Current Trends in Network Design and Implementation

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Abstract — *This paper contains current trends in network design and implementation. This is a vast field. So this paper will discussed about this topic in several topics. Mobile industry, World Wide Web, Transition to IPv6 from IPv4 will talk in deep in this paper. People who want to know about currents trends in networking, this paper may be useful.*

I. Introduction

World is now heavily depends on telecommunication. Imagine a day without television, mobile phone or internet. They are the main streams which connect us with the world. Moment you know that you are not connected by the world you will feel poisoned or alone. So we need connectivity to feel live and connected. So who or which is responsible for providing this connectivity. Collection of different purpose networks are the elements which provides us this connectivity. Some you may know as internet or as mobile networks etc. So in this document we consider the new trends in networking or you can say new trends in connecting you with the world. In the future the world is all about information, the value of information and how fast it reaches you will determine your state. So this is an important field to explore. Though network field is a vast area we specifically focus in three factors,

- Telecommunication
- Internet
- Manufacturing of devices

Our review is mainly base on these three.

II. Trends in Mobile Industry

In this part of our literature review, we are going to discuss about trends in Mobile Industry. In this section we will be talking about MAT and IN. MAT means Mobile Agent Technology and IN means Intelligence Network.

First of all let's see what is mean by MAT. According to the research paper [1] that I read, it says that an agent can be described as a software component that performs a specific task or function autonomously on behalf of a person or organization. So an agent naturally contains some level of intelligence, which we call as Artificial Intelligence mechanisms. Mobile or even active objects, which are used in various applications may need move from one system to another to access remote resources or even meet other agents and work together with them. We can categorize agents in to two main categories. Agents with flexibility like mobile agents or agents which are static like Knowledge Query Manipulation Language (KQML). But we are more interested in mobile agents.

We can identify there are some MAT architectures exists. CORBA is a one of this architecture. Meaning of CORBA is Common Object Request Broker Architecture.

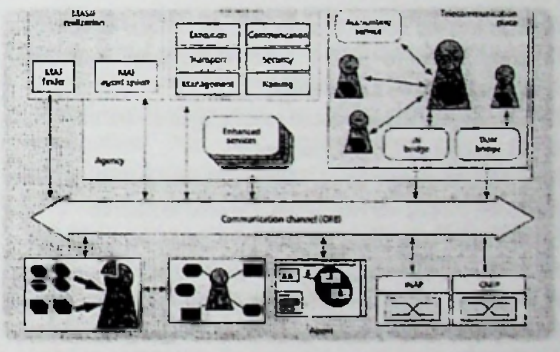


Fig 1: CORBA based mobile agent environment

For mobile agent development two main bodies provide MAT standardization. They are Object Management Group (OMG) [2] and Intelligent Physical Agents (FIPA) [6]. These main bodies have identified the basic attributes of mobile agents. Lifecycle Support, Security mechanisms and transport service are among these attributes. So to be a good MAT plat form these attributes should be integrated to the system.

Now I am going to describe about Intelligence Networks. The definition of IN according to the research paper [1], it says that, "The Intelligent Network (IN) is an architectural framework which helps to give rapid and uniform provision of advanced telecom services which are not limited to Plain Old Telephone Service (POTS), such as call forwarding, private numbering plan, incoming call screening, etc. IN services are advanced than the traditional network is because they are based on additional service logic and data on top of different switched telecommunication networks.

There are some architectures exists in IN too. The structure of

that kind of architecture is shown below. This structure is currently use structure in IN.

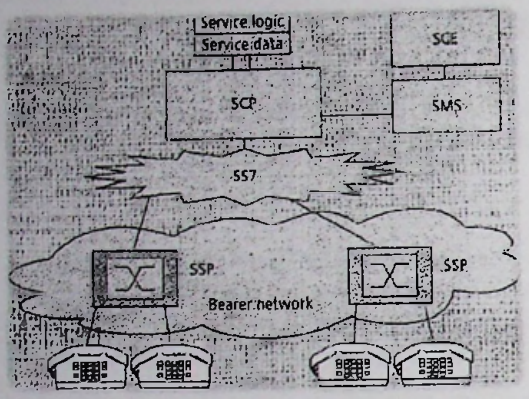


Fig 2: Current IN architecture

According to the research paper [1], we can see an active in environment based on mobile agent technology. Now I am going to describe how it is possible.

