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Recommendations for xDSL Technologies and Applications

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Abstract

All kinds of data such as audio, video and text are transmitted without errors, quickly and easily in media such as fiber, radio or copper cable. The transmission environments used must be user-supported, highly usable, portable and qualified. DSL (Digital Subscriber Line) technology is used in order to enable users to transmit and process the data quickly and securely on advanced systems and to handle this data, apart from modem technology. DSL technology is examined in this study; xDSL technology is explained in terms of usage areas, distance and speed relationships. DSL varieties called xDSLs are handled separately and compared in terms of data transmission speeds (download / upload), structures (symmetric / asymmetric) and transmission distances. And it is presented in detail. According to the researchers made, it has been suggested which xDSL technology model is more suitable for which application or system. Thus, the advantages of DSL technology for institutions, organizations or individual users are mentioned.

Keywords: *ADSL, DSL Technologies, xDSL, xDSL Applications*

1. INTRODUCTION

Today, usage area of computers and internet is getting bigger. The amount of data that are used and stored is also increasing, and transmitting of these data is becoming a huge problem. It is vital that the data exchange should be fast and error-free. Day by day, the technologies that are used are getting better. Any type of data(voice, image, text, video, etc.) can be created at any time so it is a necessary that transmission medium should be convenient to use, suitable for carrying, multi-user provided, and qualified.

Other than a modem, DSL(Digital Subscriber Line) technology is also using in order to transmit and processing of data fastly and securely. DSL as a technology performs remote connection and transmitting of high dimensional data successfully. In addition, it provides fast, economical, and easy process.

In this study, DSL technology is examined in terms of usage area, distance, and speed relations. Each DSL type (xDSL) is analyzed and compared to the data transmission speed (upload, download), structure (symmetry, asymmetry), and transmission distance. We provide suggestions about which xDSL technology is more convenient to a specific application. Possible benefits that the DSL technology can provide is also mentioned. It is observed that the DSL technology can work with different type of applications integrated and the efficiency can be increased.

2. DSL TECHNOLOGY

DSL has been developed for compressing a large number of data in a fast way across the line. This technology aims to provide faster access for people, higher communication speed, and services for advanced data.

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DSL is also shown as a technology that transmits signals to user devices on a unit-time basis. In general, a DSL consists of a pair of modems connected to the end of a copper line. It is used to compress high speed data going from point A to point B along the copper wire. In other words, a modem pair connected to a line forms a digital subscriber line. In short, DSL is not a line but a modem. Two-way data is sent with DSL modems. In other words, depending on the technology used, the data flow is inversely proportional to the distance [1].

Digital subscriber lines are divided into two: symmetric and asymmetric. The symmetry of a line means that during data transmission over that line, the data can reach the network at the highest speed in the same way from the user to the network or from the network to the user. On an asymmetric line, the highest speeds that can be reached during these two data streams are different.

Because DSL technology uses a wide frequency range, it is possible to have voice and data at the same time with the use of a single copper connection. The voice call will normally be sent over the 0-40 kHz spectrum and the data will be sent using higher frequencies. In a unique way, data will be sent over a LAN / WAN connection. Certainly, this sharing of copper can reveal some problems. In particular, most phones can interfere with the DSL data stream and cause interference on the handset.

The data capacity of xDSL on a physical network is based on many factors. Factors affecting data capacity: signal attenuation in copper pairs, interference with other copper pairs in use, other noise sources on the network, and airborne transmissions.

3. TYPES OF DSL TECHNOLOGY (XDSL)

DSL variants include ADSL, RADSL, HDSL, SDSL and VDSL. The abbreviation xDSL defines the technology as a whole. The view of xDSL family tree prepared by Teleconnect Company is given in Annex-1. They are separated by features such as technique, distance, number of used pairs of wires, download-upload, bandwidth, speed.

3.1. ADSL (Asymmetric Digital Subscriber Line)

ADSL is initially designed to deliver custom video at 8Mbps download and 640Kbps upload speeds. Today, ADSL is especially used as a form of high-speed internet access [1]. ADSL is intended for home and small businesses. It is a standardized technology in 1995. It is used to send a large amount of data in one direction and a small amount of data in the other direction using a copper cable. Due to its asymmetrical structure, data transmission is done to the user fast. The data transmission is done the reverse direction slowly. Table 1 shows the speed distance relation in ADSL technology. ADSL also provides simultaneous phone calls to users [2].

Table 2. Speed Distance Relation in ADSL

Distance	Speed
5.5 Km	1.544 Mbps
4.8 Km	2.048 Mbps
3.6 Km	6.312 Mbps
2.7 Km	8.448 Mbps

3.2. ADSL-Lite / DSL.Lite / UADSL/ UDSL/ G.Lite

ADSL-Lite technology is easy to use. It provides high data transmission speeds for Internet access. It also offers long transmission distance, flexible data rate options, compatibility with ADSL [3]. G.Lite, also known as universal ADSL, makes it possible to establish an internet connection to home and business computers up to 1.5Mb / s via regular telephone lines.

