

# Application of Mobile Agents in Managing the Traffic in the Network and Improving the Reliability and Quality of Service

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**Abstract**—Currently telecommunication networks consist of heterogeneous networks, therefore controlling and managing the traffic in these networks will be complex tasks and difficult. Network management activities for these diverse networks require gathering and analyzing huge amount of data from the network. Then based on the activities involved in the network, decisions must be made at different times, and the real-time requirements for various types of traffic must be set instantly. Existing network management follows a centralized approach thus the process of data gathering and analysis usually involves huge transfer of management data. This consequently generates congestion in the area around management stations and it causes lack of scalability, especially if they are connected by wireless links. Therefore, we need to have a model for distributed and intelligent network management with mobile agents that can analyze data and make decisions in order to preserve the reliability and quality of service for the end users. Mobile agents are the intelligent entities and are option to the distributed network management. They can move across the networks, and by using load balancing method regularly, they can distribute the load over a network. In addition, mobile agents can make decisions in order to reduce the network traffic. This paper discusses and analyzes the application of mobile agents in distributed network management for improving its reliability and quality of service.

**Index Terms**—Congestion, Load balancing, Mobile Agent, Network traffic, Quality of Service

## I. INTRODUCTION

Various applications, particularly those related to multimedia, require guaranteeing transmission of data with a certain degree of reliability and quality of service in a communication network. A network management system

performs the tasks of managing a network, undertaking its proper functionalities, maintenance, security control, gathering and archiving of data and fault management [1].

Current network management systems such as simple network management protocol (SNMP) for data networks [2], and common management information protocol (CMIP) for telecommunication network [3], are typically designed according to a centralized model, which are characterized by lack of distribution, a low degree of flexibility, re-configurability, efficiency, scalability, and fault tolerance [4]. They also require network administrator to make real-time decisions and find solutions for the series of problems in the network. These network managements deal only with data gathering and reporting methods, which in general involves substantial transmission of management data. This causes to consume a lot of bandwidth, computational overhead, a considerable strain on the network at all the times and a reason for traffic jam at the manager host [5]. These management activities are limited, and since they can not do intelligent processing such as judgment, forecasting, decision making, analyzing data, and make positive efforts to maintain quality of service. Therefore, all these problems recommend distribution of management intelligence by using mobile agent to overcome the limitations of centralized management and meet today's requirements.

Mobile agents are computer programs, which are autonomous, proactive and reactive, and have ability to learn. They move from one node to another node and interact with each other, sharing information to better carry out their goals. Mobile agents spread intelligence across the network [6], while they move in a network. The mobility of mobile agents allows them to be created, deployed, and terminated without disrupting the network configuration [4].

Network components (e.g., hosts, gateways, servers) in a centralized network management, have management agents, but these agents are different from mobile agents, and they carry out the network management tasks [7]. Consequently various nodes in a centralized network may be managed with a single network management station, which causes traffic and congestion in a network.

The fundamental problem in telecommunication network management is load balancing, which avoids overloading and traffic congestion in networks, even if many of the network's

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nodes are not used to their capacities at all [8]. Therefore, we need to use mobile agents for managing the network. Mechanism of the mobile agents is based on the load balancing method and by using this method there will be no routers idle or overloaded and lets a network uses all its capacity efficiently.

Quality of service method proposes ways for managing the network resources in a well-organized approach. It lets for better use of the exciting network infrastructure, improves service to the end users and reduces the cost of providing these services. The main purpose of the quality of service is to dedicate bandwidth, control jitter and avoid latency, which are required by some of the real time applications, and for recovering loss qualities [9].

The rest of this paper has the following structure. In section II, we review the related work on the implementation of mobile agent technology in network management. In section III, we present mobile agent technology and discuss a number of advantages that cause agent technology to influence the telecommunications industry, its management systems and communication services. In section IV, we describe distribution network management, and finally we conclude our paper in section V.

## II. RELATED WORK

Over the past few years extensive research work, on mobile agent implementation in network management has been done. Also, due to the increasing requirements in telecommunications, variety of transported flows in network must handle multimedia data traffic reliably with a high quality of service.

There are several threads of research that have used mobile agents in a telecommunications network to manage connectivity and load balancing. Reference [10] shows an early paper suggesting using mobile agents with AI-like strategies to dynamically provide load-balancing in a telecommunication network.

The objective of the project mobile intelligent agents for the management of the information infrastructure (MIAMI) as in [11] is to examine the applicability of mobile agents to a network and its service management. MIAMI has defined a case study and associated environment, which will allow co-operating customers to dynamically form virtual enterprises for providing services to end-users. The virtual enterprise makes use of services offered by an active virtual pipe provider, a business role similar to a telecommunication management network value added service provider or telecommunications information networking architecture retailer.

Reference [12] shows decentralizing control and intelligence in network managements. Network management is seen as capable of scripting and delegating agents to remote sites where they are incorporated into the local network management program and are used for intelligent tasks such as management information based filtering. This application brings mobile agents into network monitoring and network control. Indeed, facilitating the migration or traversal of mobile agents in a telecommunication network and allow asynchronous and cooperative processing of tasks, specialization of services,

network configuration, decentralization of management, active service usage, intelligent communications such as negotiations among agents, and dynamic information flow.

