The Global Accelerator Network (GAN) – Globalization of Accelerator Operation and Control

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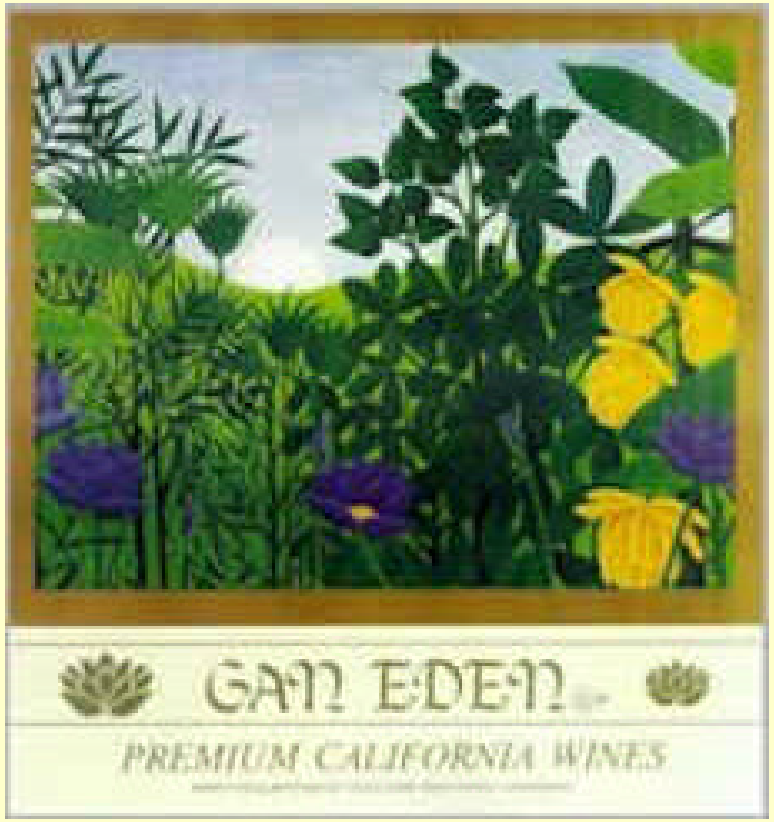
What is GAN?


GAN EDEN
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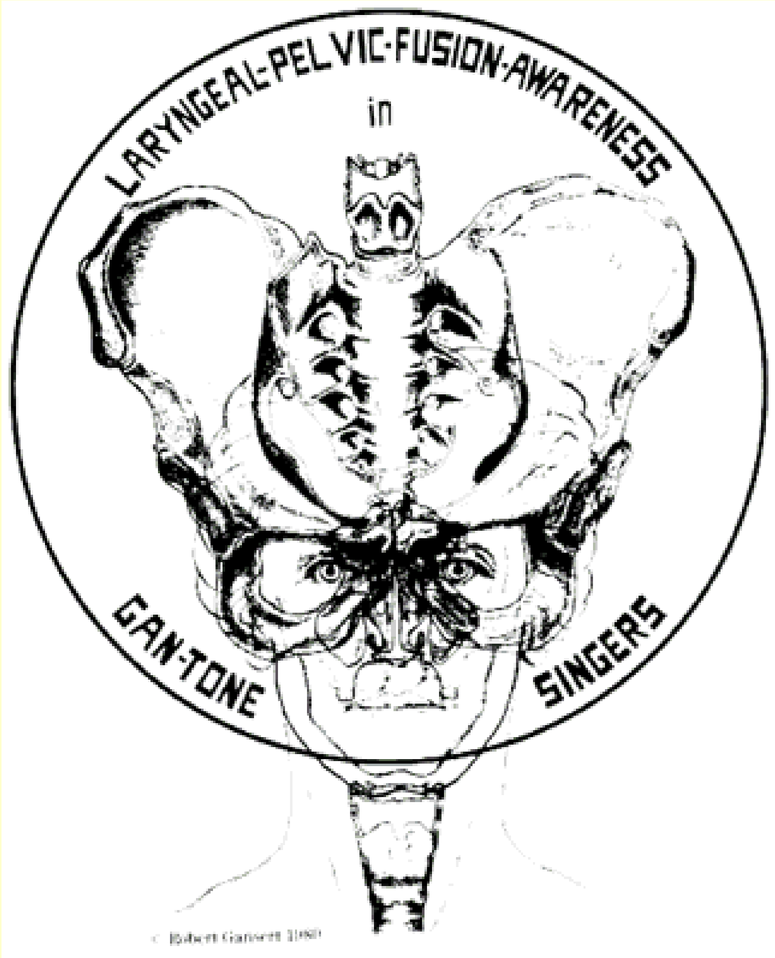
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What is GAN? (cnt'd)

