SIEMENS

XpressLink

Broadband Access with xDSL technology

System Overview

Application

Using XpressLink (XL) in the access area expedites the cost-effective introduction and provision of broadband services, such as fast Internet, high-bit-rate data transmission and video on demand (VoD) for both residential and business customers. XpressLink is based on asynchronous transfer mode (ATM) technology. ATM provides multi-service signal transmission and flexible, future-proof access to broadband networks. The system's revolutionary concept makes it possible to find economically viable solutions for a wide range of applications.

Providing broadband services previously involved considerable capital expenditure, as laying new lines on the so-called „last mile" was required. Using XpressLink allows you to avoid this cost by utilizing your existing copper cable infrastructure. At the same time, it allows you access to existing narrowband telephone services (POTS and ISDN-BA) over the same copper pair. The signals for the narrowband services are transparently passed through by XpressLink. For this purpose, splitters are employed as diplexers on the network and subscriber sides to combine/separate the narrowband and broadband signals.

XpressLink is connected via a standardized STM-1/OC-3c, E3/DS3 or n x E1/DS1 interface to an ATM core network or a router-based core network with ATM interface. The interfaces for accessing the exchanges in the Public Switched Telephone Network (PSTN) and digital data networks are retained.

Subscriber terminal equipment for broadband services (PC, set-top box) is either connected externally (via ATMF25, Ethernet-10BaseT or USB interfaces) or is integrated in a PC via a PC-card (NIC).

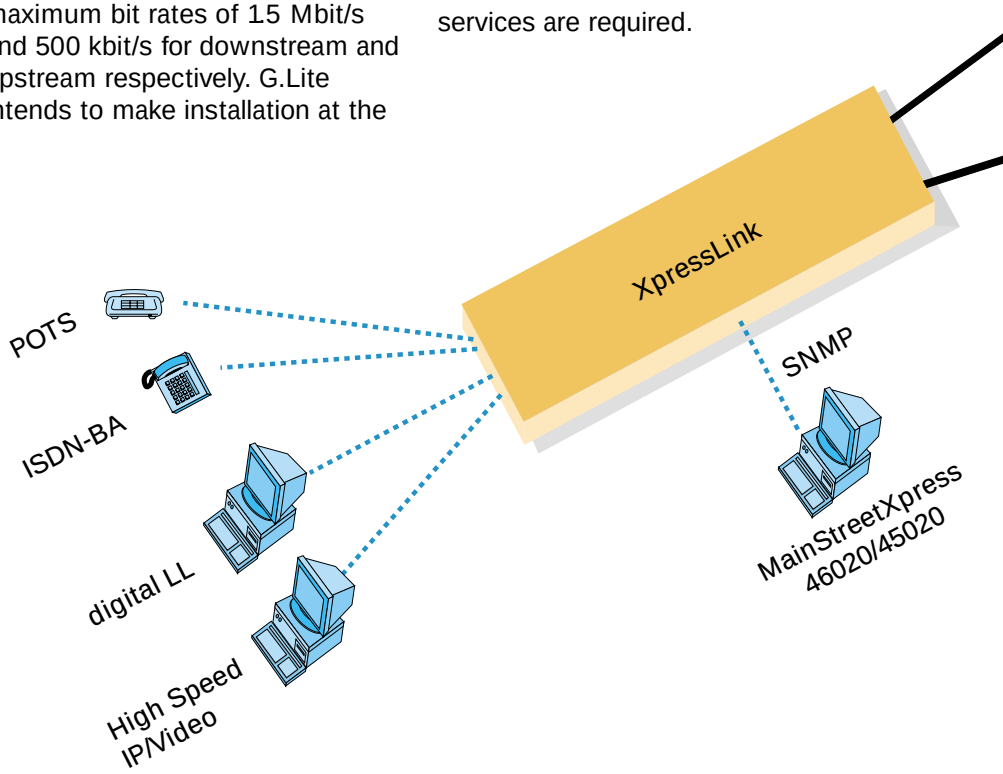
XpressLink today provides broadband services using Asymmetric Digital Subscriber Line (ADSL) technology on existing copper cable networks. Using the Discrete Multitone (DMT) Modulation, the maximum data transfer rate is contingent upon line length, line quality and potential sources of interference. XpressLink automatically adapts transmission rates to current conditions by detecting and monitoring parameters during ADSL connection set-up for individual lines, so that uninterrupted, maximum bandwidth is always available. ADSL allows broadband signals to be transmitted bidirectionally at bit rates of up to 8 Mbit/s to the subscriber (downstream) and 800 kbit/s towards the network (upstream). This is achieved by utilizing a frequency band not used for telephony, extending from above 30/120 kHz (for POTS/ISDN-BA) up to 11 MHz.

A variant of ADSL is G.Lite, also known as UDSL. G.Lite provides maximum bit rates of 15 Mbit/s and 500 kbit/s for downstream and upstream respectively. G.Lite intends to make installation at the customer side easier by avoiding the installation of a splitter.

Specialised business applications (like video conferencing, LAN/LAN connections) may require a symmetric transmission capacity. SDSL can be the solution for these applications with a transmission rate of 2.3 Mbit/s in both upstream and downstream direction.

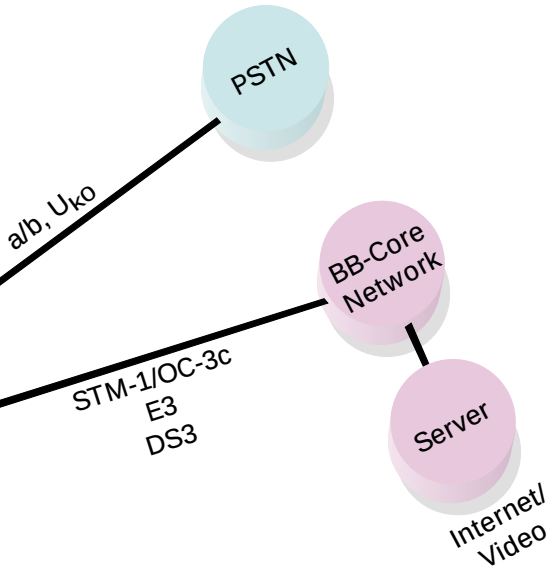
The available bit rate can be further increased by employing Very high-bit-rate Digital Subscriber Line (VDSL) technology. VDSL achieves bit rates of up to 12 Mbit/s downstream and upstream for symmetric services and up to 26 Mbit/s downstream and 3.2 Mbit/s upstream for asymmetric services. VDSL is still under standardization in ETSI and will be available in the near future.

ADSL solutions are ideally suited to provide broadband services both to residential customers and small and medium size businesses. SDSL and VDSL solutions can be used in addition, to better address the market for business customers where enhanced broadband services are required.



The distances that can be spanned with ADSL/UDSL, SDSL and VDSL are about 5 km, 3.5 km and 1.5 km respectively. With Fiber-to-the-Curb (FTTC) solutions providing optical fibers nearer to the subscriber, the distance between the local exchange and the subscriber is virtually unlimited. For FTTC the XpressLink DSLAM has to be deployed nearer to the customer buildings, e.g. separate from the Central Office (CO) building.
For this outdoor version, a shelter is available.

As subscriber density increases in the future, it is possible to cascadate DSLAMs to consolidate the traffic of several DSLAMs, on one core interface.



Network Operation and Management

The management system of XpressLink is the MainStreetXpress 46020/45020. It is the management solution not only for XpressLink but also for the Siemens/Newbridge ATM product family MainStreetXpress. Other SNMP based devices like the B-RAS can be integrated in the NMS in conjunction with HP OV. As a consequence, the 46020/45020 ensures real ATM end-to-end network management for integrated Network Elements from the XpressLink access to the ATM backbone (MainStreetXpress product family). One NMS for the whole ATM environment means that the costs for installation, training and maintenance of the NMS are minimised.

The XpressLink nodes are configured and administrated on a graphical basis using form windows, logical navigation trees, asynchronous notification mechanisms and object listing applications. Management includes configuration, alarms, diagnostics and performance. The XpressLink DSLAM (XLD) and Network Termination Software can be downloaded and upgraded centrally through the 46020/45020. The 46020/45020 is a field-proven and scalable system.

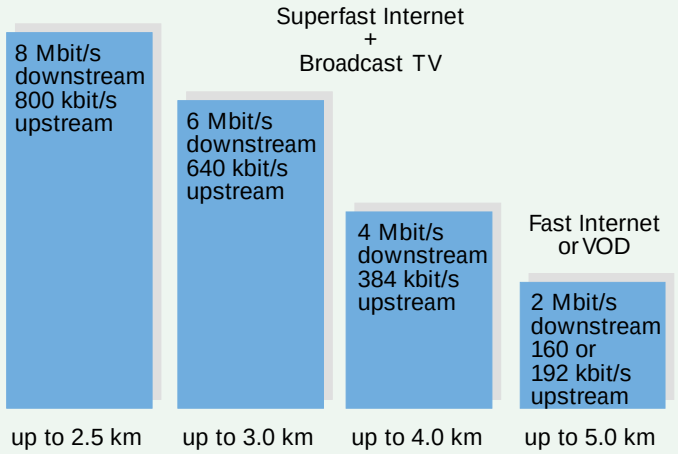
XpressLink offers a Web-based local Craft Terminal (LCT) for field maintenance tasks and small trials, comprising a laptop with Windows NT and MS Internet Explorer software. Connection to an XpressLink node can be local to the node using its Ethernet interface or remote via an IP network through Web browsing.

Main Features of the XL system

- Provision of broadband ADSL, G.Lite and SDSL based services (e.g. Fast Internet, VoD) with simultaneous, transparent transport of narrowband telephone services (POTS or ISDN-BA). Evolution to VDSL on the existing platform using universal slot architecture.
- Highly scalable and cascadable platform with high port density for large scale DSL roll-out.
- STM-1/OC-3c, E3/DS3, nxE1/DS1 interface to the broadband core network.
- Large variety of CPE options: ATMF25, Ethernet (10BaseT) and Universal Serial Bus (USB), PC-NIC and Ethernet router.
- Max. bit rate of 8 Mbit/s downstream and 800 kbit/s upstream with ADSL.
- Max. bit rate of 15 Mbit/s downstream and 500 kbit/s upstream with G.Lite.
- Max. bit rates of 2.3 Mbit/s symmetrically with SDSL.
- Max. bit rates of 12 Mbit/s downstream and upstream (symmetric) or 26 Mbit/s downstream and 3.2 Mbit/s upstream (asymmetric) with VDSL.
- Outdoor solution available.
- IP access with DSLAM and Broadband Remote Access Router (B-RAS), independently of interfaces to the subscriber.
- Network management with MainStreetXpress 46020/45020, full ATM PVC end-to-end management system.
- Web-based LCT for field maintenance tasks.

