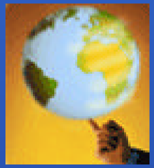
Global Accelerator Network GAN

DESY Seminar on Computing in High Energy Physics
November 3, 2003



F. Willeke, DESY-MHE

- International Collaboration on LC
- Far remote Operation
- Technical Issues
- Sociological Issues
- Organizational Issues
- Where do we stand today

Dilemma of Particle Physics

The questions posed today by particle physicists are highly specialized and abstract and it is an arduous task to convey the essence of such pursuits to non-experts →

Particle Physicists struggle to defend the case of their science

⚡

Future Accelerator based particle physics require large funds and commitment of society

International Collaboration

The large accelerator laboratories involved in linear collider research share the view that the next generation accelerator project is too big to be handled by any of the existing laboratories

➔

The LC will have only a chance to become reality in a large international collaboration

➔

Proposal to ICFA in 1999 by A. Wagner to create a Global Accelerator Network

GAN Considerations

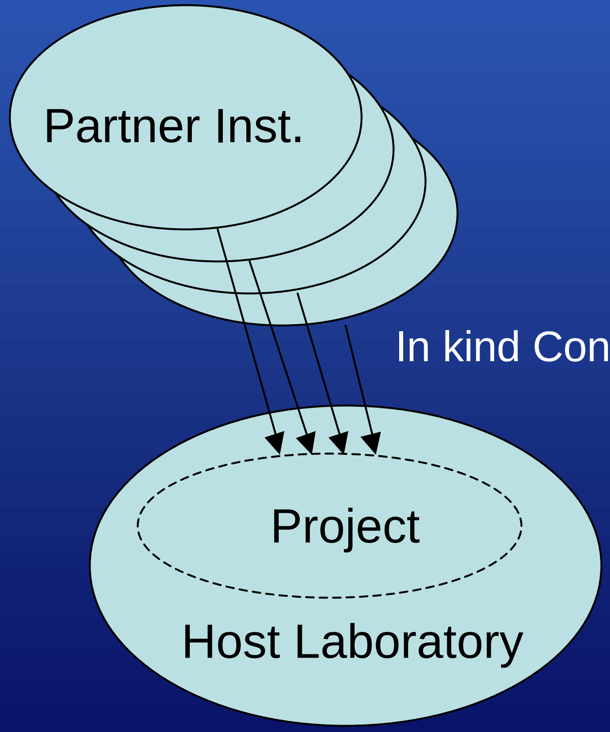
- The symbiosis between competing laboratories with their own cultures, their expertise and particular strengths has been one of the key elements for the success of particle physics and accelerator technology
- Extracting the expertise and combining it in a “world laboratory” at one single site would be a difficult, time consuming task with uncertain success (see SSC)

➔

Existing laboratories stay intact and collaborate over long distances building the next large accelerator

Collaboration Models

HERA/LHC Model



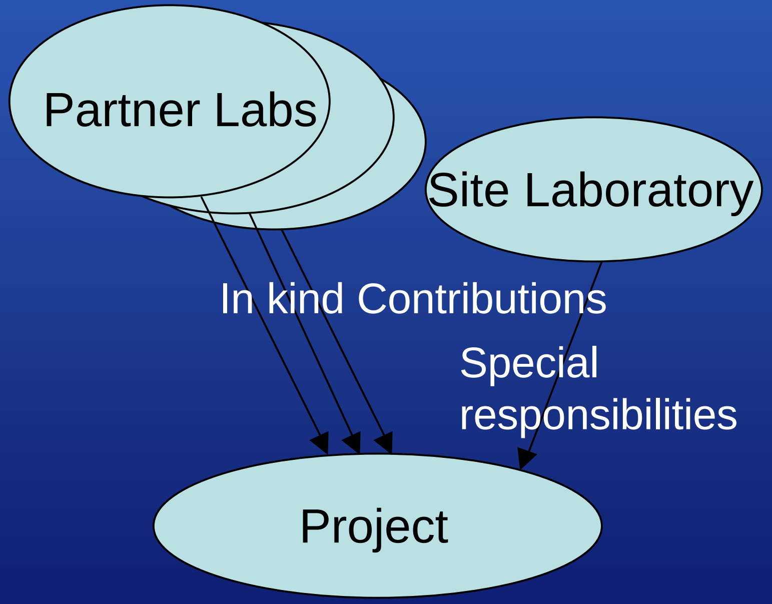
Partner Inst.

In kind Contributions

Project

Host Laboratory

GAN Model



Partner Labs

Site Laboratory

In kind Contributions

Special responsibilities

Project

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

Accelerator Site

Agreeing on an accelerator site is a most difficult question to settle for any collaboration

However, since large accelerators are remotely controlled and since one expects further rapid progress and evolution of communication technology in the next decade,

Far Remote Operating

should be feasible and could lead to a

➔ de-emphasis of the importance in the choice of the accelerator site

Recent Progress towards GAN

1999

- A. Wagner proposes GAN at ICFA
- 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
- ICFA initiates a new term of the Loew Panel for technical review of the linear collider projects

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
- Loew Panel presents its report
- Proposal on possible ways to collaborate on TESLA submitted as part of the TESLA proposal

ICFA Study Groups

on an accelerator facility which is designed and built in collaboration

and is far remotely operated and maintained

Group 1

Management, Organizational and Sociological Aspects of

(chair: Allan Astbury, TRIUMF)

Group 2

Technical, Organizational and Sociological Aspects

(chair: F. Willeke, DESY)

Conclusions of ICFA Taskforce 1

chaired by Allen Astbury

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 cxontributions 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

ICFA Taskforce 2 Conclusions

- Extrapolation of present large accelerators to GAN-like environment looks encouraging
- Experience on far-remote operation of telescope is an existence proof that there are no unsolvable technical problems
- Networking and controls technology at today‘s level is already 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

Experience from HERA, LEP, SLC...

Maintenance, Trouble Shooting Repair:

essentially **“REMOTE FACILITIES”**,:

- problems diagnosed remotely before intervention,
- interventions by **non-experts** successful in 90% of the cases,
- experts help via telephone suffices or via remote access
- unscheduled presence of experts on-site is an exception

Remote Operating with the ESO Remote Telescopes

CAT and NTT telescopes operated from Garching

- remote access to the site computer network (*limited to upper level of the control system)*
- networking based on lab's own 12-14GHz satellite connection

rate of 0.7Mbit s^{-1} : >sufficient for operating & acq. experimental data

Δt=450ms sufficiently fast for videoconference transmissions

Cheapest, best operational safety & stability (at the time)

Remote Experience

Remote operations Garching-La Silla: no technical problems.

Remote trouble shooting but Repairs& tuning on complex mechanics

Performed routinely remotely by experts on site

experts relocated on site increased their efficiency (30% → 5%)

expert crew on site, remote operations lost its attractivity.

CAT lifecycle : operated remotely from Garching,

NTT telescope : was operated locally after
control system modernized. the site in Garching became incompatible.

