



Smart Grid, Multi-Agent Systems And INGENIAS

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About Smart Grids

- Making the powergrid more intelligent
 - Distribution
 - Generation/Micro-Generation
 - Demand
- How?
 - Using Agents

smartgrid

Aproximadamente 19.300 resultados (0,07 s)



smartgrid agent

Aproximadamente 15.100 resultados (0,07 s)

Déjà vu:

- You decide you want your own agent architecture
- You think your architecture is generic
- You use too much AI
- Your agents have no intelligence
- You have too many agents
- You see agents everywhere
- You have too few agents
- You spend all your time implementing infrastructure
- Your system is anarchic
- You confuse simulated with real parallelism
- You start from scratch
- You ignore standards
- You oversell agents
- Getting religious or dogmatic about agents
- You don't know why you want agents
- You don't know what your agents are good for
- You want to build generic solutions to one-off problems
- You confuse prototypes with systems
- You believe that agents are a silver bullet
- You confuse buzzwords with concepts
- You forget you are developing
- You don't exploit related technology
- Your design doesn't exploit concurrency

Michael Wooldridge, Nicholas R. Jennings: Pitfalls of Agent-Oriented Development. Agents 1998: 385-391

Déjà vu:

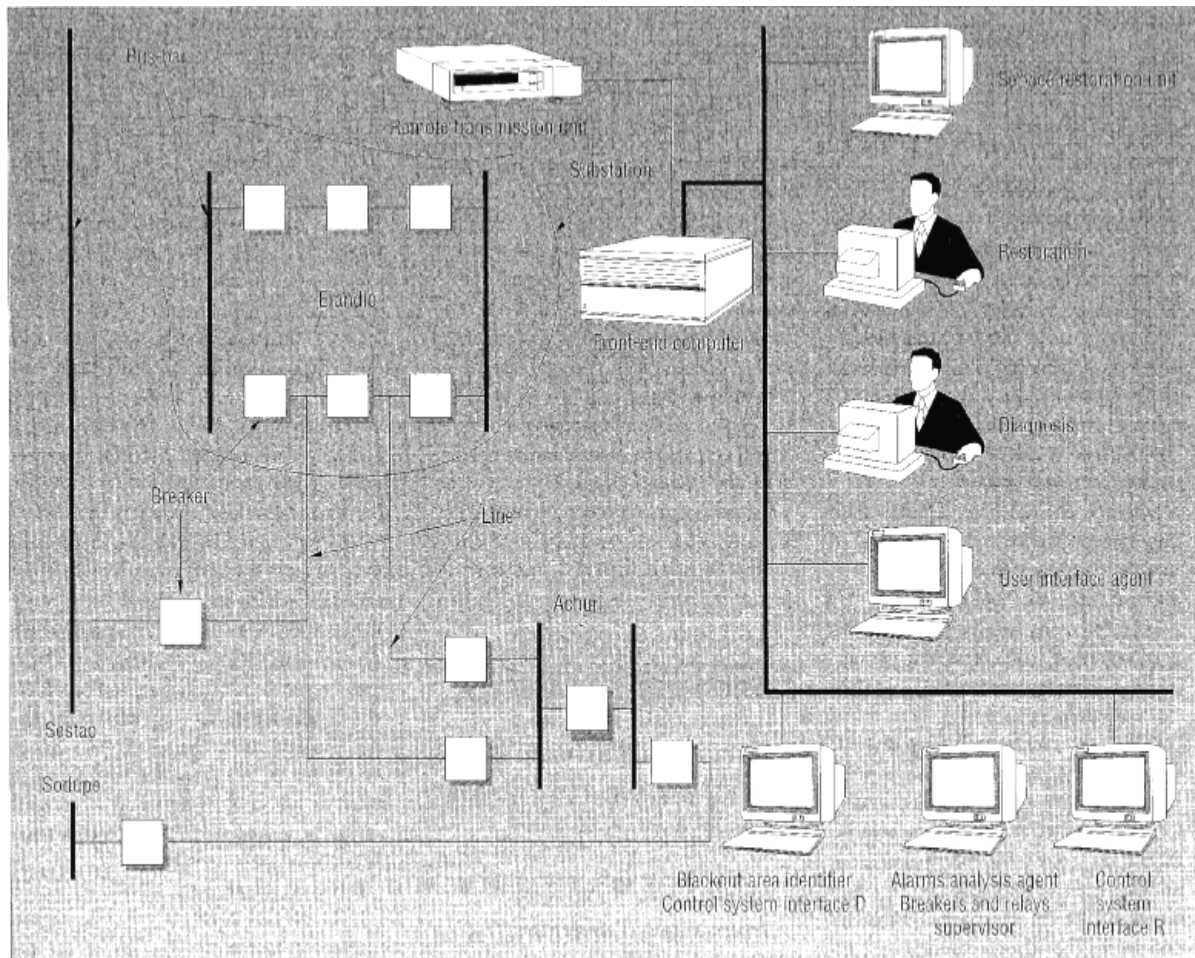
Michael Wooldridge, Nicholas R. Jennings:
Pitfalls of Agent-Oriented Development.
Agents 1998: 385-391