- **GAN** = **G**lobal **A**ccelerator **N**etwork

- **GAN** = A model to design, build, operate and maintain a future large accelerator (e.g. a TeV or multi TeV e+e-collider, a multi TeV hadron collider, a neutrino factory, a muon collider, …)

- **GAN** = Proposed in 1999 by A. Wagner (chairman of DESY directorate) inspired by the operation model of large particle physics experiments

Organizational Models for High Energy Accelerator Facilities

- **National or regional facilities (small and medium-size projects):** built and operated by the host country or region
- **HERA – Model (large projects):** planned and reviewed by an international collaboration, built by a host laboratory with "in-kind" contributions from the collaboration, operation is the responsibility of the host laboratory
- **CERN – Model (very large projects):** common funding for construction and operation in the frame of an international organization

Organizational Models for High Energy Accelerator Facilities (cnt'd)

Alternative approach:

GAN – Model (very large projects): international collaboration with a comparable share of the total construction and operation cost, facility is a common property of the collaboration partners which share the responsibility and provide the staff

Helps to:

• maintain and nurture the scientific culture, experience and special knowledge of the participating laboratories

• provide the visibility and vitality of each partner

What Benefit does GAN provide?

• Allows to collaborate based on long-term agreements.

• Allows to integrate and share scientific and technological knowledge, ideas and resources

•Allows to facilitate the thorny problem of site selection for new large accelerator facilities.

• Allows to design, build and operate a new accelerator facility collaboratively with equal partners; the accelerator would be built at the site of an existing laboratory to benefit from available experience, manpower and infrastructure; however, the accelerator is remote from most of the collaborating institutions.

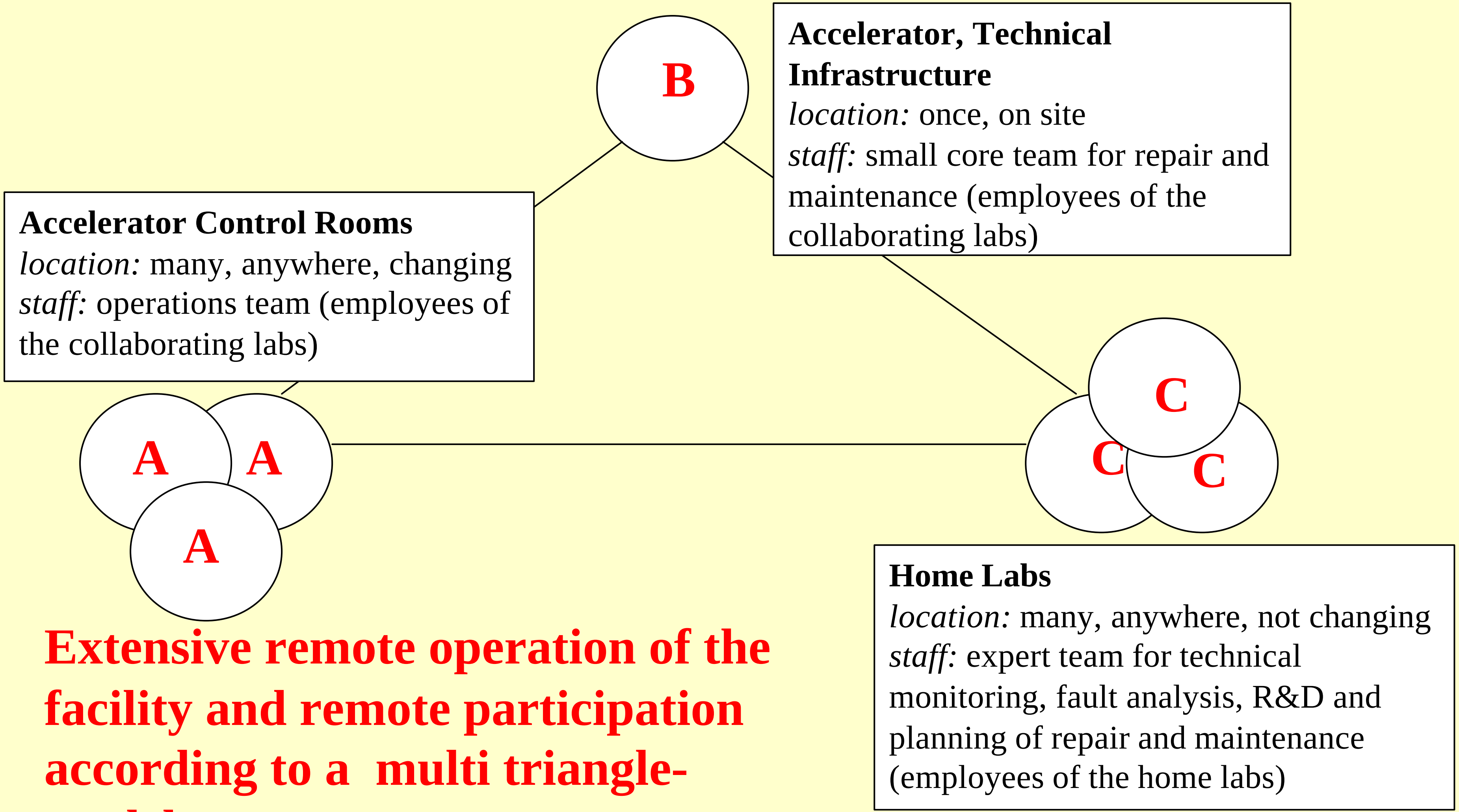
What Benefit does GAN provide? (cnt'd)