3.3. HDSL (High bit rate Digital Subscriber Line)

Interest in modulation techniques that provide full Duplex transmission of approximately 1.6 Mb / s is increasing in recent times. This technology is the antithesis of HDSL. This technology will enable digital services to be procured at low cost and quickly [4]. HDSL is the oldest of xDSL technology and standardized in 1992. It can transmit symmetrically up to 2 Mbit / s. It transmits and receives data at the same rate and uses less bandwidth [5], [6]. It performs operations on approximately 3.5 Km lines. HDSL requires 2 or 3 wires and only transmits data (does not transmit audio).

3.4. SDSL (Symmetric Digital Subscriber Line)

In SDSL technology, digital data is transferred on one line and in two directions at the same time. The same bit rate exists in both directions because it has a symmetrical structure. SDSL connections generally provide 6 Mbit / s transmission in both directions and require a 4-wire connection [1]. This is generally more expensive than ADSL and is provided by commercial telephone companies. However, SDSL is more suitable for home users with a single phone line compared to HDSL. SDSL is suitable for phone, data and multimedia data [7].

3.5. VDSL (Very High-bit-rate Digital Subscriber Line)

VDSL uses a copper wire pair as the physical medium. This is a numeric data transfer technology limited by the medium. Symmetric and asymmetric data streams are supported to provide more flexibility in the implementation of certain applications [1]. Another advantage of the VDSL architecture is the security approach provided by point-to-point connections. This is a significant advantage over technologies based on bus architecture.

This technology provides higher bandwidth compared to ADSL and DSL. VDSL is usually associated with a bundle of packets. Like existing xDSLs, it can provide high speed internet access and voice services. Due to the increased bandwidth requirement, VDSL provides faster internet access. It can also carry more audio channels and digitally encoded videos at the same time. Symmetrically 20 Mbit / s and asymmetric 52 Mbit / s can be achieved [8]. This can provide both short-reach symmetric and long-reach asymmetric operation. VDSL was announced by ETSI in 1995. The VDSL speed distance relationship is shown in Table 2.

Table 2. Speed Distance Relation in VDSL

Distance	Speed
12.96 Mbps	1.4 Km
25.82 Mbps	900 m
51.84 Mbps	300 m

3.6. VoDSL (Voice over DSL)

VoDSL technology has emerged as a result of the rapid increase of network capacity due to the combination of voice and data. VoDSL offers quality voice services. It also supports a wide range of data applications over the existing line in the area where the user is located and uses copper infrastructure. It simultaneously provides data information and multiple audio information (including fax transmission) on the high-speed digital line offered by ADSL. At the DSL Forum Technical Committee Meeting in 2001, VoDSL technology was taken into consideration.

VoDSL allows the transmission of data and multiple voices call over a single copper pair. It offers high speed internet access to users on a single DSL copper line. It also provides local and long distance telephone service [9]-[11].

3.7. SHDSL/ G.SHDSL (Single-line High Speed DSL/ Symmetrical high-bit-rate DSL)

SHDSL is based on HDSL and is recommended by ITU. Currently, SHDSL can operate at data rates with higher ratios, ranging from 192 kbps to 2.312 Mbps (in 2-wire mode) and 384 Kbps to 4.624 Mbps (in 4-wire mode) [4]. It has compatible with all other DSL technologies. It can be used for multi-audio channels and video conferencing applications. SHDSL is the best choice for high flow bit rates in medium and long lines. It also includes a convergence similar to VDSL for packet transmission [12]-[14].

3.8. RADSL (Rate Adaptive Digital Subscriber Line)

RADSL is an ADSL-based technology developed by Westell. It is possible to set the data rate according to the status of the line via software. It is possible to exceed the maximum speeds that ADSL can reach. The advantage of RADSL is that it can automatically adjust the speed of the line to reach the proper speed. This technology allows users to make phone calls and transmit data over a single copper pair [15], [16]. RADSL allows different data types such as voice, data, and multimedia depending on the communication type.

This technology adjusts the internet connection speed depending on the length and quality of the local loop. In addition, it increases connection speeds for the remote users from the telephone exchange. It extends the broadband area from 3.5 to 5.5 km [17].

3.9. IDSL/ G.SHDSL (Single-line High Speed DSL/ Symmetrical high-bit-rate DSL)

ADSL technology is adapted to work with existing technologies. IDSL technology has been developed for this. IDSL technology provides a full 128 Kbps ISDN connection to users at home or at work. It is only a data connection, so it does not carry audio information [18], [19].

3.10. Comparision of xDSL Technologies

The types of xDSL technology are compared with the specified features and presented in table form in Annex-2 [2], [3], [14], [17]-[20]. The features used when making comparisons are important for these technologies. For example, download / upload speeds, distances.

