Ontology-based approach in the scheduling of jobs processed by applications running in virtual environments

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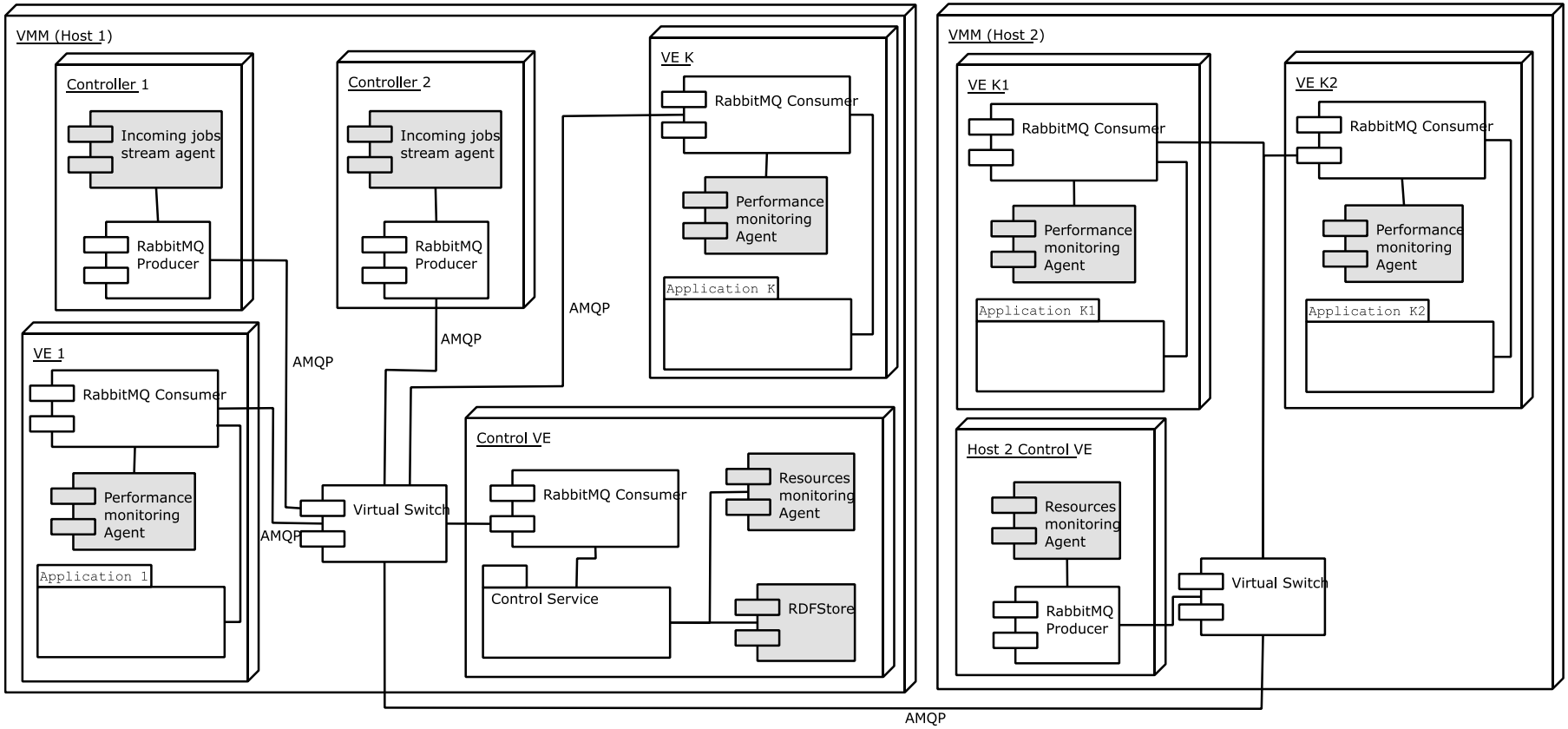
Introduction and motivation

- Scheduling and resources allocation are two the most important problems when it comes to controlling cloud computing systems.
- A cloud system control model is required.
- Situations occur when parameters such as number of applications that process jobs and their performance change with time.

Ontology-based multi-agent system architecture

- Agents' ontologies will be integrated into agents that perform their own tasks and the whole ontology will be stored in a knowledge base.
- The knowledge base must contain actual information and its synchronization between agents.
- The model of interactions supposes that three kinds of intelligent agents exist.

