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A NEW APPROACH FOR BROADBAND BACKUP LINK TO INTERNET IN CAMPUS NETWORK ENVIRONMENT

Mohd Nazri Ismail

Faculty of MIIT, University of Kuala Lumpur (UniKL), MALAYSIA, mnazrii@miit.unikl.edu.my

Abstract

Most research focus on applying backup resource reprovisioning when a network failure occurs at some particular intervals over a certain time. In this study, we investigate the benefits of performing backup link to improve network connections after the primary link failure as well as backup bandwidth utilization in campus network environment. We study and examine the effect of different backup link such as dial-up (modem and ISDN) and xDSL (new approach back link). This study proposes a new approach for backup link to internet in campus network environment. Our new approach on backup link is able to operate in two conditions: i) when primary link failure, the backup link will take over; ii) when primary link achieve 90%-100% network utilization then backup link will provide an additional bandwidth capacity. Our results demonstrate that our approach achieve better backup capacity utilization and network robustness, compare to a conventional backup link when a network failure occurs.

Keywords*: xDSL, backup link, utilization, bandwidth*

1. Introduction

Typical of most network decisions, which dial backup methodology, to use to implement link backup is not always a clear choice. Each approach has advantages and disadvantages. Some of the more critical tradeoffs include speed of response to failure, reliability of response to failure, call stability, testability, link performance, and ease of implementation. Backup Link is designed to provide an alternate connection in case of a failure in the primary link. The service offers speeds from 2Mbps to 2.5Gbps to the internet. For today's modern campus, it is crucial that the communication network is always available for the critical applications without any interruption or failure due to the access link. Dial backup is frequently used as a low-cost method to improve network availability. However, care must be taken to ensure that the backup link will be activated whenever it's needed; otherwise, the availability improvement may be illusory. Nowadays, the famous backup link is ISDN. Unfortunately, this option sometimes did not often provide enough flexibility to meet the campus needs of the entire institution. In our new approach, we use broadband technology as our backup link. VDSL is used as broadband technology in our experiment and VDSL will link up with the primary line network in campus environment.

2. Related Works

Broadband access networks are mainly based on xDSL(Digital Subscriber Line), cable modem, and Ethernet[1],[2],[3]. DSL technologies can deliver data at multi Mbits/s over the unshielded twisted pairs of the public telephone network (PSTN) [4], [5], [6]. Broadband applications and increasing Internet usage have created a bandwidth demand that supersedes the capabilities of analog transmission over telephone lines. Use of Digital Subscriber Line (xDSL) technology enables existing telephony infrastructure to deliver broadband services, which is the most robust xDSL technology [7], [8]. Therefore, remote office connectivity and high-bandwidth applications, such as live video on demand and fast Internet access, can now be implemented at

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minimal cost by using the wholesomeness of Ethernet with the economy of VDSL (Very high bit rate Digital Subscriber Line). Figure 2.1 shows characteristics and functionality of xDSL families that can be selected for broadband backup link in campus environment.

There are two important differences between DSL networks and other access networks. First, like cable networks, DSL networks often have asymmetric bandwidths; their downstream bandwidth is higher than their upstream bandwidth. Second, the maximum data transmission rate falls with increasing distance from the DSLAM [9]. Various protection and restoration schemes have been proposed and investigated to recover traffic when a network failure occurs, e.g., when a fiber link is cut [10], [11], [12].

DSL Type	Symmetric/Asymmetric	Loop range (kft)	Downstream (Mbps)	Upstream (Mbps)
IDSL	Symmetric	18	0.128	0.128
SDSL	Symmetric	10	1.544	1.544
HDSL	Symmetric	12	1.544	1.544
ADSL	Asymmetric	12	6	0.640
VDSL	Asymmetric	3	26	3
	Asymmetric	1	52	6
	Symmetric	3	13	13
	Symmetric	1	26	26

Figure 2.1: xDSL Technology Comparison

3. Methodoloy

Figure 3.1 shows our new approach using broadband backup link design. We have setup a real network environment in University of Kuala Lumpur, Malaysia. We use xDSL technology as our broadband backup link implementation in campus environment. VDSL technology is selected to be linked up with existing primary link. Figure 3.2 shows the conventional backup link using dial up technology. Dial up technology can be divided into two categories such as modem and ISDN technology. Dial up technology is able to provide low bandwidth and higher error rate.

