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   REVIEW OF LITERATURE

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   STATEMENT OF THE PROBLEM

   OBJECTIVES

   HYPOTHESES

   RESEARCH METHODOLOGY

   RESULTS & DISCUSSION

   FINDINGS

   RECOMMENDATIONS/SUGGESTIONS

   CONCLUSIONS

   SCOPE FOR FURTHER RESEARCH

   ACKNOWLEDGMENTS

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   APPENDIX/ANNEXURE

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SELF-MANAGING COMPUTING

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ABSTRACT

The increasing scale complexity, heterogeneity and dynamism of networks, systems and applications have made our computational and information infrastructure brittle, unmanageable and insecure. Most software is fragile: even the slightest error, such as changing a single bit, can make it crash. Complexity is increasing rapidly as a result of two factors: the increasing use of distributed systems and the increasing scale of these systems as a result of the addition of many new computers to the Internet.To manage this new complexity, we propose an approach based on self- managing systems. The goal of autonomic computing is to realize computer and software systems and applications that can manage themselves in accordance with high-level guidance from humans. This paper motivates about its principles, challenges and related discussions about autonomic computing with hackers.

KEYWORDS
heterogeneity, dynamism, unmanageable, complexity, managing, hackers.

1. INTRODUCTION

Self managing computing helps to address the complexity issues by using technology to manage technology. The idea is not new many of the major players in the industry have developed and delivered products based on this concept. Self managing computing is also known as autonomic computing.

Autonomic Computing is an initiative started by IBM in 2001. Autonomic computing refers to the self-managing characteristics of distributed computing resources, adapting to unpredictable changes while hiding intrinsic complexity to operators and users. The term autonomic is derived from the autonomic nervous system of the human biology. The autonomic nervous system monitors the heartbeat, checks the blood sugar level and keeps the body temperature close to 98.6°F, without one's conscious awareness. In much the same way, self managing computing components anticipate computer system needs and resolve problems with minimal human intervention.

Self managing computing systems have the ability to manage themselves and dynamically adapt to change in accordance with business policies and objectives. Self managing systems handle more and more tasks on their own, without the need for intervention on the part of the IT staff. It can perform management activities based on situations they observe or sense in the IT environment. Rather than IT professionals initiating management activities, the system observes something about itself and acts accordingly. This allows the IT professional to focus on high-value tasks while the technology manages the more mundane operations. Self managing computing can result in a significant improvement in system management efficiency, when the disparate technologies that manage the environment work together to deliver performance results system wide.

2. OBJECTIVES OF THE STUDY

The goal of autonomic computing is to create systems that run themselves, capable of high-level functioning while keeping the system's complexity invisible to the user.

To create autonomic systems researchers must address key challenges with varying levels of complexity.

Self-managing systems can perform management activities based on situations they observe or sense in the IT environment. Rather than IT professionals initiating management activities, the system observes something about itself and acts accordingly.

3. AUTONOMIC COMPUTING

Self-Management is the process by which computer systems shall manage their own operation without human intervention.

The increasing heterogeneity of big corporate computer systems, the inclusion of mobile computing devices, and the combination of different networking technologies like WLAN, cellular phone networks, and mobile ad hoc networks make the conventional, manual management very difficult, time-consuming, and error-prone.

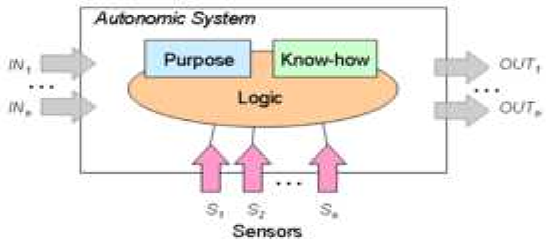
An autonomic system makes decisions on its own, using high-level policies; it will constantly check and optimize its status and automatically adapt itself to changing conditions. An autonomic computing framework is composed of Autonomic Components (AC) interacting with each other.

Driven by such vision, a variety of architectural frameworks based on "self-regulating" autonomic components has been recently proposed. A very similar trend has recently characterized significant research in the area of multi-agent systems.

Autonomy-oriented computation is a paradigm proposed in 2001 that uses artificial systems imitating social animals' collective behaviors to solve difficult computational problems. For example, ant colony optimization could be studied in this paradigm.

4. CONCEPTUAL MODEL

FIG. 1: COPNCEPTUAL MODEL



A fundamental building block of an autonomic system is the sensing capability (*Sensors* S_i), which enables the system to observe its external operational context. Inherent to an autonomic system is the knowledge of the *Purpose* (intention) and the *Know-how* to operate itself (e.g., bootstrapping, configuration knowledge, interpretation of sensory data, etc.) without external intervention. The actual operation of the autonomic system is dictated by the *Logic*, which is responsible for making the right decisions to serve its *Purpose*, and influence by the observation of the operational context (based on the sensor input).

