The Global Accelerator Network Multipurpose Virtual Laboratory

International ICFA Workshop on HEP Networking, Grid and Digital Divide Issues

for Global e-Science

- The GANMVL Project:
  - Motivation and Scope
- History of GAN
- The GANMVL User Query
- Deliverables

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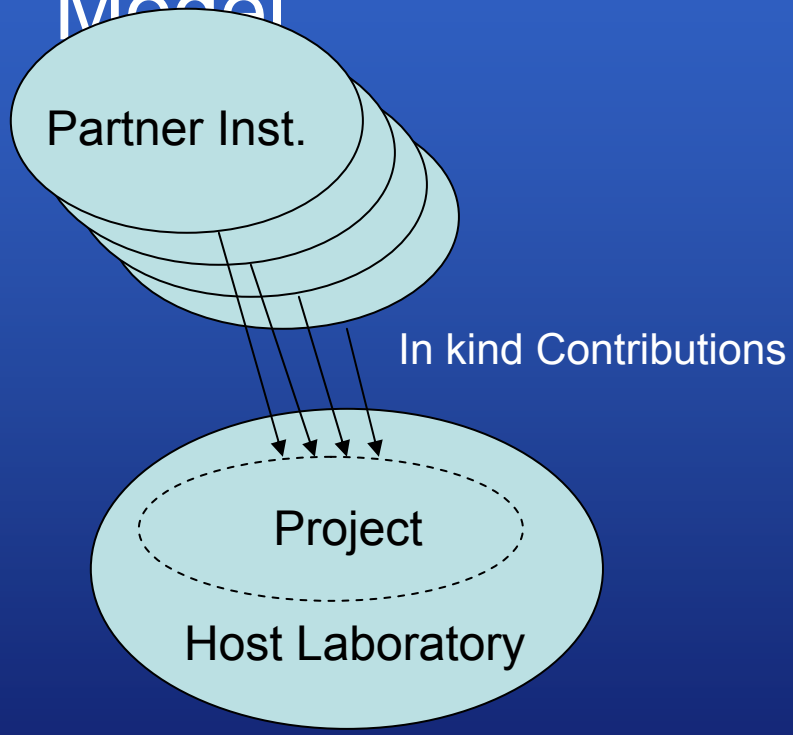
Matthias Kasemann / DESY

Multipuprose Virtual Laboratory Motivation

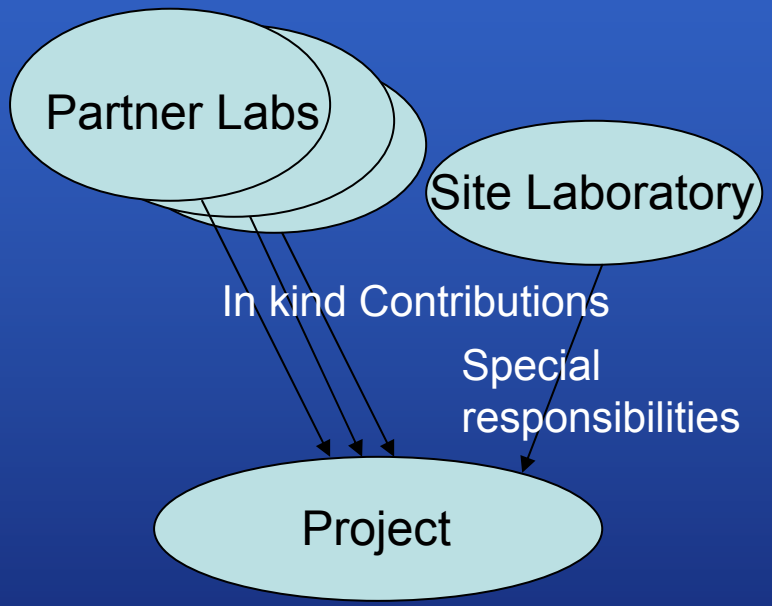
- The most likely scenario of a **Linear Collider** is that it will be built by a collaboration of existing laboratories.
  - They will remain involved during the operation of the accelerator.
- Examples of distributed responsibilities are :
  - Prototypes will be developed in one institution and tested with beam in another laboratory
  - Equipment will be built and delivered by one partner and needs to be integrated into the accelerator complex by another partner
  - Whole parts of the facility will be provided by a remote partner and need to be commissioned and possibly operated with the experts at their remote home institutions
  - In situ trouble shooting and repairs needs to be performed with the support of off-site experts
  - and many more …
- Advanced means of communication will be necessary to support efficient collaboration.