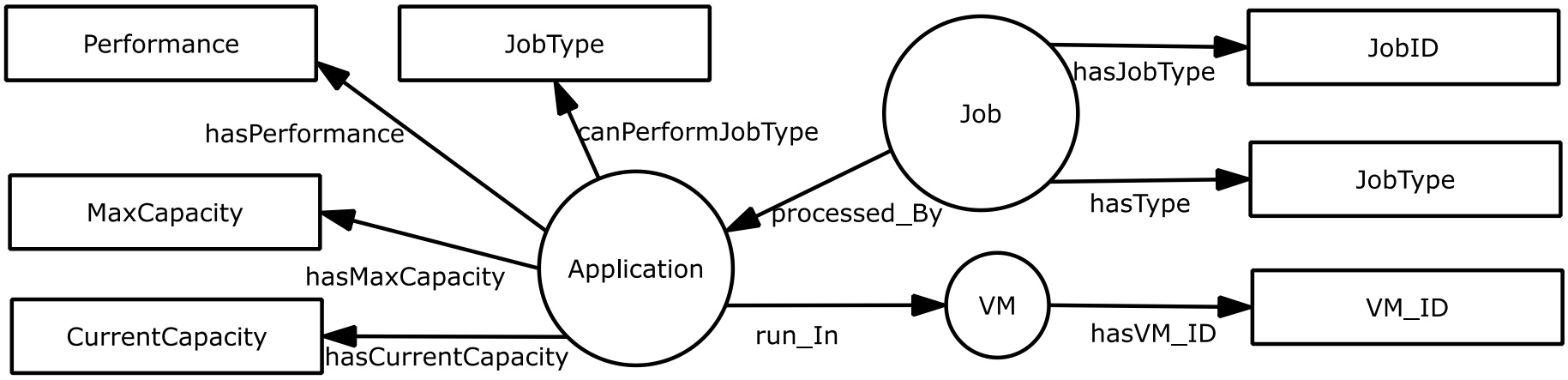
Model of interactions



Performance monitoring agents

- Work in virtual machines with applications and perform an evaluation of their performance.
- As a parameter for evaluation a time needed to process one request of the same type is taken.
- Entities, that this agent works with:
  - “virtual machine”;
  - “application”;
  - “job”.

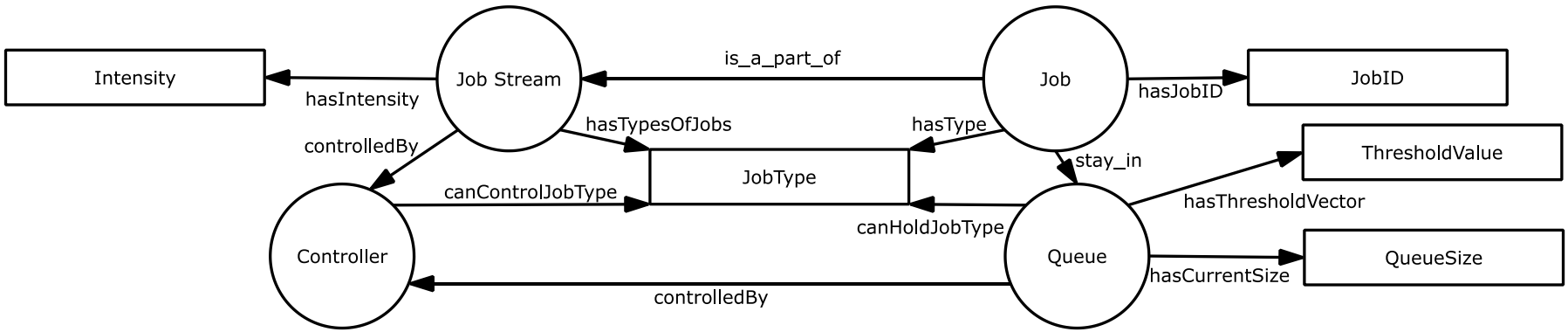
Performance monitoring agent's ontology



Incoming jobs stream monitoring agents

- Work in every controller and evaluate incoming jobs stream intensity.
- Entities this agent works with:
  - “controller”;
  - “queue”;
  - “job stream”;
  - “job”.

