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USING ASYMMETRIC DIGITAL SUBSCRIBER LINE (ADSL) FOR FAST INTERNET AND MULTIMEDIA SERVICES

Ioannis Kompatsiaris¹, Michael G. Strintzis¹ and Iakovos Orfanos²

¹Information Processing Laboratory, Electrical and Computer Engineering Department, Aristotle University of Thessaloniki, Thessaloniki 54006, Greece, Email: strintzi@eng.auth.gr

²Department of Research and Development, National Organisation of Telecommunications, Athens, Greece, Email: iorfanos@ote.gr

ABSTRACT

In this paper the design of an experimental ADSL network and the applications used are presented. Digital Subscriber Line (DSL) technologies enable the use of the twisted pair copper telephone lines, that reach practically every home and business (Public Switched Telephone Network) with very large bandwidth, typically from 1.5 - 6 Mbps downstream and 640 Kbps upstream, by placing a pair of modems at the user (home) and at the C.O. (PTT Central Office) side. After a small introduction on broadband access networks the design of an experimental ADSL network is presented. Furthermore, the design of high bandwidth, rich in content applications taking advantage of the high speed ADSL network is given.

INTRODUCTION

Over the past decades, a number of technological advances have created a huge consumer need for high bandwidth access networks. Among these advances are the rapid development of multimedia technology and applications, such as image, video processing, stereo and 3D applications, standards and communications, the huge computational power of the Personal Computer (PC) and above all the Internet. Although early users of such applications were located at universities and large enterprises, new applications scenarios such as teleworking and home access to the Internet involve the home consumer.

The analog modem was the first way to use the available to almost every home, copper Public Switched Telephone Network (PSTN). Starting from initial bitrates of around 300 bps, it seems that nowadays has reached the technological barrier at 56 kb/s analog modems. While they are cheap and easy to install, even 56 kb/s is a very limited bitrate for rich multimedia applications. Integrated Services Digital Network (ISDN) also uses with some

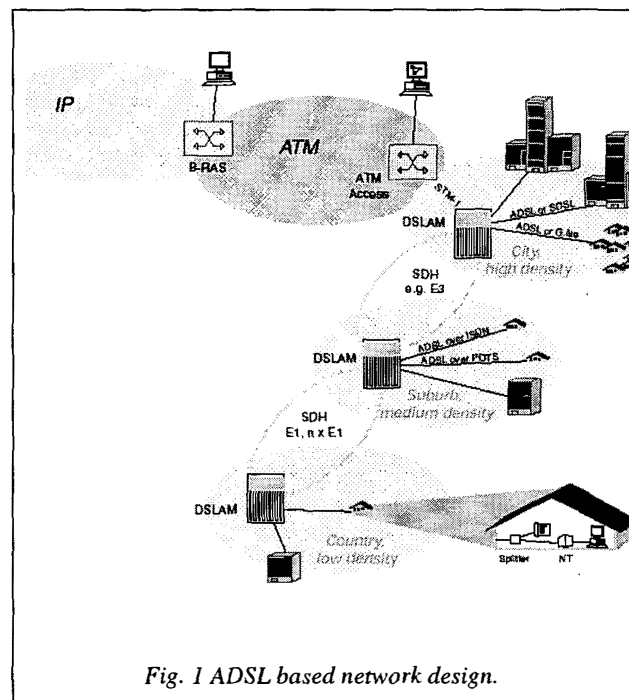


Fig. 1 ADSL based network design.

modifications the PSTN, offering basic bitrates of 2×64 kb/s or when the two channels are combined together, at 128 kb/s. It is affordable but it offers only twice the bandwidth of the analog modem.

In order to solve the above problems and to exploit existing infrastructure other than the PSTN, new network technologies have appeared. Telephone companies have been experimenting with Fiber to The Curb (FTTC) technology to bring broadband service via fiber optics to 32 homes (or small businesses) using a combination of twisted pairs and coax drops from the node to each subscriber. On the other hand, cable companies are using Hybrid Fiber/Coax (HFC) technology to upgrade their

networks. HFC uses fiber optics to bring broadband services to a distribution node, bypassing a portion of the in-place coax trunking equipment. The remaining distribution portion of the coaxial cable plant is upgraded to provide two-way capability and more downstream bandwidth to serve each residence. Small adoption of such systems is partly due to the high construction or update cost. Furthermore, they aim at gigabit bitrates having in mind mostly high quality video applications, since their ideas were conceived before the vast Internet expansion, where smaller bitrate is currently necessary.

In this paper, early steps of designing and implementing a Digital Subscriber Line (DSL) technology network is presented [1]. DSL technology is just a next generation modem technology. In DSL one of the modems must (almost always) be located in the telephone company's central office (Fig. 1). It becomes the telco's responsibility to recover the subscriber's data and transfer it to a pure datacom network for delivery to the destination [2].

ADSL TECHNOLOGY

DSL is often written as "xDSL" indicating that it is a (growing) family of standards and technologies, all designed to provide high-speed datacom over long spans of twisted pair wire. One of the most promising implementations is the Asymmetric Digital Subscriber Line (ADSL). It offers up to 8 Mb/s over about 2 km of copper, with typical downstream bitrates from 1.5 to 6 Mb/s. The upstream bitrates are from 64 to 640 kb/s. There are two types of modulation used, one called Discrete Multitone (DMT) and another simpler and cheaper method called Carrierless Amplitude and Phase (CAP). DSL technology offers the following advantages:

- Reuse of existing twisted pair infrastructure: no need to invest in new fiber optic distribution systems and distribution nodes.
- Available anywhere: since DSL uses the existing twisted pair infrastructure, service can be supplied to virtually any subscriber with phone service, be they in a residential neighbourhood, small office park, or downtown office tower.
- There is no need for costly central office switch upgrades as with ISDN.
- No extra phone line is necessary; DSL implementations can share the same phone line providing the subscriber's voice service.
- DSL provides a dedicated high-speed digital two-way access channel for each subscriber rather than using a shared media distribution architecture.

OTE EXPERIMENTAL ADSL NETWORK

The aim of this work is the experimental introduction of ADSL technology to the Public Switched Telephone Network (PSTN) of the Greek PTT (OTE). All aspects of

the ADSL network are examined including consumer electronics such as ADSL modems and splitters. Results of this work will include:

- Examination of suitability of the Greek PSTN for ADSL.
- Examination of technical and functional requirements of ADSL (including components located at the consumer side).
- Examination of the effect of ADSL to the IP network and billing policies.
- Study of a full ADSL implementation by OTE.
- Evaluation of different types of network components (including those located at the consumer side)

The network will be implemented in two phases:

- I. In the first phase, an experimental ADSL network was implemented inside the R&D building of OTE at Athens.
- II. In the second phase, two ADSL networks were implemented at Thessaloniki and at Patras with a restricted number of selected test users.

The network was designed and implemented in such a way that it will be compatible with the TCP/IP protocol. All experimental applications use the TCP/IP over ADSL protocol for communication between the user and the server. During the ADSL network project, the following applications were tested:

- Teleconferencing
- Video streaming
- 2D [3] and 3D (Stereo) [4] image transmission
- Voice over IP
- Video on demand
- Internet access
- Comparison with ISDN technologies

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