Collaboration Models

HERA / LHC Model



GAN



The remote user should be enabled to participate in accelerator studies, assembly of accelerator components, trouble shooting of hardware or analysis of on-line data

as if he or she would be present on site.

Experience from the SLC, LEP HERA: the LC is expected to be in a state of continuous commissioning and improvement

How to assure commitment beyond the construction and first commissioning of the parts contributed by the various laboratories?

➔

Need to keep the off-site designers and experts involved and interested

➔They need to be part of the team, which operates, trouble shoots, improves and pushes performance of the accelerator

➔ Collaboration beyond design and construction phase via

Far Remote Operating

Recent Progress towards GAN

- A. Wagner proposes GAN at ICFA

1999
- First Discussions between SLAC and DESY on Far Remote Operating

2000
- ICFA initiates two taskforces to explore the managerial and organizational aspects and the technical implication of Far Remote Operating

2001
- Report of the Taskforces: no technical show stoppers but main difficulties in management, sociology and organization
- Discussion of Far Remote Operation in Accelerator Community ➔ Large resonance
- International and European LC Steering groups initiated

2002
- 2 GAN Workshops: March in Cornell, September near BNL

Conclusions of ICFA Taskforce 1
Management, Organizational & Sociological Aspects

General:
A participation in GAN may not be sufficient to keep a laboratory alive, developing adequate organizational models will be difficult, sociological aspects are important!

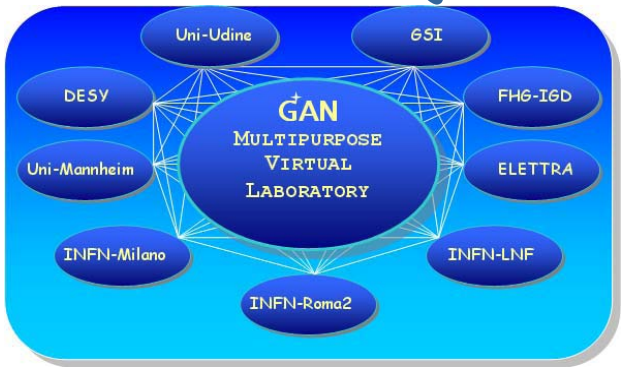
- GAN model based on in kind contributions from partners
- Collaborating must be able to maintain strong control
- need to keep number of partners small:
  channel contributions through big laboratories
- Next to in-kind contributions in components collaborators need to contribute cash funds
- Site Laboratory: special task of providing infra structure
  (no green field site)
- Important to involve partners in the design stage
- Project leader position compared to spokesman of high energy experiment