We can design more advanced mobile agents with the advanced support of IN environment.

Using Mobile Agent based service implementations in IN environment, mobile service agents are able to find, in accordance with their provided service capabilities and based on their inherent autonomy and intelligence, the best location inside the network in order to provide the service with minimum usage of the signaling network. Programmable switches equipped with a mobile code platform [2] helps to deploy customized services at the switch other than the service processing. Once service code is deployed at the nodes, data arriving on the transmission path can be processed at these active network nodes.

III. World Wide Web

The World Wide Web or the www is a system of interlink hypertext documents that can be accessed via the internet. (http://en.wikipedia.org/wiki/Www)

IV. History

In March 1989, Tim Berners-Lee wrote a proposal that referenced ENQUIRE, a database and software project he had built in 1980, and described a more elaborate information management system.

With help from Robert Cailliau, he published a more formal proposal to build a "Hypertext project" called "Worldwide Web" (one word, also "W3") as a "web" of "hypertext documents" to be viewed by "browsers" using client–server architecture.(http://en.wikipedia.org/wiki/Www)

A NeXT Computer was used by Berners-Lee as the world's first web server and also to write the first web browser, Worldwide Web, in 1990. By Christmas 1990, Berners-Lee had built all the tools necessary for a working Web: the first web browser (which was a web editor as well); the first web server; and the first web pages, which described the project itself.

V. Function

The terms Internet and World Wide Web are often used in everyday speech without much distinction. However, the Internet and the World Wide Web are not one and the same.

The Internet is a global system of interconnected computer networks. In contrast, the Web is one of the services that run on the Internet. It is a collection of text documents and other resources, linked by hyperlinks and URLs, usually accessed by web browsers from web servers. In short, the Web can be thought of as an application "running" on the Internet.

Viewing a web page on the World Wide Web normally begins either by typing the URL of the page into a web browser or by following a hyperlink to that page or resource. The web browser then initiates a series of communication messages, behind the scenes, in order to fetch and display it. As an example, consider accessing a page with the URL http://example.org/World_Wide_Web.

VI. Www prefix

Many domain names used for the World Wide Web begin with *www* because of the long-standing practice of naming Internet hosts according to the services they provide. The hostname for a web server is often *www*, in the same way that it may be *ftp* for an FTP server, and *news* or *nntp* for a USENET news server. These host names appear as Domain Name System (DNS) subdomain names, as in www.example.com. The use of 'www' as a subdomain name is not required by any technical or policy standard. The first ever web server was called nxoc01.cern.ch, and many web sites exist without it. Many established websites still use 'www', or they invent other subdomain names such as 'www2', 'secure', etc. Many such web servers are set up such that both the domain root (e.g., example.com) and the *www* subdomain (e.g., www.example.com) refer to the same site.

VII. Realizing The Transition to Ipv6

Nowadays IPV6 is spreading all over the world. Now internet is completely covering with IPV6. The people who invented IPV6 say that the progress of this new protocol is slower than initially as they hoped.

