EUROEXA
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EuroEXA

Co-design, demonstration and evaluation using a rich set of exascale-class applications

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Project ID: 754337

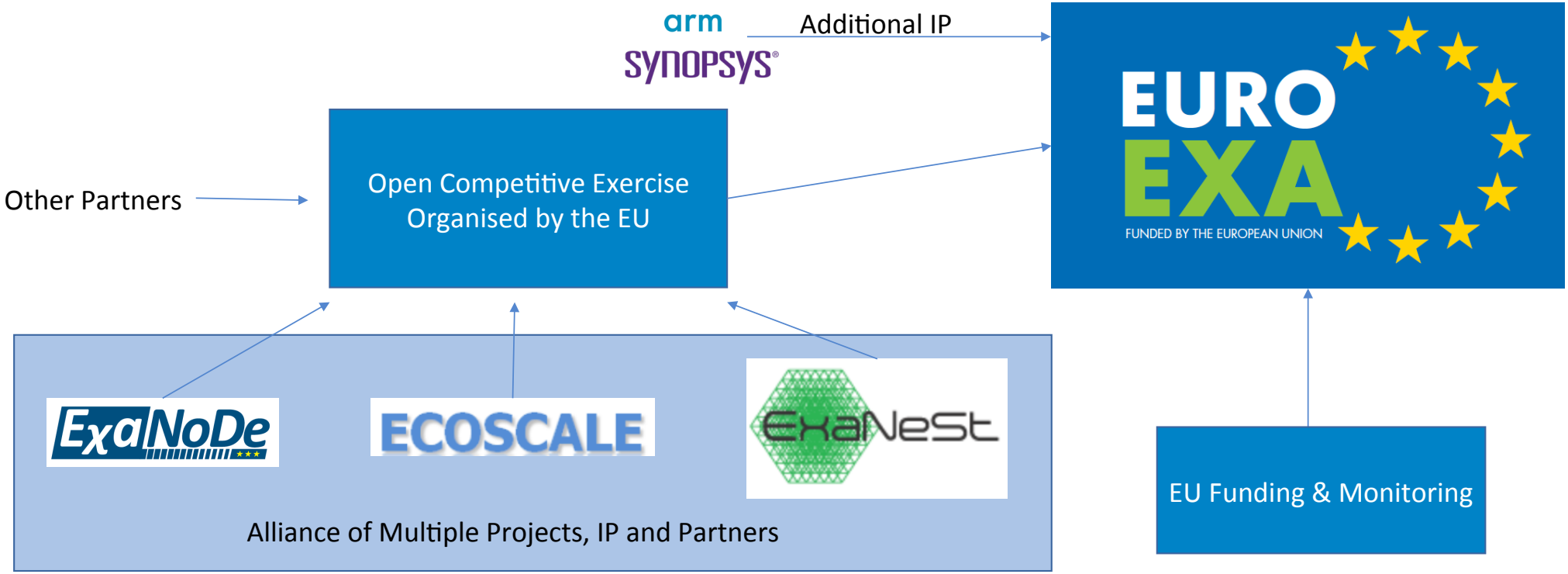
EURO EXA

EuroEXA

- Build on foundation from previous projects
- Co-design and demonstrate 1 PF+ testbed in operational environment

- Apply design flexibility of UNIMEM architecture
- *Aim* to deliver available performance to full-scale production applications
- Achieve balance between compute resources and demands of applications
- Technology is ARM multicore + FPGA for acceleration of apps and comms

What is EuroEXA?



