FET European Projects Coordination Experience:
SHAPES (2006-2009) and EURETILE (2010-2014).

… a few hints about project preparation and initial phases.

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researcher – INFN Roma

coordinator – EURETILE and SHAPES FET projects

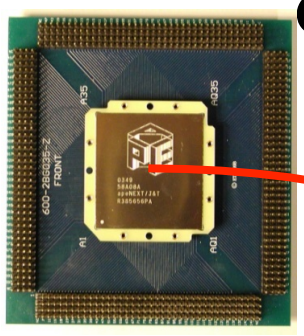
Personal background

- Research area: co-design of parallel/distributed hardware, system software and algorithms for numerical simulations/numerical signal processing
  - (since 1984) with the “masters” of APE: Nicola Cabibbo, Giorgio Parisi
- 1984-1997 INFN researcher @ APE lab: massively parallel hardware and software for numerical simulations: APE, APE100, APEmille
  - Several technology transfer actions / industrial applications
- 1997-2009:
  - 4 years detachment for technology transfer, then part-time INFN researcher)
  - founder of IPITEC then Chief Technical Officer of ATMEL Roma (silicon design center embedded digital signal proc.)
- European projects:
  - MAGIC-FIPU FP5 ESPRIT project - architecture responsible (1997-2001) (6M€ funding)
  - DIAM EUREKA project coordinator (2001-2005) (4M€ cost)
  - **SHAPES** FP6 FET project coordinator (2006-2009) (10M€ cost)
  - **EURETILE** FP7 FET proj. coord. (2010-2014) (5M€ funding, 1.6M€ INFN)
- 2010-2014 back to INFN as full-time researcher, EURETILE coordination

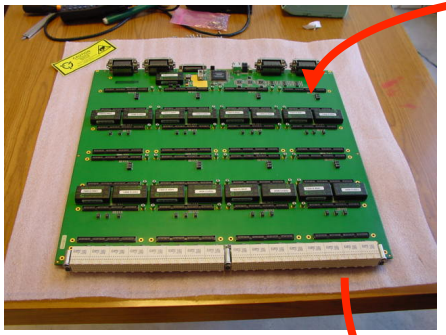
(2006) HW Background INFN
Numerical Massive Parallel Systems

