INTERNET-DRAFT December 2, 1996
Expire in six months

SIMPLE EXTENDED AREA NETWORK (SEAN) ARCHITECTURE

<draft-kamath-sean-00.txt>

Nara Kamath

RCG Incorporated

1. Status of This Memo

2. Abstract

This document describes a Simple Extended Area Network (SEAN) architecture to offer comprehensive services as part of a Full Service Network (FSN) by service providers. The motivation for this document is that today's networks are far too complicated to design, deploy and operate, and incurs network overhead and

inefficiencies that would soon drive up the costs and the rates to consumers. This cost and complexity situation is also a barrier to deploy advanced and useful network services that offer audio-visual communications. There are technologies like XDSL available today that can simplify network implementations and operations and at the same time provide the bandwidth and other capabilities that allows migration to a simpler network architecture in the future. This document describes the current problems that thwart progress and offers a solution based on XDSL technology to overcome or avoid unnecessary complexities and limitations.

This document does not specify an Internet Standard of any kind. It is presented for discussion purpose only.

3. Language Conventions

The following language conventions are used in the items of specifications in this document:

* MUST, SHALL or MANDATORY - this item is an absolute requirement of the specification.

* SHOULD or RECOMMEND - this item should generally be followed for all but exceptional circumstances.

* MAY OR OPTIONAL - this item is truly optional and may be followed or ignored according to the needs of the implementor.

4. Introduction

The goal of this document is to describe an extended area network which is defined as inclusive of users' LANs and local loop access networks (AN) that connects the user to the Wide Area Networks backbones. The extended area network is called a Simple Extended Area Network (SEAN) because it eliminates many of the complexities and processes imposed on the networks due to conceptual design limitations, such as shared media, of the past.

The basic architecture defined for the SEAN is based on XDSL, which can be any one of Rate Adaptive Digital Subscriber Loop (RADSL), Asymmetric DSL (ADSL) or Very High Speed DSL (VDSL). What is new described in this document is the application of XDSL for LAN as well whereas the industry has been thinking of XDSL in the local loop only for access to the service providers central office (CO).

This document demonstrates the simplicity of LAN and AN implementation using the DSL technology and also points out some different set of issues that need to be addressed. Overall, the approach simplifies networking required to offer voice, high speed data and video or television as part of a FSN offering. With the approach described, LAN to WAN communications would become truly 'seamless'.

5. Problems With the Current Network Implementations

Current LAN implementations use Ethernet, Token-Ring and FDDI network technologies which are shared media designs. ATM LAN, though not a shared media design, is in its infancy and has been characterized as 'a duck that can swim, run and fly' by a few. But, as a superstructure, LANs as well as WANs are implemented at the network layer using higher layer TCP/IP protocol. The problem with these LAN and TCP/IP combinations is that the network nodes have more than one type of addresses, for example, every workstation has an Ethernet address and an IP address. The obvious reason for dual addresses and the resulting complexities is due to the shared media nature of the three major LAN technologies, in conjunction with the network layer IP routing. The costs associated with operations, administration and maintenance (OAM) and the network performance overhead in this situation can be and should be eliminated without sacrificing the network features and functionality.

6. The XDSL Solution

A solution based on XDSL for LAN as well as Access Network (AN) implementation eliminates the need for hardware addresses like an Ethernet address. All DSL technologies are based on dedicated media connections for every device, very much like a telephone circuit, and likewise does not need a device address embedded or associated with the device. Since the current 10BaseT wiring is already in place almost universally, LAN communications will be implemented using an DSL router on the customer premises, i.e, CPE-placed router over existing wiring. Like a telehone company Centrex implementation, this router may be network-placed in a service providers CO, POP, a shared kiosk or a junction box. For obvious reasons, CPE-placed DSL router will be a more desirable solution for large and medium size businesses whereas network-placed routers will provide cost effective solutions for the residential market. A basic network diagram is as shown in Figure 1.

```
      <-------SEAN(incl. LAN and AN)----->|<------WAN

         ------          ------          ------

        |End     |              |        |              |        |

        |User    | Copper       |XDSL    |              |WAN     |
        -------

        |Device|----------|Router|----------|Router|     |      |

        |        |          |   |        | Fiber or     |        |-----|Head|

         ------ Splitter|        ------  Copper  -----  Fiber|End       |

                              |
                              -------

                              |

                              |                            -------

                              |           POTS Copper     |Tel.     |

                              --------------------|Central|

                                                          |Office |
```

```
                                                                   -------
```

Note: XDSL router can be CPE-placed or network-placed

Figure 1: Example of Link Speed Settings

For the conceptual design described, there is no need for hardware addresses like Ethernet, Token-Ring or FDDI addresses. Routing will be based on the IP addresses of the nodes for high speed data and television/video. Telephone service will remain the same as today using existing NANP telephone numbering plan over the DSL pair to the customers, residential as well as businesses.

The solution provides dedicated high speed communications at 784 Kbps to 9 Mbps or more at each of the host nodes and end user devices (EUD). The on-premise cable plant need be no different than a 10BaseT cable plant. The individual interfaces on a router can be different DSL interfaces such as ADSL, HDSL, VDSL, and RADSL depending on the device and applications. The DSL interfaces will modulate the data stream accordingly. This offers flexibility in link speed settings to match traffic profiles. Thus the server interface can be 52 Mbps from the server to the router, the EUD interface can be 784 Kbps from

the EUD to the router, and so on as shown in Figure 2 below.

```
 ------          ------          -----
|        |52Mbps-->     |XDSL    |6Mbps-->      |       |
|Server|----------|Router|----------| EUD       |
|        |<--6Mbps      |        |<--784Kbps|   |
 ------          ------          -----
```

Figure 2: Example of Link Speed Settings

This provides simplicity and flexibility to fine to tune a network for optimal performance which have not been available in any other previous technology.