EuroEXA partnership

Commercial Partners

ICEOTOPE

SYNELIXIS

arm

MAXELER Technologies
Maximum Performance Computing

ZeroPoint Technologies

Academic/Gov. Partners

ICCS

MANCHESTER 1824
The University of Manchester

INAF ISTITUTO NAZIONALE DI ASTROFISICA

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

imec

FORTH
FOUNDATION FOR RESEARCH AND TECHNOLOGY - HELLAS

Fraunhofer

Hartree Centre
Science & Technology Facilities Council

ECMWF

neurasmus
The Erasmus Neuroscience Company

INFN
Istituto Nazionale di Fisica Nucleare

Supporters

XILINX

SYNOPSYS
Silicon to Software

SKA
SQUARE KILOMETRE ARRAY

Met Office

cnag
centre nacional d'anàlisi genòmica
centro nacional de análisis genómico

janssen

NYU School of Medicine
NYU LANGONE MEDICAL CENTER

CRS4
IDEAS BECOME LIFE

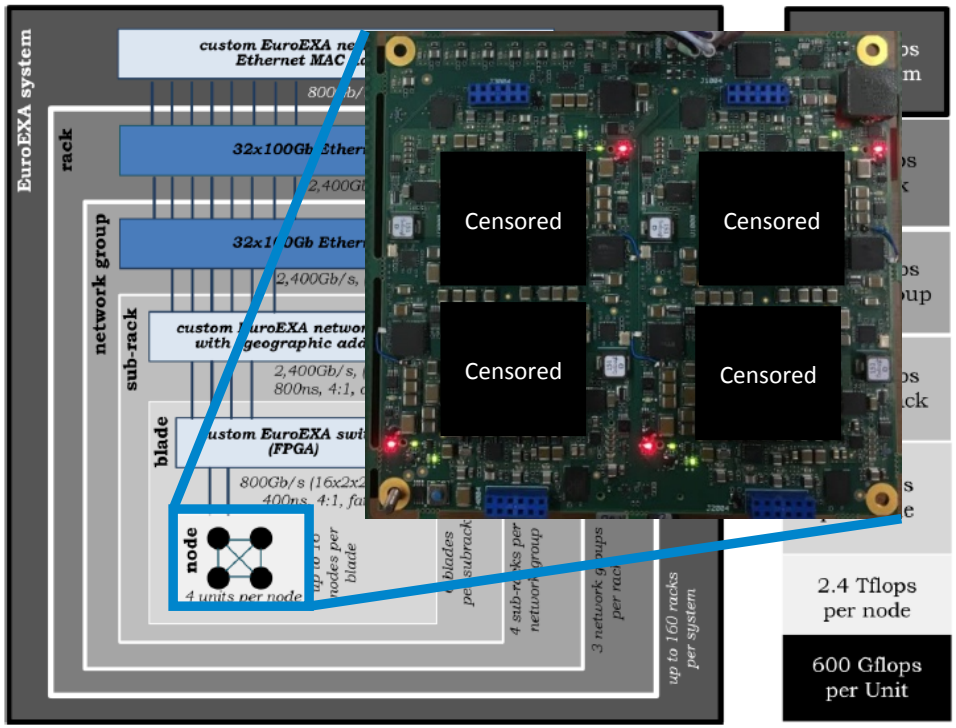
Schneider Electric

Noldus
Information Technology

SOLVAY
asking more from chemistry®

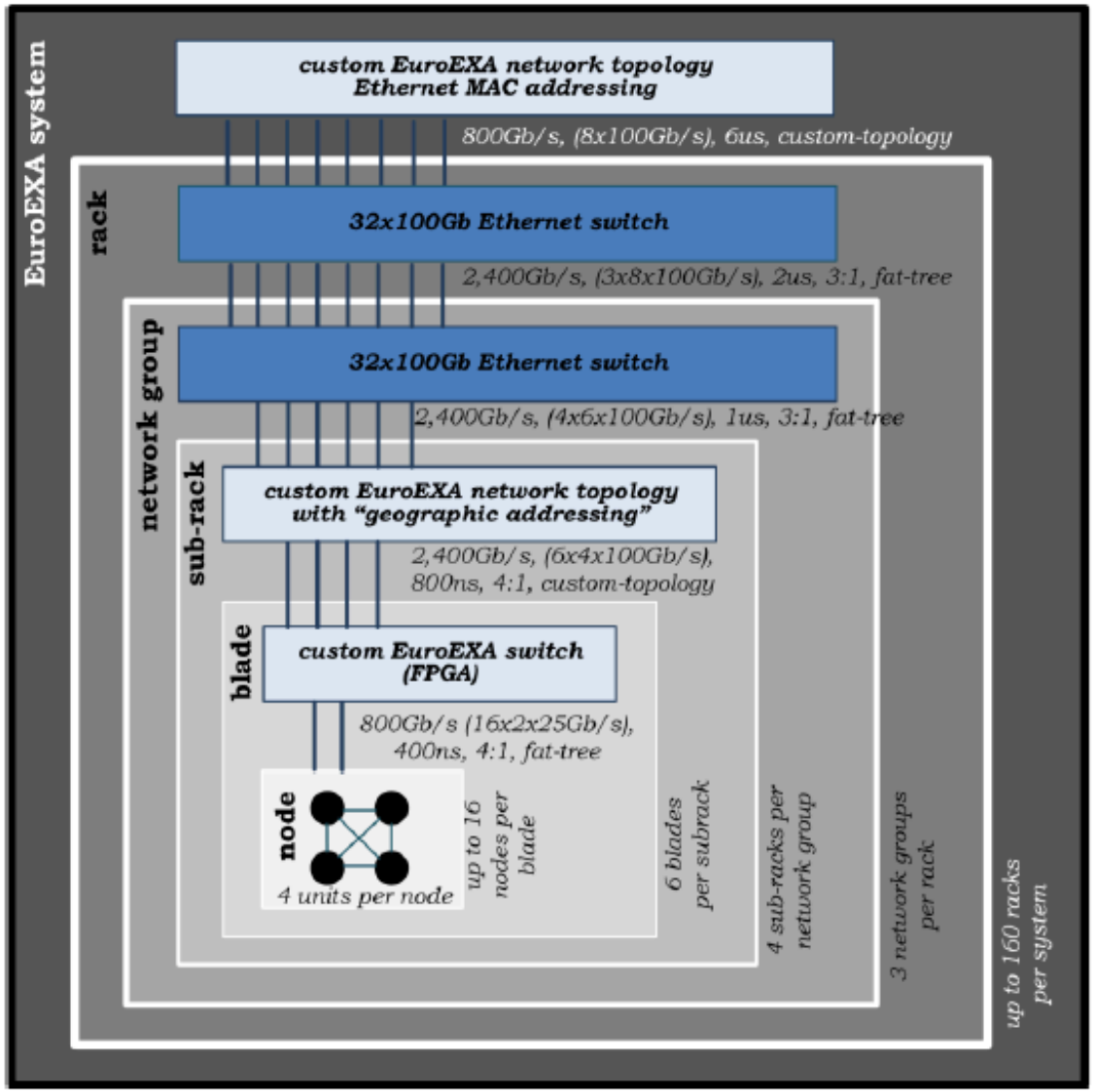
- September 2017 – February 2021 (3.5 years)
- Budget €20 M

System architecture and technology: Compute node



Technology from FORTH (QFDB board):

- 12 cm x 13 cm
- 4 ARM Processors and 4 FPGA Accelerators
- M.2 SSD
- 4 x SODIMMs + Onboard RAM
- Daughterboard style
- 160 Gb/s of I/O