- **You believe that agents are a silver bullet**
- You see agents everywhere/ You have too few agents
- You oversell agents
- **Getting religious or dogmatic about agents**
- You don't know why you want agents
- You want to build generic solutions to one-off problems
- You confuse prototypes with systems
- You forget you are developing

An Original Idea ... It's not

- Jose Manuel Corera, Iñaki Laresgoiti, Nicholas R. Jennings: Using Archon, Part 2: Electricity Transportation Management. IEEE Expert 11(6): 71-79 (1996)
 - Iberdrola
 - Somewhere at the north of spain
 - Engineers cannot cope with the information obtained from SCADAs
 - Decision Making assistance
 - Coordinated Expert Systems

General scheme (from the original paper)



Actions in case of a BlackOut (from the original paper)

```
BHVR InitialBlackOutArea
(DISTURBANCE-ID ALARM-MESSAGES)           ;; mandatory input
()                                         ;; optional input
(INITIAL-AREA-OUT-OF-SERVICE)           ;; results
()                                         ;; child behaviors
((mReadNonChronologicalAlarmMessages "seize.EXECBAI-2" ( ;; Body
  (mInitialAreaOutOfService "" (
    (mClearBAI "" (
      (END "release.EXECBAI-2" )))))))) )
```

Figure 9. Specification of the InitialBlackOutArea behavior.

```
(INITIAL-AREA-OUT-OF-SERVICE
((AGENT-ID "BAI")
(DISTURBANCE-ID "921211104820")
(HYPOTHESES ( (-HYPOTHESIS_T ((ELEMENT "LTACH_ERA38") (CF 90.0)))
  (~HYPOTHESIS_T ((ELEMENT "LACH_SDP38") (CF 50.0)))
  (~HYPOTHESIS_T ((ELEMENT "ACH38A") (CF 30.0)))
  (~HYPOTHESIS_T ((ELEMENT "ACH38B") (CF 15.0))))))
```

Figure 10. Initial-Area-Out-of-Service result.

The Agents We Are Looking For Are ...

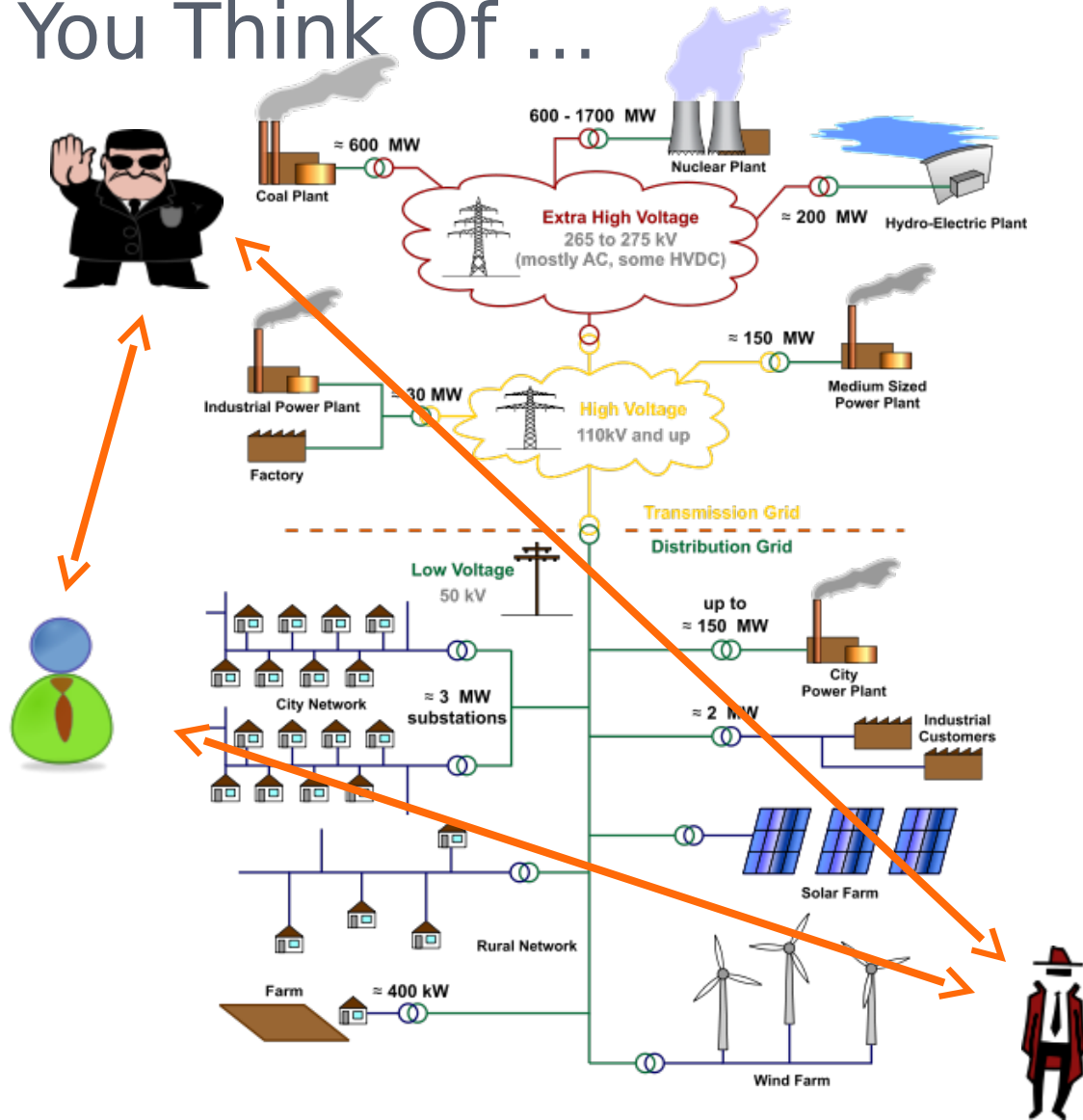
- Agents as “Programs at the Knowledge Level”
- AI container
 - Promoted by Russell&Norvig, Artificial Intelligence: a modern approach
- Huhns-Singh Test