This model highlights the fact that the operation of an autonomic system is purpose-driven. This includes its 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 system this would be encoded as a feedback error function or in a heuristically assisted system as an algorithm combined with set of heuristics bounding its operational space.

5. LEVELS OF AUTONOMIC MATURITY

Products, systems, and IT environments can be classified in the following five levels of maturity that show how a business is evolving its use of autonomic capabilities and supporting processes and skills:

Level 1-Basic: At the basic level, IT professionals manage each infrastructure element independently and set it up, monitor it, and eventually replace it.

Level 2-Managed: At the managed level, systems management technologies can be used to collect information from disparate systems onto fewer consoles, helping to reduce the time it takes to collect and synthesize information.

Level 3-Predictive: At the predictive level, analysis capabilities are introduced in the system to monitor situations that arise in the environment, and analyze the situations to provide possible courses of actions. The IT professional makes a determination on what course of action to take.

Level 4-Adaptive: At the adaptive level, the IT environment can automatically take actions based on the available information and the knowledge of what is happening in the environment. As analysis and algorithmic technologies improve and as people become more comfortable with the advice and predictive power of such technologies, systems can progress to the adaptive level.

Level 5-Autonomic: At the autonomic level, business policies and objectives govern the IT infrastructure operation. IT professionals interact with the autonomic technology tools to monitor business processes, alter the objectives, or both.

6. AUTONOMIC COMPUTING REFERENCE ARCHITECTURE

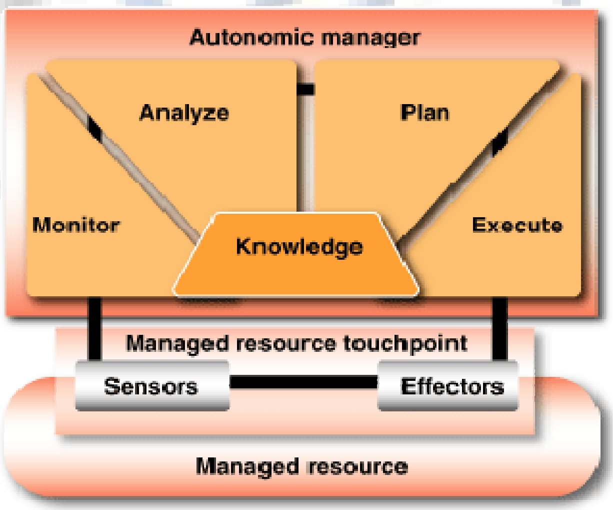
The autonomic concepts presented in this section form the basis for a common approach and the base set of terminology needed in architecting autonomic computing systems in a heterogeneous environment.

Control loop

The autonomic computing reference architecture starts from the premise that implementing self-managing attributes involves an intelligent control loop. This loop collects information from the system, makes decisions and then adjusts the system as necessary. An intelligent control loop can enable the system to have the self-configuring, self-healing, self-optimizing, and self-protecting attributes described before.

The architecture describes three types of system components, autonomic managers, managed resources, and managed resource touch points. An autonomic manager is a component that implements a particular control loop. A touch point is a component that delivers access to the managed resource. A managed resource is what the autonomic manager is controlling. Figure 1 illustrates the relationship between the different components.

FIG. 2: AUTONOMIC COMPUTING REFERENCE ARCHITECTURE



Autonomic manager: The autonomic manager is a component that implements the control loop.

The architecture splits the loop into four parts that share knowledge. They are:

- *Monitor*-provides the mechanisms that collect, aggregate, filter, manage, and report details collected from a managed resource.
- *Analyze*-provides the mechanisms to correlate and model complex situations that allow the autonomic manager to learn about the IT environment and help predict future situations.
- *Plan*-provides the mechanisms that construct the action needed to achieve goals and objectives.
- *Execute*-provides mechanisms that control the execution of a plan with considerations for dynamic updates.

The four parts work together to provide the control loop functionality. They consume and generate knowledge. The knowledge is continuously shared among the four parts, leading to more informed decisions being made by the parts. Figure 1 shows a structural arrangement of the parts, not a control flow. The bold line that connects the four parts should be thought of as a common messaging bus rather than a strict control flow.

Managed resource: The managed resource is a controlled system component. There can be a single managed resource (a server, database server, or router) or a collection of resources.

