HEP Computing in Denmark

Present status and future perspectives

rECFA meeting in Copenhagen 2022 12th May 2022

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Chairman of the board of Danish e-Infrastructure Cooperation

1. Danish contribution to LHC computing

- 2. Other HEP related computing activities
- 3. The Danish National Strategy for HPC and data management based on FAIR principles.
- 4. Future Danish contributions til LHC computing.

UNIVERSITY OF COPENHAGEN

Nordic Tier 1 – Computing and Storage for the Large Hadron Collider at CERN

Original reasoning leading to NDGF I 2002

- One big highly reliable storage system gives more value to the researchers
 - Than 4-5 smaller national storage and computing systems
 - Less effort to manage
- Cooperation saves money
 - While distributed operations have a bit of overhead...
 - The replication of effort in running 4-5 independent national systems would be worse





- 2 LHC experiments: ALICE and ATLAS
- Other non-LHC users: IceCube

Danish resources to ALICE and ATLAS

- DK-T1 is Located at the Niels Bohr Institute
 - Network: 100G
 - CPU: 23 kHEPSpec06
 - Disk: 2 PB
 - Tape: 3 PB
 - 1 FTE
- Local resources
 - 150 cores on 6 servers
 - 0.1 PB disk







CERN-related computing at SDU – Current Status

- A small pool of dedicated resources
 - 2 large GPU servers: x4 nVidia V100, x8 nVidia A100
 - A few CPU servers for numerical simulations, symbolic calculations
- Local resources at the faculty of Science
 - Old HPC cluster ~200 CPU nodes with 24cores per node
 - ~25%, ie. ~7M core*hours per year spent on CERN-related activities (theory)
 - ~600TB of data from simulations
- Use of national DeiC HPC systems and international HPC systems

DeiC ~1M core*hours per year:
 Interactive HPC (data analysis and smaller simulations),
 Throughput HPC (larger simulations),
 Large Memory HPC (data analysis)
 LUMI, other EuroHPC systems, previously PRACE

Future needs at SDU for CERN-related computing

- Similar amount of CPU core*hours: total ~10M core*hours per year
- Expected more GPU*hours needed: total ~ 2-5M GPU*hours per year
- A few workstation for symbolic calculation (e.g. with Mathematica) and software licenses
- Similar amount of storage: total ~5-600TB storage for data

The future

• LHC schedule dictates the needs



- Over the next 10 years
 - > x 3 CPU
 - > x 5 Tape
 - > x 5 Disk
 - > 400Gb/s network (CERN+NT1 "backbone")





The national collaboration on digital infrastructure for research and education



Strategi for nationalt samarbejde om digital forskningsinfrastruktur

Anbefalinger fra strategigruppen

December 2018

December 2018



Danish e-Infrastructure Collaboration (DeiC) is a result of the national e-Infrastructure strategy, created to handle the research data network, HPC and data storage for the 8 Danish universities. 50 MDKK extra for HPC and storage.

The 8 university rectors are directly represented at the DeiC Board. For the universities with CERN activities the board members are:

DTU – IT-chef Steen Pedersen AU – Prodekan, prof. Brian Vinter SDU – dekan, prof. Henrik Bindslev KU – prof. John Renner Hansen (Chair)



A new HPC landscape

The future national HPC landscape:

> Researchers in Denmark have access to 4 types of HPC installations:



- > Universities asked to calculate their future needs for national HPC divided in 4 categories
- > How are we making the best possible use of the gigantic investment in EuroHPC?

A national data management strategy based on FAIR

DeiC has lead the work, in collaboration with a wide range of stakeholders towards a national strategy for data management based on FAIR the principles. Members of the working groups came from universities, ministries, private and public foundations, The Royal Library, The National Archive, Statistics Denmark, etc.

The strategy was accepted by the Ministry of Higher Education and Science August 2021.

It defines a set of principles on how the researchers, research institutions, preservation institutions, research funds etc. shall handle issues regarding data management,

based on the FAIR principles,

follow the policy prepared as a consequence of the directive on open data (PSI) article 10

The DeiC board will soon (May 2022) ask one or more universities to establish a national storage system for all sciences at Danish universities, to be ready ~ January 2023.

Nation

Deic National strategy for data management based on the FAIR principles August 2021.

European Open Science Cloud (EOSC)



From "EOSC Strategic Implementation Roadmap 2018-2020"

- Danmark is a member of EOSC
- DeiC handles the Danish obligations in connection with EOSC membership
- A prerequisite for DeiC's new national plan for data warehousing and data management is that it is compatible with EOSC

EOSC is a **federation** of infrastructures, forming a **Web** of **FAIR Digital Objects**,

including <u>publications</u>, data, metadata software <u>resources</u> and other research artefacts, and

related Services for Science.

The future

• LHC schedule dictates the needs



- Over the next 10 years
 - > x 3 CPU
 - > x 5 Tape
 - > x 5 Disk
 - > 400Gb/s network (CERN+NT1 "backbone")
- Looking towards EuroHPC (VEGA and LUMI)
 Discussions started with LUMI
- Make use of the national storage system



How do we transform NT1 from the present setup to a system within EuroHPC and EOSC agenda?

