EUROPEAN PROCESSOR INITIATIVE AND EU PROJECTS TOWARDS EXASCALE COMPUTING

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THE STRATEGIC INTERPLAY

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THE PRESIDENT OF THE EUROPEAN UNION HAS SET NEW AMBITIONS

SEPTEMBER, 16TH, 2020

Ursula Von Der Lyen
State of the Union
Brussels – September, 16th, 2020

- NextGenerationEU is also a unique opportunity to develop a more coherent European approach to connectivity and digital infrastructure deployment.
- None of this is an end in itself - it is about Europe's digital sovereignty, on a small and large scale.
- **We want the European industry to develop our own next-generation microprocessor** that will allow us to use the increasing data volumes energy-efficient and securely.
- This is what **Europe's Digital Decade** is all about!

https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_20_1655

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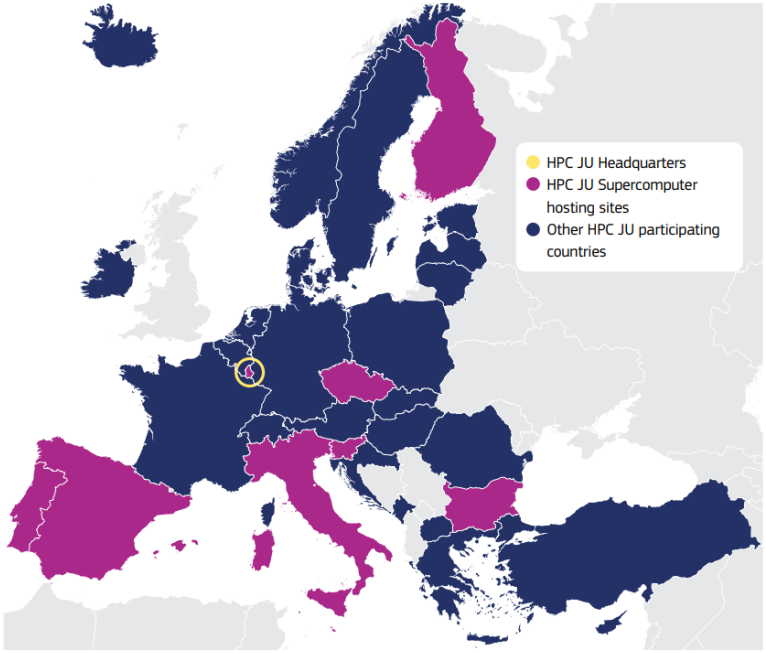
EU EXASCALE HPC STRATEGY

- March 2017, Rome: EC launched the ***EuroHPC declaration***
- November 2018, EuroHPC Joint Undertaking, a 1 billion Euro joint initiative between the EU and European countries to develop a World Class Supercomputing Ecosystem in Europe
- 13.7.2021.: EU Council established new EuroHPC JU
  - the 27 Member States, 6 other countries, 2 Private Members
  - €7 billion investment



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EUROHPC JU AMBITIOUS MISSION

- **Supercomputers**
  - reaching the next frontier of high-performance computing: the acquisition of exascale supercomputers
- **Interconnectivity**
  - interconnection through terabit networks of this supercomputing infrastructure, as well as in allowing access from the cloud to a large number of public and private users from anywhere in Europe
- **Applications for life**
  - further development of novel scientific and industrial applications
- **Skills and engagement with business**
  - increased investment in skills, education and training in the use of HPC, co-investment with industry in the acquisition of dedicated systems and in the development of large-scale industrial applications, creation of HPC Centres of Excellence
- **Technology activities**
  - the development of high-end European technologies, for example in the European Processor Initiative (EPI)

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DRIVERS OF THE EPI PROPOSAL

Societal challenges

- Climate change
- Cybersecurity
- Increasing energy needs
- Intensifying global competition
- Aging population
- Sovereignty (data, economical, embargo)