"They believe that the key reason for this is that IPV6 is evolutionary, not revolutionary"[3]. Initially IPV6 protocol is considered as a luxury till people need more security, QoS. Also run out of internet IP address also has a much force towards to the IP6 protocol. Also people needed to solve the problems which rise due to IP4 protocol and the IP6 has good

approach in addressing those problems. Furthermore, IPv6 is the only real solution we have in impending this problem. When we consider all around the world, Europe and Asia has the largest use of IPV6 protocol. But initially the protocol is used in North America. The two major reasons for this are Europe and Asia faced the problem of insufficient IP address. North America is allocated 70 percent of the IP addresses in the world while Europe and Asia has left with a small number of IP addresses although they have much more population in the world. The second reason is that3G wireless technology used in Europe and Asia. Europe and Asia has the world largest demand for mobile technology which increased the address demand. Since they have much larger network with them, they faced the insufficient address problem and they went towards to the IPV6 protocol as a solution. In japan the government has declare a dead line to transform from IPV4 to IPV6 for ISPs to upgrade their systems. That is the political influence for IPV6. Other than that most of the largest companies are now supporting IPV6 for their products. Already millions of IPV6 compatible devises are using the internet. Although there are much more reasons to go for the IPV6 protocol that transformation will not happen suddenly. Transformation to IPV6 must be able to adapt the changing demand for IPV6 and should allow gradual transition.

But also there are many technical problems which are arise in transition to IPV6 from IPV4. However results which are came by the work in IETF are now provide much more feasible solutions for those problems and make it easier to migrate to IPV6. From these work, they believe that proper mechanisms in the transition are NAT-PT, 6 to 4 tunnels and configured tunnels. These transition technologies are already most widely deployed and have fulfilled the basic interoperability within the existing internet.

VIII. Efficient and Scalable, End-to-End Mobility Support for Reactive and Proactive Handoffs in IPv6

Mobile IPV6 is currently having a major demand among other devises which used internet because mobile devises are everywhere in the world and most of the people try to use mobile devices instead of non-mobile devises. Efficiency of IP layer configuration mechanism and flexibility of mobile devises so it can schedule and parallelize the signaling [4]. This article will widely describe on handoff performance with standard IPv6 protocols and Mobile IPv6 protocol and also it will identify and describe several reasons for the delay of on the use of IPv6 protocol in the mobile devices. Some of the reasons are already known by the most of the people while some of them are not been fully identified. But optimized and widely applicable handoff approach is not identified yet. Still there are researches going on that topic. Most of the people who research on these delays are considering on localized mobility management architectures. But the main problem is that such an approach will lead towards poor scalability and limited deploy ability. The reason is to investigate on this is that when considering on the terms of financial investment and coordination among administrative borders it is more efficient. So this article takes the lead on investigating number of most effective and most useful IPv6 end to end mobile IPv6 optimization proposals. Some of the methods which are described in here currently under the standardization with the IETF. Also this article will describe on how to combine those significant improved handoffs without loss of scalability of reducing the loss of scalability. "This article will also describe how these optimizations may not only improve reactive handoff performance, but also facilitate efficient proactive handoff management"[5].

Although mobile IPV6 optimizations for localized mobility management and fast handoff support feature real-time capabilities, it requires high investments and coordinative overhead for access providers. This happens due to the need to extend the functionality of network entities and interconnect routers, possibly across administrative domain. For better scalability it is suitable to use end-to-end techniques. For the performance of localized optimizations can be obtained by given efficient mechanisms for router discovery, address configuration, and movement detection. This article describes on those aspects and some of the shortcomings of the today`s IPV6 and mobile IPV6 protocol standards. And also provide some better solutions for those problems and it examines how those interact, and how they can be combined into efficient mobility solutions for reactive and proactive handoff management.

IX. The Design and Implementation of an IPv6/IPv4 Network Address and Protocol Translator

IPv6 is a new version of the internetworking protocol designed to address the scalability and service shortcomings of the current standard, IPv4. But IPv4 and IPv6 are not directly compatible, so programs and systems designed to one standard cannot communicate with those designed to the other, It is necessary to develop smooth transition mechanisms that enable applications to continue working while the network is being upgraded.

There are two main scenarios where network address and protocol translation are applicable. An IPv6 site communicating with IPv4 nodes. An IPv4 site communicating with IPv6 nodes.

To enable communication between an IPv4 and IPv6 node, a translator needs to do both address and protocol translation. Protocol translation involves mapping of fields from one version of IP to the other. Address translation involves

converting addresses for packets crossing the protocol boundary.

