OpenAdap.net : an evolvable information processing environment

Alessandro E.P. Villa, Javier Iglesias

Neuroheuristic Research Group[1,2]

[1]*Grenoble Institute of Neuroscience, Inserm U836-Eq7*
Université Joseph Fourier Grenoble 1, France

[2]*HEC, Faculty of Business and Economics*
University of Lausanne, Switzerland

Motivation, problem area

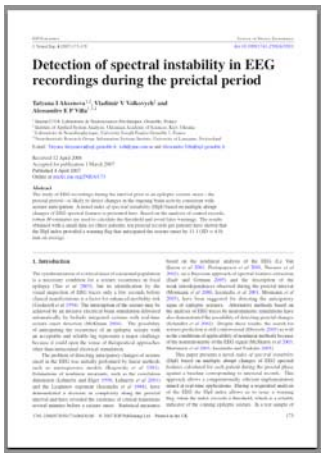
- **Knowledge sharing: social obstacles**

CONTRIBUTOR

OBSTACLES TO KNOWLEDGE DISSEMINATION

The richness circulating in the Cyberspace is poorly exploited because of **difficulties to share the know-how. Delays** appear until newly developed methods of information processing become available even within a specific field or discipline.

DISSEMINATION


Detection of spectral instability in EEG recordings during the preictal period

ACCESS

CONTRIBUTOR

"INVENTION"

$$N_c^{(r)} = Q(a, c, \Omega) \cdot \tilde{N}_c^{(r)}$$

$$\tilde{N}_c^{(r)} = K \sum_{S_c \in \xi_c} e^{-m(S_c)/K} \cdot \frac{1}{r!}\left[\frac{m(S_c)}{K}\right]^r$$

$$Q(a,c,\Omega) = F(c-a,a) \cdot \frac{\Omega!}{(\Omega-a)!a!}$$

$$K = \frac{(w/\Delta)^{c-1}}{(c-1)!} \equiv \frac{w^{c-1}}{f_\Delta(c-1)!}$$

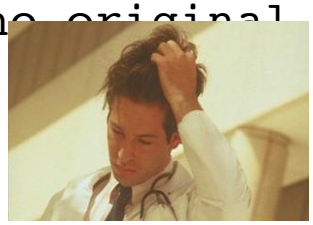
OpenAdap.net

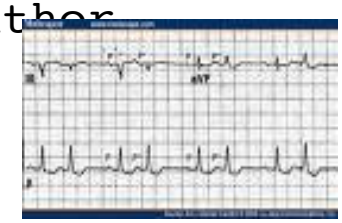
Motivation, problem area

- **Transdisciplinarity: technical obstacles**

The software is generally based on **tailored needs** and platforms **too narrowly designed.** Due to lack of a transdisciplinary vision **knowledge remains undiscovered** to users specialized in fields of competence other than that of the original author.

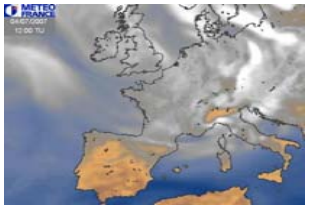
LIFE AND CLINICAL SCIENCES

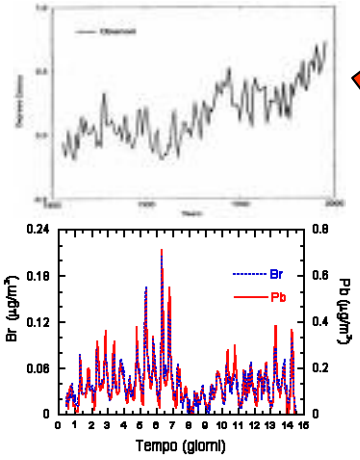




ECONOMY AND FINACE

CLIMATE AND METEREOLOGICAL SCIENCES





TRAFFIC JAM AND POLLUTION FORECAST

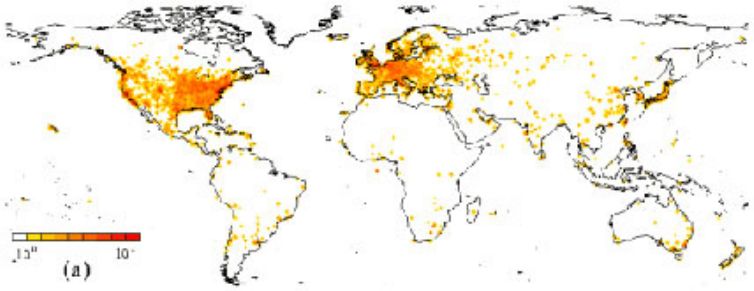
OpenAdap.net

Motivation, problem area

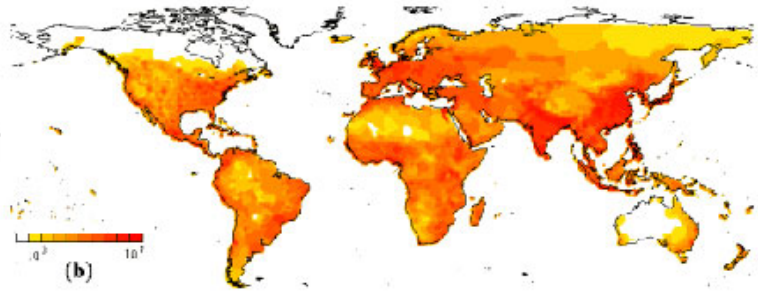
- **Digital divide**

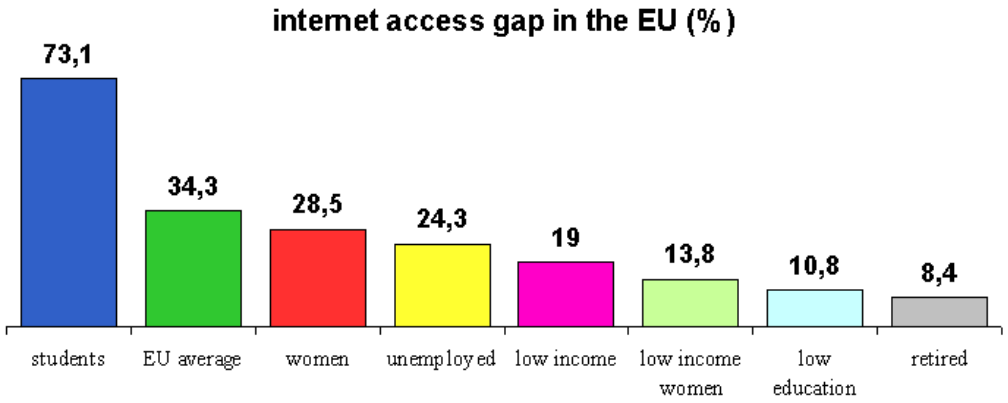
The existence of **barriers** in the flow of information processing **increase the overall cost** of knowledge production and distribution and **restrict its availability to developing countries as well among social classes of developed countries.**

Router density



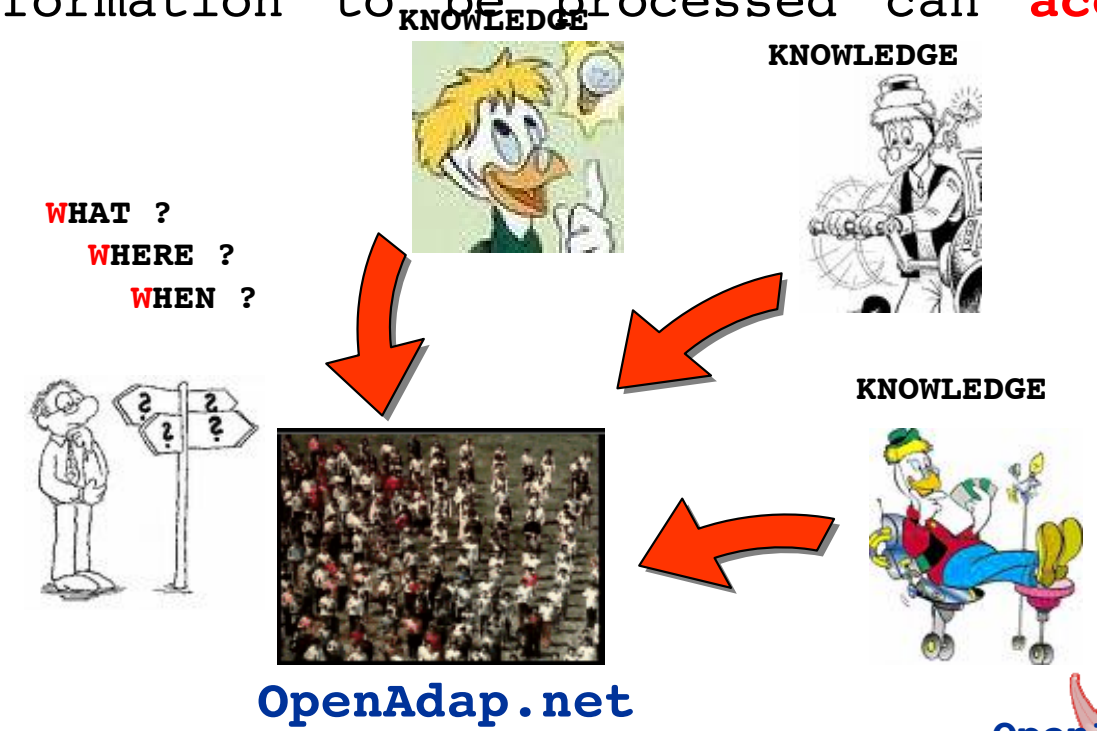
Population density





Research Objectives (1)

- To **avoid the "re-invention"** and **"re-discovery"** of existing knowledge so to **save time and expenses** by the whole society and prevent incorrect applications.
- To promote the development of **Communities with semantically related interests**. Community members who provide new knowledge become able to **share** their contribution and members who have information to be processed can **access** these services.



Research Objectives (2)

- To provide Communities the possibility to **transparently compose meta- resources**, based on the available resources, by means of a **network-centric operating system** driven by the activity of **intelligent adaptable brokers** with the advantages and features of Grid computing, Web Services and Peer-to-Peer applications.

Grid: a user has to process an information with one application distributed acro

WS: many users exploit the same services provided by a centralized authority

P2P: many users dyamically exchange pieces of information in an unsupervised way

	Data treatment distribution	Hardware resource allocation	Hidden execution hosts	Applications sharing	Published application interfaced	Data sharing	Highly dynamic system	Transparent connections users ⇔ resources
Grid	X	X	X					
Web Services			X	X	X	X		
P2P						X	X	X
openAdap.Net	X	X	X	X	X	X	X	X

Research Objectives (3)

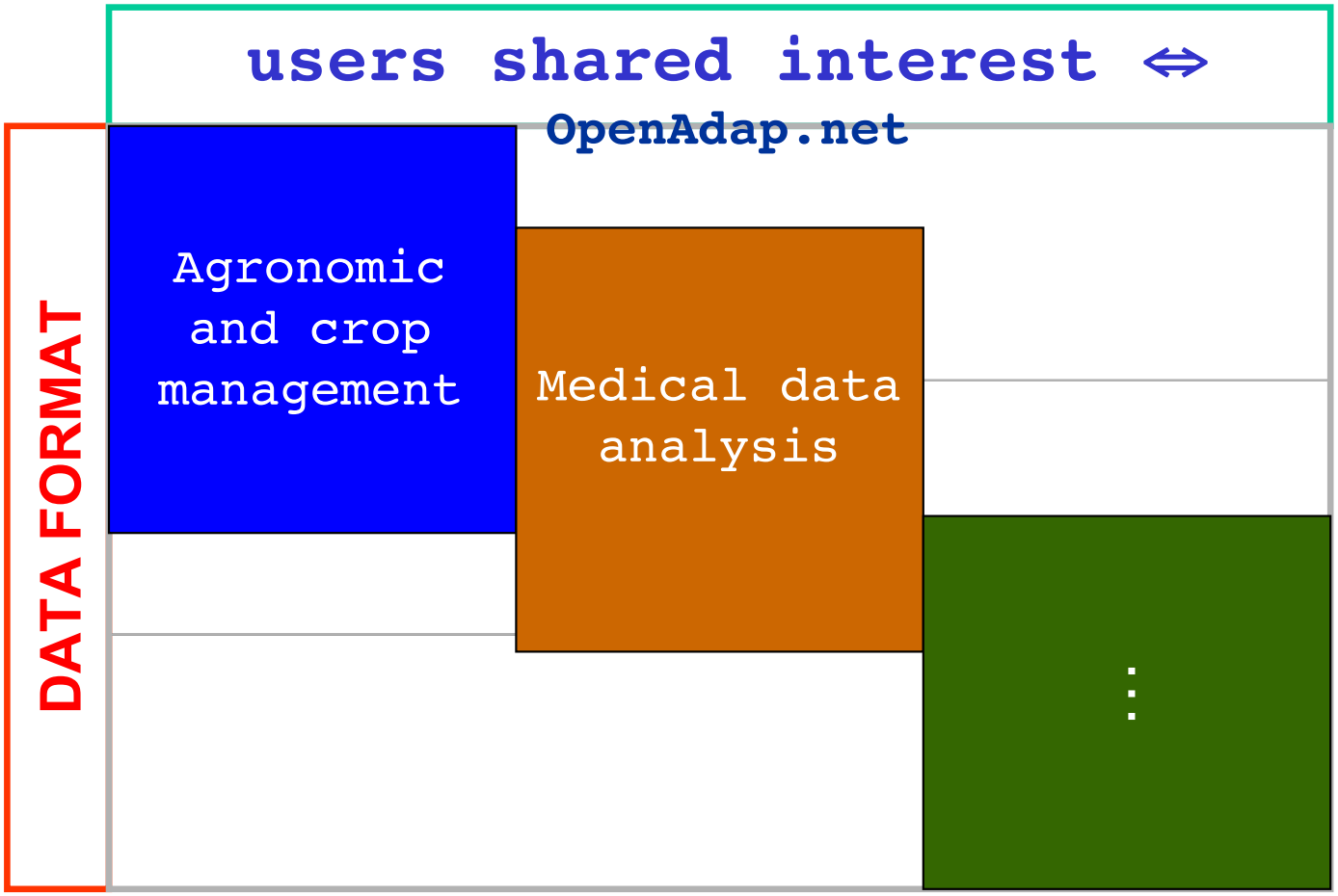
- To develop a new **OpenAdap.net** protocol (**oan://**) for field instrumentation and wireless communication over Internet aimed at **easy ubiquitous knowledge sharing and access**.



OpenAdap.net

Research Objectives (4)

- To develop new business opportunities for Third Parties from all over the world, **SMEs** in particular, aimed at **added value services** *(educational, commercial, governmental, ...)*.

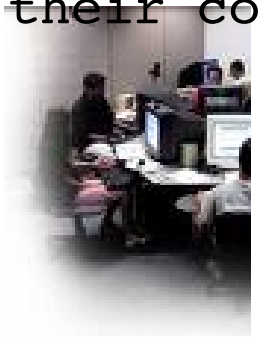


Target Audience

COMMUNITIES

People who share a **knowledge representation** (common data format) driven by common interests.

CONTRIBUTOR : people who would like to **share their knowledge** with the Community. They maintain the authorship and keep **control and responsability** over their contribution.



USER : people interested to **process their own information** or **access knowledge stored elsewhere** (e.g., in a public database) and **extract the results of their processing.** They exploit Contributors' applications in a trusted way.

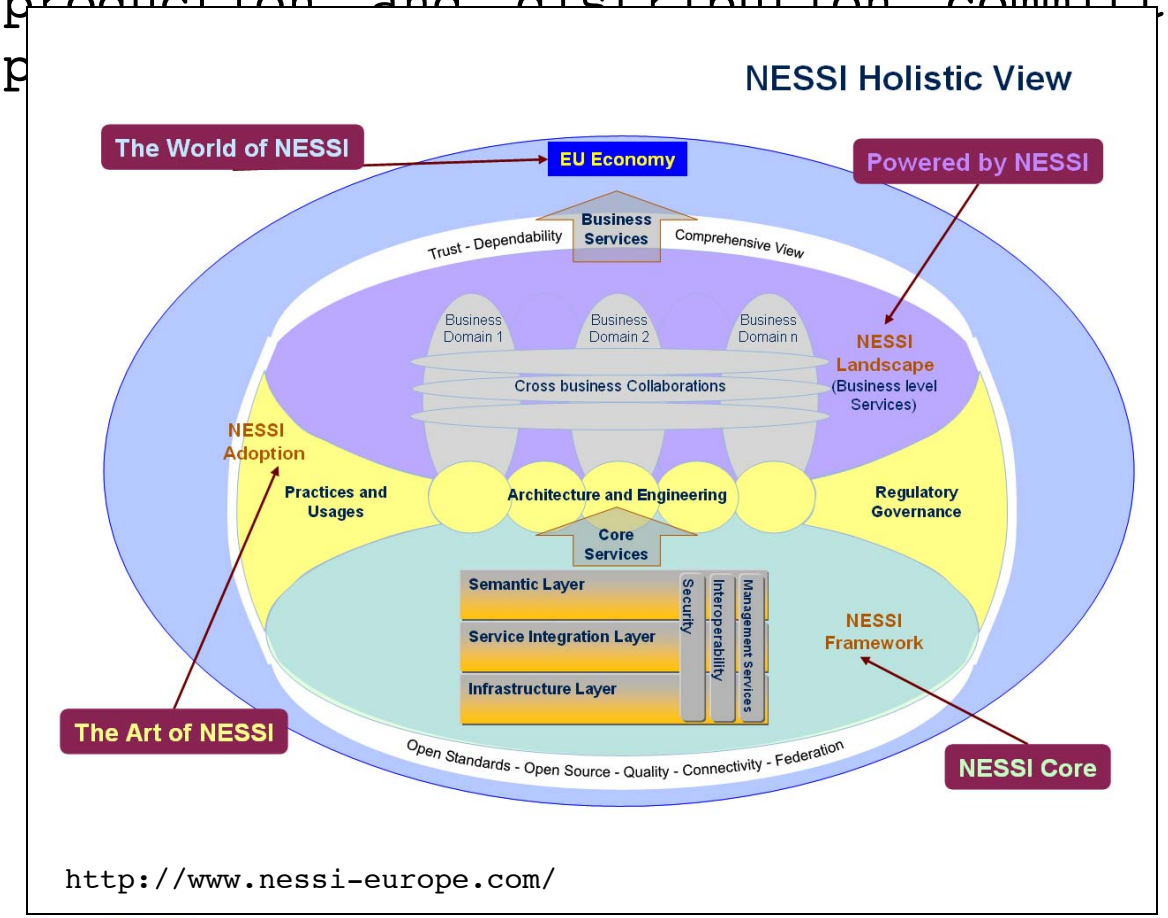
OpenAdap.net

CONTRIBUTORS

USERS

Research approach, Methodology (1)

The key is the development of a new original project caled **OpenAdap.net**, that is **independent of a specific data type**. The project is aimed to enable a middleware that is an **Open Source software platform** providing flexible tools for knowledge production and distribution committed to the holistic view p

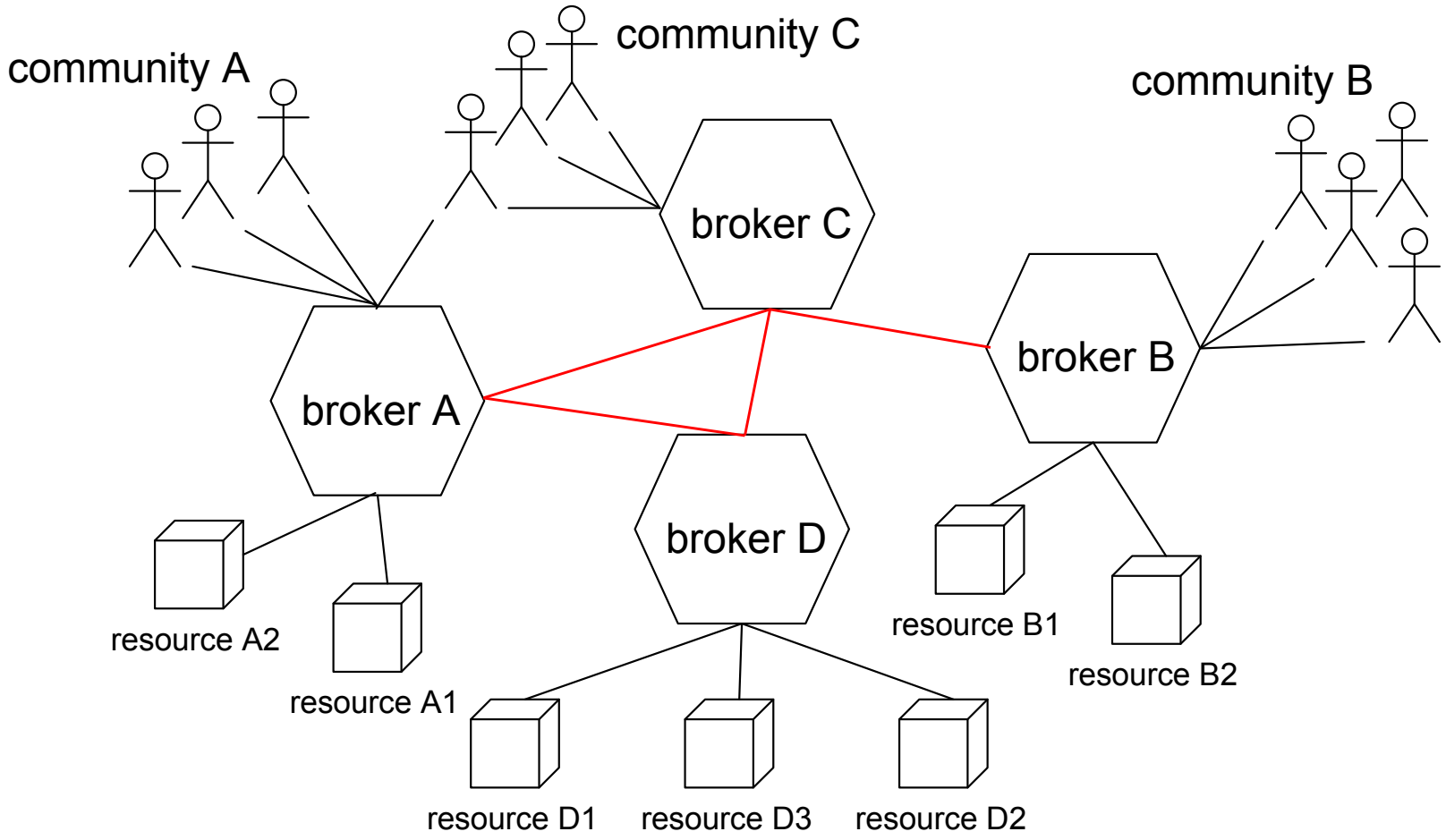


http://www.nessi-europe.com/

Evolving from vision to delivery, the **N**etworked **E**uropean **S**oftware and **S**ervices **I**nitiative (**NESSI**) has defined a model, architecture and proposed implementations of **NEXOF**, the **NESSI Open Framework**, the embodiment of its Strategic Research Area.

