NEXTEP *Broadband* **White Paper**

Introduction to ADSL

A primer on Asymmetric Digital Subscriber Line transmission technology.

A NEXTEP Broadband White Paper
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NEXTEP BROADBAND
Broadband Networks Group

Introduction to ADSL

OVERVIEW

Until recently, the available methods for transmitting and receiving data at high capacity were equally high-cost. Large companies used microwave and satellite networks to span long distances, and rented expensive T1 and E1 lines for dedicated telephone and data communications between facilities.

Needless to say, these technologies were out of reach for small and medium business enterprises (SMEs).

Today, superior data capacities can be achieved at a relatively low cost using Asymmetric Digital Subscriber Line (ADSL) technology. Using existing telephone lines, on-site transceivers and shared exchange multiplexers, any high-rise building, multi-office company or campus, or Internet Service Provider (ISP) can have dedicated high-speed broadband service.

EXTENDING THE CAPACITY OF COPPER

Modern telephone networks start at the consumer end with twisted-pair copper cable that runs to a switching centre or exchange, where it connects into the telephone network. The backbone that connects these exchanges is now mainly fibre optic cable, which provides high-capacity, high-quality transmission.

The consumer-end copper wire was designed to carry voice or modem signals within the frequency band of 0 Hz to 3.4 kHz at speeds up to 56,000 bits per second (56 Kbps). This narrow-band, low frequency enabled the wire to carry transmissions up to 18,000 feet (5500 meters) to an exchange without attenuation or degradation of sound quality.

Achieving higher data transmission speeds means utilising a much broader range of frequencies, which is referred to as broadband communications. Each range of frequencies can act as a separate channel on the same wire, so the more frequencies you use, the more data the wire can carry. Unfortunately, high frequencies transmitted over copper wire lose energy or attenuate rapidly, and encounter interference or crosstalk, so the data distorts or doesn't travel far enough to even reach the exchange.

Optical fibre is capable of far greater bandwidth and greater transmission speeds at greater distances without attenuation, giving it the capacity to carry much higher volumes of data than copper wire. However, optical fibre comes at a high cost, and extending it to each and every household and business is prohibitively expensive, as cable operators often find in rollouts.

The question then is how to increase the capacity of copper cable to support high-speed broadband data such as video conferencing, multi-media, high-speed internet access and interactive services.

The answer is ADSL.

ADSL TECHNOLOGY

ADSL is an important variation of the DSL family of technologies. When both a modem and a POTS splitter are used, ADSL provides both normal telephone service and high-speed digital transmissions on an existing telephone line, as shown in the following diagram

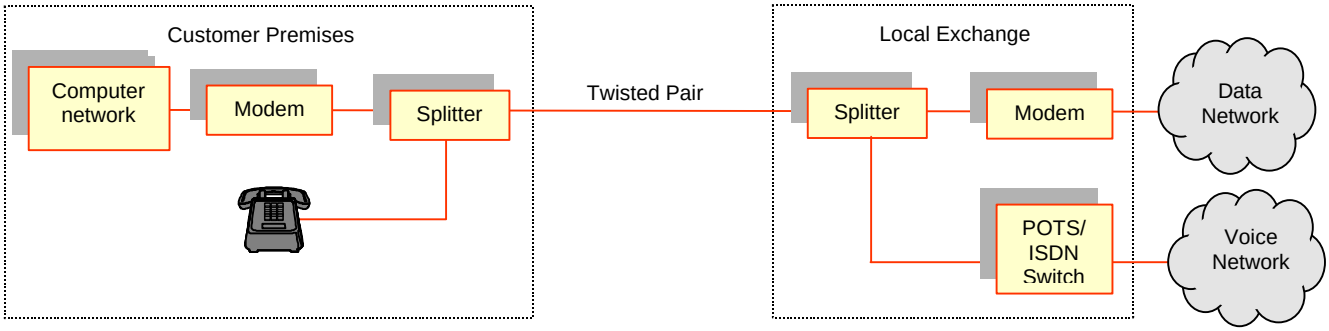

Figure 1 – Detailed ADSL Configuration

This allows a single existing twisted-pair copper wire to carry:

(1) normal telephone communications in the 0 to 3.4 kHz range,

(2) data upload from the consumer in the 30 kHz to 138 kHz range, and

(3) data download to the consumer at up to 1104 kHz.