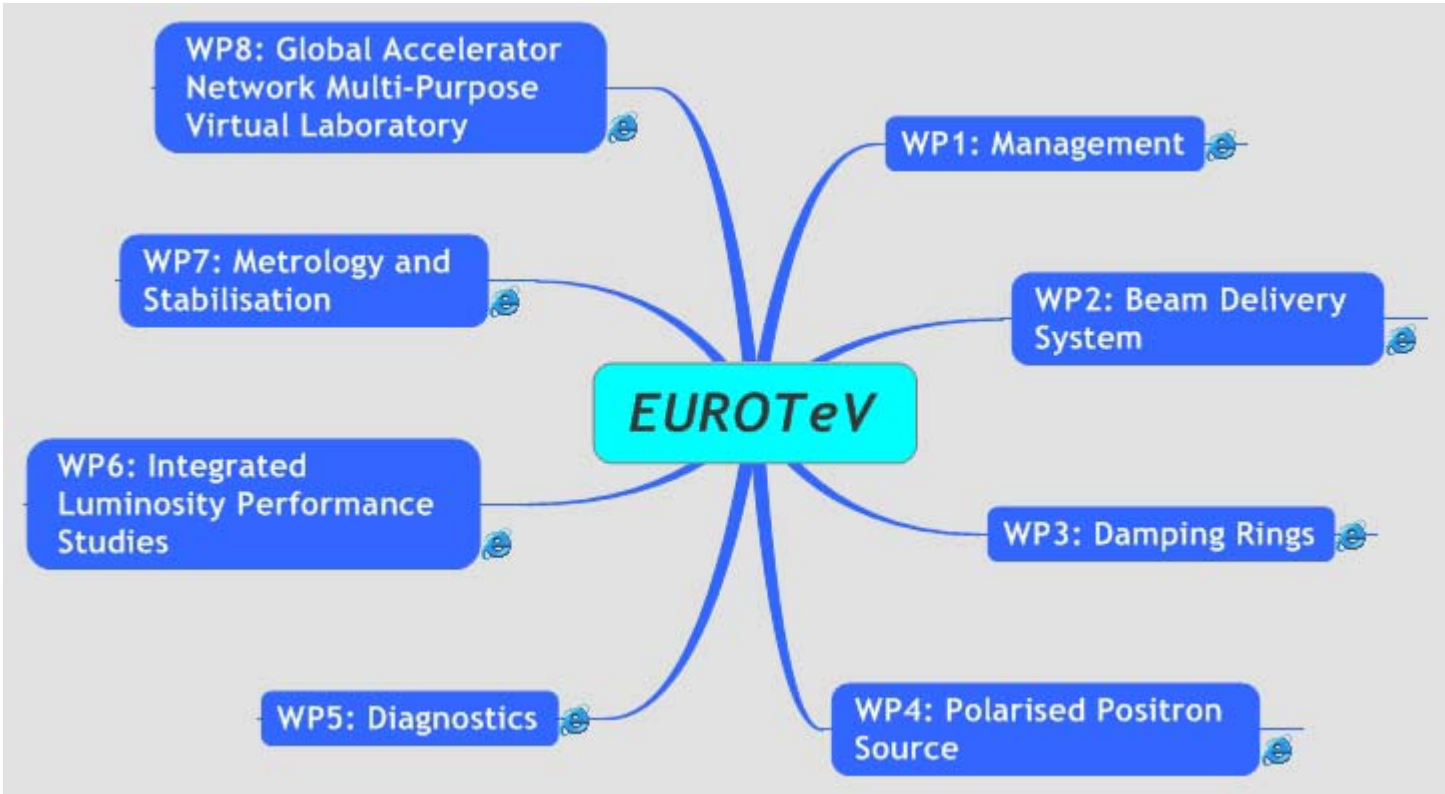
Conclusions of ICFA Taskforce 2: Technical, Organizational & Sociological Aspects

- Extrapolation of present large accelerators to GAN-like environment looks encouraging
- Experience on far-remote operation of telescopes is an existence proof that there are no unsolvable technical problems
- Networking and controls technology at today's level is sufficient for needs of remote operations
- Diagnostics in hardware must be sufficiently increased, this must be taken into account in the early stage of a design (obvious), major challenge of hardware design is reliability, which is independent of GAN
- Challenge lies in organization of operations, maintenance, communication, need formalized procedures, need dictionaries and formal use of language, development of communication tools

The GANMVL Project part of EuroTeV (EU Project)

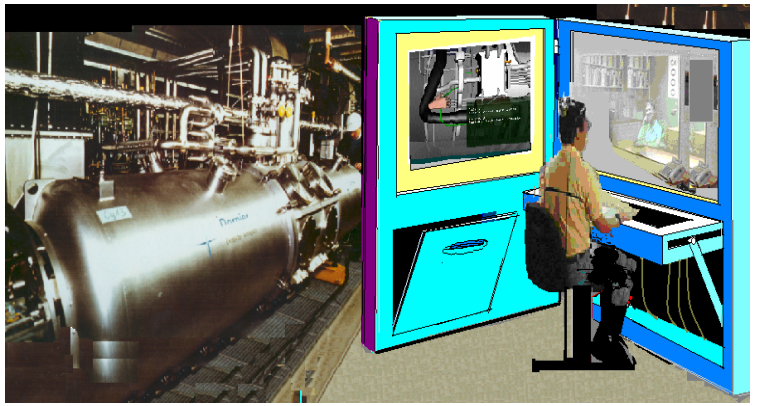
- EUROTeV: Linear Collider Design Study (EU funded)
  - 3 years: 2005-2007
  - WP 8: GANMVL





Multipuprose Virtual Laboratory Scope

- GANMVL is a project to design and build a novel collaboration tool and test it on existing accelerator collaborations.
  - GANMVL stands for "Global Accelerator Network Multipurpose Virtual Laboratory".