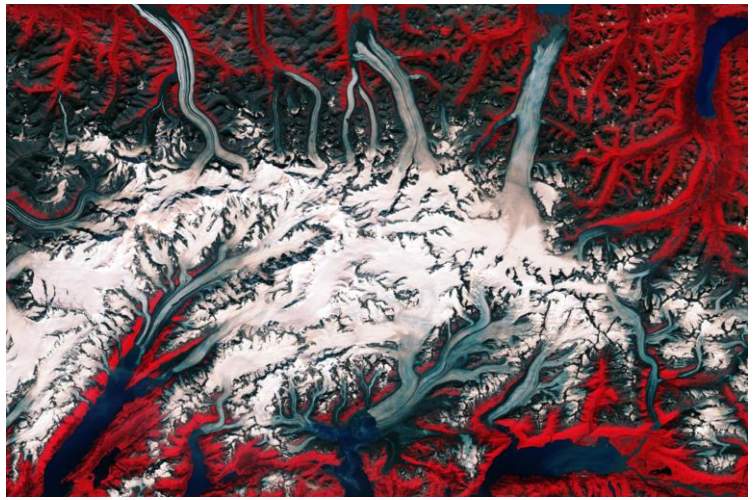

Image: https://www.compbiomed.eu/services/software-hub/

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DRIVERS OF THE EPI PROPOSAL

- Connected mobility & ***A**utonomous **D**riving computing needs beyond 2023*
- Develop customized processors able to meet the performance needed for autonomous vehicles that would offer:
  - implementation of vehicle perception tasks in real-time in a fail-operational manner
  - increased computing performance, fail-operational, functional safety, cyber-security and real-time behaviour (RT)
  - compute resources with the same characteristics as their “big brothers” in exascale class supercomputers
- Sovereignty (data, economical, embargo)
- EU car manufacturing supremacy

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28 PARTNERS FROM 10 EU COUNTRIES

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EPI OBJECTIVES

- **Overall: Develop a complete EU designed high-end microprocessor, addressing Supercomputing and edge-HPC segments**
- Short-term objective
  - supply the EU-designed microprocessor to empower the EU Exascale machines
- Long-term objective
  - Europe needs a sovereign (=not at risk of limitation or embargo by non-EU countries) access to high-performance, low-power microprocessors, from IP to products
- EPI has been set to fulfil this objective
- EPI has to cover all Technical Readiness levels (TRL)
  - TRL 1-3 are for long-term objectives (EU IP)

  and
  - TRL 4-9 are for short to mid-term objectives (decade) with products designed in EU