Custom VLIW Asic

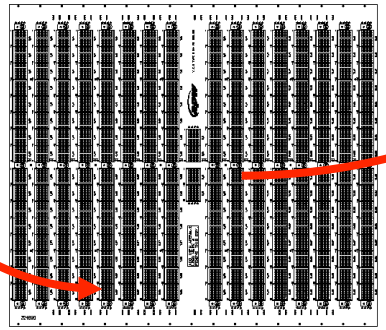
Distributed Mem



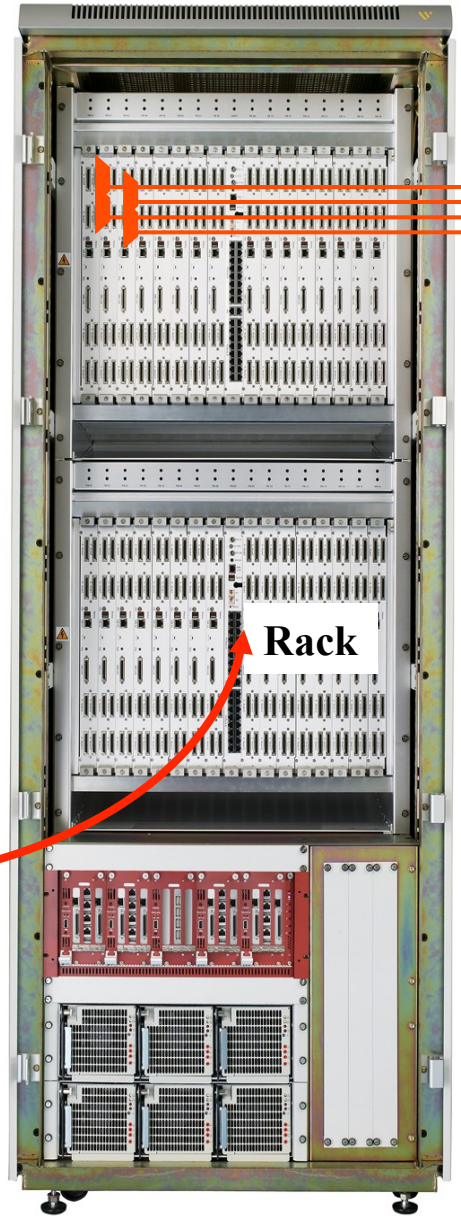
J&T module

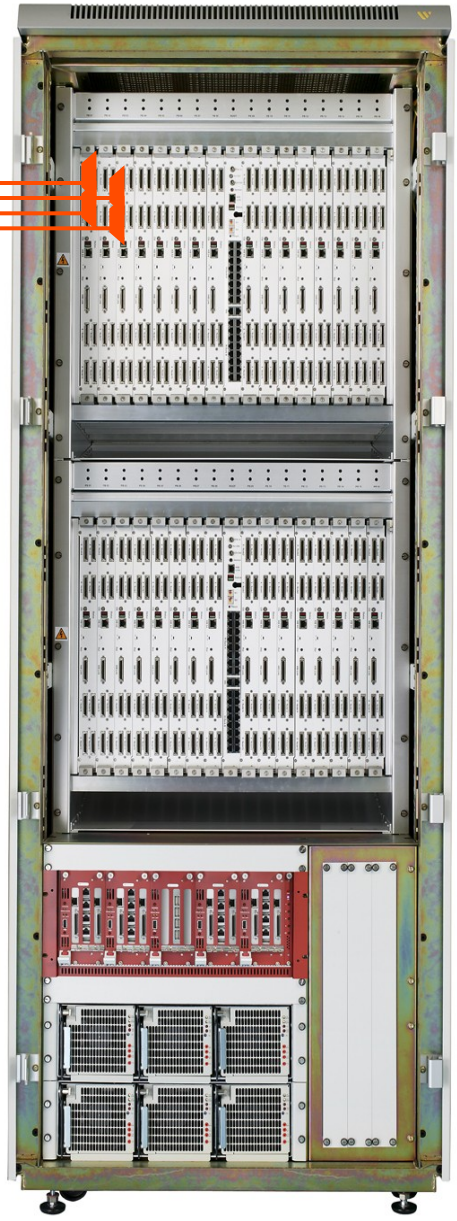


PB



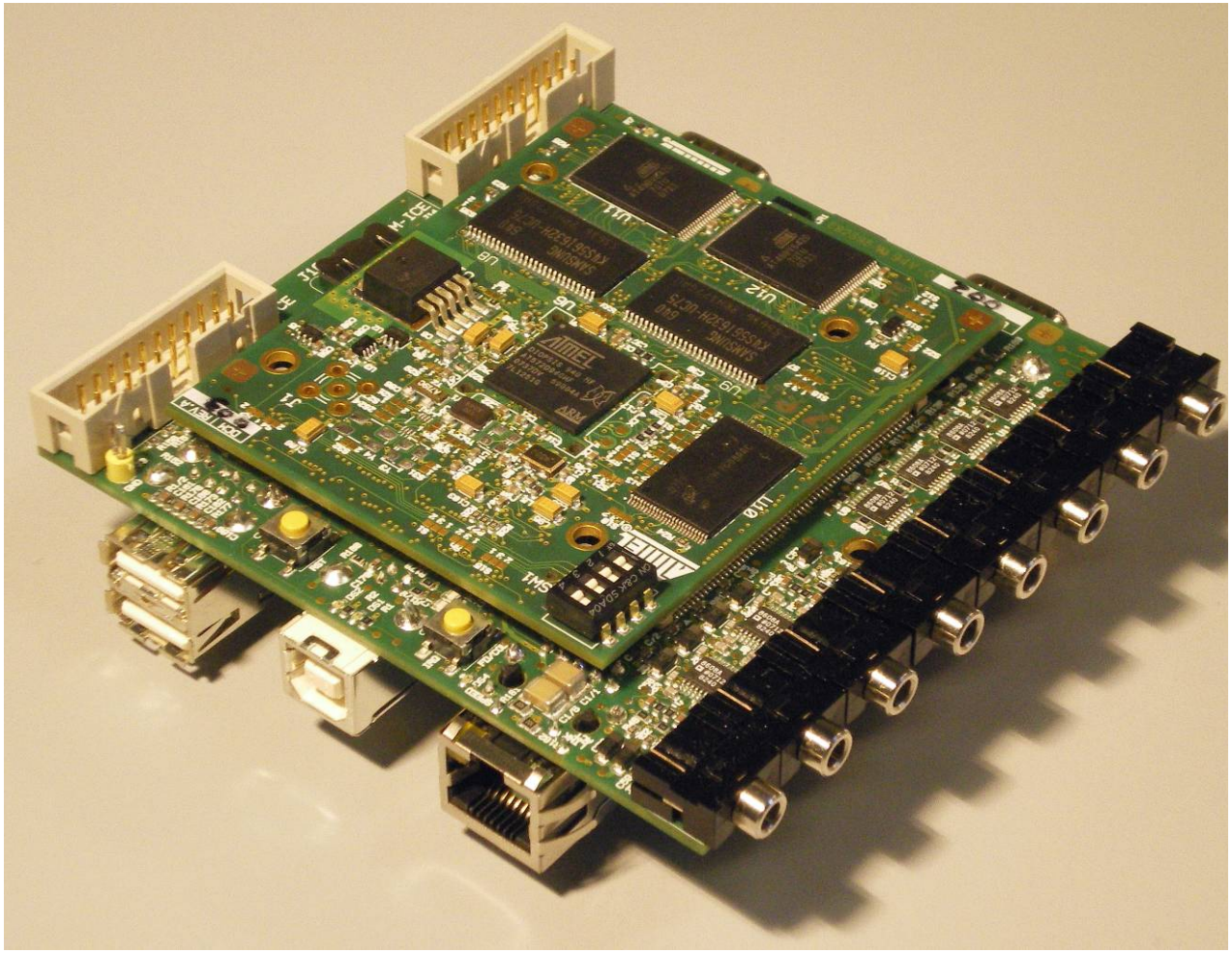
BackPlane





Rack

HW Background - Atmel Diopsis = RISC + mAgicV VLIW GigaFlops Numerical Processor MPSOC



- Multi-Processor tile
- Specific Processors for
  - Control (RISC)
  - Data Processing (mAgicV VLIW floating-point)
- SHAPES tile obtained adding the Distributed Network Processor

First example, coordination of 2006-2009 SHAPES FET-ACA project MULTI-TILE Architecture – 10 M€ cost

- Scalable SW HW Architecture Platform for Embedded Systems
- **Multi-Tile** distributed memory HW architecture
- **Each Elementary Tile** composed of **3 processors**:
  - Distributed Network Processor for inter-tile communications
  - RISC processor for control part/user interface
  - mAgicV Floating-point VLIW processor for DSP/numerical computation
- Holistic compilation-chain for DSP/numerical/data streaming applications
  - Application described by “network of processes”
  - Automatic mapping/binding on available resources
  - Automatic generation of Distributed OS
  - Simulation/execution provides quantitative feedback for automation of mapping/binding/OS generation
- 8 tile SHAPES simulator available
- HW RISC+VLIW computational tile **available on silicon**
  - **ATMEL Diopsis 940HF – development board on the market**