- Allows to take responsibility for certain components of the project designed, built and tested at home before being delivered to the host site and operated as well as maintained from home after delivery.

- Allows to remain most of the manpower in the partner institutions, except during periods of installations and overhauls; component maintenance, operation and development would be carried out as much as possible from the home institutes.

- Allows participating institutes to continue important activities at home while being actively engaged in a common project elsewhere.

The GAN Operation Model



Extensive remote operation of the facility and remote participation according to a multi triangle-model

What are the Critical Items?

Critical items have been identified and discussed at:

- ICFA Task Force report to study the GAN proposal and its implications, December 2001
- Workshop on “Enabling the Global Accelerator Network”, Cornell, March 2002
- Workshop on “Remote Operations”, Shelter Island, September 2002

What are the Critical Items? (cnt'd)

Human aspects:

- How can we achieve the desired "corporate identity" and a common culture?

- How do we adopt different cultures and experiences (e.g. of accelerator operations crews)? What are the implications for the home labs and the individuals? How do we keep people involved and interested?

- How do we establish mutual trust, "personal connections" and information exchange mechanisms?

- How do we make decisions and achieve a "flexible consensus"?

What are the Critical Items? (cnt’d)

- Why would the site laboratory relinquish control?
- Which language should we use?
- How much manpower is needed permanently on site?
- How much manpower is needed in the home labs?
- Which are the necessary qualifications of the staff?
- …

What are the Critical Items? (cnt'd)

Technical aspects:

- How do we perform a common technical management (rules, procedures, standards, criteria, etc.)?
- How do we solve the "1%-problem" (on about 20 occasions/year experts presence on site maybe required)?
- How do we minimize accelerator down-time? Is the availability of technical components high enough?
- What are the requirements for hardware as well as software components?

What are the Critical Items? (cnt'd)

- What is the appropriate control system architecture? How do we fulfill the different user's needs (standardization versus accommodation)?
- Availability of network bandwidth and security standards?
- Is the performance of modern communication technologies sufficient?
- …

Common conclusion: GAN is feasible!

