

Danish National HPC Facility

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Status of HPC in Danish Universities

In the past years the Danish Center for Scientific Computing (DCSC), now merged into DelC, has established regional operating centers at the five major Danish universities. From 2007 to 2012, DCSC has granted funding to research projects for HPC hardware, which has been installed and maintained by the five regional centers.

A crude summary of the present status of the HPC hardware in the five regional centers is presented in the table below.

	Name	#nodes	Speed (TFlops)
SDU			88
	HS8	27	10
	HS7	12 GPU	25
	HS6	~260	45
	HS5	~100	8
AU			251
	Grendel	~900	84
	Grendel GPU	~60 GPU	150
	Huge	4	1
	Genome	~100	16
KU			210
	Steno	~450	60
	Steno GPU	~50 GPU	150
DTU			64
	FYS	~870	56
	MAT/MEK	48	6.5
	CBS	256	1.5
AAU			6
	Fyrkat	84	6

It should be noted that the machines with the largest number of units (nodes) are composed of many smaller subsystems, e.g. Grendel at AU is composed of ~15 different smaller machines, which have been acquired over a period of several years.

The Danish landscape of High Performance Computing resources is very fragmented and lacks the presence of a system comparable in size and speed to the ones available in many other European countries, such as UK, Germany, Italy, Spain, France, Norway or Sweden. Organizations such as PRACE (Partnership for Advanced Computing in Europe) provide researchers with access to large European computing infrastructures on a competitive basis. However as Denmark is currently not contributing the pool of available resources, Danish researchers could be penalized by the present situation.

Moreover the Danish HPC systems listed above have been bought with DCSC grants and are assigned to specific projects. Therefore at present it is not possible to share resources neither at the national nor at the regional level.

The vision for a national HPC infrastructure

A common national infrastructure would have some substantial advantages:

1. better sharing of resources and overall efficiency with reduced operational costs;
2. direct availability of a European-level machine to Danish research and industry.

We give here a very rough estimate of the costs involved in the setup of an HPC machine corresponding to roughly ten times the total computing power available at KU. Such machine would compare favorably to similar systems in Europe.

We use as a model for the envisioned Danish machine the current #1 supercomputer in the world, a machine in Oak Ridge National Lab (USA) named "Titan" (see <http://www.olcf.ornl.gov/titan/>). This machine is designed to satisfy the needs of a very wide range of scientific and industrial users.

A Danish machine with 1500 nodes, corresponding to about 8% of Titan, of which 1/3 with GPU accelerators would have a computational power of about 2400 TFlops. This corresponds to the above mentioned tenfold increase respect to the total resources presently available at KU. Such a machine would rank around #40 in the world.

From the total cost of development of Titan of about 100M usd, we can estimate an expense of about 45M dkk needed to build the Danish machine. It should also be noted that when building such a large machine at a national level, a substantial discount for the price of the hardware can be expected from the providers (which is already included in our estimate).

The machine will use about 450 kW of power corresponding to a running cost of about 6M dkk per year. An additional cost of roughly 50% for running the cooling system should also be included (exact figures depend on the actual system).

The physical space required for this Titan-like machine is about 50 sqm.