Evaluating the tradeoffs of mobile code paradigms in network management application [13] have performed tradeoff experiments regarding mobile code design concepts in network management applications by developing a quantitative model that provides the bandwidth used by traditional and mobile code design of management functionalities.

A framework for network management using mobile agents has been shown in [14]. Mobile agents in network management control network's devices on site and thus save the manager capacity and network bandwidth. The architecture of the framework for network management is a hybrid model, it provides an additional network management interface to administrators on top of SNMP layer so that the administrator can have the flexibility of using the most appropriate management approach according to the network characteristic and nature of management activities.

## III. MOBILE AGENT

Mobile agents are programs being sent across the network from the client to the server or vice versa. An agent that can be executed after being transferred over the network will be called an agent host [15]. A software agent is a common name and describes a software entity that computerizes some of the regular or difficult tasks on behalf of human or other agents. Mobile agents can travel in network following their itinerary and carrying logic and data to perform a set of management tasks at each of the visited nodes in order to meet their designed objectives [16].

Mobile agents allow the transformation of current networks into remotely programmable platforms. Mobile agents are a powerful software interaction model that let a program to be moved between hosts for remote execution. They are solutions for managing distributed networks.

The concept of remote programming using mobile agents is considered as an alternative to the traditional client-server programming based on the remote procedure call or the static distributed object paradigm (e.g. CORBA) [17].

A software agent is recognized by a life-cycle model, a computational model, a security model, and a communication model. But a mobile agent is additionally identified by a basic agent model and navigation model [9].

The primary goal of using mobile agents in management of telecommunication network is reducing network traffic by using load balancing and building scalable and reliable distributed network management system.

Some of the advantages of using agent technology in telecommunication networks are as follows [6], [18]:

- 1) Deals with the huge amount of data, which agents can search, collect and filter.
- 2) Allows more intelligence to be used in managing a network, integration of different services to value added services and negotiation of quality of service.
- 3) Develops higher level communication, and organizing a network.

- 4) Re-activeness, agents can react quickly to local events, such as the breakdown of a link.
- 5) Robustness, agents can carry out their tasks at least to a degree, even if parts of the network are not reachable temporarily. This is important in mobile computing, where links are expensive and unstable.
- 6) Distributes management code to the SNMP agents for reducing bandwidth in wireless network.
- 7) Decentralizes network management functions. Mobile agents can autonomously, proactively carry out administration tasks and reduce traffic need for management.
- 8) Dynamically changes network policies. Mobile agents can change the rules underlying network management from time to time.
- 9) Network monitoring, mobile agents are useful for supervision of SNMP variables and long-term controlling of network elements, especially in wireless network as the configuration might change over time.

In order to perform the above properties, agents must communicate to find their peers, to cooperate and negotiate in open environments. It is significant that agent systems build on an interface with a diversity of existing and upcoming standards at the underlying network systems level.

#### IV. DISTRIBUTED NETWORK MANAGEMENT

Network management systems based on SNMP and CMIP are largely static and require many procedures to describe new managing plans. SNMP manages and monitors only network elements and SNMP agents provide a limited and fixed set of functions [19]. Existing network management systems basically use the client/server method for their functionalities. These systems regularly suffer from poor scalability due to an increase in the amount of communication and generate too much traffic in the network and the number of failures in nodes and channel. For managing a network system, sometimes network administrator needs to locally observe and control components on multiple nodes in the system. The traditional network management architecture is inefficient, expensive and difficult to change. Hence we need to increase the level of the automation for improving the effectiveness of management operations and reducing the cost [9].

Therefore there is a need to employ mobile agents as an autonomous entity in network management and transfer the administration tasks to them. Also under this situation the network management tasks and computational load are distributed instead of being centralized towards and on the manager host. One of the important goals of the network management is to have balanced loading and reliable loading on the network such that connections in the network can be established quickly without noise, or several trails. Network management also aims to organize the networks in order to work professionally, successfully adjust to changes, and react to problems such as traffic patterns [7].

The important function in the area of network management is performance measurement, which involves gathering statistical

information about network traffic, methods to reduce, and present data. Measuring performance of networks using centralized SNMP based management is very difficult due to reasons like network delays and information traffic jam at the central management station [20].

It is now widely recognized that the use of decentralization in this kind of applications potentially solves most of the problems that exist in centralized client/server solutions. Hence applications can be more scalable, more robust, can be easily upgraded or customized and they reduce the traffic in the network.

In a distributed network, the network operator monitors the trend of network flow to assess network performance and identify unusual conditions. The analysis of data can be achieved from the management information base. The management information base preserves various data objects for network management. The information in management information base is ordered in clusters and maintained in a tree-like structure. Thus management information base manage the complex network tasks in the distributed network management environment [21].

The management of heterogeneous networks requires the capabilities to combine different types of data and to account for events occurring on different time scales.

#### V. CONCLUSION

Network management systems based on SNMP and CMIP use more bandwidth and create network traffic. They can not satisfy the various requirements of heterogeneous networks, maintain an essential level of quality of service and reliability for the end user and multimedia applications. Therefore, mobile agents offer a solution to the flexible management of today's telecommunication networks. Agents are autonomous entities and their usage in network management reduces the number of necessary human interactions. Furthermore, mobile agent based network monitoring and management can overcome the shortcomings of SNMP and CMIP by decentralizing network monitoring and management.

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