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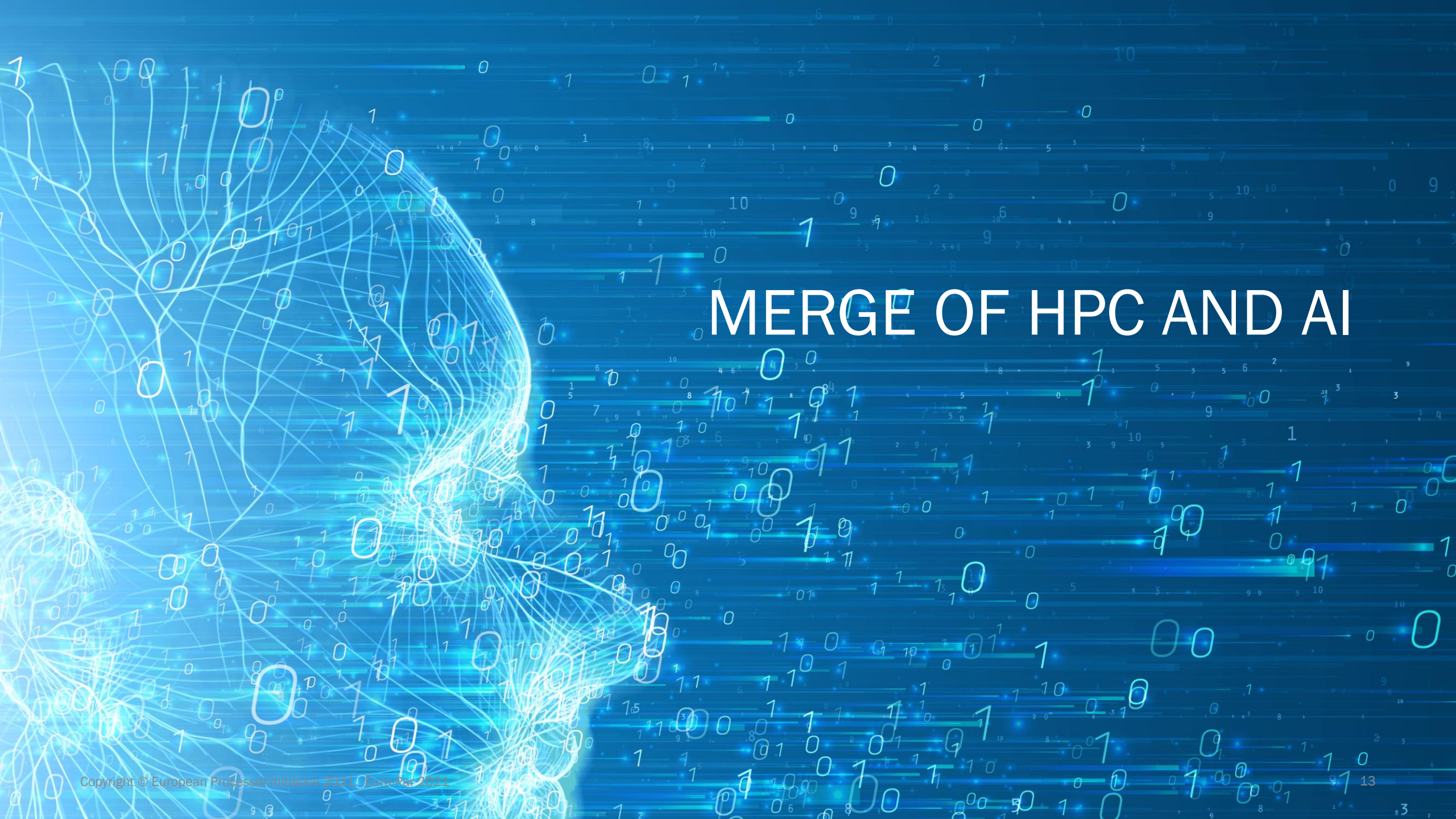

MERGE OF HPC AND AI

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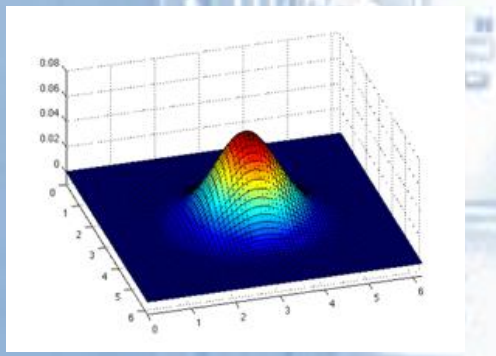
HPC BEFORE ARTIFICIAL INTELLIGENCE

Theoretical model → **HPC Application** → **Results**

$$\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2}$$

```
190           C
191                 PIN=0.02
192                 IF(DDT.NE.0.0)  THEN
193                 DT=DDT
194                 ELSE
195                 DT=PIN
196                 ENDIF
197                 WRITE(*,'(A)') '    PLEASE ENTER NAME OF OUTPUT FILE (FOR EXAMPLE
198                *  B:II.DAT)'
199                 READ(*,'(A)') FNAMEO
200                 OPEN(6,FILE=FNAMEO,STATUS='UNKNOWN')
201                 PV=WFLX/TH
202                 RS=NEQ*ROU*KD/TH
203                 CO=CS
204           C
205                 TIME=0.0D0
206                 EF=0.0D0
207               5 CONTINUE
208                 GAMMA=DT/(2.D0*DX*DX)
209                 BETA=DT/DX
210                 IF((BETA*PV).GT.0.5D0) GO TO 7
211                 IF((GAMMA*D/(BETA*PV)).LT.0.5D0) GO TO 6
212                 GO TO 8
213               6 DX=DX/2
214                 GO TO 5
215               7 DT=DT/2
216                 GO TO 5
217               8 CONTINUE
218                 N=COL/DX
219                 NM1=N-1
220                 NM2=N-2
221                 NP1=N+1
222                 GAMMA=DT/(2*DX*DX)
```



