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THE COLLABORATIVE CONTROL ROOM FOR FUSION ENERGY SCIENCES

by
THE NATIONAL FUSION COLLABORATORY PROJECT TEAM

JULY 2004

DISCLAIMER

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The National Fusion Collaboratory Project Team
Contact: D.P. Schissel, *General Atomics, P.O. Box 85608, San Diego, CA 92186*
email: schissel@fusion.gat.com, Phone: (858) 455-3387, Fax: (858) 455-3586

The Road Ahead

- The future of fusion energy research points toward several new very large experimental devices that will be supported by the worldwide experimental and theoretical community. KSTAR, to be built in Korea, is on a 5-year time scale and ITER, to be built in France or Japan, is on a ten-year time scale. ITER will be the largest and most expensive scientific instrument ever built for fusion research. Currently there are no plans for experimental devices of this scale to be built in the United States.
- Although these devices will not be located in the United States, U.S. scientists will use them extensively. As such, an effective international collaboration environment will be needed to maximize their value to the U.S. fusion program.
- The control room of a fusion experiment is a highly dynamic environment where today on the order of 20 to 30 scientists make decisions informed by data analysis on an approximately 15-30 minute time scale. For future experimental devices, this control room will become distributed, as the worldwide community supports experimental fusion research in real time. For ITER, this collaborative control room could contain on the order of several hundred scientists distributed over several continents.

Technical and non-Technical Barriers to more Aggressive Adoption

- Ease of use issues is a major reason for the slow pace of adoption of Grid technology by scientists. These issues include the difficulty in installing and using Grid middleware either as a Grid user or a service provider and the difficulty in managing X.509 certificates. Combining these very real obstacles with the natural inertia from users and the lack of a case sufficiently compelling to overcome this inertia, limits the growth curve of Grids.
- The lack of certain functionalities also limits the growth of Grids. For example, easy to use authorization tools are needed for service providers and site security experts. Quality of service (QoS) in Grids is needed to support the pseudo-real-time needs of the collaborative control room. Additionally, there is a general lack of resources to support users and application developers.
- The lack of interplay between Grid security (single sign on) and site security (firewalls) presents a significant barrier to the aggressive adoption of Grid technologies within the fusion energy sciences community. In a science community that has over 30 research sites in the United States, it is very likely that a Grid service request will require numerous other services unbeknownst to the requestor. The ability to have a one-time Grid login that dynamically traverses site firewalls is necessary for Grid technology to be widely adopted within fusion energy sciences.
- Previously there has been an emphasis in the computer science community on technology without good connection to the end users. This has changed with the Scientific Discovery through Advanced Computing (SciDAC) Initiative and needs to be strengthened.
- Enhanced collaborative environments that include audio, video, and shared applications lack good session management tools. Desirable features might include “presence” (follow me, find me), on

demand extensible conferencing, extended privacy and access control, broadcast, forwarding, and advanced directory services with links to POTS, email, IM and voicemail. It is worth noting that these capabilities are being built into VOIP services – we should begin looking at these technologies.

- A solution needs to be presented that allows for large-scale data management over Grids that can support the pseudo-real-time needs of the collaborative control room. Additionally, collaborative tools are needed to assist both collocated and remote scientists in communicating ideas and sharing data views. These include tools for data visualization along with methods for sharing display information and simultaneous control. These collaborations must be capable of happening across a variety of hardware platforms and physical environments.

Cyber Security with Distributed Applications

- Seamless integration of site security and Grid security yielding a true single sign-on capability is required for wider adoption of Grids. For example, when a scientist logs onto their computer using their site-assigned username and password, all necessary credential management for logging onto the Grid should be handled automatically. Authorization and auditing of the use of Grid services also needs to present an interface that is uniform across sites, but can satisfy individual site requirements.
- It is our experience that only a solution that is designed, tested, and implemented by both Grid security experts and site security experts will succeed. Neither party will want a dictated solution. Ownership by both parties should insure success and adoption of a unified Grid and site security solution.

A Decade of DOE Collaboratories

- In the U.S. fusion community, the ability to remotely view experiments and to control selected instrumentation and analysis tasks was demonstrated as early as 1992. Full remote operation of major fusion experiments was demonstrated in 1995 and 1996.
- The MDSplus data acquisition & management system has been in use for over 10 years and is presently at over 30 sites worldwide. Its adoption has greatly facilitated data sharing and collaboration.
- The NFC Project has deployed FusionGrid securing MDSplus with Globus GSI for worldwide fusion data access. The TRANSP fusion code has been deployed as a FusionGrid computational service resulting in better support for users with less effort and users gaining access to faster computations with the latest code version.
- The NFC project has deployed Tiled Display Walls in control rooms for both collocated and remote visualization and information sharing. Access Grid technology has also been deployed into the control room and demonstrated remote experimental operation between the U.S., Europe, and Japan.

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