Commissioning of new telescope always by experts on site.

emergency stops and similar safety features hardwire

Recent Examples for Far Remote Operation

- TTF capture cavity was operated and maintained in the commissioning phase by SACLAY
- TTF operations from MILANO
- Fermilab Photo Injector Studies from DESY
- SNS injector Studies at the LBL build injector at Berkeley

Accelerator Controls

Control systems layered approach, adequate,

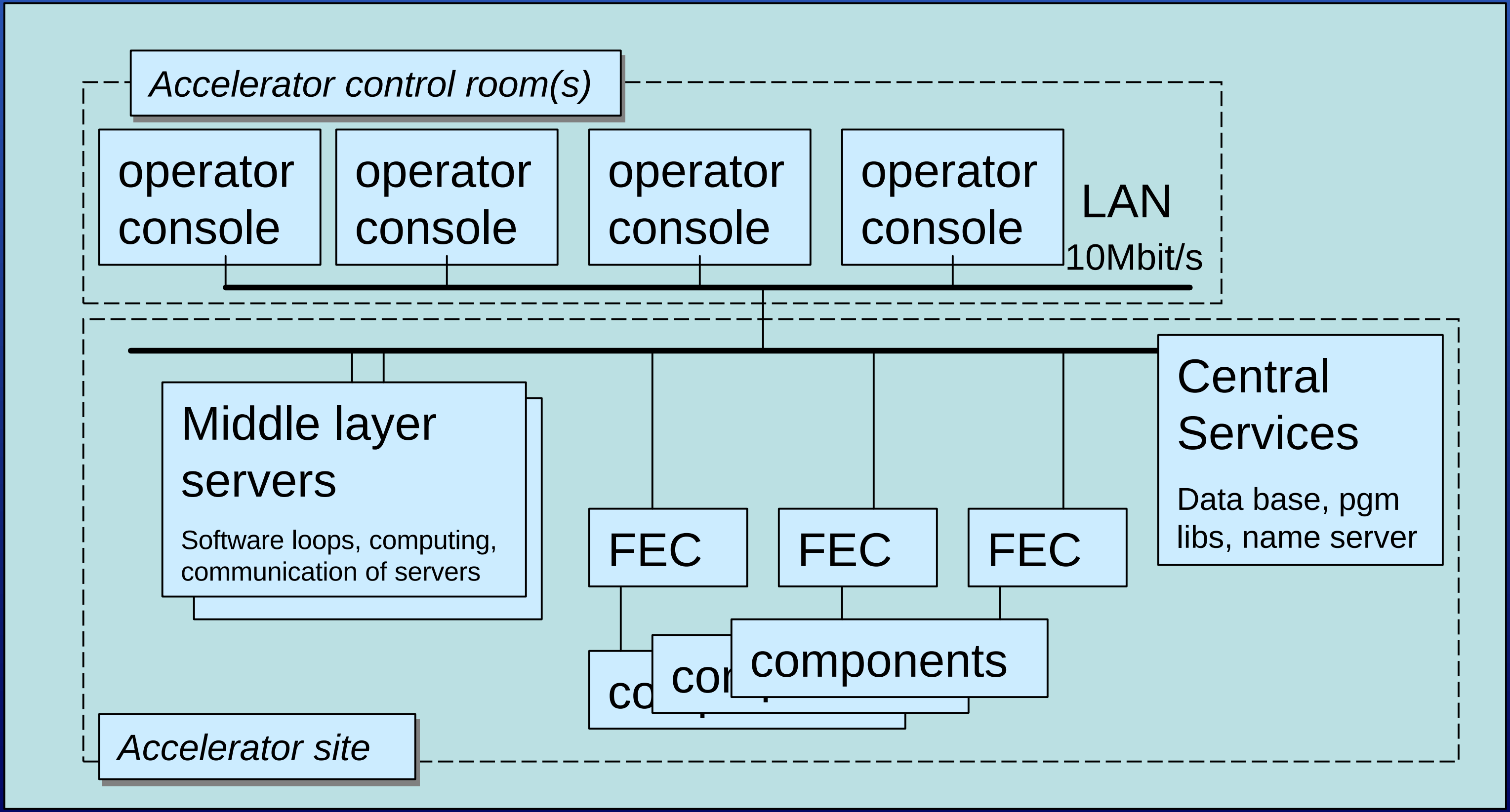
Control Room Segment < 10Mbit/s

fast feedback loop confined to hardware environment

analog signals replaced by digital technology

➔ Remote trouble shooting routinely performed

➔ Experience Available in Remote Console Operation



Accelerator control room(s)

operator console

operator console

operator console

operator console

LAN

10Mbit/s

Middle layer servers

Software loops, computing, communication of servers

FEC

FEC

FEC

Central Services

Data base, pgm libs, name server

components

Accelerator site

Networking

Trans-oceanic net

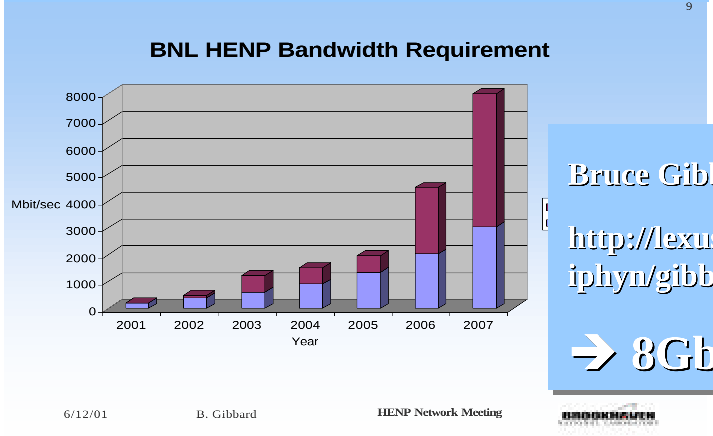
Based Fiber Optic Technology
 is growing fast

"Inexhaustible" Capacities?

Multi-Terabit/sec

System	Owner	Terminal Points	Technology Wavelength x Line Speed	Fiber Pairs Per Leg	Trans-Atlantic Legs	T.Bit/s Per Leg
Apollo	Cable & Wireless	UK - USA France - USA UK - France Interlink	80x10	4	**2**	**3.20**
Flag Atlantic -1	Flag Telecom	UK\France - USA (Single US Landing)	40 x 10	6	**2**	**2.40**
360Atlantic	360 Networks (Worldwide Fiber)	UK-Canada (Link to USA)	48 x 10	4	**2**	**1.92**
Yellow	Level 3;	UK -USA	47 x 10	4	**1**	**1.88**

Particle Laboratories plan upgrade to exchange data from LHC, RHIC, TEVATRON-II, HERA...