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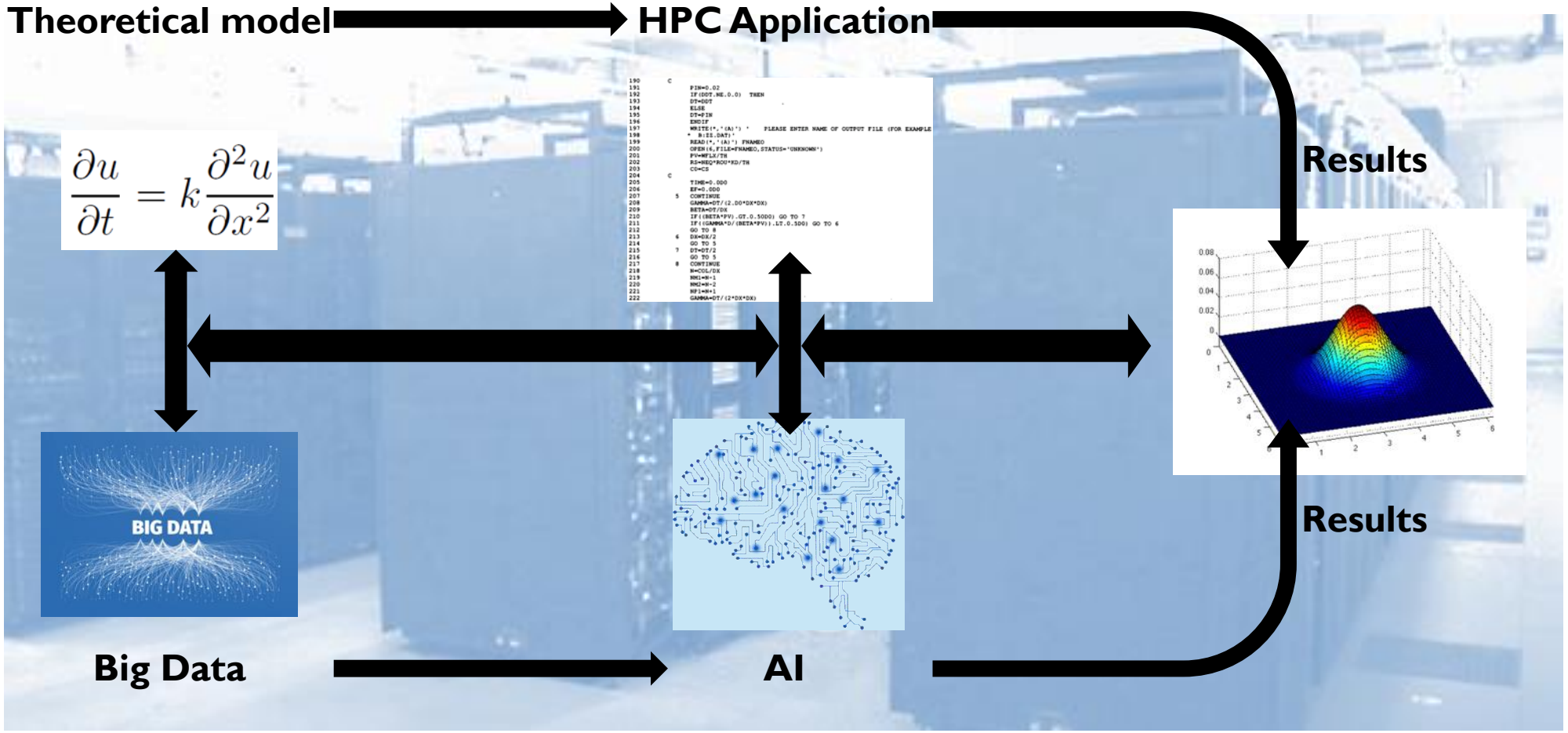
HPC WITH ARTIFICIAL INTELLIGENCE



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Cambrian explosion
Achieving performance through specialization
Courtesy Steve Scott
Cray CTO

TOP10 (GREEN) OVER THE LAST 10 YEARS

	2009 – Nov.	2014 – Nov.	2020 – Nov.	(Post) Exascale
CPU only	9	5	2	0
CPU + ACC.	1	5	8	10

