Integration of Neural Systems

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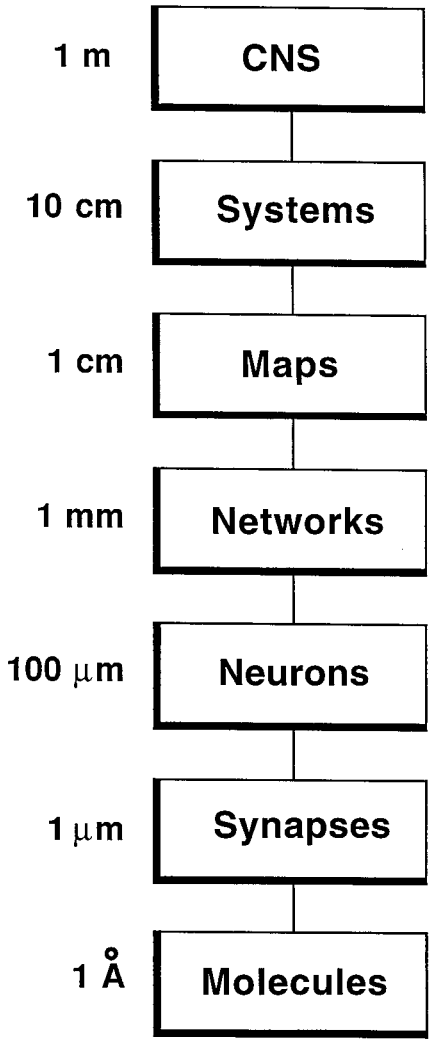
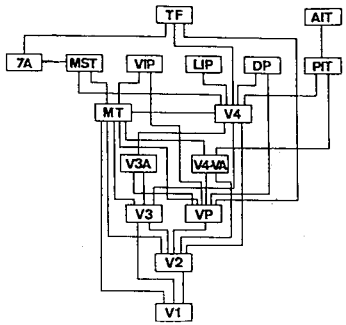
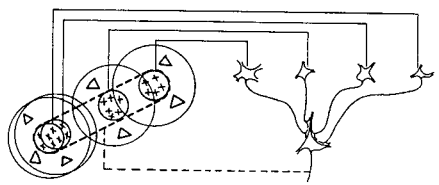
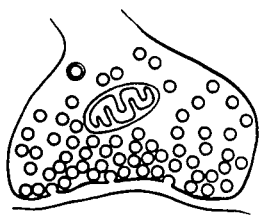
Levels of Investigation









Models that are:

- large
- collaborative
- multiple contexts
- heterogeneous

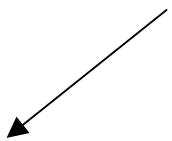
Resource Constraints

"man-to-the-moon" scenario

- well-funded
- strong management
- comprehensive training

"academic research" scenario

- few funds
- many small independent teams
- little training



Resistance to imposed constraints

- (perceived) lack of effectiveness
- (perceived) lack of suitability
- required learning curve
- negative impact on creativity

Sharing

Rebuilding published work

- ✓ rebuilding validates the work
- ✗ publication may be incomplete
- ✓ rebuilding ensures understanding
- ✗ costly

Integrating work as components

- ✗ components aren't validated
- ✓ a component is complete
- ✗ black boxes preclude understanding
- ✓ cheap and scalable

Multiple Target Implementations

The use of a model and its components by **multiple researchers** and within the context of **multiple tasks** implies a **range of target implementations**:

- simulated task or real task
- virtual time or real time
- range of engineering and hardware constraints
- range of memory models
- use of specialised hardware such as aVLSI and digital hardware

