

The background of the slide features a white wolf standing in a snowy, digital landscape. The scene is overlaid with a grid pattern and various digital artifacts, creating a high-tech, futuristic atmosphere. The LUMI logo is prominently displayed at the top center.

LUMI

The pan-European supercomputer of the North

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Outline

- The long story of LUMI and EuroHPC (made short)
- The opportunities and benefits for research, development and innovation offered by LUMI
- How to prepare for LUMI?
- Q&A

The EuroHPC Initiative

- The **EuroHPC Joint Undertaking** will pool EU and national resources in high-performance computing (HPC)
 - **acquiring and providing a world-class supercomputing and data infrastructure** for Europe's scientific, industrial and public users
 - supporting an ambitious **research and innovation agenda**
- The EuroHPC declaration has been signed by **32 European countries**
- The first generation of EuroHPC systems announced in June 2019
 - 3 pre-exascale systems to Finland, Italy and Spain
 - 5 petascale systems to Czech Republic, Bulgaria, Luxembourg, Portugal and Slovenia
- Next generations of systems planned for 2023-2024 and 2026-2027

LUMI Consortium

- Unique consortium of 10 countries with strong national HPC centers
- The resources of LUMI will be allocated per the investments
- The share of the EuroHPC JU (50%) will be allocated by a peer-review process (cf. PRACE Tier-0 access) and available for all European researchers
- The shares of the LUMI partner countries will be allocated by local considerations and policies – seen and handled as extensions to national resources



LUMI Datacenter in Kajaani

100% hydroelectric energy up to 200 MW

Very reliable power grid: Only one 2 min outage in 38 years

100% free cooling available, PUE 1.03

Waste heat reuse: effective energy price 35 €/MWh,
negative CO₂ footprint: 13500 tons reduced every year

Extreme connectivity: Kajaani DC is a direct part of the Nordic backbone.
4x100 Gbit/s to GÉANT in place, can be easily scaled up to multi-terabit level

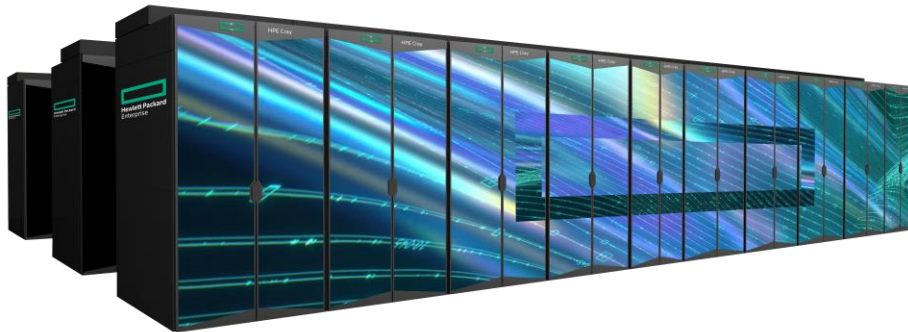
Elevated security standards guaranteed by ISO27001 compliancy



Benefits and opportunities for R&I by LUMI

LUMI: one of the fastest supercomputers in the world

L U M I



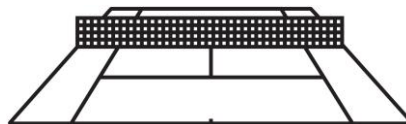
- LUMI will be an **HPE Cray EX** supercomputer manufactured by **Hewlett Packard Enterprise**
- Peak performance over **550 petaflop/s** makes the system one of the world's fastest
 - Fastest today is Fugaku supercomputer in Japan with 513 petaflop/s, second fastest Summit in USA with 200 petaflop/s)

