Neuromorphic Computing In the European HBP

Programmatic Aspects

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NICE2017, IBM, Almaden

Commission européenne

European Framework Funding Program Horizon 2020

Total Budget 2014- 2020 (project start dates) : 79 B€

- Excellence in Science : 24 B€
  - ERC (individual researchers) : 13 B€
  - Marie-Curie (mobility) : 6.1 B€
  - Infrastructures : 2.2 B€
  - Future Emerging Technologies (FET) : 2.7 B€
    - FET open : approx. 1.1 B€
    - FET proactive : approx. 0.8B€
    - FET flagships : approx. 0.8B€
      - Graphene : approx. : 0.4 B€
      - Human Brain Project : approx. : 0.4 B€
      - NEW : Quantum Technologies : ??
        - Neuromorphic : approx. : 0.025 B€

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

HORIZON 2020

Future Emerging Technologies actions are expected to initiate radically new lines of technology through unexplored collaborations between advanced multidisciplinary science and cutting-edge engineering.

HBP Neuromorphic Computing Systems will use brain-like principles of computing and architectures to achieve high-energy efficiency and fault tolerance, together with learning and cognitive capabilities comparable to those of biological organisms.

Funding and Contractual Structure of the HBP

Pilot Phase
12 months

Ramp-up phase
October 2013 – March 2018

Funded through
Framework Program 7

Specific grant agreement SGA1
Start April 2016 – March 2018

Specific grant agreement SGA2
Start April 2018 – March 2020
Currently under preparation

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Funded through
Horizon 2020

Project specific
Framework Partnersgip
agreement (FPA)
APPROVED

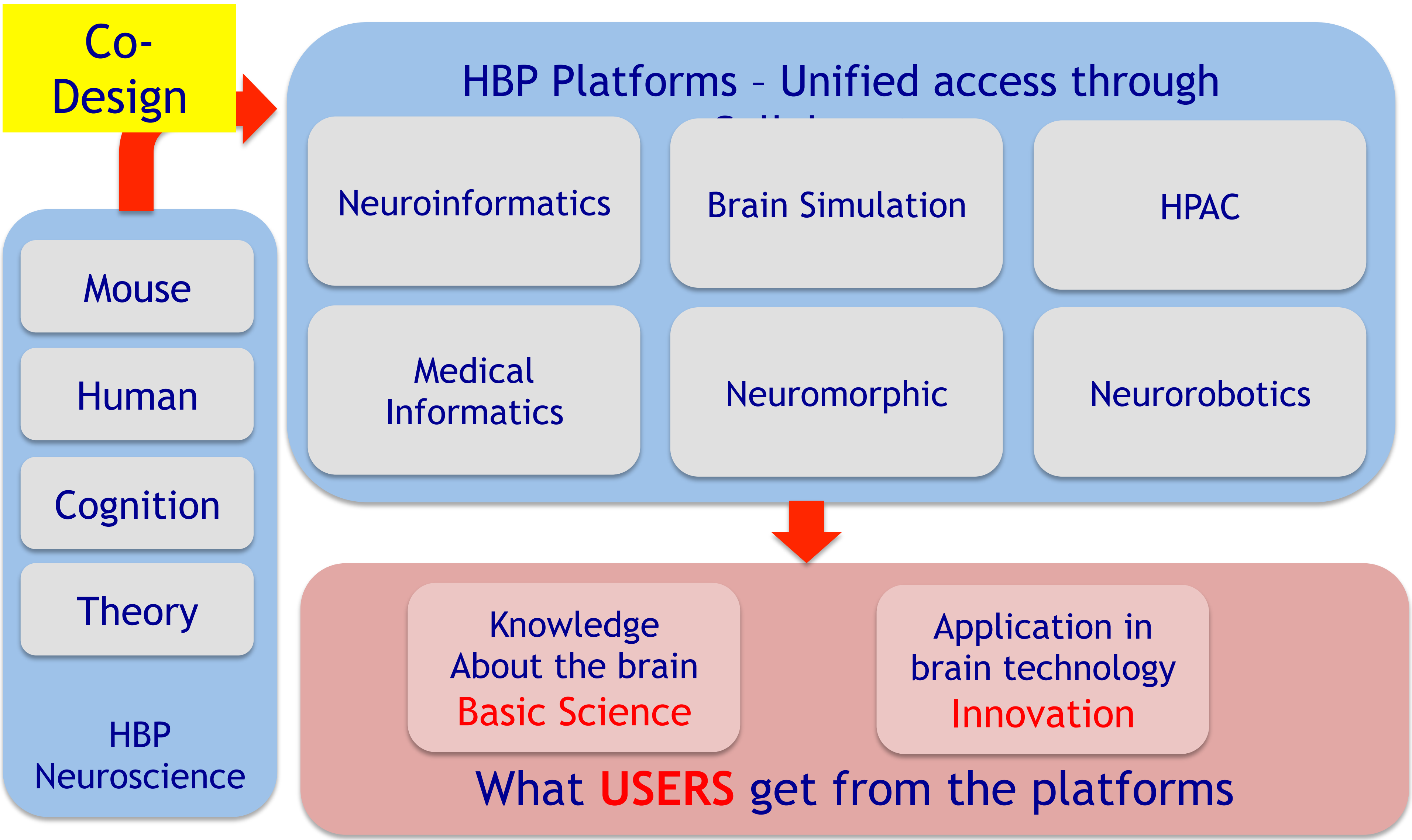
European Commission

FET FLAGSHIPS
Interim Evaluation

... likewise for the Human Brain Project, even though it is still at an early stage. Developments such as the neuromorphic computing architectures have scope for high economic impact ...