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6/12/01 B. Gibbard **HENP Network Meeting**

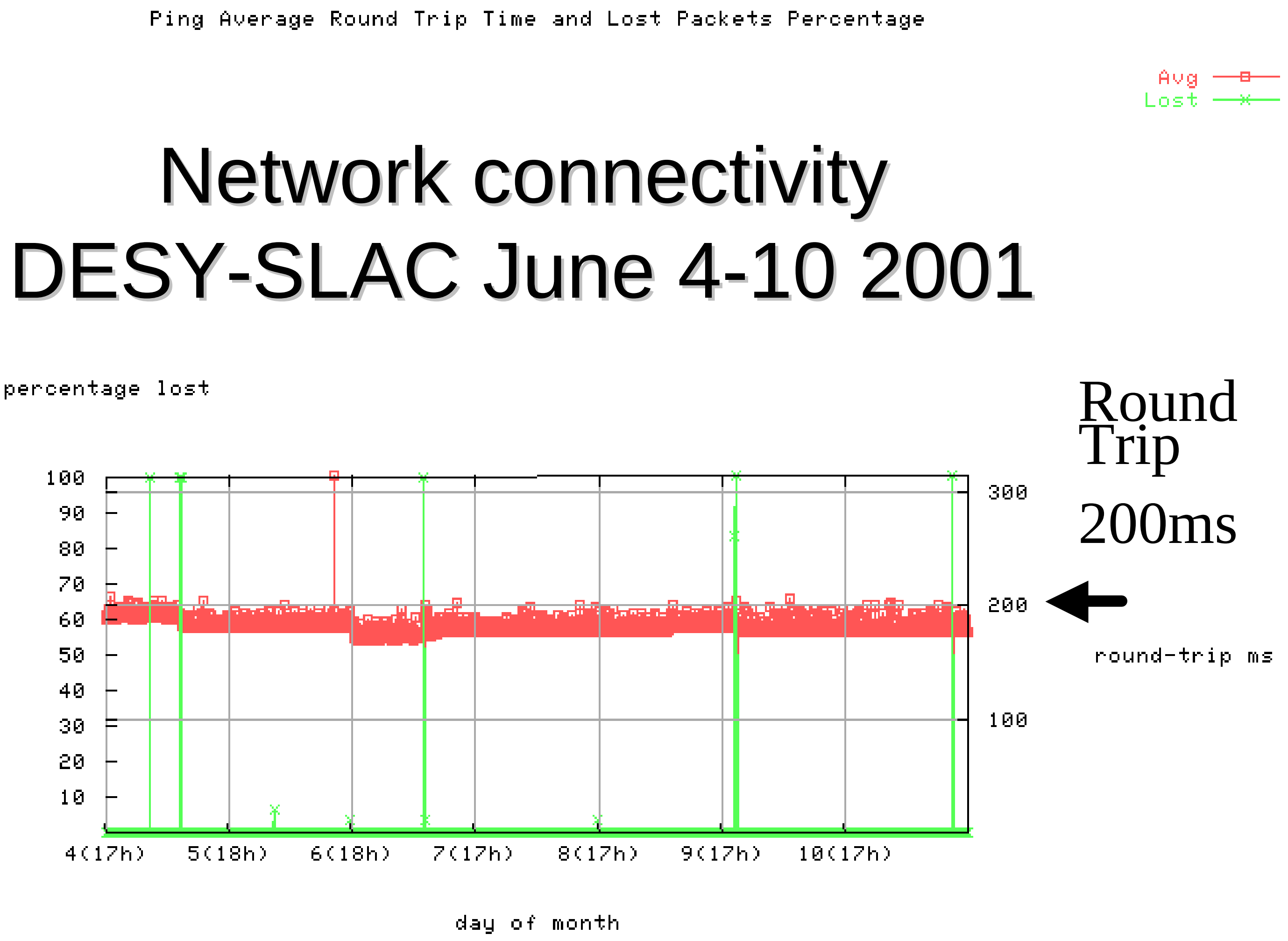
Bruce Gibbard, BNL

http://lexus.physics.indiana.edu/griphyn/gibbard.ppt

➔ 8Gbps in 2007

No Limitations for Remote Operations

Network connectivity DESY-SLAC June 4-10 2001



Round Trip

200ms

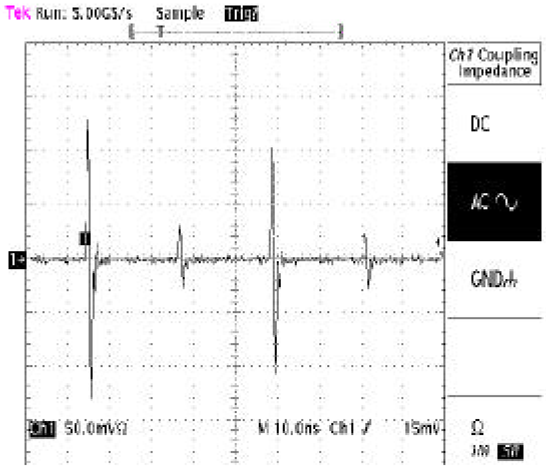
Flexible Diagnostics

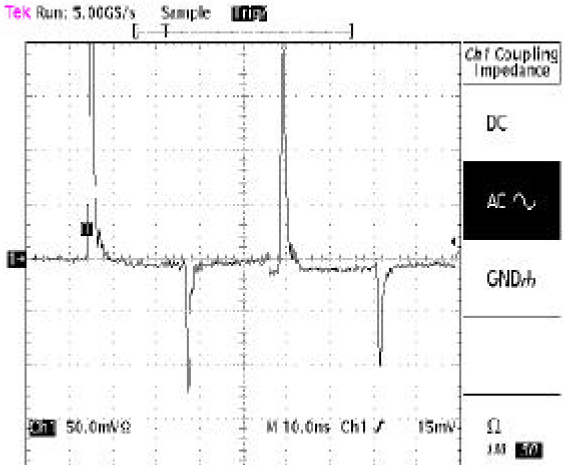
Example from recent HERA recommissioning

Operations and tests from remote control center

Few but **important** exceptions:

Example: Inspection of BPM analog signals with fast scope to steer beam through an IR with a broken magnet (could be diagnosed only by „steered through“ beam)





Hardware Requirements

On-site, majority of repairs => exchange of modules.

=> Components be composed of modules Reasonable transportable size, Easy to restore interfaces

Requirements essentially identical for ANY large complex technical facility.

- Redundancy of critical parts, (costs!)
- Avoidance of single point failures
- Comprehensive failure analysis,
- Over-engineering of critical components
- Standardization, Documentation:

  design procedure & components & quality assurance
- avoidance of large ΔT, thermal stress,
- Control humidity and environmental temperature extremes.

Specific features connected to remote operation **(additional costs reasonable)**

High modularity

ease troubleshooting & minimize repair time,

Complete Remote Diagnostics **CRUCIAL!**

Simultaneous Operation & Observation.