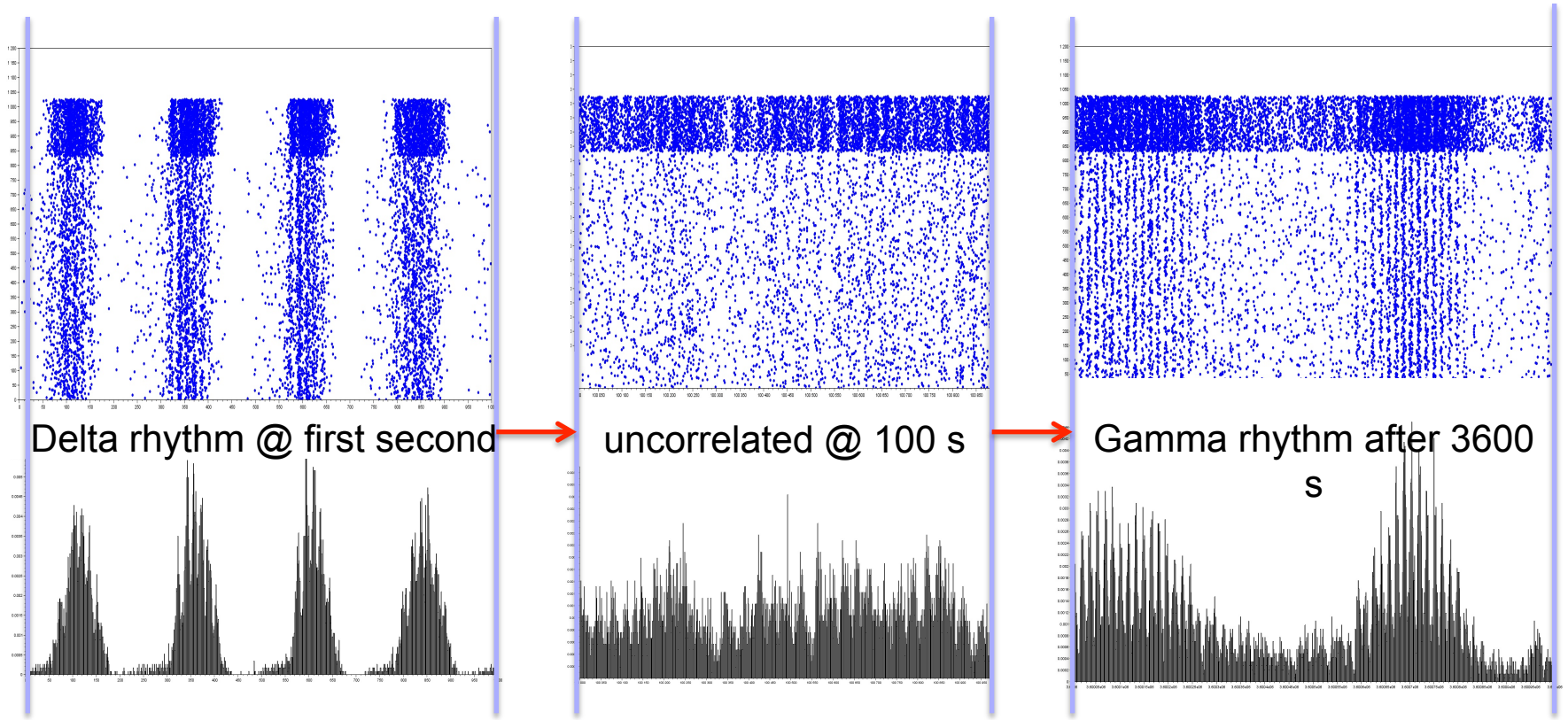
(2010-2014) Project Objectives and Expected Final Results

- **Objectives:**
  - investigate brain-inspired, foundational innovations to the software and hardware architecture of fault-tolerant and dynamic many-tile systems…
  - ... to be applied to those High Performance Computers and Embedded Systems and requiring numerical computations and Digital Signal Processing: e.g. Brain Simulation / Simulation of Large Scale Neural Networks, multi-media data-streaming applications
- **Expected Final Results: the project will deliver**
  - European Reference Experimental Platforms for the study of many-tile systems in the scenarios of Embedded Systems and HPC
  - A many-tile programming/optimization/simulation environment, to be applied to dynamic, fault-tolerant, many-process numerical/DSP applications, with foundational innovations
  - A set of application benchmarks, representative of both HPC and Embedded Systems domains, coded using the new programming environment, including a simulator of neural activity and synaptic plasticity and dynamic multi-media data streaming applications