Remote control, diagnostics and participation is THE key element of the GAN approach

This implies:

• modern communications technologies, tools and security standards to operate from multiple control rooms, to attend meetings or to facilitate error search and maintenance from a remote site: e.g. Access Grid, white and smart boards, high quality audio transmission, display walls, modern secure authentication and authorization mechanisms, VPN, …

Example 1: Access Grid Project (ANL)

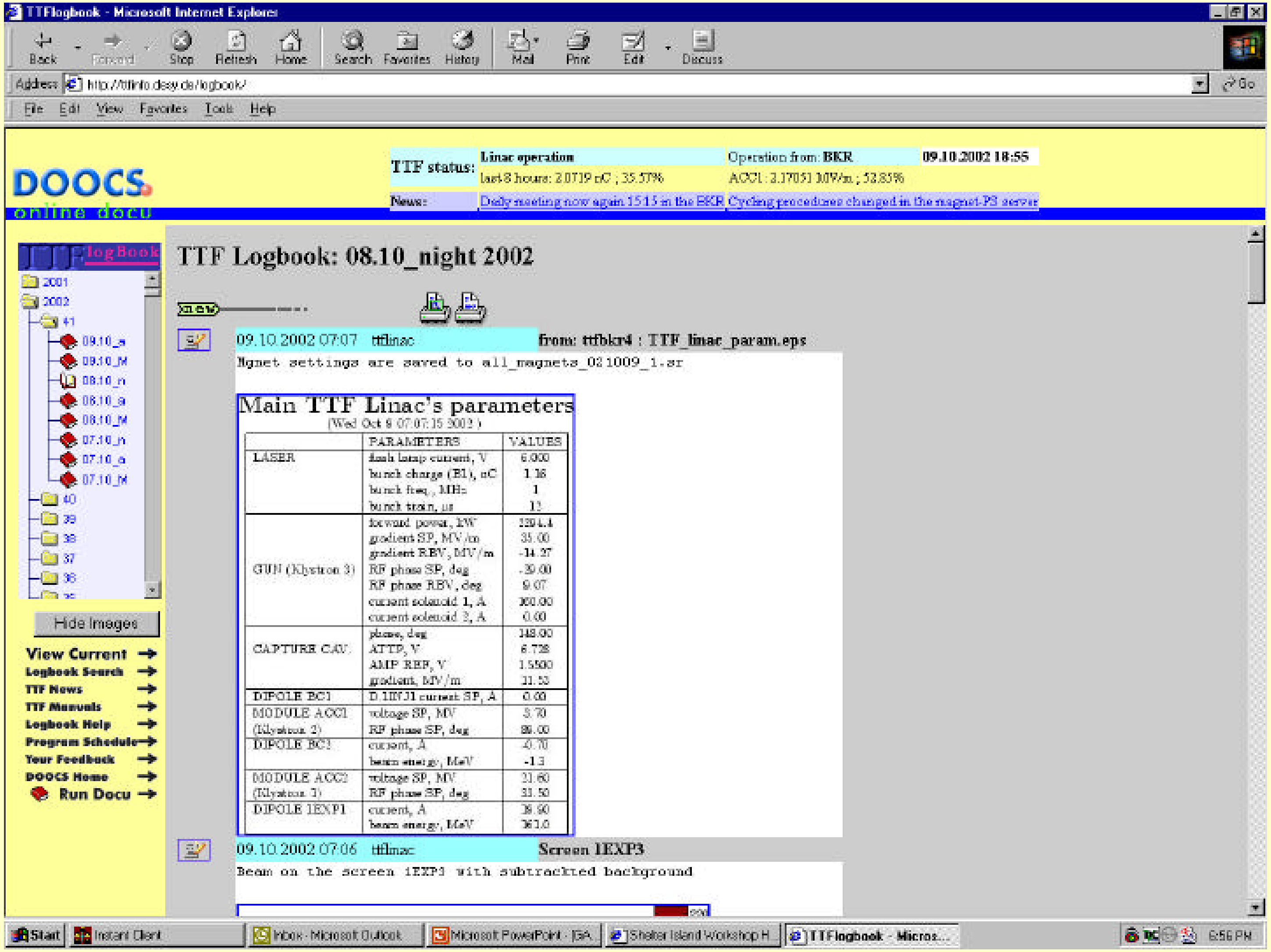
- Enables group-to-group interaction and collaboration
- Goes beyond teleconferencing
- Enables complex multi-site visual and collaborative experiences
- Build on an integrated Grid Services architecture

Remote control, diagnostics and participation is THE key element of the GAN approach (cnt'd)