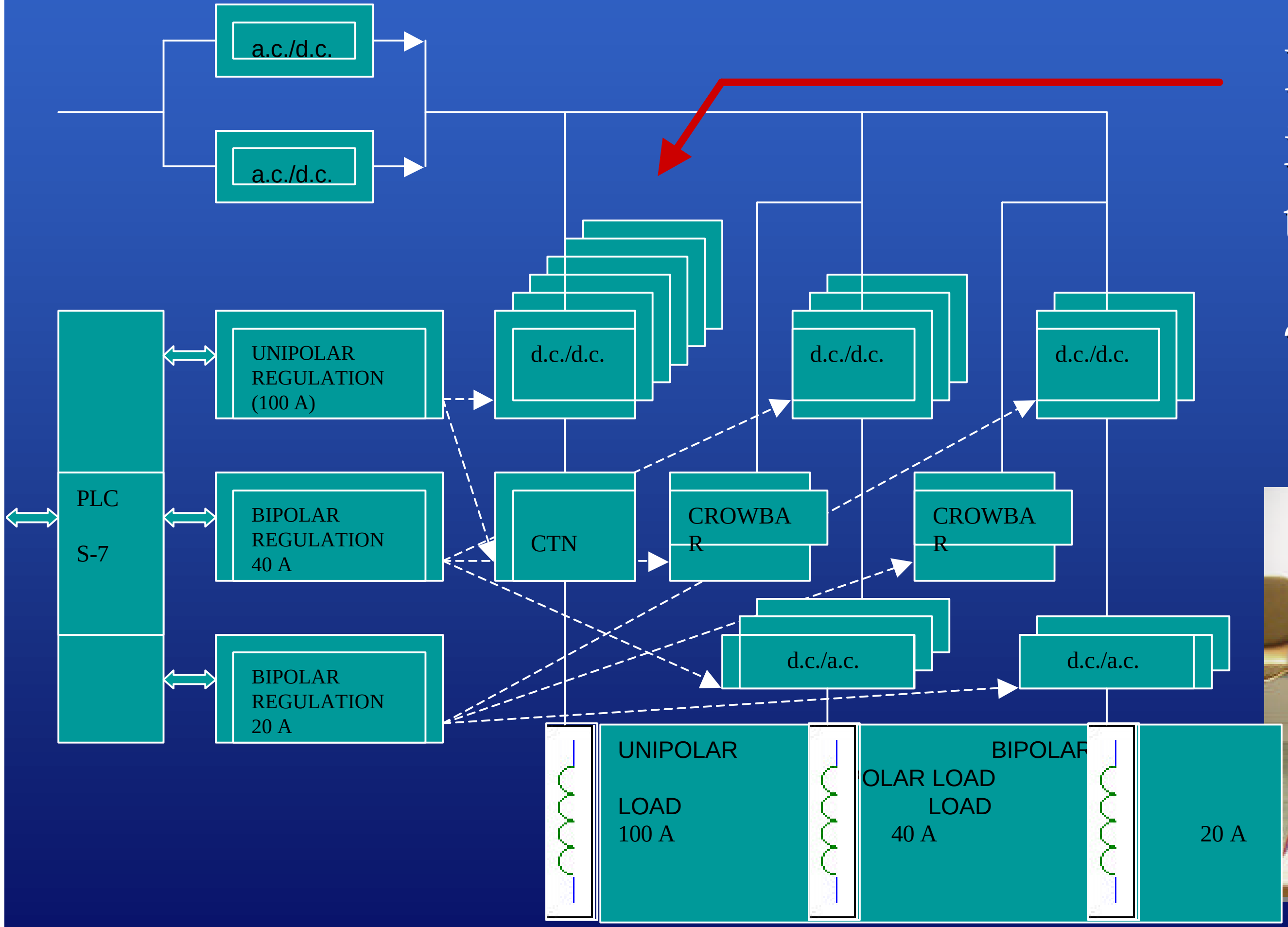
Already planned anyway!

Challenge: Need large T.b.F

HERA PS: 40 000 h

LC: 400 000 h

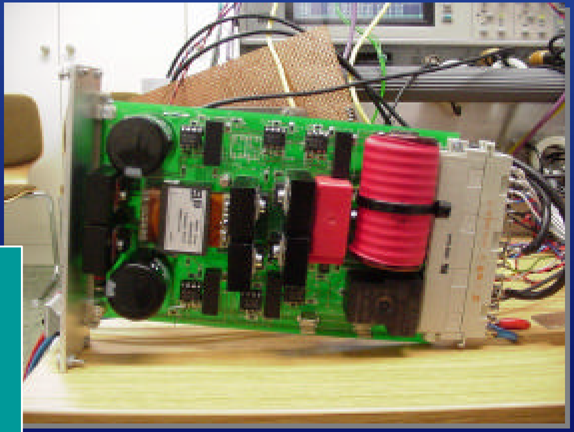
Example for a far remote friendly PS design approach: TESLA Correction S.M.Power supply ~3200 units



Redundant, independent, easy to exchange PSB

~200,000h tbf

Power supply board



Model for a Remote Facility

- Collaboration of Equal Partners (no **“host”** laboratory but “**near-by**” laboratory)
- Facility **far away** from most Collaborating institutions
- Each collaborator responsible for **major section** of the machine incl. subsystems *design, construction, commissioning, maintenance, trouble shooting, development*

  → Collaborators remain responsible for the part they contributed after construction

- Experts remain based at the home institution

  → Most of the activities via **remote operating and remote access**

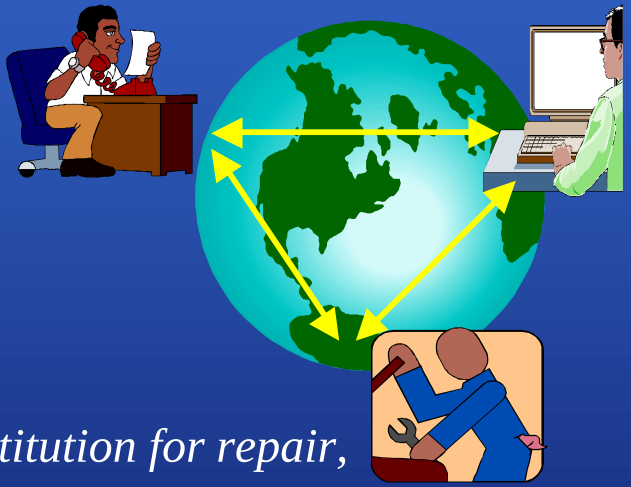
- **Central Management** responsible for the over-all issues, *performance goals, design, interface, schedule, quality control, standards, infra structure, safety*
- Operation **centrally organized**: *planning & coordination, commissioning, operation, maintenance, machine development*
- Operation performed by **decentralized operations** crews

Model for Remote Operations

- Central board supervises operations
- there is always **one control center** responsible for the entire complex
- *handles operation commissioning, routine operation for physics, machine development studies, ongoing diagnosis, and coordination of maintenance, repairs and interventions*
- resides at **different, but identical control rooms** at the collaborating institutions
- operating is performed by **remote crews**
- Control will be **handed off between control rooms** at whatever intervals are found to be operationally effective.
- **Supporting activities** may take place at the other control centers **if authorized** by the active control center.