The Consortium: Roles of Beneficiaries

- **INFN – coordinatin partner** (P.S. Paolucci - project coordinator, M. Giovagnoli,- administrative coordinator, P. Vicini, INFN key-person) / **TARGET Compiler Tech**
  - DPSNN: distributed simulator of neural activity and synaptic plasticity
  - Many-tile HPC HW Platform Prototype
  - DNP (Distributed Network Processor) HW IP
  - Cogeneration of ASIPs (Applic. Specific. Instr-set Proc) HW IP /SW Tools
- **ETH Zurich**
  - DAL/DOL Many-Process Dynamic/Hierarchical Programming/ Optimization/Mapping Environment
  - Multimedia/DSP/Embedded Systems Benchmarks
- **UJF-TIMA Grenoble**
  - Automatic Synthesis of Platform Dependent System SW/ Communication
- **RWTH-Aachen**
  - Scalable Embedded System Simulation/Debugging Platform

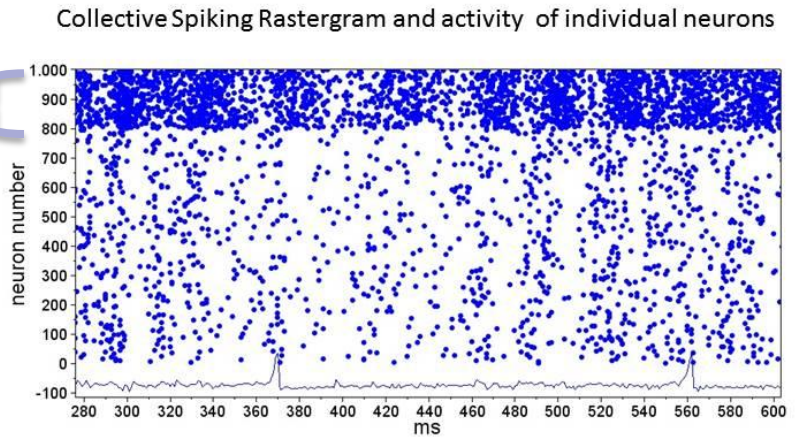
Emergent Biological Behaviour: Spontaneous Evolution of Rythmic Activity due to Polychronism and Synaptic Plasticity

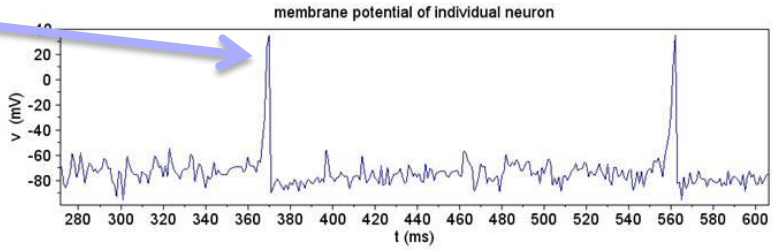


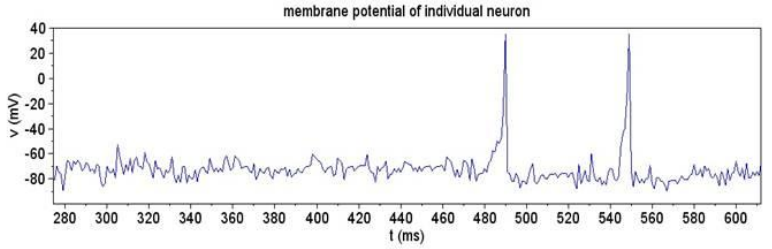
- As synaptic weights evolve according to STDP (synaptic spike-timing dependent plasticity, initial **delta** frequency oscillations (2-4 Hz @ first second activity) dissolves for a while into **uncorrelated** Poissonian activity (activity @ 100 seconds) and then **gamma** frequency activity emerges (30-100 HZ @ 3600 seconds)

DPSNN-STDP simulates Spiking Activity and Synaptic Plasticity (already proved from 100 K up to 6.6 Giga synapses, from 1 to 128 software processes)