Address binding is the phase where an IPv4 address is associated with an IPv6 address and vice versa. The translator maintains key-to-value tuples, to map between IPv4 and IPv6 addresses. Once a binding is established it can be used for address lookup and translation. Address unbinding is the phase when the association between an IPv4 and IPv6 address is broken. Protocol translation consists of a simple mapping between the two IP protocols, with some special rules for handling fragments and path MTU discovery. The translator silently drops single hop ICMP messages as well as ICMP messages with unknown Type fields. For the remaining ICMP messages the header format is nearly identical for ICMPv4 and ICMPv6. The only exception is the ICMP Parameter Problem message, which an 8-bit pointer value in ICMPv4 and a 32-bit pointer value in ICMPv6.

The goal of the translator is to transparently work for "real world" applications, and it used a representative set of programs that exercise the TCP, UDP, and ICMP protocols via the translator. The Test applications consist of an IPv6 version of an Apache web-server, ttcp, finger, telnet, ping, traceroute, and ftp.

In principle the function of IPv6/IPv4 address translation is similar to an IPv4 Network Address Translator (NAT), which converts private internal addresses to globally unique addresses that are passed to the Internet backbone and vice versa.

Finally, a proposal called "Assignment of IPv4 Global Addresses to IPv6 Hosts" (AIIH) enables dual-stack IPv6/IPv4 nodes to temporarily acquire a global IPv4 address to communicate with other IPv4-only nodes. This approach may be the initial stepping stone to allow sites to configure a large set of IPv6 hosts without having to statically assign each host a globally unique IPv4 address.

X. Design, Implementation, an Evaluation of a Programmable Bandwidth Aggregation System for Home Networks

In a Programmable Bandwidth Aggregation System the difference is that we can dynamically change the bandwidth aggregation as we need. So this will make the use of bandwidth more and more efficient. But also it will make the system much more complex. But since we are more concerned with speed of a network connection we try to overcome complexity and try to gain the Programmable Bandwidth Aggregation System to a reality.

This is a very good and economical system which will be a future trend in each and every home network system. Although it is currently used in many advanced systems where as needed. But we usually don't see them in home networks.

Since our topic is on Current trends in network design and implementation, this research paper will be a good enforcement to the topic.

In the research document we are not concern on the Programmable Bandwidth Aggregation System. But we concern on how they re-configure the network system to co-work with the Programmable Bandwidth Aggregation System because we are interested in future trends on network implementation. So we will narrow this document to the network aspects only.

Since this system is working on bandwidth of the network, and also it is going to change the bandwidth aggregation dynamically, it is necessary re-configure the network implementation is a manner where it can co-exist with the system.

So according to the above mentioned points, we can see that the above document will be a good reassures to our report.

XI. Design issues to consider in designing Merchant Switch Devices

Most network in the current telecommunication networks are packet switching networks. These networks are mainly consist of routers. So packet switch devices are the core of large number of LAN/MAN/WAN routers. There are many different attributes required for different domains. Most common attributes are the price and performance. These factors are the main two qualities that manufactures explore. Most manufactures focus their design on one or a group of Application-Specific Integrated Circuit (ASIC) chips. Most of the networking device manufactures use ASIC chips integrated circuit which explores the performance factor but they have a higher price tag. This is due to the lengthy design cycles and continuously rising chip costs. High price tag cause fewer customers so many manufactures are now moving to Commercial devices which are available in the market. They are known as semi-customized off-the-shelf devices, or Application-Specific Standard Products (ASSP). ASSP switches are similar to a memory, hard drive, or graphic chipset which we can buy in the market.

