ENHANCED AUTONOMIC NETWORKING MANAGEMENT ARCHITECTURE (ENAMA)

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ABSTRACT

A Computer Network which automatically configures itself and adopts the services which fulfil user requirements according to their needs is called autonomic network. Autonomic network self manages the services for heterogeneous devices and modify polices for users to satisfy them from network services. In ENhanced Autonomic network Management Architecture (ENAMA), we propose two blocks of processing which control the operations of management as well as for learning from environment and take decisions for network related issues. QoE will be used for collecting data for learning from external environment and store in Long Term Memory (LTM) block for future analysis and decisions. The proposed ENAMA is the fast learning autonomic network management architecture; it will take most accurate decisions to handle the critical situations.

Keywords: *Autonomic Network, Quality of Service (QoS), Quality of Experience (QoE), Policy Based Network, Learning, Decision*

1. INTRODUCTION

The foundation of autonomic network is based on human nervous system and intelligence of the brain. Autonomic network reacts on every action within few seconds, have no fix policy for users, polices and decisions are change on the behalf of users needs. There were different architecture models developed by reported originations like IBM, DARPA and FOCALE ,but these models couldn't work fully like human brain. Therefore, there is a need for new architecture model that work like human brain very intelligently and can learn from environment within short time and make accurate decisions to handle the situation.

In policy based networks, administrator set policies for long time, due to the fix policies, there was problem for connect new devices with network and also there is no permission for using new type of services [1]. Administrator had to do work hard to provide QoS to client and provide access of new services while solving the problems of connectivity with heterogeneous devices with network.

Autonomic network provides many advantages over the manual network. Autonomic network is self-configuration; self-optimization and self-healing. By using these features network manage all resources and take actions or make decisions automatically [8]. The challenges and limitations behind such implementation include the representation of knowledge at the resource management level, unification and simplification of business processes, information technology across the domain, and precise and scalable knowledge base. Systems should have solutions to cover different standards and allowing interoperability between equivalents but heterogeneously instantiated domain knowledge. Existing operators cannot manage the domains and they do not adopt same representation for their managed entities including their properties, relationships and operations.

Autonomic networks reduce the burden from the administrator to automatically configure devices on network. There is no fix policy for the user. The policies are changed on every new request of the user and provide quality of service (QoS) to clients. QoS was used in past by several organizations to improve technological aspect of network devices to fill the user needs, but they didn't succeed at all. In ENAMA, we use QoE which depends on user experience. It measures the QoE from user actions, analyzes their needs on the network and tries to fulfill the user and organization requirements [2]. QoE is all about user perception, feelings, errors and satisfaction at the time when he uses particular service or product. QoE data is analyzed to extract their experience about the services and this data provides help to administrators for improving the technological aspects for the betterment of QoS for end users [9].

In ENAMA (ENhanced Autonomic Network Management Architecture), we propose new monitoring idea for learning and decisions which are based on human learning and decision ability. Fact is that human beings learning ability depends on trying different experiments and by keeping focus on environment and surroundings entities then finally

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they made accurate decision for the solution of problem. In old ideas predefined techniques were used for monitoring or fix policies, so monitoring section monitors environment within the limited scope and blocked the new services and process for execution. If any authorized user will launch the attack or attach malicious type process then the system fails to respond. In our proposed model we use two processing units, one active doing processing and other for backup and this model allows processes for once execution. In ENAMA model, two processing blocks working same like left right brain functionality of human beings, left side of brain used for learning skills and right of brain is used for creation of innovation also for holistic thoughts [3, 4].