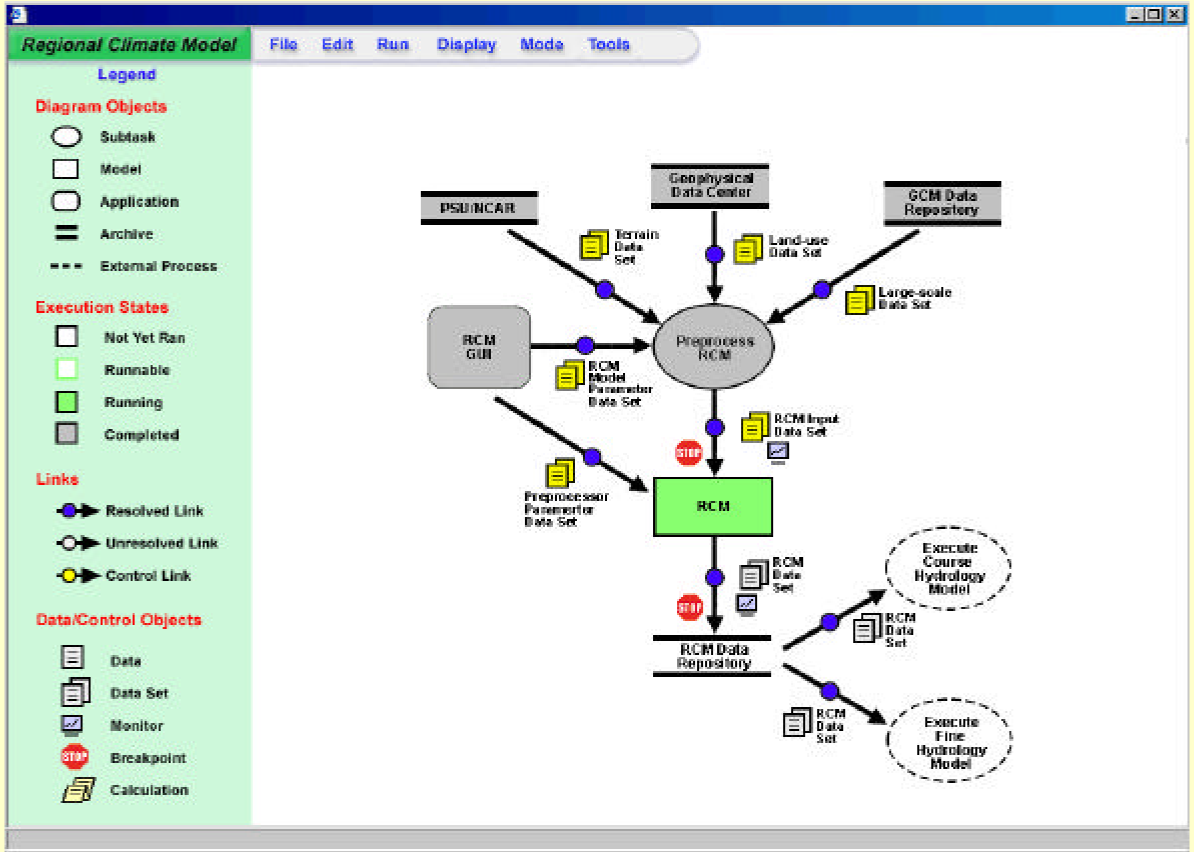
This implies:

• modern collaborative tools, common information management system or training material: e.g. electronic logbooks, work flow charts, common data bases, management or oversight tools, Grid technologies, industrial frameworks, …

Example 2: E-Logbook of TTF (DESY)



Example 3:Workflow Chart (LBNL, PNNL)