Integration-centric Approach

- integrate existing work
- invariant to target implementation

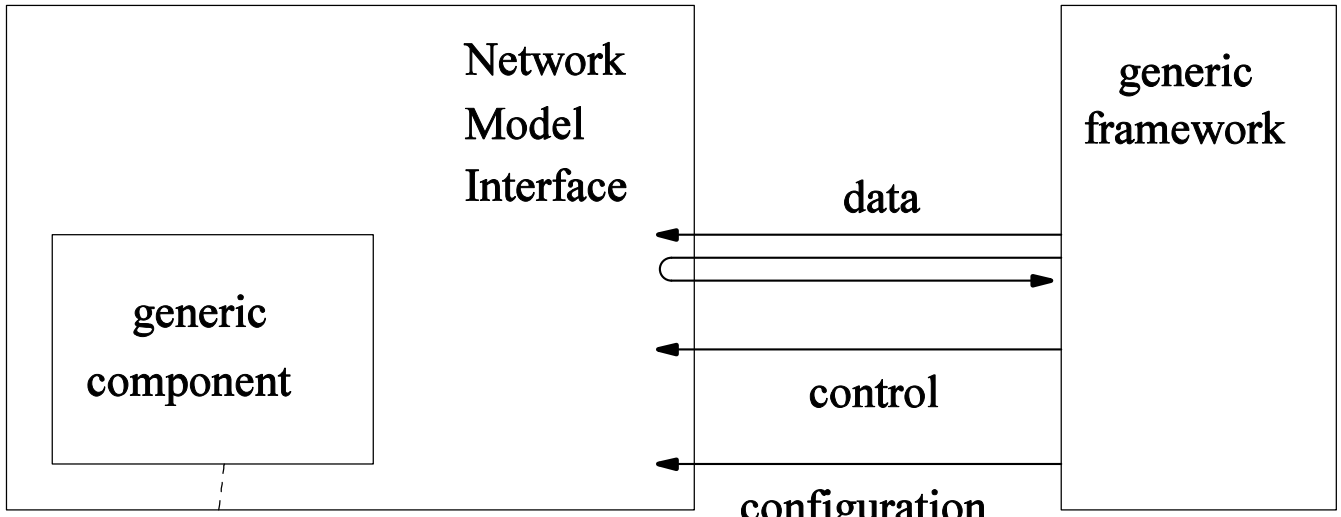
} flexibility and reusability

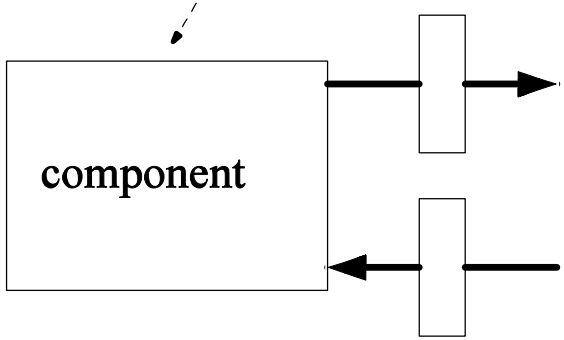
- little training
- low risk

} low barriers to use

- validation ???
- sufficient understanding ???

