

# LUMI

A white wolf is the central focus, standing in a futuristic, blue-toned digital environment. The background is filled with vertical data streams, server racks, and glowing particles, creating a high-tech, cybernetic atmosphere. The wolf is looking slightly to the right of the camera.

**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



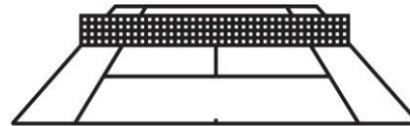
# LUMI: one of the fastest supercomputers in the world



- 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 CO<sub>2</sub> 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

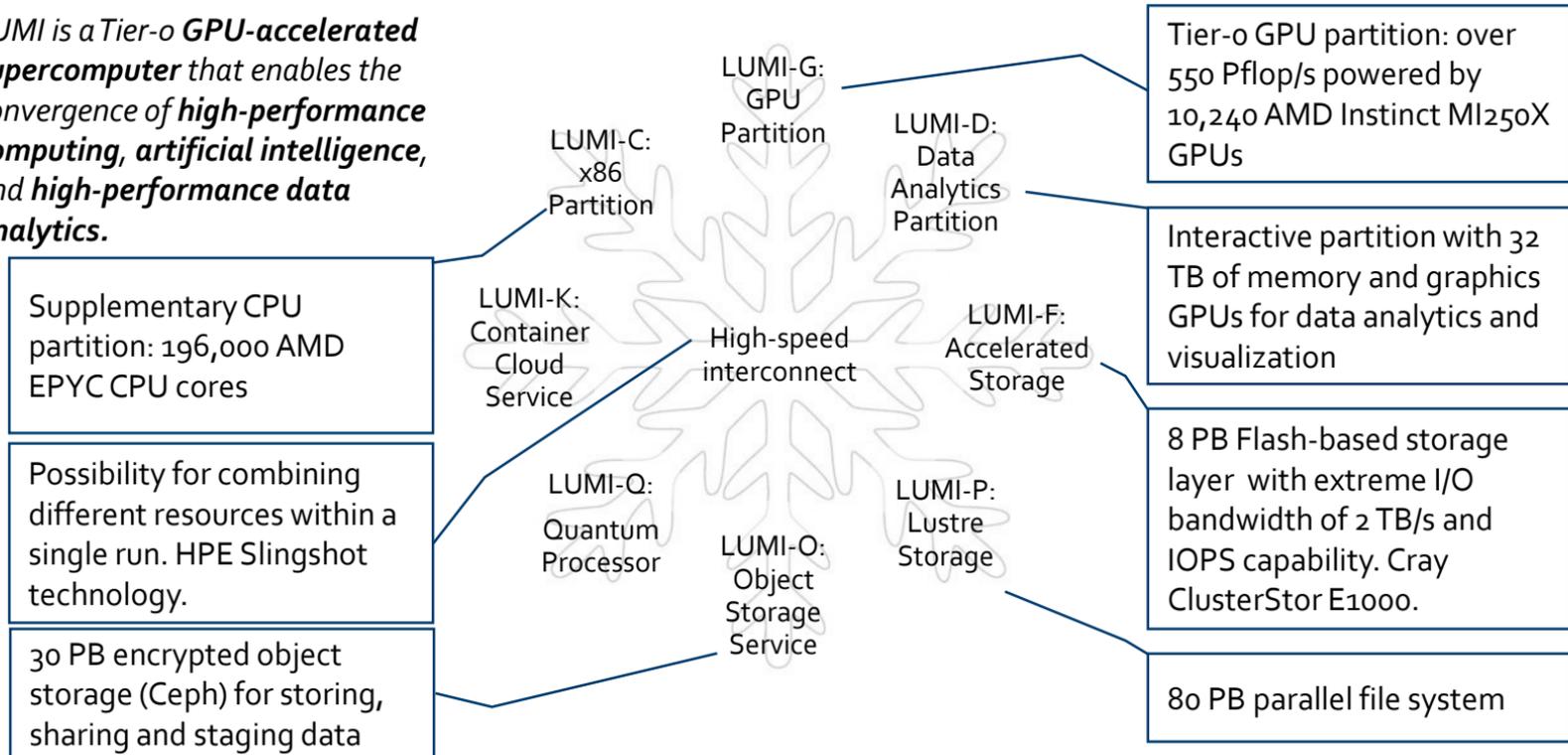