The reason ADSL succeeds where previous technology failed is because it takes advantage of a phenomenon that was observed in crosstalk interference of signals between copper telephone wires.

When a signal comes into an exchange, it has greater crosstalk than the signal going out of the exchange. This is because the copper wires are combined into large bundles as they get closer to the exchange, and signals transmitted at the same frequency can “leak” from one line to another. This crosstalk has little or no effect on normal telephone communications at low frequencies, but is one of the primary factors limiting transmissions at higher frequencies.

Because there is more crosstalk on signals coming into an exchange, ADSL minimises its impact by transmitting from the consumer in the lower-range frequencies of 30 to 138 kHz. Since the lower frequencies have less attenuation, the signal is still strong when it reaches the noisy crosstalk within the exchange.

Conversely, the signal coming out of the exchange has very little crosstalk, which means the ADSL transceiver 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 coming from the consumer uses a narrow range of frequencies, it has less data capacity than the broad range of high-frequency signals coming in. This is shown in Figures 2 and 3.

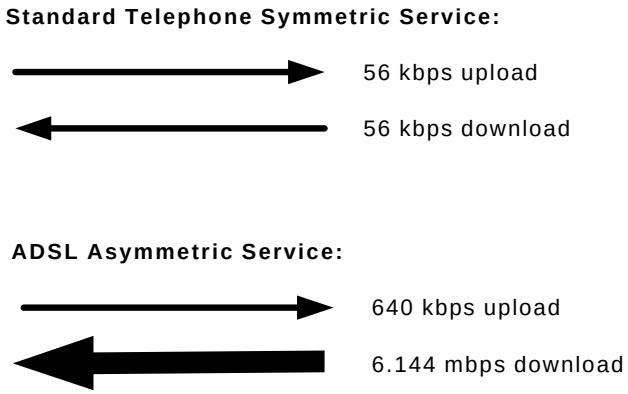

Figure 2 - Symmetric vs. Asymmetric

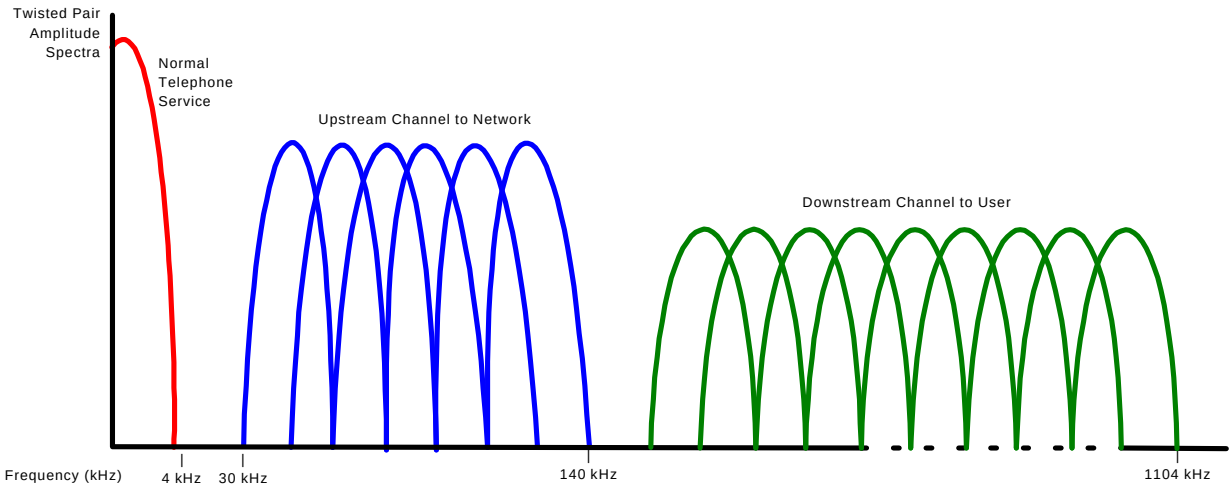

Figure 3 - ADSL Frequency Spectra

System Configuration

At the consumer end, a remote ADSL Transceiver Unit (ATU-R) is placed at the customer's site and configured as needed to support voice, data and video. If the location is a high-rise building with multiple offices and apartments, or a campus with various data needs, the ATU-R can be equipped with additional functionality such as bridging, routing or multiplexing.