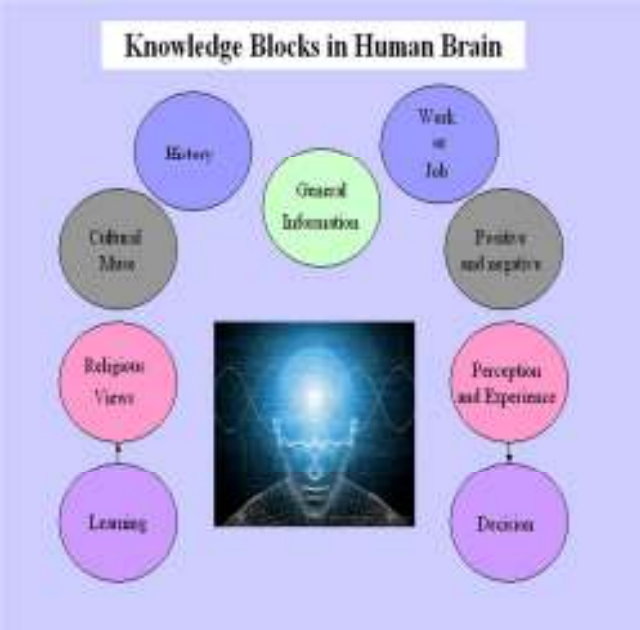

Fig 1. Knowledge Representation in Human Brain

2. RELATED WORK

The architecture of autonomic network was given by different researchers and organizations such as IBM, DARPA (Defense Advanced Research Project Agency) FOCALE architecture, Cognitive Network, Bionet project from NSF (National Science Foundation).

Autonomic network is combination of highly heterogeneous distributed systems, which depend on set autonomic entities (AE). Every entity is a set of managed resources, services and offers services to user or peer autonomic network. The architecture of autonomic components require abilities to allow every entity to analyze the behavior of local processing and also monitor the environment and react on event, configure itself on the basis of data which was collected from the other entities. Communication between the entities and components in the network environment provide collective intelligence to achieve the goal.

This IBM Autonomic element architecture model is composed of different modules that enable the expected autonomic behaviors through the set of autonomic operations can achieve by using self adjusting control loop. [6] Control loop depends on components of system, every component transfers signal to other components with policy driven management rules for controlling the system operations. The outputs of components are sent because autobody panels' emphasis curved surface whole artistic effects, measurement accuracy is not the first problem considered in the course of the measuring car body, but trying to make the development time shorter [4]. Signal to system for adjust the operations according to messages given by the autonomic elements [1, 6].

The control module introduces two types of components called sensors and effectors. Sensors collect data from environment and effectors allow the configuration of its managed resources. Autonomic entity of monitoring module collects data using different techniques, aggregates, filter and manage information collected by sensors from environment. All information goes to analyze phase that analyze the information of environment and make plan to control the components. Then loop moves to execute module that executes the plan, performs set of specified actions. Once the goal is specified, the interaction workflow between different modules and allows the router to behave in autonomic manner without administrator interaction. There are two level of control over managed resources and autonomic entity. The control loop of autonomic entity allows immediate action to modify in the autonomic entity to be imposed another general loop called global control loop aspire to impose a automatic behavior of the autonomic entity as regards more compulsory condition changes in its surrounding environment. [1].

2.1 Cognitive Network DARPA

In this approach there is main focus on the cognitive capabilities of future network architecture. [7] The aim of cognitive network architecture is to produce cognitive process of human computational model. Cognitive architecture should not be implemented partly but it needs complete implementation of various aspects of cognitive behavior as well as complete system. The aim of architecture is to reproduce the action on the basis of short term and long term and also learn from previous execution. These cognitive aspects are aligned with IBM approach but they differ in terminology and definitions DARPA proposed three processes related to cognitive behaviors; reactive, deliberative and reflective reason process. It is same like IBM and FOCALE architecture.

The reactive processes get information from environment automatically and react on that information by storing information for future. Deliberative process analyzes compares and evaluates the situation and the reflective process monitors and controls failure behavior response to previous performance by using cognitive element and execution history for decisions.

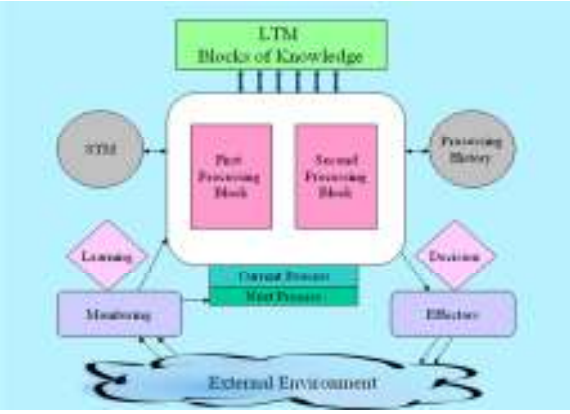

Fig 2. Enhanced Autonomic Network Management Architecture (ENAMA)