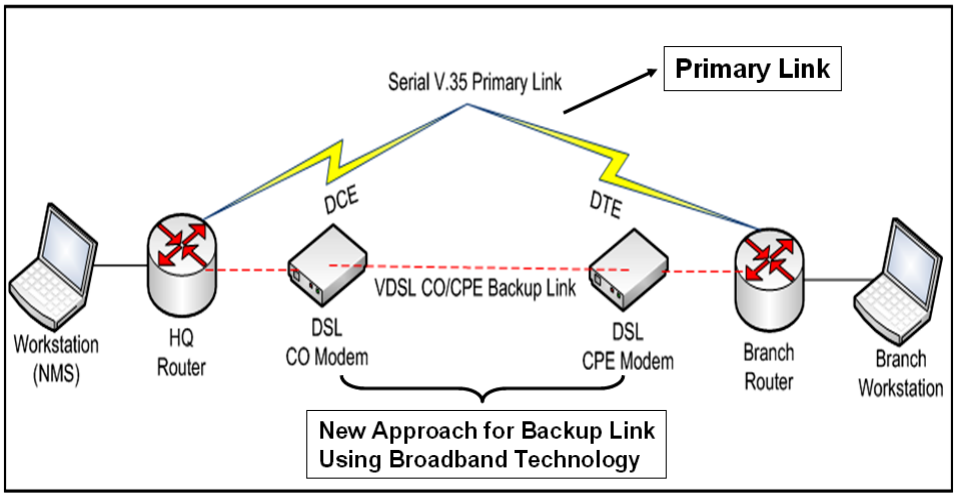

Figure 3.1: New Approach for Broadband Backup Link Design

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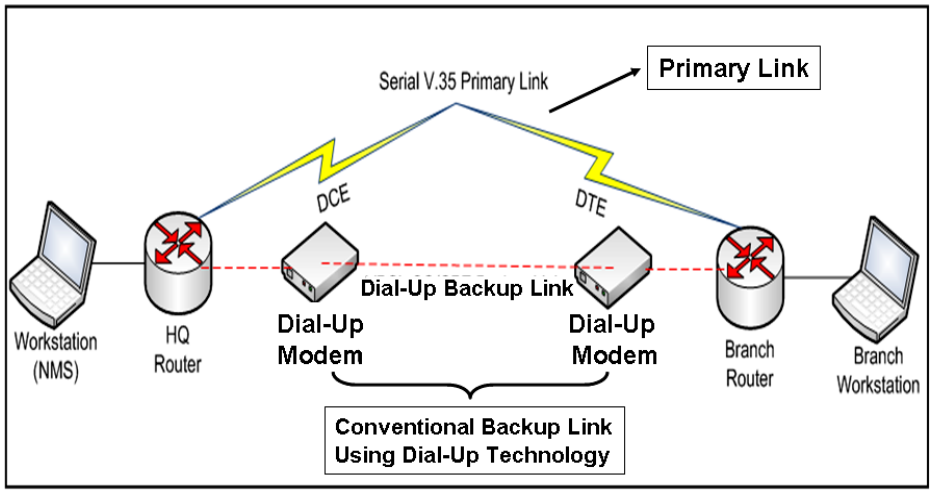

Figure 3.2: Conventional Backup Link Architecture

Figure 3.3 shows the comparison of conventional and broadband backup link technology. We will compare the performance and functionality of bandwidth, utilization, traffic and packet lost. We will demonstrate that broadband technology able to provide better network performance compare to conventional approach.

