

## **Integrated Communications in Support of ITER**

ITER, the international thermonuclear experimental reactor (to be sited in Cadarache, France) will employ magnetic confinement techniques to study "burning plasma" physics. It will be the largest and most expensive scientific instrument ever built for fusion research and is the next major step toward proving the scientific viability of controlled fusion as an energy source. Participants in the project include the US, European Union, Japan, Korea, China and Russia. (India is currently negotiating entry). US scientists are engaged with their international partners in defining requirements and approaches for distributed collaboration and remote participation on this experiment. The plan is to test these approaches on existing facilities, such as the Alcator experiment at MIT, where widely based collaborations are already in place.

A unique feature of fusion energy research is the requirement to access, analyze, visualize and assimilate scientific data in near-real-time, to support decision making during operation of experiments. (This contrasts with large experiments in other fields, such as high-energy or nuclear physics which operate primarily in a batch mode.) Fusion experiments put a particular premium on near real-time interactions with data and among members of the team. Informal and ad hoc discussions are a critical element of the ongoing research. Enabling effective international collaboration on this scale will require the construction of a working environment that is equally productive for on-site and off-site personnel engaged in experimental operations.

We have found that the greatest challenges involve communication and engagement between remote and local researchers rather than specific technical problems. With the research team distributed geographically and communications more awkward, relationships are difficult to establish and maintain. Our hope is to exploit the ongoing convergence of telecommunications and computing technologies, integrating communications channels (audio, video, messaging, email, etc.) and data to aid in the development of a productive collaborative environment. Advanced directory services that allow people and data streams to be identified, located, scheduled and connected into a flexible communications fabric need to be developed and deployed. The directory would be augmented by "presence" information supplied implicitly or explicitly by users. The directory and communications infrastructure must support "roles"; that is, there is a need to locate and communicate with people who are distinguished by function rather than name or location. Examples would be the session leader of an experiment or the technical support personnel for various subsystems. Implementation of these capabilities implies a tight coupling between databases and communications tools.