Test Huhns-Singh

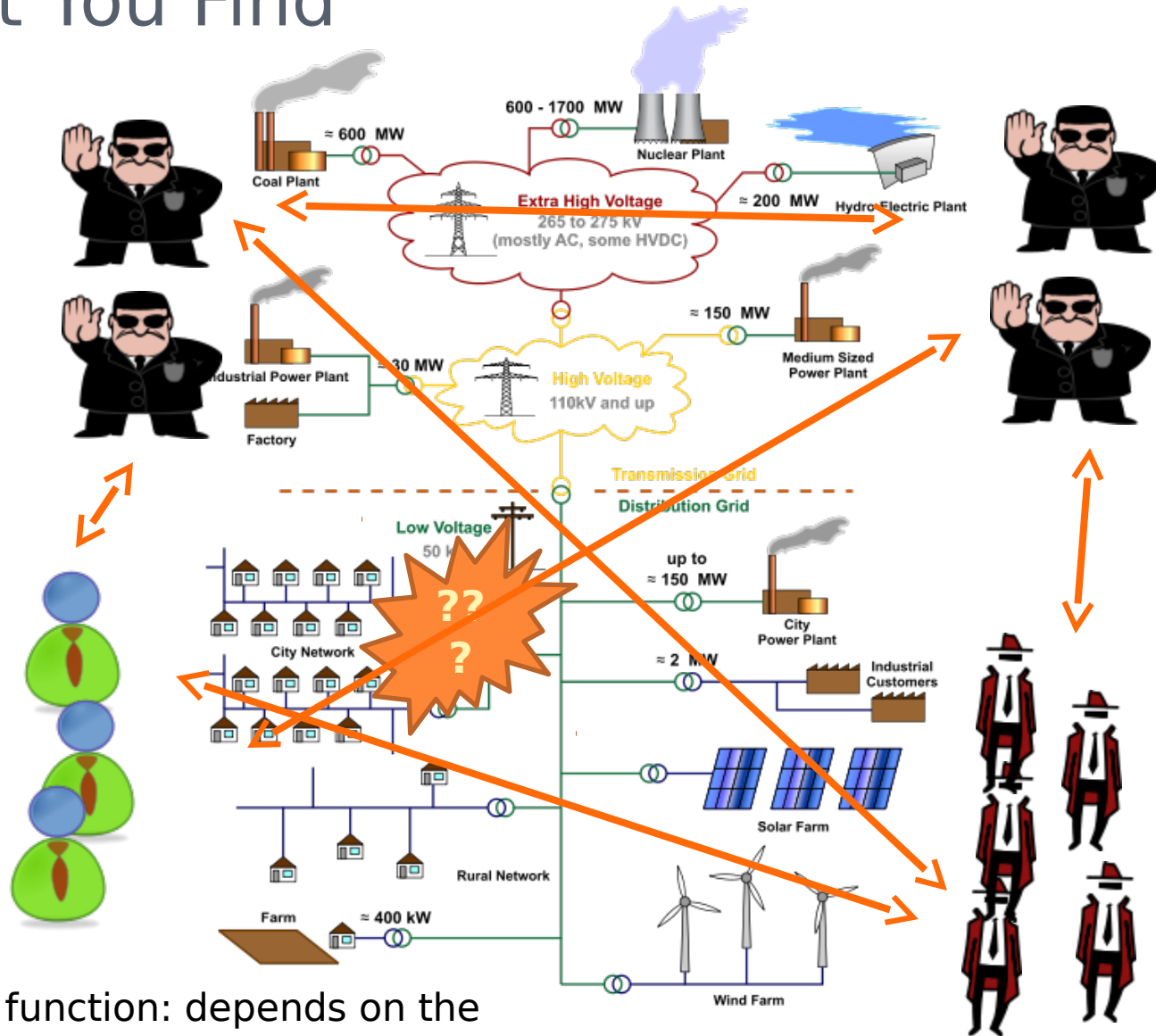
A system containing one or more reputed agents should change substantively if another reputed agent is added to the system