ADSL Technology

XpressLink employs the Asymmetric Digital Subscriber Line technology from TI. The transmittable payload data rate with ADSL is dependent on line length.



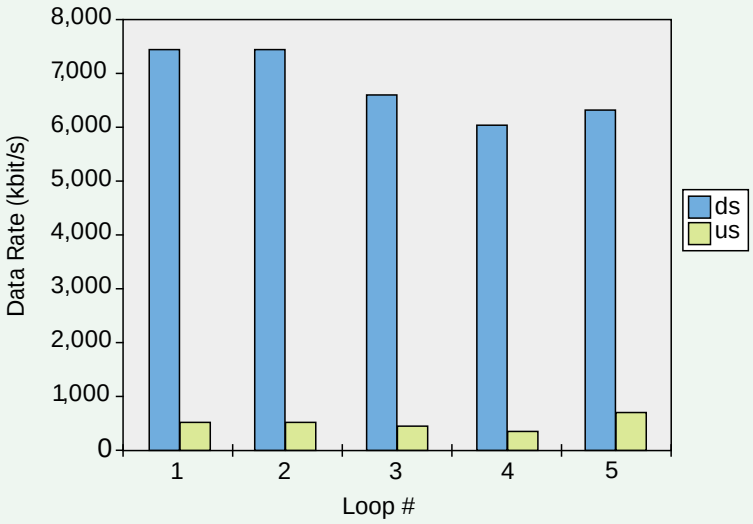
Data Rates with ADSL as a Function of Line Length

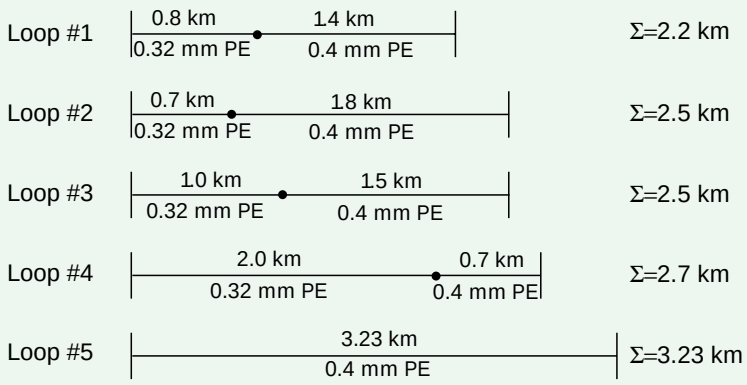
Measurements on XpressLink, see also graphic on right, confirm excellent performance in terms of both maximum bit rate and reach:

- Bit rates of up to 8 Mbit/s towards the subscriber (downstream) and up to 800 kbit/s towards the network (upstream)
- Range > 5 km at 1 Mbit/s downstream and 64 kbit/s upstream
- High performance margins guarantee high transmission reliability and the availability of the required bandwidth.

Interoperability

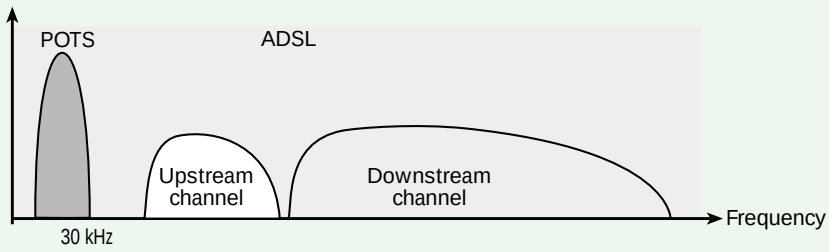
Siemens and TI are members in the ADSL Forum and UAWG standardization group. Siemens has proved via extensive interoperability testing, that its xDSL access platform, XpressLink, is compatible to xDSL systems of the other major xDSL system suppliers. Besides testing under the co-ordination of the ADSL Forum and UAWG, Siemens has successfully proved interoperability in their ADSL competence center. Interoperability refers to the ADSL, ATM and application layer between DSLAM and CPE. Interoperability of xDSL equipment means flexibility for operators and customers. It is a condition for xDSL mass-market deployment.



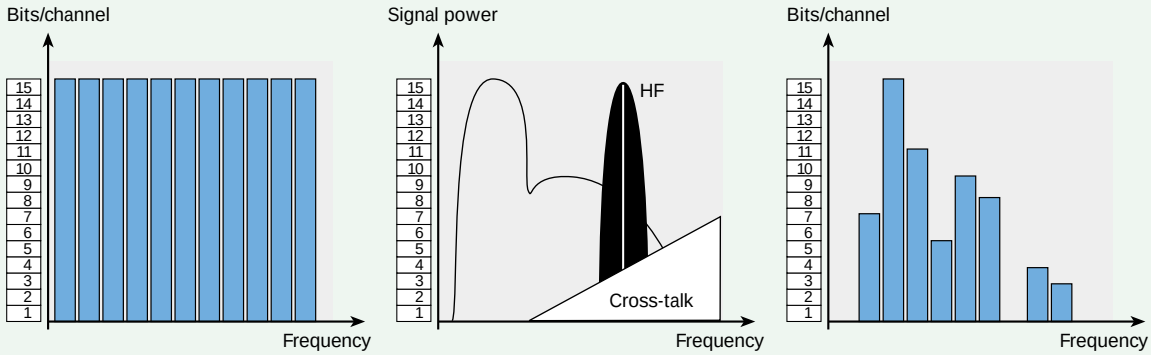


Discrete Multitone Modulation

The ADSL technology from Siemens / TI employs Discrete Multitone (DMT) modulation. For ADSL signal transmission, this technique uses a frequency range above 30/120 kHz (POTS/ISDN-BA) up to 1.104 MHz. The entire frequency range is divided into several discrete carrier frequencies. Each carrier frequency (upstream and downstream) is assigned a bandwidth of 4.3125 kHz.



Assignment of the Frequency Range for ADSL over POTS



Automatic Bit Rate Adaption to Interference for Copper Pair with Attenuation, RF Interference and Cross-talk

The usability of the individual, resultant frequency channels is determined by line parameters (e.g. attenuation) or any interference sources present. Interference-free channels are assigned with the maximum bit rate. If frequency channels are degraded by interfering signals or raised line attenuation, the bit rate is then automatically adjusted. If a frequency channel is severely degraded, e.g. due to RF interference, the channel is ignored until signal transmission conditions are improved.

ADSL over POTS versus ADSL over ISDN

For POTS service, FDM with separate bands for up- and downstream traffic is deployed to obtain maximum interoperability with other CPE vendors worldwide. Echo cancellation improves the ADSL performance.

As ISDN service needs more bandwidth than POTS (120 kHz versus 3.4 kHz) the available bandwidth for ADSL transmission is less than for POTS. The integrated asymmetric echo canceller allows the upstream and downstream channels to overlap. The advantage is that the low frequency range which is particularly suitable for signal transmission is available for both the downstream and upstream direction. This allows ADSL over ISDN to have a similar performance than ADSL over POTS.

Main ADSL Features

- Conforms to ANSI Standard T1.413 Issue 2 and ITU G.Dmt. (G.992.1)
- DMT-based
- FDM for ADSL with POTS and frequency overlap for ADSL with ISDN
- Echo cancellation for ISDN and POTS
- Reed-Solomon forward error correction
- Wei-4D-Trellis coding
- Multiport architecture
- Automatic bit rate adaptation
- Bit rates of 8 Mbit/s downstream and 800 kbit/s upstream over a distance of 2.5 km
- TI software.

System Architecture

The standardized interfaces and modular design of XpressLink make it ideally suited for cost-effective expansion of existing narrowband networks because it allows shared use of the established infrastructure to provide broadband services via xDSL. This applies to the copper cables in the subscriber loop through to the existing PDH/SDH transport systems for accessing the core network.

The XpressLink DSLAM operates as a multiplexer, which consolidates the traffic originating from a number of subscriber lines to a single feeder interface towards the ATM network.

