Autonomic Computing

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Adaptive Computing Systems

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Definition of autonomic systems
First approach of autonomic computing
Context and challenges
Formal definition
Key properties
Properties on the hosted software
Properties of the autonomic system
Architecture
Sensors
Monitor
Analyze function
Plan function
Execute function
Knowledge
Recap and perspectives

Outline

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Recap and perspectives

First approach of autonomic computing

- "***Dealing with Autonomic Computing is reaching a totally new paradigm***" [Paul Horn : IBM Senior Research VP, Harvard University, October 2001]
  - From solving uni-case problems (smaller, faster, cheaper)
  - To building machines to solve future problems independently from the problem to solve
- Autonomic computing is not machine learning
- Autonomic computing is dealing with the highly increasing need of hardware and software resources

Context and challenges

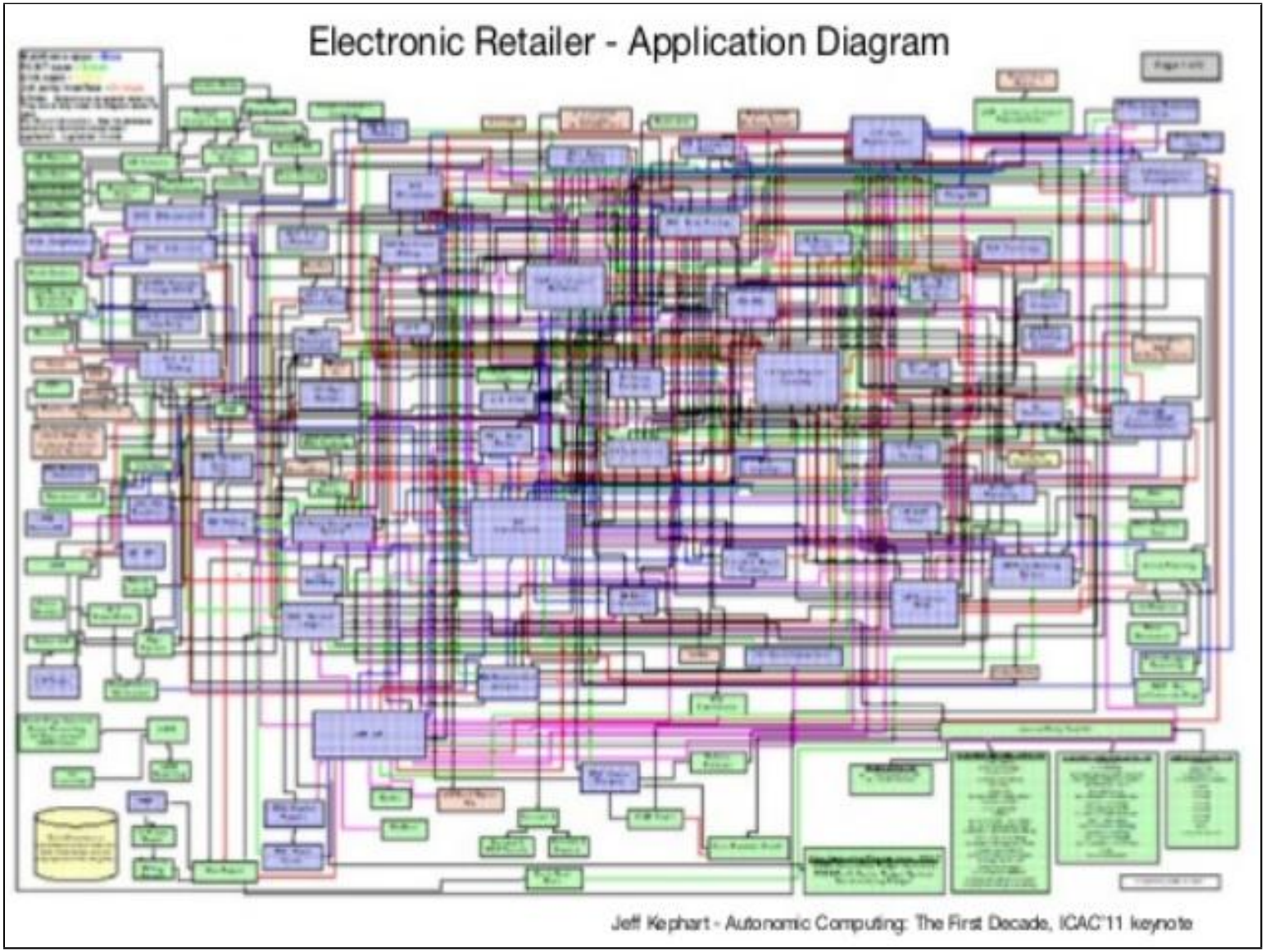

Figure – Interaction between hardware and software components

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Formal definition

"***An autonomic computing system is an environment of distributed systems designed to host running software. This software would seek for resource without considering the issues of providing them.***"
[Autonomic Computing : The First Decade, IBM research corporation, 2001]

