NEXTEP *Broadband* **White Paper**

# DSL Variations

Definitions and differences of Digital Subscriber Line variations.

*A NEXTEP Broadband White Paper*
*May 2001*

NEXTEP BROADBAND
Broadband Networks Group

# DSL Variations

## EXECUTIVE OVERVIEW

Digital Subscriber Line (DSL) technology unlocks the capacity of existing copper wire telephone infrastructure, enabling broadband service on the same line as the telephone without interfering with the telephone signal.

The NEXTEP Broadband symmetric DSL service provides data transfer rates of up to 2 megabits per second (Mbps), whereas the NEXTEP Broadband asymmetric DSL service soars at speeds up to 6.141 Mbps.

Compared to the standard modem speed of 56 kilobits per second (Kbps), and the ISDN combined channel speed of 128 Kbps, it is obvious that DSL is the fastest and most cost-effective solution.

But what are the differences between DSL, SDSL, ADSL, RADSL, VDSL and so forth? And which solution is best for your needs?

This white paper explains each of the DSL variations and their primary usage differences.

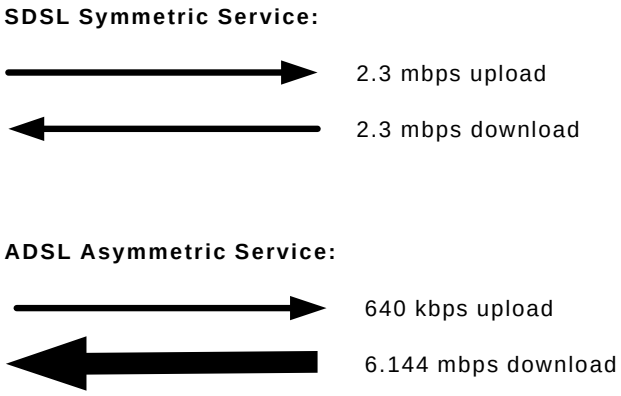
## WHAT IS DSL?

Digital Subscriber Line (DSL) refers to technology and equipment deployed on a telephone system to provide multi-channel high-speed network access on a single twisted-pair copper telephone line.

For more background information on DSL, refer to the NEXTEP Broadband white paper titled "*Introduction to ADSL: A primer on Asymmetric Digital Subscriber Line transmission technology*".

### Symmetric vs. Asymmetric

The difference between symmetric and asymmetric DSL is best illustrated in the following diagram:




**Symmetric DSL** is the transmission of two data channels, upstream and downstream, each with the capacity of up to 2.3 Mbps.

Due to the signal attenuation (drop-off) effect of crosstalk interference at high frequencies, symmetric DSL uses mid-range frequencies which offer reliable high-speed data transmission in both directions.

Symmetric variations include SDSL, SHDSL, MSDSL, HDSL, HSDL-2 and IDSL. The equal speeds make symmetric DSLs ideal for local area networks (LANs), bi-directional video conferencing and web hosting.

NEXTEP employs SHDSL (Symmetric High bit rate Digital Subscriber Line), which is the industry standard conforming to ITU G.991.2 (referred to as G.shdsl). This achieves 20% better loop reach than older versions of symmetric DSL and generates less crosstalk interference.

Symmetric DSL installations that are based on G.shdsl are fully inter-operable, and are best suited to data applications that require high-upstream bit rates.

**Asymmetric DSL (ADSL)** is the transmission of multiple data channels at different capacities. ADSL takes advantage of a phenomenon that was observed in crosstalk interference.

When a signal comes into an exchange, it has more crosstalk than the signal going out of the exchange. The higher the frequency, the more signal is lost going upstream. ADSL minimises the effect of crosstalk by transmitting upstream in the lower-range frequencies of 30 to 138 kHz.

Conversely, the signal coming out of the exchange has very little crosstalk, which means the ADSL modem can send data from the exchange at high frequencies and the signal will still be strong enough to reach the consumer at the other end.

The difference in data-carrying capacity between these frequency ranges gives rise to the term asymmetric. Because the signal going upstream is at a lower frequency, it has less data capacity than the high-frequency signal coming downstream.

Asymmetric variations include ADSL, G.lite, RADSL and VDSL.

The NEXTEP ADSL service can be configured to deliver over 6 Mbps from the network to the user. This makes it ideal for Internet access, remote data access, datacasting, multicasting, remote video monitoring, streaming video, and video-on-demand.

Our ADSL installations conform to ITU standards G.992.1 and G.992.2 and ANSI T1.413

## DSL VARIATIONS

Following is a reference guide to different variations of DSL.

**Note:** *xDSL* is a generic term referring to all forms of DSL technology.

### ADSL

Asymmetric Digital Subscriber Line.

High-speed, broad frequency (broadband) transmission using much higher data rates downstream than upstream.