An autonomic manager communicates with a managed resource through the manageability interface. A touch point is the implementation of the manageability interface by a specific managed resource. For example, a database server might implement a touch point for communicating with an autonomic manager.

Managed Resource Touch point: The touch point, one of the three main elements of the autonomic computing architecture, delivers the manageability interface to the autonomic manager.

In the simplest terms, sensor operations are typically used to transmit events or properties to an autonomic manager, whereas effecter operations are typically used to cause some sort of change in a managed resource, such as altering state data or setting property values.

Sensor and effecter operations each can have two interaction styles:

- Sensor retrieve-state
- Sensor receive-notification
- Effecter perform-operation
- Effectors call-out-request

In both the sensor retrieve-state interaction style and the effectors perform-operation interaction style, the autonomic manager makes first contact. In the sensor receive-notification and effectors call-out-request interaction styles, it is the managed resource that makes contact first.

The combination of sensor and effectors operations forms the manageability interface that is available to an autonomic manager. For example, a configuration change that occurs through effectors should be reflected as a configuration change notification through the sensor interface.

7. SYSTEM OVERVIEW

Currently, the most important industrial initiative towards realizing self-management is the Autonomic Computing Initiative (ACI) started by IBM in 2001. The ACI defines the following four functional areas:

FIG. 3: SPECTRUM OF SELFMANAGING COMPUTING

1. Self-configuring

Software tools, disciplines, and automatic with or without manual intervention can be applied to help for a self-configuring process:

- Z/OS Wizards are Web-based dialogs that assist in z/OS customization.
- Capacity upgrade CPU provides instant access to additional processors or servers, memory, I/O.
- Customer-initiated upgrade.
- Automatic hardware detection/configuration.
- Automatic communication configuration.

When hardware and software systems have the ability to define themselves "on-the fly," they are self-configuring. This aspect of self-managing means that new features, software, and servers can be dynamically added to the enterprise infrastructure with no disruption Systems adapt automatically to dynamically changing environments. Self-configuring not only includes the ability for systems within the enterprise to configure them into the e-business infrastructure of the enterprise.

2. Self- healing

The characteristics of z/OS that can be considered as self-healing address many different aspects of the system's health.

1. Some of them are related to the capability of the hardware to detect a failure and solve it. The solution can be:
   – Repair - as in the *Error Correction Code* (ECC) scheme.
   – IBM System z Hardware has spare units on many components. This is called N+1 design.

This design provides fault-tolerant capabilities, allowing:

- Use of spare Pus
- Use of spare memory chips
- I/O has multipath access

2. There are also design points that allow these schemes to work, for instance the Chip kill memory design.

3. *Electronic Service Agent* - this offers "call home" support. Every IBM System z machine can, and usually does, have a phone connection with the nearest plant.

4. *Concurrent updates*

- Most maintenance can be done while the systems are up and running. Nevertheless, updates are usually done during periods of low activity using System Modification Program/E, which manages the system software configuration and checks for pre-requisites and co-requisites.
- The way hardware is packed allows users to have more capacity (CPs and memory) than needed.

5. *System software*

There are self-healing capacities in system software, as well. These capacities fall into three main areas, dealing with data replication, automation tools, and virtualization techniques:

- Data replication
- Coupling Facility (CF) structure duplexing
- Synchronous copy

– Automation engines

- System automation for z/OS
- Geographically Dispersed Parallel Sysplex

– Virtualization

- Dynamic Virtual IP takeover and take back
- Dynamic disk balancing

3. Self-optimizing

Self-optimizing features include:

- Intelligent Resource Director (IRD) extensions (non-z/OS partitions - CPU(Linux), I/O, server-wide) - allows dynamic resource allocation on IBM System z servers
- Dynamic LPAR, WLM LPAR extensions for Linux
- Parallel Sysplex Extensions - Sysplex Distributor, CP Coupling
- BIND9 DNS-DNS BIND Version 9.0 on z/OS
- z/OS Workload Manager (CPU, memory, I/O, TCP/IP QOS, Web request management, and batch initiator balancing)

Self-optimization requires hardware and software systems to efficiently maximize resource utilization to meet end-user needs without human intervention.

4. Self-protecting

Self-protecting features include:

- LPAR
- Intrusion detection IDS, PKI
- Hardware cryptographic (coprocessors, accelerators and CP assist) adapters
- Digital certificates providing identity authentication
- SSL and TLS (manages Internet transmission security), Kerberos (authenticates requests for service in a network), VPN, encryption
- Tivoli Policy Director
- LDAP (aids in the location of network resources)

Self-protecting systems must have the ability to define and manage user access to all computing resources within the enterprise, to protect against unauthorized resource access, to detect intrusions and report and prevent these activities as they occur, and to provide backup and recovery capabilities.