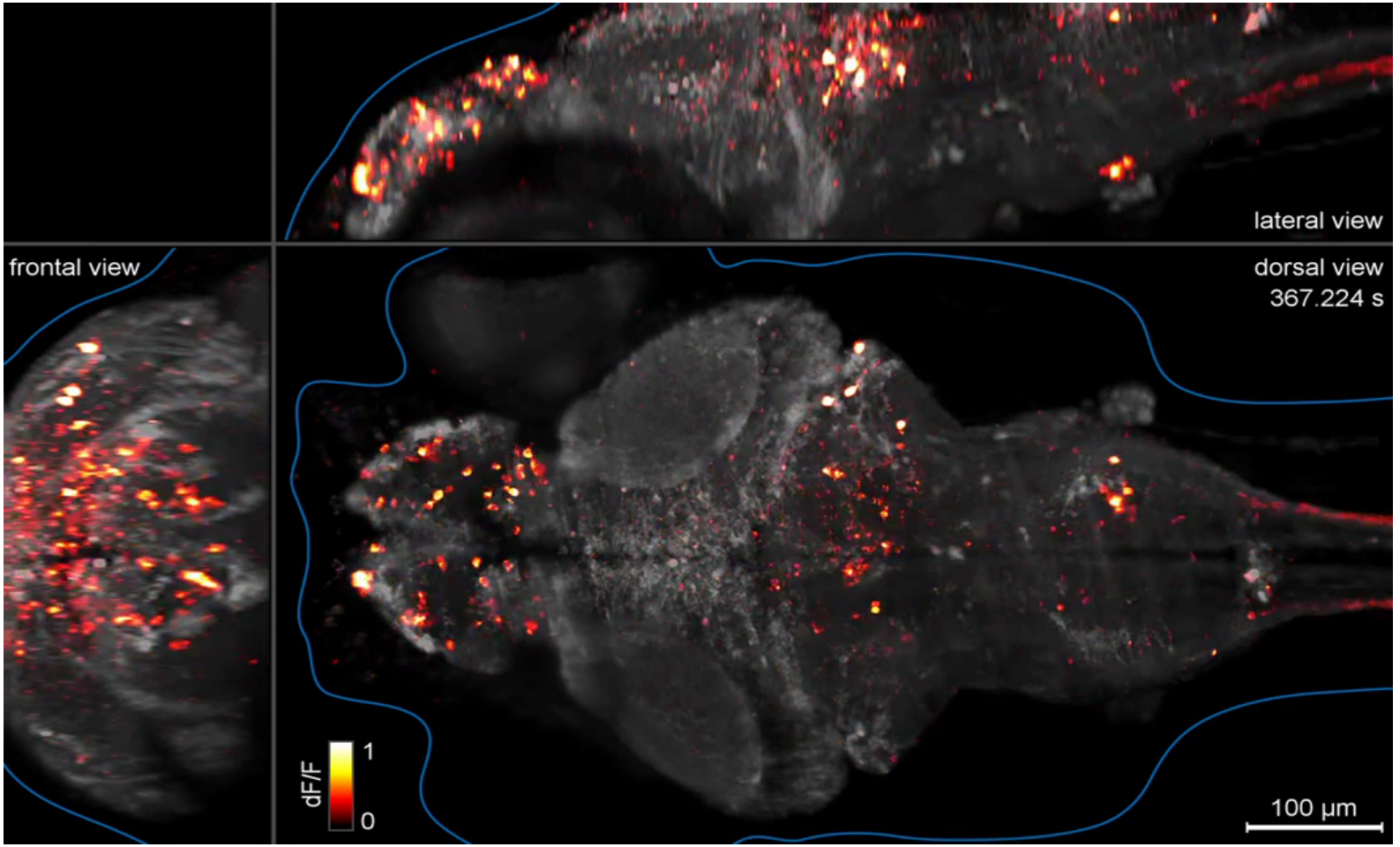
- The picture represents the evolution of a neural network computed by the DPSNN-STDP code
- This picture:
  - 200 inhibitory neurons
  - 800 excitatory neurons
  - total 100 000 synapses
  - Time resolution: 1ms (horizontal axis)
  - Each dot in the raster gram represents an individual spike
  - The evolution of the membrane potential of each neuron is simulated
  - The evolution of individual synaptic strength is computed (not shown in the picture)
  - Polychronism: individual synaptic delays are taken into account
  - Individual connections and neural types can be programmed







Spiking activity of individual neurons observed in real-time (e.g. in a Zebra Fish Larva)



Misha B Ahrens, Philipp J Keller, «Whole-brain functional imaging at cellular resolution using light-sheet microscopy», Nature Methods, 18 March 2013, DOI:10.1038/NMETH.2434

Howard Hughes Medical Institute, 3D recording of temporal spiking activity of ~100 000 neurons. Note: the effective time resolution is still only ~1 s.