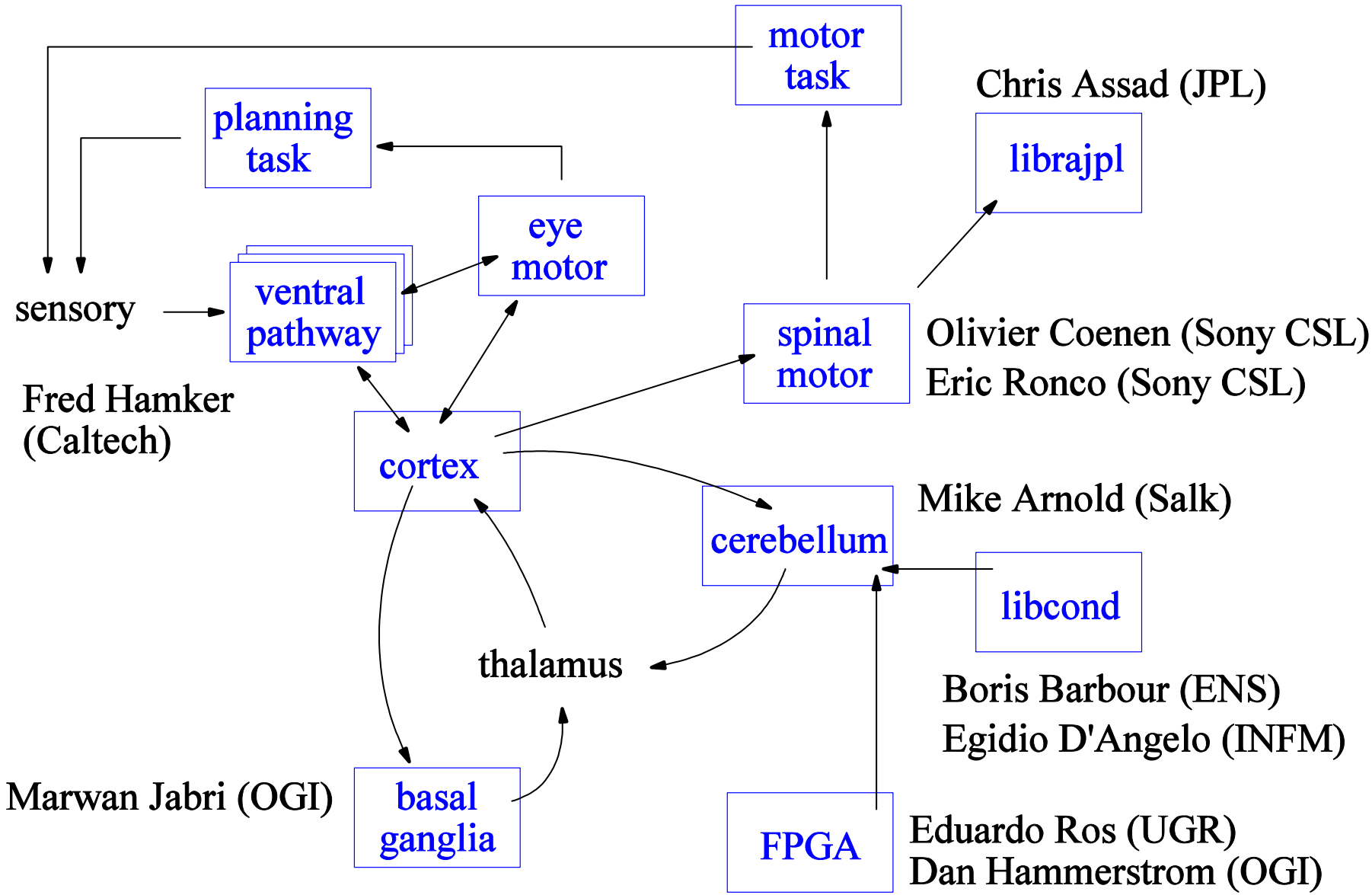
Network Model Interface (NMI)





channel
- tag
- size
- type

1. configure
2. build
3. get tags
4. run
   - pass input
   - calculate $t_1 \rightarrow t_2$
   - request output


motor task
Chris Assad (JPL)
planning task
librajpl
eye motor
ventral pathway
sensory
spinal motor
Olivier Coenen (Sony CSL)
Eric Ronco (Sony CSL)
Fred Hamker (Caltech)
cortex
Mike Arnold (Salk)
cerebellum
libcond
thalamus
Boris Barbour (ENS)
Egidio D'Angelo (INFM)
Marwan Jabri (OGI)
basal ganglia
FPGA
Eduardo Ros (UGR)
Dan Hammerstrom (OGI)