Michael N. Huhns, Munindar P. Singh: Agents on the Web: The Agent Test. IEEE Internet Computing 1(5): 78-79 (1997)

What You Think Of ...



What You Find



Evaluation function: depends on the actor:
-Distribution losses
-Price of kWh

Basic Questions

- How do we ensure interoperability?
- How interactions lead to the intended system behavior?
- Where is the intelligence?

- What is the system doing?

MIRED-CON

- An INNPACTO (2012-2014) project leaded by ZiV and with collaboration of UZ (+CIRCE), CEDER-CIEMAT, UCM
- Distributed Intelligent control for Micro-Generation/Micro-consumption

**Can agents fit
in here?**

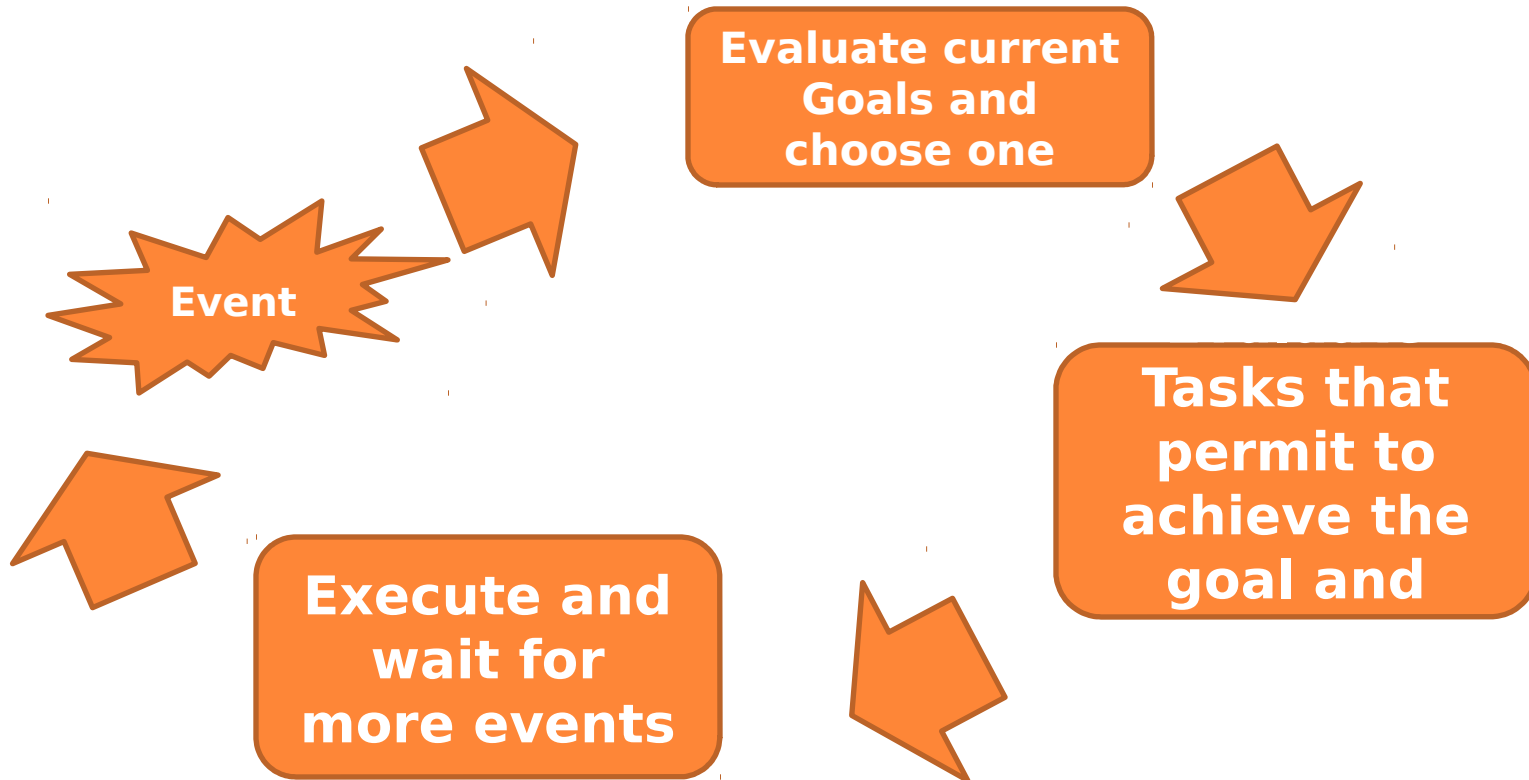


Creating a MAS

- Not “just do it”
 - Think before coding
- Decide the role of Artificial Intelligence
- Engineering problem
 - ¿Computer Science > Software Engineering?
 - ¿Computer Science < Software Engineering?
 - Computer Science != Software Engineering
- Integrating with Engineering Practices

Jorge J. Gómez-Sanz: The Construction of Multi-agent Systems as an Engineering Discipline. ESAW 2006: 25-37