400 Pflops per system

2.7 Pflops per rack

920 Tflops per netgroup

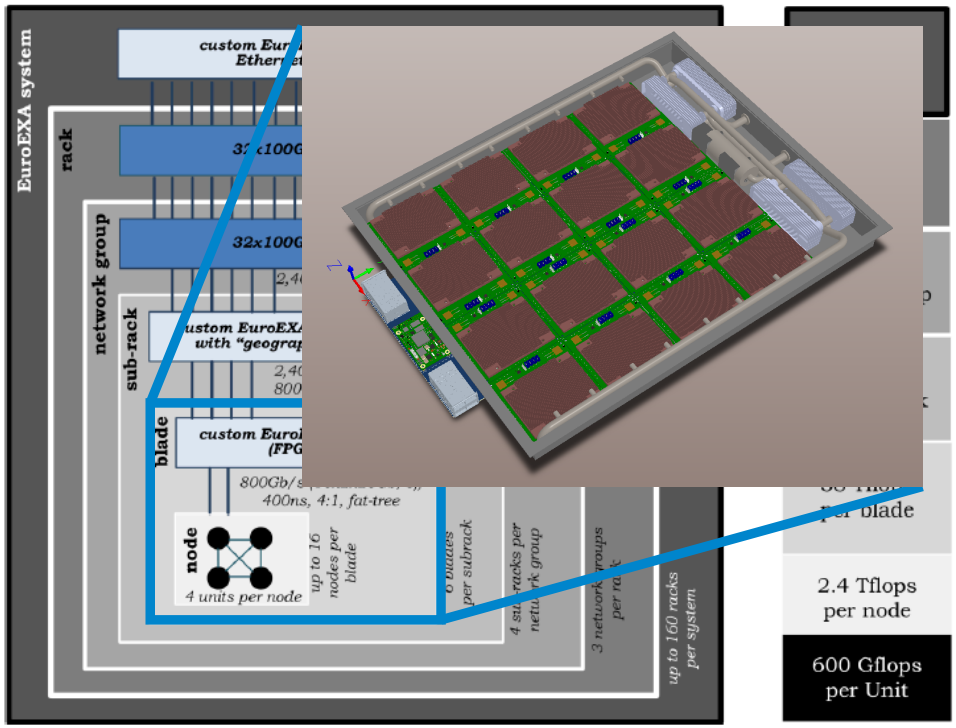
230 Tflops per subrack

38 Tflops per blade

2.4 Tflops per node

600 Gflops per Unit

System architecture and technology: Blades



Technology from Iceotope:

- 16 Node half depth 1u chassis
- 2 x 3.2 kW per u (back2back)
- Total Liquid Cooling technology
- 48 V DC distribution
- Hot water out, chiller-less operation

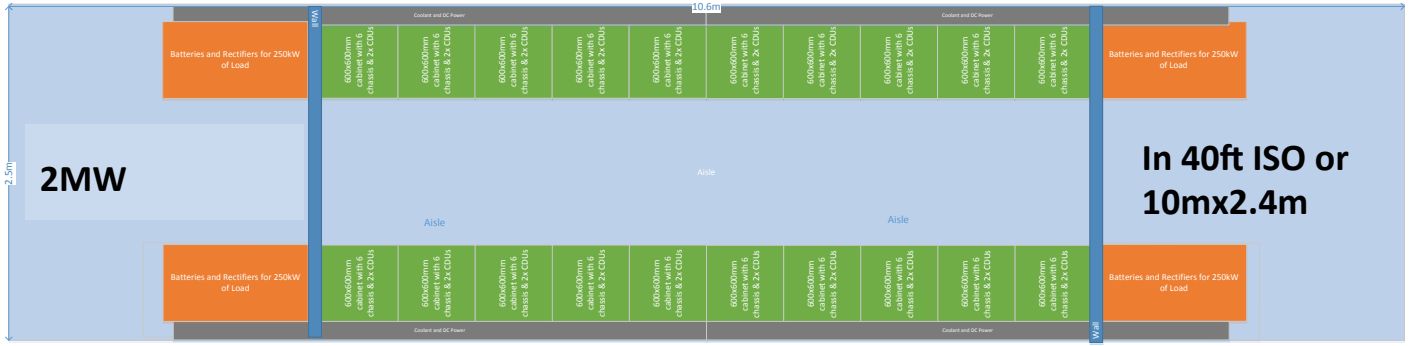

ICEOTOPE

Technology – Data Centre

Technology from Iceotope:

- Shipping Container Optimised Cabinets (2 rows)
- 2MW per shipping container
- Enables 3D stacking to minimise distances

