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Autonomic Communication - A New Wave

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Abstract- Next generation networks will certainly face requesting access from different parts of the network. The heterogeneity of communication and application software's changing situations in the environment, from the users, the operators, the business requirements as well as the technologies. Users will be more and more mobile, protocols, etc. will increase and render the network more complex to manage. Autonomic networking aims to design networks that are capable to self-manage, while optimizing their configurations and interactions to the changing needs of the users and the environment. The present paper deals with overview of autonomic communication and its role in digital global world.

Index Terms- Adaptability, autonomic communication, configurable, technology, wireless Communication.

I. Introduction

Autonomic communication studies the individual network element as it is affected by and affects elements and the often numerous groups to which it belongs as well as network in general. Autonomic is a way, being able to self-configure, self-monitor, self-adapt, and self-heal. Autonomic communication studies the individual network element as it is affected by and affects elements and the often numerous groups to which it belongs as well as network in general. The goals are to understand how desired element's behaviors are learned, influenced or changed, and how, in turn, these affect other elements, groups and network [1].

The Autonomic Communication (AC) is to allow self-adaptable, self-configurable, technology independent, robust, secure, scalable, and easily deployed services and infrastructures. Autonomic Communication is a paradigm in which the applications and the services need not ported onto a pre-configured network, but where the network itself grows out of the services that end users desire.

II. Advantages of Autonomic Communication

The following are the main benefits of this advanced technology:

1. Reduce network complexity
2. Cope with proliferation of WLANs and numerous ad hoc, peer to peer networking paradigms which may occupy same frequency space.
3. Share the cost of managing the networks (as IBM's Autonomic Computing)[1].
4. Support mobile, personalized Services
5.Improve efficiencies through context awareness, etc.
6. End-user is becoming a resource-powerful engine.
7. Contributes its resources to the network
8.The autonomic, powerful end-user is becoming the network.
9.The network will be made up of zillions of autonomic nodes.

III. Issues In Autonomic Communication

The increasing density of the global network operators, developers and users both dramatic advantages and significant challenges:

3.1 Industry

The need to maintain diverse and complex networks is often a significant (and increasing) cost of doing business. A more autonomic infrastructure would reduce these costs and facilitate new opportunities, but only if made sufficiently flexible, robust and secure for use across the spectrum of corporate communications.

3.2 Operators

Increasing interconnectivity potentially allows improved robustness capabilities and closer integration with the and bandwidth, but also increases the complexity of management and the fragility of protocols in coping with a highly dynamic and largely scale free environment composed of diverse networks and technologies. Fine-grained mobility and roaming require that the relationships between operators, and between operators and users, be extensively re-thought.

3.3 Developers

Mobile and pervasive networks allow applications and services to extend into the environment, both providing and benefiting from sensing personal and social goals of users, but at the cost of massively increased programming and configuration complexity [4].

3.4 Users

Mobility and ubiquity tilt the balance of communications systems in the users' direction, placing individually- and socially-focused adaptations at the core of the systems architecture, but with the danger that the increased potential for surveillance and complexity will erode the privacy of individual and further disenfranchise entire social groups.

IV. Vision of Autonomic Communication

1. It is to allow self-adaptable, self- configurable, technology independent, robust, secure, scalable, and easily deployed services and infrastructures.

2. ACs is a paradigm in which the applications and the services need not ported onto a pre- configured network, but

where the network itself grows out of the services that end users desire.

The following desirable properties are envisioned

1. Zero- effort deployment
2. Autonomously Controlled Network Entities – self-organized, self- managed, self-configured, self- healed, self-learning system [2].
3. Morphing capabilities - changing (add, delete, modify) functionality.

V. Features of Autonomic Communication

The main features of autonomic communication are the ability to adapt to an evolving situation where new services can become available.

5.1 Network Architectures

Network Architectures that are heterogeneous, resilient, evolvable, distributed and highly dynamic. Multi- mission/ reprogrammable functionality and communications Services [4]. As Network Architectures consists of traditional communication and coordination models which are heterogeneous in nature means no autonomic adaptability.

5.2 Self- aware Communications Protocols

Self-aware Communications Protocols that enable self-adaptive anytime/ anywhere operations in a heterogeneous mix of networks.

5.3 Security and Protection

Since autonomic nodes could self program their networking behavior out of cooperative mechanisms, this calls for novel techniques for trusted software.