- The tool is a mobile communication centre, it provides:
  - immersive video and audio capture
  - reproduction of an accelerator control room, or
  - a laboratory workplace environment or
  - an accelerator hardware installation.

- It is able to connect to standard measurement equipment (scopes, network analyzers etc.) and to elements of accelerator controls and make these connections available to a remote client.

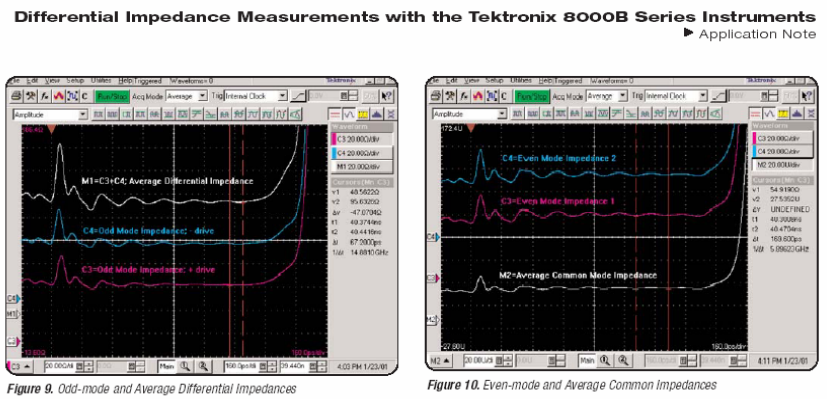


Figure 9. Odd-mode and Average Differential Impedances

Figure 10. Even-mode and Average Common Impedances

GANMVL Sociological Aspects

- The Sociology departments from University of Mannheim and Udine performed a **user survey.**
  - Do we really want to work together with a colleague in a far remote office?
  - How does it change our daily work in a control room?
- With the user survey, we aimed at:
  - making the community aware of our work
  - assessing acceptability of MVL (as envisioned)
  - getting feedback about planned/missing features and their importance
  - pointing out issues which need to be recognized and properly taken care of (e.g. social / organizational challenges)
  - getting suggestions/ideas from previous related experiences

- We asked approx. 600 potential users of GANMVL, accelerator physicists as well as operation and controls people to fill a query.
  - Some 20 % of them answered, this is a normal percentage.
  - When interpreting the results, we have to keep in mind, that probably users with a negative attitude towards the idea of remote operation did not answer at all.

Response Rate/Personal Data

Gender	Number
Female	11
Male	138

Years of relevant accelerator experience	Number
0 - 5 years	12
5 - 10 years	11
10 - 15 years	8
15 - 20 years	33
20 - 25 years	31
25 - 30 years	23
over 30 years	31

Occupation	Number
All Users	155
Accelerator user	2
Accelerator physicist	51
Designer of Accelerator Components	19
Accelerator Maintenance & Troubleshooting Operator	14
IT/Control Expert	23
Experimental Physicist	21
Management	3
Technician	5
Others	17

Experiences with Previous Collaborations (Continuation)

22. The need for remote access to accelerator equipment may increase in an accelerator project carried out in collaboration between several partner institutes.

	Number	Average	Quota (in %) 1 strongly disagree	2 disagree	3 partly	4 agree	5 strongly agree
All Users	96	4,28	2	9	47	42	
Accelerator user	2	4,50			50	50	
Accelerator physicist	39	4,28		13	46	41	
Designer of Accelerator Components	11	3,82		18	82		
Accelerator Maintenance & Troubleshooting Operator	3	4,67			33	67	
IT/Control Expert	15	4,53		7	27	67	
Experimental Physicist	16	4,31		6	50	44	
Management	2	5,00				100	
Technician*	0						
Others	8	4,00			25	50	25

23. Typical activities in the construction and operation of accelerators like assembly of equipment, maintenance and tune-up can be troubleshooting, operation, testing, substantially supported by off-site experts.