Neuro-synaptic activity and Plasticity

- Key areas of present INFN activity on large scale neural modeling
  - Coding of scalable Parallel/Distributed simulator
    - INFN developed the DPSNN-STDP simulator in the EURETILE FET Project. Proven simulation up to 6.6 G synapses, 128 cores.
    - See arXiv:1310.8478 (Apr 2014)
  - Comparison with experimental neuro-biological data and calibration of the INFN simulator
    - Will be performed in the CORTICONIC FET project (starting from Oct 2014, end Dec 2015) (cooperation with ISS, TUM, IDIBAPS)
  - Interface with experimental systems /
    - Will be investigated by the INFN “COSA” (iniziativa di gruppo 5), start Jan 2015
  - Co-design of simulation code and execution platform, inclusion of the simulator into robotic platforms
    - The plan is to start from “COSA” and “CORTICONIC” to prepare the participation to a future European project on this topic

Proposal: Coordinator goals vs project goals

- The goal of the future project must overlap to a large degree with the kernel interests of the coordinator
  - Personal goals of the coordinating person
  - Goals of the coordinating company / research institution
- The coordinator must clearly state in written form its original goal before starting the consortium composition and proposal definition
- Detailed goals can change, even a lot, during the proposal preparation, due to contribution of the partners. Anyhow a substantial overlap with the kernel interests of the coordinator must persists.

Consortium: Team-work Attitude of Key-Persons

- Integrated research projects are a problematic arena for “excessively-introvert” individual contributors.
- Integrated research projects are a good playground for excellent key-persons with team-work attitude
- Key-persons requisites for Integrated Projects:
  - Excellent Listening skills
  - Team Management skills
  - Problem Solving attitude
  - Excellent Technical skills
  - NO sympathy for Problem Creation
  - Confident in the capacity of a team composed of excellent key-persons to find (usually) better solutions then excellent individuals
- Otherwise, an integrated project can easily turn into a night-mare…

Consortium Composition: Complementary Partners

- The coordinator must select with great care a kernel of complementary key partners / key persons:
  - Personal trust between key persons
  - Reciprocal technical appreciation between key persons
  - Ideally no overlap/conflict of interest between partners

- An ideal consortium starts from a set of complementary key-persons with reciprocal personal trust and technical appreciation

- You are entering a four-five year collaboration. A wrong set of partners can turn your next years into a nightmare

Starting the consortium definition

- Start with one/very few key person you respect / trust
- Check their real interest on the project goal, mutual cooperation and willingness to commit
- Identify additional partners to be invited as a consequence of technical areas not yet covered
- Ask advice to confirmed partners before starting the invitation trial of a new partner
  - to avoid conflicts of institutional interest
  - to avoid personal conflicts
- Add one partner at a time to the original kernel, otherwise you could remain blocked by cross vetoes

For each new partner…

- The key person of the new partner considered for participation must state, in separate one to one colloquium, his/her:
  - Personal trust with key persons already on board
  - Technical appreciation of other key persons already on board
  - The working area/responsibility/technical goal which will be covered by himself/herself
  - Identification of potential areas of overlap with existing partners
  - If an overlap/potential conflict of interest exists check immediately the capacity of the new key person to reach a written (e.g. e-mail) agreement with the pre-existing partner.
  - If no agreement reached immediately, discard the new partner
- Look for body language and any hint of distress – if any doubt discard the invitation
- Actual complementarity is a key point to avoid future problems