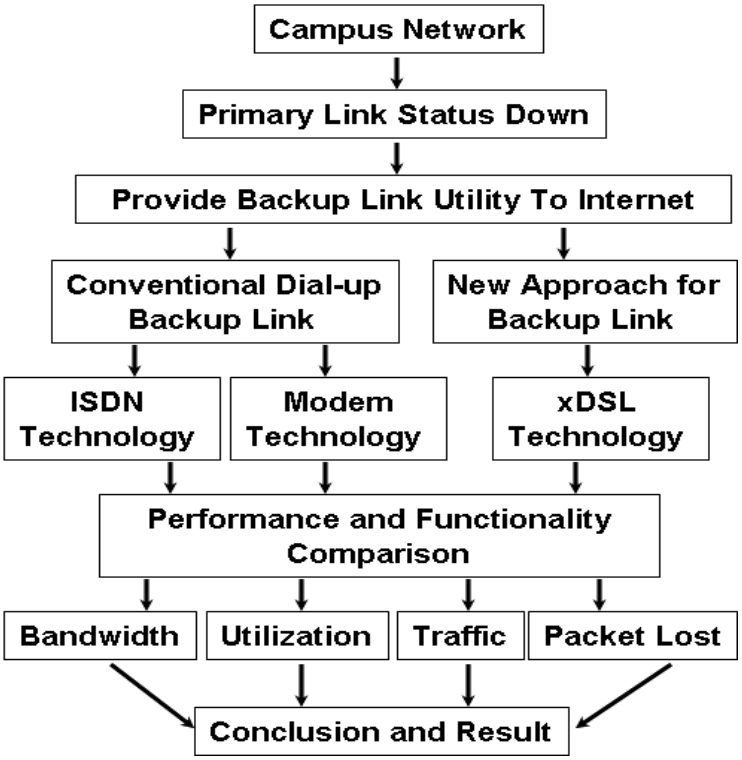

Figure 3.3: Comparison of Conventional and Broadband Backup Link Technology

4. Results and Analysis

We examine three important characteristics of broadband networks, namely link bandwidths, packet flow, traffic and packet error. Analyzing these properties is important because they affect the performance of protocols and systems running over broadband backup link. We used a network management application to capture traffic flow in back up link real network environment. Figure 4.1 shows the experimental is used Solarwinds Network management. Figure 4.1 show that serial interface (primary link) is down and the traffic has routed to xDSL backup link.

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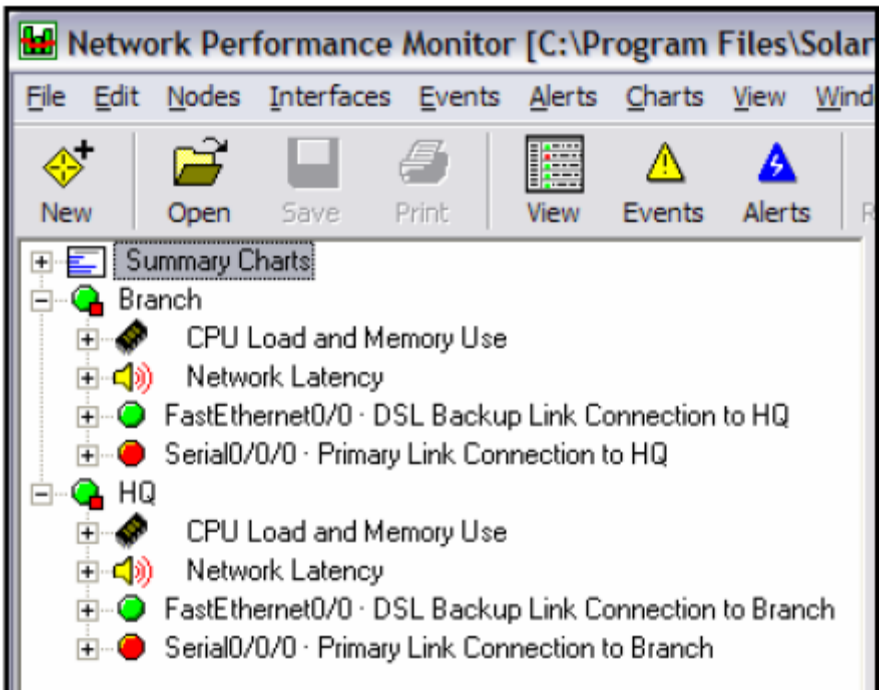

