Autonomic Computing

Deepankumar S.
Asst. Professor, Department of Computer Science & Applications
Sri Krishna Arts & Science College
Coimbatore, Tamil Nadu, India

Naren K.
Department of Computer Science & Applications
Sri Krishna Arts & Science College
Coimbatore, Tamil Nadu, India

Manikandan U.
Department of Computer Science & Applications
Sri Krishna Arts & Science College
Coimbatore, Tamil Nadu, India

Abstract— **Autonomic computing is a computer's capability to manage and control itself automatically through adaptive technologies that further computing capabilities and cut down on the time required by computer professionals to solve system problems and other maintenance such as software updates. The progress towards autonomic computing is controlled by a desire for cost reduction and the need to lift the obstacles presented by computer system complexities to allow for more advanced computing technology. Autonomic computing was implemented by IBM in 2001.**

Keywords— Self-configurable; Networking; Manager; Computing.

I. INTRODUCTION

Autonomic computing can be defined to be self-managing characteristics of distributed computing resources, where it adapts itself to unpredictable changes while hiding inseparable complexity to operators and users. In the year 2001, the IBM industry has taken an initiative to develop computer systems capable of responsibility, to overcome the rapidly growing complexity of computing system management and also to reduce the barrier that complexity poses to further growth. The concept of the system is to make flexible decisions, using high level policies it will continuously examine and shape up its status and automatically modify itself to changing the given conditions. Ac system has two main control schemes in the form of local and global with sensors for self-monitoring and effectors for self-adjustment. Architecture of ac can also be termed as monitor-analyze-plan-execute. In this vision there are variety of constructive frameworks based on self-regulating components has been recently proposed. Similar trend has recently indicated significant research in the area of multi-agent systems. most of these approaches are generally originate with centralized or cluster based server architectures in mind and it addresses for reducing management costs rather than need of enabling innovative services. Autonomic computing architecture is shown in the Figure: 1.0.

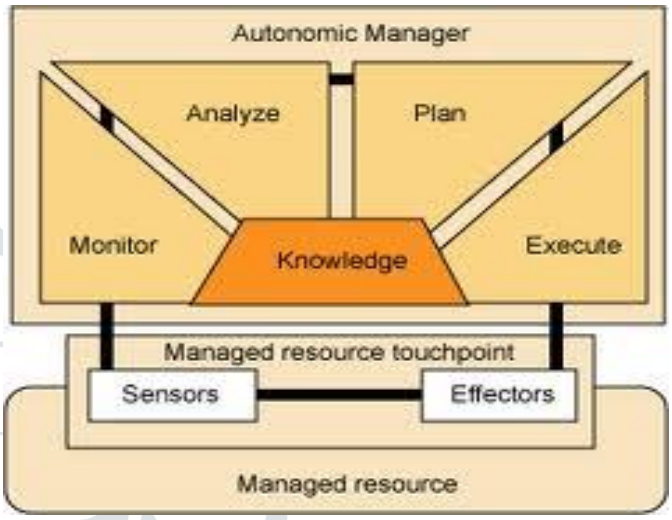

Figure 1.0: Autonomic computing architecture

II. PROBLEM OF GROWING COMPLEXITY

Forecasts suggest that the average complexities of devices are increasing and it will grow at a rate of 38% per year. Presently this complexity is managed by talented humans, but the demands for IT resources are already outstripping supply. A huge economic support is needed to automate the maintenance of those computing devices. The IEEE Computer magazine article states that the essence of autonomic computing is self-management, freeing administrators from low level task management while delivering better system behavior.

A common problem among the modern computing system is their complexity; this is being a significant limiting factor in their future development. The distributed applications running on these computer networks ranging from internal control processes to presenting web content to client support. In addition to this, mobile computing supports the employees to communicate while they are not in their office. They are using wireless technologies to access their company's data. This creates complexity in overall network, where this creates difficulties in controlling by manual operations. Manual control is time consuming, and sometimes error prone. The problems in infrastructure happen at the client specific application. Most of the autonomic service providers may guarantee only up to the basic plumbing layer.