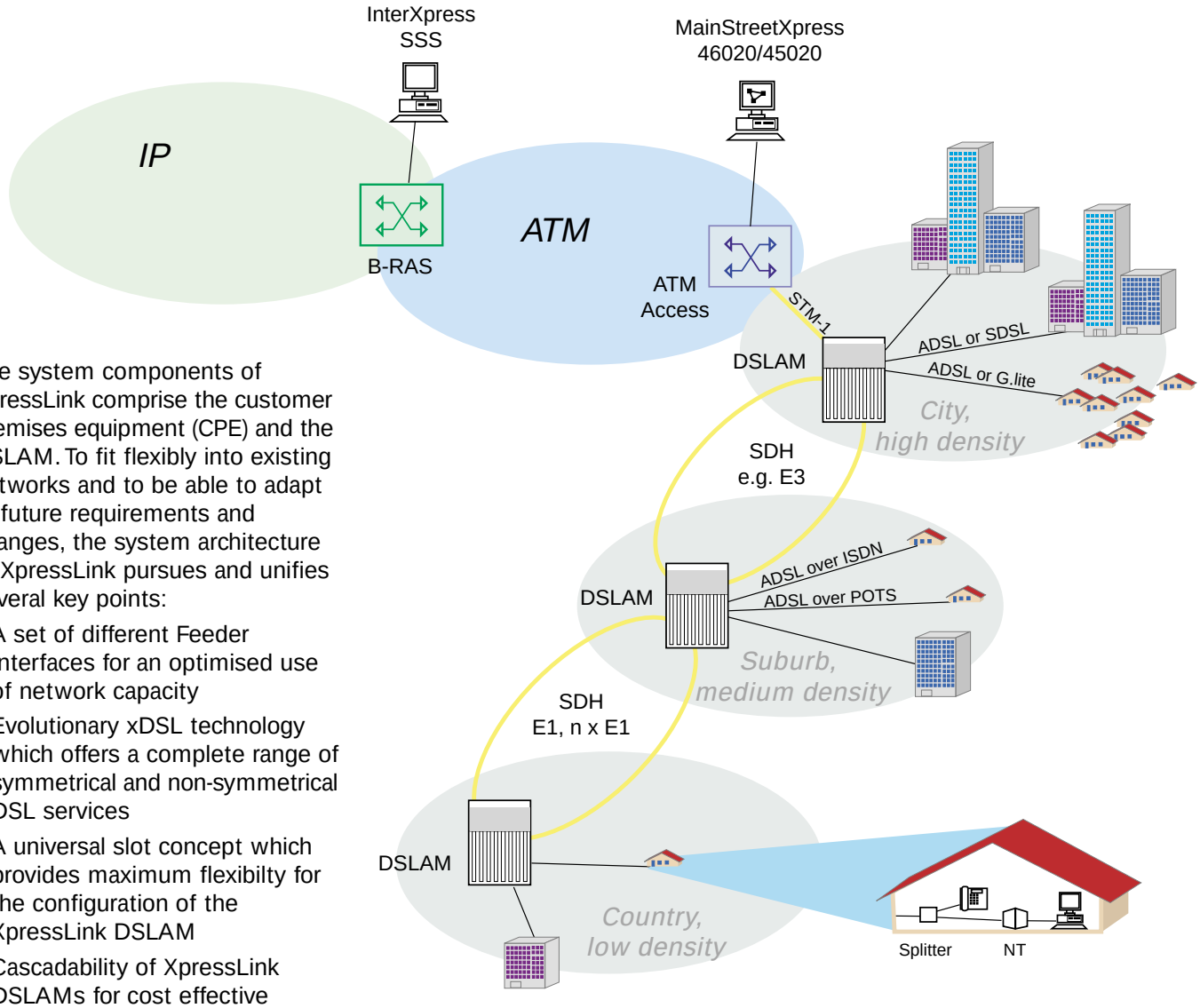
The feeder interfaces employ established transmission technologies (PDH, SDH) with bit rates starting at n x E1, n x DS1 (n = 1..8), E3, DS3, and up to STM-1 or OC-3c.

Evolutionary xDSL Technology

G.Lite is a variant of ADSL. The purpose of this technology is to simplify installation at the subscriber premises on the basis of the existing cabling at the location. It is not possible however to combine G.Lite with ISDN. Moreover, it provides significantly lower bit rates

The system components of XpressLink comprise the customer premises equipment (CPE) and the DSLAM. To fit flexibly into existing networks and to be able to adapt to future requirements and changes, the system architecture of XpressLink pursues and unifies several key points:

- A set of different Feeder Interfaces for an optimised use of network capacity
- Evolutionary xDSL technology which offers a complete range of symmetrical and non-symmetrical DSL services
- A universal slot concept which provides maximum flexibilty for the configuration of the XpressLink DSLAM
- Cascadability of XpressLink DSLAMs for cost effective usage of network infrastructure
- Complementary technology (B-RAS and SSS) to offer IP functionality and services



Optimized network architecture with 3 level DSLAM cascadation

than ADSL. Since the basic technologies for ADSL and G.Lite are very similar, XpressLink uses the same HW technology for ASDL and G.Lite and integrates both DSL solutions in one SW.

XpressLink provides SDSL and VDSL as an evolutionary path from ADSL architecture. It can thus provide subscribers with symmetric and asymmetric high bandwidth services. With symmetric 2.3 Mbit/s, SDSL supports business applications which require symmetric transmission rates on a similar level to 2 Mbit/s leased lines. SDSL provides transmission for a length of up to 3.5 km.

VDSL facilitates enhanced video applications and high bit rate data services. Symmetric bit rates of up to 12 Mbit/s (up to 500 m) and asymmetric bit rates of up to 26/3.2 Mbit/s (up to 1.5 km) are possible. Because VDSL has a shorter range, the DSLAMs are typically located closer to the subscriber within an FTTC/FTTB architecture.

Universal Slot Concept

Thanks to its evaluative design based on the xDSL universal slot concept, the XpressLink platform can be easily reconfigured or upgraded with new features and additional xDSL interfaces.

An ATM cell bus architecture, which provides 1 Gb/s capacity for up- and downstream traffic, avoids any kind of bottlenecks within the ATM path, and ensures a future proof DSLAM platform.

Cascadation of DSLAMs

A continuous evolution towards ADSL mass market and high penetration rate of BB services will necessitate a differentiation of ADSL nodes:
small nodes in remote areas and large nodes in densely populated areas. By this time, XpressLink will have available boards to cascade small remote DSLAMs towards a single DSLAM in the central location.

Using nxE1/DS1 interfaces, remote locations can be connected very efficiently using already existing SDH transport infrastructure. The collecting DSLAM on the higher network level collects the remote DSLAMs via the nxE1/DS1 interface. Two nxE1 interfaces will be available on one nxE1 cascading board.

For large central office applications the DSLAMs can be connected locally to provide a high degree of traffic concentration onto one STM-1 core interface.

In the future, E3 and STM-1 links will be available as a cascadation interface to enlarge the overall system capacity.

Higher Layer (IP) solutions

One part of the future proof and evolutionary concept is the Broadband Remote Access Server (B-RAS). As an integral part of the complete Siemens product portfolio for IP over ATM, XLD not only offers xDSL solutions, but provides the means to build an end-to-end broadband network with all the capabilities to support IP based services with the multi service class and Quality of Service features inherent to an ATM transport platform.

In addition, using the higher layer access and subscriber management of a Service Selection Server (SSS) the carrier is able to offer wholesale access products and services providing a single and personalized page, a so called "portal page."The service selection is a subscriber-initiated operation and is fully automated for the carrier.

Customer Premises Side (Residential and Business)

On the customer premises side a complete family of DSL modems is available. The least costly modems are the PCI NIC cards, which are installed directly in a PC, and the USB modems that are linked to the PC by a standard USB interface. XpressLink supplies an ADSL router for business users, who need a modem with extended routing capabilities, e.g. for a LAN-WAN connection. The modem family is completed by the Network Termination (NT) with Ethernet 10BaseT or/and ATM25 interface. The NT is managed and controlled centrally by the xDSL operator through the XpressLink management system 46020/45020, thus providing the capability to fully control the whole ADSL network.

The narrowband signals for POTS and ISDN-BA are passed through by XpressLink transparently. Splitters are employed for this purpose at the subscriber and on the network side. The function of these splitters is to separate or combine narrowband signals and broadband signals.

End-to-End Solutions

XpressLink is used to provide end-to-end network solutions for new broadband services. The key to successful deployment of xDSL is end-to-end compatibility of all communication layers, i.e. both for the existing infrastructure (Frame-Relay-based Internet, Internet Service Provider POPs, etc.) and for new broadband systems from different vendors.

The system architecture for our end-to-end solutions is based on existing standards, in particular the Point-to-Point Protocol (PPP) over ATM and the PPP over Ethernet (PPPoE). This ensures that the system can be implemented rapidly and provides the following important service requirements:

- Access to Internet, corporate networks, local content servers and peer-to-peer communication
- Simple migration of existing ISP infrastructures to IP over ATM based end-to-end networks
- Integration of new broadband services on existing IP service platforms
- Flexible transport platform based on ATM
- Supports multicast service
- Supports various traffic classes (CBR, UBR, VBR)
- Quality of Service (QoS).

XpressLink is based on ATM transmission over ADSL, permitting Permanent Virtual Connections (PVC) and being transparent for Switched Virtual Connections (SVC).

The End-to-End Solution with XpressLink for IP over ATM

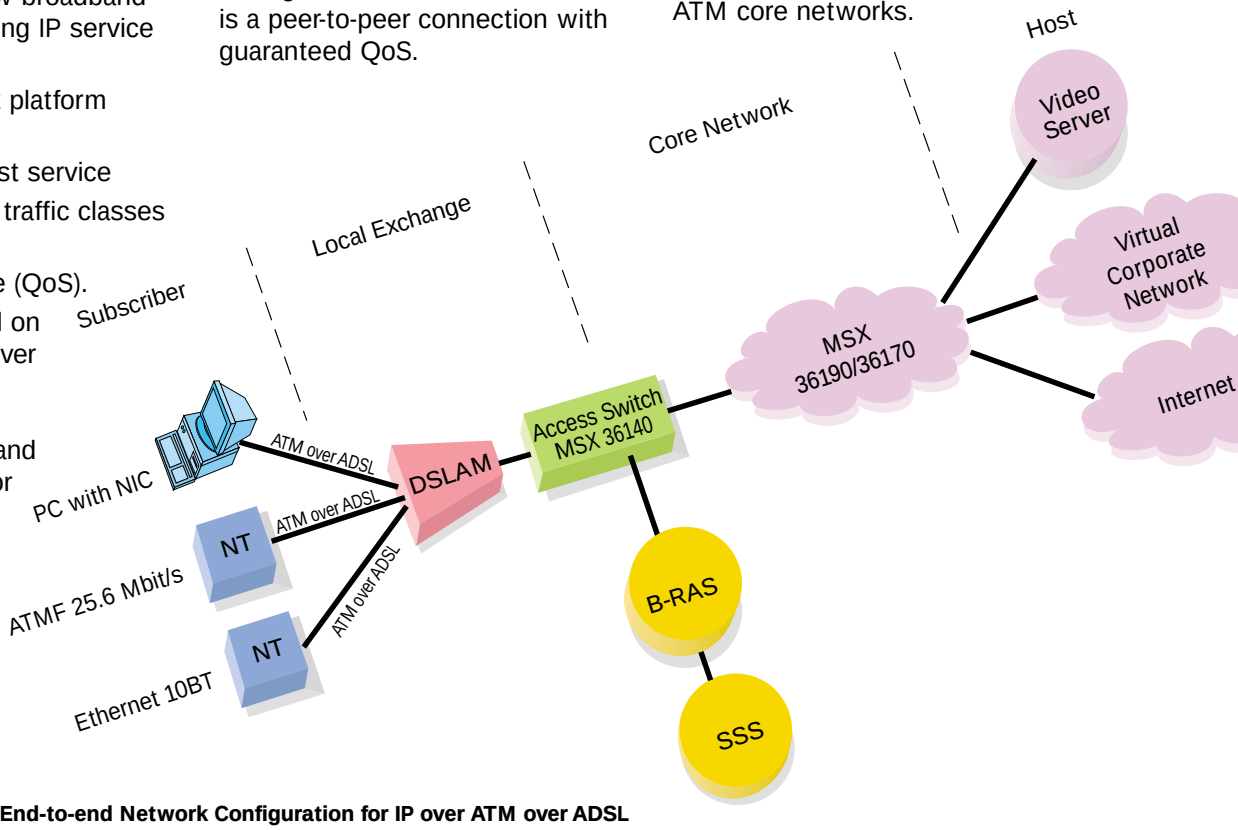
The XpressLink access network solution is fully integrated in the superordinate IP over ATM network architecture. The superordinate network architecture also includes the Siemens/Newbridge product family, MainStreetXpress (MSX) in the core network area. This integration allows diverse services to be provided, e.g. switched virtual connections to Internet/ISP, and the creation of Virtual Private Networks (VPN) with various QoS options.