Figure 4.1: Backup Link Connection Availability

Network management application has captured packet flow in broadband backup link. The result shows that broadband backup link is able to receive and transmit the packets in vast amount (refer to Figure 4.2). Figure 4.2 shows broadband backup link has transmitted 5000 packet per second (pps). Figure 4.3 shows average bandwidth measurement on broadband backup link connection. The result shows that this broadband backup link is able to transmit and receive traffic approximately 50 Mbps to 60 Mbps. Therefore, this broadband backup link is able to support higher bandwidth and higher performance compare to conventional backup link. The maximum bandwidth can support by conventional backup link approximately 33 Kbps to 128 Kbps only.

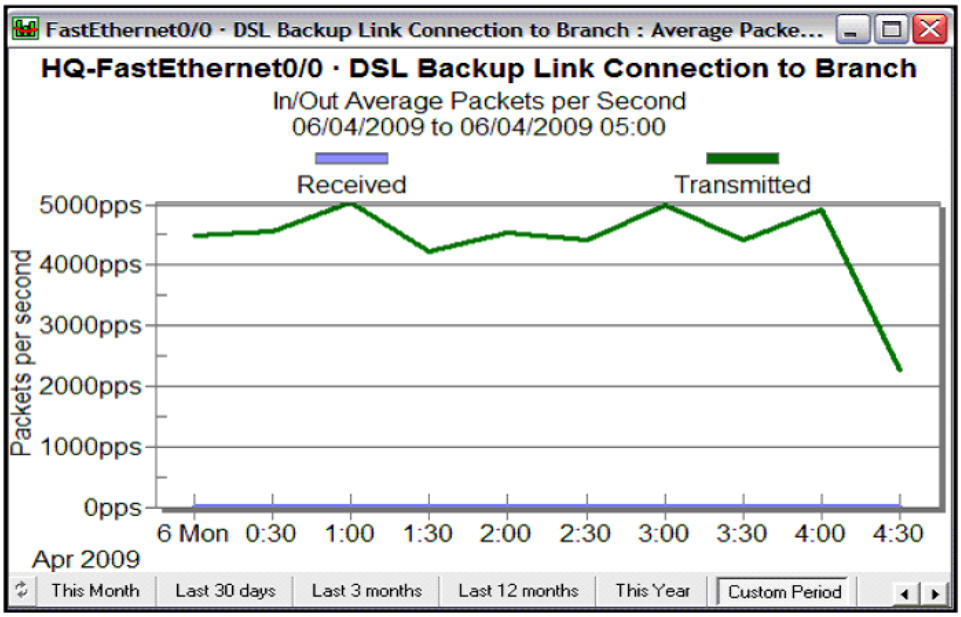