By Hubert.Knop - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=29173440



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Our path: prototypes

- Three testbeds to be deployed at STFC, Daresbury

Testbed 1

50 nodes of new technology for **software development**

Testbed 2

500 nodes and new infrastructure technologies to **test scaling**

Testbed 3

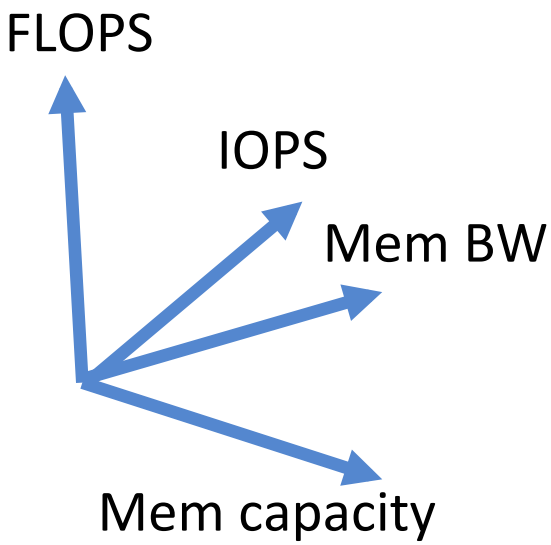
Test **new node and processor technologies** that will ultimately project to Exascale

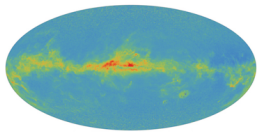
Mid 2018

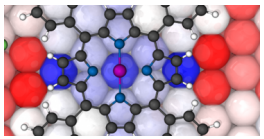
Late 2018/ early 2019

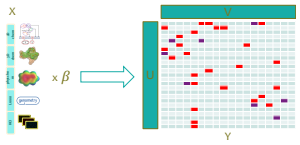
2020

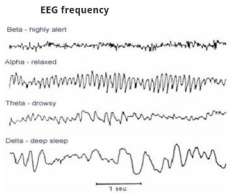
EuroEXA: co-design, demonstration and evaluation using exascale-class apps