Downstream full data rates can be configured to deliver in excess of 6 Mbps (6000 Kbps) from the network to the user.

A single ADSL system operating at 6.144 Mbps can deliver three VHS-quality channels, or one broadcast-quality real-time MPEG 2 encoded channel with digital stereo sound.

ADSL installations are fully inter-operable if based on International Telecommunications Union (ITU) standards G.992.1 and G.992.2 and American National Standards Institute (ANSI) standard T1.413.

### G.lite ADSL

G.lite, or ADSL lite, refers to the ITU G.992.2 standard, which was specifically developed for the plug-and-play consumer market. It is a medium bandwidth version of ADSL that delivers up to 1.5 Mbps downstream and 500 Kbps upstream.

### HDSL

High data rate Digital Subscriber Line

Older version of symmetric DSL created as an alternative to T1 E1 service. It splits a 1.544 Mbps signal into two twisted wire pairs which run at 784 Kbps, allowing the service to run on longer loops without repeaters, e.g. 12,000 feet (3700 meters) on 24 gauge (.5mm) wire. May also use three twisted pairs for even further distance.

Does not allow standard telephone service over the same line.

Standards are available through ITU and European Telecommunications Standards Institute (ETSI).

### HDSL2

Second generation HDSL

Delivers 1.5 Mbps symmetric service both directions over a single twisted wire pair. Also provides support for data, video and sound using either asynchronous transfer mode (ATM), private-line service or frame relay, but does not allow standard voice service on the same wire pair.

### IDSL

Integrated services digital network (ISDN) DSL

Supports symmetric data rates up to 144 Kbps using existing phone lines and ISDN terminal adapters (modems) talking to ISDN-compatible line cards.

Differs from ISDN in that it is always available. Used for Wide Area Network (WAN) applications. Does not support general telephone service.

### MSDSL

Multi-rate Symmetric Digital Subscriber Line

Similar to RADSL (*described below)*, but builds on symmetric DSL technology to support changing the operating line rates, and consequently the operating distance, of the transceiver. This is an important development in meeting carrier requirements, as it maximises the bit rate for each customer.

For example, the Carrierless Amplitude & Phase Modulation (CAP) version supports eight distinct rates allowing 64 Kbps / 128 Kbps service to reach 29,000 feet (8900 meters) on 24 gauge (.5mm) cable, stepping down to 15,000 feet (4600 m) at a full rate of 2.0 Mbps.

### RADSL

Rate Adaptive Digital Subscriber Line

Asymmetric technology that allows the modem to adapt the rate of transmission up to 7 Mbps downstream and 1 Mbps upstream.

Achieves higher speeds because it allows the transceiver to automatically increase the line speed to the highest obtainable data rates, e.g. small files can be sent at a faster bit rate than large files. The adaptive channel capacities allows RADSL to support both asymmetric and symmetric applications.

RADSL standards have been established by ANSI.

### SDSL

Symmetric Digital Subscriber Line

Provides high-speed data transmission over a single twisted-pair phone line for T1 or E1 services. May include bit rates up to 2.32 Mbps, typically running on an Ethernet interface between the modem and the customer.

Being standardised by the ITU, ANSI and ETSI to provide higher performance under G.shdsl technology.

### SHDSL

Symmetric High bit rate Digital Subscriber Line

Industry standard for symmetrical DSL, conforming to ITU G.991.2 (referred to as G.shdsl). Achieves 20 percent better loop reach than older versions of SDSL and generates less crosstalk interference.

The standard includes multi-bit rate (MSDSL) technology. It also allows two twisted pair wires to be used on longer loops. For example, 1.2 Mbps can be transmitted 20,000 feet (6100 meters) on two pair of 26 gauge (.4mm) wires.

Best suited to data applications that require high-upstream bit rates. Does not carry voice like ADSL, but voice-over-DSL techniques can be used to convey digitised voice and data.

NEXTEP installations are based on G.shdsl and are fully inter-operable with more than 20 major customer premises equipment (CPE) vendors and a range of backend server, switch and transmission equipment.

### VDSL

Very high bit rate Digital Subscriber Line

Asymmetric transmissions which can achieve rates from 25 to 50+ Mbps over very short distances (up to 50 meters), e.g. from the fibre optic cable to the curb. Can also be configured for symmetric transmissions.