III. CHARACTERISTICS OF AUTONOMIC SYSTEMS

An applicable solution could be to activate modern, networked computing systems to have control over them with indirect human intervention. The Autonomic Computing

Initiative (ACI) focuses at establishing the foundation for autonomic systems. It is similar to that of the autonomic nervous system of the human body. [1] These nervous systems have control over main bodily functions (e.g. respiration, heart rate, and blood pressure) with unconscious intervention.

In a self-managing autonomic system, the human operator takes on a new dimension: rather than controlling the system directly, he/she defines general policies and instructions that manage the auto-management process. [2]

Four types of properties is defined by IBM for this process to refer to as self-star (also known as self-*, self-x, or auto-*) characteristics.

1. *Self-configuration:* Automatic configuration of components.
2. *Self-healing:* Automatic discovery, and correction of mistakes. [3]
3. *Self-optimization:* Automatic checking and management of resources to ensure the effective functioning with respect to the defined needs.
4. *Self-protection:* Proactive identification and security from arbitrary attacks.

Others such as Poslad and Nami and Bertel[4] have extended on the plot of self-star as follows:

1. *Self-regulation:* A system that functions to maintain some range, e.g., Quality of service, within a reset range without external control;
2. *Self-learning:* Systems use machine learning techniques such as unsupervised learning where external control is not required.
3. *Self-awareness (also called Self-inspection and Self-decision):* System must understand itself. It must know the extent of its own content and the contents related to it. A system must know of its internal components and external links in order to have control and to manage them.
4. *Self-organization:* System structure is obtained by physical-type models without explicit pressure or involvement from external system that is outside.
5. *Self-creation (also called Self-assembly, Self-replication):* System controlled by ecological and social type models without explicit pressure or involvement from external system that is outside. A system's members are self-motivated and self-controlled, creating problems and sort in a creative response to a continuously changing strategic requirement.
6. *Self-management (also called self-governance):* A system that controls itself without external interference or intervention. What is being controlled can vary depending on the system and application. Self -management also refers to a set of self-star functions such as autonomic computing rather than a single self-star function.
7. *Self-description (also called self-explanation or Self-representation):* A system explains about itself. It is capable and efficient enough of being understood and manageable (by humans) without further details.

Figure 1.1 shows the block diagram of autonomic management system.

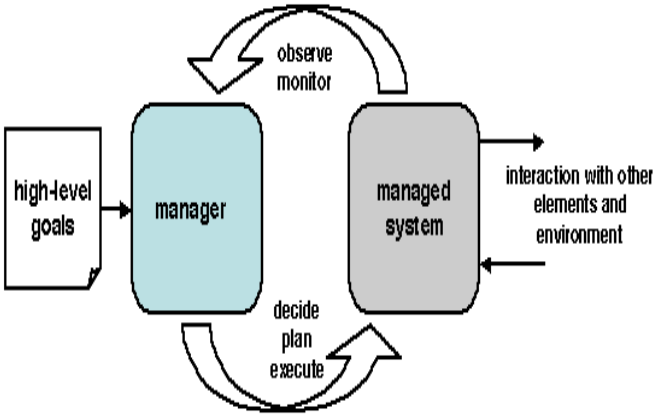

Figure 1.1: Autonomic management system

IV. EVOLUTIONARY LEVELS

For the deployment of autonomic systems, IBM defined five evolutionary levels, or the autonomic deployment model.

- Level 1: This level is the basic level that gives the current status where systems are mainly managed, which is not automatic.
- Levels 2 – 4: This presents growingly automated management functions.
- Level 5: This shows the primary aim of autonomic, self-managing systems.[5]

V. CONCEPTUAL MODEL

A fundamental and basic building block structure of an autonomic system is the sensing capability (Sensors S_i) and efficiency, which enables the system to observe or watch keenly its external operational context. The conceptual model diagram is shown in the Figure: 1.3. Inherent to an autonomic system is the knowledge of the volunteering Purpose (intention) and the Know-how to manage itself (e.g., bootstrapping, configuration knowledge, interpretation of sensory data, etc.) without external intervention or interference. The actual operation or process of the autonomic system is explained by the Logic, which is responsible for making the right decisions to serve its intention, and inspire by the observed operational context which is based on the sensor input of a system.

