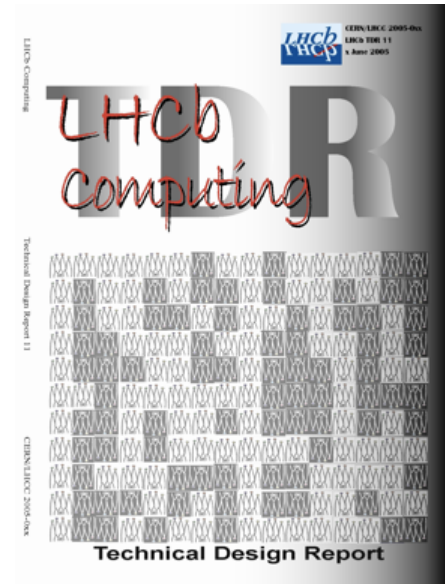


Experiment Computing Models

Slides prepared by Borut Kersevan

Experiment Computing Models

- The LHC experiment Computing Technical Design Reports were produced in ~2005, with the best knowledge available at the time.
 - No plan survives the reality, in this case the arrival of the data:
 - Operational experience introduced significant modifications and improvements in Run 1.
 - Significant technological evolution until today also impacted (and continues to impact) the optimal operational models:
 - For example network bandwidths increased more than anticipated, one can make better use of resources with more dynamic data movement.
 - ‘In-house’ technical solutions custom-made by experiments to optimize the operation proliferated:
 - Several solutions to the same problems.
 - Expensive to maintain and develop in terms of manpower.
 - Awareness that searching for common use cases between experiments could boost the activities and economize manpower is becoming crucial in view of the current financial climate.



ATLAS
Computing

Technical Design Report

Issue: 1
Revision: 3
Reference: ATLAS TDR-017, CERN-LHCC-2005-022
Created: 20 June 2005
Last modified: 4 July 2005
Prepared By: ATLAS Computing Group

Run 2 Computing Models

- WLCG and LHC computing a big success in Run 1!
 - Computing was not a limiting factor for the Physics program of the LHC experiments.
 - Many thanks to our Grid sites for their excellent performance and contributions!
- The LHC experiments have even more ambitious Physics plans for Run 2!
 - with a more demanding LHC environment, especially in terms of higher pile-up of collisions.
 - For example, increasing the trigger rates by experiments up to 1 kHz (ATLAS, CMS):
 - Physics motivated, to preserve the robust trigger thresholds from Run 1.
- The demands in computing resources to accommodate the Run 2 physics needs increase:
 - The experiments need to show that they exercise due diligence in evolving their Computing models, software and operational models to optimally use the required resources.
- Request from the LHCC referees to prepare an updated and common Computing model document by the 4 LHC experiments.
 - Quite some work but also an opportunity to clearly present our plans and identify the areas of common interest and collaboration potential.