2.2 Bio-Networking Architecture

This architecture was developed with Bionet project at the University of California, Ervine and supported by NSF and DARPA. This architecture is like biological system to scale, adopt and survive automatically [5, 7]. In this architecture, cyber entities are used as autonomous mobile agent to implement network system. The Bio-Networking approach relies on mobile agent's background and reuse its concepts but it's not clear today whether autonomic network should relay on mobile agent or not. [1, 7]

2.3 FOCALE Architecture

FOCALE (Foundation, Observation, Comparison, Action and Learning Environment) was introduced by Motorola in collaboration with the LRSM lab of the University of Evry and TSSG Lab.

In this architecture, managed resources can be turned into an autonomic component. Autonomic Computing Element (ACE) is used to manage resource and functionality throughout the system [6, 7].

The ENAMA architectures have different features compare to other autonomic network architectures and comparison is given in table 1. Automatic policy change is also feature of this architecture which is given in EQoM framework [14].

For automatic policy ,the network architecture collect data of every user from network and compare that data of user with user default policy, if user can't services according to SLA than it upgrades the services for particular user and provide quality of service to end users.

3. ENAMA ARCHITECTURE

ENAMA system will work by monitoring the network environment and collect data about network services,

devices and also QoE data of user. This data will be stored in LTM blocks for future usage. The purpose of adding QoE domain is to act like human beings as they get experience from conversation with different people in different situations, behaviors and attitude to make human more knowledgeable to make decision. QoE is involved to obtain users needs, service usage level of expertise because system update database of LTM block according to user behavior and respond them according to their requests otherwise system will not be more intelligent it's decision making ability will not satisfy the user.

ENAMA will learn from environment by agent based framework, agents run from server to client and monitoring network by collecting information of network devices like switches, routers their status and about heterogeneous nodes which are connected with network. Components of ENAMA (Enhanced Autonomic Network Management architecture) are given in figure 2.

Table 1. Comparison of Enama with other Autonomic Architectures

Autonomic Architectures	IBM [10]	FOCALE [11]	Bionet [12]	Cognitive Architecture [13]	ENAMA
QoE Support	No	No	No	No	Yes
Learning ability from new process	Limited	Limited	Limited	Limited	Advance
Action on Malicious or new type of process	Access prevent	Access prevent	Access prevent	Access prevent	Allow access and damage control ability
Human Brain Architectures support	Yes	Yes	Yes	Yes	Advance
Policy change according user needs	No	No	No	No	Yes

