The Wilson HPC Cluster

Institut für Kernphysik Johannes Gutenberg-Universität Mainz

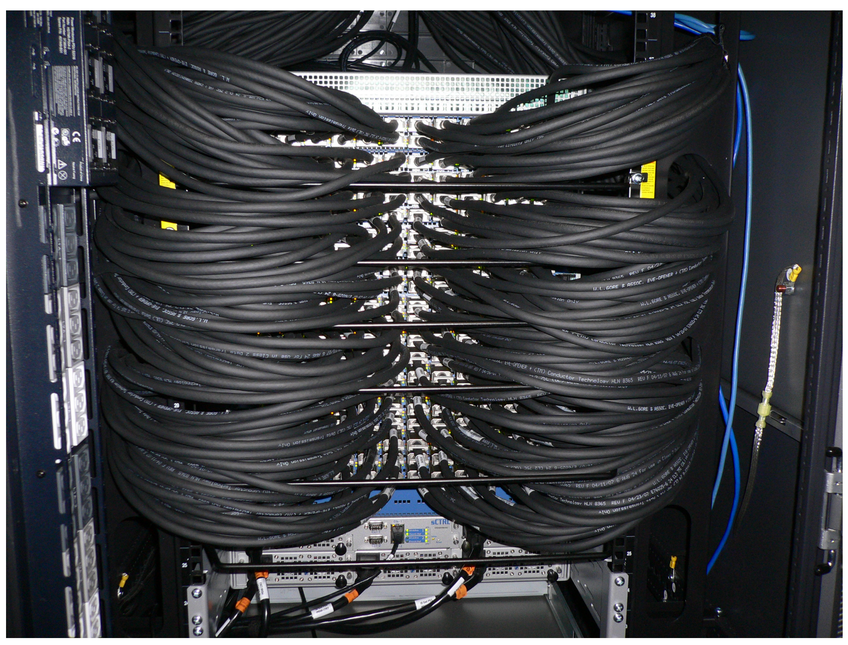
Overview

Computer simulations play an increasingly important role in physics, and have established themselves as a third pillar besides the more traditional disciplines of experimental and theoretical physics. In particle and nuclear physics, Monte Carlo simulations are becoming the standard tool in order to understand the forces between quarks inside atomic nuclei at the quantitative level. The theoretical foundation is Quantum Chromodynamics (QCD), which describes the interactions between quarks and gluons. The formulation of QCD on a discrete space-time lattice makes it amenable to large-scale numerical simulations, similar to Monte Carlo simulations applied in condensed matter physics.

Wilson

Currently, one of the largest high performance computing (HPC) cluster installations dedicated exclusively to simulations of lattice QCD is operated by the Institute for Nuclear Physics at the University of Mainz.
The Wilson cluster consists of

- 280 compute nodes → HP DL 165:
  2 AMD QuadCore CPU's (2.3 GHz), 8 GB RAM
- 288 ports @ 20 Gbps Infiniband switch → Voltaire ISR 2012



Rear view of the Infiniband switch

- 1 management node → Hewlett-Packard DL 385:
  2 AMD QuadCore CPU's (2.3 GHz), 16 GB RAM
- Storagecapacity 9 TB (2 × Raid 5) → 2 HP MSA 60
- 2 switches in each rack → HP ProCurve 2650/2848
- 1 air cooled and 7 water cooled racks

One row of water cooled racks

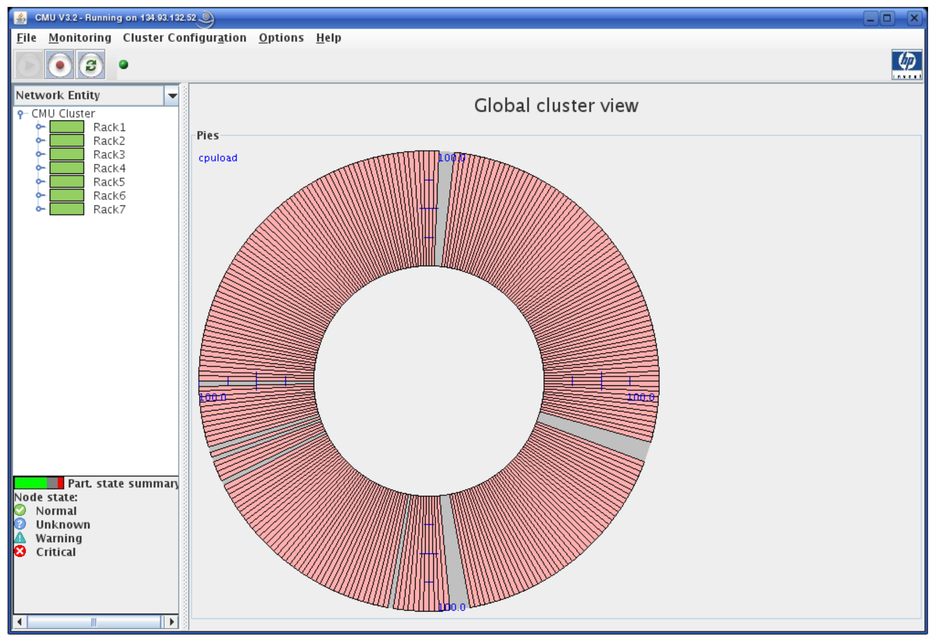
Operating System

We run Red Hat Enterprise Linux 5.1 on all servers, including the 280 compute nodes. Automatization of OS installation is realized via *cloning* of nodes. Utilizing the Cluster Management Utility (CMU) provided by HP, the distribution of the operating system over the entire cluster takes only 1 hour!

Management & Monitoring

HP's Cluster Management Utility (CMU) provides

- efficient installation of the OS via cloning,
- sensor information of the computes nodes,
- parallel shell.



Graphical interface to CMU

We designed and implemented our own tailor-made monitoring. The monitoring gathers and archives status and sensor information of

- water cooled racks,
- air condition,
- sensor information of the compute nodes,
- server room temperature and humidity sensors.

Data visualization is based on rrd-tool and can be accessed via a web interface

Web interface to sensor values of rack 1.

Emergency Handling

The monitoring also implements emergency handling scripts. Crucial parameters are regularly checked against user defined policy tables, according to which appropriate actions are undertaken to resolve the issue or preserve the system from further damage.
The emergency shutdown scripts already proved invaluable in the case of an air condition failure, which led to a substantial heat up of the server room within a short time. In addition to the software driven precautions a circuit breaker connected to room temperature sensors was installed, physically interrupting the cluster's power supply if the temperature thresholds are exceeded.

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