1 system
550
Pflop/s

Peak Performance

Computing power
equivalent to
1 500 000

Modern laptop computers



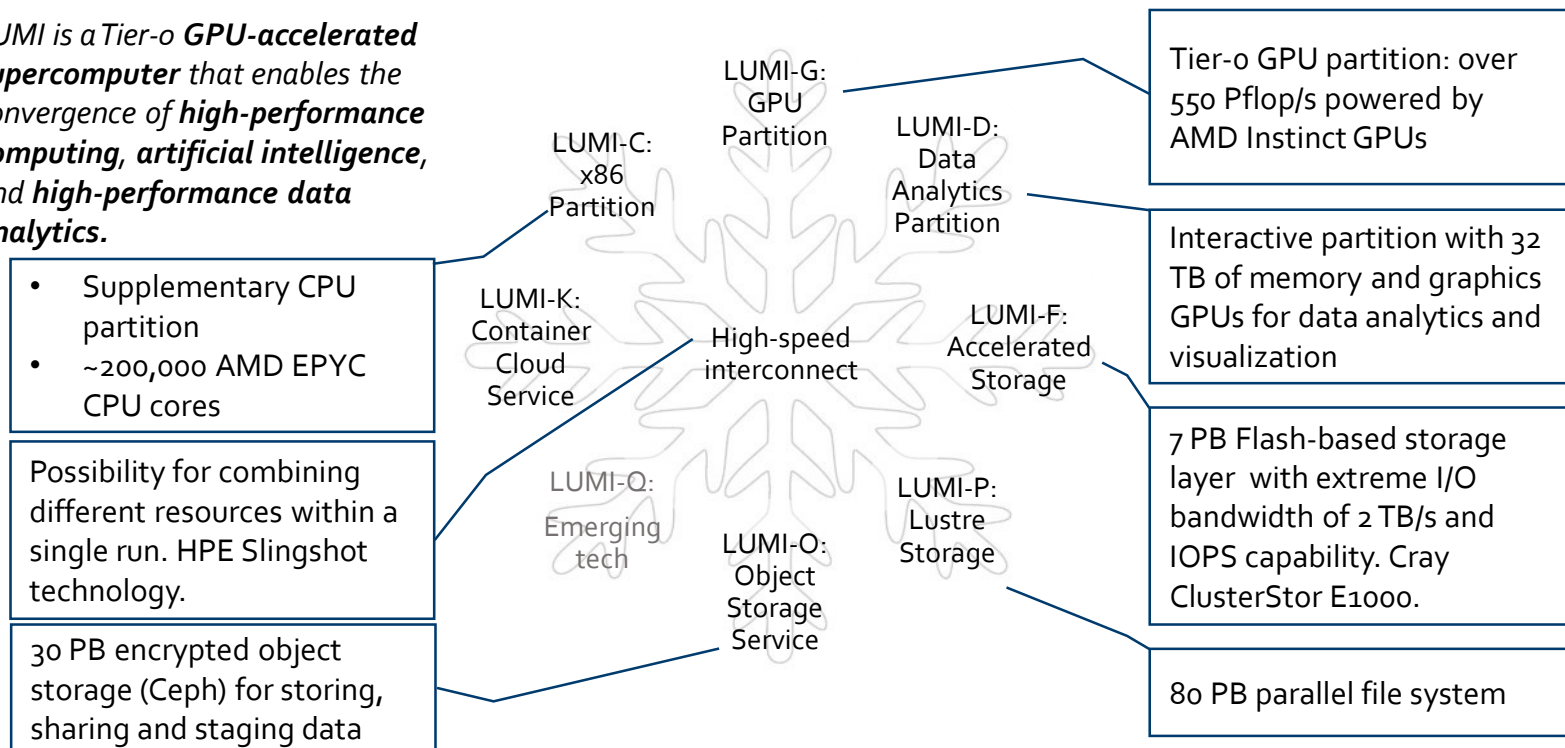
Size of a tennis court

Modern platform for
High-performance
computing,
Artificial intelligence,
Data analytics

Based on GPU technology

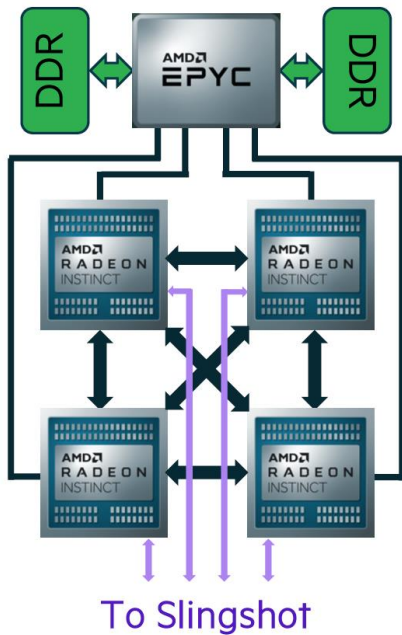
LUMI, the Queen of the North

*LUMI is a Tier-0 GPU-accelerated supercomputer that enables the convergence of **high-performance computing**, **artificial intelligence**, and **high-performance data analytics**.*