Model for Remote Maintenance and Trouble Shooting

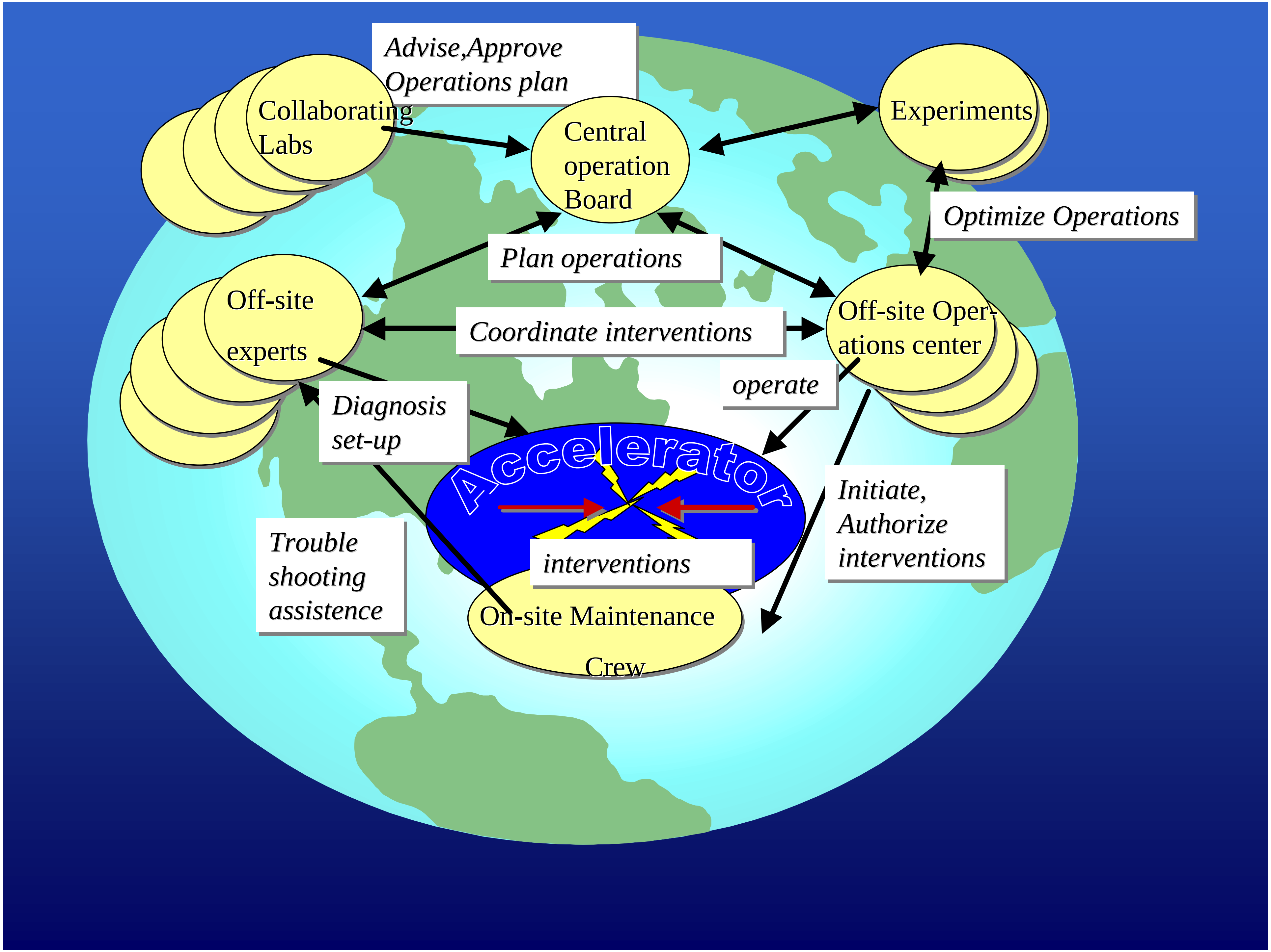
The collaborators remain responsible for the components they have built must provide **an on-call service** for remote trouble shooting to support current operations crew (can authorize intervention)



An **on-site crew** is responsible for exchanging

- *putting components safely out of operation,*
- *small repairs,*
- *disassembling a faulty component or module and*
- *replacing it by a spare,*
- *assisting the remote engineer with diagnosis,*
- *shipment of failed components to the responsible institution for repair,*
- *maintenance of a spares inventory,*
- *putting the component back into operation*
- *and releasing the component for remotely controlled turn-on and setup procedures.*

Decisions about planned interventions by the operations board in close collaboration with the laboratory responsible for the particular part of the machine.



Advise,Approve Operations plan

Collaborating Labs

Central operation Board

Experiments

Optimize Operations

Plan operations

Off-site experts

Coordinate interventions

Off-site Operations center

operate

Diagnosis set-up

Accelerator

Initiate, Authorize interventions

Trouble shooting assistence

interventions

On-site Maintenance Crew

Cornell Workshop March 21-23 02:

Enabling the Global Accelerator Network

Goal: ***Start the discussion in the community on the needs for controls and communication for a GAN***

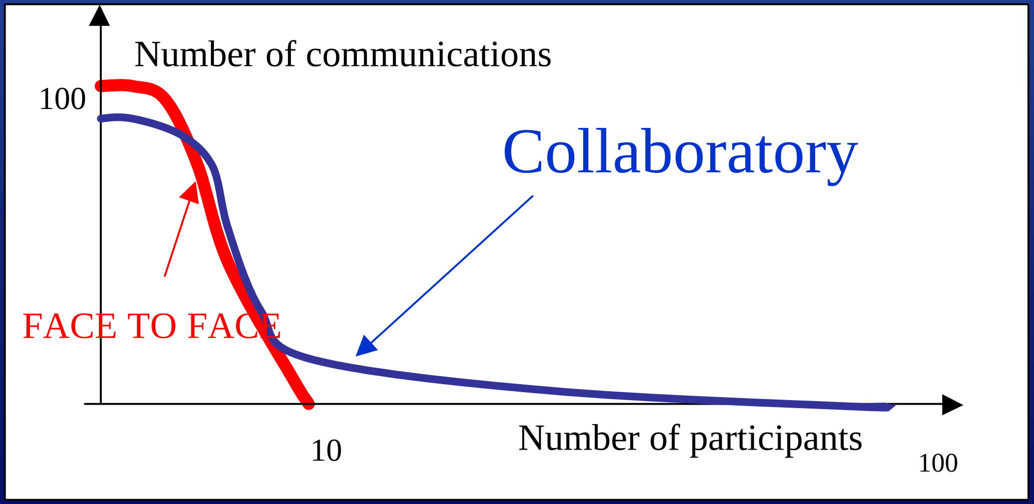
Proposed view point: Participate in a Linear Collider Project as a non-local collaborator

- Working Group 1 Elements of a Global Control System
- Working Group 2 Tools for Implementing Control Systems
- Working Group 3 Communication and Community Building

42 Participants from Cornell, LBL, CLEO, JLAB, DESY, FNAL, SNS, ARECIBO, BNL, SLAC, CEA, KEK, RAL, SPARC

General Impressions

- Very open discussion and constructive atmosphere
- Surprising amount of consensus among participants
- Very interesting interactions with communications scientists