XpressLink can be connected to the ATM core network via the ATM Access Switch. The Access Switch also allows flexible traffic concentration and routing, e.g. according to subscriber type (residential, business customer) and the service required by the subscriber. A business customer accessing VPN applications can be connected throughout the network. The result is a peer-to-peer connection with guaranteed QoS.

An end-to-end IP session is realized with the Point-to-Point Protocol. A Broadband Remote Access Server (B-RAS) is employed in Siemens' network architecture exactly for this purpose. The B-RAS can be connected both to the ATM concentrator and to the switch in the core network.

Among other functions, the B-RAS provides subscribers with access to Internet Service Providers (ISPs) or to corporate LANs. These connections are set up using the PPP dynamic address assignment or permanent IP address assignment functionality. The B-RAS provides the PPP functionality, e.g. authentication and supervision of the PPP session. The graphic below represents this network configuration.

Other configurations are also possible. For example, the B-RAS can be connected to the switch in the ATM core network or be interposed between the DSLAM and ATM core networks.

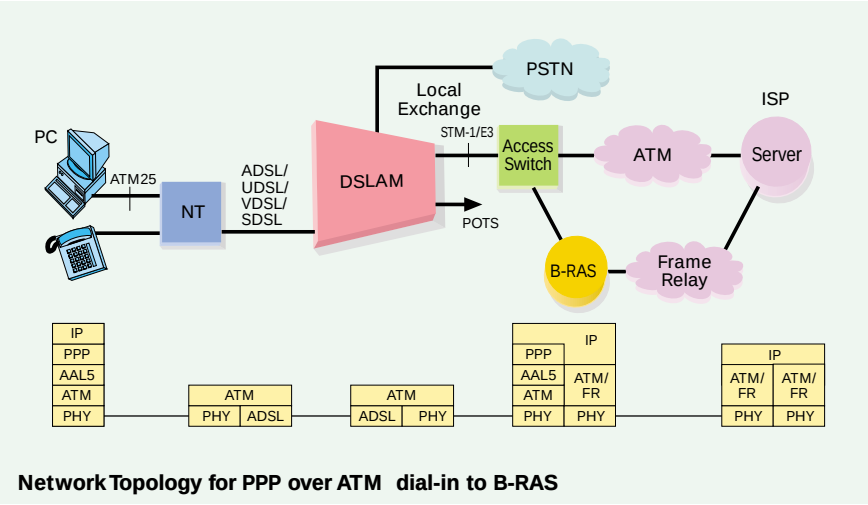


End-to-end Network Configuration for IP over ATM over ADSL

In its efforts to provide a customizable broadband access platform, Siemens has developed a software solution, called the Service Selection Server (SSS). Using this solution, the Internet user reaches a remote access server (for example via dialing in). The personalized service selection page ('Portal') is downloaded from the SSS to the user's standard Web browser. By clicking on the respective icon in the portal page the user selects ISPs and/or service/content providers. Accounting is then started for the service selected, enabling the IP access carrier to collect units of usage for later billing purposes. Billing is possible on a per-service, per-usage (time/volume), per-data basis.

PPP over ATM

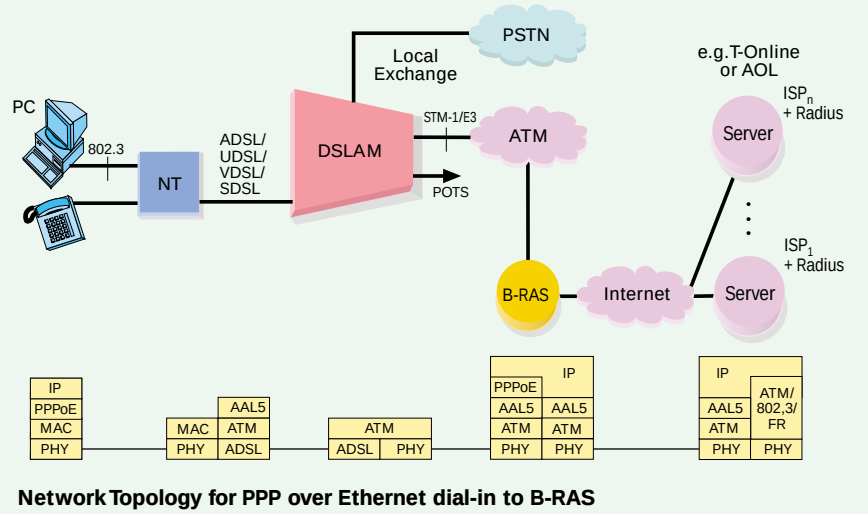
Through this method, the PPP session is terminated in the BB-RAS. IP packets are extracted from the PPP and forwarded via an IP-based broadband core network (FR, ATM) to the addressed ISP or corporate LAN. The graphic below is an overview of the network architecture and the data processing at protocol level. PPP over ATM is a solution mainly for residential subscribers. It is applicable for any ATM based NTs, USB modems and NICs.



Network Topology for PPP over ATM dial-in to B-RAS

PPP over Ethernet

Regarding the XpressLink Ethernet NT, bridging is supported by being transparent to the PPPoE protocol. Support of RFC1483 allows the assignment of an IP address to the user PC through DHCP. In this scenario, the DHCP server can be the B-RAS or a separate server, e.g. located at the ISP. The graphic on the right is an example of a PPP over Ethernet network architecture.



Network Topology for PPP over Ethernet dial-in to B-RAS

Digital Subscriber Line Access Multiplexer (DSLAM)

The DSLAM terminates the subscriber loop network. Its Line Unit provides the option of an optical or electrical interface STM-1/OC3 (155 Mbit/s), an electrical E3/DS3 (34 Mbit/s / 44 Mbit/s) interface or a nxE1/DS1 IMA (n x 2 Mbit/s / n x 1.5 Mbit/s, n = 1 ... 8) interface to the BB core network. A connection to an ATM Access Switch is also possible.

Because the DSLAM can be equipped with different units on a modular basis, it is possible to flexibly implement diverse network requirements with a minimum investment of capital.

The DSLAM provides the following ATM functions:

- Cross-connection
  Translation of the Virtual Path and Virtual Channel Identifiers (VPI/VCI) between the BB signal on the core network side and the xDSL signal on the CPE side. Permanent Virtual Connections (PVCs) are set up according to the cross-connections established.
- VP Multiplexing
  Multiplexing the individual ATM cells on the xDSL lines into an ATM signal to the ATM/SDH core network, and demultiplexing them in the opposite direction. All the VCs belonging to the path are passed through transparently. Signaling is passed through transparently in accordance with the virtual UNI definition.
- VC Multiplexing
  Alternatively, the XpressLink can also be configured as a VC cross-connect. This reduces the number of VPs in the direction of the ATM switch. Owing to the virtual UNI definition, this is only possible for PVCs.
- Traffic Management
  Services of traffic classes CBR, VBR-rt, VBR-nrt and UBR can be transmitted simultaneously, UBR services being processed on a lower priority basis.

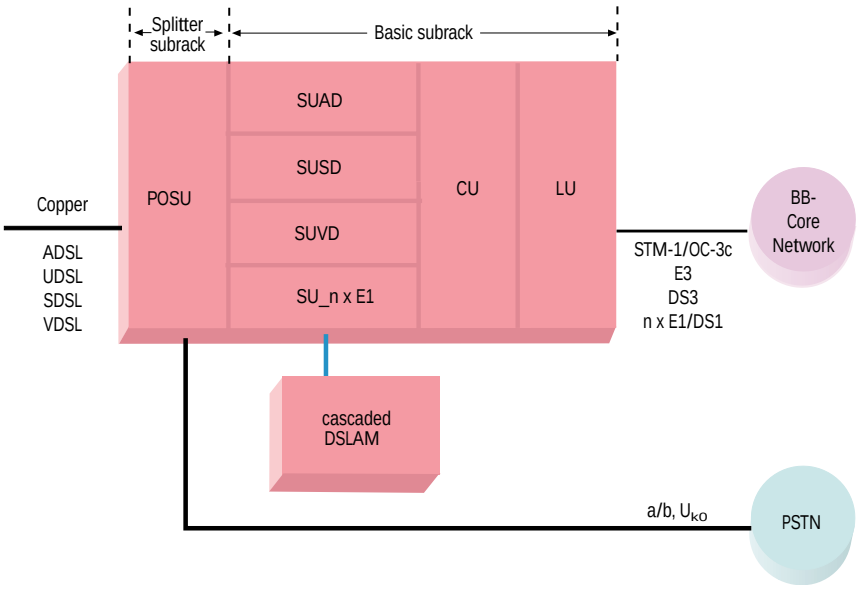
The central processor is part of the CU (Central Unit). The LU provides the interface to the core network via a standard ATM interface. The SU_AD16 offers 16 ADSL or G.Lite drop interfaces to the subscribers. There is no HW or SW difference between ADSL and G.Lite. One DSLAM can serve up to 224 ADSL (G.dmt or G.Lite) subscribers, each line card carries 16 ports. There are different line cards for SDSL and VDSL (SU_SD16 and SU_VD24). To ensure optimum usage of the network infrastructure, the SU_nxE1/DS1 interface enables the operator to cascade several 224 subscriber DSLAMs to one single uplink (in the future, cascadation will be also supported with STM-1/E3 interface). Two cascadation nxE1 interfaces are available on one cascadation interface board.