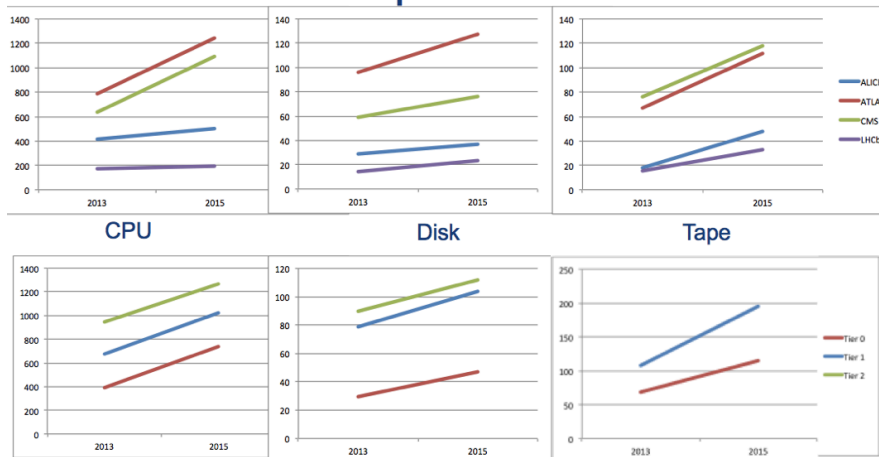
Brief Content Overview

- Many topics need to be covered in this document:
 - Data models – types of data, event sizes, relationships, etc.
 - The operational workflows are strongly correlated to these.
 - Data flows, replication and placement policies.
 - Optimal use of resources to provide the best possible physics throughput.
 - Role of Tiers and sites with emphasis on functionalities and services required.
 - Anticipated event rates and data streams in Run-2.
 - Non-event data handling.
 - For example evolution of database usage and technologies, e.g. Oracle, Frontier, Hadoop, CVMFS...
 - Software evolution.
 - Further software optimization in terms of processing speed, event sizes, parallelization etc..
 - Data preservation.
 - ... and several more..
- An important point is to demonstrate clearly also the progress we made from the Computing TDRs until now, not just the envisaged progress towards Run2.
- Also, clearly identify the envisaged commonalities between experiments and potential input from the wider scientific community.

Resource projections for Run-2

- Resource requirements and their evolution in 2015-2018 by the four experiments are to be part of the common document.
 - Certainly big uncertainties still exist: we are all currently evaluating, prototyping and developing our software to optimize it as much as possible (within the manpower constraints).
 - There are several topics that have not been commonly addressed in the past and the experiments need to understand, which should be part of these projections:
 - Determine what is a 'flat budget' - what is reasonable to expect in terms of technological advancement with a constant budget including replacements? Is Moore's law too optimistic?
 - What are the optimal metrics for 'optimal utilization' of disk, CPU, network?
 - Last, but not least, provide the common method and coherence on how the resource needs are estimated by the experiments.

Evolution of requirements



Currently understood needs in 2015, compared with 2013 capacities

Moore's law

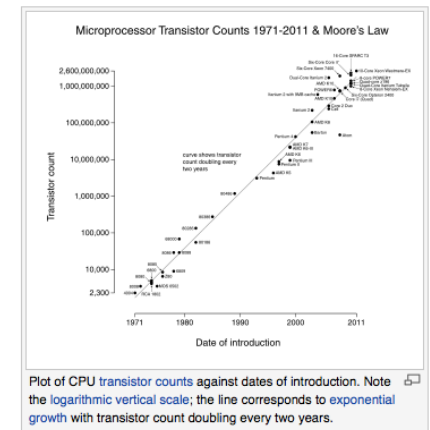
From Wikipedia, the free encyclopedia

Moore's law is the observation that over the [history of computing hardware](#), the number of [transistors](#) on [integrated circuits](#) doubles approximately every two years. The period often quoted as "18 months" is due to [Intel](#) executive [David House](#), who predicted that period for a doubling in chip performance (being a combination of the effect of more transistors and their being faster).^[1]

The law is named after Intel co-founder [Gordon E. Moore](#), who described the trend in his 1965 paper.^{[2][3][4]} The paper noted that the number of components in integrated circuits had doubled every year from the invention of the integrated circuit in 1958 until 1965 and predicted that the trend would continue "for at least ten years".^[5] His prediction has proven to be uncannily accurate, in part because the law is now used in the [semiconductor](#) industry to guide long-term planning and to set targets for [research and development](#).^[6]

The capabilities of many digital electronic devices are strongly linked to Moore's law: [processing speed](#), [memory capacity](#), sensors and even the number and size of [pixels](#) in [digital cameras](#).^[7] All of these are improving at (roughly) [exponential](#) rates as well (see [Other formulations and similar laws](#)). This exponential improvement has dramatically enhanced the impact of digital electronics in nearly every segment of the world economy.^[8] Moore's law describes a driving force of technological and social change in the late 20th and early 21st centuries.^{[9][10]}

This trend has continued for more than half a century. Google in 2005 predicted that



Plot of CPU transistor counts against dates of introduction. Note the logarithmic vertical scale; the line corresponds to exponential growth with transistor count doubling every two years.

To Sum Up...

- A new coherent effort by the four experiments to provide the updated joint computing models and derived resource requirements for Run-2 is in the making, as required by the LHCC.
- Quite some work, but a good opportunity to provide high quality documentation on the experiment plans for the Run 2 computing.
 - A special focus on the future common efforts.
- A milestone in providing the plans for the best possible Physics throughput in Run-2!