BaBar Computing Upgraded

How computing systems could scale for a Super B Factory, with a focus on the data processing.

Teela Pulliam, Ohio State University
Super B Factory Workshop
Honolulu, Hawaii
April 22, 2005
Overview

• Update of Rainer Bartoldous's talk from last year's workshop.
• Main difference is improved scaling in prompt calibrations.
• Idea to give an overview of computing tasks, based on current BaBar computing structure, and how they could scale with higher luminosity.
• No concrete figures ($) but rather estimate to provoke discussion and planning.
Computing plays a large role...

- **Data Acquisition (DAQ):** detector readout, multi-level triggers
- **Calibration:** rolling and static calibration management
- **Reconstruction**
- **Monte Carlo (MC) Production**
- **Physics Skimming:** produce user level data
- **Data (MC) Storage and Access**
- **Analysis Batch System**

How do all these tasks scale with increased luminosity?
The beginning and the end.

- **DAQ:** definitely an important issue.
  See Gregory Dubois-Felsmann's talk from last year's workshop.
- **Logging rate is the driving force since it is the input for all that follows.**
- **Data Storage and Analysis Batch System:**
  See Stephen Gowdy's talk.
  - This scales by adding disks, CPUs, distributing the data over many sites.
Data Path

From detector to user...

Physics
Skims

Skim
Collections

Event
Collections

Event Reconstruction

Data Processing

Prompt
Calibration

Calibrations

DAQ

L1
L3

XTC

calib
**Prompt Calibration (PC)**

- **DAQ rate** depends on lumi
- **full rate**
- **raw data file**
  - events/time increases with luminosity
  - events/time constant
- **calib data file**
- **filter out only events needed for calibrations**

- **Does not need to scale with lumi** since uses only fixed rate of events
- **Currently use 6Hz:** 1Hz Bhabha, radiative Bhabha,
  - hadronic, cosmic; 2Hz mu pair
- **Filtering does need to scale with luminosity:**
  - pseudo-on-line, but can be redone quickly off-line to accommodate changes in calibration requirements.

T. Pulliam - OSU SuperB Workshop, April 22, 2005
Prompt Calibration (PC)

Output of PC is Rolling Calibrations:
- follows changes in detector with time
- use information from sequential runs
- runs must be processed in sequence
- quick: provides prompt feedback on data quality
- done at SLAC, conditions exported for reco and analysis
- conditions management is an administrative issue

PC: non-parallizable, bottleneck is calib data file production
Event Reconstruction (ER)

- Reconstruct all events, slow.
- Distributed computing: reconstruction done in Padova.
- Move raw and reco data across ocean, exploit network.
- Scales by adding additional farms... become question of $\$\$\$.
- Current data rates: 3 ER farms (6 PP farms) = 1 PC farm

T. Pulliam - OSU, SuperB Workshop, April 22, 2005
Monte Carlo (MC)

- distributed production,
- collected back at one site,
- then must be skimmed, and
- then distributed to analysis sites.

Must scale with luminosity:
- now produce $3\times$ generic $B$,
  $1\times$ continuum, signal as requested.
- Exploit large network bandwidth.
- Scales by adding sites, CPUs, disks;
  Becomes an issue of $$.
Skimming

- Input is data (ER) or MC, user defined sparse physics skims.
- Parallelizable: 1 cpu – 1 job, merge N skims to avoid many small collections (files).
- Fast: plan for 3-4 skim cycles a year, can include some reconstruction and conditions updates without full processing.
- Many cycles increases user data size, but minimize with some pointer collections, some deep copy collections.
- Managed by central bookkeeping (at SLAC)
- Scalable by adding CPU, disk, tape = $$$

T. Pulliam - OSU, SuperB Workshop, April 22, 2005
With a large amount of data and many step processing from data collection to user analysis there also administrative issues that become important.

- **Conditions Management:** largely administrative issue
  - conditions from different sources:
    - detector, static and rolling calibrations from sub-systems,
    - physics level conditions
  - need to guarantee consistent conditions between
    Reconstruction – Skimming – Analysis; may be at different sites
- **Bookkeeping, Datasets:** flexible tools as well as admin for production and analysis users to keep track of data/MC.
- **Manpower is also a consideration:**
  - how to attract and retain experts – more publicity?
Costs and Assumptions

- CPU and disk resources: Use Moore's Law
- 2010 turn on, peak lumi $5 \times 10^{35}$, integrated/yr $10^{ab}$
- only 25% MC CPU – 75% institutions costs
- based on current BaBar event sizes, reco code
- does not account for higher backgrounds, bigger event size

$6M$ production; $5M$ CPU, $1M$ disk
$40M$ analysis; $30M$ CPU, $10M$ disk

= $46M$

This is a large number.
in summary:

Computing plays a large role...

- Costs should not be overlooked; substantial.
- Most tasks are already parallelized:
  - scaling = more $\$$
- Calibration datafile is new... makes PC truly scalable.
- Exploit large network bandwidth with distributed production and analysis.
- On SuperB timescale, LHC computing will be a large focus of labs and resources... will have to compete.
- Administration issues are also important.