In addition, the DSLAM has an Ethernet interface for connection of an LCT or the MainStreetXpress 46020/45020 for the operation, administration and maintenance of all XpressLink components. Remote network elements can be connected to a MainStreetXpress 46020/45020 via inband management.

Splitter Units (POSU) combine the xDSL signals and the narrowband signals for common transmission to the subscriber and split the signals for transmission to the relevant core network. Since the splitters are purely passive devices, the availability of the narrowband services is not affected by any disturbances occurring in the broadband system. The splitter boards are located in a separate subrack for high flexibility and packaging density. One splitter module serves 16 POTS or ISDN lines. The splitter subrack can be co-located in the DSLAM rack, or remotely in separate racks.

Each DSLAM system consists of 2 subracks:

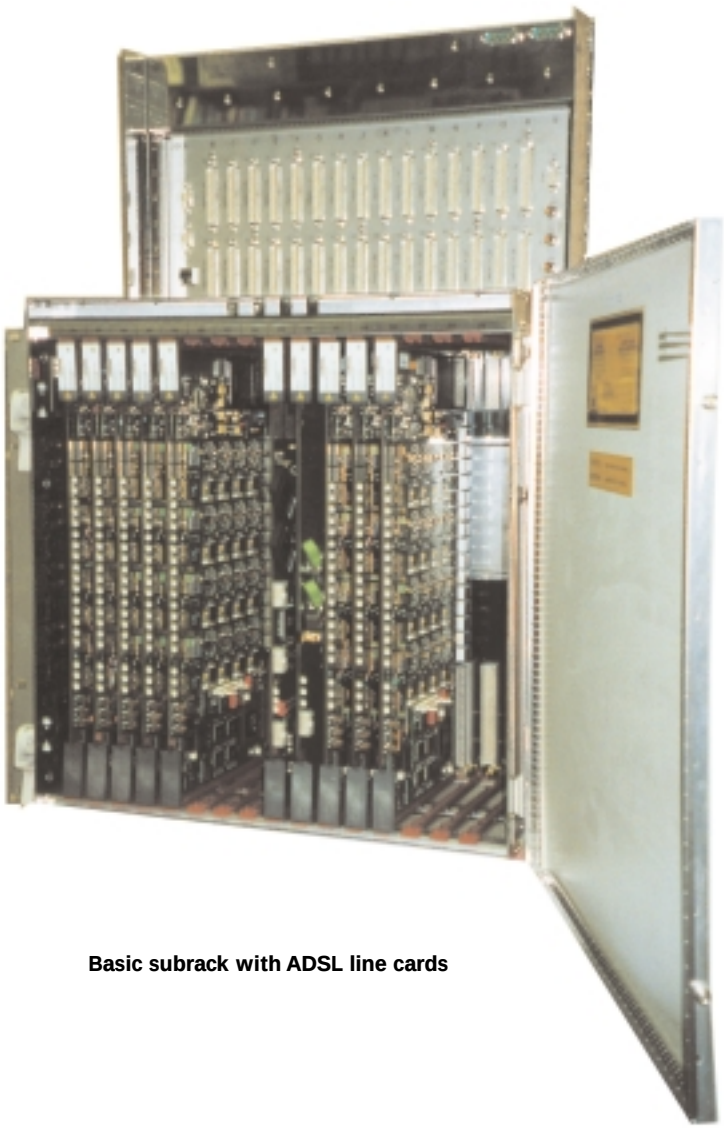
- Basic subrack for CU, LU and SU_ADSL, SU_VDSL SU_SDSL and SU_nxE1
- Subracks for the passive splitter units.



The concept of seperate basic subracks and splitter subracks allows cost optimized single rack architectures to be extended to accommodate more subscribers at any time through cascadation. From the XpressLink NMS point of view, each basic rack – cascaded or not – is one single network element.

Only the slot adress of the CU und LU units are fixed. Due to the universal slot concept, it is possible to use any other slot of the basic subrack for the operation of either ADSL, G.Lite, SDSL or VDSL applications in the DSLAM or to install an SU_nxE1.

The lower part of the basic subrack supports all the boards and the upper part contains the wire interfaces and the external powering voltage.
Each rack contains a terminal panel with fuse panel and an optional clock distributor supplying an external clock signal T3.

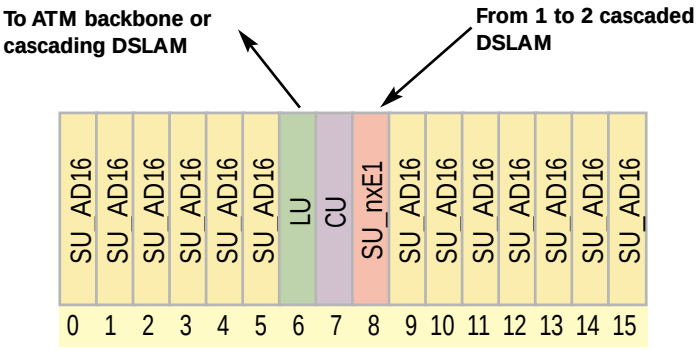


Basic subrack with ADSL line cards

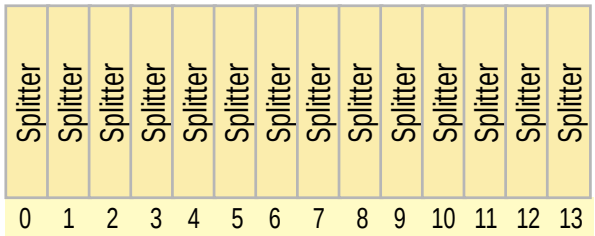
The DSLAM design has a decentralized power supply, all necessary electronic voltages are generated with on-board DC/DC converters. This allows a flexible and modular design. The DC input voltage is nominal – 48 V / – 60 V; onboard DC converters input voltages ranging from – 38 V to –75 V).

The racks can also be equipped with rear panels and doors to prevent unauthorized access. All external electrical DSLAM interfaces are accessible from the front via the connector panel.

For FTTC applications, the racks are installed in weatherproof enclosures. These are fed from the public power supply network and are equipped with backup batteries.



Configuration of the basic subrack for All-ADSL and SU_nxE1 for cascadation



Splitter Subrack with 224 (16 x 14) splitters

Customer Premises Equipment (CPE) Family (I)

• Network Termination and Splitter

To economically and flexibly provide high bandwidths on demand, Network Terminations (NTs) offer standardized interfaces that expedite the connection of terminal equipment (PC or STB). These cover the entire range of residential and business customer applications (SOHO, SME).

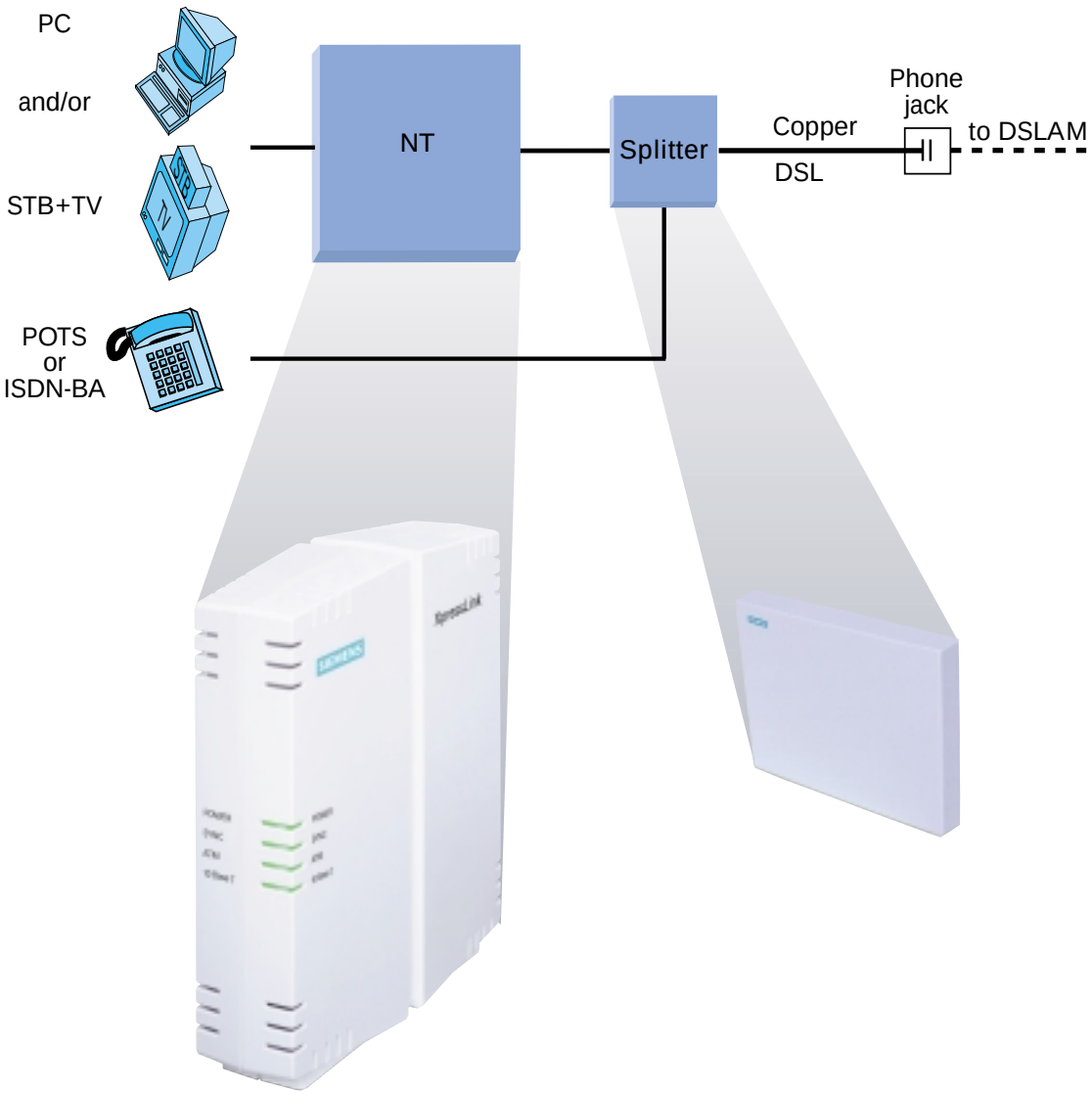
The NTs are fed via an integrated AC adapter plug from the public power supply network (110 V or 230 V).