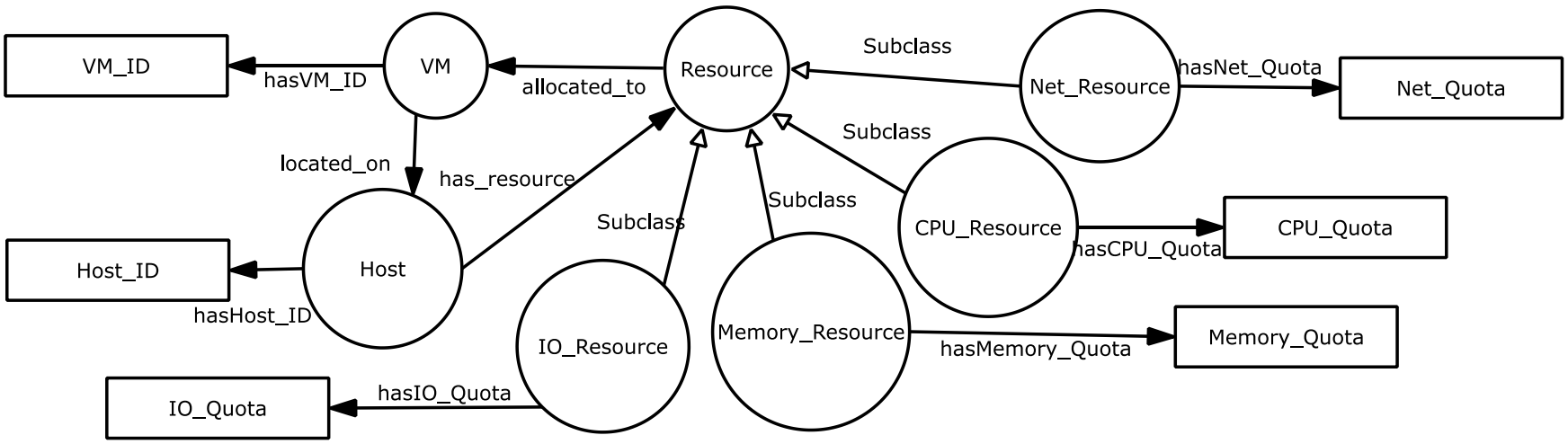
Incoming jobs stream monitoring agent's



Resources monitoring agents

- Work on hosts and interact with virtual machines monitors to get actual info about changes in resources quotas that the monitor provides.
- Entities this agent works with:
  - “host”;
  - “virtual machine”;
  - “resource”;
  - “resource types”.