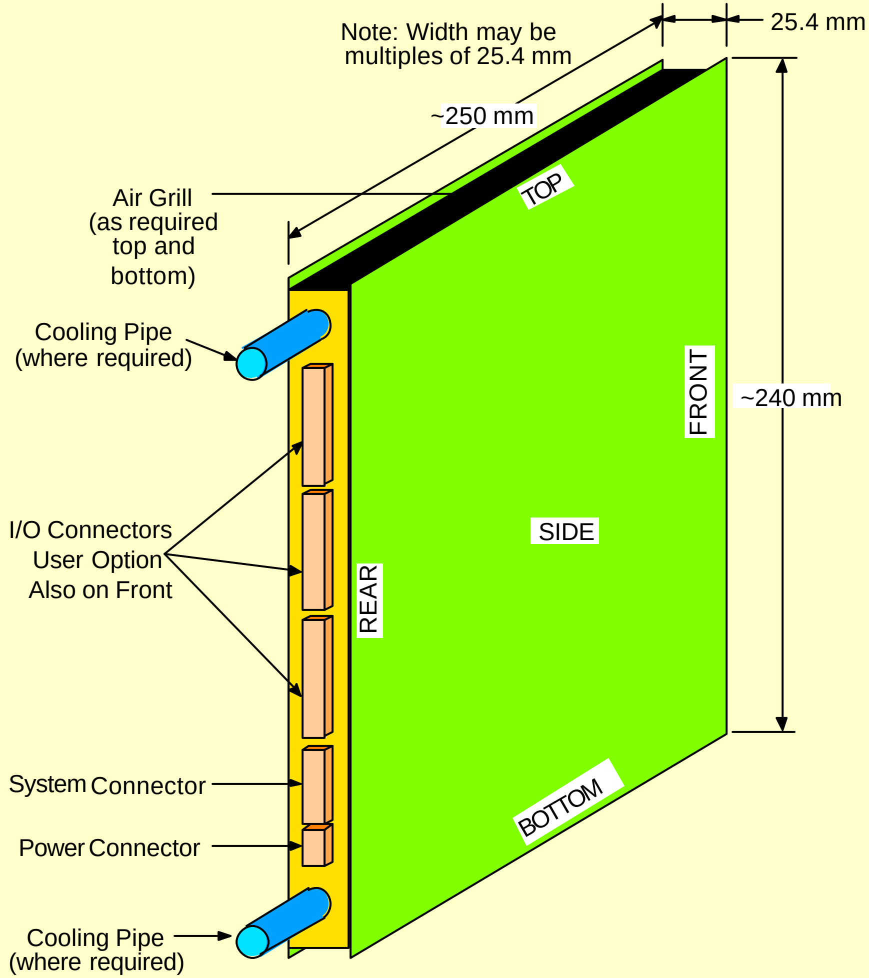


Remote control, diagnostics and participation is THE key element of the GAN approach (cnt'd)

This implies:

• appropriate system design for all kind of accelerator components: e.g. modularity and interfaces, robustness, data acquisition and streaming, local intelligence, redundancy, high level of availability, …

Example 4: VSO Concept (SLAC)



Concept of a back-plane less module

Experiments to Proof Particular Aspects of GAN

Examples of experiments which have been proposed at the workshops in Cornell and on Shelter Island:

• SNS SRF commissioning (TJNAF, LANL): gain experience and assist SRF commissioning