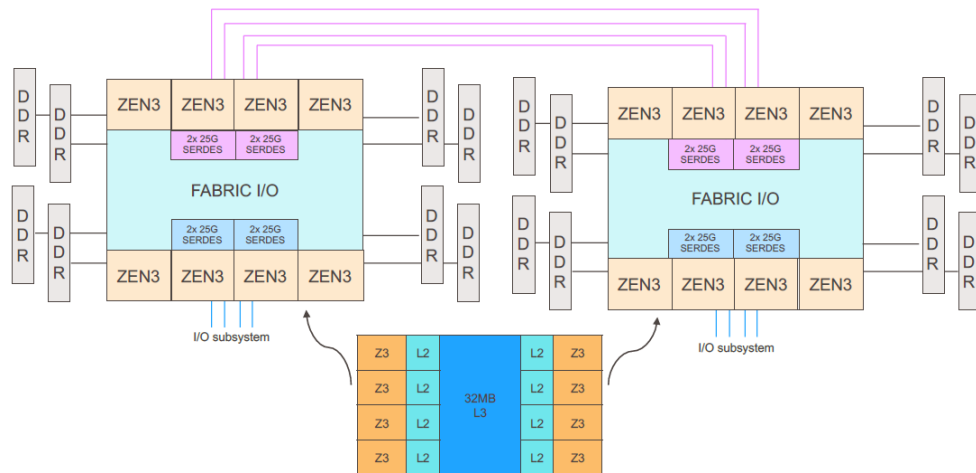


LUMI compute node configurations

LUMI-G

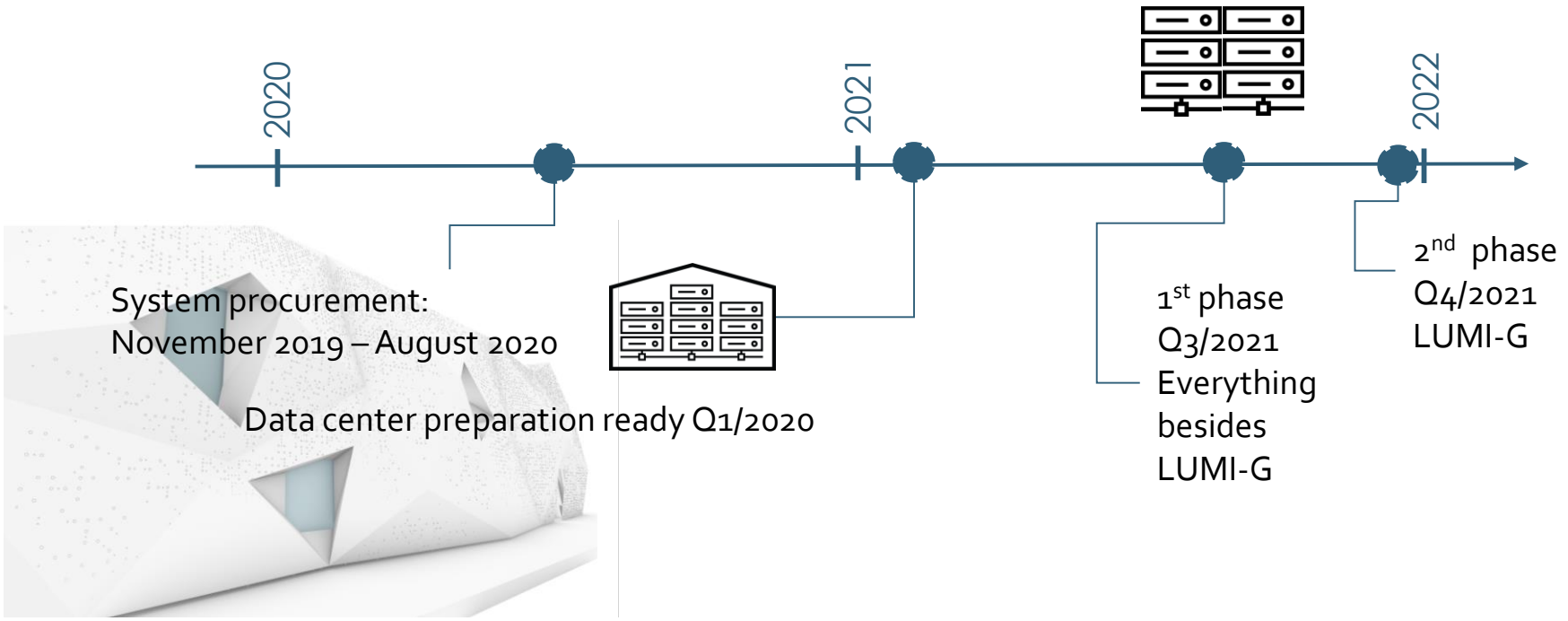


LUMI-C



2x 64-core AMD Milan processors per node
1376 nodes with 256 GB, 128 with 512 GB and 32 with 1 TB