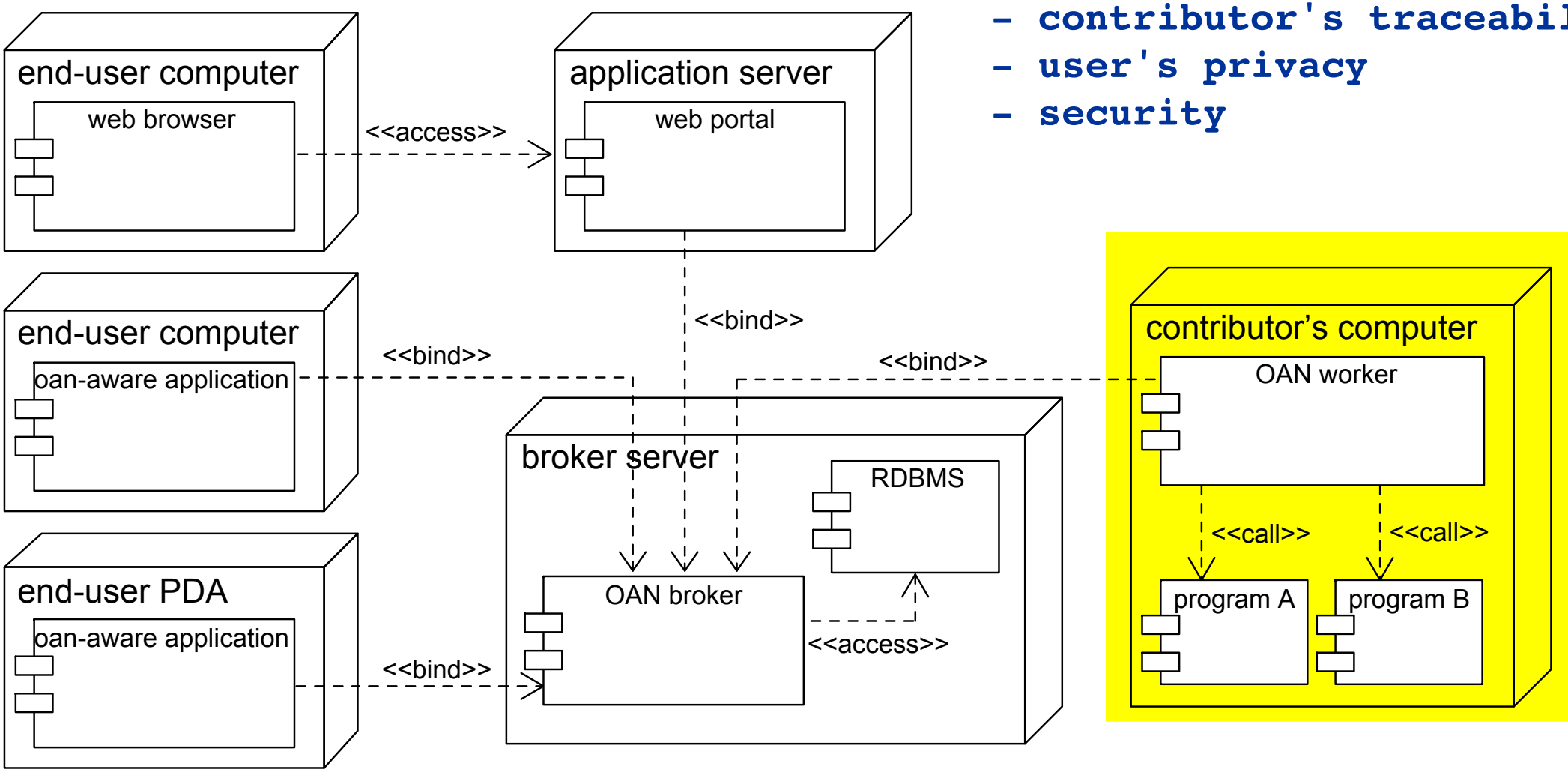
Research approach, Methodology (2)

Resources are semantically organized and appear as a single entity able to orchestrate **unlimited, heterogeneous and dynamic resources distributed across multiple platforms.**



Research approach, Methodology (3)

- contributor's traceabil
- user's privacy
- security



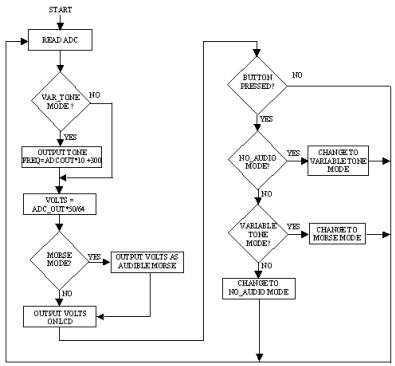
UML DEPLOYMENT SCHEME

NEURO - HEURISTIC
RESEARCH GROUP

contributor: joining the Community

EDITING SOURCE CODE

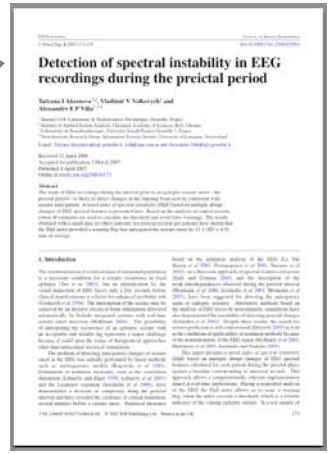
PROGRAMMING FLOWCHART



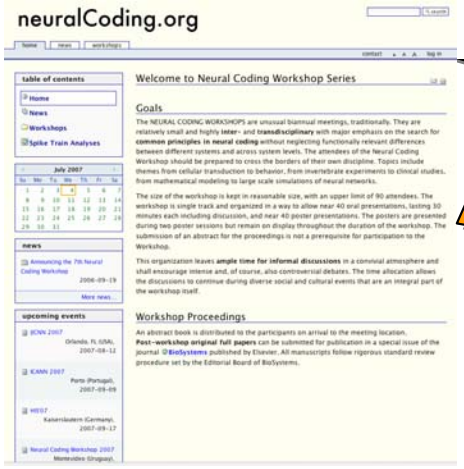
CONTRIBUTOR

RUNNING THE APPLICATION

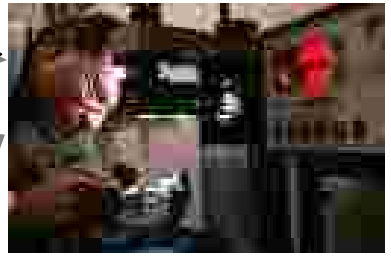
PUBLISHING



COMMUNITY WEB PORTAL



USER INTERESTED IN THE APPLICATION



OpenAdap.net

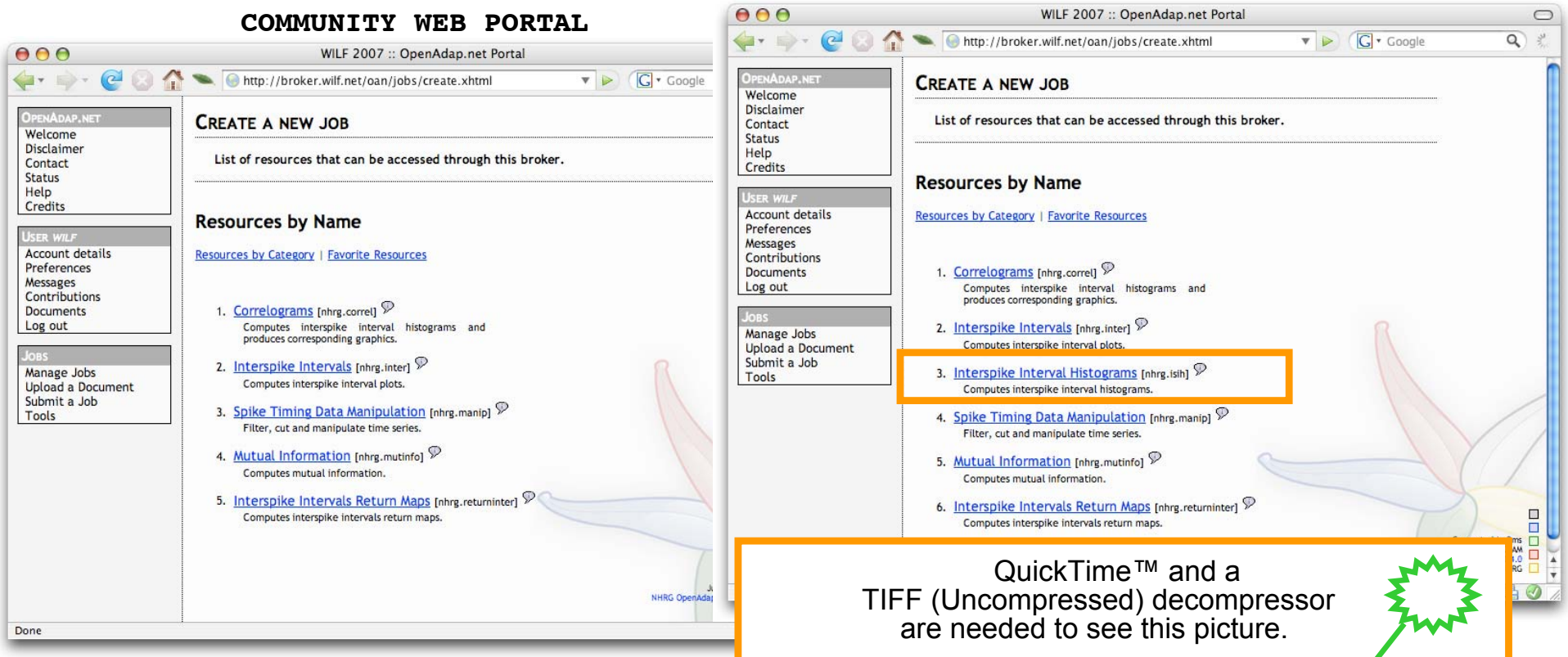
Information Society

UNIVERSITE JOSEPH FOURIER SCIENCES TECHNOLOGIE MEDECINE

UNIL | Université de Lausanne

contributor: disseminating the knowledge

COMMUNITY WEB PORTAL



QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

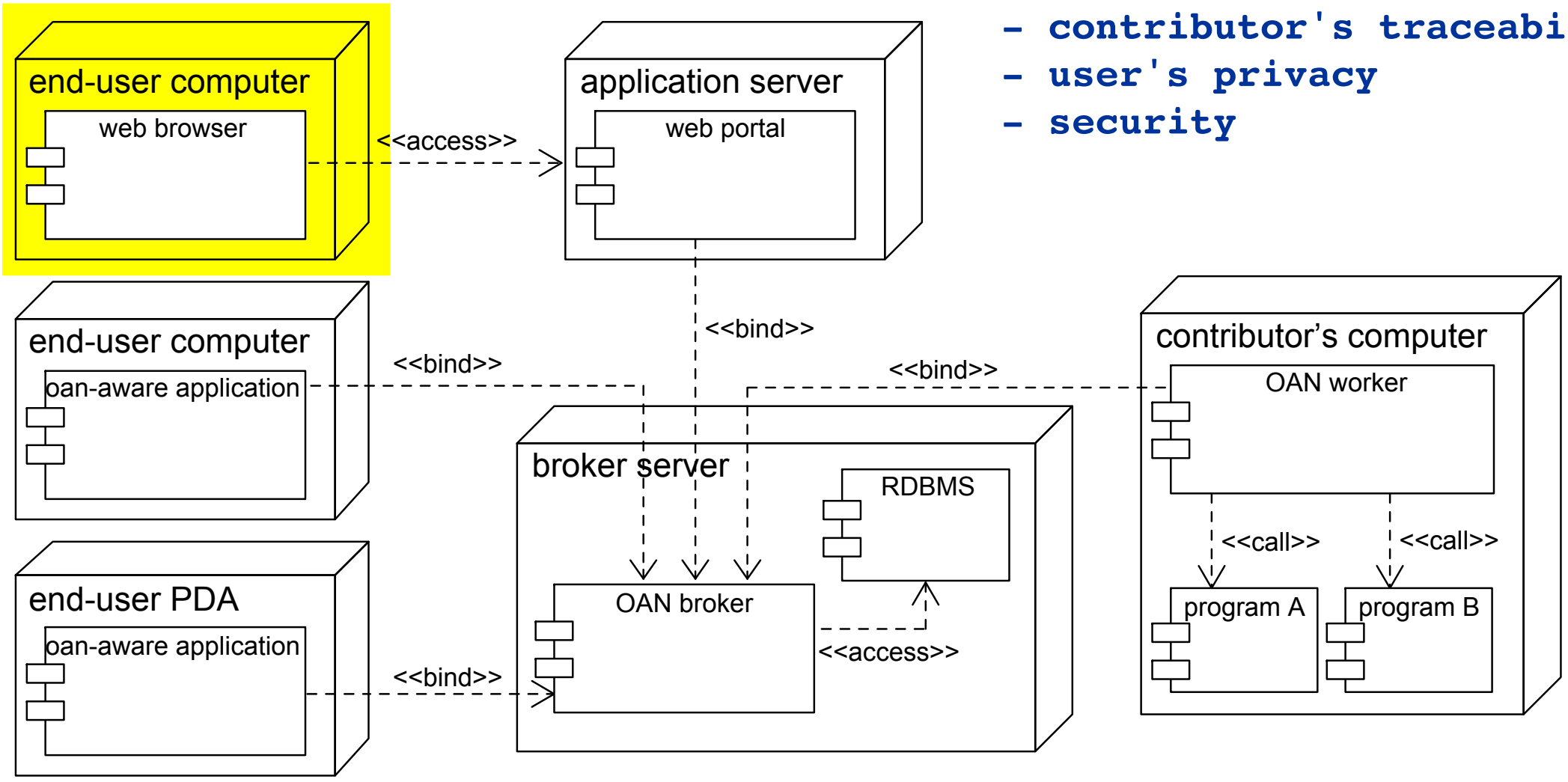
JOINING THE COMMUNITY

- responsability
- acknowledgement
- control

OpenAdap.net

Research approach, Methodology (4)

- contributor's traceabil
- user's privacy
- security



UML DEPLOYMENT SCHEME

Research approach, Methodology (5)

User's data
(on-the-fly analyses)

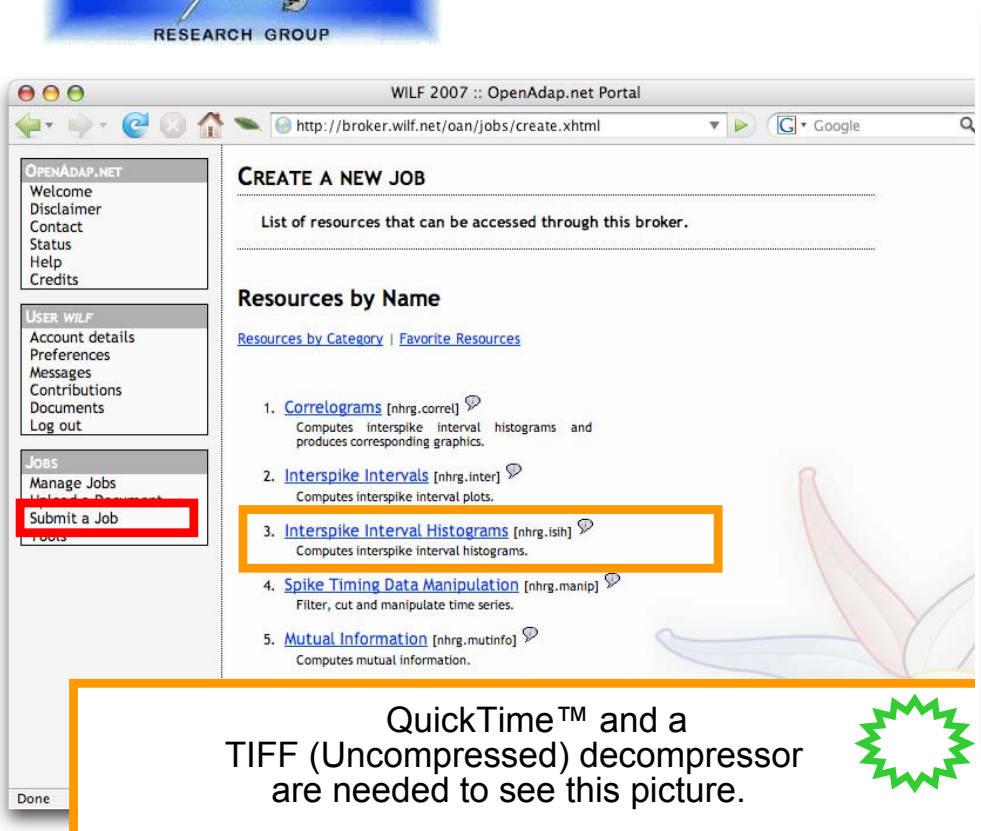
Privacy

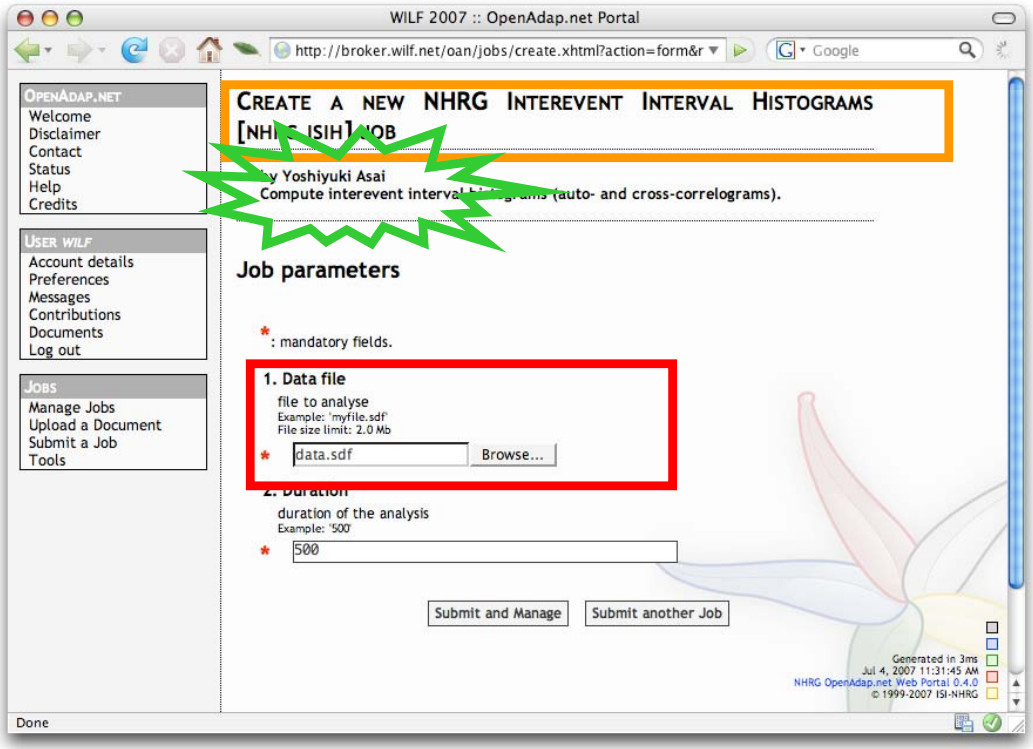
OpenAdap.net

USERS

NEURO - HEURISTIC
RESEARCH GROUP

end-user computer: Web Portal (1)



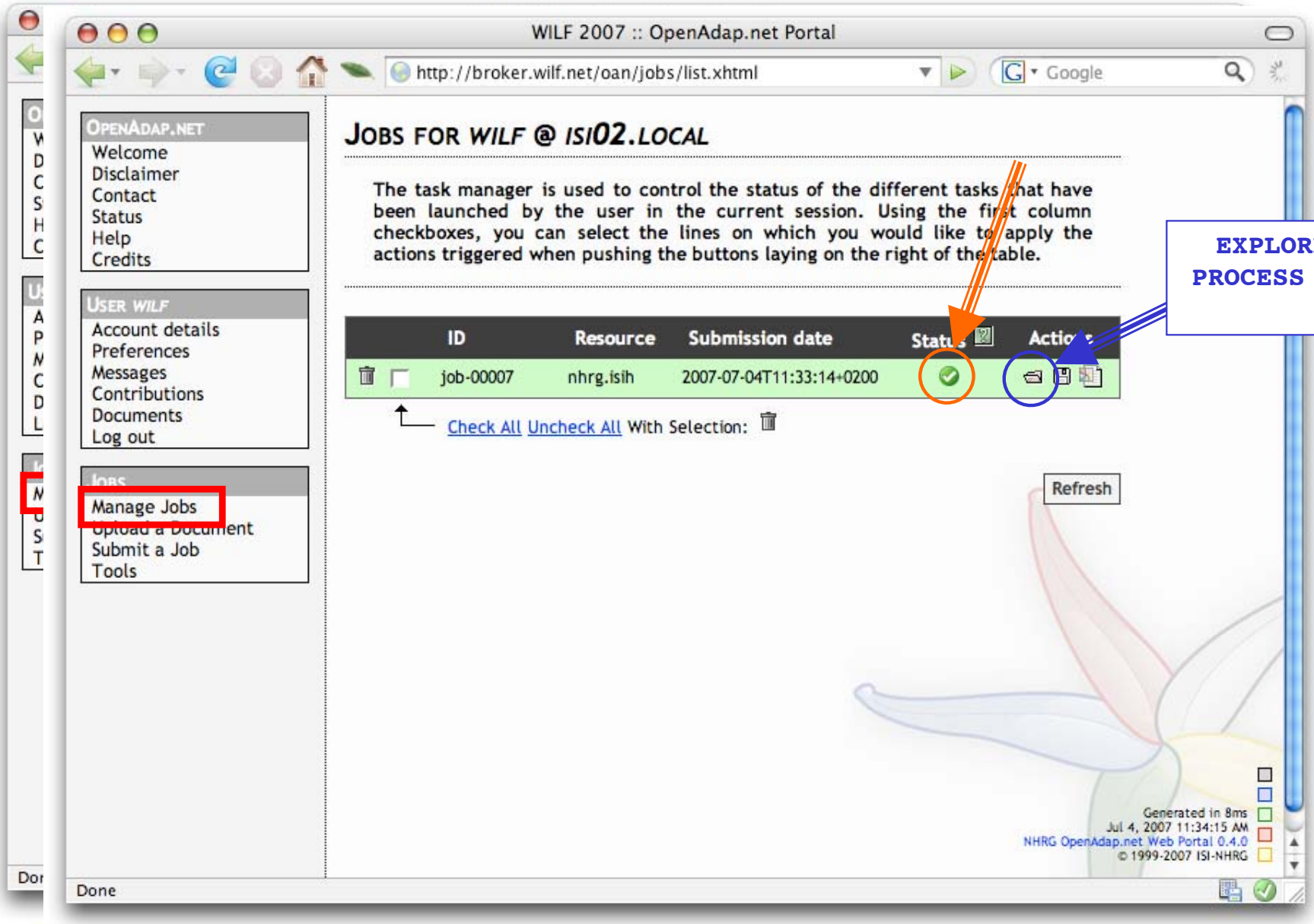


QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

PROCESSING OWN INFORMATION IN A TRUSTED ARCHITECTURE

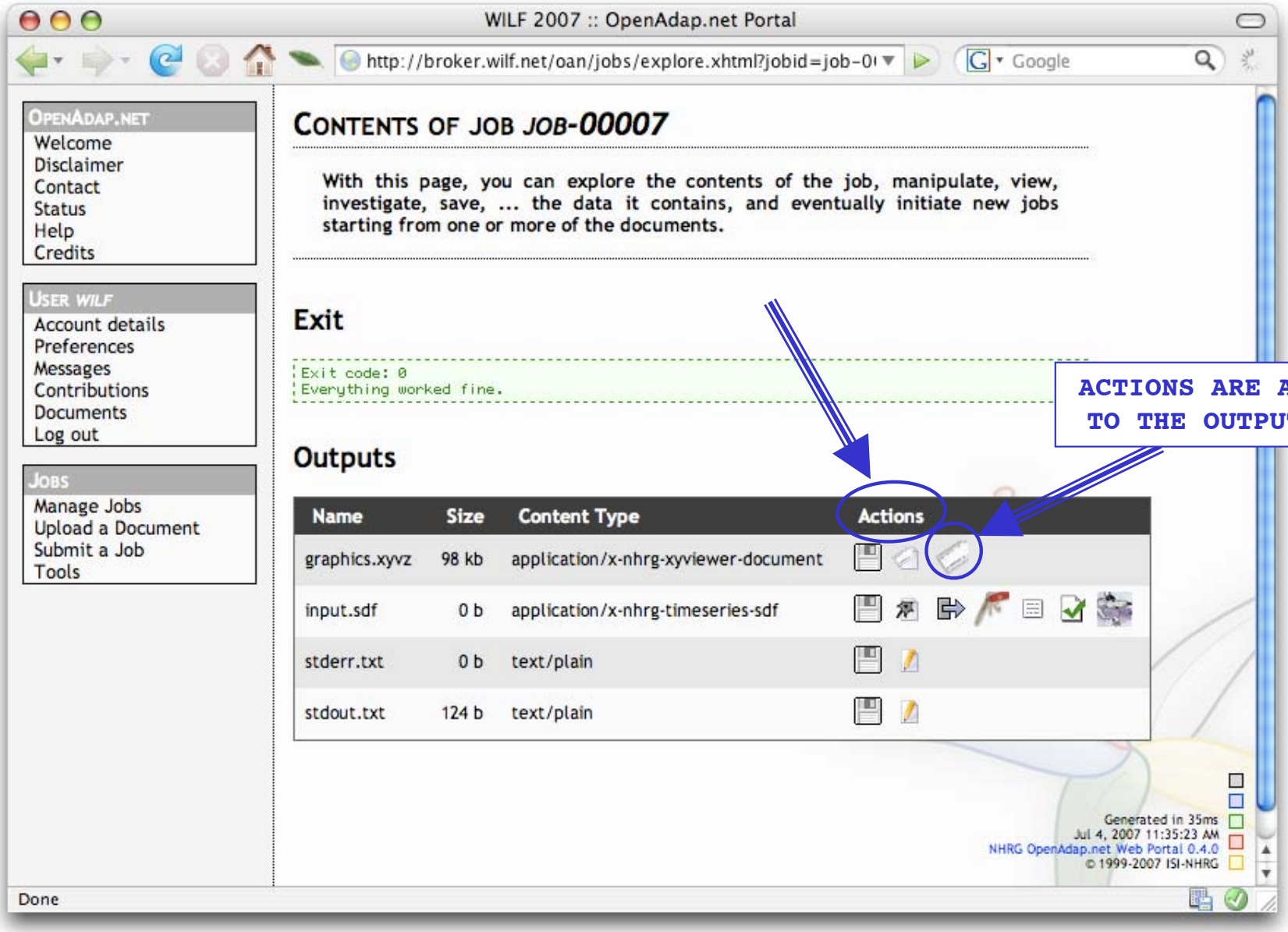
end-user computer: Web Portal (2)