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THE EPI TECHNOLOGY: COMMON PLATFORM

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GPP AND COMMON ARCHITECTURE

European Processor Initiative

ZEUS

(ARM)

CCIX (RHEA)
CCIX & CXL (CRONOS)

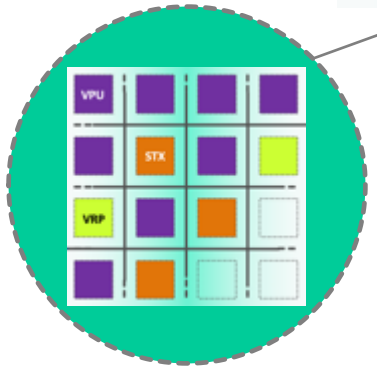
Kalray

Dedicated cryptographic IP

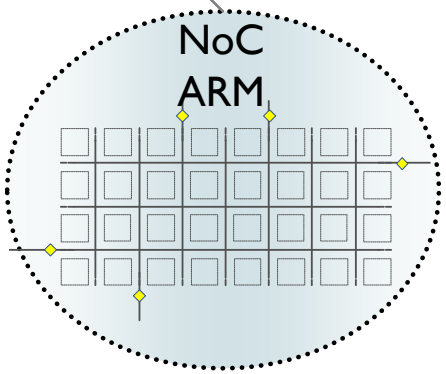
EPI Common Platform open vision is to integrate most of EPI IP's development

FPGA

Menta (FR)



NoC ARM



- Network on Chip (NoC) – ARM
- CPU – ARM – ZEUS
- EPAC – EPI Accelerator
- MPPA – Multi-Purpose Processing Array
- eFPGA – embedded FPGA
- Cryptographic ASIC (EU Sovereignty)
- Any other ASIC

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THE EPI TECHNOLOGY: ACCELERATORS

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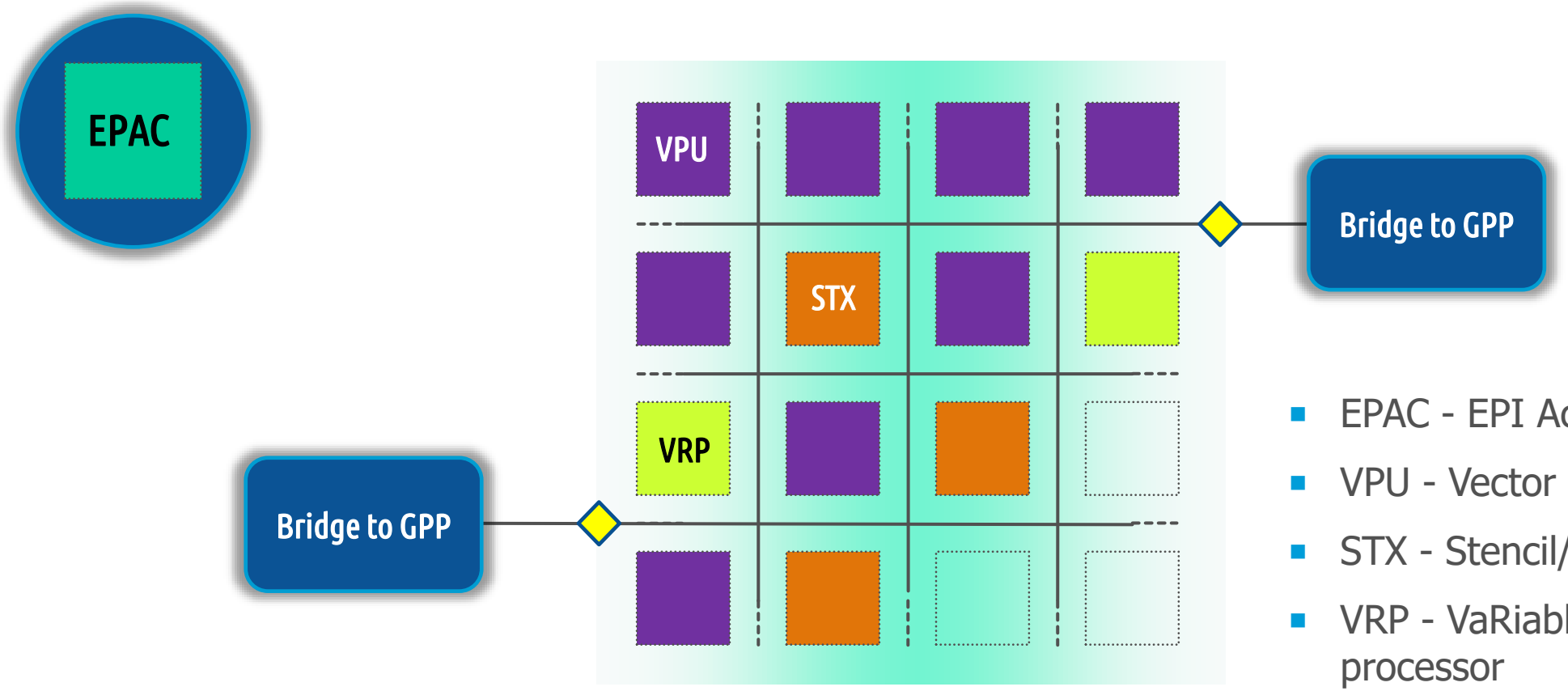
EPAC – RISC-V ACCELERATOR FOUNDATIONS