	Number	Average	Quota (in %) 1 strongly disagree	2 disagree	3 partly	4 agree	5 strongly agree
All Users	97	3,62	2	8	32	41	16
Accelerator user	2	3,00			100		
Accelerator physicist	39	3,46	3	10	38	36	13
Designer of Accelerator Components	10	3,50		10	40	40	10
Accelerator Maintenance & Troubleshooting Operator	3	4,00			33	33	33
IT/Control Expert	16	3,88		6	25	44	25
Experimental Physicist	17	3,88		6	18	59	18
Management	2	2,50			50	50	
Technician*	0						
Others	8	3,75		13	25	38	25

Remote Access to Accelerator (Continuation)

56. In my opinion, any communication between the server and the client must be encrypted.

	Number	Average	Quota (in %) 1 strongly disagree	2 disagree	3 partly	4 agree	5 strongly agree
All Users	111	3,88	2	10	20	35	33
Accelerator user*	1			100			
Accelerator physicist	38	3,55	3	13	29	37	18
Designer of Accelerator Components	13	4,38			23	15	62
Accelerator Maintenance & Troubleshooting Operator	11	3,82	9	9	18	18	45
IT/Control Expert	19	4,05		11	16	32	42
Experimental Physicist	15	4,07		7	13	47	33
Management	2	2,50		50			50
Technician	3	4,33				67	33
Others	9	4,33				67	33

57. In my opinion, the system needs secure mechanisms to identify and authenticate users.

	Number	Average	Quota (in %) 1 strongly disagree	2 disagree	3 partly	4 agree	5 strongly agree
All Users	115	4,57		3	35		62
Accelerator user*	1					100	
Accelerator physicist	40	4,43			5	48	48
Designer of Accelerator Components	14	4,71				29	71
Accelerator Maintenance & Troubleshooting Operator	11	4,73				27	73
IT/Control Expert	20	4,75				25	75
Experimental Physicist	15	4,73				27	73
Management	2	3,00			50		50
Technician	3	4,33				67	33
Others	9	4,67			11	11	78

Benefit of MVL

60. How would you rank the possible benefits from far remote operations (a-d)?

a. reduced travel costs

	Number	Average	Quota (in %) 1 very unimportant	2 unimportant	3 partly	4 important	5 very important
All Users	117	3,70	6	32		49	14
Accelerator user*	1				100		
Accelerator physicist	41	3,78	2	27		61	10
Designer of Accelerator Components	14	3,36	14	43		36	7
Accelerator Maintenance & Troubleshooting Operator	11	3,91		27		55	18
IT/Control Expert	18	3,72	6	39		33	22
Experimental Physicist	16	4,00	6	13		56	25
Management	3	3,33		33		67	
Technician	3	2,67		33		67	
Others	10	3,50			60	30	10

b. faster availability of experts

	Number	Average	Quota (in %) 1 very unimportant	2 unimportant	3 partly	4 important	5 very important
All Users	118	4,36	2	4		51	43
Accelerator user*	1						100
Accelerator physicist	41	4,32	2	2		56	39
Designer of Accelerator Components	14	4,36		7		50	43
Accelerator Maintenance & Troubleshooting Operator	11	4,55				45	55
IT/Control Expert	19	4,37		5		53	42
Experimental Physicist	16	4,44		6		44	50
Management	3	4,33				67	33
Technician	3	3,67			33		67
Others	10	4,30		10		40	50

Benefit of MVL (Continuation)

c. reduced operations crew

	Number	Average	Quota (in %) 1 very unimportant	2 unimportant	3 partly	4 important	5 very important
All Users	117	2,68	9	33	42	15	2
Accelerator user*	1				100		
Accelerator physicist	41	2,73	7	37	34	20	2
Designer of Accelerator Components	14	2,50		57	36		7
Accelerator Maintenance & Troubleshooting Operator	11	2,36	18	36	36		9
IT/Control Expert	18	2,72	6	33	44		17
Experimental Physicist	16	3,13	6	13	50	25	6
Management	3	1,67	67			33	
Technician	3	2,33		67		33	
Others	10	2,60	10	20	70		

d. improved local operations

	Number	Average	Quota (in %) 1 very unimportant	2 unimportant	3 partly	4 important	5 very important
All Users	118	3,46	2	11	35	45	8
Accelerator user*	1					100	
Accelerator physicist	41	3,27	5	20	29	37	10
Designer of Accelerator Components	14	3,50			50	50	
Accelerator Maintenance & Troubleshooting Operator	11	3,27		9	55	36	
IT/Control Expert	19	3,37		11	42	47	
Experimental Physicist	16	3,63		6	38	44	13
Management	3	4,33				67	33
Technician	3	4,00				100	
Others	10	3,80		10	20	50	20