MONITORING AND MANANGING THE JOB PROCESS



EXPLORE THE PROCESS OUTPUT

end-user computer: Web Portal (3)



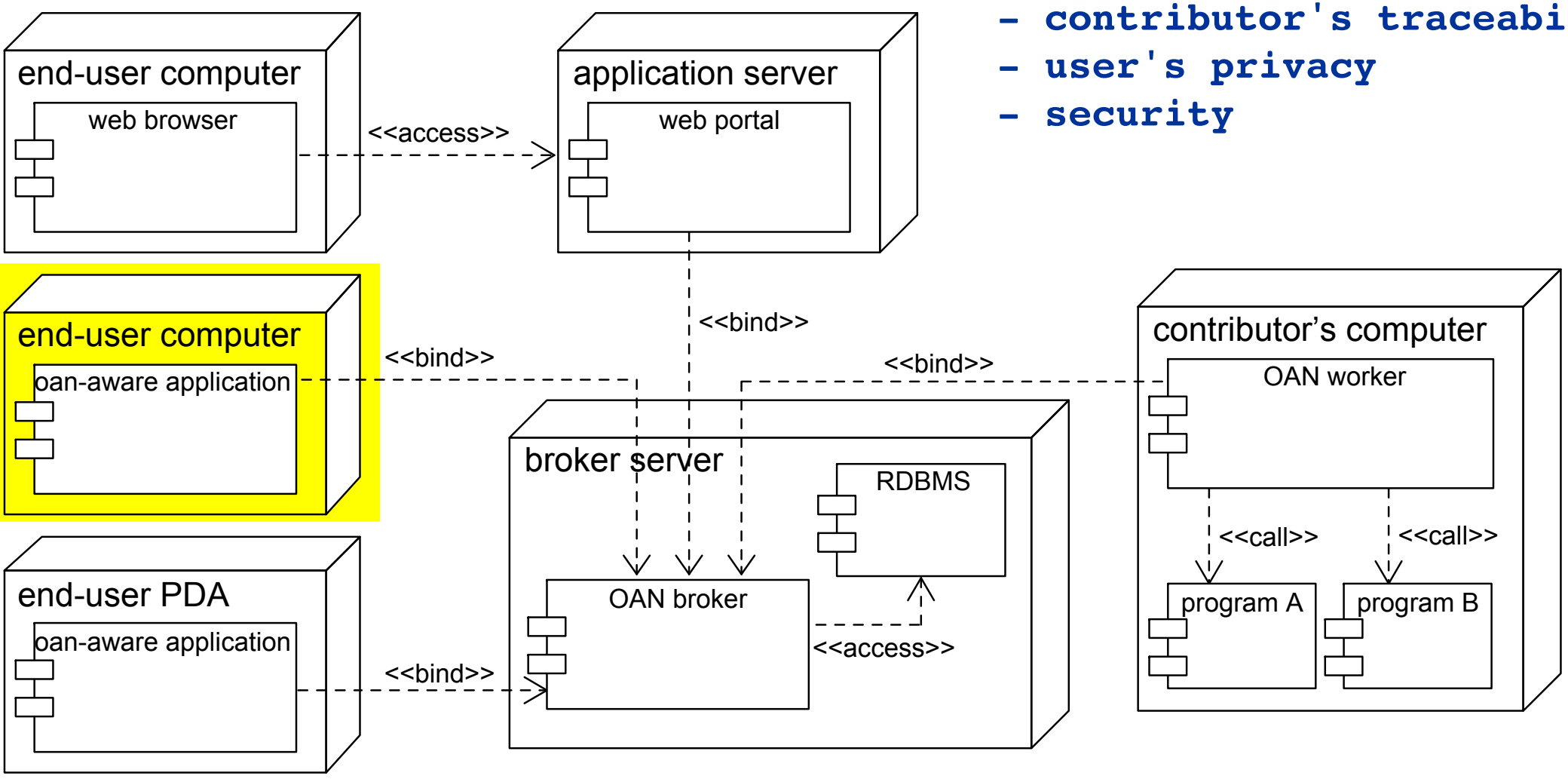
ACTIONS ARE ASSOCIATED TO THE OUTPUT CONTENT

OpenAdap.net

end-user computer: Web Portal (4)

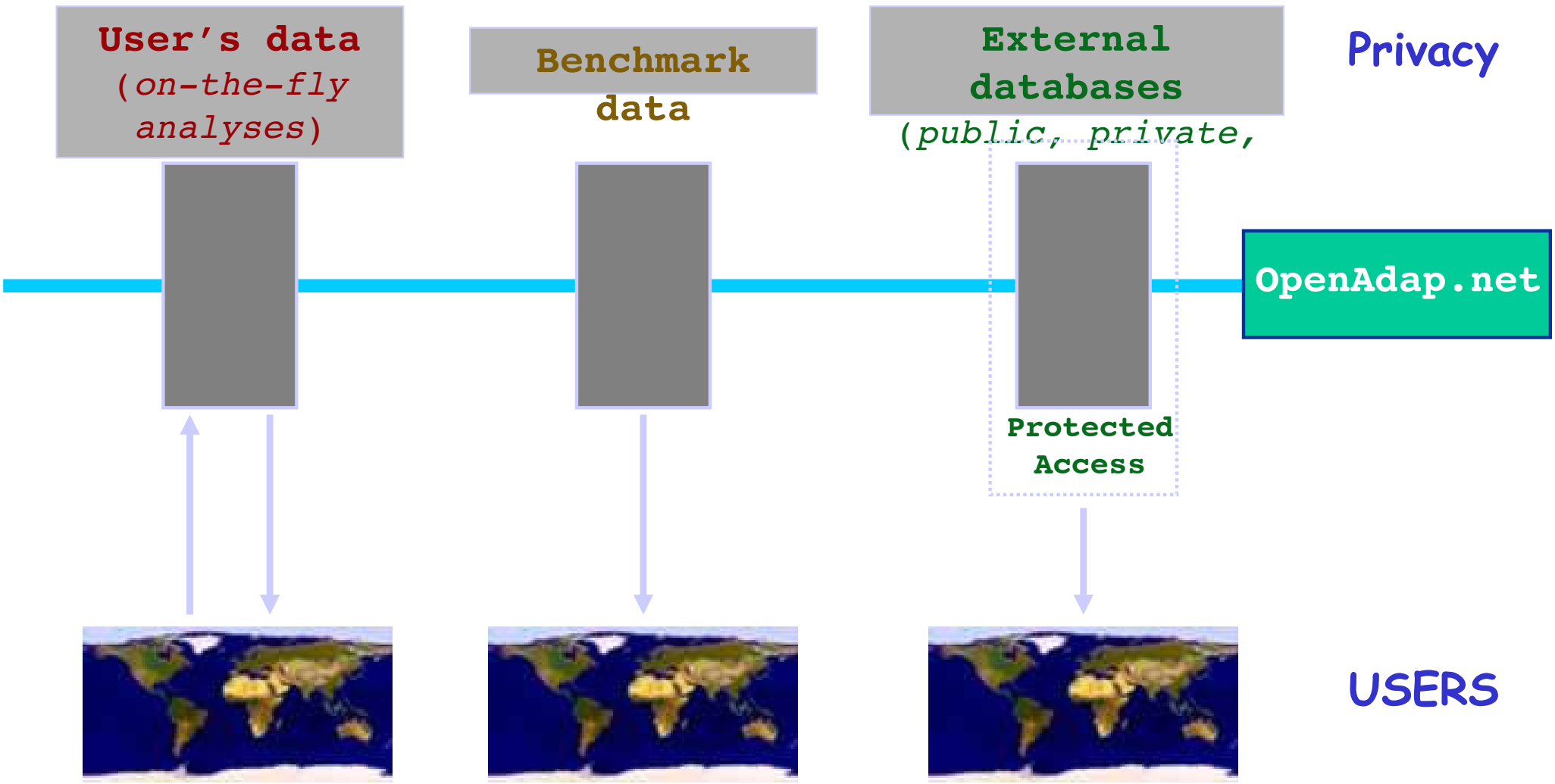
Research approach, Methodology (6)

- contributor's traceabil
- user's privacy
- security



UML DEPLOYMENT SCHEME

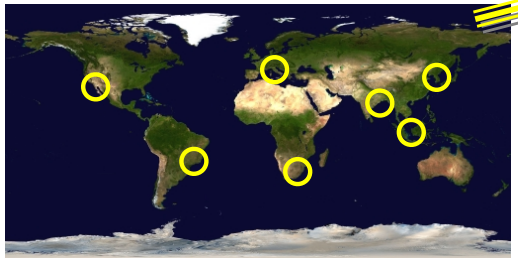
Research approach, Methodology (7)

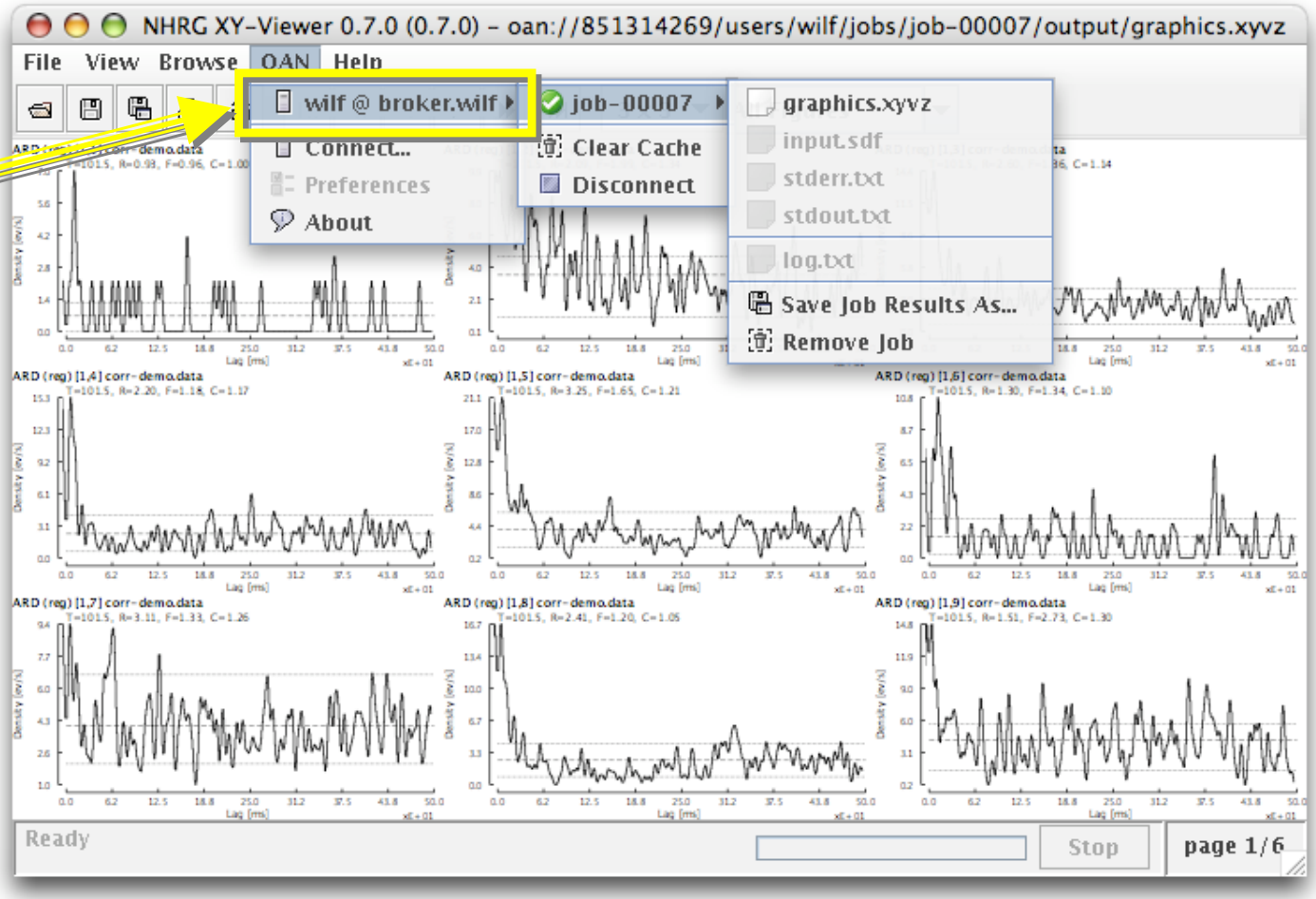


NEURO - HEURISTIC RESEARCH GROUP

end-user computer: oan-aware XY-Viewer

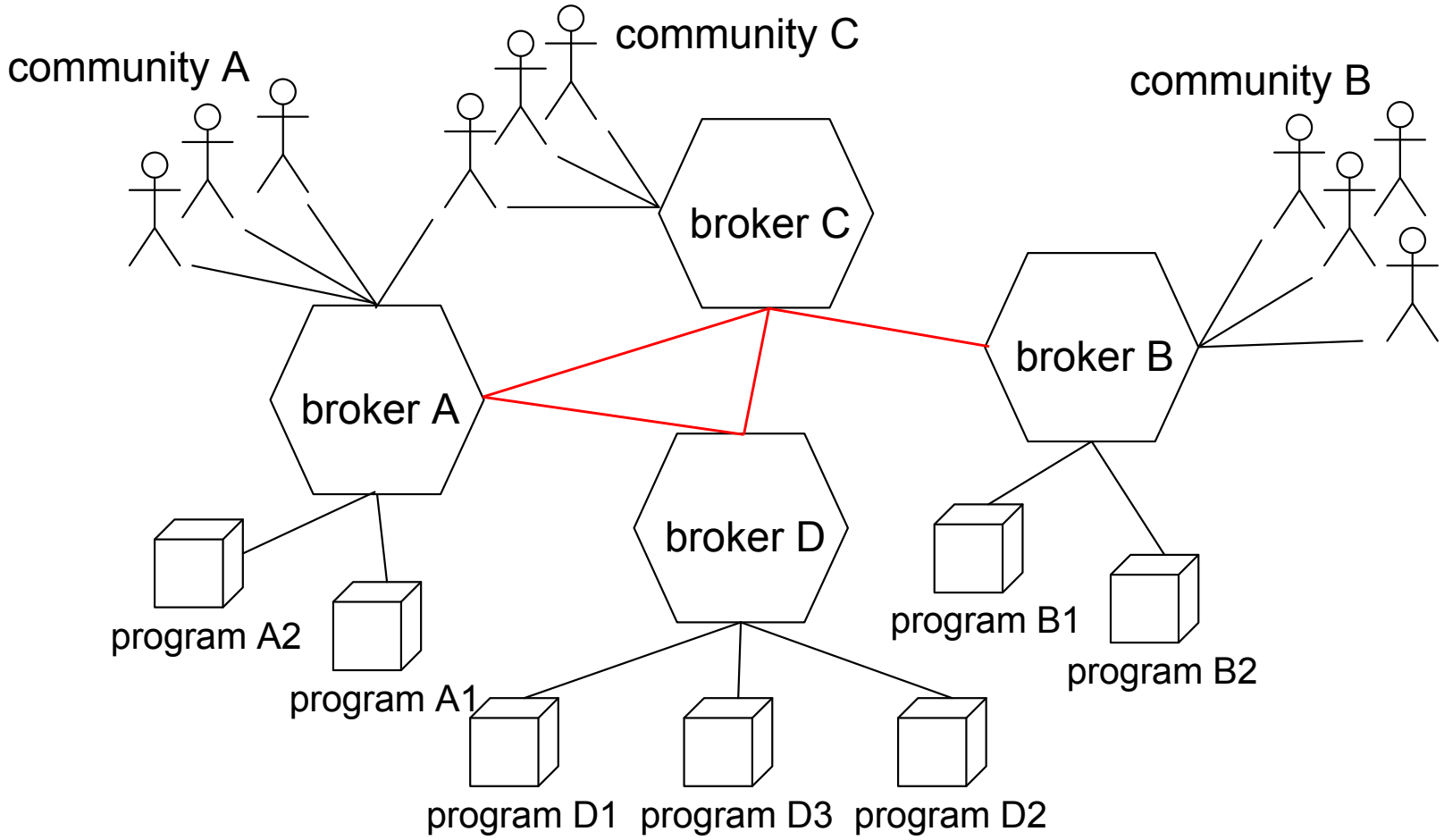
ENABLING COLLABORATIVE WORKING ENVIRONMENT





OpenAdap.net

Brain inspired evolvable connectivity

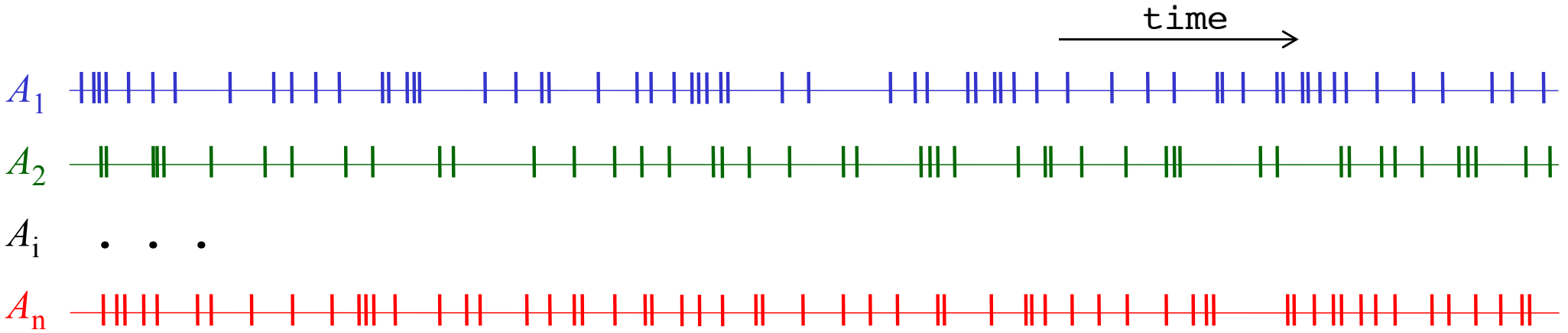


Brain inspired evolvable connectivity

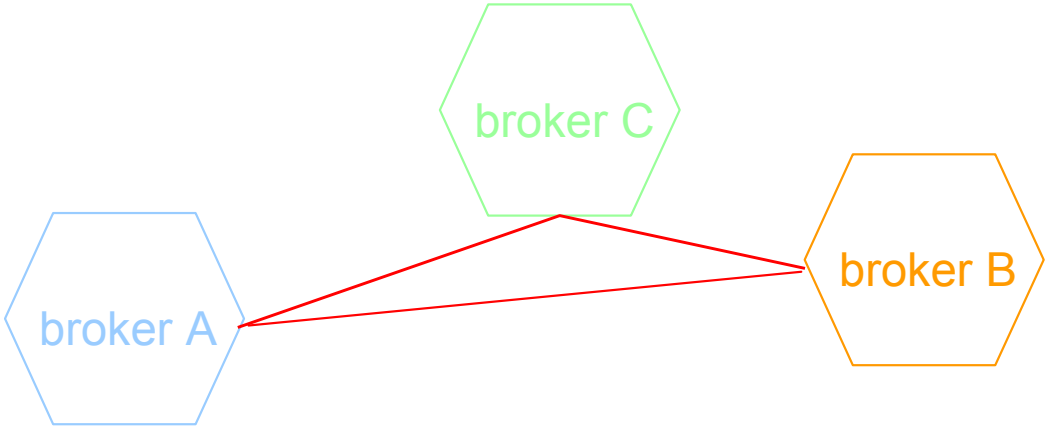
broker A

Each broker is characterized by multidimensional parameters $\{X_i\}$ like the computing load generated by specific tasks, the availability of the resources, the number of accesses or the semantic proximity with the other brokers.