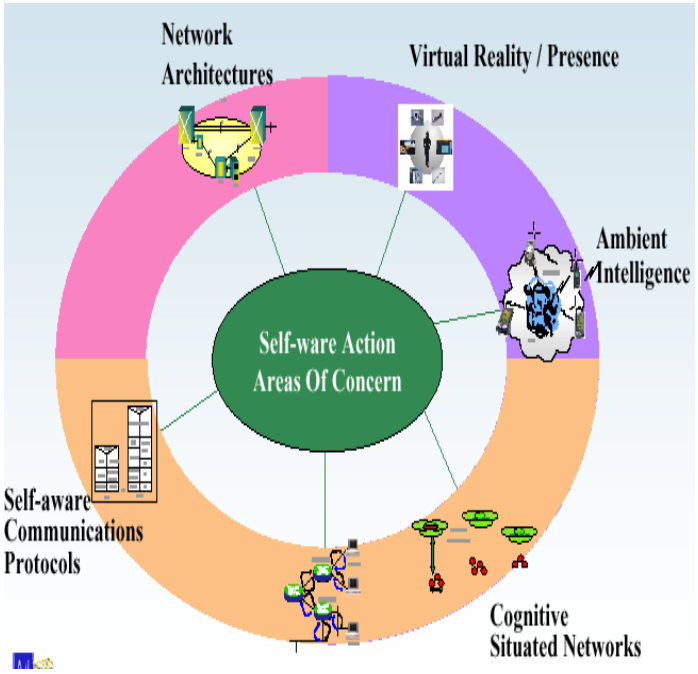

Fig 1: Autonomic communication system self-ware areas

5.4 Cognitive Situated Networks

Cognitive Situated Networks no longer act as a means to simply propagate information from one machine to the other but become a living partner enabling "on- the- fly" interactions with the environment. Nano-sensor technology to gather, filter, aggregate, and map information that live in multiple and dynamic contexts.

5.5 Virtual Reality & Virtual Presence

Virtual Reality & Virtual Presence natural interaction by Video tracking, Eye tracking, Gesture and Emotion Recognition.

5.6 Ambient Intelligence

It is an emerging interface paradigm in which the computer intelligence is embedded in a digital environment that is aware of the presence of the users and is sensitive to their needs, habits, gestures and emotions. In this interaction through all senses - devices- to- device, devices- to- person, devices- to- environment and devices- to- cyber. Figure 1 shows different components of this technology.

VI. Functionalities Of An Autonomic System

In order to grant an autonomic behavior to autonomic system, the following functionalities will be foreseen and enabled both at the autonomic node or component as a single point of decision and the whole system.

6.1 Self-locating

With this feature the autonomic node establishes, and dynamically updates, a reference system to identify neighbor nodes and locate the resources required by its coordination scheme. The reference model will help in the behavior correlation process.

6.2 Self-configuring

With the ability to dynamically configure itself on the fly, an information pervaded environment can adapt immediately and with minimal human intervention to the deployment of new components or changes in the information-pervaded environment.

6.3 Self-healing

Through self-healing, systems state can be evaluated and corrective actions can be initiated without disrupting system operation. The corrective actions may lead the system/subsystem to alter its own state and/or influence changes in other elements of the environment. The information pervaded environment as a whole becomes more resilient as changes are made to reduce or help to eliminate the impact of failing components.

6.4 Self-optimizing

This feature refers to the ability of the information-pervaded environment to efficiently maximize resource allocation and utilization to meet end-users needs with a minimal human intervention. In the near term, self-optimization primarily addresses the complexity of managing system performance.

6.5 Self-protecting

The goal of self-protecting environments is to provide the right information to the right users at the right time through actions that grant access based on the users role and predefined privileges. A self protecting information-pervaded environment can detect hostile or intrusive behavior as it occurs and take autonomous actions to make itself less vulnerable to unauthorized access and use, viruses, denial-of-service attacks and general failures.

6.6 Self and context-aware

These features refer to perception and cognitive reaction to an event or more generically to a condition, relevant to the same intelligent node or, respectively to the environment. Context-awareness is a foundation for the rest of the operational features: self-configuring, self-healing, self-optimizing, and self-protecting.

VII. Cognitive Radio in Autonomic domain

Cognitive architectures are characterized by certain properties: the cognitive behavior should not be implemented partly but it should concern the complete system implementation of various aspects of the cognitive behavior as well as the complete system (Holistic view of the cognitive system). The system aims to learn and adapt its future reactions based on statistics about the previous executions. DARPA proposes architecture for cognitive nodes that introduce 3 processes related to cognitive behaviors: reactive, deliberative and reflective (meta management) reasoning process.