- EPAC - EPI Accelerator
- VPU - Vector Processing Unit
- STX - Stencil/Tensor accelerator
- VRP - VaRiable Precision co-processor

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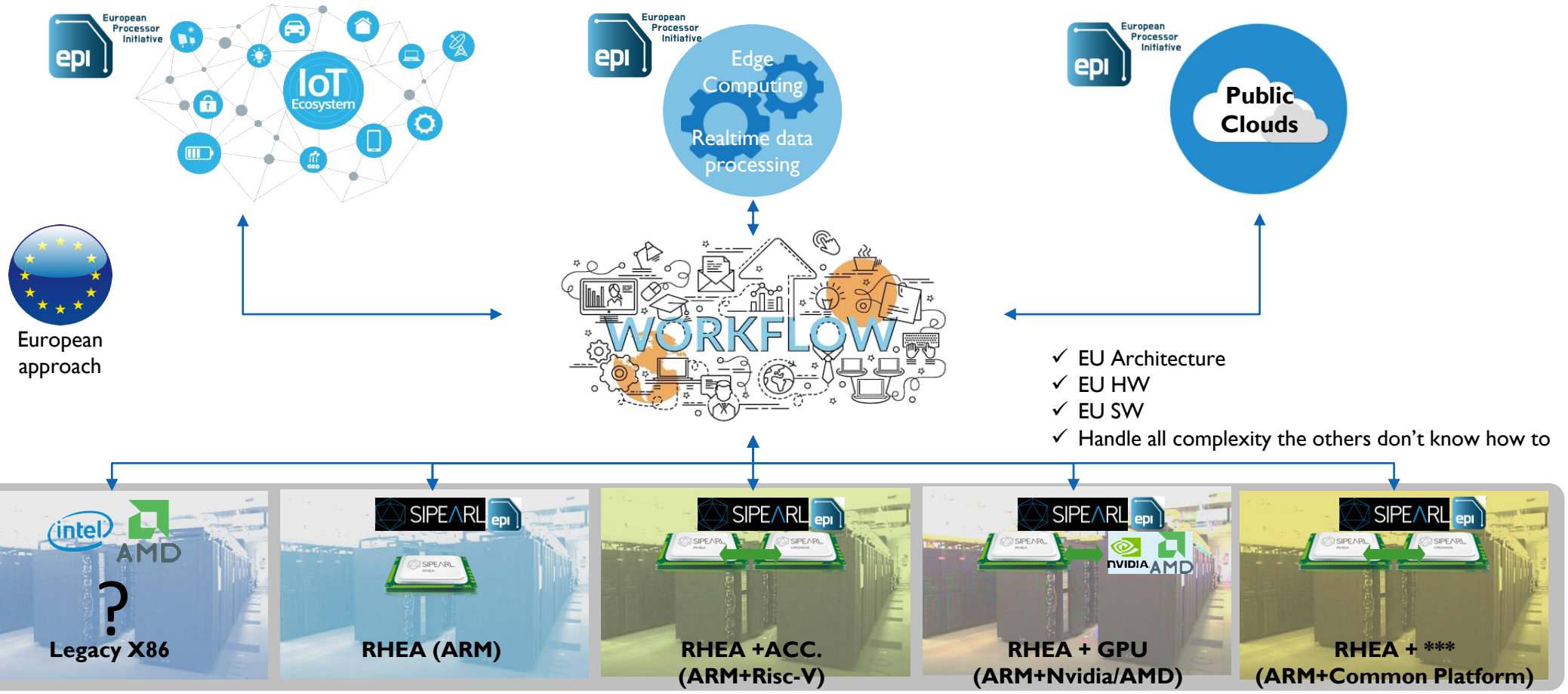
THE EPI EU APPROACH