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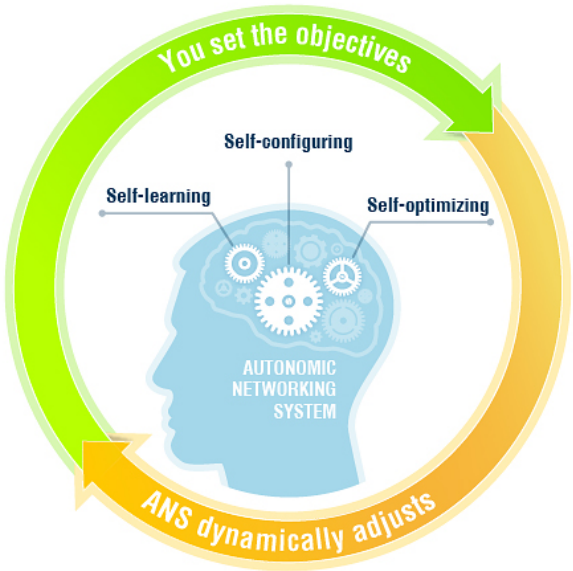
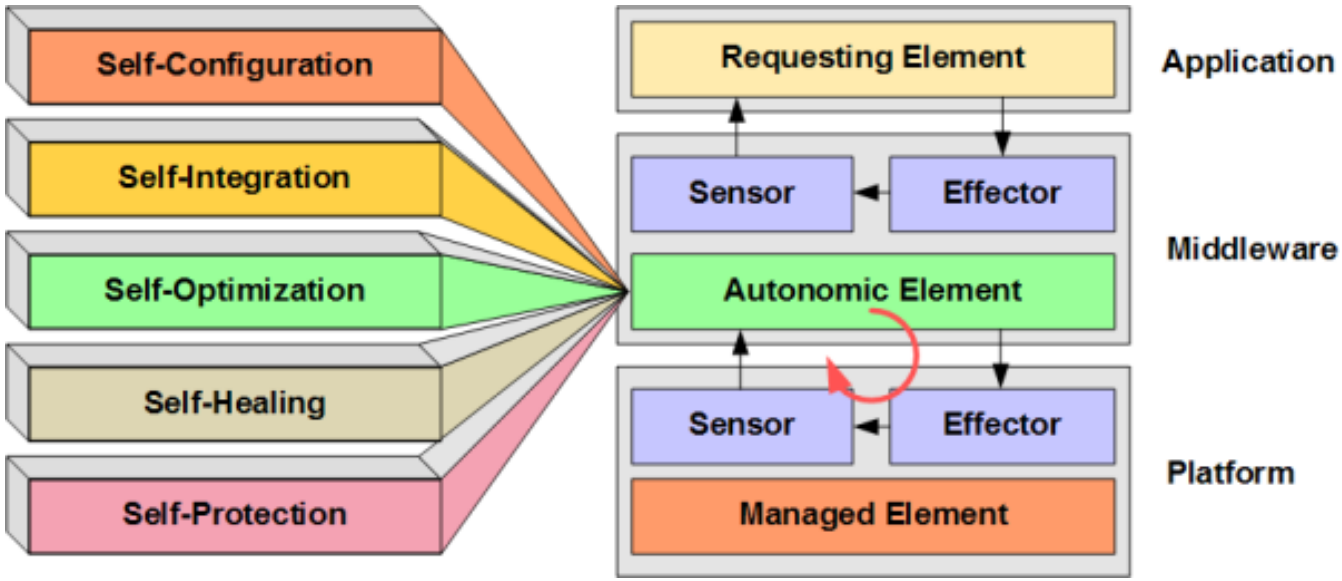
Recap and perspectives

Properties on the hosted software

- The hosted software ***ignores the existence or the characteristics of the host environment.***"
- Inspired from biological observations