Figure 4.2: Average Packets Flow

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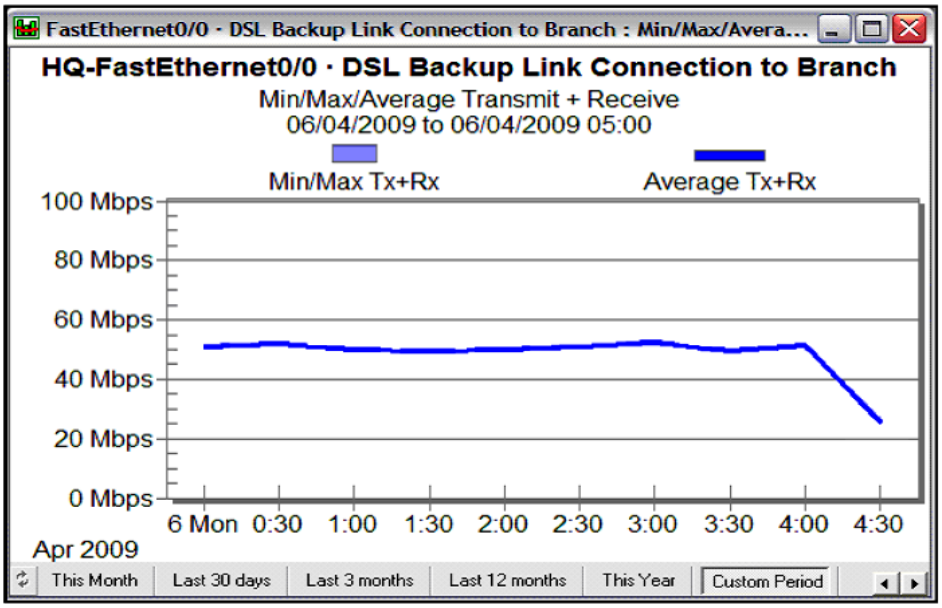

Figure 4.3: Average Bandwidth Transmitting and Receiving on Backup Link Interface

Figure 4.4, proved that broadband (VDSL) backup link technology able to generate higher bandwidth usage from 25 Mbps to 30 Mbps meanwhile the dial up backup link (ISDN) technology only can generate a low bandwidth usage 0.2 Mbps. Therefore, it confirmed that xDSL technology can provide higher bandwidth compared to dial up technology. VDSL is an emerging broadband technology that promises higher data rates over relatively short distances. Therefore, broadband backup link can reduce or eliminate receive and transmit error rate due to higher bandwidth availability provide by broadband backup link (refer to Figure 4.5)