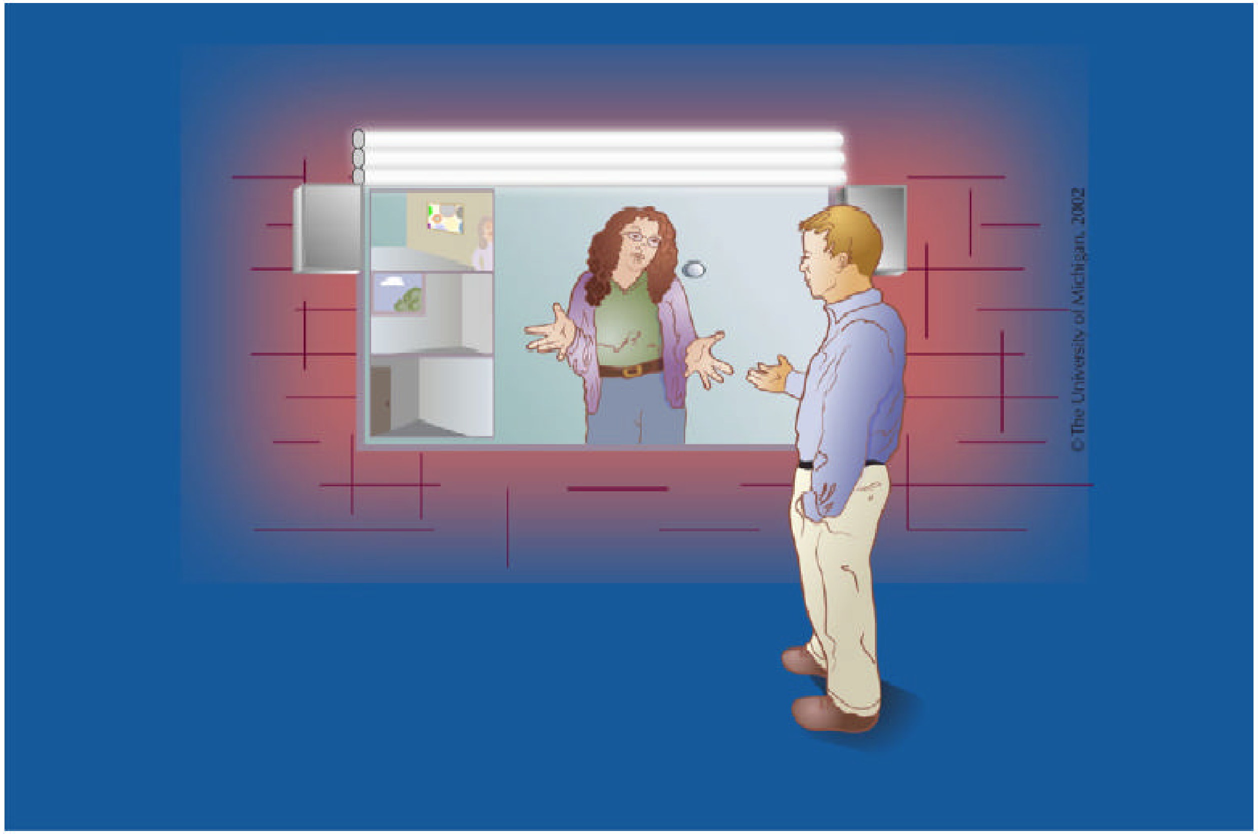
• Coherent beam-beam interaction studies (BNL, FNAL): test remote operation of beam study from another lab

• Emmittance studies (DESY, Cornell, Ohio State, University, University of Michigan): do remote machine shifts

Experiments to Proof Particular Aspects of GAN (cnt’d)

- Virtual control room (CMS, FNAL): test a collaborative environment
- Virtual coffee corner (PSI, TJNAF, LBNL, BNL, ORNL, KEK): explore videoconferencing technologies and support community building
- …

Imagine …



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Some Thoughts on Controls

Questions and Challenges:

• How can we fulfill the needs of the different users of a control system (operators, scientists, hardware experts, programmers, system experts, ….)?

• How can we deal with diversity (different experiences and and approaches in different labs) without generating a disastrous fragmentation of the control system?

• How can we sustain and up-grade the control system over a period of 20 years?

• …

Some Thoughts on Controls (cnt'd)

Possible design features of a GAN control system:

• Distributed system: mainly implemented locally on site, global extension for remote operation and participation

• Layered or structured framework architecture with a transparent separation of tasks: front-end device or resource layer, visualization or GUI layer, communication layer, software bus / middleware …)

• Efficient communication protocols (e.g. remote method invocation, messaging services, uni- and multicast) based on modern internet standards

Some Thoughts on Controls (cnt'd)

• Web-based clients for visualization: powerful GUI framework, wizards and rendering

• Common, object-oriented software bus or middleware with business logic, virtual devices and interfaces: platform independent, flexible and appropriate model for abstract device properties and methods

• Intelligent front-end devices: standardized interface to software bus, either "secret code" nor "hidden variables", different hardware standards (VME, PCI, …) and software platforms (Linux, Windows, real-time OS, …), support of industrial lab automation software packages, wizards and generators, simulators, Ethernet everywhere

Some Thoughts on Controls (cnt'd)

• Multiple interfaces: interfacing complete industrial supervisory systems (e.g. cryogenic process control), interfacing complex scientific-oriented analysis software (e.g. MatLab), interfacing local Web servers for maintenance purposes

Useful References

• GAN proposal:
http://www.cerncourier.com/main/article/40/5/15

• ICFA Study:
http://www.agsrhichome.bnl.gov/RemOp/docs/icfa_tforce_reports.html

• Cornell Workshop:
http://www.agsrhichome.bnl.gov/RemOp/docs/cornell_final_report.pdf

• Shelter Island Workshop:
http://www.agsrhichome.bnl.gov/RemOp/