User Query results: Experience with Previous Collaborations

- Results for "Experience with Previous Collaborations"
  - Good experiences with trust in the professional background of the participating colleagues.
  - In some projects, responsibilities weren't clearly defined.
    … need for assistance in project management.
  - The main forms of communication in previous collaborative projects were face-to-face and email communication.
    - Importance of telephone and video conferences rated 50/50
    - Instant messaging and chat were mostly unimportant.
    - Electronic communication tools (e.g., videoconference, mail, chat) were more used by accelerator users, operators, and physicists, and less by other users (i.e. technicians, engineers).
    - Some concerns regarding the technical implementation (technical difficulties, lack of technical competencies/equipment).
    - Data and/or video sharing seems to have been useful for some users.

The majority seems to be willing to use the system.
The idea of developing a communication tool like GANMVL is perceived as very useful.

User Query results: Supported Activities

- A list of proposed activities was given as follows:
  - Assembly of accelerator equipment
  - Setting up a test
  - Test of new equipment or entire accelerator
  - Commissioning of equipment or entire accelerator
  - Equipment maintenance
  - Trouble shooting
  - Remotely assisted repair
  - Accelerator studies
  - Tune-up of components
  - Tune-up of accelerator beam parameters
- Users favored MVL in accelerator maintenance and routine operations.
- Users disfavored the "hardware-sided" activities, …lack of imagination?
- Users perceive MVL as a reasonable and not too ambitious project.
- The willingness to use the tool seems to be high.

User Query results: Cooperation with Off-site Experts

- Remote cooperation between experts and control room operators with MVL is perceived as positive.
  - Some concerns about problems with not speaking the same mother tongue.
  - There should be some face-to-face meetings on-site to get to know the accelerator and the staff there (gaining trust)

- A critical aspect seems to be the observation of control room operators with cameras (continuous presence, "supervision")
  - If this feature will be implemented, there should be a mechanism that allows observation only by permission of the observed operators.
  - There are also legal aspects in some countries that have to be considered.

User Query results: Elements of MVL

We asked which elements would be needed / used:

- In general, video, audio and mobility of the solution is judged important.
- Risks and concerns pointed out:
  - 3-D audio is perceived by some as not important.
  - prefer a more simple and stable tool is preferred over "fancy" technical features.
  - MVL, in the effort of unifying different functions into a single tool, will be technically obsolete in a few years (i.e. it will be difficult to integrate upcoming technologies).
  - The project may be too ambitious or is considering a too wide set of functionalities,
- Much interest in video / application / desktop / pointer sharing (i.e. tools for synchronous collaboration)
  - Many point out the need for a well-designed and effective help functionality (either provided by the system or human experts).

More User Query results…

- Safety is perceived as an issue;
  - The project should investigate to point out clearly what MVL will do with respect to safety on the accelerator site.
  - Simply allowing remote users to observe is not perceived as a good solution (too limiting?), but security / safety mechanisms are needed.
- Benefits expected from GANMVL:
  - Wider availability of experts (and generally, wider participation) is perceived as the greatest benefit.
  - Another aspect is the social benefits of reduced traveling.
- In general, users trust (but not completely) that MVL will give them these benefits.

Benefit of MVL (Continuation)

66. All in all, developing the MVL is a good idea.

	Number	Average	Quota (in %) 1 strongly disagree	2 disagree	3 partly	4 agree	5 strongly agree
All Users	117	4,01	3	15	61		21
Accelerator user*	1				100		
Accelerator physicist	41	4,07	2	12	61		24
Designer of Accelerator Components	14	3,93		14	79		7
Accelerator Maintenance & Troubleshooting Operator	11	3,91		27	55		18
IT/Control Expert	19	3,74	11	21	53		16
Experimental Physicist	16	4,25		13	50		38
Management	3	4,00			100		
Technician	3	4,00			100		
Others	9	4,11		22	44		33