8. AUTONOMIC COMPUTING RESEARCH ISSUES AND CHALLENGES

Key research issues and challenges are presented below.

Conceptual Challenges: Conceptual research issues and challenges include (1) defining appropriate abstractions and models for specifying, understanding, controlling, and implementing autonomic behaviours; (2) adapting classical models and theories for machine learning, optimization and control to dynamic and multi agent system; (3) providing effective models for negotiation that autonomic elements can use to establish multilateral relationships among themselves.

Architecture Challenges: Autonomic applications and systems will be constructed from autonomic elements that manage their internal behaviour and their relationships with other autonomic elements in accordance with policies that humans or other elements have established. As a result, system/application level self-managing behaviours will arise from the self-managing behaviours of constituent autonomic elements and their interactions.

Middleware Challenges: The primary middleware level research challenge is providing the core services required to realize autonomic behaviours in a robust, reliable and scalable manner. These include discovery, messaging, security, privacy, trust, etc. Autonomic systems/applications will require autonomic elements to identify themselves, discover and verify the identities of other entities of interest, dynamically establish relationships with these entities, and to interact in a secure manner.

Application Challenges: The key challenges at the application level is the formulation and development of systems and applications that are capable of managing (i.e., configuring, adapting, optimizing, protecting, healing) themselves. This includes programming models, frameworks and middleware services that support the definition of autonomic elements, the development of autonomic applications as the dynamic and opportunistic composition of these autonomic elements, and the policy, content and context driven definition, execution and management of these applications.

9. PROPOSED IDEA: AUTONOMIC COMPUTING WITH HACKERS

The principles and concepts of autonomic computing have led to the creation of autonomic computing framework where management and computing elements are joined together to observe and act directly on the computer resources to enhance their performance. Autonomic computing allows system to adapt dynamically to the changing environment using policies provide by the IT professionals. It can detect malfunctions and create policies without disrupting the IT environment.

Using autonomic computing, we can anticipate, detect, identify and protect against threads from anywhere like hostile behaviors such as unauthorized access and use, virus infections, denial of service attacks etc. Moreover using the principle of self optimizing, the system can monitor and manage the resources automatically, such that the needs of end users or business needs are met properly and avoids the probability of scarcity of resources. But after this all still we are facing numerous illegal attacks from hackers.

A **Hacker** is a person who is interested in the working of any computer operating system and breaks into other people systems, with malicious intentions. Hackers gain unauthorized access, destroy important data, stop services provided by the server, or basically cause problems for their targets. Hackers can easily be identified because their actions are malicious. Many malicious Hackers are electronic thieves. Just like anyone can become a thief, or a robber, anyone can become a Hacker, regardless of age, gender, or religion. Technical skill of Hackers varies from one to another. Some Hackers barely know how to surf the Internet, whereas others write software that other Hackers depend upon.

Information security research teams and **detection systems** exist to try to find these holes and notify vendors before they are exploited and to track attacking hackers while the attacking hackers develop by-passing techniques which are eventually resulted in bigger and better detecting and tracking systems respectively. The **Ethical Hacking** with the intent to discover vulnerabilities from a Hacker's viewpoint so systems can be better secured. Ethical Hacking is part of an overall information Risk Management program that allows for ongoing security improvements.

From the time autonomic computing was first initiated by IBM until the exiting today, we are still facing the threads and losses from hackers. Even though autonomic computing was meant for self-managing and self-protecting the system without any consciousness of the users, till now no one could find a complete solution for detecting and disrupting the hackers. And so in the future we need more software engineering methods and theories to implement to clear out the hackers.

10. CONCLUSIONS

Autonomic computing is about shifting the burden of managing systems from people to technologies. When the Self-Managing Autonomic Technology and self-management capabilities delivered by IBM and other vendors can collaborate, the elements of a complex IT system can work together and manage themselves based on a shared view of system wide policy and objectives. Autonomic computing architecture is a range of software technologies that enable you to build an information infrastructure that can, to lesser and greater degrees, manage itself, saving countless hours (and dollars) in human management and all this without giving up control of the system.

The future of autonomic computing is heavily dependent on the developments and successes in several other technology arenas that provide an infrastructure for autonomic computing systems including Web and grid services, architecture platforms such as service-oriented architecture (SOA), Open Grid Services Architecture (OGSA), and pervasive and ubiquitous computing. Even if autonomic computing technology is readily available and taught in computer science and engineering curricula, it will take another decade for the proliferation of automaticity in existing systems.

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