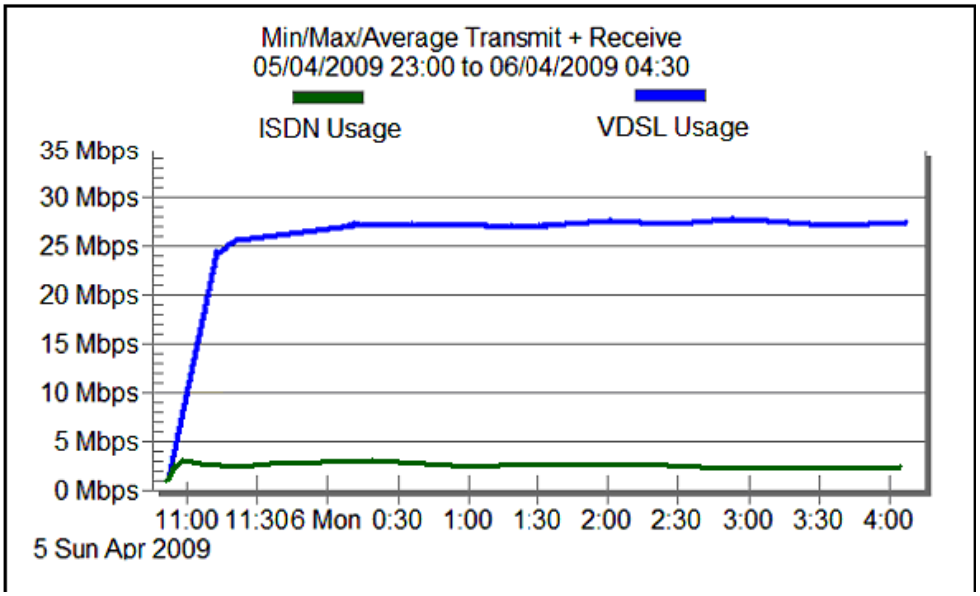

Figure 4.4: Bandwidth Data Rate of ISDN and VDSL (Broadband) Comparison

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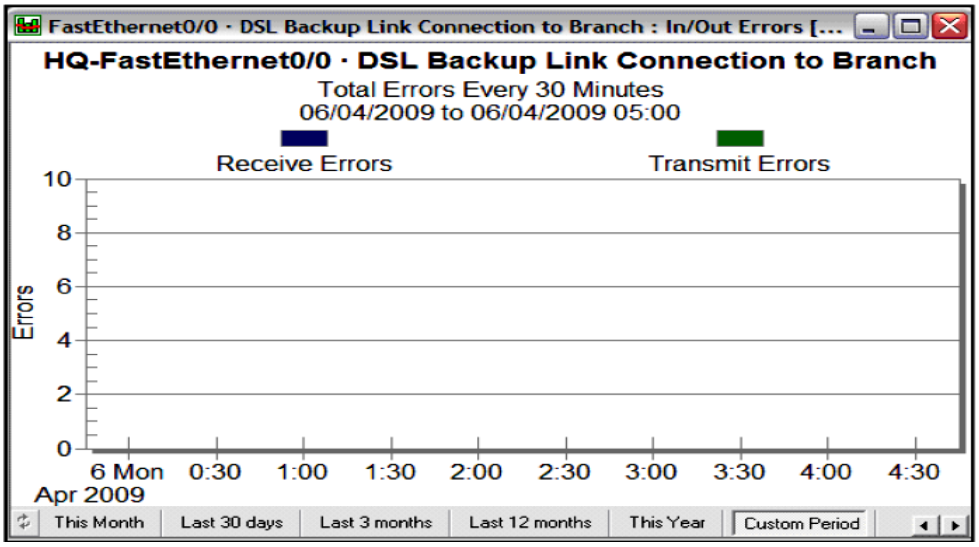

Figure 4.5: Broadband Backup Link Error Rate

We show several comparisons of xDSL performances with other technologies such as:

i. xDSL with Dialup technology
ii. xDSL with Cable Modem technology
iii. xDSL with T1 line
iv. xDSL with ISDN technology

Our study characterized several important characteristics of broadband networks, including available link capacities, packet transmission, and packet error.

Table 4.1: comparison between xDSL with Dialup technology

DSL vs. Dial-Up

Issues	DSL	Dial-Up
Speed	• **DSL** offers guaranteed speeds (symmetrical up to 1 Mbps or 35 times faster than 28.8 Kbps analog modem).	• **Dial-Up** access offers speeds up to a maximum of only 56 Kbps.
Flexibility	• **DSL** provides Internet access to multiple PCs/end-users on one single connection, thereby not charging extra for all additional PC/end-user access. • **DSL** is a fully scalable service possessing a wide range of potential speeds that are inexpensive and easy to upgrade.	• **Dial-Up** access is capable of providing Internet access to only one PC/end-user, thereby charging extra for each additional PC/end-user access. • **Dial-Up** access is not a scalable service due to its bandwidth limitations of 56 Kbps.
Reliability	• **DSL**, by being dedicated, avoids disruptive and time consuming process of dialing in for Internet access.	• **Dial-Up** access is faced with the sometimes tedious process of dialing in for Internet access.

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Table 4.2: comparison between xDSL with Cable Modem technology