The NT is housed in a compact plastic case for convenient wall mounting or desktop use. It is to be installed directly on residential or business customer premises.

There are different variants with ATMF 25.6 Mbit/s interfaces and/or Ethernet-10BaseT interface. In the direction of the DSLAM, an ADSL interface is implemented.

The difference between a NT and other CPE's (USB, PC-NIC, etc.) is that the NTs are capable of being completely managed by the Management System 46020/45020. Management includes SW download and upgrade, configuration management, self test monitoring, fault and performance management. Communication to the Management System is carried by an inband ATM management channel (default PVC).

A separate splitter preceding the NT allows broadband and narrowband services (POTS or ISDN-BA) to be used simultaneously. The two types of services are transmitted between the NT and DSLAM via a common line.



NT with Ethernet-10BaseT

For those service users who are still operating subscriber terminals with Ethernet interfaces this NT is the right choice. The interface conforms with the Ethernet Standard. The interface to the DSLAM is an ADSL interface. The Ethernet NT supports three different modes: self-learning bridge, static router or PPP forwarding through PPTP tunnel.

NT with ATMF-25.6-Mbit/s Interface

This NT is used to realize „ATM end-to-end“ or ATTH solutions. The interface to the subscriber terminal equipment conforms to the ATM Forum standard. It can be connected to a PC for data applications or to a Set-top box for video applications.

The NT converts the signals between the ATMF 25.6-Mbit/s interface and the ADSL interface.

NT with Ethernet-10BaseT and ATMF-25.6-Mbit/s Interfaces

If customers need to have the flexibility to use either Ethernet or ATM interface, XpressLink offers the so-called Twin NT. This NT contains both an ATMF 25.6-Mbit/s interface, and an Ethernet-10BaseT. The two interfaces can be operated at the same time.

Splitters

Splitter Units are installed at the customer’s premises if both broadband and narrowband services (POTS or ISDN-BA) are required.

The splitter is a purely passive device, that separates and combines narrowband and broadband signals. The splitter can be used to connect terminal equipment for POTS or ISDN-BA.

It is housed in its own compact plastic case for either wall mounting or desktop use.

Customer Premises Equipment Family (II)

• Network Interface Cards

Network Interface Cards (NICs) can be installed in any Peripheral Component Interconnect (PCI) bus slot within a PC. PCI bus slots are available on most Pentium-based desktop PCs. Siemens offers three types:

the 25-Mbit/s ATM adapter, the ATM-ADSL and the ATM-G.Lite adapter.

25-Mbit/s ATM Adapter

This card is a very cost effective ATMF 25.6-Mbit/s interface, ideal for all kinds of ATM- and IP-based applications. Preconfiguration and proven interoperability simplify installation and ensure widespread deployments. The adapter card can be operated under Windows 95/98 and Windows NT.

ATM-ADSL and G.Lite Adapter

The ATM-ADSL and the G.Lite-ATM adapters are an alternative to using Network Terminations for standalone PC applications. In this case, the DSL subscriber line is connected directly to the PC. All the ATM and DSL functions are provided by the adapter and by driver software installed on the PC. The main features of this card are:

- Network access via ATM over ADSL or G.Lite
- industry standard DMT ADSL at up to 8 Mbit/s or G.Lite at up to 1.5 Mbit/s downstream.
- Seamless operation under Windows 95/98 and Windows NT

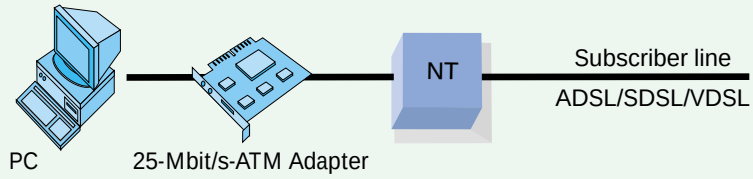
Installation and Configuration

The hardware is quick and easy to install without having to set jumpers or DIP switches. Installation of the software is just as simple.

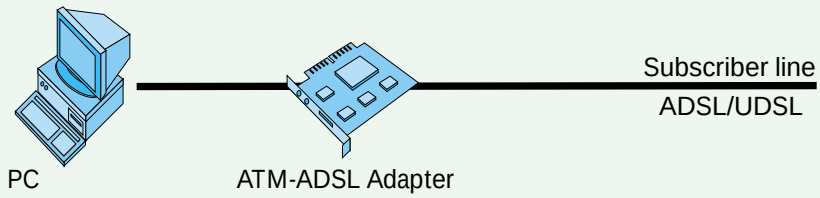
Easy and error-free installation minimizes requests to the network operator for support.

The ADSL and G.Lite adapter will be delivered to the customer with a driver SW. The SW contains all the necessary preconfigurations. As a result, the DSL subscriber has the advantage of a simple ‘plug-and-play’ solution.

Network Interface Card (NIC)



PC-Configuration with 25-Mbit/s-ATM Adapter



PC-Configuration with ATM-ADSL Adapter or ATM-UDSL Adapter

- USB modems
- DSL router

USB modems

Similarly to the PC integrated ADSL and G.Lite adapters the USB modems provide low cost solutions for ADSL and G.Lite deployment. Connection to the PC is provided through a Universal Serial Bus (USB) port, available on most desktop PCs sold from mid 1997. The USB modem can also provide remote network access for a workgroup or a small business by attaching it to a PC based on Windows 95/98 or Windows NT.

USB Modem or DSL Router

DSL router

Some cases of application might require deep routing capabilities, concentrated at the customer premises side. When a business customer wants to connect several subscribers over a router to a WAN network, this modem is the right choice. The DSL router supports the common features like PAP, CHAP, TCPIIP, RIP1, RIP2, etc.

The external DSL router provides high speed remote network connections for one or more Ethernet-attached PCs, workstations or other networked devices. The router sends and receives ATM cells over standard phone lines, using DMT digital subscriber line (DSL) transmission. Connection to local computers is provided through a 10BaseT Ethernet port.

Software-based installation and configuration (USB)

Because a standard USB port is employed, installation of an adapter card inside the PC is avoided. Therefore, installation is even easier than for NIC cards. Configuration is the same for ADSL and G.Lite PC. There is no HW difference between a G.Lite and an ADSL modem. For ADSL a splitter is required additionally to separate the broadband signal from the voice signal at the CPE side.

Installation and configuration (router)

Setting up the router is no problem. Advanced routing features like Network Address Port Translation and complete DHCP and DNS functions enable all LAN workstations to access the Internet without requiring reconfiguration.

The ADSL router has a serial RS 232 port for local management. The router is managed through an intuitive Web-based graphical user interface.

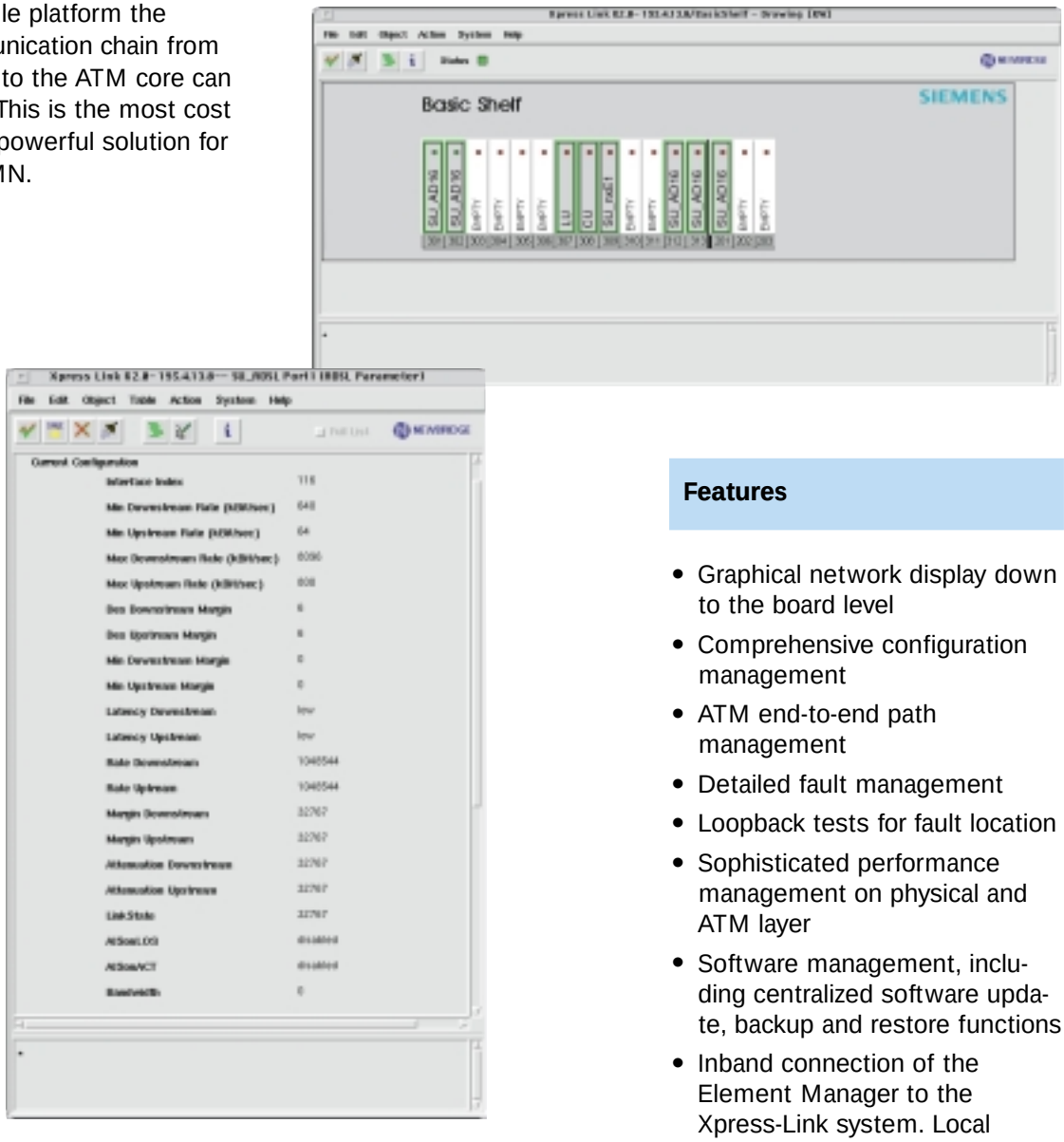
Future proof CPE concept

Siemens XpressLink comprises a complete suite of modems as customer premises equipment. For future applications Siemens will offer further types of modems. As voice and data services grow together more and more, a modem will be available concentrating up to 16 voice ports and one Ethernet interface on one ATM-over-ADSL line towards the DSLAM. On the CO side a voice gateway transforms the voice over ATM signal into the appropriate narrowband signal to transmit it to the voice switch. For users who do not want to install new home wiring when on the high-speed data highway, an NT with wireless access will be the answer in the future.