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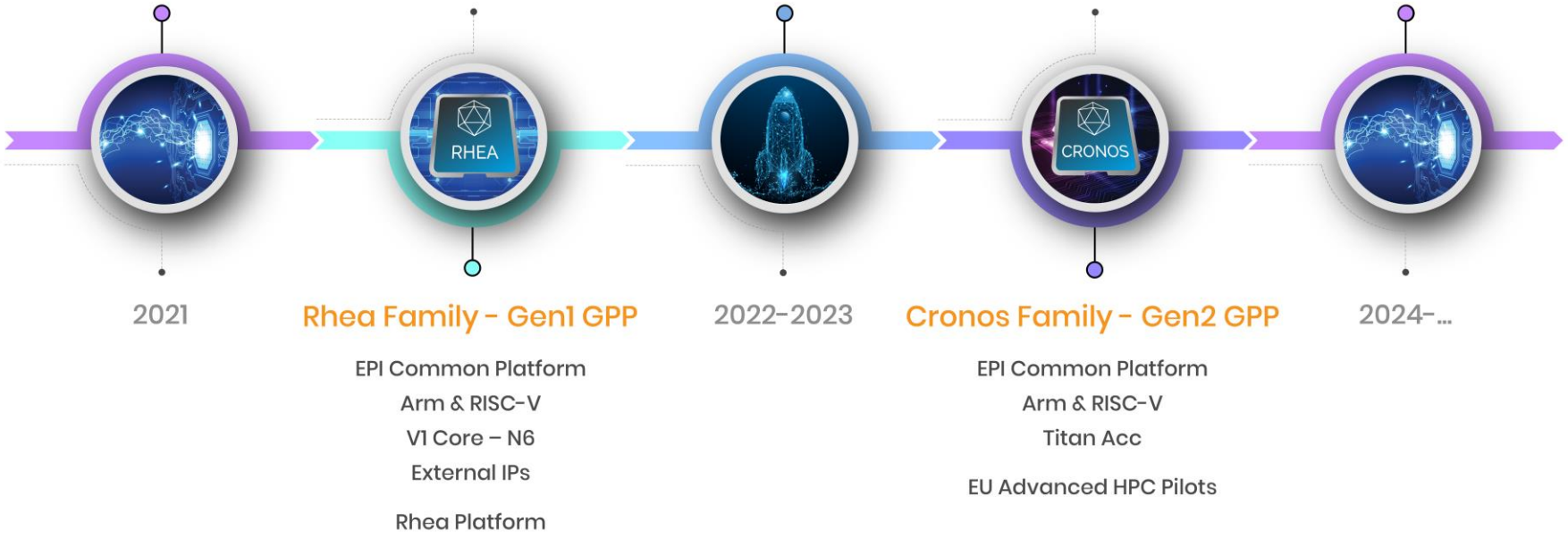
EPI ROADMAP



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TO CONCLUDE

- Use of HPC and AI is cornerstone of successful address of societal and global challenges
- Future science, technologies and applications require processing of vast amount of data and there is a large need for efficient HPC
- HPC provides needed competitiveness for industry and society
- The expertise for developing high-end and complex processing units in Europe, after decades of dis-investment
- The European Processor Initiative aims to provide an EU HPC processor, accelerators and system/application design for exascale HPC systems in Europe and around the globe

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