Properties of the autonomic system



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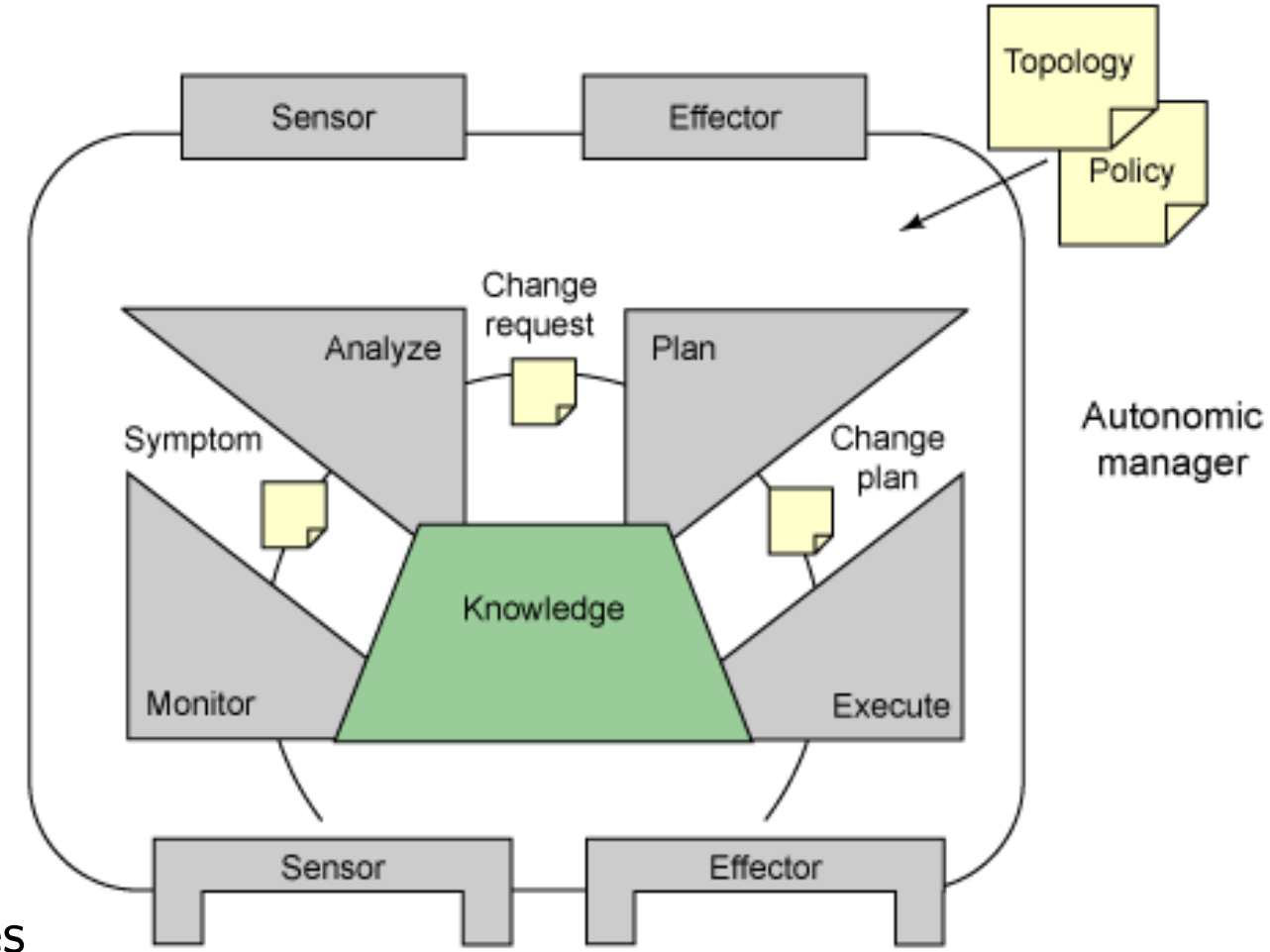
Autonomic manager

- self-managing component of the system



eferences

Sensors

Definition

An interface that exposes information about the state and state transitions of a managed resource.

Example

A user connects to www.example.com and tries to login. The sensor receives an error from the website application. (there are 2 users with the same credentials in the database).

Monitor

The monitor provides the mechanisms that collect, aggregate, filter, manage, and report details.

1. collect the details from the managed resources (sensors, effectors, logs...)
2. correlate them into symptoms that can be analyzed
3. store the distilled data in the knowledge base.

Example

A user has two different entries with the same ID in the *Users* table.

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Analyze Function

The analyze function provides the mechanisms to observe and analyze situations to determine if some change needs to be made.

- The analysis is influenced by stored knowledge data
- If changes are required, the analyze function generates a change request and passes that change request to the plan function
- two different levels of changes : necessary or desirable.

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Analyze Function

Example

Policy = No duplicates in the *Users* table. A change is required : it is necessary to delete duplicate users

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Plan Function

The plan function creates or selects a procedure to enact a desired alteration in the managed resource.

- The plan is influenced by stored knowledge data
- It creates a change plan and sends it to the execute function which will take care of applying the changes.

Example

The plan function identifies the duplicate users and keep only the first ones created.

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Execute Function

The execute function provides the mechanism to schedule and perform the necessary changes to the system.

Example

SQL queries are generated and then executed in the database.

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Knowledge

Definition

The knowledge is an implementation of a registry, dictionary, database or other repository that provides access to knowledge according to the interfaces prescribed by the architecture. It is shared between the different functions of the architecture.

3 kind of knowledge :

- Solution Topology Knowledge
- Policy Knowledge
- Problem Determination Knowledge

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Data stored in the knowledge

- topology information
- historical logs
- metrics
- symptoms
- policies
- etc.

Example

Our knowledge contains :

- database containing the *Users*
- policy "no duplicate users"
- change requests, change plans...

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Overview

- Autonomic computing has put the basis of modern distributes architecture (cluster, cloud computing, ...)
- IBM has leaded the autonomic computing researches by :
  - Financing scholarships, and events all over the world
  - Gathering all the scientific papers to identify the main trends and theoretical breakthrough
- Analyzing the result of this researches has leaded to identify the main vision :
  - Bio-inspired computing
  - Recovery computing

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References

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