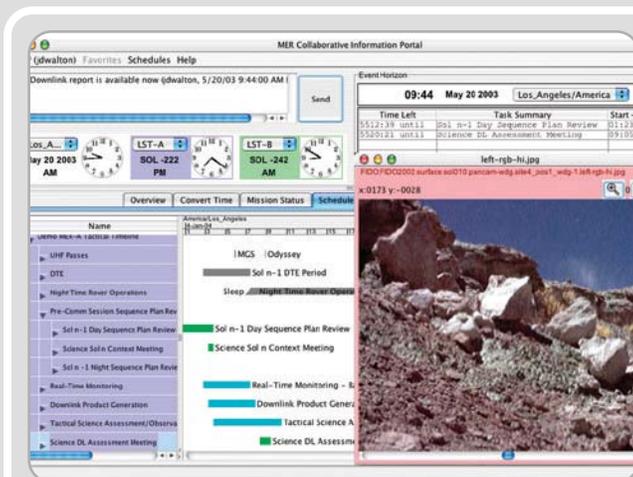
- Three-tier Java-based architecture supporting multiple client systems
- Unique metadata repository for data integration and query
- Secure communications between middleware and clients via Web services
- Automatic notification to users when new data or reports come in

Benefits

- Offers easy, secure, remote access
- Produces updated progress reports
- Enables users to send and receive broadcast announcements
- Supports customization by user
- Enables real-time collaboration among team members

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MERCIP (left) displays mission schedules, plans, and reports, as well as clocks in various time zones (including current Mars times at the two landing sites). It also enables users to send or receive broadcast announcements.



Each Mars Exploration Rover (artist's rendition, left) will explore three to four kilometers of Martian terrain during its 90-day mission on the planet. MERCIP will keep team members informed of each discovery and enable the 240-member team to collaborate on deciding and scheduling each day's tasks.

Sciences Division's Information Design Group at NASA Ames Research Center. "They needed a way to not only integrate the vast amount of mission information and incoming data, but also coordinate the 240 scientists and engineers working on three overlapping shifts that span the Martian day. We designed the Collaborative Information Portal to help them," she says.

Looking under the hood of MERCIP

MERCIP is a three-tier system (client, middleware, back-end) based on Java 2 Enterprise Edition standards. The client applications are Swing-based desktop Java™ applications that run on multiple platforms. The middleware runs on Sun® Solaris® servers and was built using BEA® WebLogic® enterprise application server, Enterprise Java Beans™, the Java Message Service, and Java Database Connectivity. Web services provide secure communications between the middleware and the client applications. The back end consists of Oracle® databases and Java-based data loaders and file monitors.

"MERCIP allows the 240 users to customize their individual content and presentation to accomplish different tasks at different times from different places around the world," says Walton. They use MERCIP to display data and images downloaded from the Mars rovers, and to collaborate on the rovers' next targets and goals. They can view mission schedules, plans, and reports, see clocks in various time zones (including current Mars times at the two landing sites), and send and receive broadcast announcements.

Integrating data from multiple sources

"We faced numerous technology challenges in developing MERCIP," says Walton's colleague John Schreiner, CIP project manager at Ames' Computational Sciences Division. "They included integrating heterogeneous

engineering and scientific data sources, managing large amounts of data, and supporting the use of unstructured data. The users don't have time to search two or three times to find what they need," he says. "So MERCIP integrates and packages the data they've subscribed to see, and notifies them when it's ready."

The file monitor in the back-end's Data Acquisition Module looks for new data from the MER Mission Data Systems. Parsers in the data loader are designed to read specific MER sources. They retrieve and format relevant data for storage in MERCIP's meta-database, which integrates structured and unstructured data from legacy sources such as Microsoft® Word documents, Adobe® Portable Document Format (PDF) files, and Web-based HTML files. Both the structured and unstructured data are converted to XML, encrypted, and streamed securely over the Web to users, enabling them to access both types of data from a single interface. The middleware caches frequently accessed data for rapid delivery to all requestors.

Securing access for multiple clients

MERCIP's Java-based middleware ensures secure, remote access for hundreds of users on a variety of client devices. The Enterprise JavaBeans provide reliability, scalability, maintainability and platform independence. The Java Message Service notifies multiple clients simultaneously that data they have subscribed to has arrived. Web services support both Java and C++ clients by providing language-independent communications between the middleware and client applications. Web services also ensure secure, encrypted communications by transmitting the XML-based protocol, SOAP, over HTTPS. The middleware provides the clients with user management services, data access

services, time services, file and directory services, and messaging services.

Efficient, demand-driven, client support

"The Java-based client application runs on the leading scientific platforms, including Solaris®, Windows®, Mac® and Linux® workstations," says Schreiner. "Thus, it's more flexible than a server-side implementation and uses client host resources. To maintain a small resource footprint, it's also demand-driven, loading only the data that the user wants."

A new information infrastructure

"Unlike much of the technology for previous missions," says Walton, "MERCIP will be adaptable to other missions as well. It's part of a new generic information infrastructure, called Info-Core, that we are developing to integrate scientific and engineering data."

Meanwhile, the MER team will find MERCIP crucial to helping them steer and track the twin Mars rovers in their search for clues to one of humanity's greatest questions: Did life ever exist on Mars?

—Larry Laufenberg

For other information or stories online, see www.cict.nasa.gov/infusion

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