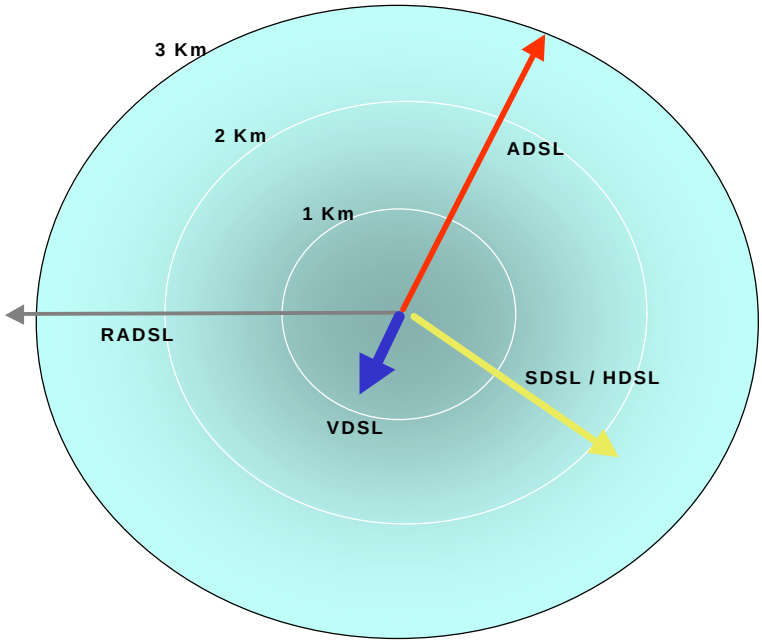
Particularly useful for campus environments, such as universities or business parks, where there is a short distance to a neighborhood cabinet that is linked by fibre optic to the exchange. Currently being introduced to deliver on-demand video services in high-rise or compact developments.

## COMPARISONS

The following table compares the features of each DSL variation.

| DSL Variation | Symmetric or Asymmetric | Bit Rates | | Supports data & telephone? ** | Required # of twisted pairs |
|---|---|---|---|---|---|
| | | Downstream | Upstream | | |
| ADSL | Asymmetric | 1.5 Mbps to 6.1 Mbps | 64 Kbps to 640 Kbps | Yes | 1 |
| G.lite ADSL | Asymmetric | Up to 1.5 Mbps | Up to 500 Kbps | Yes | 1 |
| HDSL | Symmetric | 1.5 Mbps | 1.5 Mbps | No | 2 / 3 |
| HDSL2 | Symmetric | 1.5 Mbps | 1.5 Mbps | No | 1 |
| IDSL | Symmetric | 144 Kbps | 144 Kbps | No | |
| MSDSL | Symmetric | 1.5 Mbps | 1.5 Mbps | No | 1 |
| RADSL | Both | 1 Mbps to 7 Mbps | 128 Kbps to 1 Mbps | Yes | 1 |
| SDSL | Symmetric | 2.3 Mbps | 2.3 Mbps | No | 1 |
| SHDSL | Symmetric | 2.3 Mbps | 2.3 Mbps | No | 1 / 2 |
| VDSL | Asymmetric | Up to 52 Mbps | Over 1.5 Mbps | Yes | 1 |

The following diagram compares the transmission distance on a single twisted pair.




---

* **Note:** Voice-over DSL techniques can be used to convey both digitised voice and data on symmetric DSL services.

## CONTRIBUTING COMPANIES

For over a year, two of Australia's leaders in DSL technology have worked together to perfect a cost-effective high speed broadband service for small and medium enterprises (SMEs).

The result is a new business enterprise, NEXTEP Broadband, bringing together the expertise of NEC Australia and xDSL Limited.

### NEC Australia

NEC Australia has more than 7 years experience with broadband deployments in Australia, New Zealand, Spain, Japan, Venezuela and Hong Kong, and is the DSL Global Design Centre for NEC Corporation.

NEC's DSL-based system is a standards-based, fully managed, multi-service access platform designed for carrier and enterprise applications. System interoperability has been tested and confirmed with more than 20 major customer premises equipment (CPE) vendors and a range of backend server, switch and transmission equipment.

### xDSL Limited

xDSL Limited was established in 1999 to explore the commercialisation of DSL as a broadband technology in Australia. Its major shareholders include ASX-listed Sirocco Resources N.L., the RMB Ventures group and AIB investments.

xDSL has a 26.7% interest in VOD Pty Limited, a joint venture with the Sirocco group and Civic Video. VOD is currently deploying video-on-demand over the TransACT network in Canberra.

xDSL has considerable experience in deploying content and other broadband services in commercial environments. The success of xDSL is due in large measure to its highly focused and skilled team assembled from a broad mix of backgrounds and disciplines.

"DSL Variations" Rev. 1.1
Written by Michael C. Bouy for NEXTEP Broadband


This document is printed for informational purposes only and the information herein is subject to change without notice.

This document is written for installations where all items are supplied by NEXTEP Broadband and the system integration has been completed by NEXTEP Broadband personnel. NEXTEP Broadband is not responsible for overall system performance, thermal characteristics, EMC and safety issues where the customer uses third party equipment and the system integration has been completed by parties other than NEXTEP Broadband.


649-655 Springvale Road
Mulgrave, Victoria 3170 Australia

Phone: (03) 9271 4240
Fax: (03) 9271 4249