LUMI Timeline



Enhanced user experience

- In addition to traditional CLI, we wish to support high-level interfaces on LUMI, i.e. seamlessly integrate Jupyter Notebooks, Rstudio and such to back-end to LUMI
 - Ultimately the LUMI resources being an extension to your laptop
- Large software budget will enable a rich stack of pre-installed software
- Datasets as a Service: curated large reference datasets available and maintained
- Support for handling sensitive (GDPR subjected, IP-closed, etc) data

LUMI user support

- LUMI user support and a centralized help-desk by the distributed LUMI User Support Team
 - The model is based on a network of **dedicated LUMI experts**: each partner will provide one full-time person for the task
 - User Support Team will also provide end-user training, maintain the software portfolio and user documentation of the system
- “Level 3” support (e.g. application enabling, methodology support) via local centers as well as the EuroHPC Competence Centers



How to prepare for LUMI?

LUMI capacities, a brief summary

- Extreme computing capacity based on LUMI-G and LUMI-C partitions
 - LUMI queue policies will support jobs from single CPU core or a GPU to 50% of the nodes, even 100% with special arrangements
 - Jobs can combine resources from both sides within a workflow, even within the same executable
- Interactive use (visualization, data analysis, pre/post processing,..) on LUMI-D
- Broad stack of pre-installed scientific software, databases and datasets, both commercial and community
- Sharing datasets over LUMI-O service
- Running microservices on LUMI-K
- Exploring the quantum computing world with LUMI-Q

Getting LUMI resources

- LUMI resources are allocated in terms of GPU-hours, CPU-core-hours, and storage hours
 - Each project applies and gets a combination of this
 - No dedicated hardware - all users can access the whole system within the batch job policies
 - All countries receive shares of these pools per their share of the TCO – 4% for Sweden
- Resources brokered in terms of
 - Preparatory access projects (XS) – single-PI
 - Development access projects (S) – single-PI
 - General access (Tier-1) projects (M) – single-PI
 - Extreme scale (Tier-0) projects (L) – single-PI, should be mostly GPU hours
 - (Strategic Community Access projects (XL) – multi-PI, multi-year)
- Researchers affiliated to Swedish institutions can apply from the EuroHPC allocation or from Sweden's allocation

How to prepare for LUMI?

- Thinking projects and use cases for Lumi
 - Cases for Tier-0 grand challenges
 - Combining simulation and AI methods within the same workflow
- There is a vast pool of GPU-enabled community codes
 - See if your favorite software suite already has been enabled - if not, consider moving to a competing package that is
 - Perhaps only part of the application needs to be GPU-enabled, rest running on the CPU nodes
- Modernizing applications and GPU-enabling them
 - "even if it works, fix it"