This model highlights and specifies the important fact that the operation or process of an autonomic system is purpose-controlled. This includes its aim or mission (e.g., the service it is supposed to offer), the policies (e.g., that define the basic

behavior), and the "survival instinct". If seen as a control management system this would be encoded as a feedback error function process or in a heuristically assisted system as an algorithm (step-by-step procedure) combined with set of heuristics bounding its operational space.

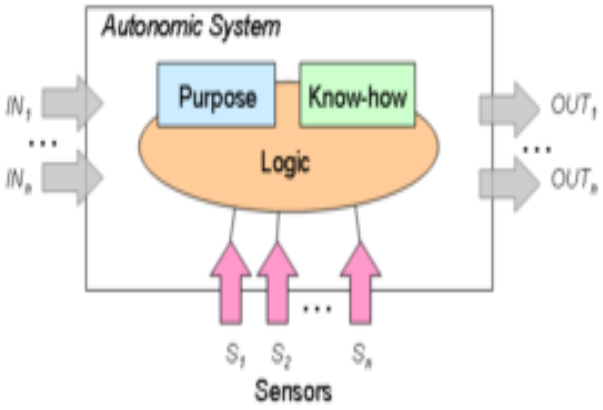

Figure 1.2: Conceptual model

VI. BENEFITS

The most important benefit of an autonomic computer is reducing Total Cost of Ownership which is known as TCO. Crackup will be less frequent and reducing maintenance costs. And less numbers are required to manage the systems. The 80 percent of computer systems are twist around hardware and the software procumbent in earlier times. The trained personnel are required to manage these systems. And the cost of the personnel will be twice higher than now. The immediate benefit of the autonomic computing is surely reducing the deployment and the maintenance cost of the system. And it will increase the stability of the system through animation and also reduces the time for the new systems in upcoming days. The challenge for the user today is that the IT infrastructure is likely assorted meaning it's comprise of hardware from many vendors .This makes difficulty to add or maintain a system. For this we need to autonomic capabilities so that IT infrastructure can be self-protecting .Automatic computer technologies provide maximum system availability and minimize cost and effort of human.

VII. AUTONOMIC NETWORKING

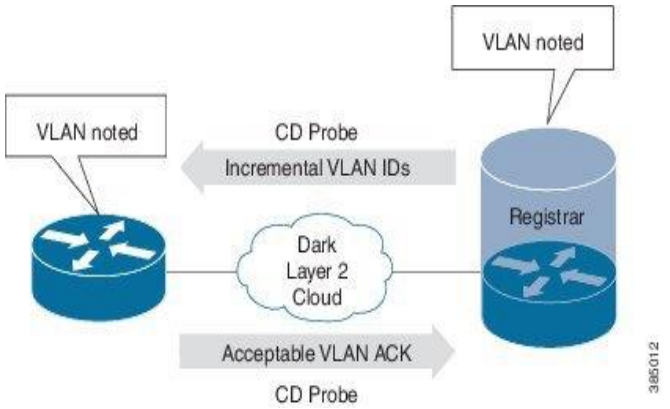

Figure 1.4: Autonomic networking

Autonomic Networking inspires the concept of Autonomic Computing, which is an initiative started by IBM in 2001. As shown in the Figure 1.4, Its ultimate and main mission is to create self-managing and controlling networks to overcome the rapidly growing complexity problem of the Internet and other networks and to enable their upcoming growth, far beyond the size of to that present day. The autonomic nervous system (ANS) is the part of the nervous system of the higher life forms that is controlled unconsciously. It regulates body functions and the processes of specific organs in human body. As declared by IBM, future communication systems might be designed and structured in a similar way to the ANS. As autonomics conceptually comes from biological entities such as the human autonomic nervous system, each of the parts or areas can be metaphorically related or linked to functional and structural aspects of a living being. In the human body, the autonomic system facilitates, provides and regulates a variety of functions including respiration, blood pressure and circulation, and emotive response. The autonomic nervous system is the structure consists of interconnecting fabric that supports feedback loops between internal states and various sources by which internal and external conditions are observed.

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