Consortium Agreement

- you followed the “complementarity” rules described by previous slides…
- …then, the definition of a quarter page per partner, the essential contribution to the definition of a consortium agreement should be an “easy” task
  - Existing individual background
  - Expected individual foreground
  - Basic rules enabling:
    - Future cooperation
    - Independent continuation of work

Project Plan - At least one deliverable/(partner and reporting period)

- My (non-standard?!) advice:
  - Each partner should be responsible for at least one main work-package during the central phase of the project
  - →
  - No “passenger” partners
  - Define the individual responsibility area/specific goals/interface of each partners before starting the project proposal writing
    - A single statement can always resume the individual responsibility
  - Clear definition of a minimum set of interfaces between partners
  - Each partner should be officially responsible for at least one deliverable for each reporting period during the main course of the project ->
    - Better and simple reporting
    - Simplify the task of the officers and reviewers

Project Plan – Interaction between partners

- **Before** starting the project proposal detailed writing:
  - Define the key deliverable/technical area/final goal of each partner
  - Check the complementarity/non overlap with other partners
  - Define a work-package name and number associated to each partner
  - Design a graph of interaction between workpackages
    - Ideally each work-package in the central phase of the project should be interfaced with only two other work-packages
    - If more work-packages need to interact obtain a written agreement about the responsible partner/key-person before starting the proposal writing

Starting the project - At least three plenary meeting during the first trimester

- With several partners, my opinion is that at least three plenary meetings during the first trimester are needed to set-up a real cooperation
- Leverage on the honeymoon effect
  - Obtain results during the first 100 days
- Each plenary meeting should have
  - Plenary sessions
    - project goals, available background, definition of working groups, identification of critical issues
  - Separate sessions dedicated to working groups
  - Wrap-up plenary sessions
    - Results obtained by working groups
    - Objective of work to be done before next plenary meeting

Day to day management
A lot of bilateral/trilateral meeting…

- Each partner should be responsible for at least a work-package and must organize frequent (phone) meetings with work-packages at its interfaces
- The coordinator should be kept immediately informed of emerging issues…
- The coordinator must continuosly poll to check no blocking is happening
- Minutes of meetings MUST be distributed to all partners, also outside the work-package

One plenary 2.5 days technical workshop/year

- A typical Integrated Project involves at least 40 technical people working -> at least 15 technical working groups (one or more per partner)
- Each technical group should present
  - Theory
  - Available background
  - Practical results to the other group
- Each technical workshop creates:
  - Informal channels between technical people
  - Reciprocal understanding between technical people
  - Cross partner non-filtered information flow between technical people and management people
- The technical workshop should also include a management board meeting

Use cooperative tools

- Massive use of wiki cooperative web site and document sharing facilities
  - Each participant can publish an updated status of its work
  - A forum can be created to discuss emerging problems
  - Storage of meeting minutes and next meeting agendas
  - Administrative documents readily available
  - Sharing of SW tools and other deliverables/source codes/executables…

Person-months vs deliverable, vs work-package, vs period, vs partner.

- A well designed, shared spreadsheet is sufficient
- Share since the project proposal phase, and then during the project life with the partners a cooperative excel spreadsheet where:
  - There is one foil per partner….
  - …plus foils with automatic sums at project level
  - … where during the periodic reporting phase, each partner can insert his own forecasts for the period and the amount of person-months actually spent on each deliverable and each period
  - the foil must contain all data from previous periods
  - the automatic computation of individual data must allow an immediate control, at project level, of periodic forecasts and periodic consolidations, at the granularity of deliverable, work-package and full-project.

Drawbacks

- In my case, in retrospective, the job of European project promotion / coordination and the strictly related active technology transfer actions produced a favorable balance of plus-points, versus a few serious drawbacks …
- … let us discuss, if you like
- How to reduce the drawbacks? …a few suggestions.

Summary

- Overlap between the goals of the project and the goals of the coordinator
- Select excellent key-persons with team-work attitude
- Complementarity between key-persons and partners
- Assign individual responsibility to each partner from the beginning
- A lot of interaction – monitoring – problem solving
- Keep continuos control of forecast and consolidation of person-months and budget
- In the past, not so much bureaucracy needed

- ENJOY – integrated project create good opportunities