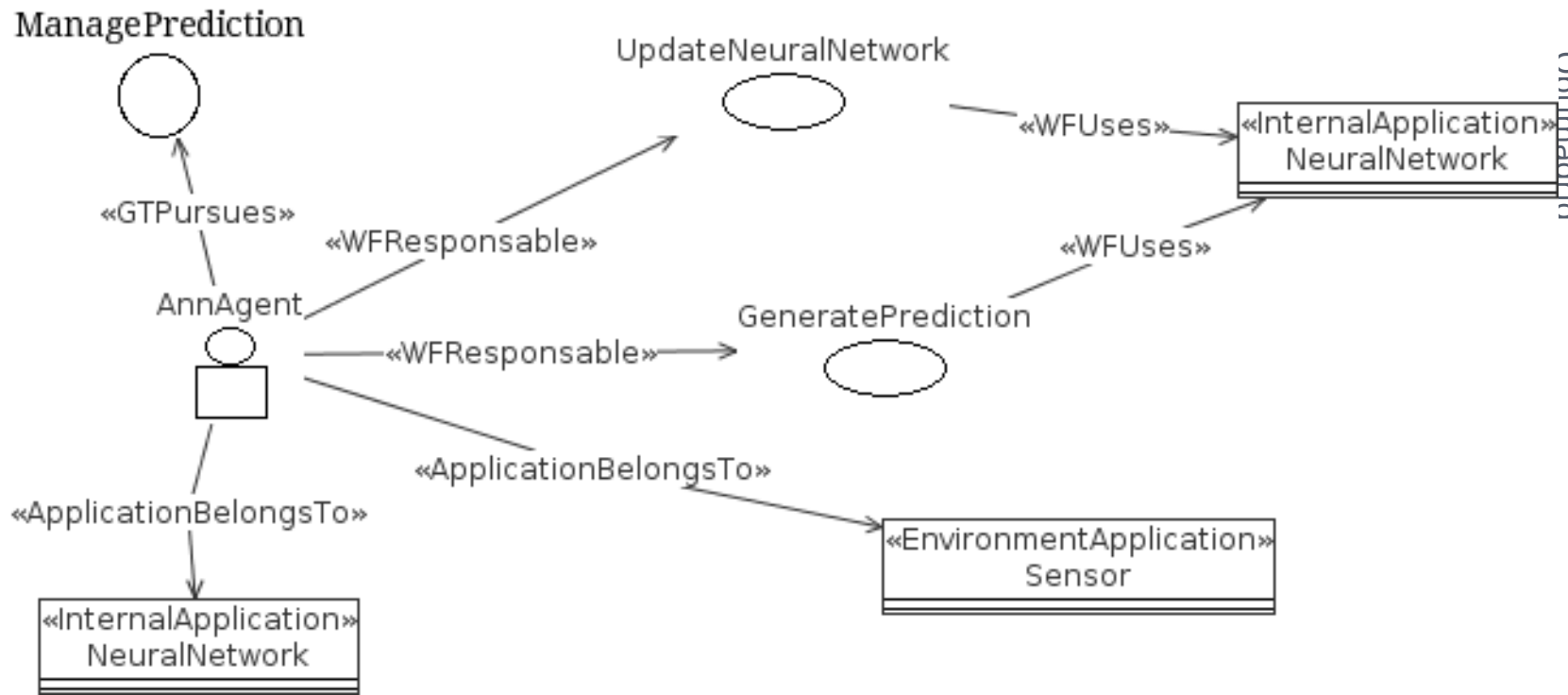
INGENIAS General Task Execution Scheme



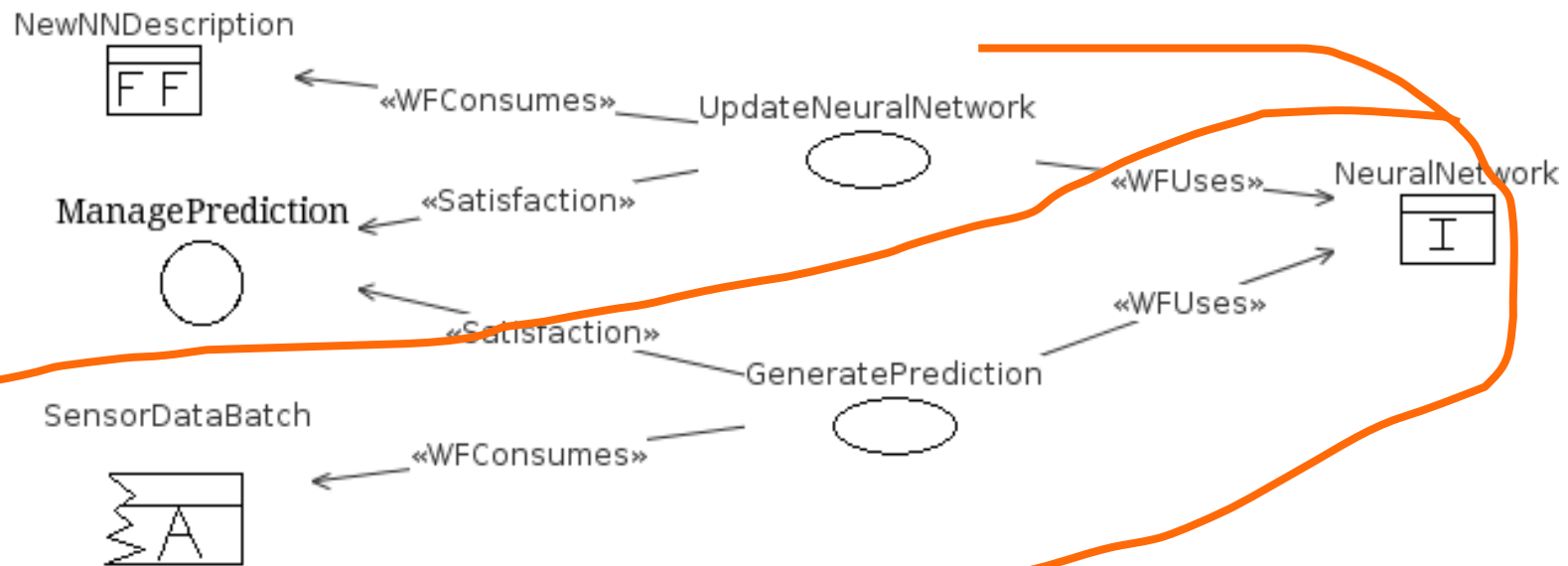
Integrating with Artificial Neural Networks

- ANN for evaluating information
 - Not for decision making
- Modeling the ANN as an Application
 - It is used to generate predictions
- Uses other external software to develop the ANN
 - Neuroph Studio
- Integrated within MAVEN
 - To create self-contained projects
 - Mix the ANN software with the Agent one
 - Maintain this combination
 - Updates/Fixes