The basic idea of the Human Brain Project

From Science to Infrastructures to Science and Innovation



HBP Neuromorphic Computing Machines

MANY-CORE NUMERICAL MODEL SYSTEM

0.5 – 1 Million ARM processors – address-based, small packet, asynchronous communication – real-time simulation

Location : Manchester (UK)

PHYSICAL MODEL SYSTEM

Local analog computing with 4 Million neurons and 1 Billion synapses – binary, asynchronous communication – x 10 000 accelerated emulation

Location : Heidelberg (Germany)

HBP neuromorphic computing - The 1st generation

Concepts developed around 2005

... state-of-the-art ... Now doing the next step in HBP

SGA1: Proof of concept – SGA2: Operational 2nd generation systems

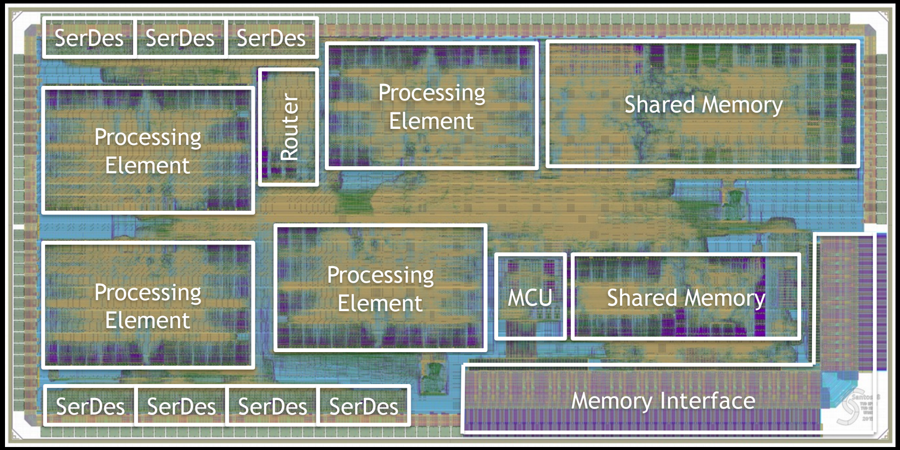
Next generation of NM computing in the HBP

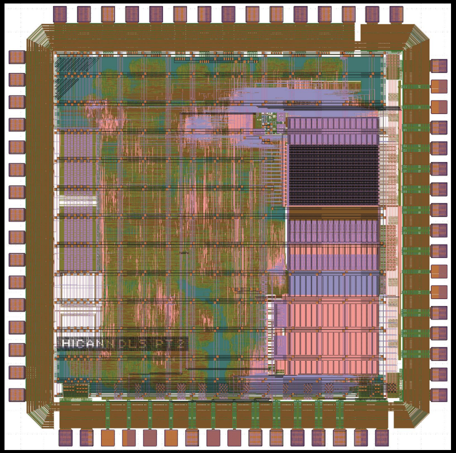
SpiNNaker-2

4-core Quad Processing Element
25 GIPS/W on a single die
Floating point precision
True random numbers

BrainScales-2

Flexible local learning
On-the-fly network reconfiguration
Structured neurons
Dendritic computation





Today : Working prototypes *2020 : Operational systems*

Overall goal : Learning cognitive machines

SP9

Organisation of work in NMC

OPERATION – MACHINES – PRINCIPLES - APPLICATIONS

9.1	Software services and platform op.	Andrew Davison	CNRS
9.2	Next generation BrainScaleS machine	Johannes Schemmel	Heidelberg
9.3	Next generation SpiNNaker machine	Steve Furber	Manchester
9.4	Computational principles	Wolfgang Maass	Graz
9.5	Applications and Benchmarks	Michael Schmuker	Hertfordshire
9.6	Management and training	Björn Kindler	Heidelberg
	Subproject leader	Karlheinz Meier	
	Subproject co-leader	Steve Furber	

Goal : Learning Cognitive Machines

FET FLAGSHIPS Co-funded by the European Union

The HBP Neuromorphic Computing Platform¶

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The Neuromorphic Computing Platform allows neuroscientists and engineers to perform experiments with configurable neuromorphic computing systems. The platform provides two complementary, large-scale neuromorphic systems built in custom hardware at locations in Heidelberg, Germany (the "BrainScaleS" system, also known as the "physical model" or PM system) and Manchester, United Kingdom (the "SpiNNaker" system, also known as the "many core" or MC system). Both systems enable energy-efficient, large-scale neuronal network simulations with simplified spiking neuron models. The BrainScaleS system is based on physical (analogue) emulations of neuron models and offers highly accelerated operation (10^4 x real time). The SpiNNaker system is based on a digital many-core architecture and provides real-time operation.

Presence of the HBP at NICE 2017

MON	K. Meier	The BrainScaleS physical model machine – From commissioning to real world problem solving
MON	E. Müller	DEMO Neuromorphic Hardware In The Loop: Training a Deep Spiking Network on the BrainScaleS Wafer-Scale System
TUE	S. Furber	SpiNNaker: Large-scale Real-time Neural Simulation
TUE	W. Maass	How Can Networks of Spiking Neurons Wire Themselves Up For a Specific Computational Task?
WED	J. Schemmel	Training and Plasticity Concepts of the BrainScaleS Neuromorphic Systems