Network Operation and Management

The XpressLink system is seamlessly integrated in the MainStreetXpress Network Management suite, based on the 46020 Network Manager and 45020 Element Manager.

With one single platform the whole communication chain from ADSL access to the ATM core can be managed. This is the most cost effective and powerful solution for Broadband TMN.



Screenshots of the XpressLink Management System 46020/45020

Features

- Graphical network display down to the board level
- Comprehensive configuration management
- ATM end-to-end path management
- Detailed fault management
- Loopback tests for fault location
- Sophisticated performance management on physical and ATM layer
- Software management, including centralized software update, backup and restore functions
- Inband connection of the Element Manager to the Xpress-Link system. Local connection via Ethernet (out-band) also possible
- Q3 interface for access to a higher layer service management system
- Local Craft Terminal (LCT) available, running under Windows NT with a Web-browser

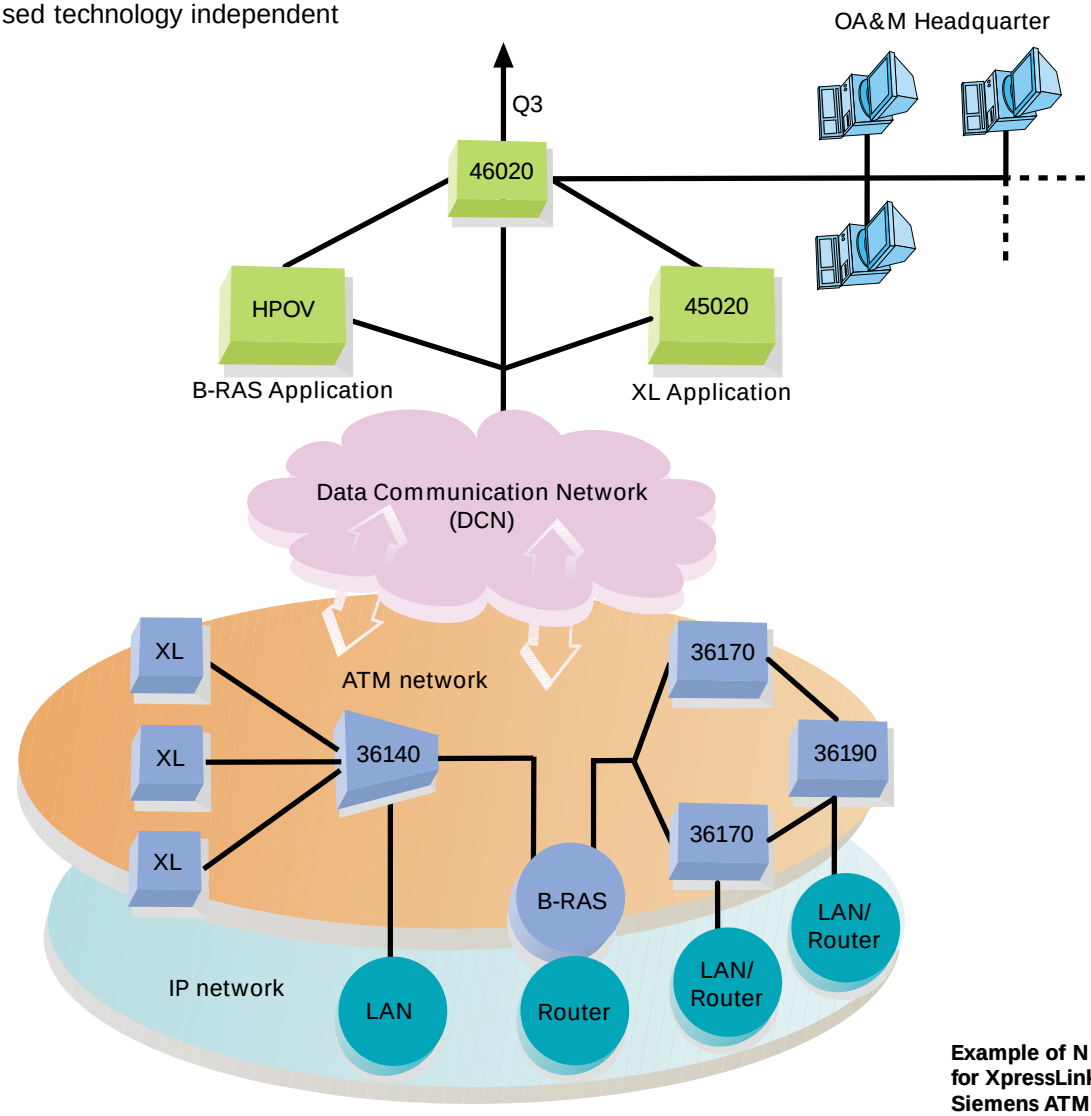
NMS end-to-end solution

The figure shows an example of the Siemens NMS architecture. The XpressLink system, the B-RAS, the 36140 and the ATM backbone switches 36170 and 36190 form an ATM network. This variety of nodes can be managed through one single management system - the MainStreetXpress 46020/45020. XpressLink application (Descriptor) runs on the 45020 runtime server. It is connected to the 46020 Network Manager. The 46020 abstracts the different technologies (SNMP, Q3) to a condensed technology independent model. The B-RAS is an example of how to integrate SNMP based devices into the 46020 via HP OV. The 46020 also offers a standard Q3 interface to higher layer (service management) management systems.

The architecture of the 46020/45020 is very flexible. The hardware configuration can be expanded in various stages, starting with a single workstation through to a distributed client / server architecture so that up to 30.000 subscribers and a corresponding number of XLD network elements can be managed by one element manager. Small networks need only one 45020 server that runs on a HP OV server.

Local Craft Terminal (LCT)

For maintenance tasks there is an LCT available, which is connected directly to the network elements or remotely via an IP network. The LCT offers a portable solution for customer service personnel. It may start, configure, monitor and diagnose an XpressLink node.



Example of NMS architecture for XpressLink, B-RAS and Siemens ATM backbone

Siemens Allround Support

System quality and reliability of Siemens' products is assured through development and production processes ISO 9001 certified and supported by global service logistics.

Planning/Project Management

Siemens project engineers establish project plans, work out the details of the project to be implemented in consultation with the operating company and produce a project implementation schedule. This includes all the activities involved, ranging from ordering hardware and providing software, as well as organizing delivery, installation and commissioning, through to providing the database and the documentation.

In addition, Siemens provides support for construction planning, network planning and in creating operator concepts.

Installation

Separate documentation is provided for installation (Installation Manual IMN), describing step-by-step the process of installing the system components.

After a suitable training period and a limited period of transitional support, local personnel are able to take over the work of installation themselves.

Commissioning

The contracted telecommunications equipment is commissioned according to the manuals and prepared for acceptance. Commissioning includes for example loading the application program, installing the database and performing off-line functionality tests. At the end of Commissioning, the system is ready for Acceptance. Commissioning includes basic network integration; complete network integration is available separately in the service Network Integration.

Acceptance

If required, acceptance of the system can be carried out with the operating company on a ready for acceptance (RFA) basis before the system enters service. This usually comprises a visual inspection of all the equipment as well as a demonstration of the hardware and software functions.

The scope of the acceptance testing is agreed contractually with the operating company on an individual basis.

Network Integration

This involves linking the system into an existing network as well as loading the database. The final tests are then performed to verify internetwork functionality.

Documentation

The operator documentation for WN products is classified according to tasks and target groups. All documents covering the description (User Manual UMN, Technical Description TED, Subsystem Description SSD), installation (Installation Manual IMN) and maintenance of the system (Maintenance Manual MMN) are structured from the top down. Introductions to the system and network begin by describing the top level, then progressively deepen the reader's knowledge down to the functional levels. Sub-dividing the operator documentation in this way optimizes system operation and facilitates fault elimination. At the same time, the documentation can be broken down into handy sized manuals for each task.

Apart from the standard hard copy, the documentation can also be supplied in electronic form.
The files can then be down-loaded e.g. to the workstations of the operations systems, thus providing significant benefits in speed and ease of handling.

Training

For the personnel of the operating company, the Siemens Training Center for Communication Systems provides training programs comprising various courses oriented to target groups, i.e. tailored to the different activities of the various personnel. The course requirements, contents and objectives are precisely laid down for each of the target groups. The training is given:

- In the Classroom
- At work
- Computer-based.

Courses can be adapted to suit the specific requirements of the operating company on an individual basis.

Technical Service Center

The Technical Services are service centers located in the operator's organization, in the regional agencies and at the Service department for Communication Networks in Munich. Their main task is to provide technical support to ensure continuous system and service availability including:

- Emergency Service
- On-Call Support
- Fault Report Processing
- Software/Hardware Update
- Field Service
- Repair and Replacement Service
- Bulletin Board
- Basic Software Upgrade

For more information about Siemens' professional services see brochure Customer Success, Order No. A50001-N12-P5-2-7600.

