

LUMI

A white wolf is the central focus, standing in a snowy, futuristic landscape. The background is filled with glowing blue structures and falling snow, creating a high-tech, cold atmosphere. The wolf is looking directly at the viewer.

**LUMI – The first European
pre-exascale system**

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Outline

- LUMI: the story so far
- LUMI capabilities

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

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 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



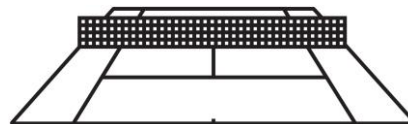
LUMI: one of the fastest supercomputers in the world



- LUMI is 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 two tennis
courts

Modern platform for
High-performance
computing,
Artificial intelligence,
Data analytics
Based on GPU technology

Enabler of world-class scientific breakthroughs

LUMI is designed as a 'Swiss army knife' targeted for **a wide spectrum of use cases and user communities.**

- **Climate research:** More precise climate models and the interconnection of different climate models: How will living conditions change when the climate is warming?
- **Data science:** analyzing and re-analyzing large data sets (simulated and measured) e.g. in atmospheric science, environmental science, climate modelling, material science and linguistics.
- **Plasma physics:** Predicting and preparing for the societal effects of extreme space weather events. Multi-scale modeling of fusion reactors.
- **Life sciences:** enabling calculation of protein function, structural protein-protein interactions.
- **Materials science:** quantum-mechanical simulations with global impact are development of better energy storage materials, more efficient solar cells, and better catalyst materials.
- **Humanities and social sciences:** Natural language processing. Large-scale data analytics from social networks and the modelling of complex societal phenomena.
- Fast-track for **urgent computing** needs in time- and mission-critical simulations, e.g. related to national or EU security or other major crisis e.g. pandemic.