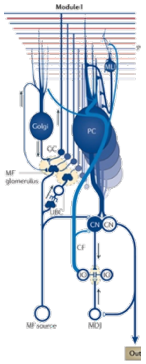

AVU-GSR


Quantum Espresso

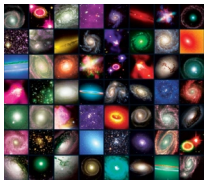

SMURFF

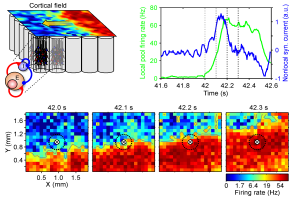


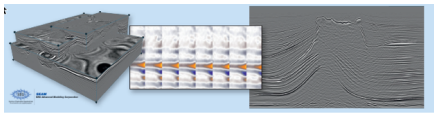
Neuromarketing

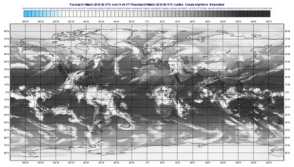

InfOli

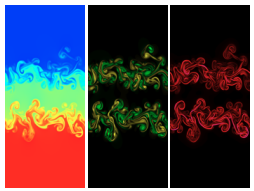

NEMO

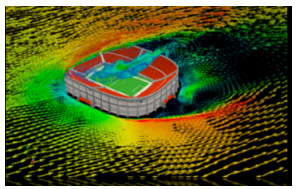

Astronomy image classification

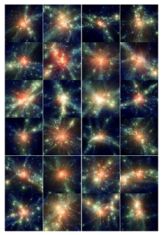

NEST/DPSNN

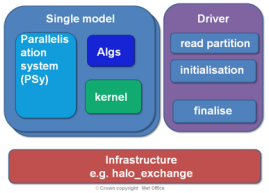

FRTM


IFS


LBM


Alya


GADGET



LFRic

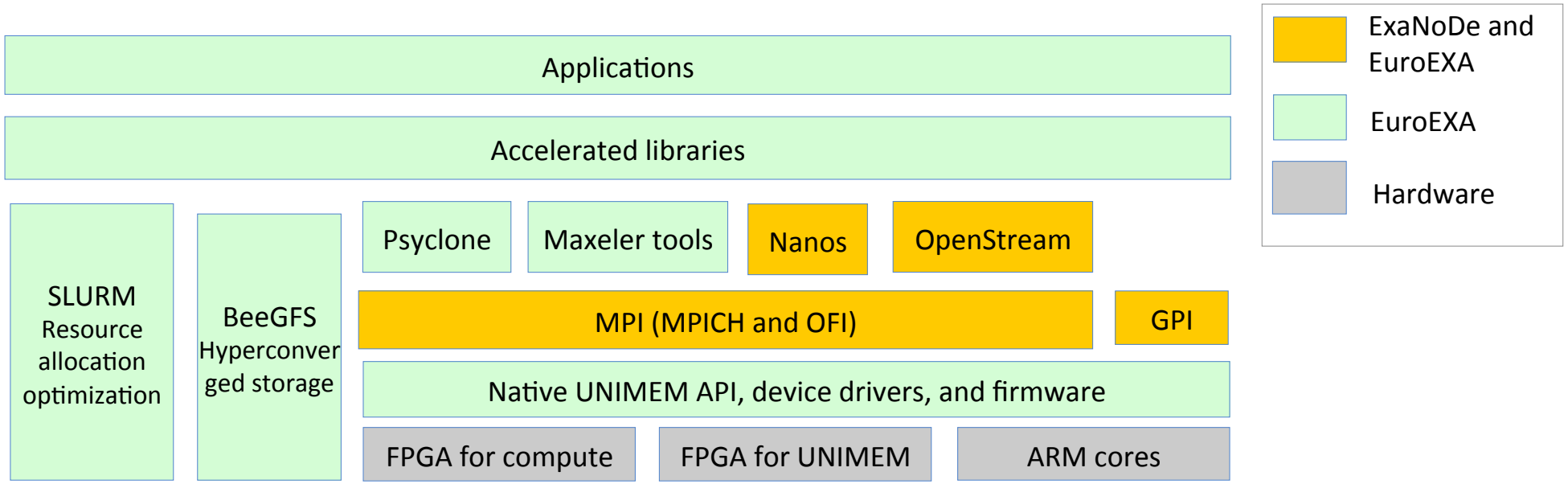
Why these 14 applications?

- Covers three important application domains
  - Climate and weather (LFRic, NEMO, IFS)
  - Physics and energy (LBM, Alya, GADGET, AVU-GSR, FRTM, Astronomy image classification)
  - Life science and bioinformatics (NEST, Neuromarketing, InfOli, Quantum E, SMURFF)
- All domains will require exascale computing in near future
- ALYA, GADGET, NEMO and Quantum ESPRESSO part of PRACE UEABS

EuroEXA programming environment

- Applications will target portable programming models / communication libraries
  - MPI, GPI (GAS programming Interface), Vivado HLS, OmpSs@FPGA, MaxJava, OpenCL (via SDSoC/SDAccel), OpenStream, and PSyClone
- Optimization for EuroEXA architecture done by programming environment
  - Building on the work in ExaNoDe project
  - Greater maturity, especially in FPGA support
  - Tuning and optimization through EuroEXA's full applications (cf ExaNoDe mini-applications)
    - Though work in Weather and Climate is focussed on kernels/mini-apps/dwarves currently
- Partners are currently porting to x86 clusters and Trenz boards / UltraScale+
- Will migrate to Testbed 1, 2 and 3 as available

EuroExa software stack… Building on ExaNoDe



Conclusions and vision

- First testbed architecture will be shown to be capable of scaling to world-class **peak performance in excess of 400 PFLOPS** with an estimated **system power of around 30 MW peak**
- Co-design, demonstrate and evaluate using **rich set of exascale-class applications**
- Demonstrate / make progress on FPGA-enabled applications
- Specifically, for Weather and Climate, looking at LFRic, NEMO and IFS