At the exchange end, a Digital Subscriber Line Access Multiplexer (DSLAM) is installed. A single DSLAM can handle and route traffic from multiple ATU-R installations, keeping the cost low because it is shared among all service users.

The existing telecommunications network then carries the data to the destination, such as a branch office, again going through a DSLAM and ATU-R at the receiving end. This is depicted in Figure 4.

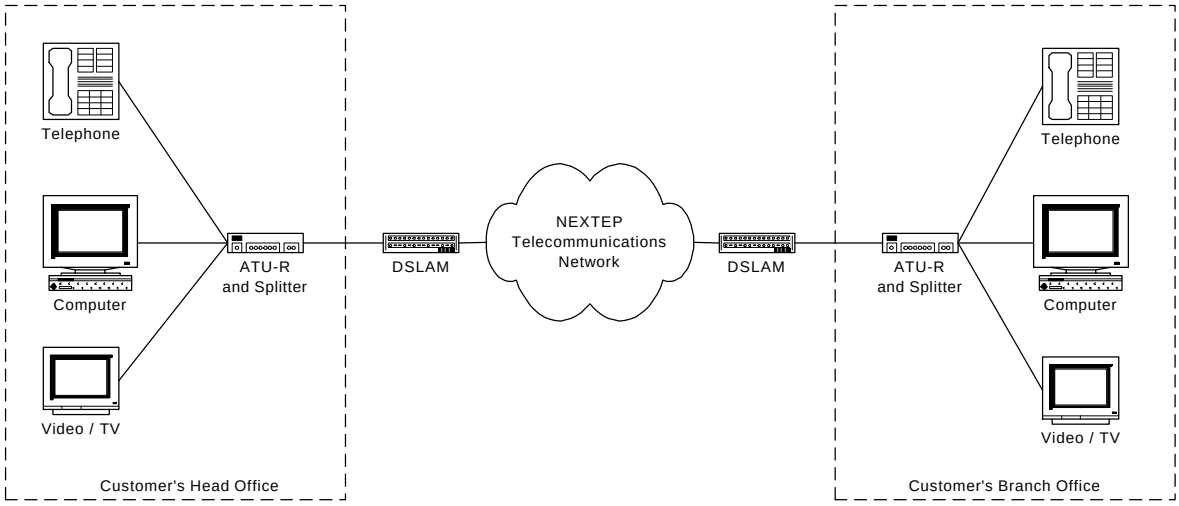

Figure 4 - Point-to-Point ADSL Configuration

BENEFITS OF BROADBAND SERVICE

ADSL unlocks the capacity of existing copper wire infrastructure enabling broadband service on the same line as the telephone without interfering with the telephone signal. There is no need to rewire offices, high-rises, campuses or dormitories because the telephone infrastructure is already in place.

The NEXTEP Broadband service enables SMEs to download data at speeds up to 6.144 megabits per second (Mbps) compared to the standard modem speed of 56 Kbps, and upload data at speeds up to 640 Kbps.

NEXTEP Broadband offers a cost-effective platform for SMEs to build wide-area networks (WANs), provide video conference links between offices, support high-speed email and data transfer, as well as high-speed internet access.

ADSL technology offers benefits that exceed any other access technology currently available, such as ISDN and T1 / E1 lines.

Cost-effectiveness	Equipment installation and usage costs are far lower.
Speed	DSL provides the fastest data transfer for applications that require intensive resources, such as broadcast-quality bi-directional video conferencing.
Ease of use	Internet and email access is instantaneous with no dialing or modem connections. The continual broadband access will support streaming applications such as multicasting for business and education.
Reliability	NEXTEP Broadband is a division of NEC Australia, one of the pioneers of ADSL technology in Australia and supplier of ADSL equipment to Telstra.
Competitive	ADSL technology is available direct from NEXTEP at highly competitive rates.

In summary, NEXTEP Broadband ADSL services provide the opportunity for small and medium-size businesses, TAFEs, universities, government departments, research institutions, providers of internet and datacasting services, high-rise developers and bodies corporate to establish high-speed dedicated digital networks.

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.

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, Venezuela, Japan and Hong Kong, and is the DSL Global Design Centre for NEC Corporation.

NEC's ADSL 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 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.

"Introduction to ADSL" Rev 1.2
Written by Michael C. Bouy for NEXTEP Broadband

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649-655 Springvale Road
Mulgrave, Victoria 3170 Australia

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