Picture of

Gary Olsens Talk reproduced by memory

Shelter Island

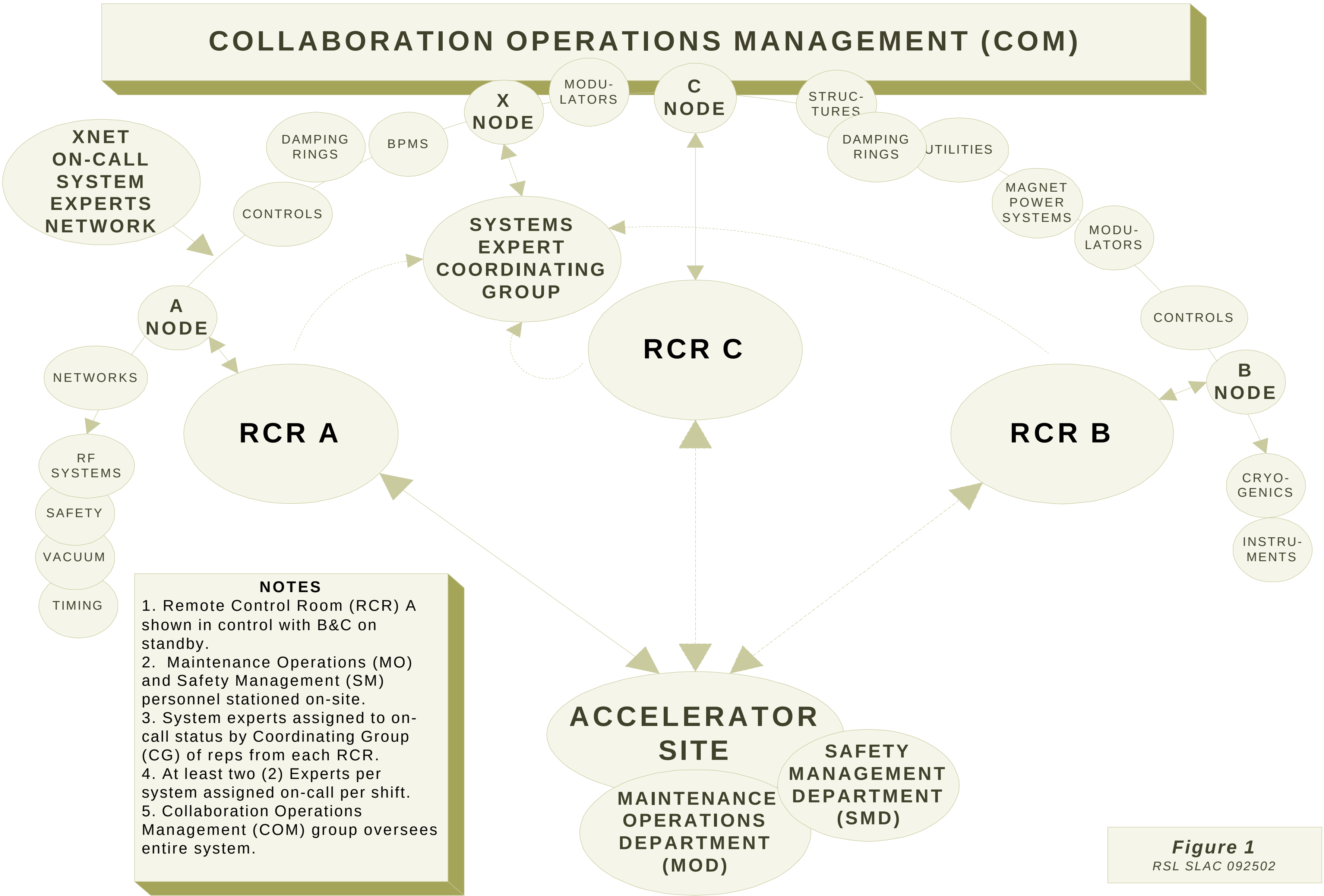
September 17-20 2002

3 Working Groups:

- Far Remote Operating Experiments
- Remote Operating Tools
- Hardware Design and Maintenance

Organization Aspect

Operational Models



NOTES

1. Remote Control Room (RCR) A shown in control with B&C on standby.
2. Maintenance Operations (MO) and Safety Management (SM) personnel stationed on-site.
3. System experts assigned to on-call status by Coordinating Group (CG) of reps from each RCR.
4. At least two (2) Experts per system assigned on-call per shift.
5. Collaboration Operations Management (COM) group oversees entire system.

Figure 1

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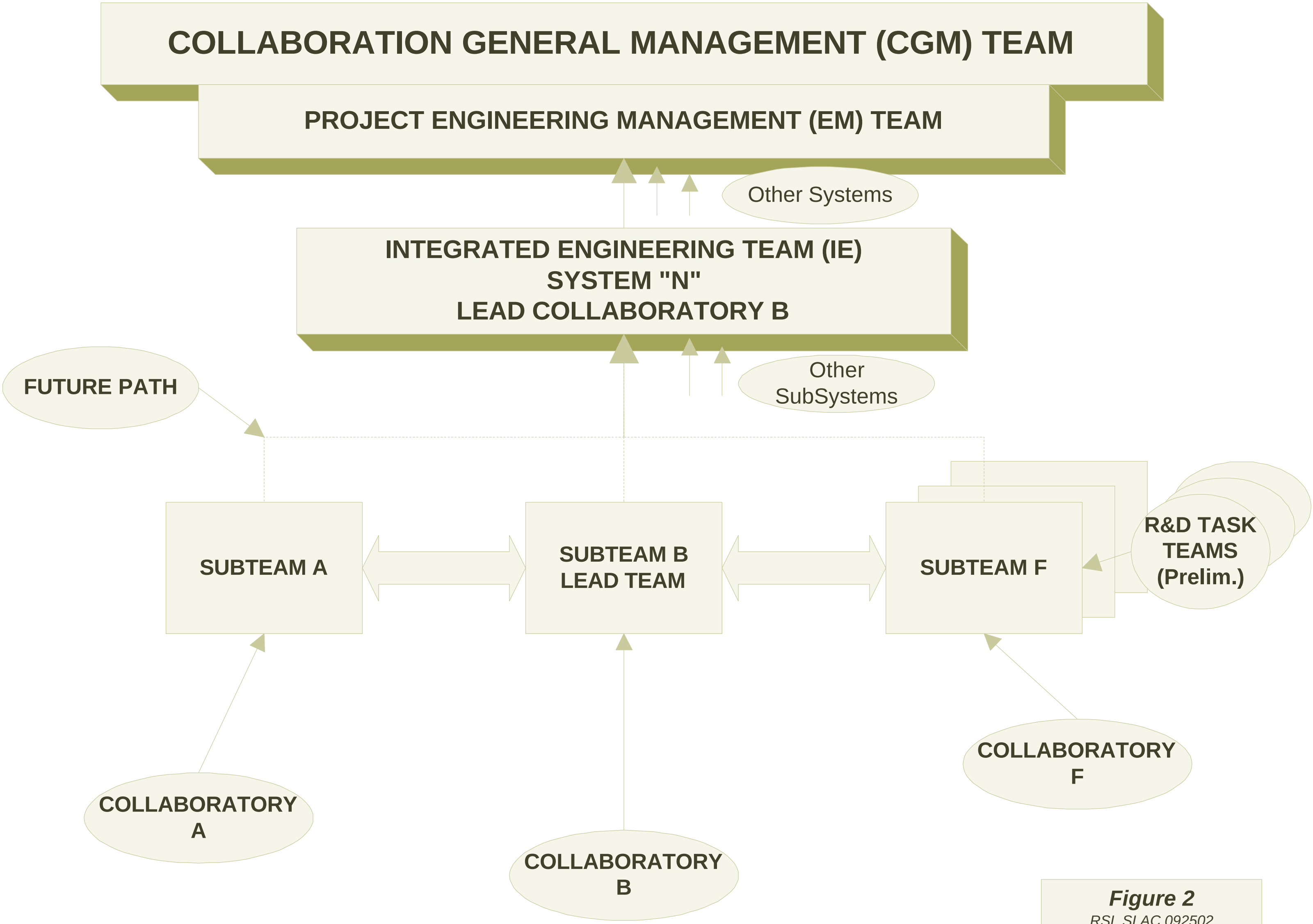