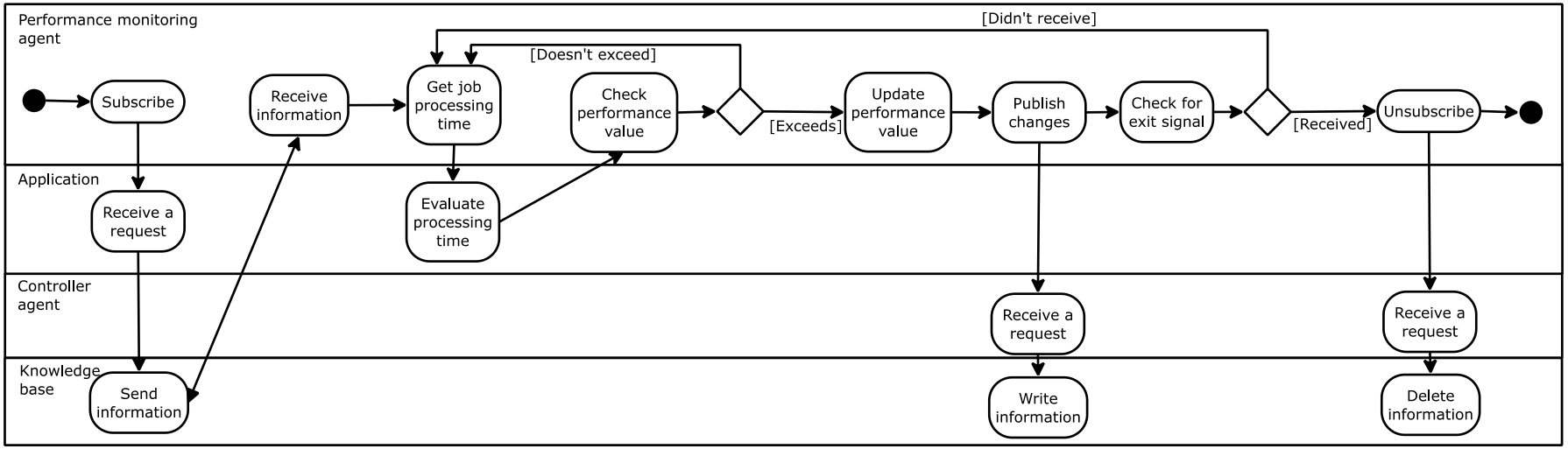
Resources monitoring agent's ontology



Agents behavior
Performance monitoring agents

- Initialized when a new virtual machine with application is created.
- Subscribes to changes in knowledge base.
- Gets an unchangeable information for its ontology:
  - its virtual machine's identification number;
  - jobs type that its application processes identification number.
- Evaluates the current performance by using moving average method.

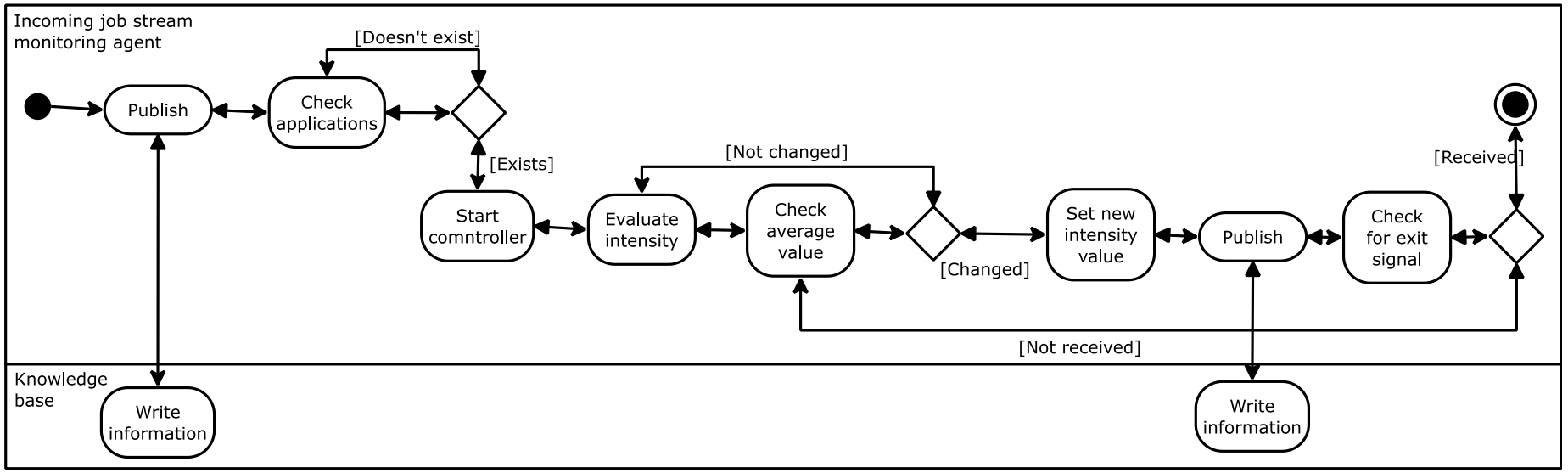
Performance monitoring agent's algorithm



Agents behavior
Incoming jobs stream monitoring agent

- Starts when a new type of jobs appear.
- Leads to creation of a virtual machine with controller inside that will manage scheduling for this type of jobs.
- Gets unchangeable information about this stream's jobs type (identification number) and publishes information about this jobs type existence into knowledge base.

Incoming jobs stream monitoring agent's algorithm



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Agents behavior
Resources monitoring agent

- Is initialized when a new physical server is started.
- Subscribes to changes in knowledge base.
- Constantly gathers information from the virtual machines monitor about active virtual machines and their resources quotas.

Agents implementation

- Agents and controllers were created with PHP5.
- ARC2 RDF system was used to manage ontologies.
- Ontologies are stored as RDF triples in a MySQL database.
- AMQP is used as a protocol to exchange information between agents and a controller.

Conclusion

- The effective control of a complex system with changing configuration demands providing actual information about many parameters to control components.
- The use of ontology-based approach allows to make information sharing between agents flexible and independent from technologies and agents algorithms.

Thank you for your attention

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