XII. Requirements for a commercial switch device

Back end routers need more performance and multilayer support. So it is OK to give them a higher price tag. How costly they are is not a problem considering the higher performance it needs. So our concern is mainly on medium size switch fabrics. For a design to be practically market as a commercial product it should need to have following characteristics,

1. Must support for large number of ports
2. Low cost per port
3. Generic Quality of Service (QoS) Support
4. Low latency
5. Low power consumption

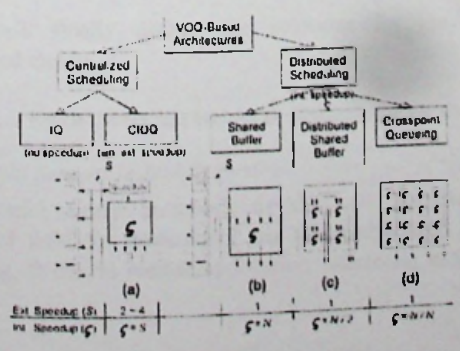
6. Multicast support
7. Higher efficiency
8. Support for a variety of heterogeneous Protocols(mpls)
9. Reliability
10. Must support most of evolving traffic patterns etc.

And these are followed by some new trends which will be key aspects in future. These are also needed to be addressed in order to be a commercial product. These facts are not very significant at this point but they may be at the future. So if you can solve these or accommodate in your design your product will have a higher value in the commercial world. If these are not met these product would be useless in the future. They are,

1. Link speed rate is increasing
2. Density of line cards is not increasing
3. Card and Backplane Connector Technology limits the maximum switched bandwidth supported by a single switch Card.
4. Copper Cable Interconnects are still preferred to Optical Fibbers in the very short reach (1 to 15 m)
5. The amount of the Switch power and pins used for transporting signals across chips is increasing
6. Integrated high speed, high density and low power Serializes/Deserializers (SERDES) are now available in ASIC Libraries[7]

So when we design a merchandize switching fabrics we have to be aware of physical structure like size, capacity and board size but also the performance factors like switch internal round up trip also. So the following architecture is suggested by a research team [6].

The architecture proposed by them is a single-stage switch architecture which uses virtual output queuing (VOQ) at the entry of the device. There is a key feature which differentiates similar architectures. That is the scheduling of the entry of virtual output queuing (VOQs) is centralized or distributed. For the centralized approach they have used input buffers organized by destination is joined with a buffer less crossbar. In the distributed approach they have eliminated the need for centralized input arbitration by using a limited number of output buffers that is basically done by integrating them in the core of the switch.



One of the key features that we emphasis and the manufacture need to identified is that not only the attributes like buffering, queuing arrangements, and scheduling algorithms but attribute like power consumption, chip count must be considered and accommodate when designing a switching device commercially.

References

[1] Markus Breugst and Thomas Magedanz, "Mobile Agents - Enabling Technology for Active Intelligent Network Implementation", IKV++ GmbH, Technical University of Berlin

[2] Summofour Open Programmable Switching http //www summa4.com/products/openswitch.htm.

[3] Realizing the Transition to IPv6, Daniel G. Waddington and Fangzhe Chang, Bell Research Laboratories

[4] Mobile IPv6-Based Ad Hoc Networks: Its Development and Application

[5] Ren-Hung Hwang, Member, IEEE, Cheng-Ying Li, Chiung-Ying Wang, and Yuh-Shyan Chen, Member, IEEE

[6] Efficient and Scalable, End-to-End Mobility Support for Reactive and Proactive Handoffs in IPv6,Christian Vogt and Martina Zitterbart, Institute of Telematics, Universitat Karlsruhe (TH), Germany

[7] Abel, F.; Minkenberg, C.; Iliadis, I.; Engbersen, T.; Gusat, M.; Gramsamer, F.; Luijten, R.P.; , "Design Issues in Next-

[8] Generation Merchant Switch Fabrics," Networking, IEEE/ACM Transactions on , vol.15, no.6, pp.1603-1615, Dec. 2007.

[9] Y. Tamir and G. Frazier, "High performance multiqueue buffers for VLSI communication switches," in Proc. 15th Annu. Symp. Computer Architectures, Honolulu, HI, Jun. 1988, pp. 343–354