These inherent advantages will help network managers in solving traffic management (TM) problems in very fundamental ways. In this sense the XDSL technology is even better than ATM since XDSL offers deterministic applications specific TM solutions whereas in ATM the term TM has connotations of Transcendental Management!

The advantages of keeping a single technology in both the LAN and the Access Network are many from the point of view of the vendors, the service providers and the users, and are left to the analyses and conclusions of the reader. Suffice it to say here that eliminating an unnecessary layer of (hardware) addresses, retaining the existing wiring in the inside and outside plant, and eliminating LAN hubs reduces the cost and the complexity.

Sections below describe how some of the existing network techniques can operate and can be migrated to the XDSL environment.

7. IP Address Resolution Protocol

One of the 'magics' of Internet operation is the Address Resolution Protocol. For the architecture described in this document, an IP ARP will be required to discover newly added workstation devices and route IP datagrams to the devices. A new workstation installed at an XDSL port will have its IP address set in its network layer software as part of its installation process. To discover the newly installed IP addresses of the devices, the XDSL router will periodically send ARP broadcasts or directed ARP polls to locally connected ports. The devices will respond with an ARP response that will include its IP address. Thus the workstation and the router will learn each other's IP addresses and the router will associate the workstation IP address with its port number for the workstation device.

A magic cookie mechanism may be implemented in the ARP response for implementing a minimum level of network security. CHAP may be implemented for additional security.

8. LAN Bridging

The concept of bridging is not germane to dedicated media implementation of XDSL architectures. Only routing at IP level is applicable for communication between devices.

9. Other Protocol Implementations

All other protocol implementations applicable for current IP networking such as DNS, DHCP, Routing Protocols (IGP, EGP, etc.), RSVP, and others can be implemented under XDSL architectures with the similar techniques and effects as today's implementations. Multiple network interface devices such as firewalls, gateways and proxies can also be implemented and supported under XDSL architectures using today's techniques and without loss of generality. So can the application sockets and daemons.

10. XDSL Network Services

The services described in this section are pertinent to internal business communications as well as external communications with the rest of the world.

XDSL technology is capable of offering unchannelized single high speed channels as well as subrated channels at different speeds over a XDSL link. Besides XDSL interfaces, the XDSL routers can be designed to support DS3 and SONET interfaces to the backbone. With affordable availability of hardware and processors at speeds of 500 MHz, a set of advanced services such as television/video on demand, imaging applications, video conferencing, real time Web access etc. along with the traditional office applications such as e-mail, workflow, etc. can be offered by the service providers under a unified SEAN architecture.

Under the XDSL architecture, separate POTS or POTS integrated with EUD or workstation devices can be offered using existing telephone networks. The XDSL technology will also be able to support analog POTS Custom Calling features currently offered by the service providers.

Over the long term XDSL will provide a very useful set of services for both businesses as well as residential communications, information and entertainment services until fiber is extended all the way to office buildings and homes.

11. Performance

For well-known network services such as Internet access and LAN/WAN communications, there should not be any drawbacks or performance problems with XDSL technology or architecture. There are a few cautions that should be mentioned. One of them is the delay between nodes which are of the order of 1 microsecond in a 10BaseT LAN. On a XDSL LAN these delays can be in 10 to 30 microseconds (a distance of approximately 1 to 3 miles at the speed of electricity over copper). The negative effects of delays are compensated by the dedicated media access as compared to the shared media access of 10BaseT. It must be emphasized that the delay problem is of relevance only in the case of a network-placed router architecture for LAN communications. But the network-placed router architecture is primarily applicable for residential services where there is virtually no LAN traffic between two homes on the same router. For CPE-placed router architecture in a business environment the delay problem does not exist for LAN com

12. Open Issues

The main issue with XDSL technology is the cost of XDSL hardware. The secondary issue with XDSL is the loop length limitations of 15,000 feet range.

With the growth in XDSL based services, the prices should come down within the next 2 to 5 years to the levels of prices for today's NICs. The approach to solving the local loop length problem for the foreseeable future is fiber, wireless or satellite.

Another major issue for a network-placed router is the physical and environmental tolerance of the router hardware which requires ruggedized hardware and control of the environment if the hardware is to be placed in the outside plant.

13. Terminology

In this document, the following terminology is used consistent with the industry usage:

ADSL - Asymmetric Digital Subscriber Loop

HDSL - Highspeed Digital Subscriber Loop

VDSL - Very Highspeed Digital Subscriber Loop

XDSL - Any one of the above

FSN - Full Service Network

CO - Central Office

DNS - Domain Name Service

DHCP - Dynamic Host Configuration Protocol

RSVP - Reservation Protocol

IGP - Internal Gateway Protocol

EGP - External Gateway Protocol

CHAP - Challenge Handshake Authentication Protocol

ARP - Address Resolution Protocol

POTS - Plain Ordinary Telephone Service

EUD - End User Device

NIC - Network Interface Card

14. Author's Address

Nara Kamath

RCG Inc.

462 Herndon Parkway, #203

Herndon, VA 20170

e-mail: rcg@interramp.com

Tel: 703-834-1155, ext. 112

Fax: 703-834-3086