4. BENEFITS OF XDSL TECHNOLOGY

DSL supports voice and data transmission and provides a permanent connection. ADSL connections will increase the number of interactive internet services since sending a message, setting up the appropriate environment for starting a phone call or video call. Also;

- Offers a low price option for internet access and transportation,
- It provides very high bandwidth for data transmission,
- Configures for each subscriber of the cable network and provides high security
- It is easy to adapt and provides convenience with interface,
- It offers the possibility of using the Internet and telephone line at the same time,
- Service providers offer DSL modems,
- It is cheaper than cable connections,
- Use copper bottom for telephone use,
- It does not require extra infrastructure investment,
- It is possible to implement existing and new methods used in communication technology on DSL,
- Symmetric and asymmetric data transfer is possible.

5. CONCLUSION AND SUGGESTIONS

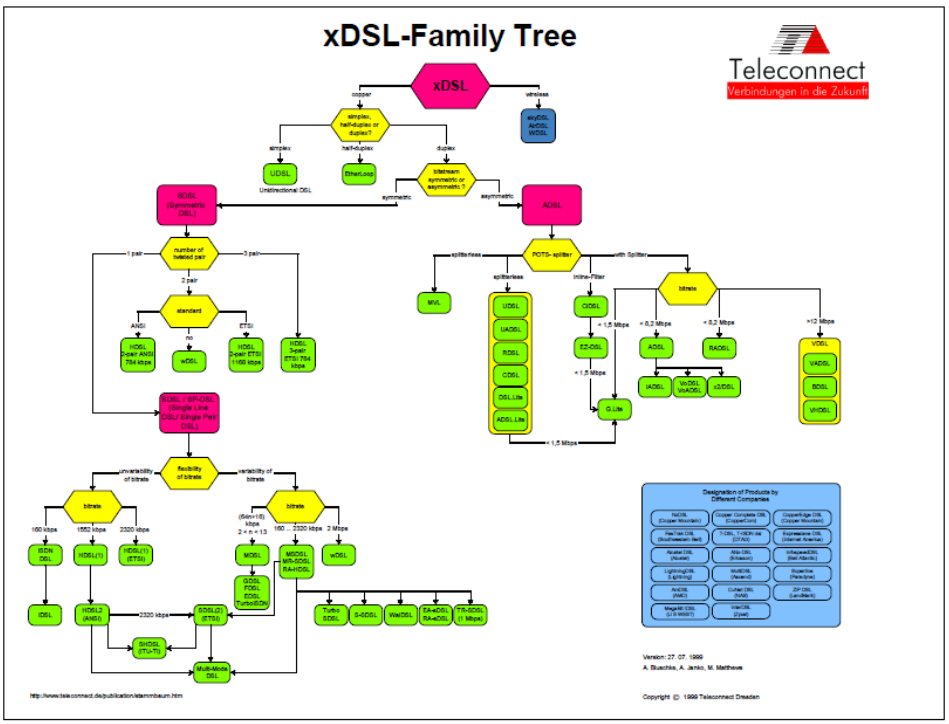
xDSL technology, widely used around the world, has given new insights to communication systems. Particularly the most important feature is the use of copper bottom for telephone use and the lack of extra infrastructure investment. The high speed of data transmission, the sufficient bandwidth, the lack of compliance problems and the economic suitability make this technology preferable. It will be integrated with many applications in the future to make it even more useful and productive.

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APPX-1. ILLUSTRATİON OF XDSL FAMİLY TREE



APPX-2. Comparisiosn of xDSL Teknologies [2], [3], [14], [17]-[20]

Types of xDSL	Data path download/upload	Distance	Scope of applications
ADSL	1.5-9 Mbps 64 Kbps-900Kbps	5.5 km	It is used for internet, web access, motion picture, video on demand and remote local network access. It needs a splitter. It is asymmetrical. It uses a pair of copper wires (two wires). It is suitable for small and medium sized home and businesses.
ADSL.Lite	256 Kbps-1.544 Mbps 512 Kbps	5.5 km	Can be used by ADSL users. It does not need a splitter. It is asymmetrical.
HDSL	1.544 Mbps 2.048 Mbps	3-4 km	Service between the server and the telephone company. Used for WAN, LAN, server access. It is symmetrical. Two double copper wires (4 wires).
SDSL	256 Kbps-2.3 Mbps 256 Kbps-2.3 Mbps	4-5 km	Suitable for businesses. It is symmetrical. A pair of copper wires (two wires).
VDSL	13 Mbps-52 Mbp 6 Mbps-26 Mbps	300m-1 km	It is used in applications where very high speed is required. Ex: TV broadcast, HDTV. It is symmetrical.
SHDSL	2.31 Mbps-4.6 Mbps 2.31 Mbps-4.6 Mbps	6 km	Same as HDSL but only needs one twisted line. It is symmetrical. A pair of copper wires (two wires).
RADSL	32 Kbps-9 Mbps 32 Kbps-1.5 Mbps	3.5-5.5 km	It is used for internet access, video broadcast, LAN access. Similar to ADSL. He needs a splitter. This technology is compatible with the line. It is asymmetrical. A pair of copper wires (two wires). Audio, data, multimedia, custom video.
IDSL	128 Kbps-144 Kbps 128 Kbps-144 Kbps	5.5 km	This only allows data transmission. Voice conversation can not be made on the same line. It is symmetrical. Suitable for home and small-scale businesses.

BIOGRAPHY

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