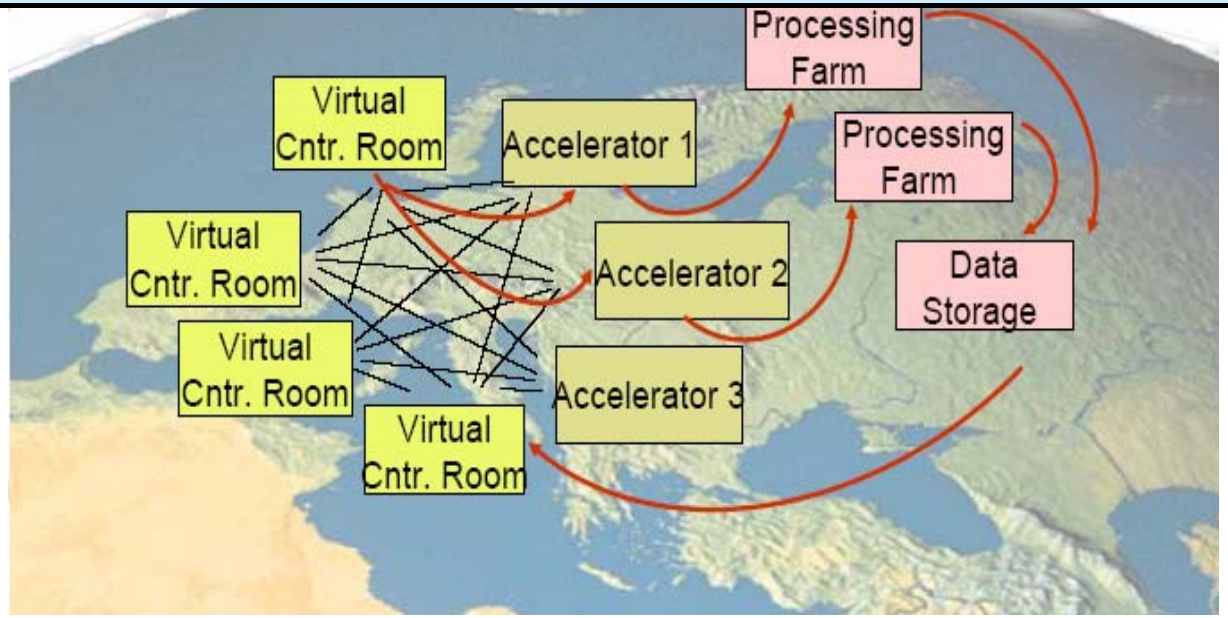
GANMVL first Tests: 9.5.2005 Remote Operation @ ELettra

- ELETTRA (Trieste, Italy) and DESY (Germany) jointly tested the GANMVL prototype.
  - linked by means of an integrated collaborative environment based on web technologies, video-conferencing and desktop-sharing tools.
    - GANMVL client – server communication

- An operator in Hamburg interacted with operators in the ELETTRA control room in Trieste.
- The operator in Hamburg successfully injected an electron beam into the ELETTRA storage ring and bring it to working energy.
  - The operation was monitored and assisted from the ELETTRA control room.
- During the night, the same tool was successfully used to carry out remote machine physics measurements on the ELETTRA synchrotron from ESRF in Grenoble.

GANMVL Deliverables '05-'07

Evaluation report of user needs (UN)	Task ODI
Eval. of human and collaboratory aspects (CA)	Task ODI
GANMVL Design Report (DR)	Task ODI
First MVL Prototype (1PT)	Task SC
Improved MVL Prototypes: 3 units (3PT)	Task ME
Evaluation Criteria Report (EC)	Task DGF
Demonstration of GAN Evaluation Report (GR)	Task DGF



Summary

- The Global Accelerator Network Multipurpose Virtual Laboratory (GANMVL) project is part of the EU funded EUROTeV project the design study of the International Linear Collider.
- The Multipurpose Virtual Laboratory can be considered the core tool to implement the Global Accelerator Network.
- It enables a Virtual Organization connecting all the international laboratories doing research in the field of Accelerators.
- Remote control of an accelerator facility is essential for collaboration on operation and exploitation of large experimental physics facilities.
- The GANMVL project will provide valuable experience for collaboration on designing, building and operating large accelerator complexes.
- It will address the important psychological and sociological issues of the Global Accelerator Network.