The INFN WAN Grid

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Summary

- Computational needs for High Energy Physics.
- The INFN project 'Condor on WAN'.
- How Condor is used at INFN.

Computational needs in HEP

- Simulation of the detectors.
- Simulation, event reconstruction and analysis of a very large amount of data (1PB/year/experiment)
- Computing power of 1.4 M SpecInt95/experiment

Computing environment in HEP

- Several hundreds of people for each experiment all around the world.
- Thousands of computers with different hardware architecture and software environment that don't share filesystems: heterogeneous resources.

Our first experience (1997)

- Monte Carlo event generation.
- WA92 experiment at CERN: Beauty search in fixed target experiment.
- Working conditions: a dedicated farm of 3 Alpha VMS and 6 DecStation Ultrix.
- Results: 22000 events/day (0 dead time).

Then Condor came...

- Production Condor Pool:
  - 23 DEC Alpha
    - 18 Bologna
    - 2 Cnaf (Bologna)
    - 2 Turin
    - 1 Rome
  - 4 HP
  - 6 DecStation Ultrix
  - 5 Pentium Linux

Then Condor came… (cont.)

The throughput of the 23 Alpha subset of the pool:

75000 to 100000 events/day plus 15000 events/day with the pool in Madison.

We got x5 the production at zero cost!

The 'Condor on WAN' INFN Project

- Approved by the Computing Committee on February 1998.
- Goal: install Condor on the INFN WAN and evaluate its effectiveness for the our computational needs.
- 30 people involved.

INFN Structure

- 25 sections and laboratories
- 5 National Groups.
- More then 10 experiments on nuclear and sub-nuclear physics.
- Hundreds of researchers involved.
- Distributed and heterogeneous resources.

Good frame for a grid!

Collaboration

- INFN and Computer Science Dept. of the University of Madison, Wisconsin.
- Coordinators for the project:
  - for CS-Madison: Miron Livny and Todd Tannenbaum.
  - for INFN: Paolo Mazzanti.

General usage policy

Each group of researchers must be able to maintain full control and priority over their own machines.

General usage policy (cont.)

A Condor job sent from a machine of the group must have the maximum access priority to the other machines of the same group.

Subpools

- With the Rank expression a resource owner can give priority to requests from selected groups:

```
GROUP_ID = "My_Group"
RANK = target.GROUP_ID == "My_Group"
```

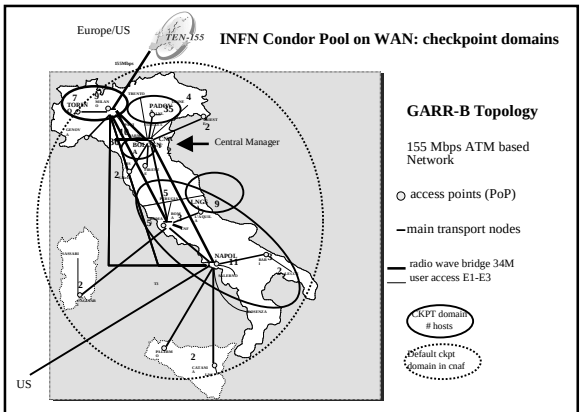
- From the group point of view it is as if the machines made a pool by themselves: a subpool.

Subpools (cont.)

- RANK = (target.UID_DOMAIN == "bo.infn.it") + (10*(target.GROUP_ID == "My_Group"))
- RANK = (target.UID_DOMAIN == "bo.infn.it") + (10*(target.GROUP_ID == "My_Group")) + (100*(target.USER_ID == "John"))

Checkpoint Server Domains

- The network can be a concern with a computing environment distributed over a WAN.
- During a checkpoint > 100MB can be moved around the WAN.
- With several checkpoint server we can improve the performance.



The INFN-WAN Pool

ALPHA/OSF1	111
INTEL/LINUX	68
HP/HPUX	10
SUN/SOLARIS	11
INTEL/WNT	1
Total	**201**

APPLICATIONS

- Simulation of the CMS detector.
- MC event production for CMS.
- Simulation of Cherenkov light in the atmosphere (CLUE).
- MC integration in perturbative QCD.
- Dynamic chaotic systems.
- Extra-solar planets orbits.
- Sthocastics differentials equations.
- Maxwell equations.

Simulation of Cherenkov light in the atmosphere (CLUE).

- Without Condor (1 Alpha):
  - 20000 events/week.
- With Condor: 350000 events in 2 weeks (gain: x9) and they are going to produce 10^6 events.

Dynamic chaotic systems

- Computations based on complex matrix (multiplication,inversion,determinants etc.).
- Very CPU-bound with little output and no input.
- Gains with Condor respect to the only Alpha used: x3.5 to x10.

MC integration in perturbative QCD

- CPU-bound, exec. size 15-30 MB
- No input, very small output
- Gains with Condor: x10.

Maxwell Equations

- 201 jobs, each with a different value of an input parameter.
- Output: 401 numbers/jobs
- Exec. size 33MB.
- Gains with Condor compared to the only Alpha available: x11

Condor Pool Usage

Month	Hours (alloc. time)
Mar 1999	39471
Apr 1999	30428
May 1999	9419
Jun 1999	23028
Jul 1999	25845
Aug 1999	24798
Sep 1999	34185
Oct 1999	17835
Nov 1999	35247
Dec 1999	35432
Jan 2000	31855
Feb 2000	26737 (38 years)

Conclusions

- HTC in HEP is an effective way to get computing resources.
- Our experience with Condor shows that it is easy to use, and provides a big increase in throughput. Users are happy!
- From the administration point of view,the setup of a national wide pool requires some organizing efforts.
- Support from the Condor Team is needed.