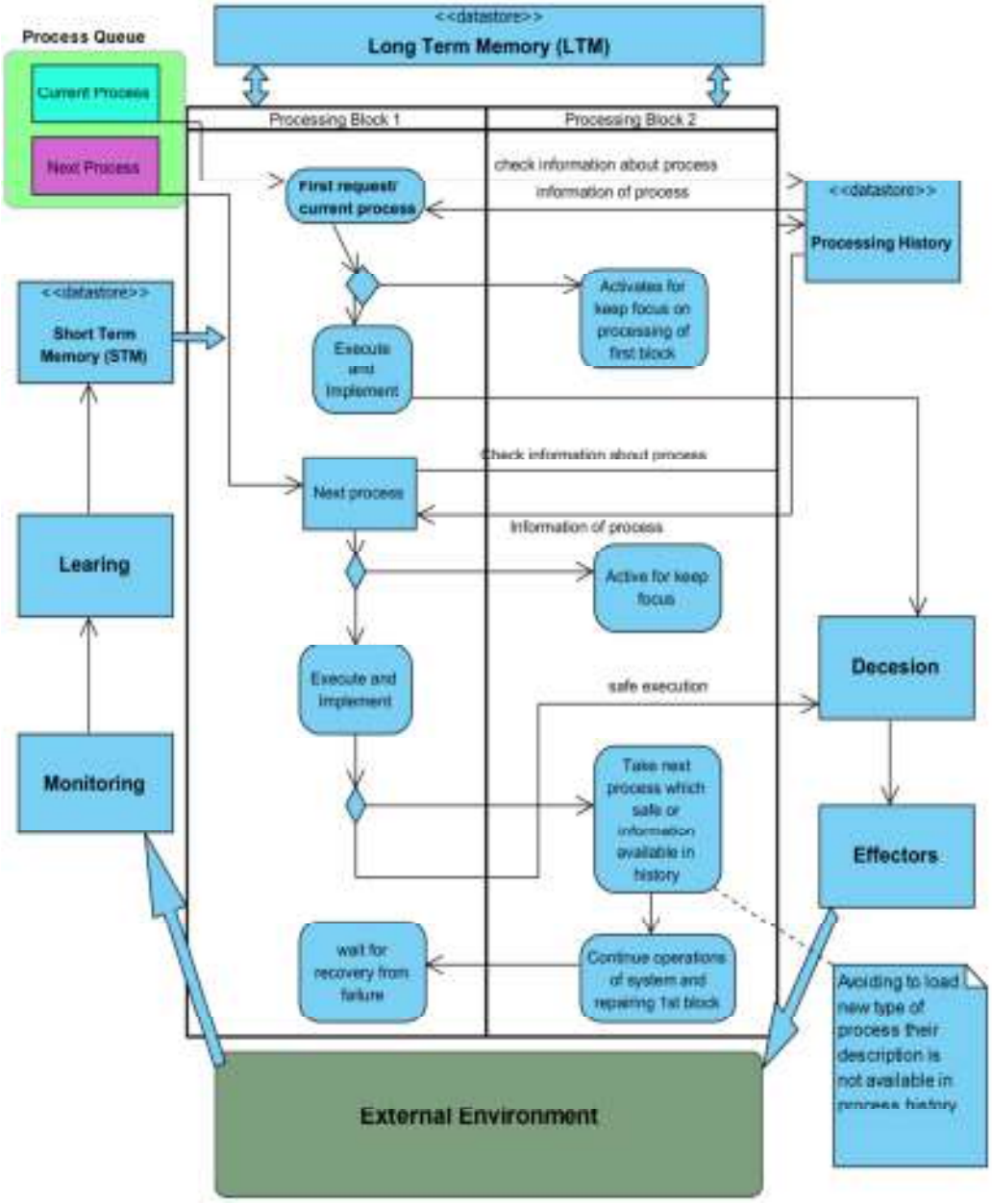

Fig 3. Activity Diagram of Enhanced Autonomic Network Management Architecture (ENAMA)

4. ACTIVITY DIAGRAM OF ENAMA

The activity diagram explains how two processor blocks executes processes in ENAMA architecture. We present execution actives of two processes.

- Processor blocks are connected with Short Term Memory (STM), which contains current data monitored from network and data of system. Long Term Memory (LTM) permanent storage which contains operating system, and other data which support for execution of process. System load a process from process queue for execution in first block, first processor block get information about process from process history, if information available about process then decision node move to executes and implement and send executed data to decision phase to apply new rules. If not then it activates the 2nd processor block for keeping eyes

and ready for controlling operation of system when first processor block goes down.

- System loads new process from process queue for execution, processor block get information from about process from process history, if information is not available about process. For new type of processes, 2nd processor block activates for keeping track of system operations and first processor block attempt to execution of process. After successful execution of process, decision node send information to decision phase, if first processor blocks fails in execution due to malicious type process then decision node transfer control to 2nd processor block to control the rest of operations of system for execution in future. In next action, 2nd processor block executes safe processes or those processes their information is already available in information history and also starts action for recovery of first processor block from failure.

5. CONCLUSION

We proposed ENAMA model based on human brain intelligence having different knowledge blocks in the mind to answer the queries and ability to take most accurate decisions according to situation. In this paper, we discussed about left right functions which help us to learn and make decisions. The same idea imposed in ENAMA model with two units of processing interconnected to adopt functionalities of learning and decision making. In the ENAMA, QoE helps to analyze the user way of using services that helps ENAMA to answer the queries of user accurately using LTM block.

In future development of hardware framework according to proposed architecture and software developer mostly open source operating system developer will try to make functionality of operating system according to proposed architecture then it will be better for service provider to satisfy users.

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