The "reactive" process provides the cognitive network with capabilities that allows reacting automatically to some events or perception of the environment. However, that sense of "reactive" excludes any possibility to take into account future possibilities, hypotheses about what might have been the case, or formulate hypotheses about what exists in some part of the system that is not currently being perceived. Deliberative process permits to leverage this limitation providing the system with the ability to represent and reason about, and to compare and evaluate, possible situations that do not exist, or exist but are not known , either because they are future possibilities, or because they are remote or hypothetical possibilities or because they might have occurred in the past [5]. Finally, the reflective process enables the cognitive elements to monitor and control their own progress to adapt their future behavior in response to previous performance. Statistics, or executions history, are an important parameter in the decision-making process.The architecture aims to reproduce the behavior of the modeled system (i.e. human nervous system) at different level of time (short term, long term reactions) to exhibit a robust behavior to errors and unknown/unexpected events.

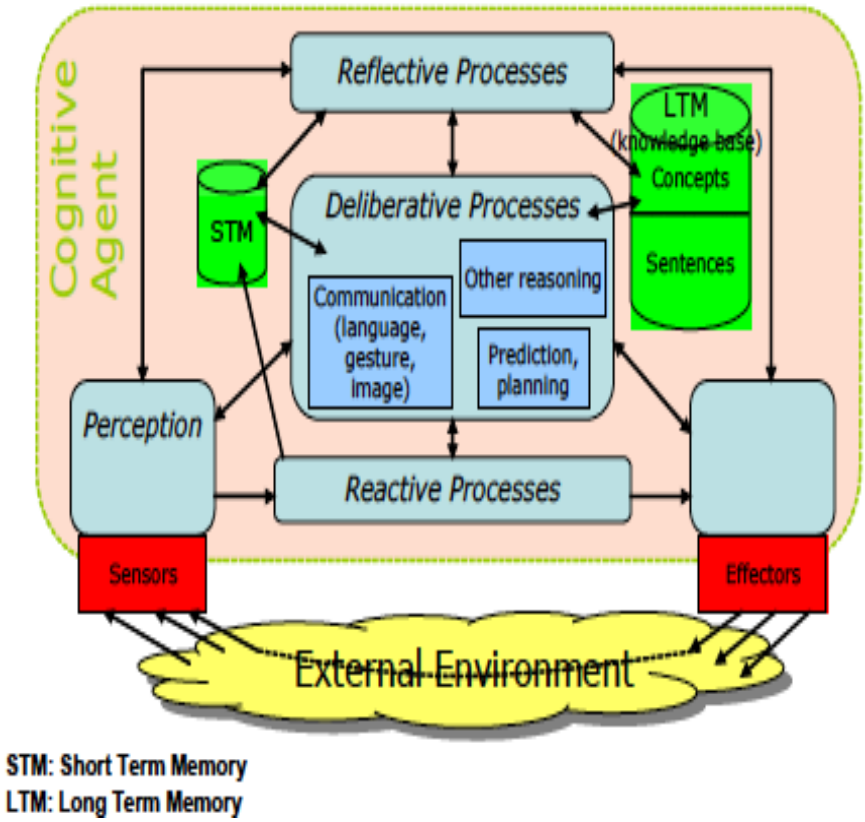

Fig 2: DARPA Cognitive Architecture

VIII. Informed Decision in Wireless Ecosystem

An extended model for autonomic computing and autonomic communications is proposed and depicted in figure 3.

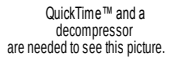

Fig 3: Model of Autonomic Computing and Autonomic communication

The model introduces some new features. The first is the functionality for sensing, assessing risks and determining behavior [3]. The second issue is the computation of fitness functions.

The following is a list of main concepts that have to be developed for the introduction of cognitive wireless networks.

1. Etiquettes: Means of interaction with environments.
2. Cross-layer abstractions: Autonomic computing and communication are highly related to cross-layer optimizations. Decisions that optimize a certain layer, directly or indirectly, can optimize the performance of other layers.
3. XDMA: Development of context Division MultiAceess Concept.

VIII. Conclusion

Continuous developments of mobile technologies and their use in everyday life increase our need to be continuously connected to others and to the Internet, anywhere and at any time. However, in mobile, pervasive environments user connectivity is mainly affected by wireless-communications constraints and user mobility. These boundary conditions do not allow us to design communication environments based on unique and fully connected networks or assume a stable path between each pair of users wishing to communicate. The present paper has overviewed state of art of autonomic communication and its impact in digital global world.

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