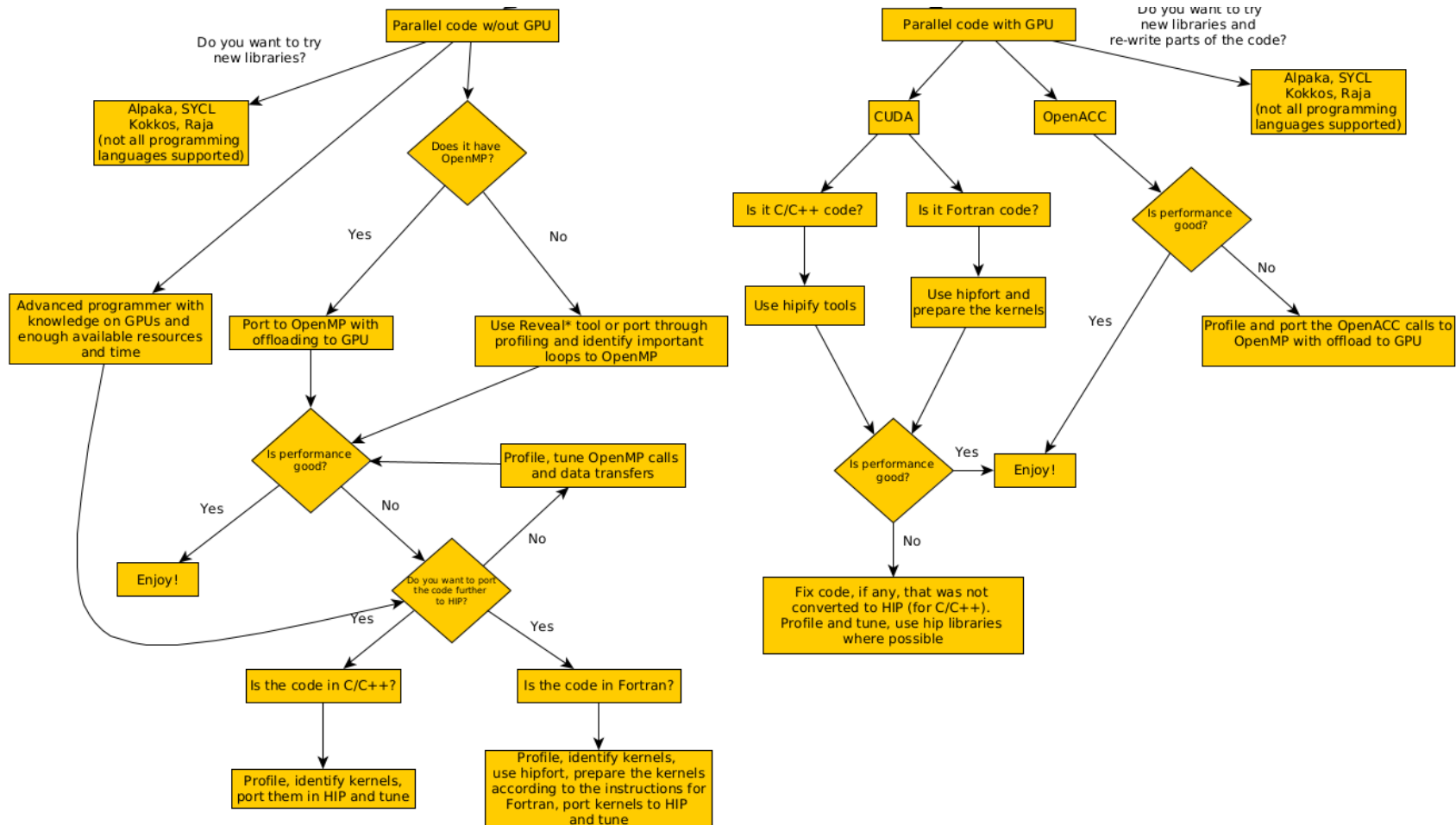
LUMI programming environment

- ROCm (Radeon Open Compute)
 - Usual set of accelerated scientific libraries (BLAS, FFT etc)
 - Usual machine learning frameworks and libraries (Tensorflow, PyTorch etc)
 - Compilers for the GPUs
- Cray Programming Environment (CPE) stack
 - Cray Compiling Environment, LibSci libraries, CrayPAT, Reveal, debuggers,...
 - CPE Deep Learning Plugin
- More information:
<https://www.lumi-supercomputer.eu/may-we-introduce-lumi/>

Preparing applications and workflows for LUMI

L U M I

- Remember the possibility of combining CPU and GPU nodes within one job – perhaps only part of the application needs to be GPU-enabled
- Consider writing your application on top of modern frameworks and libraries
 - Kokkos, Alpaka etc, or domain-specific frameworks
- Convert CUDA codes to HIP, OpenACC codes to OpenMP5
 - HIPify tools can automatize the effort
- LUMI 1st phase will come with a code porting platform (MI100 GPUs)
 - HIP porting can be done already now on Nvidia GPU platforms



Concluding remarks

- **EuroHPC era: Unprecedented amount of computational resources and capabilities** available for European research & innovation
 - Complemented by competence building and user support activities
- **LUMI, the Queen of the North:** leadership-class resource designed for a broad range of user communities and workloads, with an enhanced user experience
 - **LUMI will be a GPU system**, which needs some preparatory work – but it will be a robust production system, and not experimental or esoteric in any manner
- **Modernizing HPC applications** for harnessing the largest systems is not trivial, and needs a lot of focused effort – but it will pay off
 - It is time already to start preparing for the LUMI era



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EuroHPC
Joint Undertaking



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Leverage from
the EU
2014–2020

**Kainuun liitto**