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Introduction to the Cyfronet Supercomputer System in AGH University

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Nowadays, big data technology is developed very fast. Almost fields need to analysis with big data. Medical has the big data of patients. Bank need to analysis big data from clients, who deposit their saving in banks. Services need to big data analysis to control their big number of clients. In Geo-informatics, we collect big number of data from time series from the billions points all around the world. Day by day, our world is more complicated, the data we have collected are complicated too. With the hug numbers of data, we need to have very powerful machines to analysis. In 1973, thanks to the Krakow University Rectors' College Members, the Academic Computer Centre CYFRONET AGH was established. Since 1999, this Centre has been organizationally and financially separate unit of AGH-UST in Krakow. Now it is one of the largest supercomputing and networking centers in Poland. The most important task of Cyfronet is to provide telecommunication and computing services for the entire scientific community of Krakow and Malopolska province to support conducting of scientific research. System computers of Cyfronet include: *Zeus, Athena, Ares, Prometheus, Platon U3, Accelerated computing cluster*. Besides, Cyfronet AGH coordinates Polish activities in the *LUMI Consortium*. LUMI was installed at the CSC data centre in Kajaani, Filand. As of January 2023 is the fastest supercomputer in Europe. Finnish-led consortium, apart from Poland, also includes Belgium, The Czech Republic, Denmark, Estonia, Iceland, Norway, Sweden, and Switzerland. My presentation introduces the Cyfronet AGH's supercomputers to Vietnamese researchers. This opens up opportunities for broader cooperation between Vietnamese and Polish researchers with specifically projects, with the help of the supercomputers' system.

ATHENA SUPERCOMPUTER

Athena achieves the theoretical computing power of over 7.7 PFlops, which gave the machine 105th place on the TOP500 list of fastest supercomputer in the world in June 2022 and makes it the fastest supercomputer in Poland at present.

- Athena's configuration includes: 48 servers with AMD EPYC processors and 1 TB of RAM (6,144 CPU compute cores in total) as well as 384 NVIDIA A100 GPGPU cards.
- Athena's computing power for AI computing is almost 240 PetaFlops.
- The Athena's architecture meets the needs of users, who use the computing infrastructure both to perform standard high-performance scientific simulations (HPC) and to apply artificial intelligence (AI) and machine learning (ML) methods in order to conduct research in the field of medicine, pharmacology, biology, chemistry, physics and many other fields of science.

ARES SUPERCOMPUTER

The Ares supercomputer was deployed in 2021. Since 2021, Ares has been present on the TOP500 list of fastest supercomputers in the world.
Its architecture is based on computing servers with Intel Xeon Platinum processors, divided into three groups:
✓ 532 servers each equipped with 192 GB of RAM,
✓ 256 servers each equipped with 384 GB of RAM each,
✓ 9 servers with 8 NVIDIA Tesla V100 cards each.
✓ The supercomputer has 37 824 computing cores.
All the components make it possible to shorten the computation time of scientific tasks and address issues that could not have been run on a large scale due to insufficient memory.

PROMETHEUS SUPERCOMPUTER

Since its launch in 2015, Prometheus, working at ACK Cyfronet AGH, has been listed on the TOP500 list of the fastest supercomputer in the world 15 times in a row , highest in 38th position.
Computing cluster:
- ✓ **Operating system**: Linux CentOS 7
- ✓ **Configuration**: HP Apollo 8000, HPE ProLiant DL360 Gen10
- ✓ **Processors**: Intel Xeon (Haswell / Skylake)
- ✓ **Computing cores:** 53604
- ✓ 2232 servers
- ✓ **GPGPU:** 144 (Nvidia Tesla K40 XL), 32 (NVidia Tesla V100)
- ✓ **RAM**: 282 TB
- ✓ **Storage**: 10 PB
- ✓ **Computing power**: 2403 TFlops

The architecture of the Prometheus supercomputer responds to the diverse needs of scientists by providing resources organized in partitions:
• classic computing servers with high-performance Intel Xeon Haswell and Intel Xeon Gold processors,
• a set of servers with NVIDIA K40 XL graphics processors,
• an acceleration partition with NVIDIA K80 GPGPU cards and Intel Xeon Phi and Nallatech FPGA accelerators,
• a partition dedicated to computing related to artificial intelligence, equipped with 32 GPGPU NVIDIA Tesla V100 graphics accelerators.

ZEUS SUPERCOMPUTER

Computing cluster — Zeus	Computing cluster — Zeus BigMem	Zeus vSMP	Zeus GPGPU	Zeus FPGA
operating system: Scientific Linux 5 **configuration**: HP BL2x220c **processors**: Intel Xeon **RAM**: 23 TB **computing power**: 120 TFlops	**operating system**: Scientific Linux 6 **configuration**: HP BL685c **processors**: AMD Opteron **RAM**: 26 TB **computing power**: 61 TFlops	**operating system**: Scientific Linux 5 **configuration**: HP BL490c **processors**: Intel Xeon **RAM**: 6 TB **computing power**: 8 TFlops	**operating system**: Scientific Linux 5 **configuration**: HP SL390s **processors**: Intel Xeon **RAM**: 3,6 TB **computing power**: 136 TFlops	**operating system**: Ubuntu **configuration**: 2 x M-503 (Virtex-6 LX240T FPGA) **processors**: Intel i7 **RAM**: 12 GB **computing resources**: 241 152 FPGA Logic Cells, 768 DSP48 Slices, 14 976 kbits Block RAM

LUMI Consortium

• LUMI was installed at the CSC data centre in Kajaani, Filand.
• The supercomputer is hosted by the LUMI consortium including 10 European countries: Filand, Poland, Belgium, The Czech Republic, Denmark, Estonia, Iceland, Norway, Sweden, and Switzerland.
• Cyfronet AGH coordinates Polish activities in the LUMI Consortium.

LUMI is the fastest supercomputer in Europe and the third fastest globally (the Top500 list published in May 2023). LUMI is also the seventh greenest supercomputer on the planet (The Green500 list published in May 2023).

1 SYSTEM — 375 Petaflop/s — SUSTAINED COMPUTING POWER
LUMI's sustained computing power (HPL) is 375 petaflops (sustained performance) in its final configuration.

COMPUTING POWER EQUALS **1.5 MILLION MODERN LAPTOP'S CAPACITY**
LUMI's computing power is equivalent to the combined performance of 1.5 million of the latest laptop computers. These would form over a 23-kilometer-high tower.

100% HYDROELECTRIC ENERGY
LUMI is using 100% hydro-powered energy. LUMI's waste heat is used to heat hundreds of households in the city of Kajaani.