COLLABORATION GENERAL MANAGEMENT (CGM) TEAM

PROJECT ENGINEERING MANAGEMENT (EM) TEAM

Other Systems

INTEGRATED ENGINEERING TEAM (IE)
SYSTEM "N"
LEAD COLLABORATORY B

Other SubSystems

FUTURE PATH

SUBTEAM A

SUBTEAM B LEAD TEAM

SUBTEAM F

R&D TASK TEAMS (Prelim.)

COLLABORATORY A

COLLABORATORY B

COLLABORATORY F

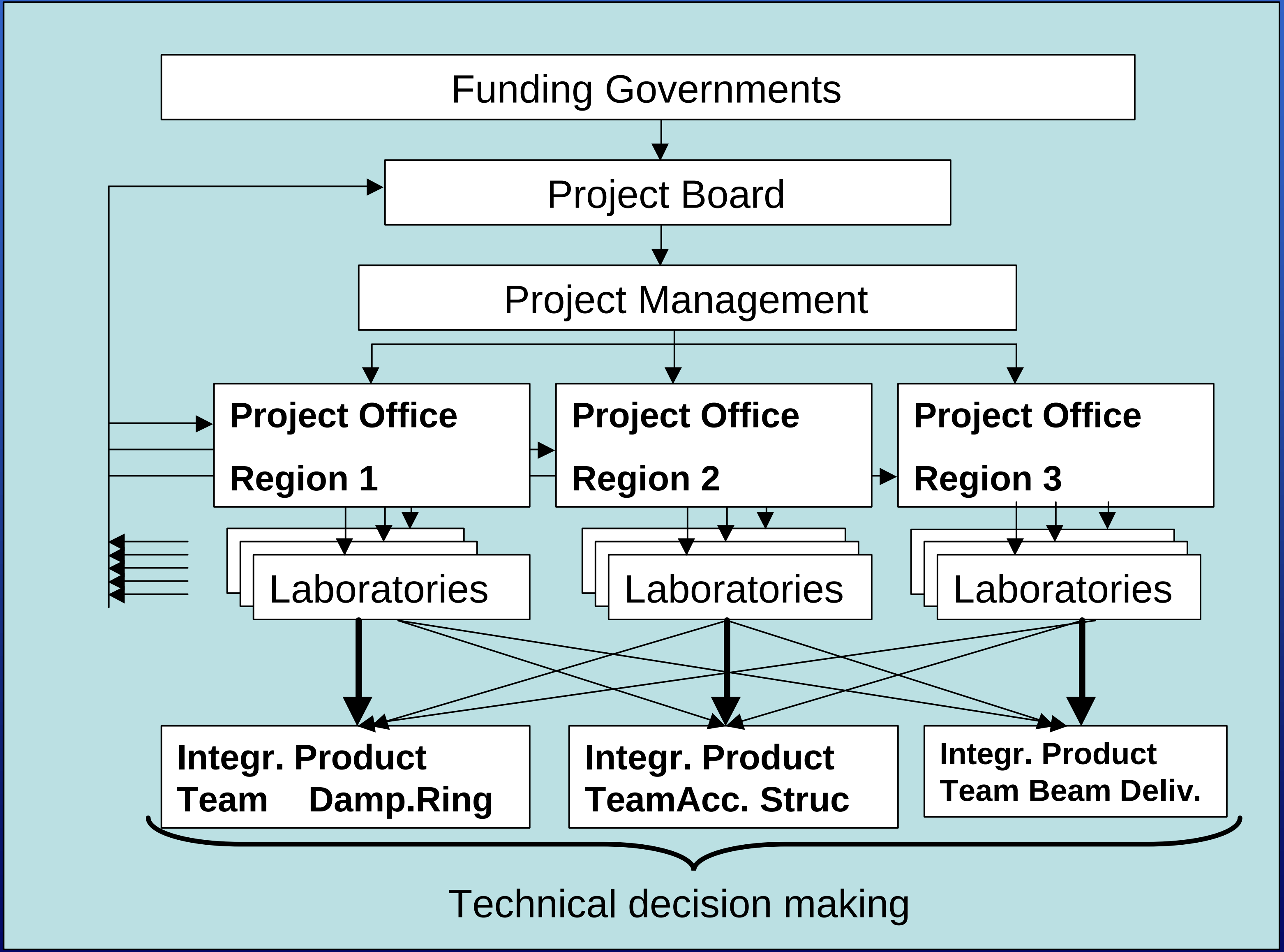
Figure 2

RSL SLAC 092502

DESY Activities

- GAN Discussion Group (W.Krechlok et al)
- Collaborations with universities (Kiel, Magdeburg) on sociological and managerial aspects of GN
- EU-project on GAN Organizational Aspects
- Proposal for International Collaboration as part of the TESLA proposal