Integrating with Artificial Neural Networks



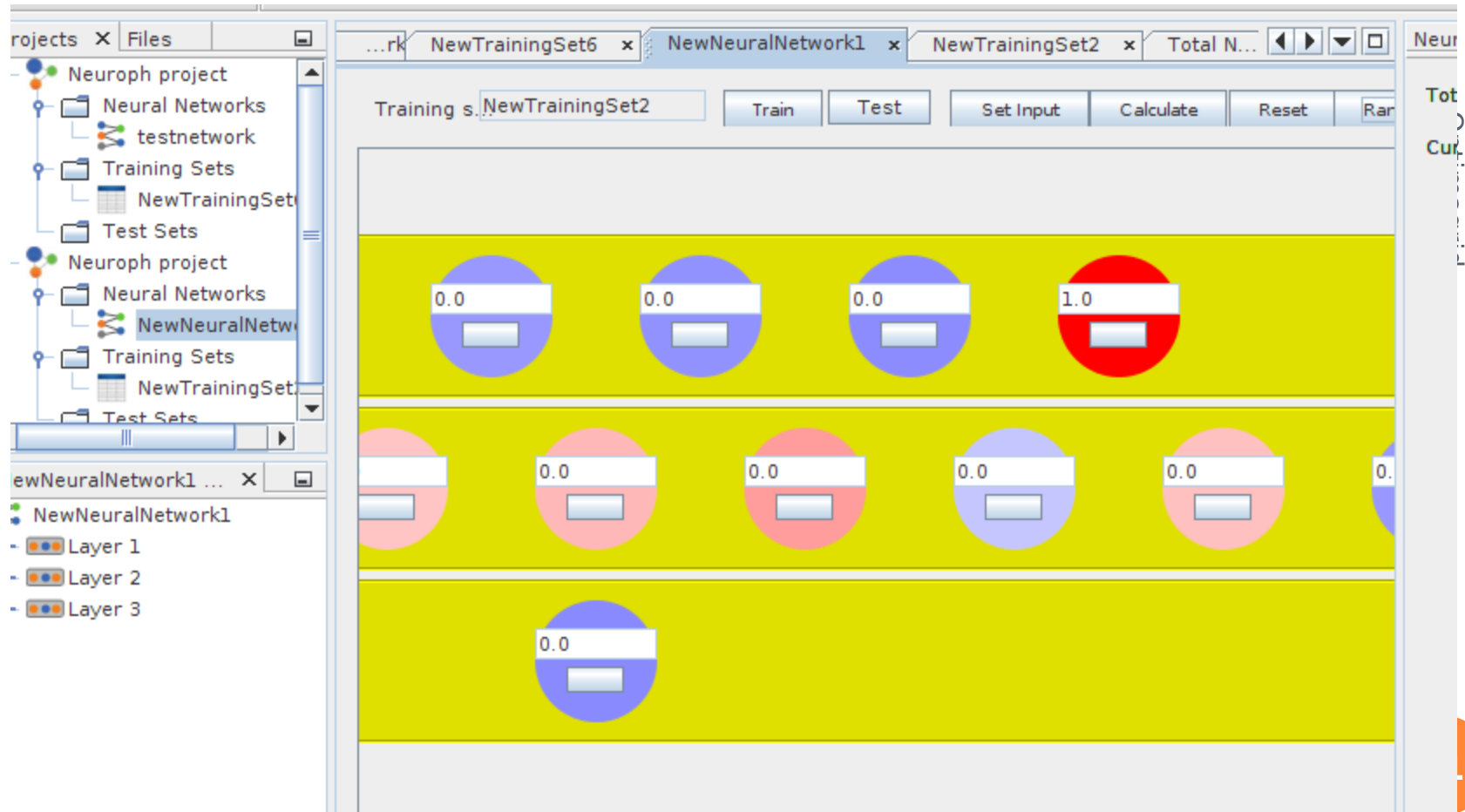
Integrating with Artificial Neural Networks