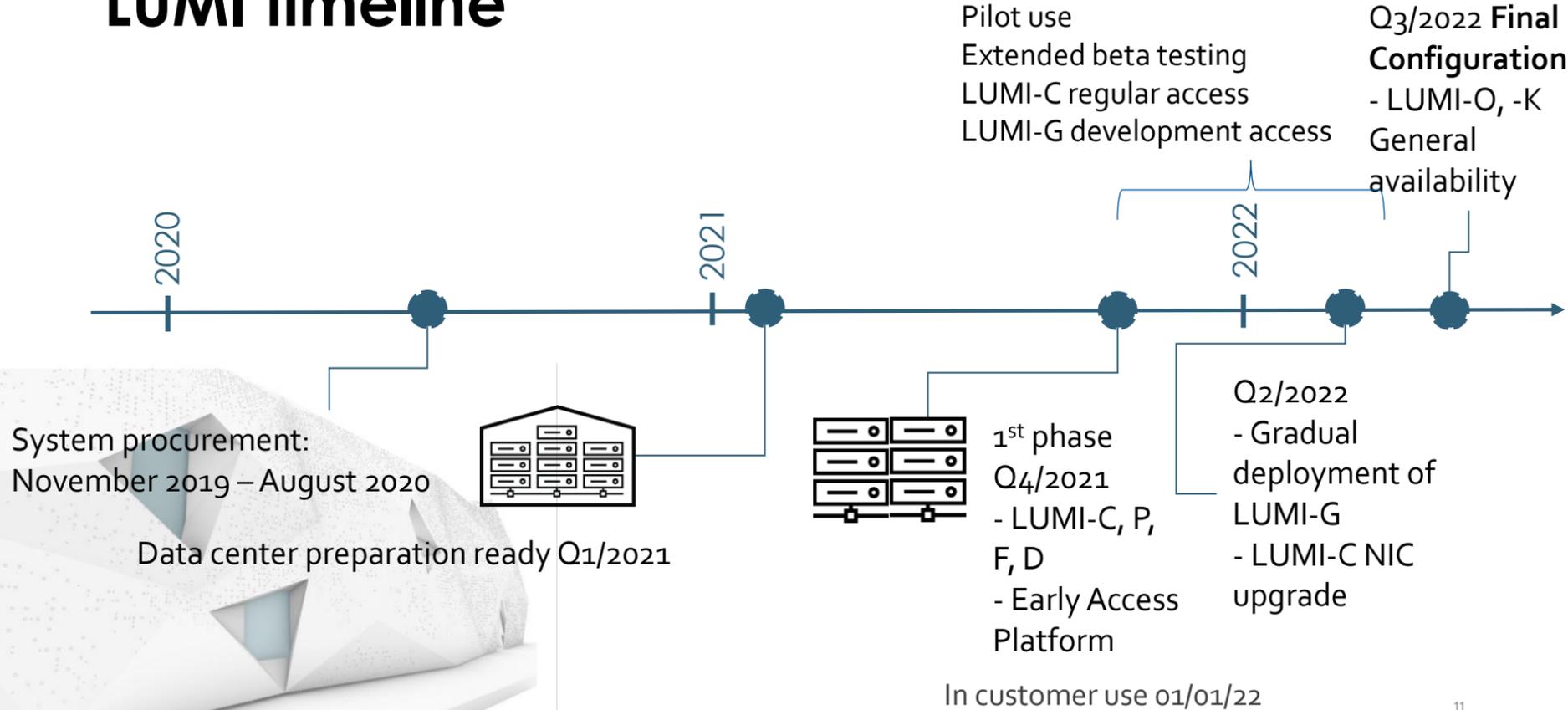
# LUMI capabilities

# 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

- 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

# LUMI



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**EuroHPC**  
Joint Undertaking



The acquisition and operation of the EuroHPC supercomputer is funded jointly by the EuroHPC Joint Undertaking, through the European Union's Connecting Europe Facility and the Horizon 2020 research and innovation programme, as well as the of Participating States FI, BE, CH, CZ, DK, EE, IS, NO, PL, SE.

Leverage from  
the EU  
2014–2020



**Kainuun liitto**