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

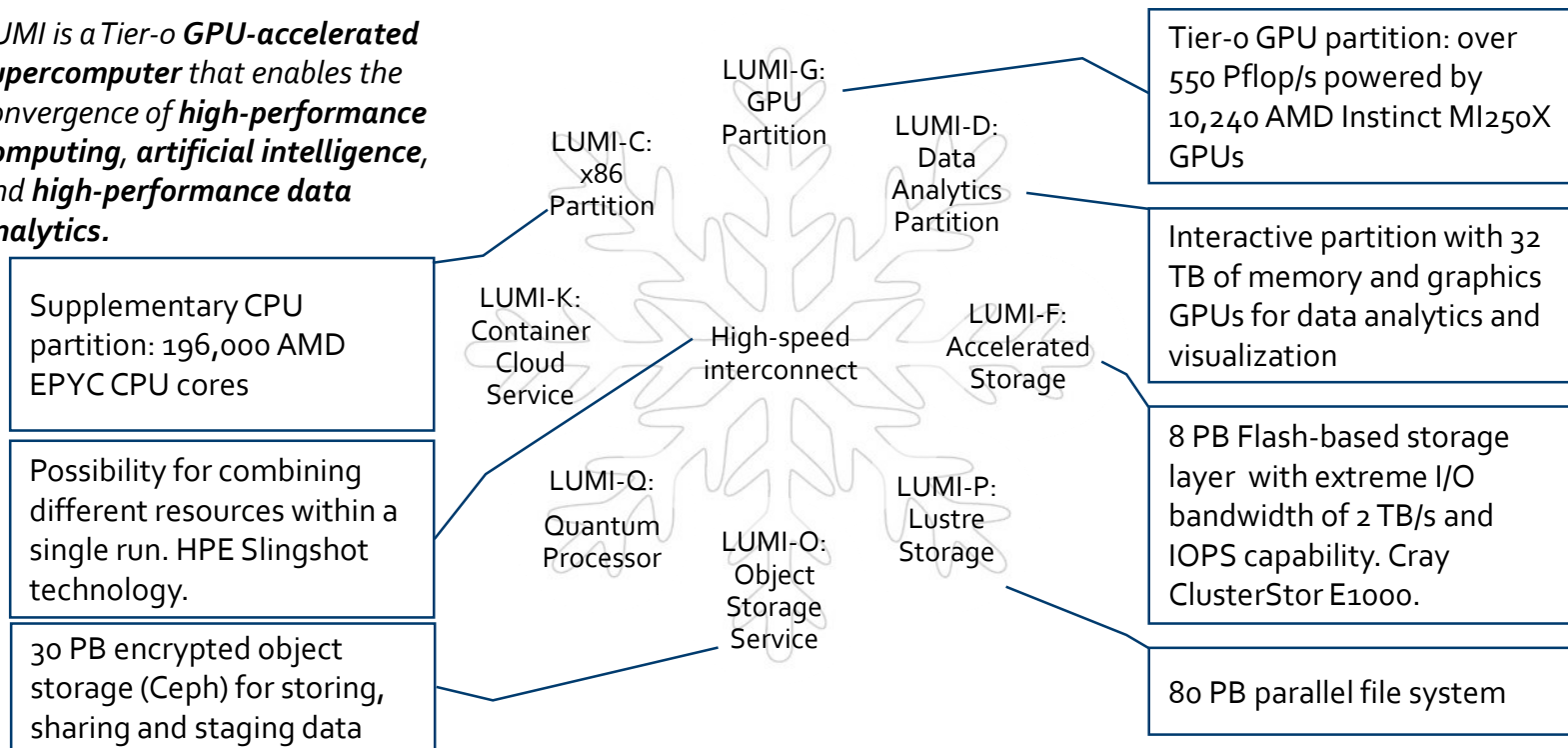




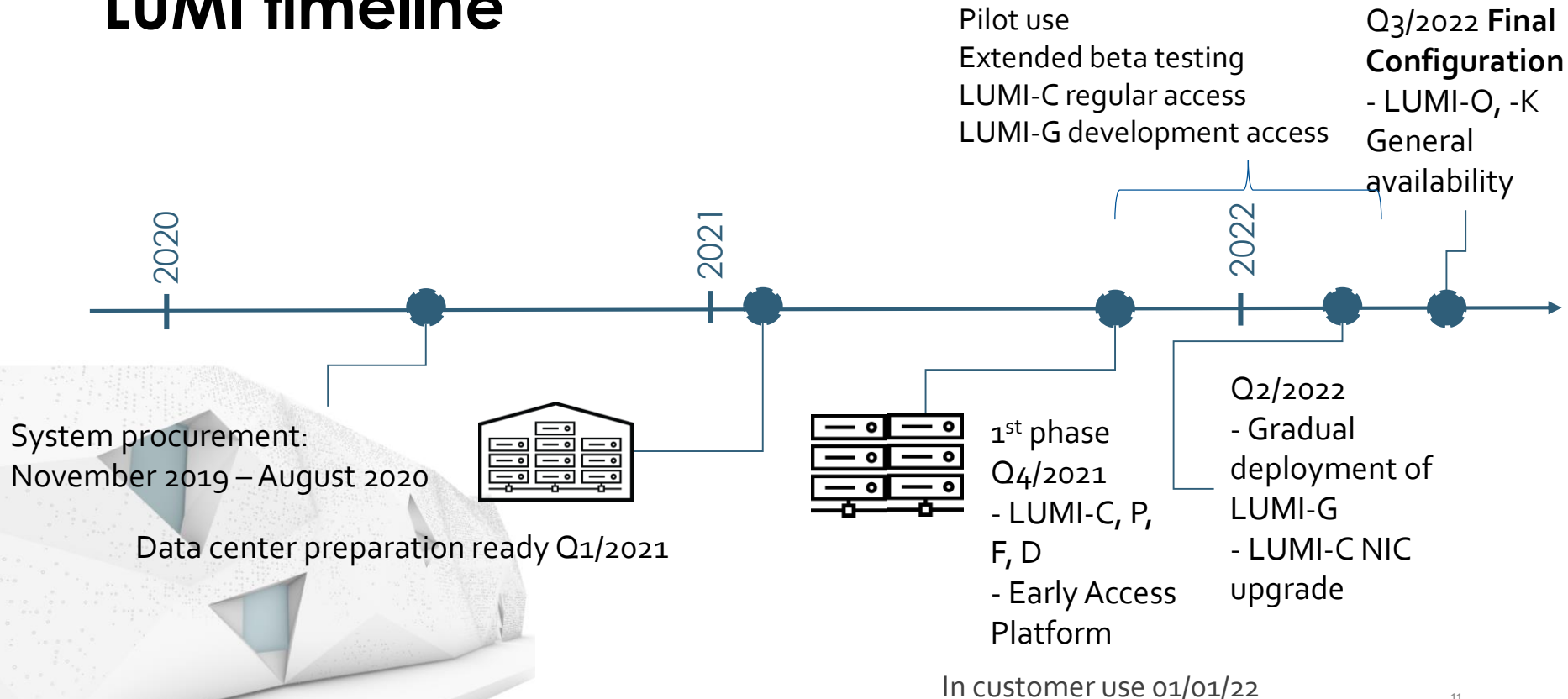
LUMI capabilities

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 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 (Q3/22)
- A rich stack of pre-installed software (Q2/22)
- Datasets as a Service: curated large reference datasets available and maintained (Q4/22)
- Support for handling sensitive (GDPR subjected, IP-closed, etc) data (Q2/23)

LUMI capacities, a brief summary

- Extreme computing capacity based on LUMI-G and LUMI-C partitions
- 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
- Deploying microservices on LUMI-K
- Exploring the quantum computing world with LUMI-Q

Getting LUMI resources

- European researchers can apply resources from the EuroHPC allocation or from national resources (if in LUMI consortium member country)
- LUMI resources are allocated in terms of GPU-hours, CPU-core-hours, and storage hours
 - Each project applies and is resourced a combination of these
 - 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 ownership
- 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

LUMI provides new opportunities for climate research

L U M I

- LUMI will be one of the computing platforms of **Destination Earth initiative** which aims to build digital twins of the Earth to support decision making
 - Two first priority digital twins will be on climate change adaptation and weather extremes.
- LUMI's extreme computing capacity enables
 - Multidecadal climate simulations at unprecedented resolution
 - Using AI/ML methods to accelerate climate models and for enhanced data-analytics
 - .. and more!

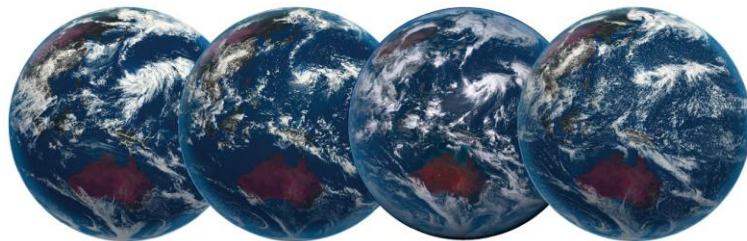


Image : Palmer & Stevens, PNAS, 2019.

Concluding remarks

- **EuroHPC era: Unprecedented amount of computational resources and capabilities** available for European research & innovation
- **LUMI, the Queen of the North:** leadership-class resource designed for a broad range of user communities and workloads, with an enhanced user experience
 - New opportunities also for climate research



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EuroHPC
Joint Undertaking



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Leverage from
the EU
2014–2020



Kainuun liitto