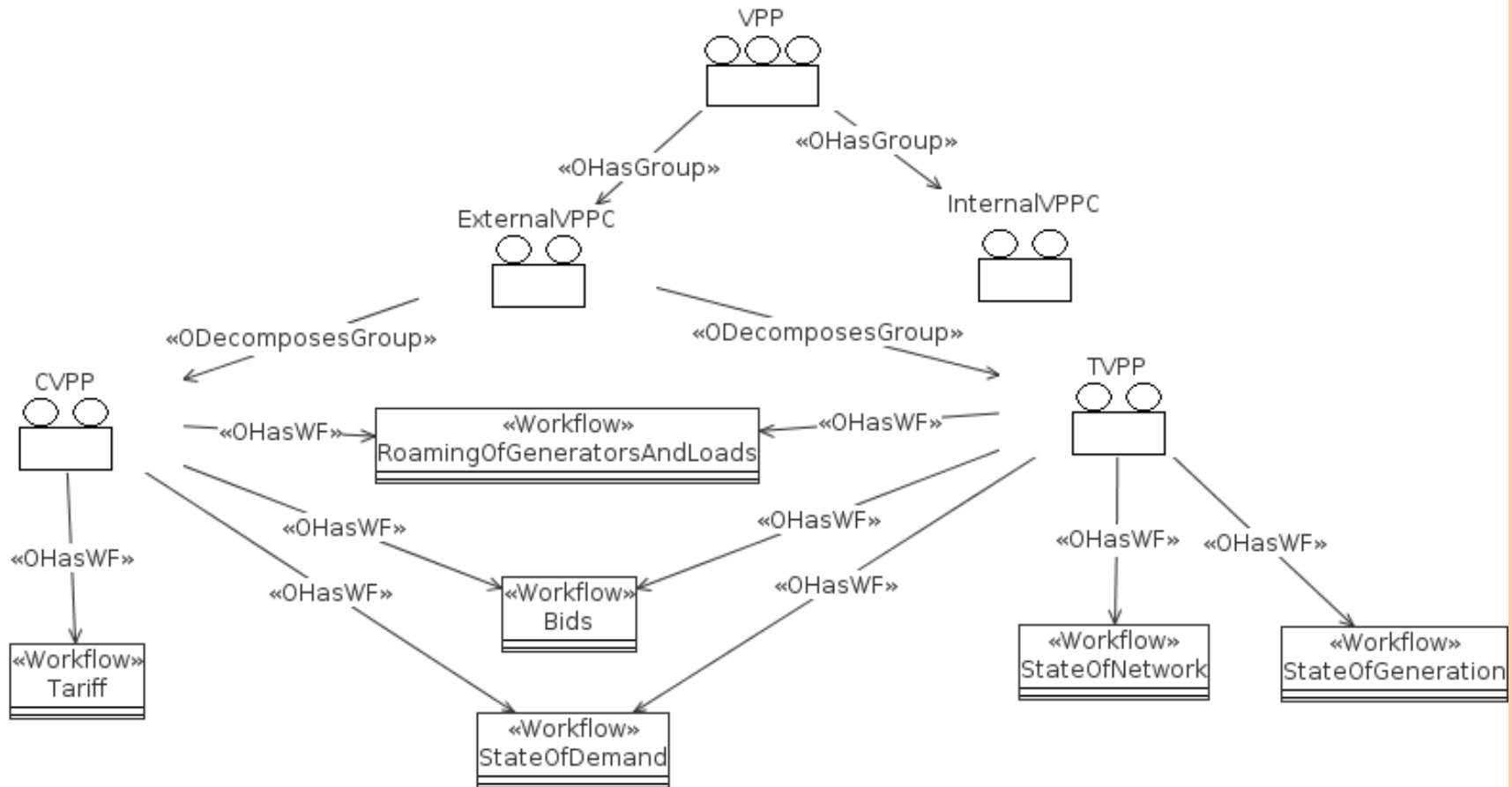
Things you should concern

- Event generation rate
 - You can make the task to consume all of the generated events
- Task execution model
 - Only one task at a time
- You can launch as many agents as you want. Each one will have its own neural network
 - You can customize on a per-agent basis

Integrating with Artificial Neural Networks (Neuroph Studio)

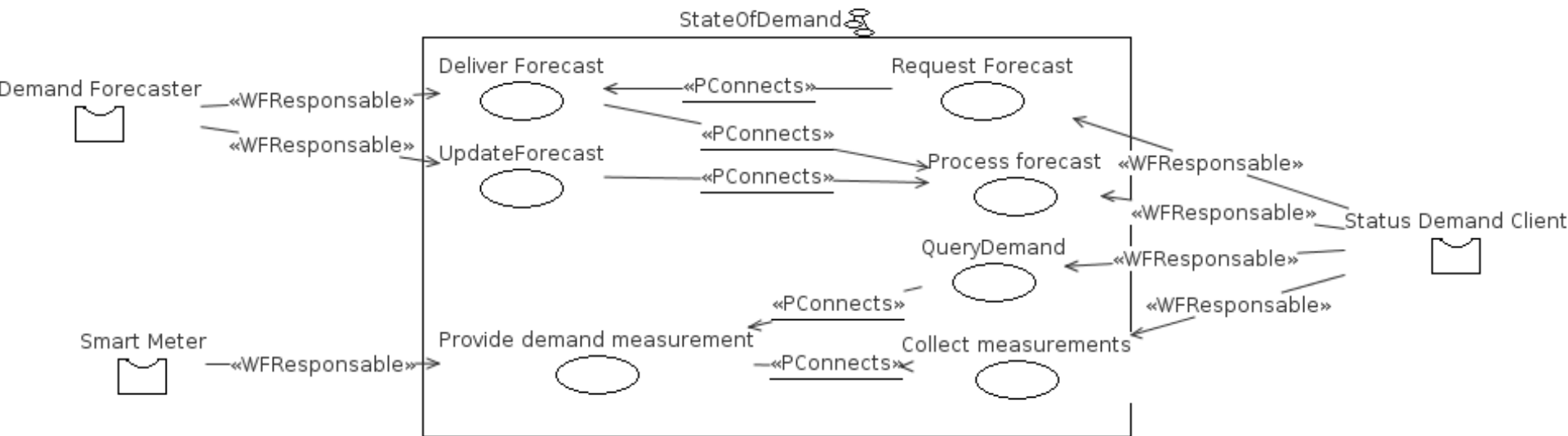


VPP Modelina



Luis Hernandez, Carlos Baladrón Zorita, Javier Aguiar, Belén Carro, Antonio Sánchez-Esguevillas, Jaime Lloret, David Chinarro, Jorge J. Gómez-Sanz, Diane Cook: A multi-agent system architecture for smart grid management and forecasting of energy demand in virtual power plants. IEEE Communications Magazine 51(1): 106-113 (2013)

State Of Demand Modeling



Conclusions

- Agents can be useful for realizing SmartGrids, but be sure:
 - What you mean with “agent”
 - If you can implement it
 - If you can test it
 - If you can maintain it
 - If it can be done within your budget
- Need it to be “yet another development paradigm”
- Ongoing effort to apply agents to energy
 - <http://grasia.fdi.ucm.es/energy>
- To know more:
 - <http://ingenias.sf.net>
 - <http://grasia.fdi.ucm.es/jorge>
 - <http://grasia.fdi.ucm.es/>