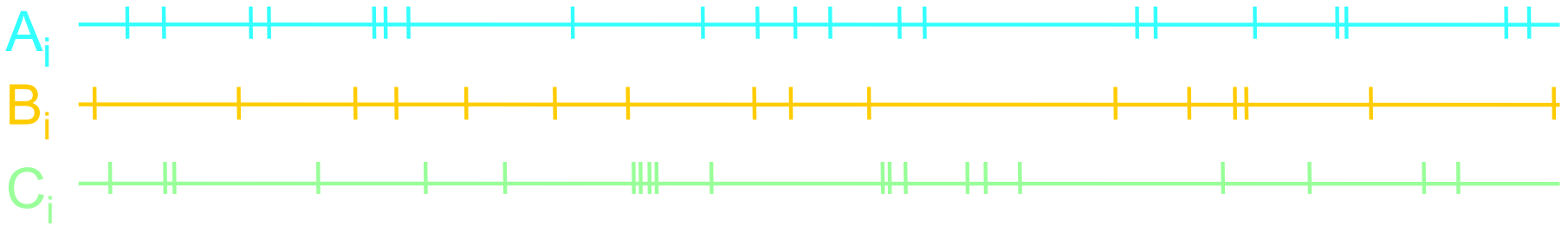
The dynamics of each parameter is expressed by a sequence of discrete values corresponding to multidimensional point processes.



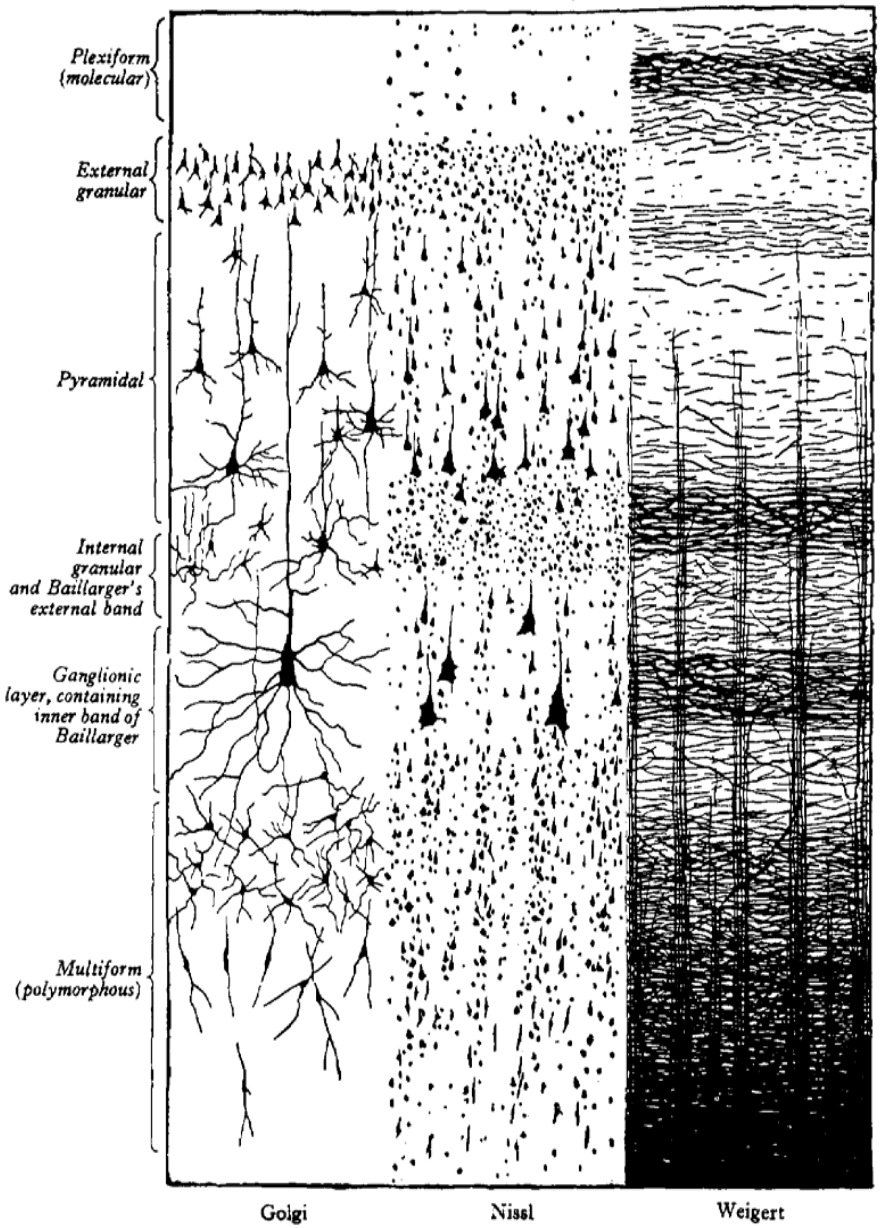
Brain inspired evolvable connectivity



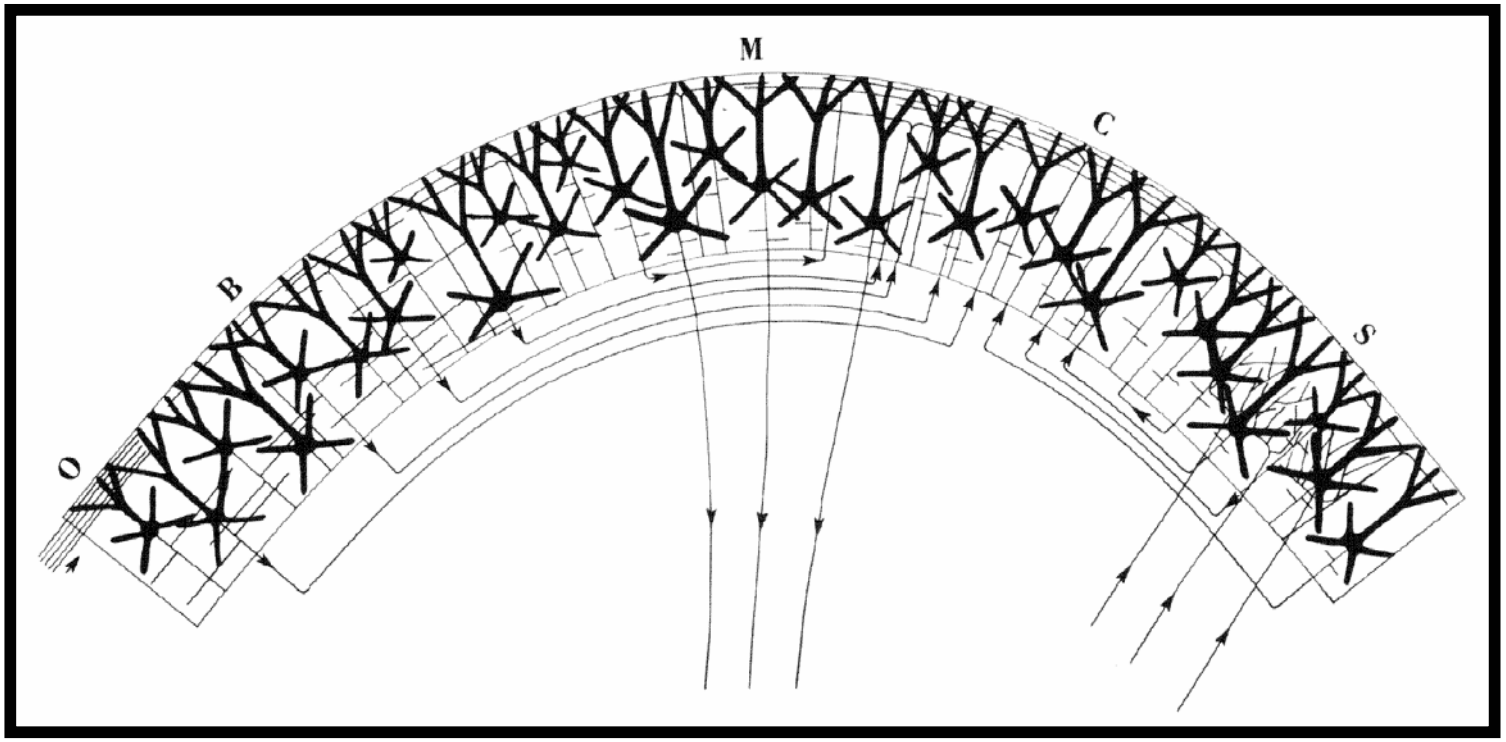
Multidimensional point processes for a specific parameter across several brokers



Brain inspired evolvable connectivity



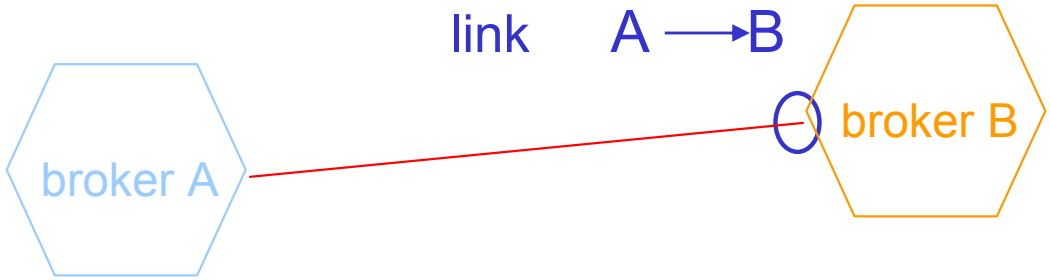
Brain inspired evolvable connectivity

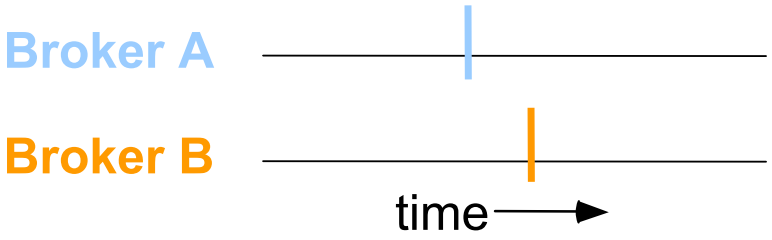


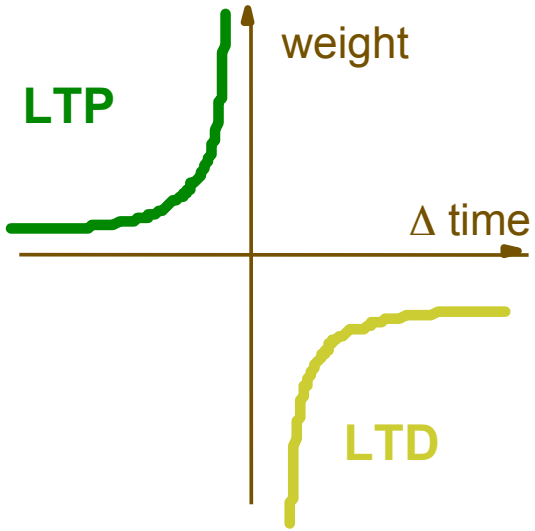
The skeleton cortex (fig. 8.3) from "On textures of Brain", by Valentino Braitenberg, Springer Verlag, 1977.

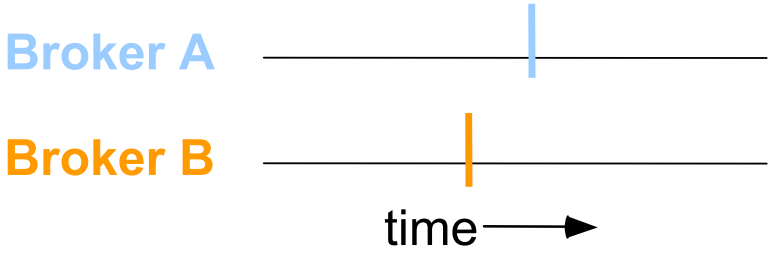
Brain inspired evolvable connectivity

Modifiable links by Event Timing Dependent Plasticity





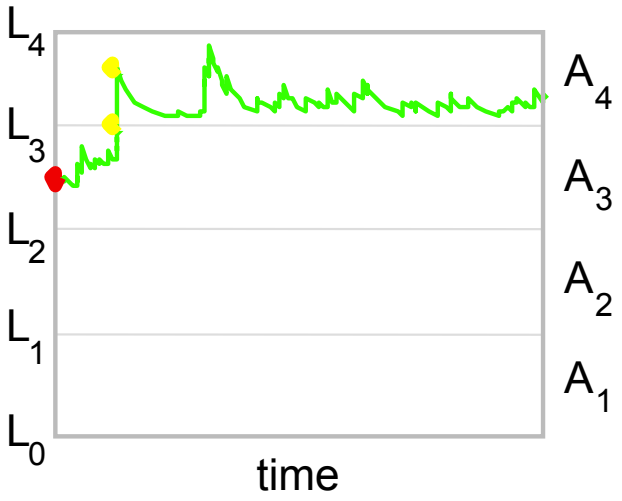




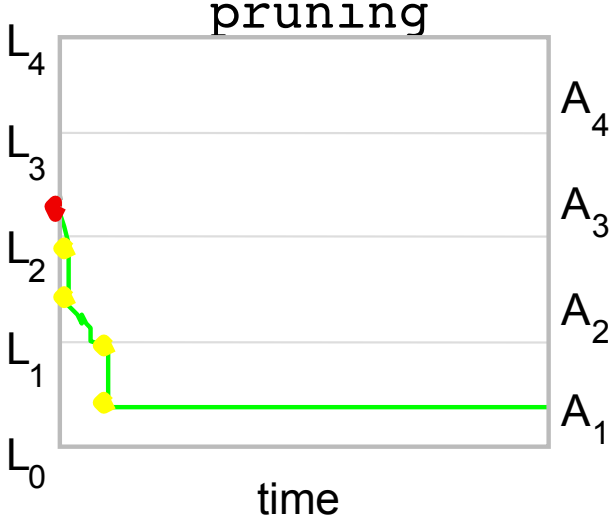
Brain inspired evolvable connectivity

Effect of Event Timing Dependent Plasticity

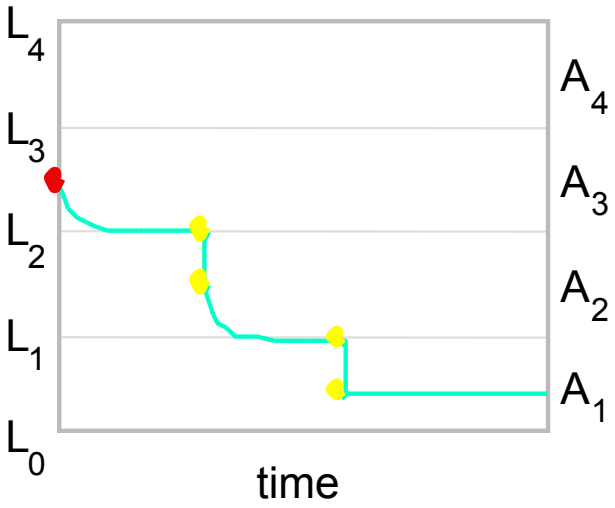
Potentiation & link strengthening



depression & link pruning



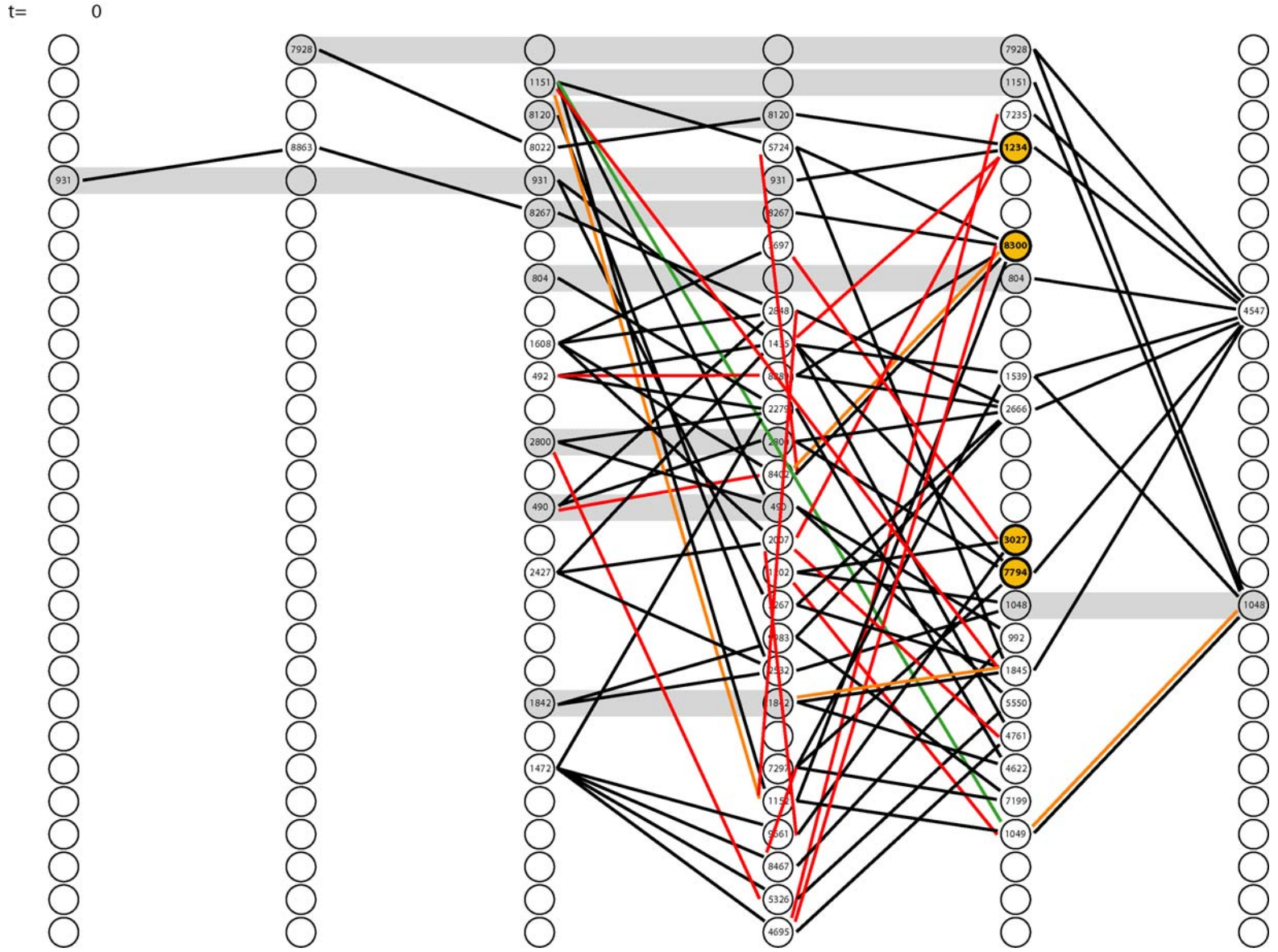
link pruning



NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

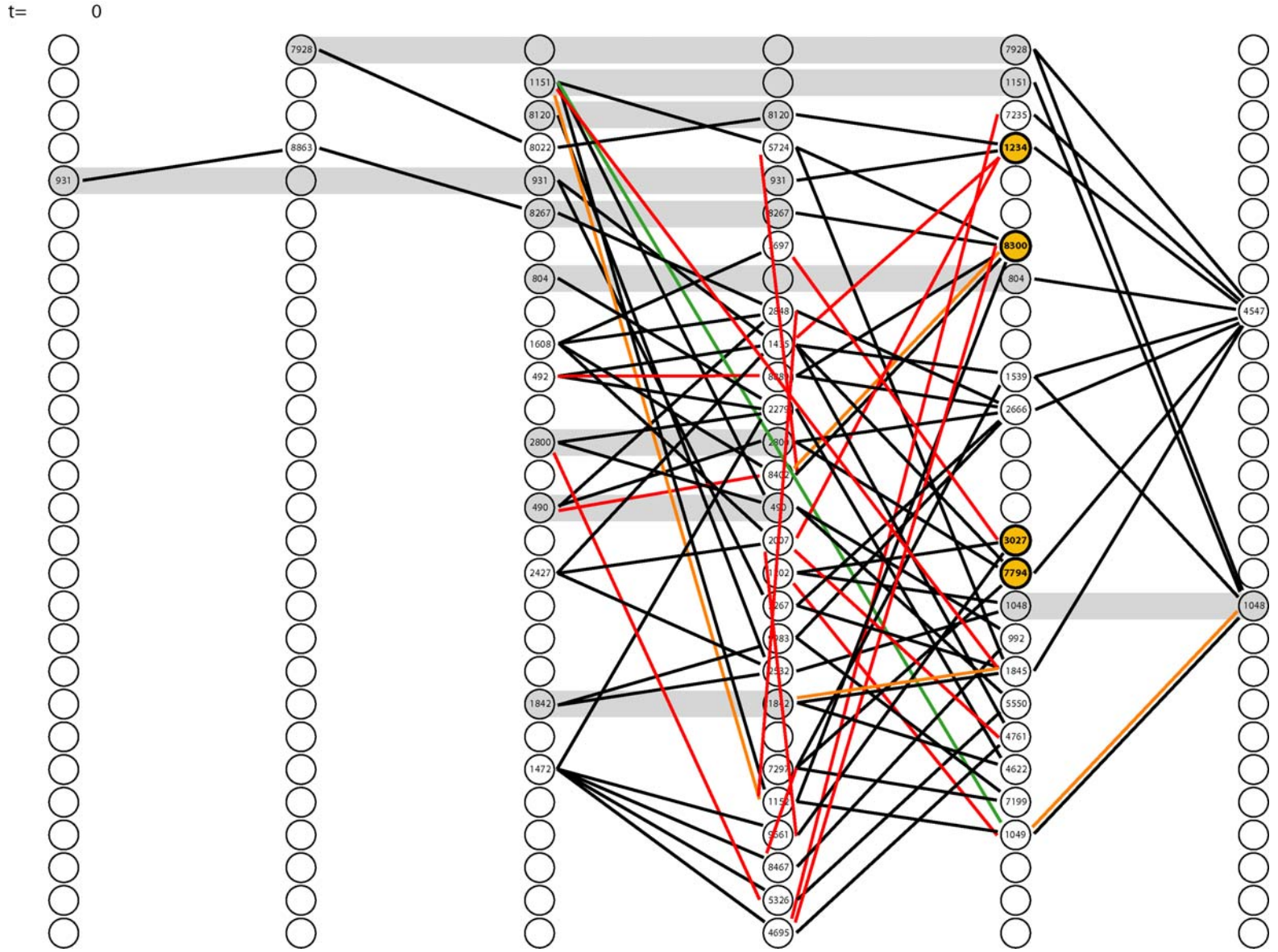
Background noise = 10 events/s | NO INPUT



NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

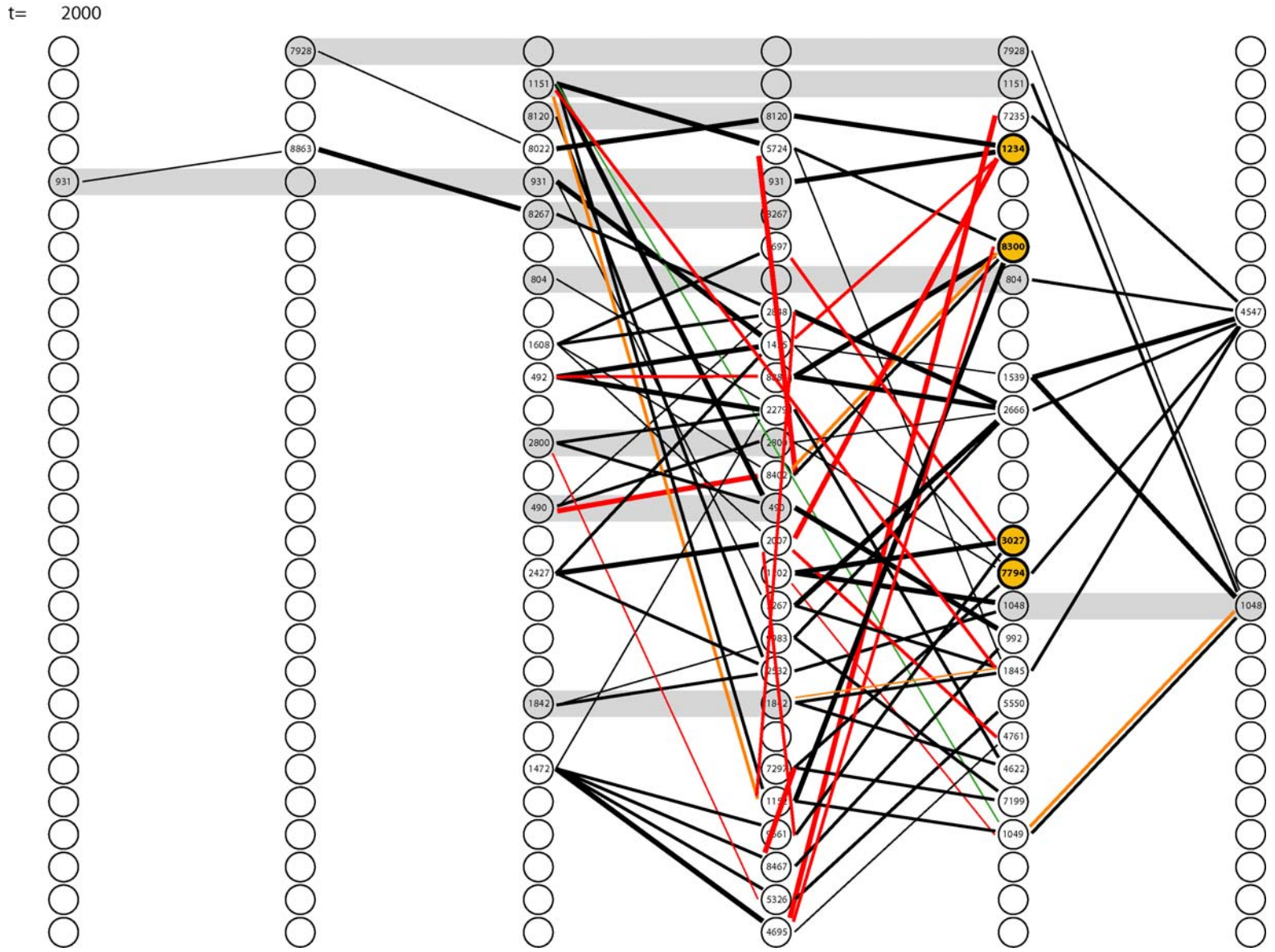
Background noise = 10 events/s | NO INPUT



NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | NO INPUT

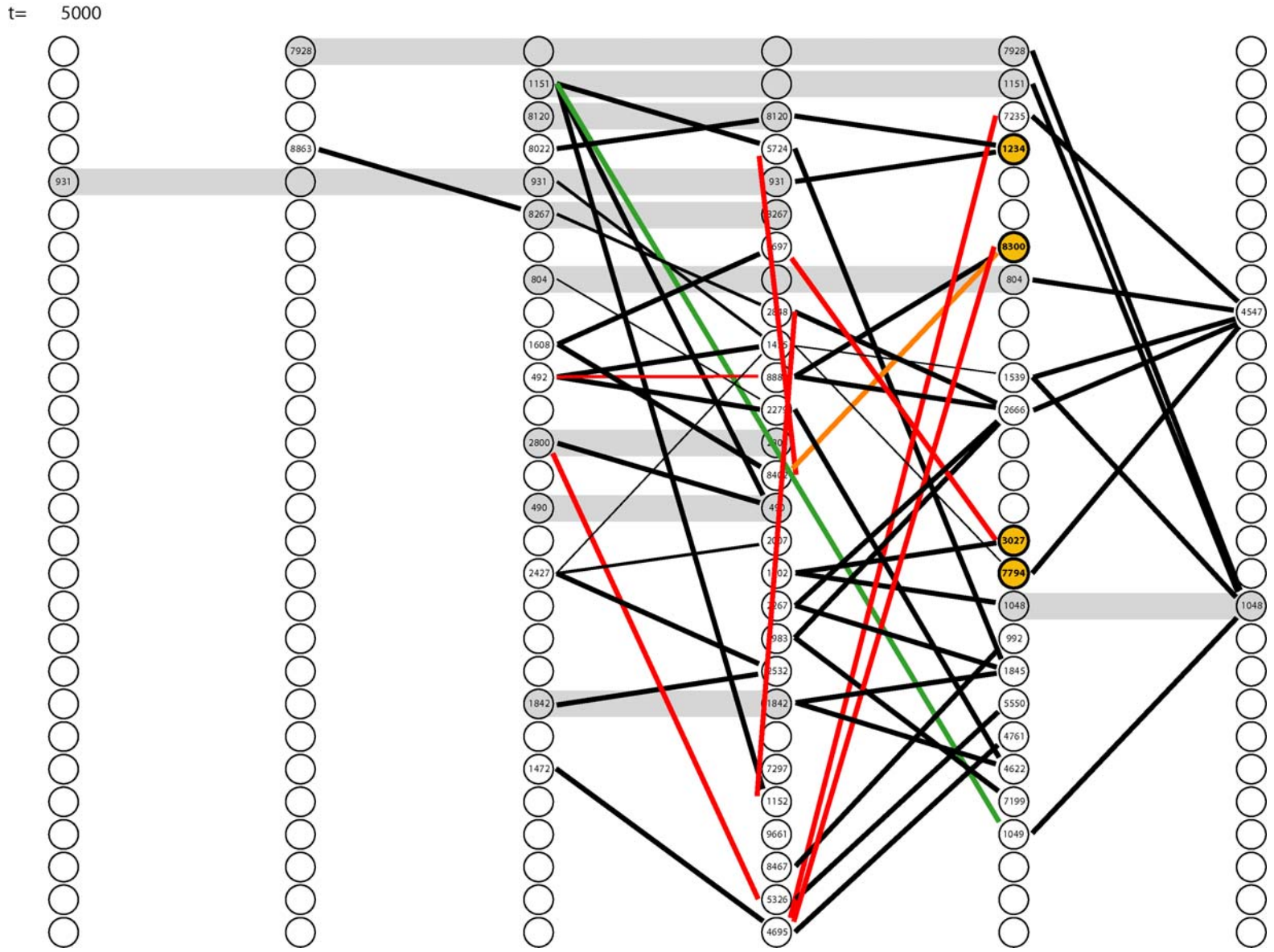


OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | NO INPUT

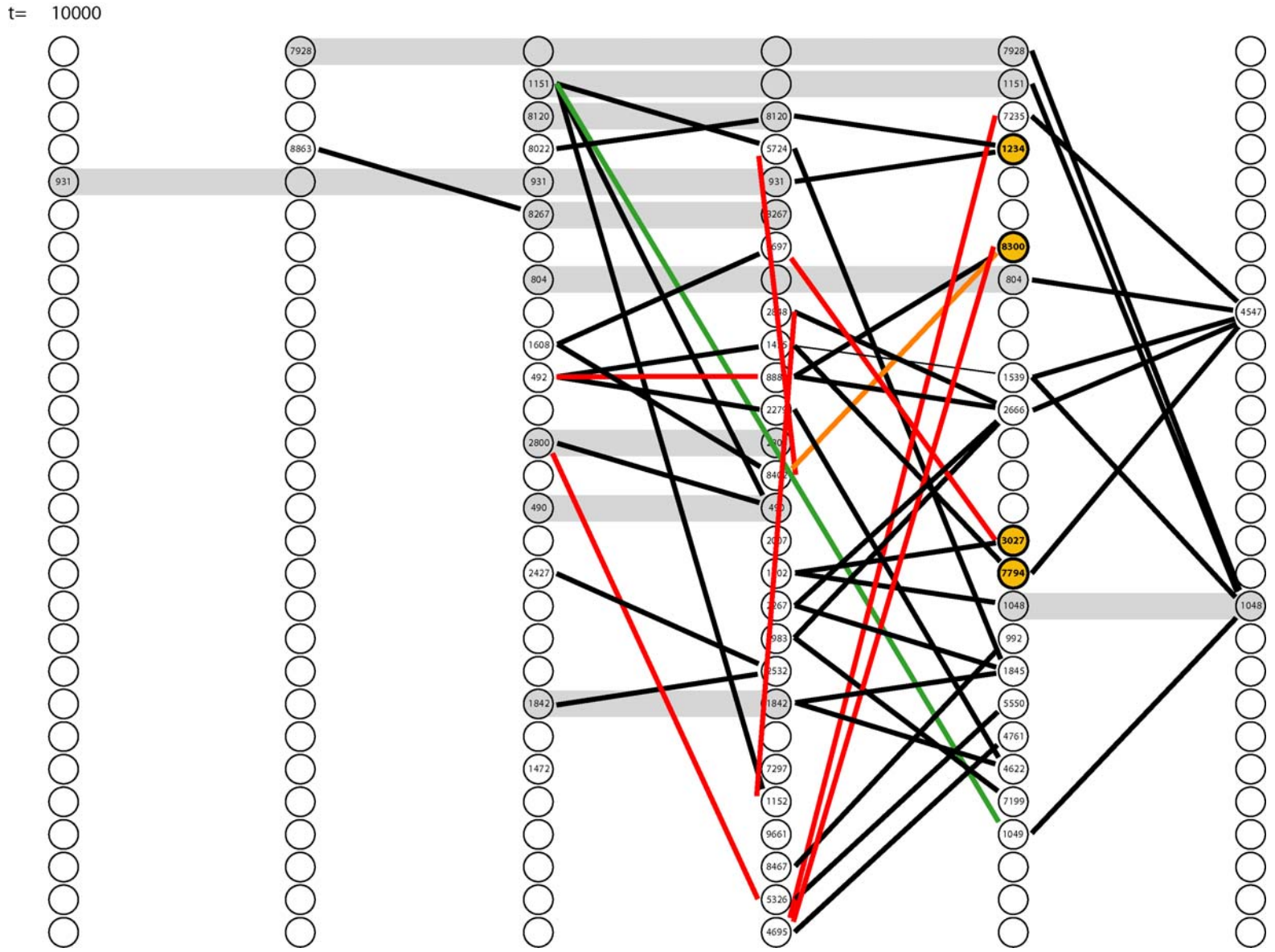


OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

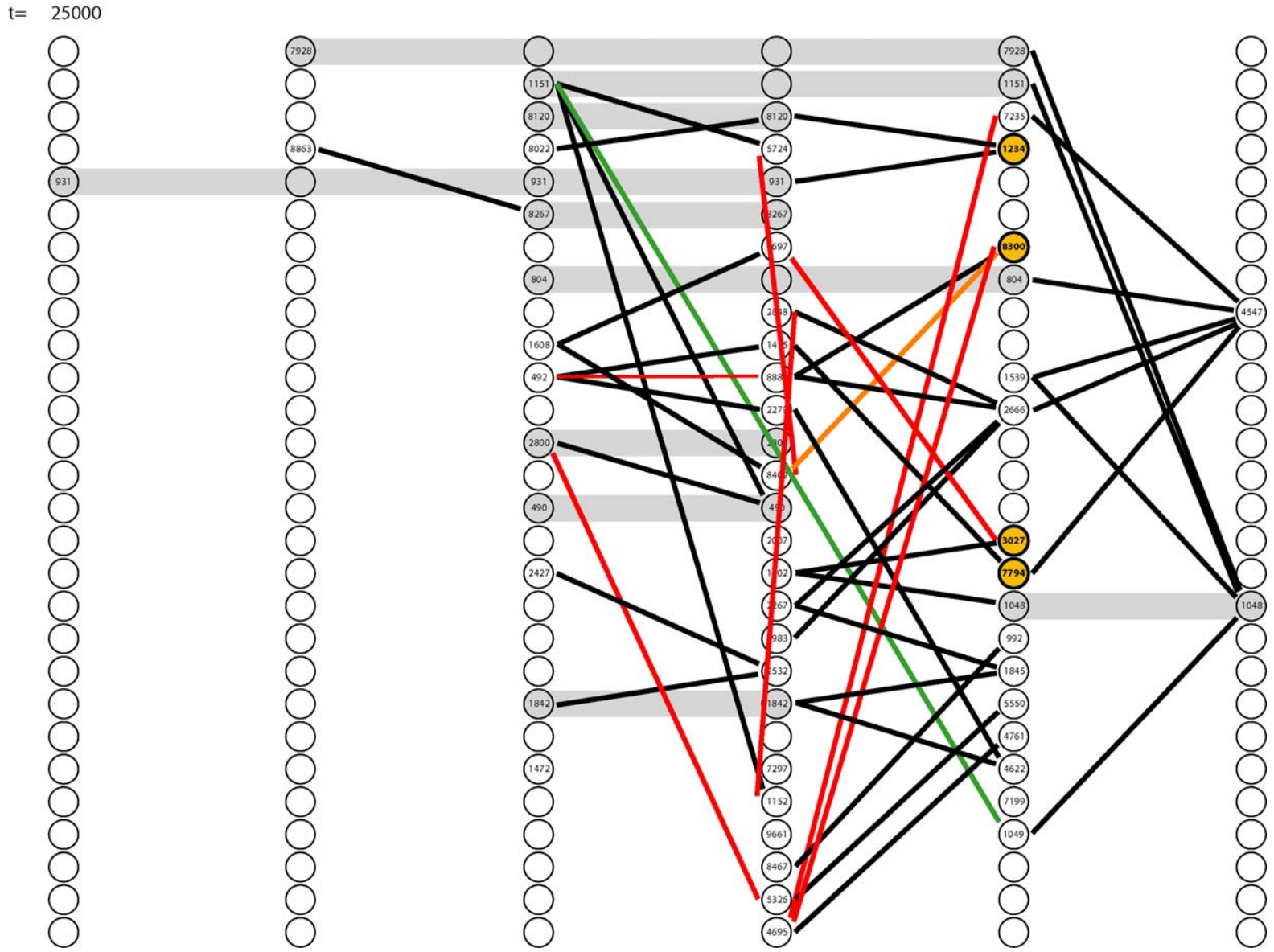
Background noise = 10 events/s | NO INPUT



NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

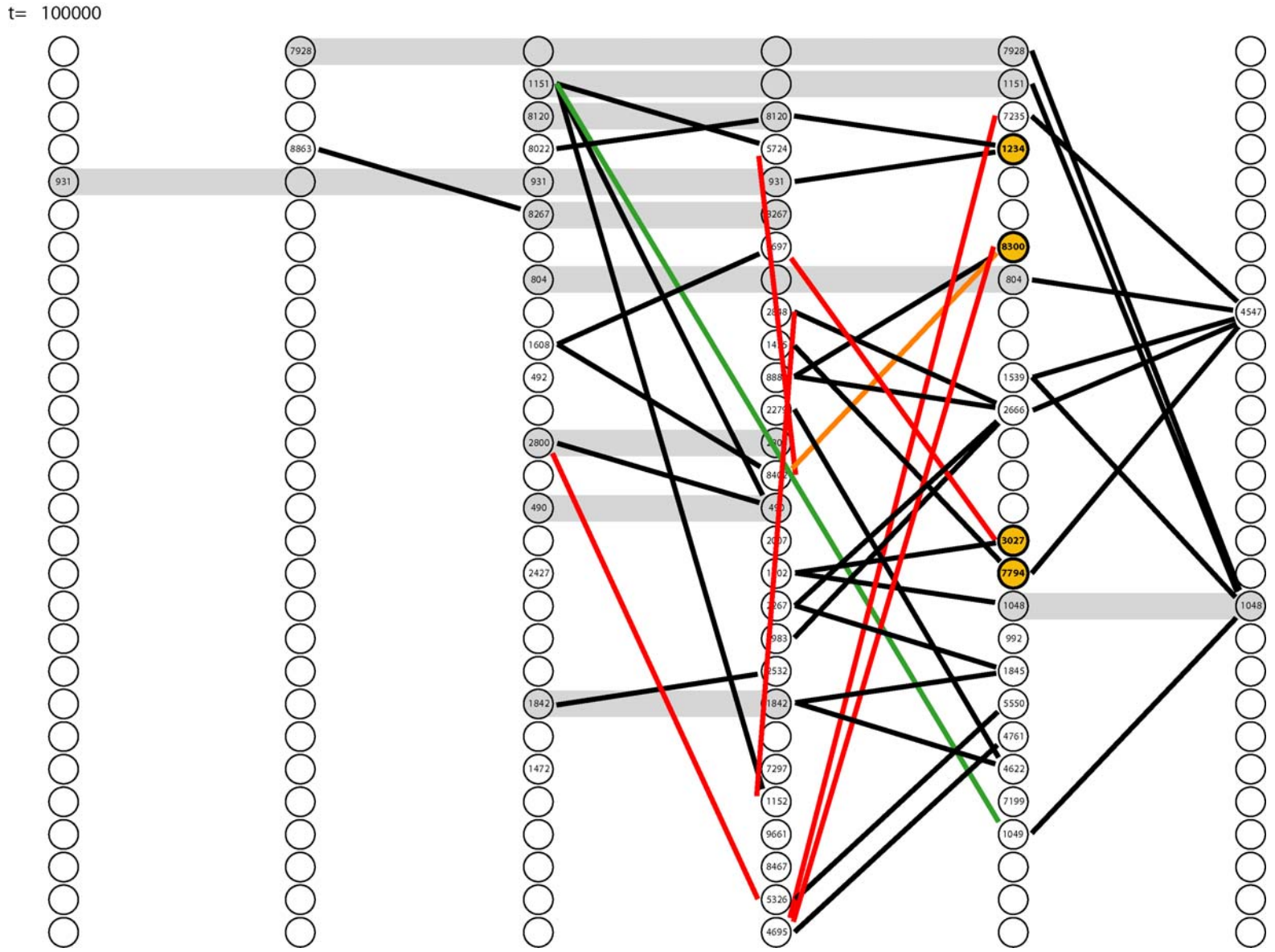
Background noise = 10 events/s | NO INPUT



NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | NO INPUT

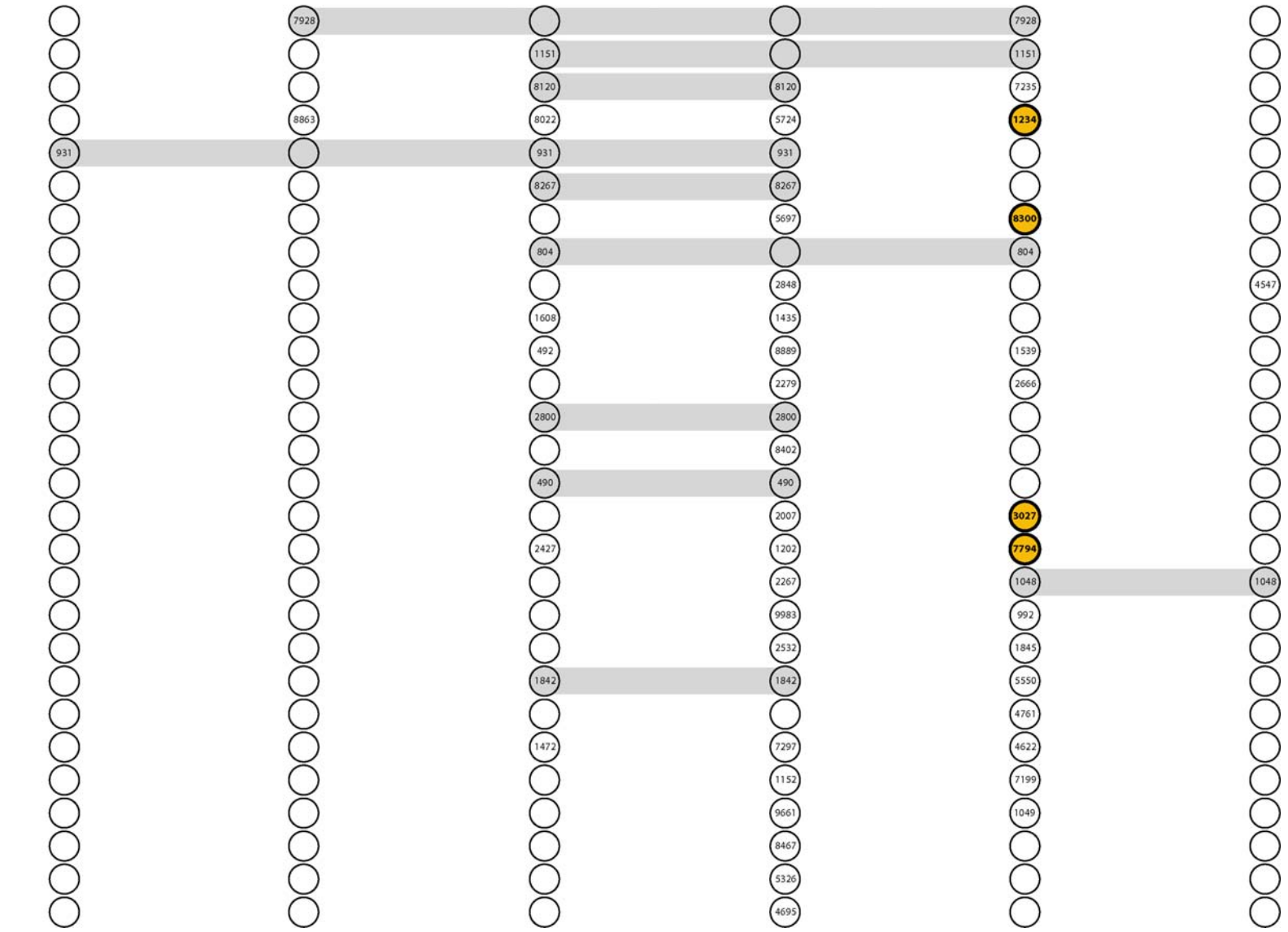


OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | NO INPUT



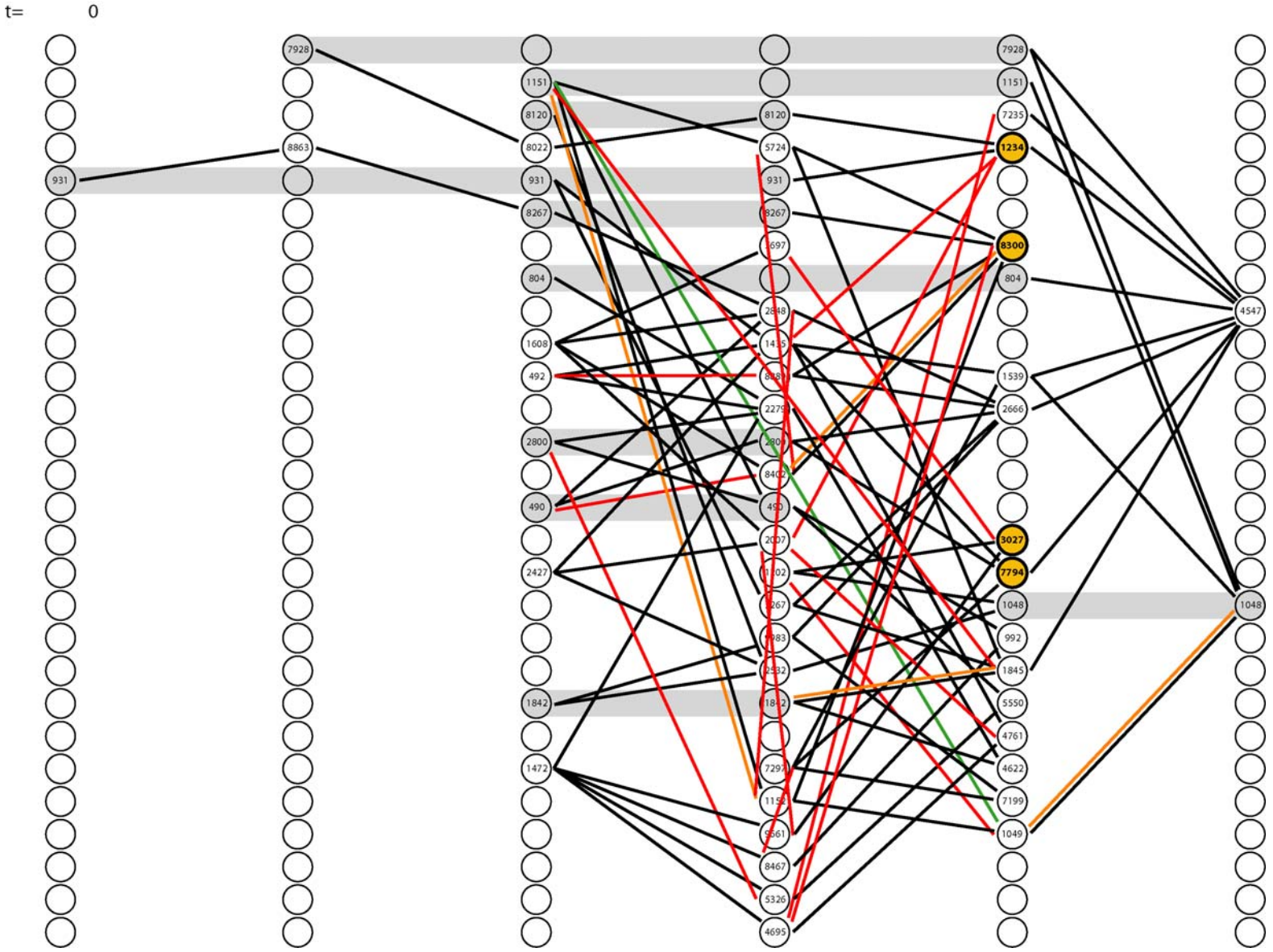
OpenAdap.net

Brain inspired evolvable connectivity

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

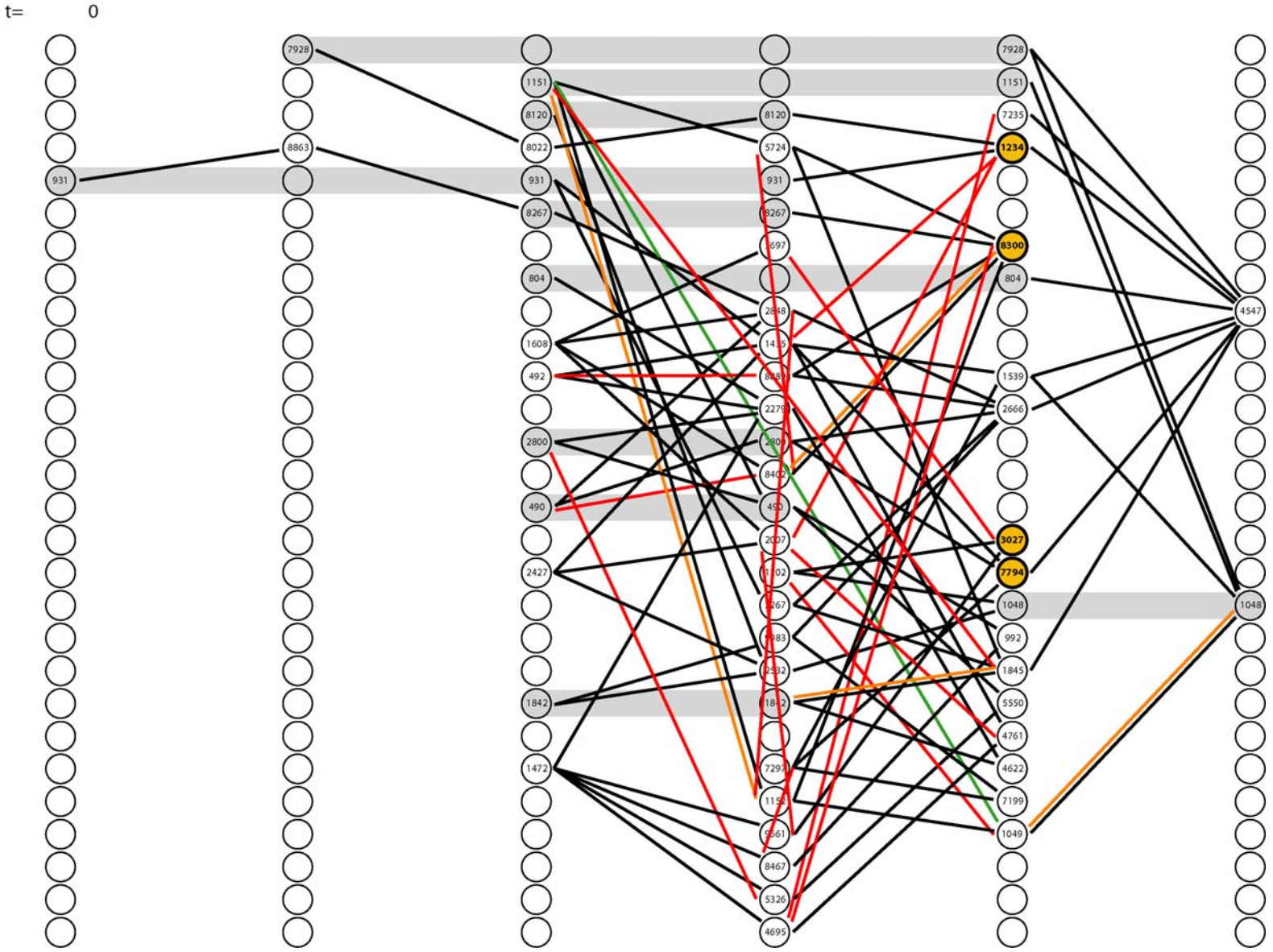


OpenAdap.net

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

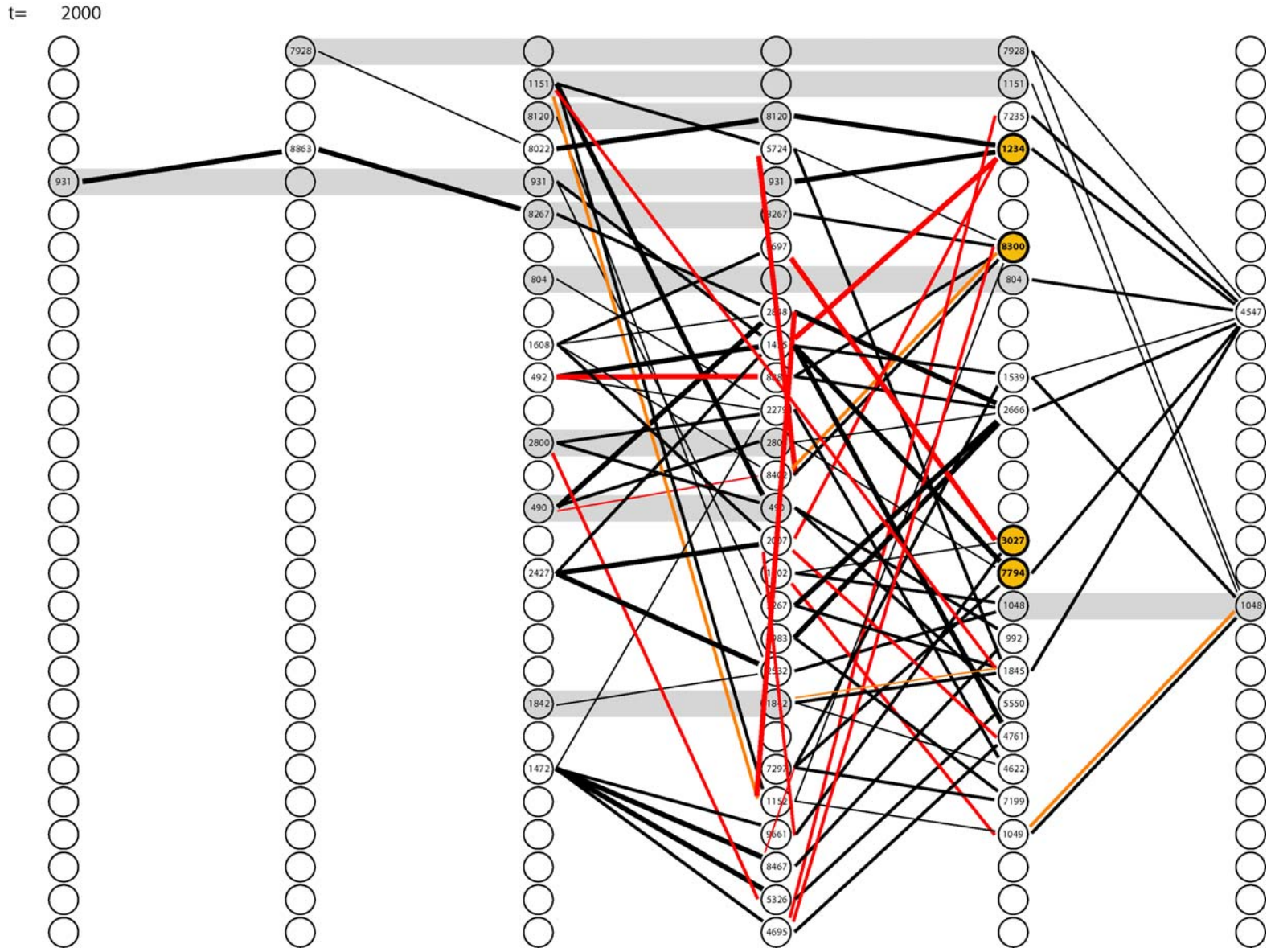


OpenAdap.net

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

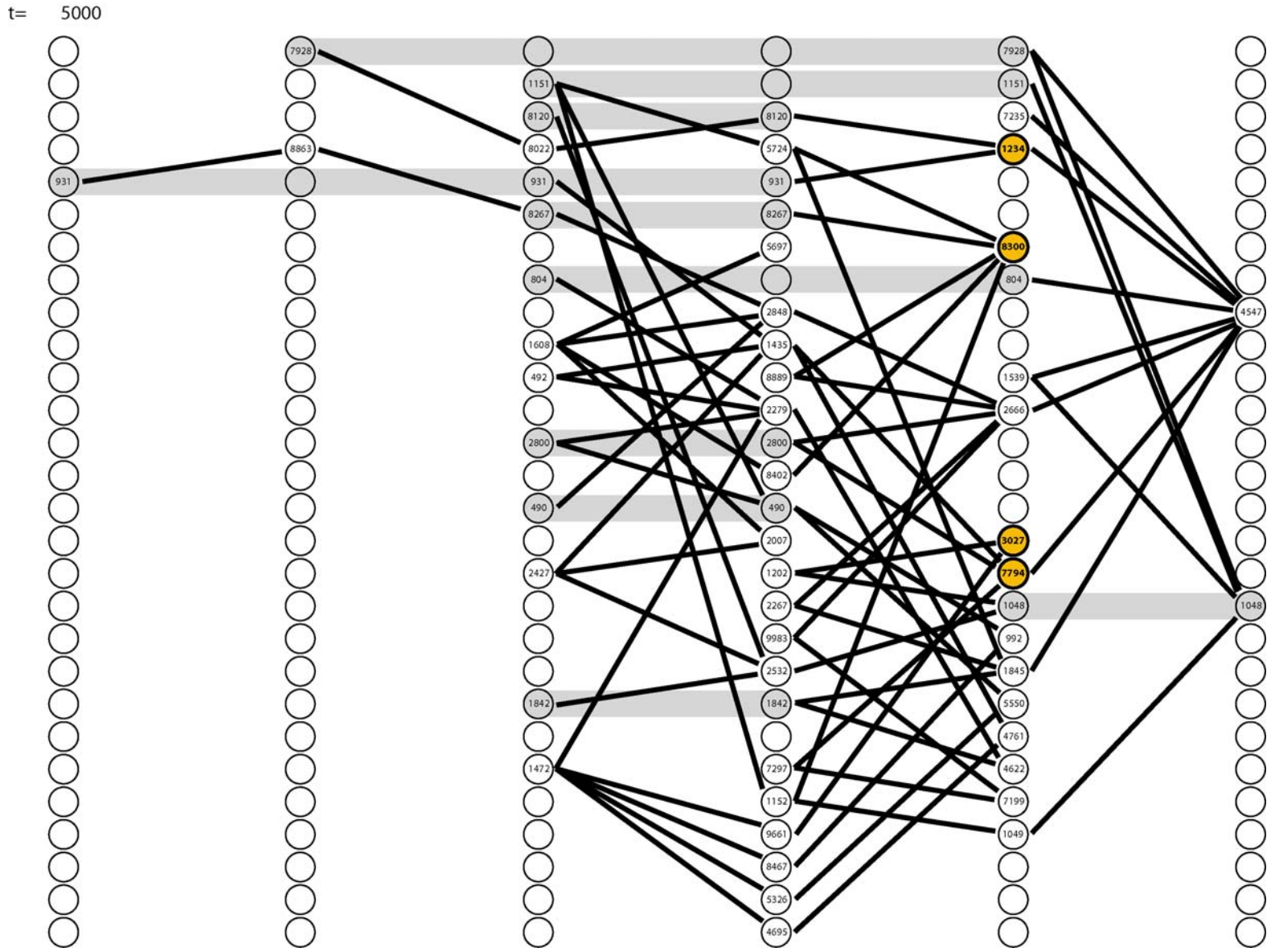
Background noise = 10 events/s | Spatio-temporal input pattern of activity



NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

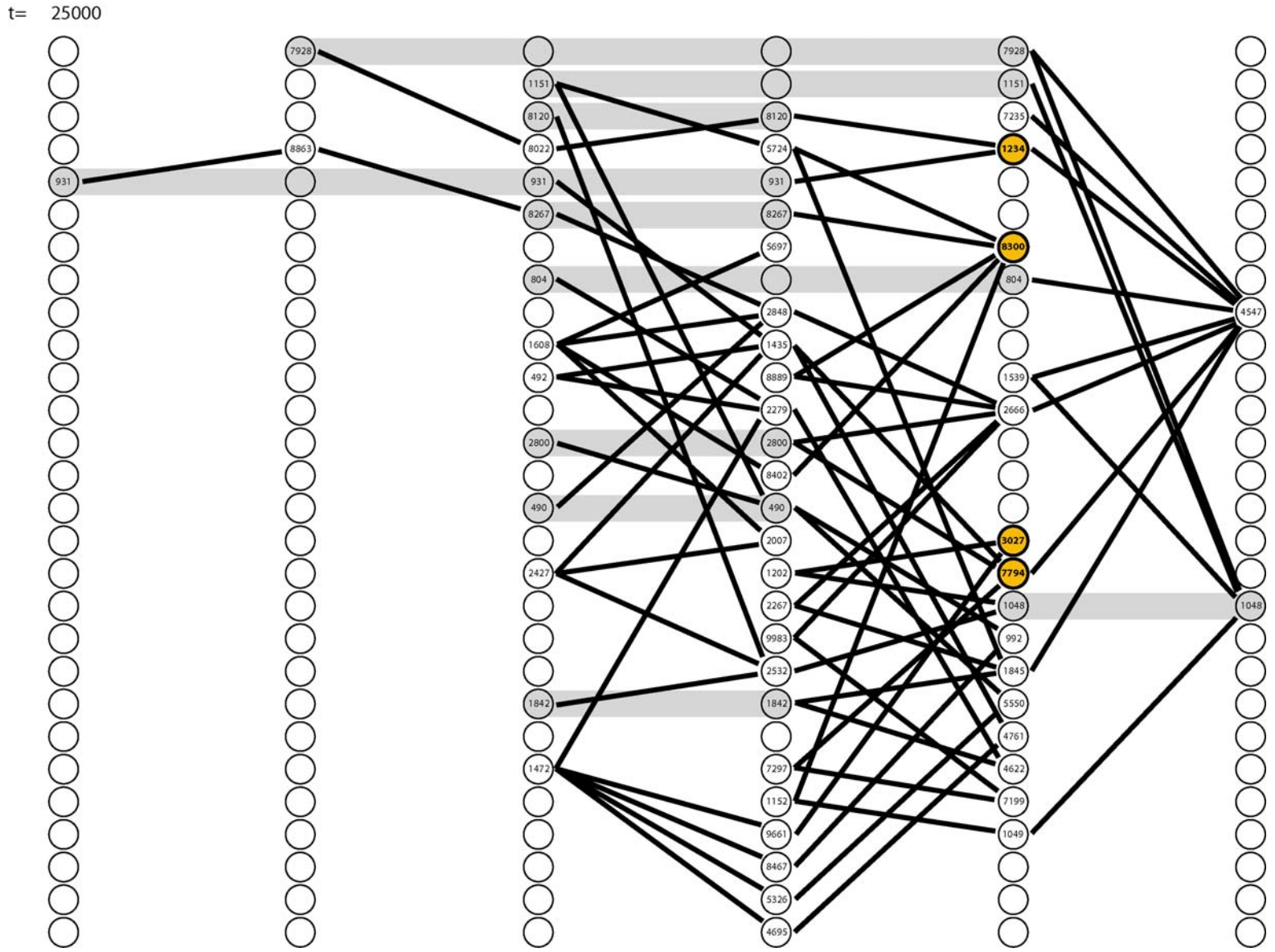


OpenAdap.net

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

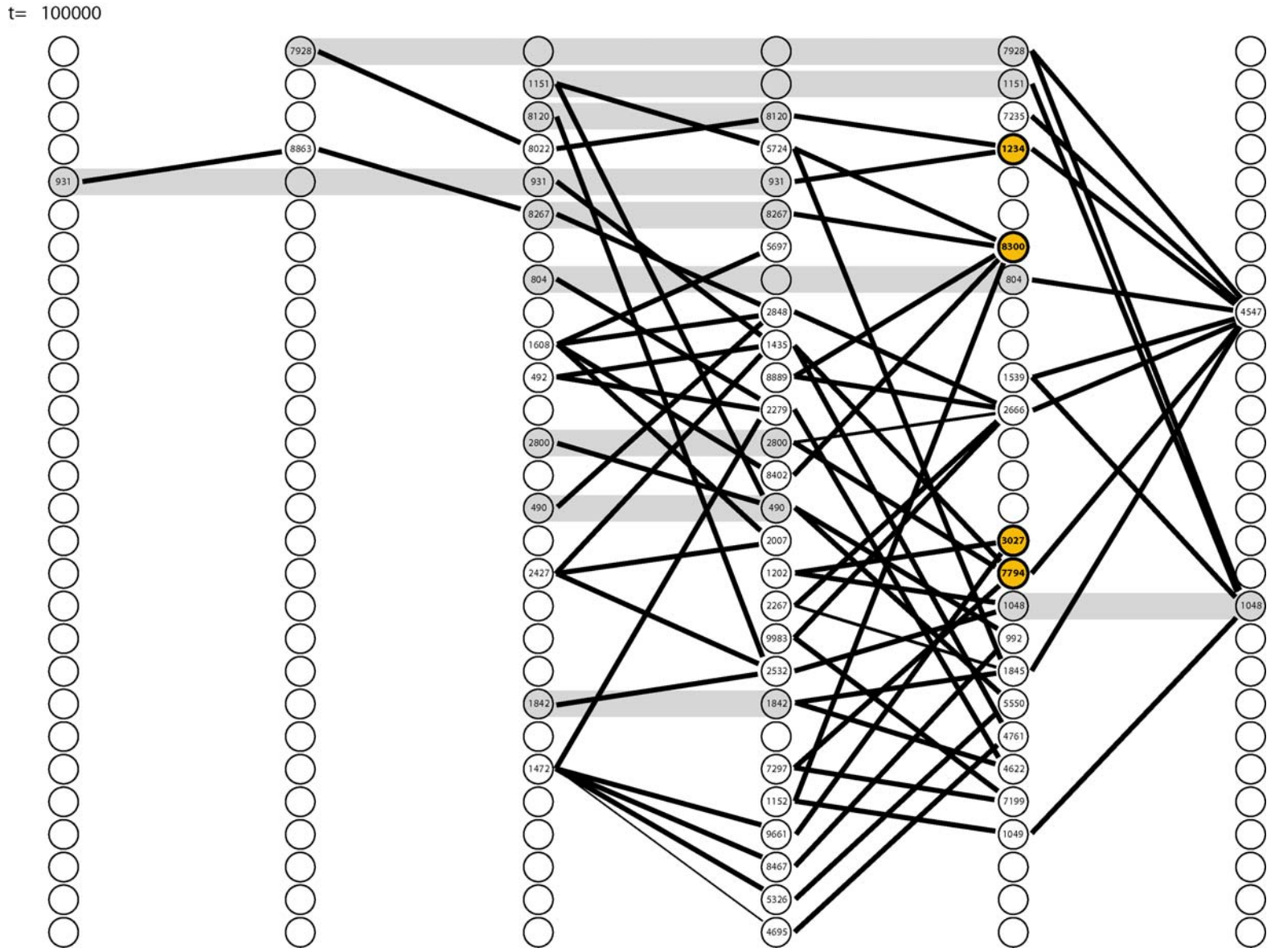


OpenAdap.net

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

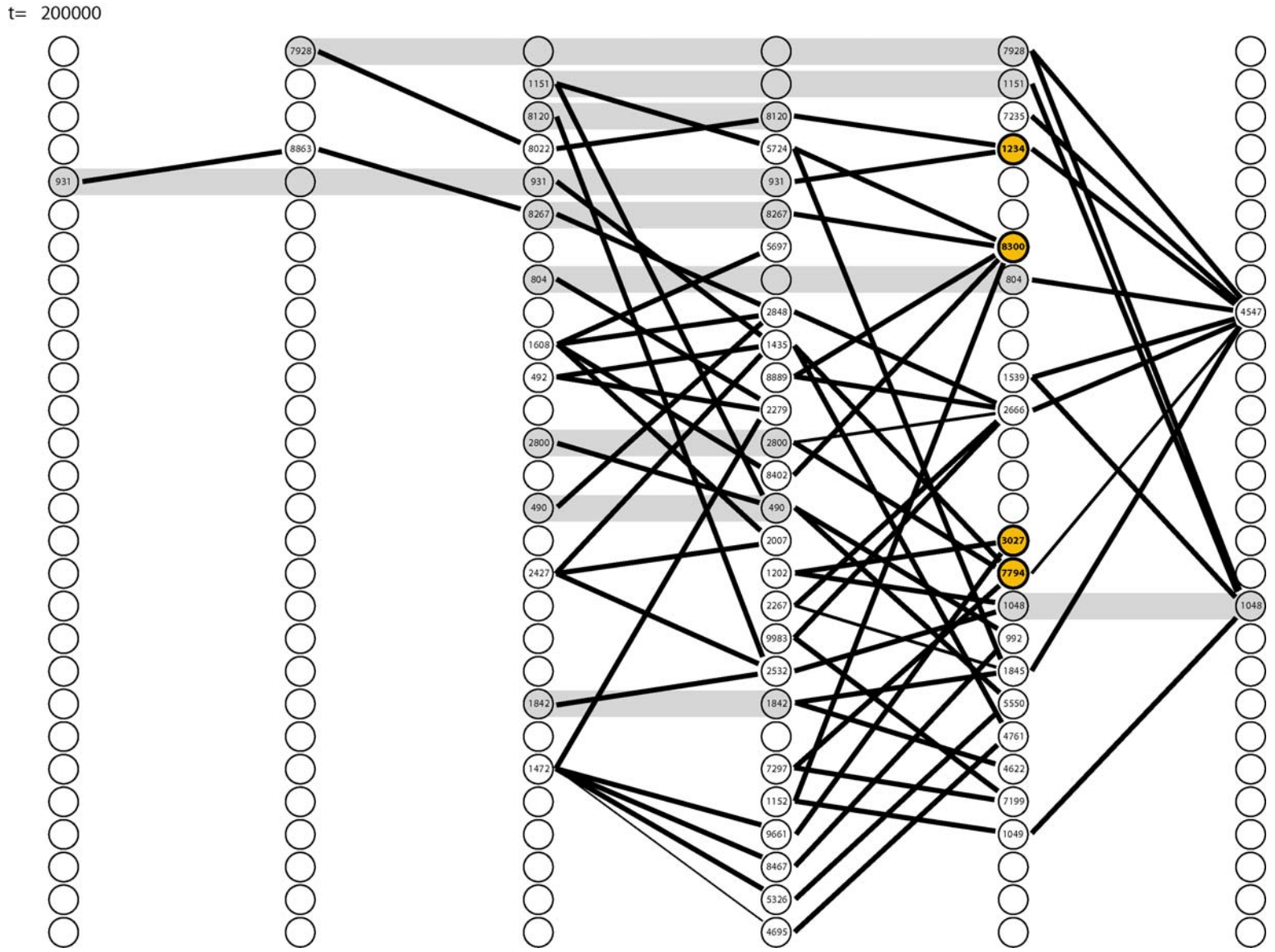
Background noise = 10 events/s | Spatio-temporal input pattern of activity



NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

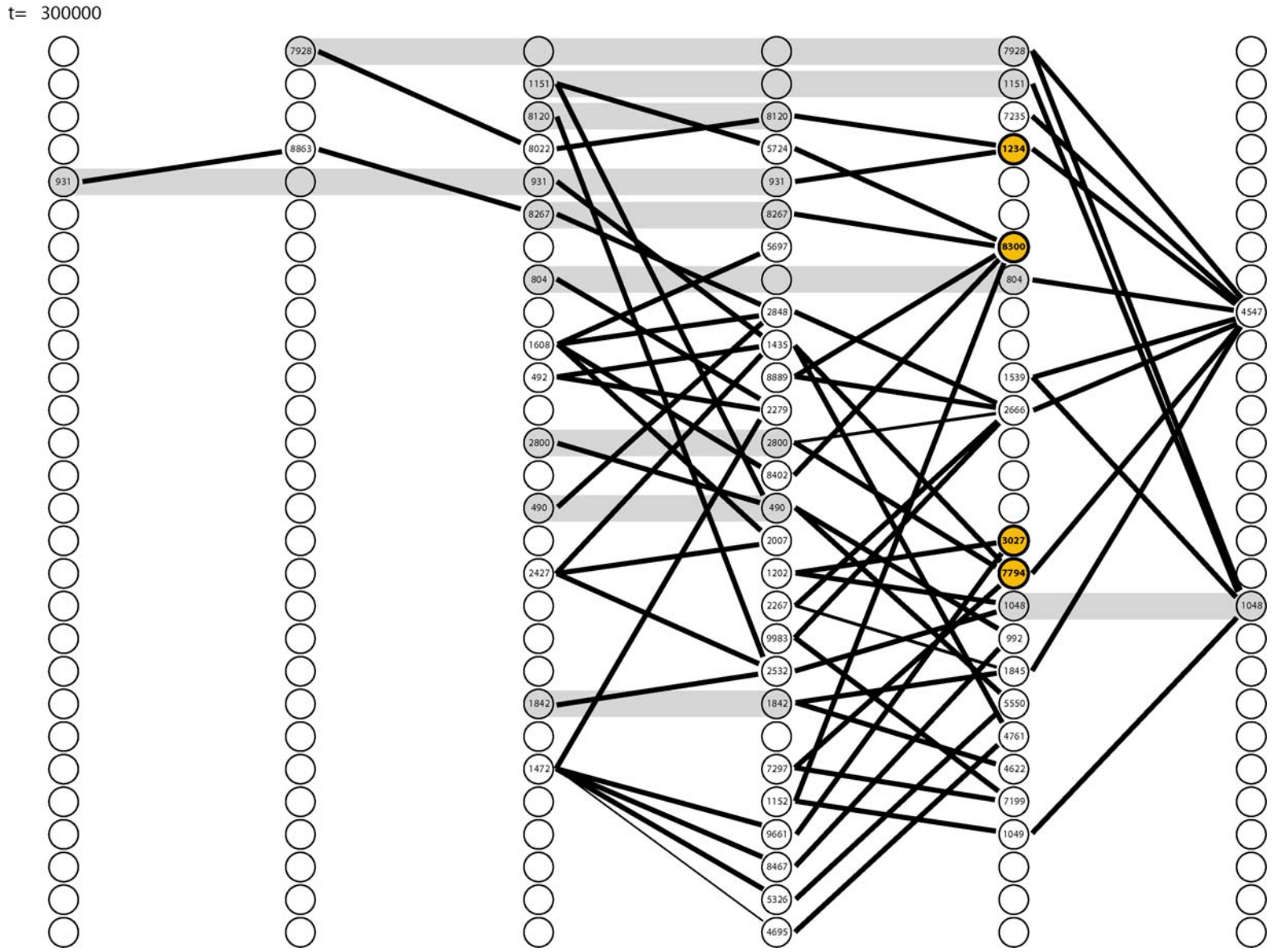
Background noise = 10 events/s | Spatio-temporal input pattern of activity



NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

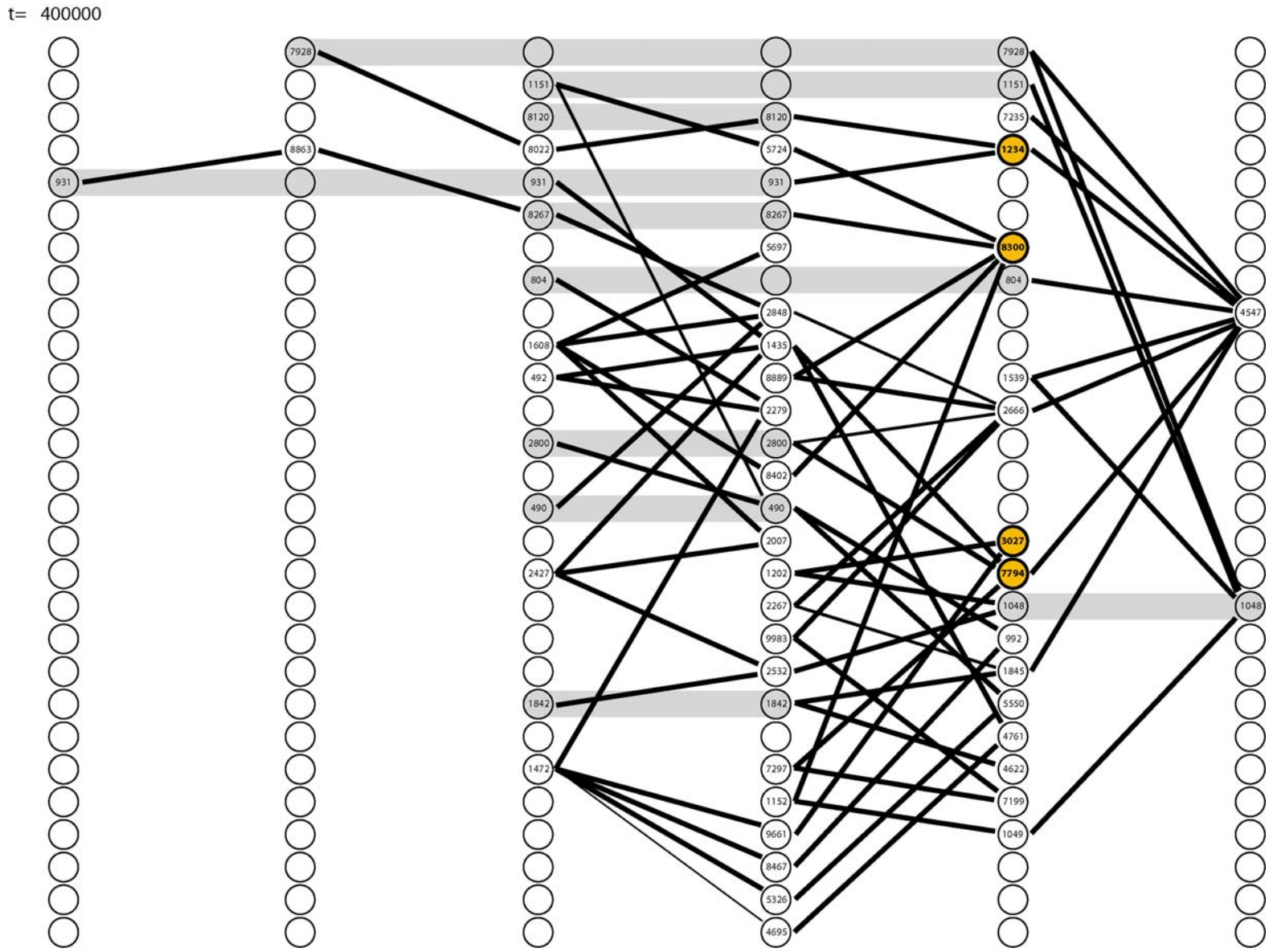


OpenAdap.net

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

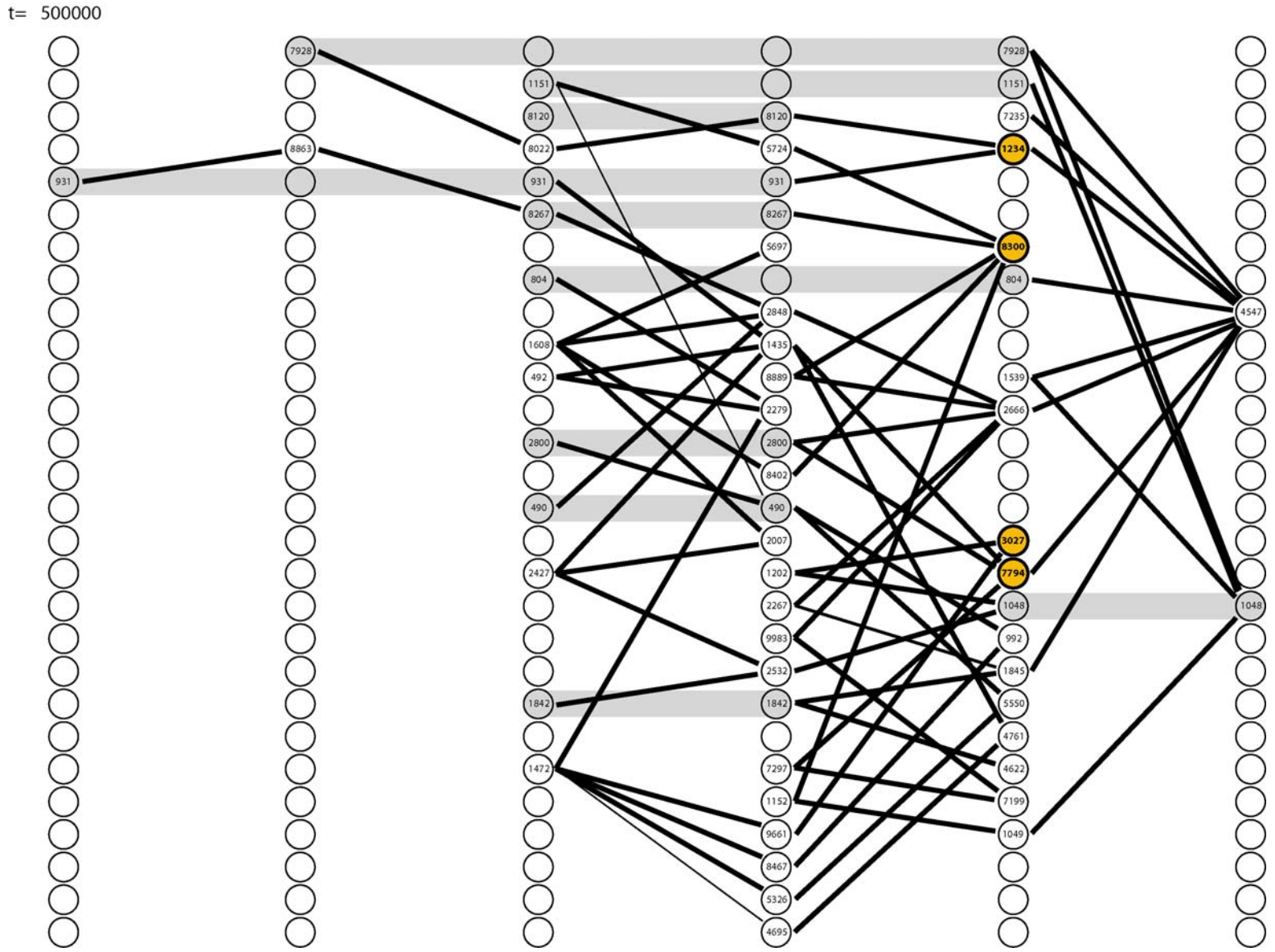


OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

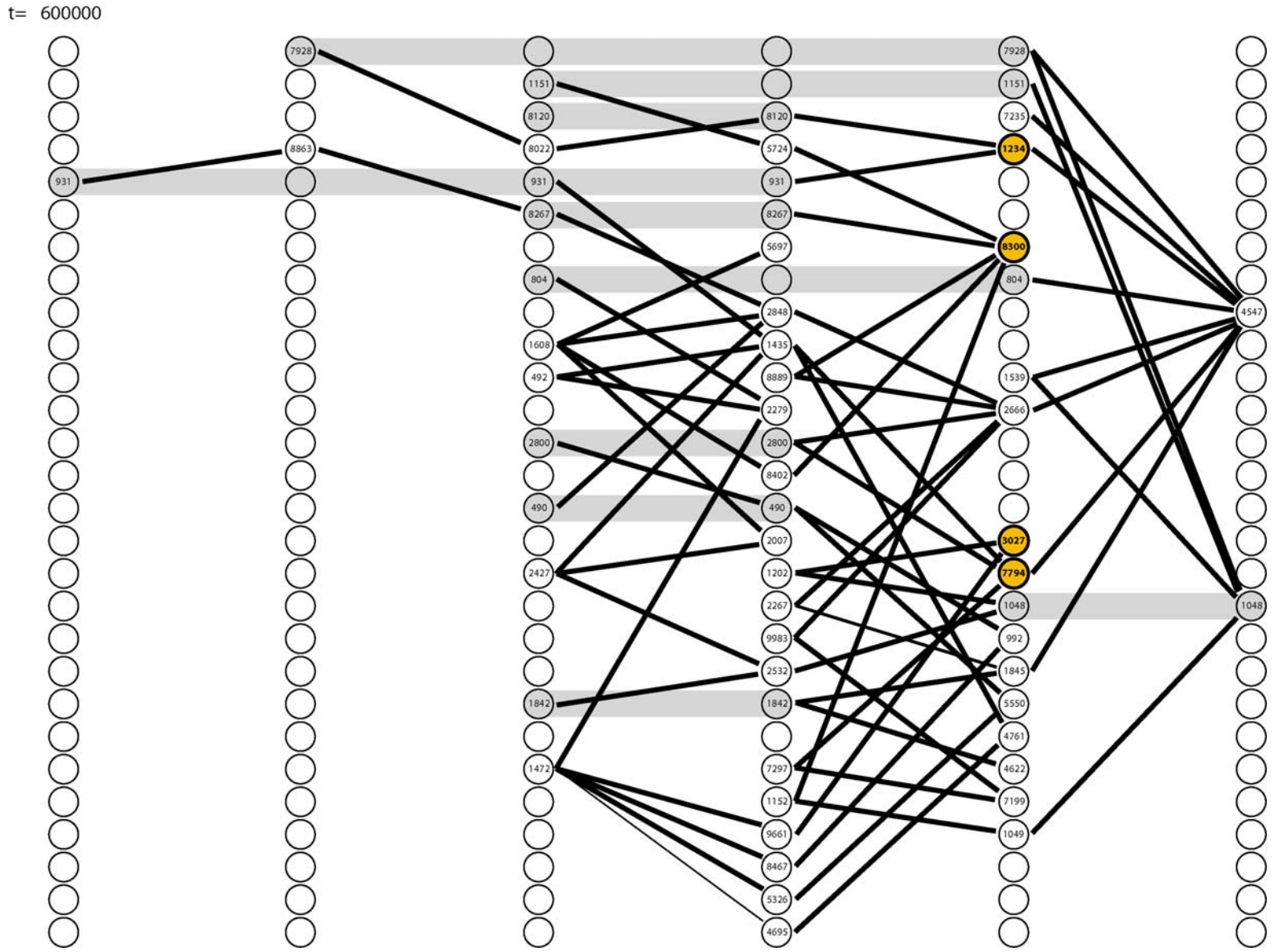


OpenAdap.net

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

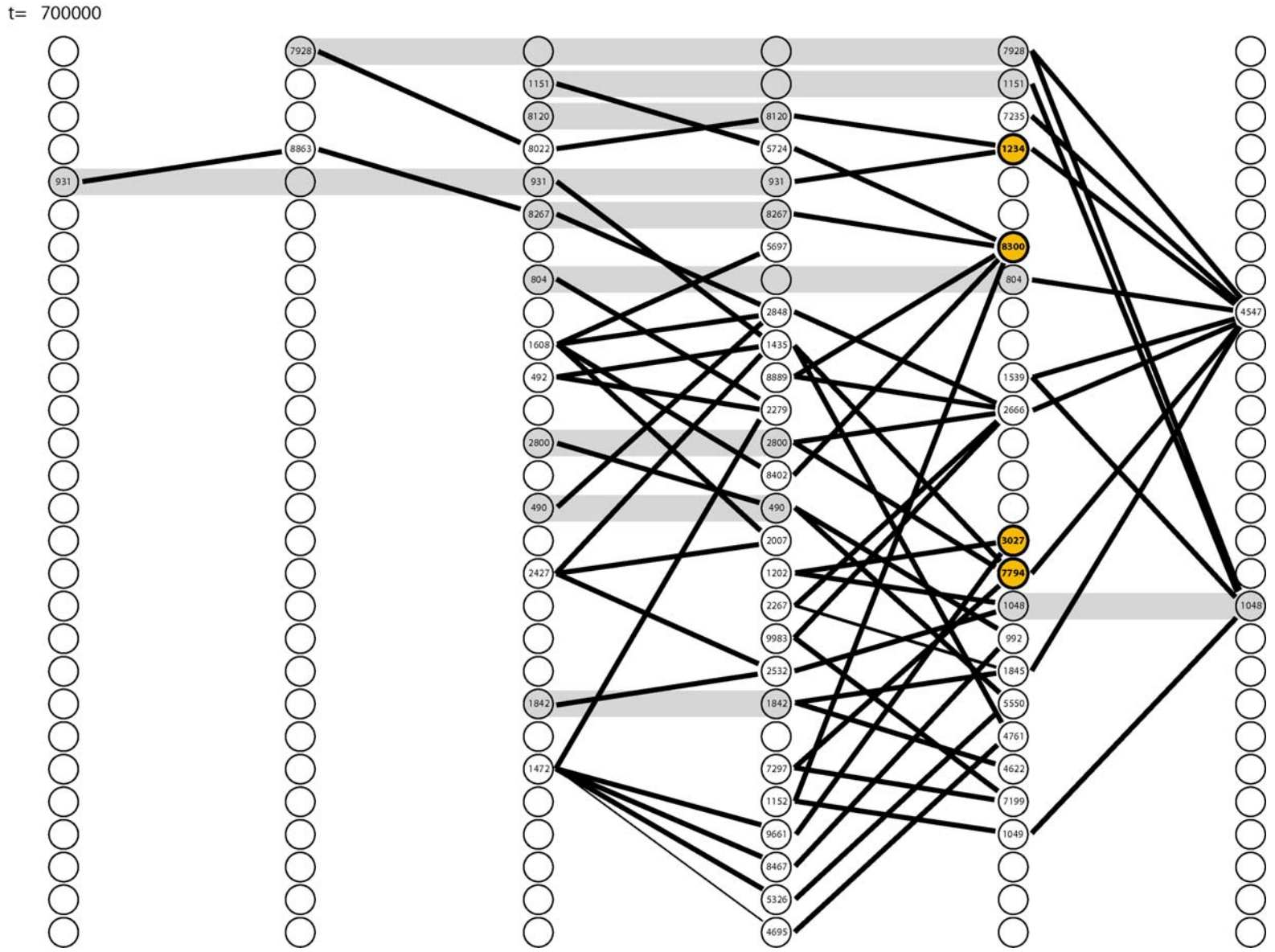


OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

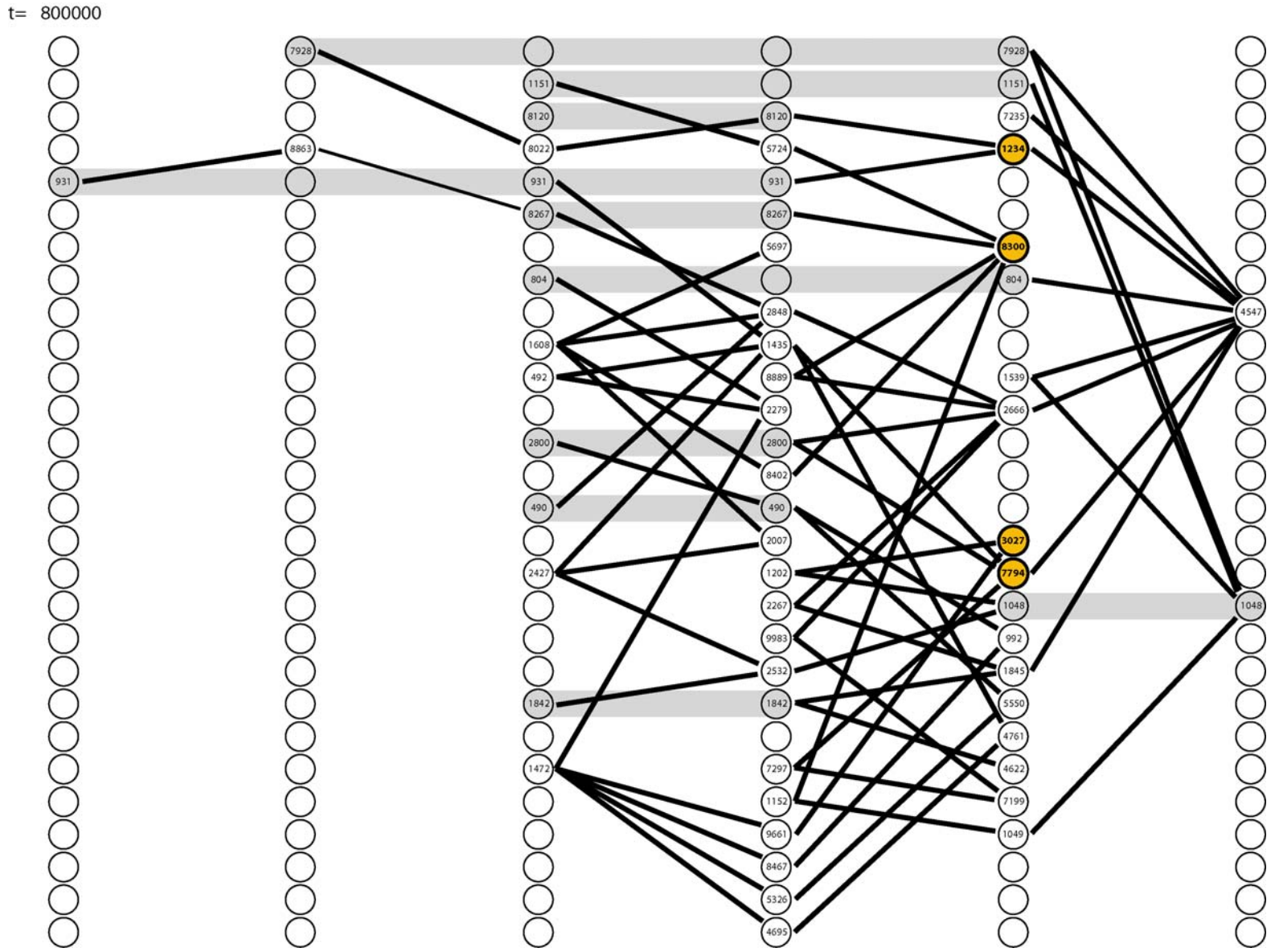


OpenAdap.net

NEURO - HEURISTIC
RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

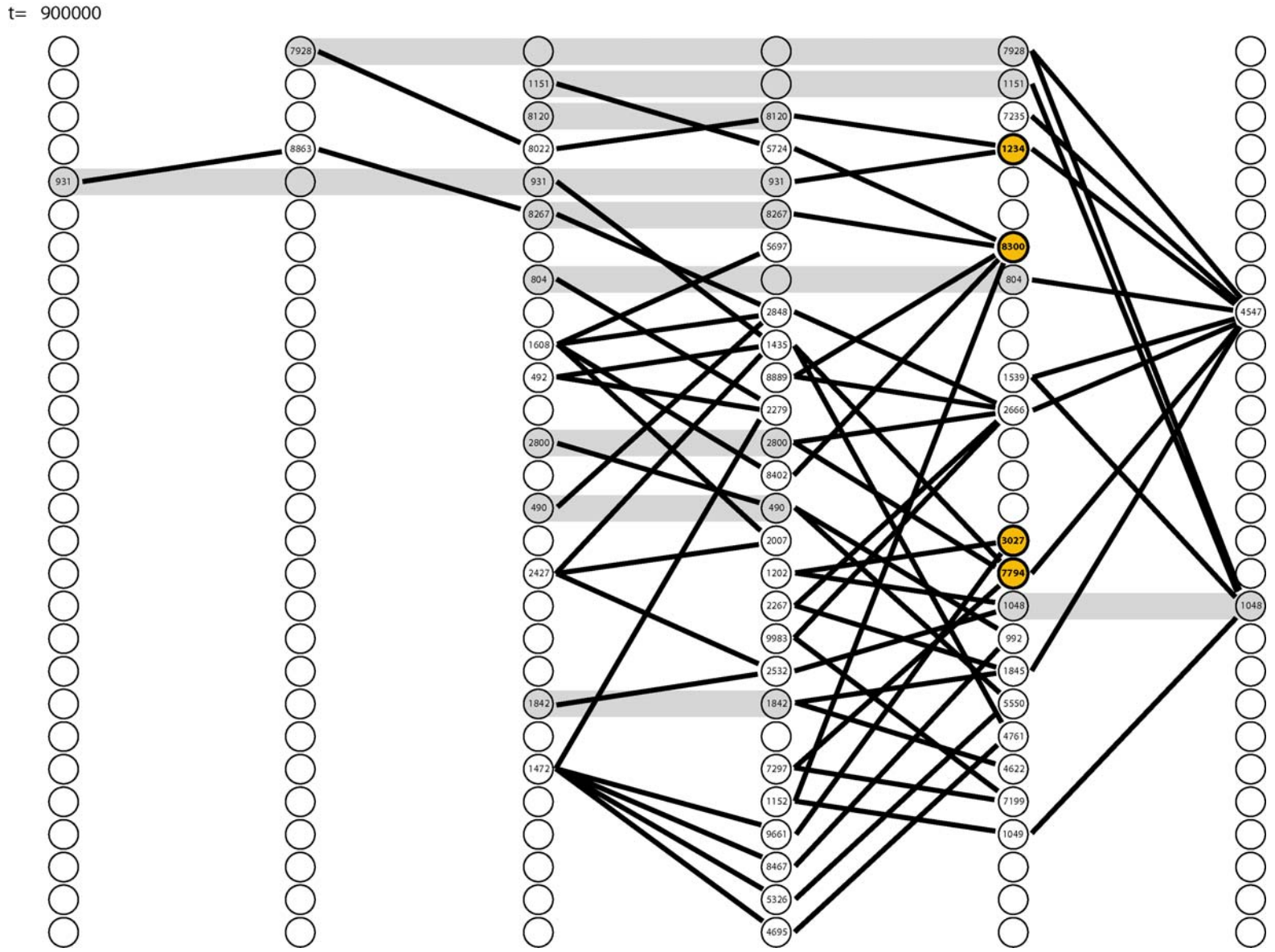


OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

Background noise = 10 events/s | Spatio-temporal input pattern of activity

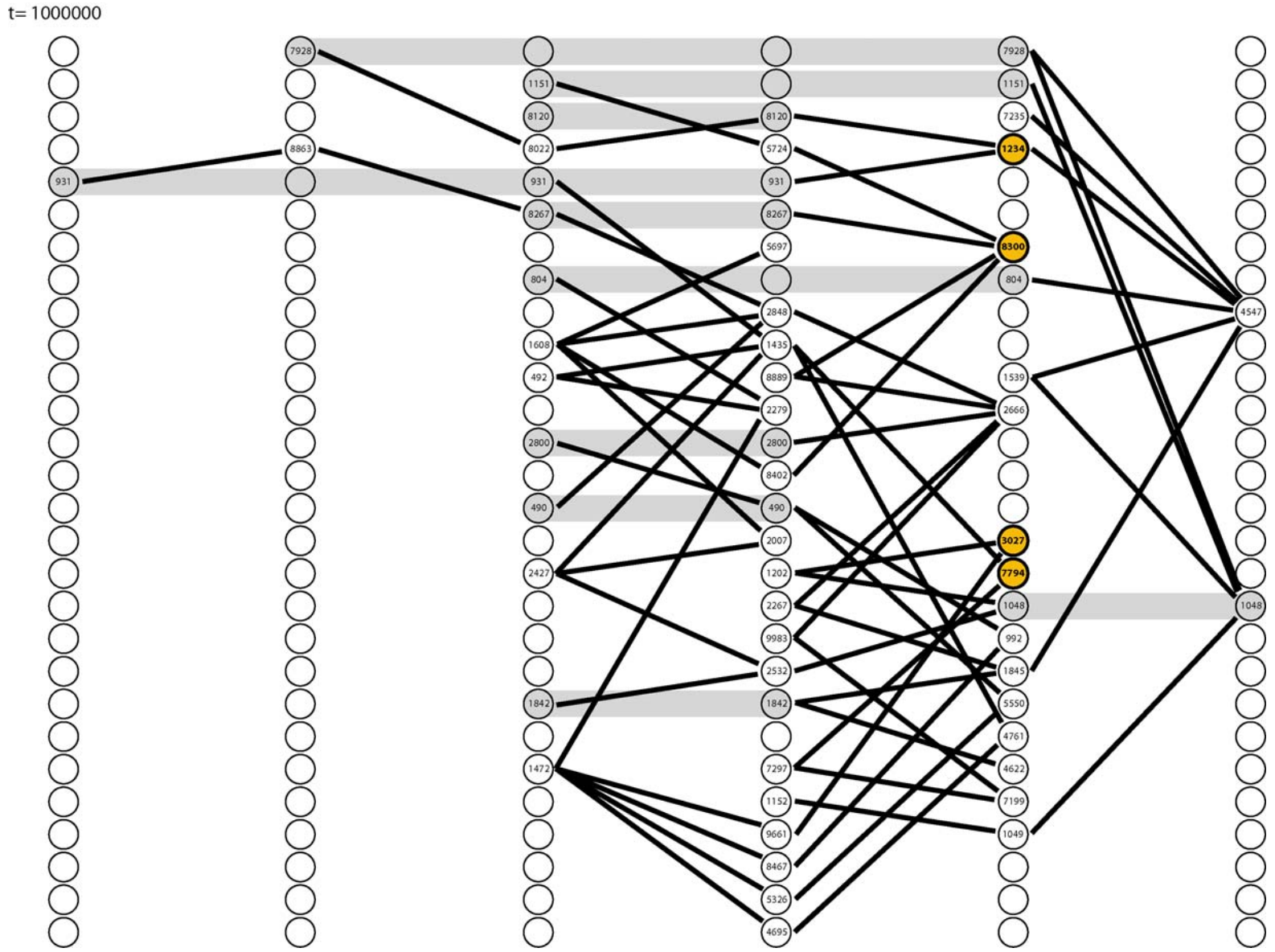


OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity

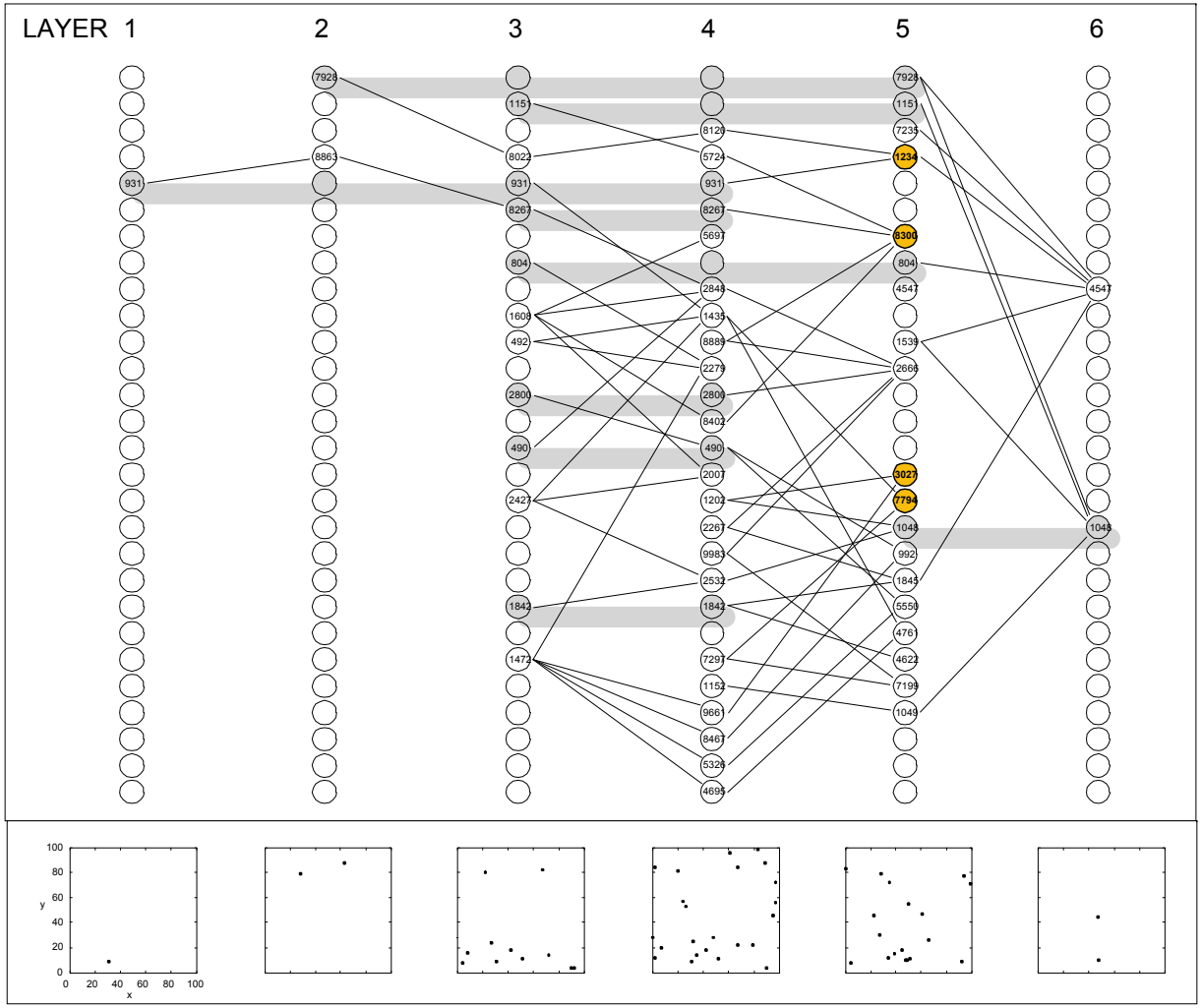
Background noise = 10 events/s | Spatio-temporal input pattern of activity



OpenAdap.net

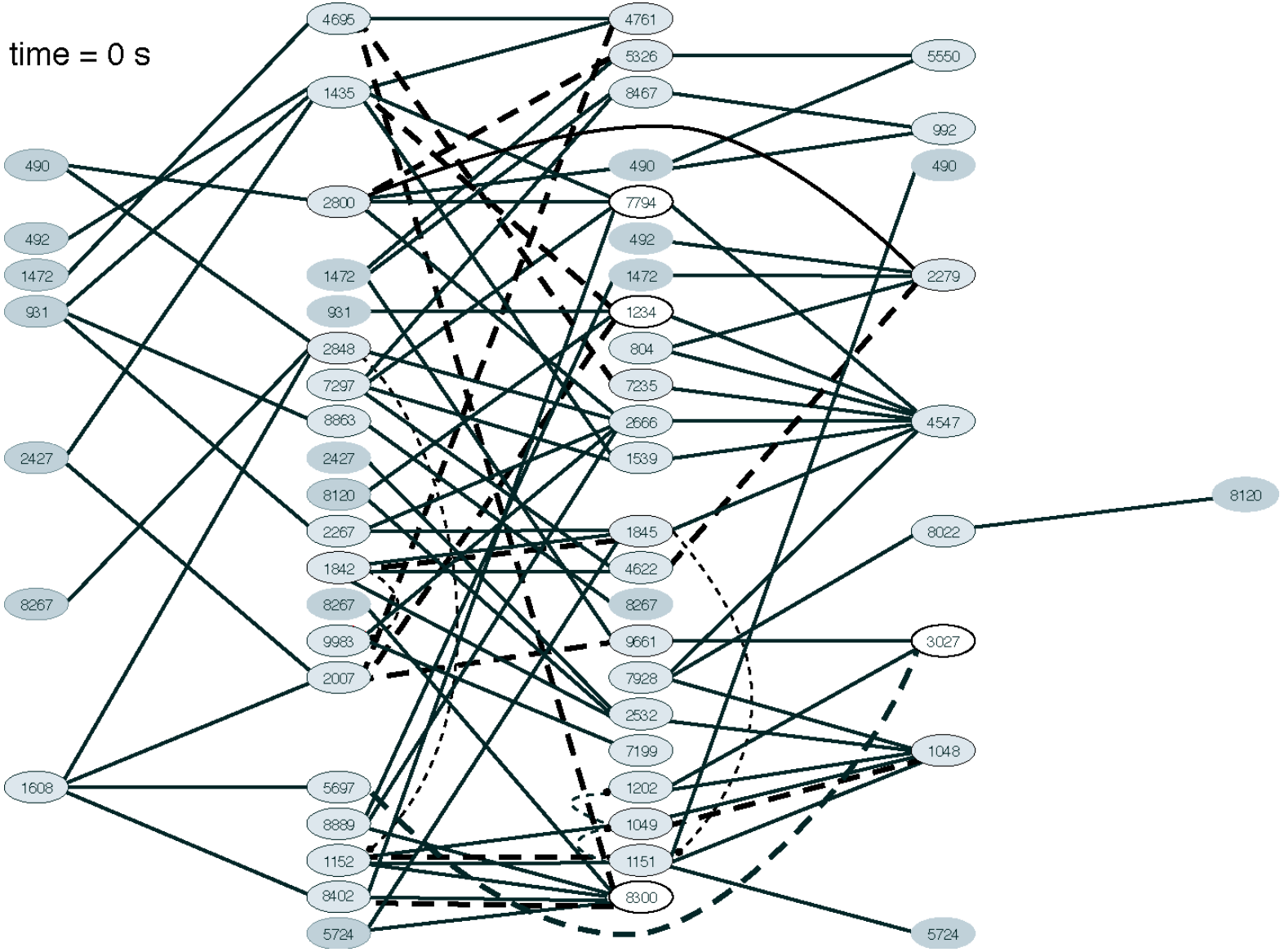
Brain inspired evolvable connectivity

At time=1'000'000 | Emergence of diverging/converging networks



NEURO - HEURISTIC RESEARCH GROUP

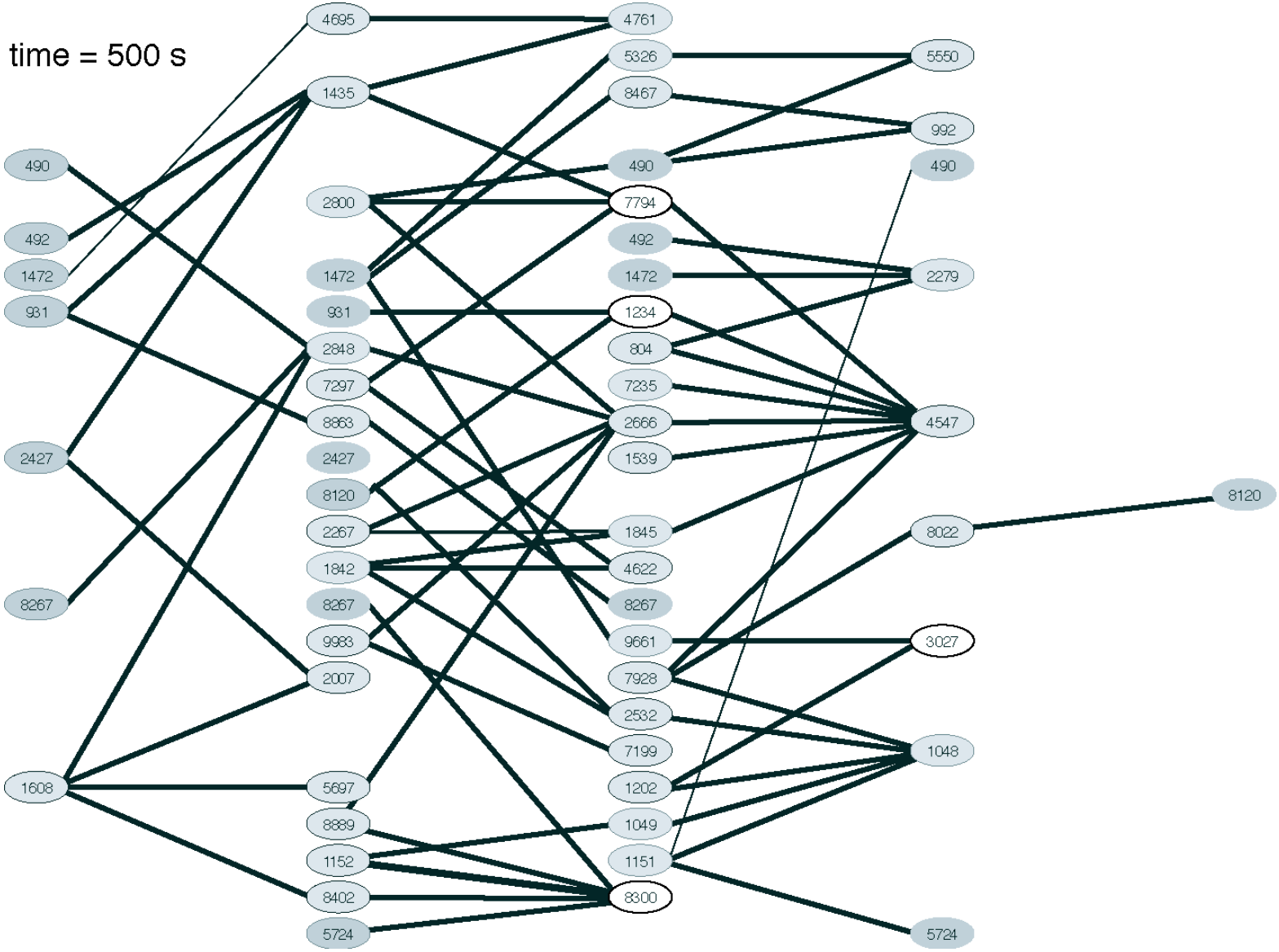
Brain inspired evolvable connectivity



OpenAdap.net

NEURO - HEURISTIC RESEARCH GROUP

Brain inspired evolvable connectivity



OpenAdap.net

Major Outcomes/Results

- **Concept proof** and **feasability** have been validated.

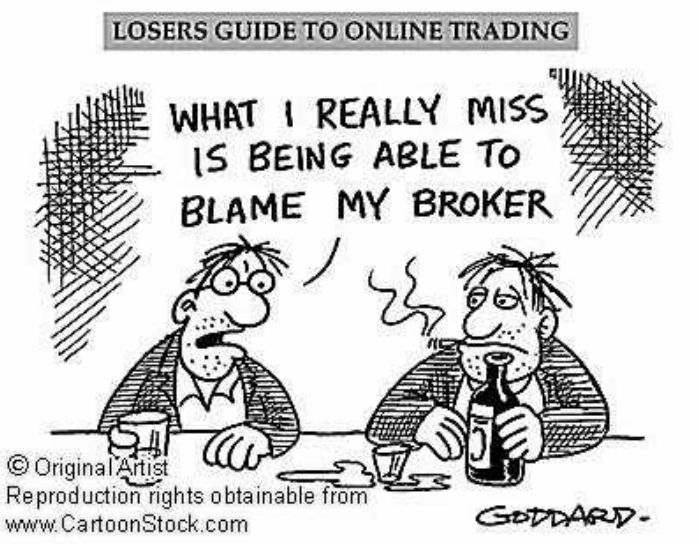
- An **OpenAdap.net testbed is active and used on a daily basis** by a Community interested in multivariate time series analyses sharing a suitable format originally developed in physics and successfully applied in financial forecasting and modeling of stock market, analysis of origin of glacial cycles, music, and biological data.

- A key element in the next stage of development consists in making the *brokers* **adaptive and dynamically interconnected** (like a neuronal network).

- The information will be processed and dispatched among all components following a set of "**learning**" **rules**, for example taking into account broker activity dependent parameters.

Major Outcomes/Results

- The rules themselves will **evolve and optimize** in an unsupervised fashion, thus allowing the emergence of **dynamic links** among the adaptive brokers. Emergence of **nonlinear dynamics** will make **OpenAdap.net** closer to the complexity of a **living organism.**



Conclusion and outlook

The service and software architecture deployed in OpenAdap.net are not bound to a specific Community. They constitute a **global virtualisation tool** offering new opportunities to **European focused SMEs** to improve their **efficiency** and strengthen their **competitiveness** independently from their domain.

A Consortium submitted a **FP7 proposal** [ICT-2007-1] (FP7-216525)


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP


NEURO - HEURISTIC
RESEARCH GROUP