Technical Specifications

ADSL specifications

Modulation . . . . . DMT
Standard . . . . . ANSI T1.413 Issue 2,
Cat. 1 (Frequency Division Multiplex) for POTS,
Cat. 2 (Frequency Overlap) for ISDN,
Echo cancellation for POTS and ISDN
ETSI ETR 328 and ITU G.992.1
Min. Downstr. bitrate . . . . . 32 kbit/s
Min. Upstr. birate . . . . . 32 kbit/s
Downstream bitrate . . . . . up to 8,16 Mbit/s
Upstream bitrate . . . . . up to 800 kbit/s
Rate adaption . . . . . 32 kbit/s step
Max. Distance . . . . . about 5 Km

Passive Splitter

Line functions:
ISDN: (2B1Q and 4B3T)
POTS: (2wire a/b): Metering tone (12 /16 kHz) and different line impedances (real or complex)

UDSL specifications

Modulation . . . . . DMT
Standard . . Implemented according to ITU-T G.992.2
and G.lite standard of UAWG
Min. Downstr. bitrate . . . . . 32 kbit/s
Min. Upstr. birate . . . . . 32 kbit/s
Downstream bitrate . . . . . up to 1,536 Mbit/s
Upstream bitrate . . . . . up to 512 kbit/s
Rate adaption . . . . . 32 kbit/s step
Max. Distance . . . . . about 5 Km

Other xDSL interfaces

SDSL

Transmission rate for SDSL:
Symmetric . . . . . .up to 2,3 Mbit/s
Max. Distance . . . . . about 3,5 Km

VDSL

Max. Data rate for VDSL:
Asymmetric . . . . . up to 26 Mbit/s (Downstream)
up to 3,2 Mbit/s (Upstream)
Symmetric . . . . . 2 – 12 Mbit/s
Max. Distance . . . . . 1,5 Km – 500 m

DSLAM

Features

Architecture . . . . . Universal slots
and board redundancy
SU_ADSL Board: . . . . . 16 ports for ADSL or UDSL
SU_SDSL Board: . . . . . 16 ports for SDSL
SU_VDSL Board: . . . . . 24 ports for VDSL
SU_nxE1 Board: . . . . . 8 E1 ports for cascadation

Network interfaces

Supported interfaces . . STM-1,OC-3c,E3,DS3,E1,DS1
Mapping . . . . . ATM
Physical interfaces: . . . . . .
STM1/OC-3c Optical . . . Single mode optical fiber,
short haul (0 - 25 km)
long haul (20 - 60 km)
multimode opt. possible
STM-1 Electrical . . . . . 155,52 Mbit/s
E3 Electrical . . . . . 34,386 Mbit/s
DS3 Electrical . . . . . .44,736 Mbit/s
E1 Electrical . . . . . .2.048 Mbit/s
DS1 Electrical . . . . . .1.544 Mbit/s

ATM User-network interface

Standard . . . . . UNI 3.1, UNI 4.0
QoS . . . . . CBR, UBR, VBR-nrt, VBR-rt
ATM functionalities . . . PVC (VP- & VC-crossconnect)
ATM OAM support

TMN interface

SNMP management interface . . . .via Ethernet 10BT

Power supply

Indoor Equipment
Primary voltage . . . . . –38 VDC to –75 VDC
DC/DC on board
Overvoltage protection. . . . . ITU-T K20

Outdoor Equipment

Primary voltage . . . . . 115 VAC or 230 VAC
50 Hz or 60 Hz

Mechanical Dimension

Integration . . . . . up to 224 links per DSLAM
Rack – Size (mm) . . . . . 2200x600x300 (HxWxD)
Rack according . . . . . to ETSI ETS 300 119-3
Subrack – Size (mm) . . . . . 721x450x276 (HxWxD)
Subracks according . . . . . to ETSI ETS 300 119-4
Board – Size (mm) . . . . . 415x235 (HxD)

Environmental Conditions

Indoor at C.O. . . . . ETSI ETS 300 019 class 3.1
Operation temperature . . . . . –5° ... +40° C
Humidity . . . . . 5% ... 95% R.H.
CE, EMC/ESD . . . . . EN 50081-1, EN 50082-2, ETS 300 386 and EN 55022 Class B
Product safety . . . . . DIN EN 60950
Indoor at Non-Telco Building . . . . . .ETSI ETS 300 019 class 3.2
Outdoor in roadside cabinets . . . . . ETSI ETS 300 019 class 4.1

Customer Premises Equipment

Interfaces

ATM . . . . . ATM 25.6 Mbp/s
Ethernet . . . . . Ethernet 10 BT / IEEE 802.2 IEEE 802.3, Ethernet V2
Serial Interface . . . . . USB Interface
NIC Type (Bus) . . . . . PCI Bus Interface
POTS/ISDN splitter . . . . . .external

Modems

XpressLink 1100 . . . . . ADSL, ATM, POTS
XpressLink 1101 . . . . . ADSL, ATM, ISDN
XpressLink 1010 . . . . . ADSL, Ethernet 10BT, POTS
XpressLink 1011 . . . . . ADSL, Ethernet 10BT, ISDN
XpressLink 1110 . ADSL, Ethernet 10BT + ATM, POTS
XpressLink 1111 . ADSL, Ethernet 10BT + ATM, ISDN
XpressLink 1090 . . . . . ADSL, Ethernet Router, POTS
XpressLink 1091 . . . . . ADSL, Ethernet Router, ISDN
XpressLink 1500 . . . . . ADSL NIC, POTS
XpressLink 3500 . . . . . UDSL NIC, POTS
XpressLink 1700 . . . . . ADSL USB, POTS
XpressLink 3700 . . . . . UDSL USB, POTS
XpressLink 9025 . . . . PC Network Card, ATM 25,6M

Services at ATM interface

PPP over ATM . . . . . RFC 2364
Multi-protocol encapsulation over ATM . . . . . RFC 1483
Classical IP over ATM . . . . . RFC 1577
Ethernet over ATM
LAN emulation (LANE) and others.

Services at Ethernet interface

Self-learning bridge
Static Routing
PPP over PPTP
PPP over Ethernet (PPPoE)

Service categories

ATM QoS . . . . . CBR, UBR, nrt-VBR, rt-VBR

Power supply

Local, external . . . . . 230V/50...60Hz, 110V/60Hz
Local, Integr. Power . . . . . 230V/50...60Hz, 110V/60Hz
Lightning protection . . . . . .EN 60950/ IEC 60950
Protection class II

Mechanical and Environmental

Climate Class . . . . . ETSI ETS 300 019-1-3 class 3.2
Operation temperature . . . . . –5° ...+50° C
CE, EMC/ESD . . . . . ETSI ETS 300 386-1, FTZ 1TR9 (11/96)
Product safety . . . . . DIN EN 60950 / IEC 60950

Management application

MainStreetXpress 45020/46020

Management via . . . . . Ethernet 10BT (IEEE 802.3) or inband ATM
Management protocol . . . . . SNMP
Hardware platform . . . . . Sun workstation
Software platform . . . . . SUN Solaris
Features . . . . . Client-server scaleable
. . . . . .Topology and Node Display
. . . . . Remote software download
. . . . . ATM Path Management
. . . . . OA&M Functions
. . . . . Full integration in Siemens end-to-end management system

Local Craft Terminal (LCT)

Management protocol . . . . . .SNMP
Interface . . . . . SNMP management interface via Ethernet 10BT (IEEE 802.3)
Hardware platform . . . . . Pentium PC or Laptop
Software platform . . . . . Windows NT (4.0, 5.0)

Further Information

XpressLink A50001-N8-P60-*-7600
MSXpress 45020 . . . . . NER:97-2388-A-*-7629
MSXpress 46020 . . . . . NER:97-2348-G-*-7629
InterXpress - SSS A50001-N8-P61-*-7600
InterXpress IAD 4700 . . . . A30808-X3641-A1-*-7629
MSXpress 36140 . . . . . NER:97-2637-A-*-7629
MSXpress 36170 . . . . . NER:97-2345-E-*-7629
MSXpress 36190 . . . . . NER:97-2346-D-*-7629

Abbreviations

ADSL	Asymmetric Digital Subscriber Line
AN	Access Network
ANSI	American National Standardization Institute
API	Application Programming Interface
ATM	Asynchronous Transfer Mode
ATTH	ATM to the Home
B-RAS	Broadband Remote Access Server
BB	Broadband
CAP	Carrierless Amplitude and Phase Modulation
CBR	Constant Bit Rate
DMT	Discrete Multitone
DSLAM	Digital Subscriber Line Access Multiplexer
EMC	Electromagnetic Compatibility
ETSI	European Telecommunications Standards Institute
FDM	Frequency Division Multiplex
FTTB/C	Fiber to the Building/Curb
IP	Internet Protocol
ISDN-BA	ISDN Basic Access
ISP	Internet Service Provider
ITU-T	Telecommunication Standardization Sector of International Telecommunication Union
L2F	Layer 2 Forwarding
L2TP	Layer 2 Tunneling Protocol
LAN	Local Area Network
LCT	Local Craft Terminal
LL	Leased Line
LTAD	Line Termination ADSL
LU	Line Unit
NB	Narrowband
NE	Network Element
NIC	Network Interface Card
NMS	Network Management System
NT	Network Termination
OF	Optical Fibre
OS	Operations System
PBX	Private Branch Exchange
PDH	Plesiochronous Digital Hierarchy
POP	Point of Presence
POTS	Plain Old Telephony Service
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Connection
QAM	Quadrature Amplitude Modulation SDH Synchronous Digital Hierarchy
SDSL	Symmetrical Digital Subscriber Line
SME	Small/Medium Enterprises
SNMP	Simple Network Management Protocol
SOHO	Small Office Home Office
SSS	Service Selection Server
STB	Set Top Box
STM	Synchronous Transfer Mode
SU_AD:16	Subscriber Unit ADSL, 16 Ports
SU_VD:24	Subscriber Unit VDSL, 24 Ports
SU_SD:32	Subscriber Unit SDSL, 32 Ports
SVC	Switched Virtual Connection
SW	Software
UADSL	Universal ADSL
UDSL	Universal Digital Subscriber Line
TI	Texas Instruments
TMN	Telecommunication Management Network
UAWG	UADSL Working Group
UBR	Unspecified Bit Rate
UDSL	Universal Digital Subscriber Line
UNI	User Network Interface
UPL	User Panel
VBR_rt	Variable Bitrate realtime
VBR_nrt	Variable Bitrate non-realtime
VDSL	Very-high bitrate Digital SubscriberLine
VoD	Video on Demand
WAN	Wide Area Network

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