

# **BUILDING** THE FUTURE OF HIGH-PERFORMANCE COMPUTING

Installing the advanced x86 compute cluster at  
Deucalion supercomputer in Portugal

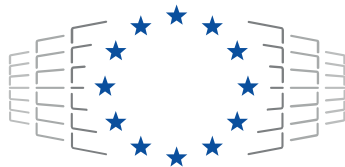
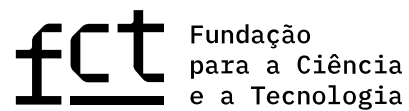
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## Case study partners

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# 01.

## Background

### **Building a cutting-edge HPC environment inside Deucalion**

University of Minho in Portugal hosts Deucalion supercomputer and is a renowned research hub known for its focus on advancing scientific research and technological innovation. With increasing demands for computational power to tackle complex simulations, large-scale data analysis, and AI-driven projects, Deucalion operations team with specialists from University of Minho, INESC TEC and FCT, through its digital services unit FCCN, faced the challenge of building a state-of-the-art high-performance computing (HPC) environment from scratch. To achieve this ambitious goal, Deucalion operations team needed a solution that seamlessly integrated various technologies while delivering exceptional performance.

Recognizing the need for expertise in designing and implementing advanced computing infrastructure, Deucalion operations team published a tender won by Fujitsu and Atos and requested the expertise of Exeliz and Do IT Now (formerly HPCNow!) with a strong reputation for their extensive experience and successful HPC installations, Do IT Now & Exeliz were chosen to play a key role in installing and configuring the x86 Compute Cluster, a critical component of the new high-performance computing environment.

# 02.

In focus

## x86 Compute cluster installation at Deucalion

The High-Performance Computing (HPC) cluster installation at Deucalion, installed at the University of Minho in Portugal, represents a major undertaking involving key industry partners such as Fujitsu, ATOS, Nvidia, and DDN. This case study highlights Do IT Now's role in the installation and configuration of the x86 Compute Cluster.



# 03.

Project summary

## Hybrid computing cluster installation with 10 petaflops capacity

This large-scale installation features a hybrid computing cluster with a total capacity of 10 petaflops, including more than 2,000 nodes. The project's size and the mix of x86, ARM and GPU technologies underscores the ambitious nature of this project. Do IT Now's extensive installation work from scratch highlights their expertise towards the integration of ARM and x86 technologies to achieve exceptional computing performance.

# 04.

## Project overview

# Unified x86 and ARM compute clusters for high-performance research

Deucalion supercomputer comprises three primary compute partitions: a x86 Compute Cluster, a GPU (x86 based) Compute Cluster, and an ARM Compute Cluster, each connected via its own InfiniBand (IB) network. Designed for high-intensity scientific research and data processing, these clusters operate as a unified system in terms of storage, user management, job scheduling and networking services.

## TECHNICAL BREAKDOWN

### Installing the x86 compute cluster



**Architecture:** Our team handled the comprehensive installation of the x86 Compute Cluster, encompassing over 500 nodes. This includes 533 compute nodes, with 33 of them equipped with GPUs to support tasks such as AI training and large-scale data analysis.

**Networking:** The x86 cluster is interconnected through a dedicated InfiniBand network, ensuring high-speed, low-latency communication essential for HPC workloads.

**Workload Management:** Do IT Now has implemented intelligent job routing via login servers, optimizing load balancing across the compute and GPU nodes to manage a variety of computational tasks. Additionally, Do IT Now has equipped all key servers with essential networking services such as DNS, NTP, HAProxy, SMTP, and SLURM, ensuring seamless system performance and efficient management.

## ARM COMPUTE CLUSTER

### A broader context for system architecture



**Architecture:** The ARM Compute Cluster, managed separately, includes 1,632 ARM-based nodes connected via an independent InfiniBand network. This cluster integrates with the overall system but operates independently from the x86 cluster.

## SHARED INFRASTRUCTURE AND STORAGE SOLUTIONS

**NAS shared storage:** Both x86 and ARM clusters utilize a 50TB Network-Attached Storage (NAS) device for centralized data management, facilitating seamless data exchange between the clusters.

**Lustre parallel filesystem:** The system features a 10PB DDN Lustre high-speed storage solution, mixing NVMe and rotational disks, ensuring rapid data access for efficient processing.

50  
TB NAS

10  
PB LUSTRE



### IMPACT ON USERS

#### Front-end and management systems

**Login servers:** Users interact with Deuca-lion partitions via login servers that manage job submissions and routing, ensuring optimal use of both x86 and ARM resources.

**Management nodes:** The management node oversees the deployment and management of the operating systems across the compute nodes, with Do IT Now & Exelix focusing on the x86 nodes.

**Virtualization servers:** Three VMware virtualization servers support virtual machine creation for different networking services like e-mail, time server, job database, etc.

## KEY OUTCOMES

**Enhanced computational power.** The successful deployment of over 500 x86 nodes, including GPU-accelerated systems, has substantially increased the center's capability to handle complex simulations and large-scale data analyses at Deucalion supercomputer.

**Seamless integration.** The robust Deucalion networking infrastructure, including a dedicated InfiniBand network, ensures high-speed, low-latency communication, facilitating optimal performance for diverse research applications.

**Streamlined management.** The implementation of intelligent workload management and essential networking services has optimized Deucalion system performance and provided a user-friendly experience for researchers and administrators.

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