Salk Institute

Terry Sejnowski

Mike Arnold

Oregon Graduate Institute

Marwan Jabri

Dan Hammerstrom

Caltech/JPL

Chris Assad

Documentation

www.cnl.salk.edu/~mikea/doc/libnmi/libnmi.html

Sony CSL

Olivier Coenen

Michele Bezzi

Eric Ronco

Ecole Normale Superieure

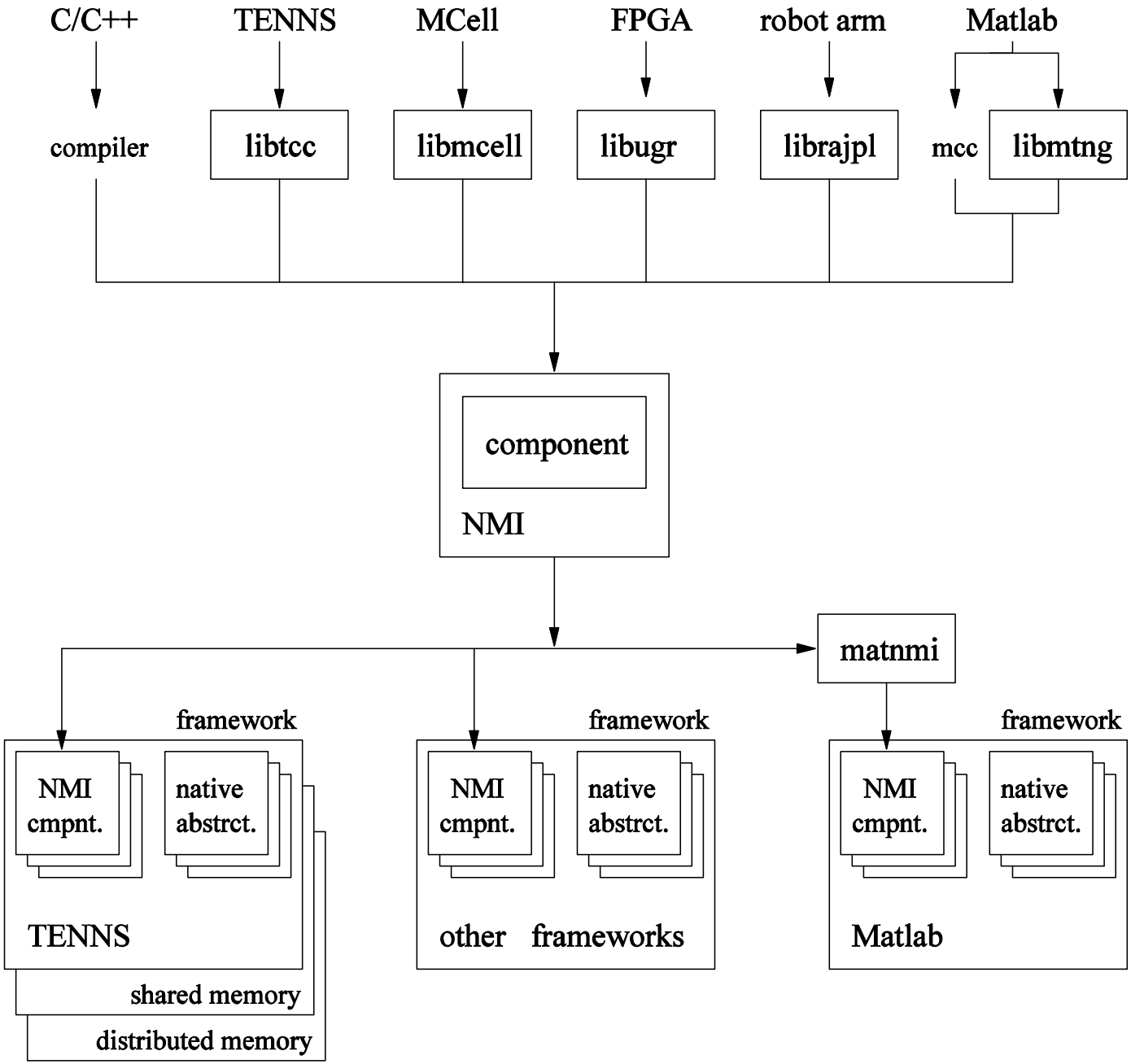
Boris Barbour

University of Pavia

Egidio d'Angelo

University of Granada

Eduardo Ros


C/C++
TENNS
MCell
FPGA
robot arm
Matlab
compiler
libtcc
libmcell
libugr
librajpl
mcc
libmtng
component
NMI
matnmi
framework
framework
framework
NMI cmpnt.
native abstrct.
NMI cmpnt.
native abstrct.
NMI cmpnt.
native abstrct.
TENNS
other frameworks
Matlab
shared memory
distributed memory

NMI: Issues and Summary

- sharing components
- **what to standardize**: the interface not the framework
- NMI requires a working group

- development of modeling methodologies that understand the balance between the science and the engineering
- managing collaborations
- validation of components
- ensuring sufficient understanding of components

- We don't really know what the issues are, NMI offers a shortest path to studying the problem at first hand.