A possible Structure for LC



Funding Governments

Project Board

Project Management

Project Office

Region 1

Project Office

Region 2

Project Office

Region 3

Laboratories

Laboratories

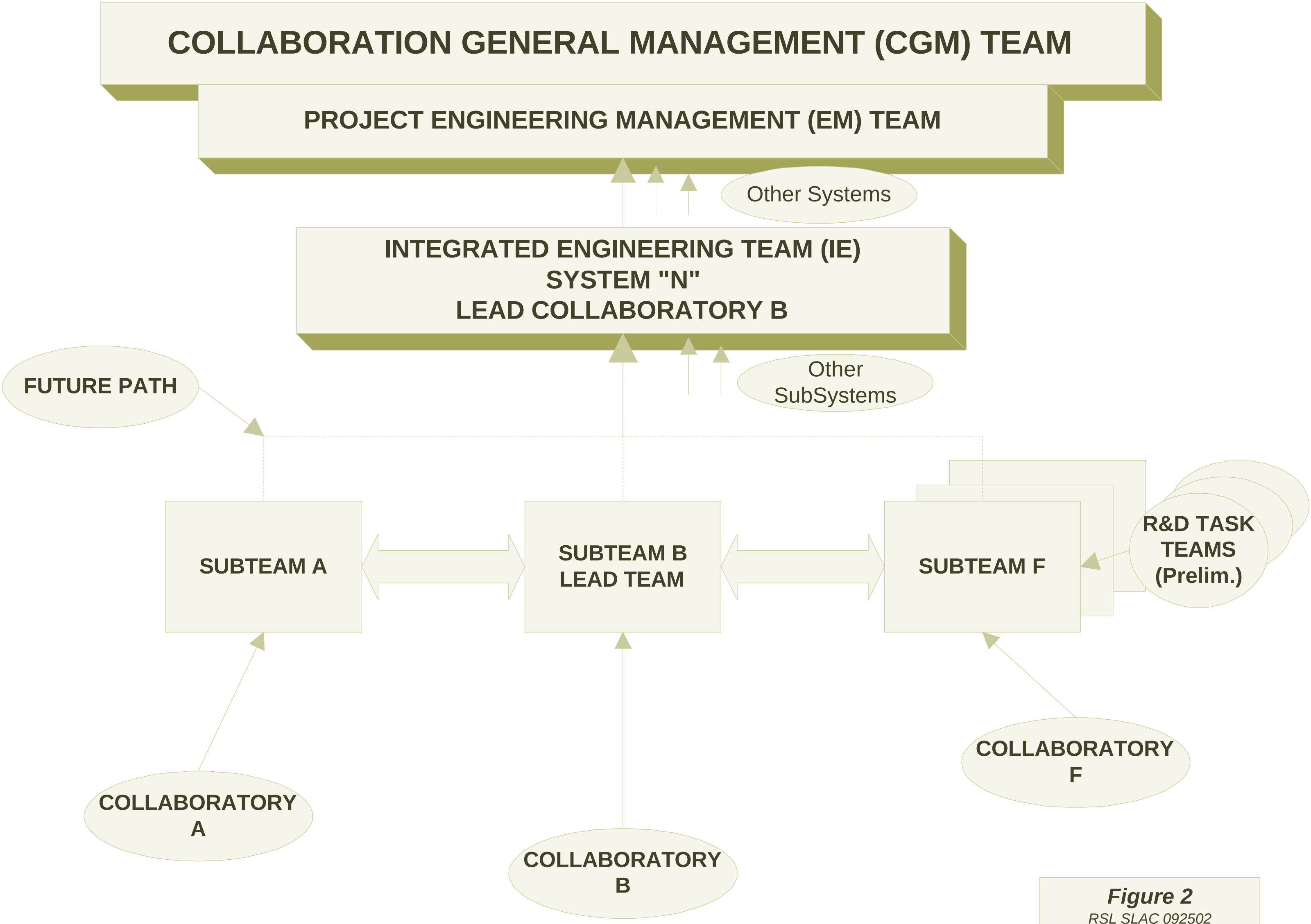
Laboratories

Integr. Product Team Damp.Ring

Integr. Product TeamAcc. Struc

Integr. Product Team Beam Deliv.

Technical decision making



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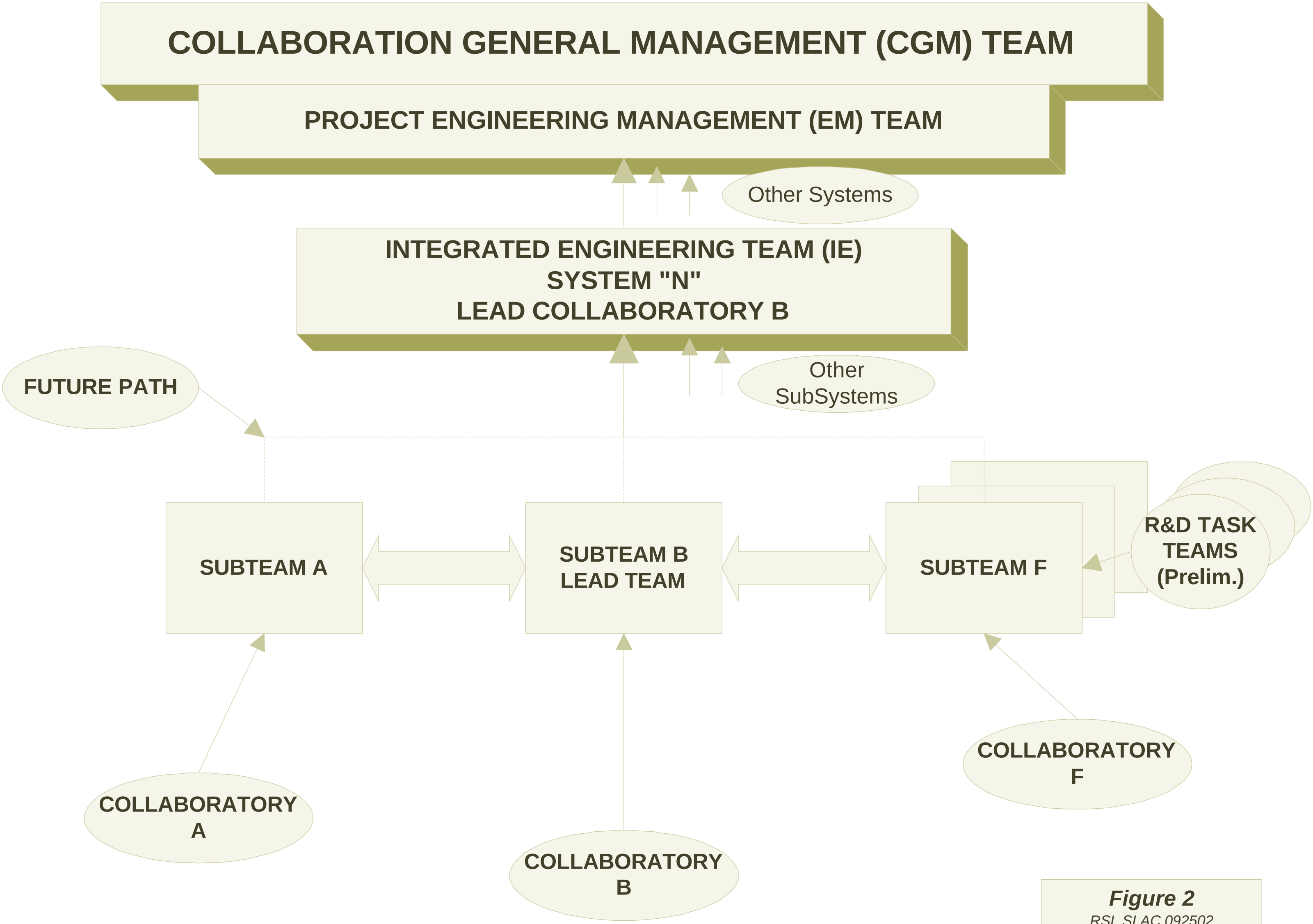
RSL SLAC 092502



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COLLABORATORY B

COLLABORATORY F

Figure 2

RSL SLAC 092502

Conclusions

- There is consensus to build the next large accelerator, LC in a collaborative effort which goes beyond the HERA model
- The idea of Far Remote Operations has widely accepted now in the accelerator community, in particular also in the non-LC part of the community (LHC, SNS,…)
- The two GAN workshop produced a number of ideas and useful interactions with communication scientists
- What is needed now are more serious steps:

  a genuine GAN experiment beyond turning knobs far remotely

  progress in defining appropriate organisational models for GAN