DSL vs. Cable Modem

Issues	DSL	Cable Modem
Speed	• **DSL** offers a wide range of guaranteed speeds as high as 1 Mbps (symmetrical).	• **Cable Modem** exists on a shared network thereby making speed performance unpredictable; it is entirely contingent on network traffic volume.
Security	• **DSL** is on a closed, dedicated circuit making it less susceptible to outside hackers.	• **Cable Modem** is on a shared network making it more vulnerable to hackers.
Reliability	• **DSL** is on a closed, dedicated circuit enabling Crocker Communications to offer guaranteed speeds.	• **Cable Modem** exists on a shared network thereby making speed performance unpredictable. • **Cable Modem** may have multiple sources (or companies) providing local service and Internet access to consumers which takes away the convenience and accountability that comes with a single-source service provider.
Accessibility	• **DSL** utilizes ubiquitous, 100-year-old telephone infrastructure (RJ-11 jacks, copper phone wire, data backbones,etc.), which makes up nearly 100% market accessibility.	• **Cable Modem** utilizes young network infrastructure that is shown to have sporadic and inconsistent service availability. • **Cable Modem** has a slower rate of market infiltration because growth of accessibility is often on a case-by-case basis.

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Table 4.3: Comparison between xDSL with ISDN Technology

DSL vs. ISDN

Issues	DSL	ISDN
Speed	• **DSL** offers a wide range of guaranteed speeds up to 1 Mbps (symmetrical).	• **ISDN** offers guaranteed speeds only up to 128 Kbps (which run on two channels at 64 Kbps each).
Flexibility	• **DSL** is a fully scalable service possessing a wide range of potential speeds that are inexpensive and easy to upgrade. • **DSL** offers access speed (SDSL, ADSL) variations to best suit specific operational and economic business needs. • **DSL** can potentially replace or augment other existing services (dial-up, ISDN).	• **ISDN** is not a scalable service; its maximum bandwidth is 128 Kbps making it unable to accomodate growing bandwidth demand.
Reliability	• **DSL** has a low risk of ownership due to minimal hardware requirements.	• **ISDN** has a high risk of ownership due to extensive hardware requirement.

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Table 4.4: Comparison between xDSL with T1 line

DSL vs. T1 Line

Issues	DSL	T 1
Speed	• **DSL** is on a dedicated, closed circuit and therefore provides guaranteed speeds (symmetrical up to 1 Mbps and asymmetrical up to 7 Mbps).	• **T 1** is on a dedicated, closed circuit and therefore provides guaranteed speeds up to 1.54M (max).
Security	• **DSL** is on a secured dedicated circuit which makes it less susceptible to hackers.	• **T 1** is on a secured, dedicated circuit which makes it less susceptible to hackers.
Flexibility	• **DSL** often offers bundled, value-added services (voice/data, managed network services, long distance and local services, web hosting, and e-mail) from one provider on one invoice. **DSL** is a fully scalable service with quick and easy speed upgrade (no truck roll out).	• **T 1** is a fully scalable service; however, a site visit is required for speed upgrade. • **T 1** often times has more growth potential than **DSL** because it is not distant-sensitive. • **T 1** has extensive and costly start-up with install of fiber lines and hardware (CSU/DSU).
Reliability	• **DSL** is on a dedicated, closed circuit and therefore receives guaranteed speeds. There is a higher degree of accountability due to the fact that **DSL** is often a single source of contact because it offers bundled services including IP.	• **T 1** is on a dedicated, closed circuit and therefore receives guaranteed speeds. • • **T 1** is not distant-sensitive and may have more growth potential (no contingencies on location and availability).

5. Conclusion

The fast development of data networks, Internet applications and multimedia capable computers creates a large demand for high-throughput connectivity over the traditional wide area networks. Broadband applications and increasing Internet usage have created a bandwidth demand that replaced the capabilities of analog transmission over telephone lines. This study has developed an alternative approach for broadband backup link as fast development solution in campus network environment and need large demand for high-throughput connectivity. Therefore, the adoption and exciting VDSL technology can provide higher bandwidth demand for backup link. VDSL provides high bandwidth over the existing copper infrastructure that is available to the network operators. Our results demonstrate that our approach achieve better backup capacity utilization and network robustness, compare to a conventional backup link when a network failure occurs. Implementation of xDSL technology is expected to replace the conventional back up link connection today, but it also gives an alternative approach in choosing backup access method for campus network environment needed.

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