



ITeX™ ADSL Development Tool (IADT)

White Paper

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Introduction

DSL (Digital Subscriber Line) and cable modem are the two technologies rapidly replacing traditional voice band modem. It is widely expected that DSL installations will surpass that of cable modems¹. Among the various DSL technologies available to the consumers, ADSL (Asymmetric Digital Subscriber Line) is considered the most likely successor to analog modem.

As the ADSL market grows at an amazing pace, there are many challenges for those who intend to provide ADSL products or services. The biggest issues facing rapid ADSL deployment is the current lack of development and diagnostic equipment. ADSL testing is a much more complicated process than the analog modem testing. Any ADSL test environment must simulate the connection between CO (Central Office) and CPE (Customer Premises Equipment). A cost effective development tool that emulates CO behavior, provides live line connection with CPE and at the same time, closely monitors the test objectives such as protocol, functionality and interoperability with user friendly GUI (Graphic User Interface) is what every ADSL developer is seeking. IADT (ITeX™ ADSL Development Tool) meets this requirement.

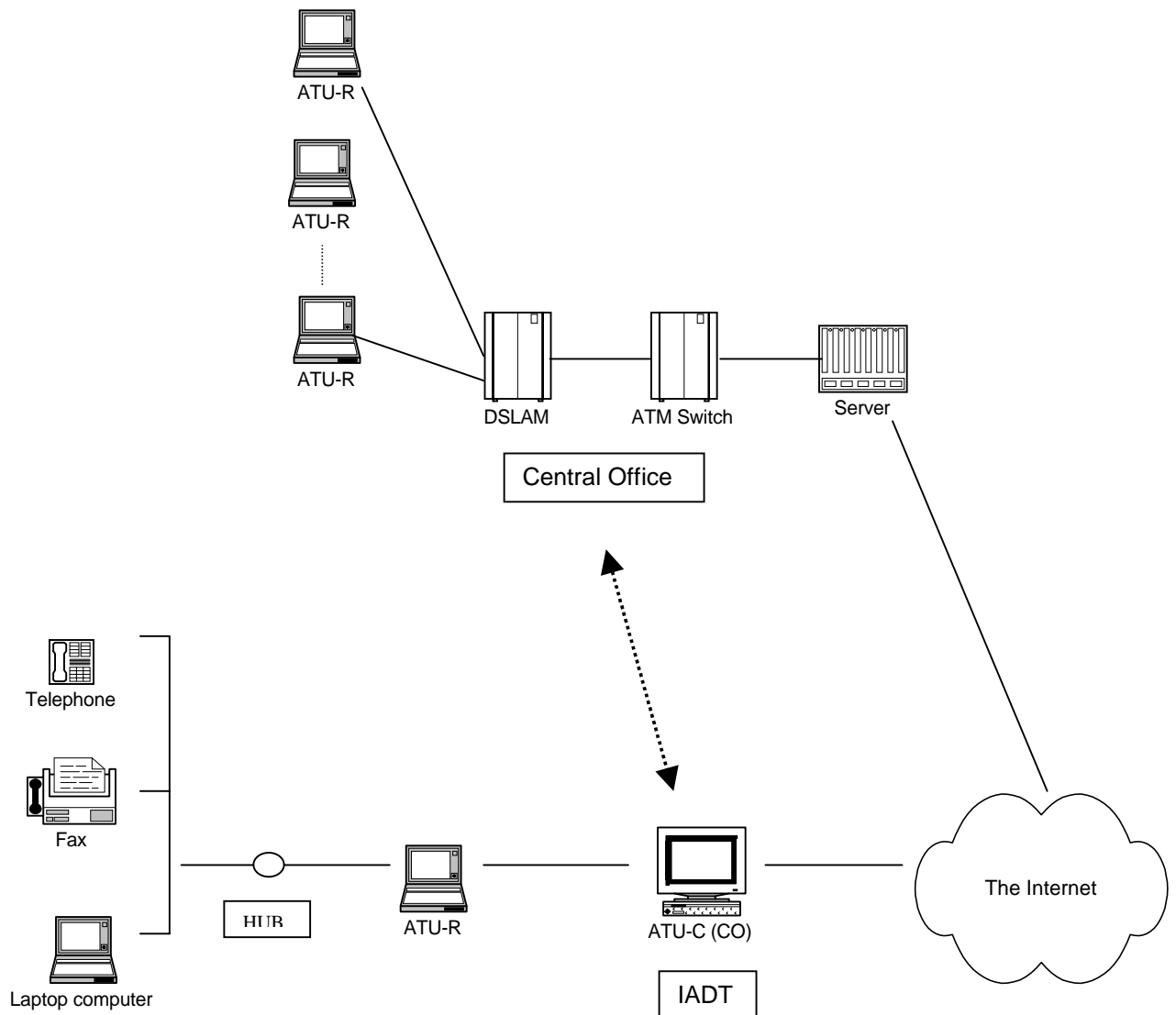
This white paper provides an in-depth discussion of IADT.

ITeX ADSL Development Tool - IADT

IADT emulates Central Office Behavior

ADSL testing requires the connection between the CO (Central Office) and CPE (Customer Premises Equipment). However, one major component of the central office, the DSLAM (Digital Subscriber Line Access Multiplexer), is extremely hard to obtain. Generally, DSLAM vendors are only willing to sell their product to ILEC (Incumbent Local Exchange Carrier), CLEC (Competitive Local Exchange Carrier) or their strategic partners. DSLAM products are expensive. IADT is a low cost solution that emulates the CO behavior. The following diagram illustrates which part in the network infrastructure the IADT is replacing.

¹ Digital Subscriber Line deployment rates could overtake those of cable modems by 2001, according to analysts.



IADT provides full protocols support

Unlike the V.90 modem technology that only utilizes the dial-in protocol, ADSL interoperability requires testing a growing field of ADSL protocol. The IADT is a diagnostic tool meant to address this diversity of ADSL and ATM protocol verification by supporting the following protocols²:

Full ADSL Protocols Support: ANSI T1.413 issue 2, ITU 992.1 G.dmt, ITU 992.2 G.lite including fast retrain, ITU 994.1 G.hs.

Full ATM Protocols Support: RFC 1483, RFC 1577, PPP over ATM, PPP over Ethernet.

² Refer to the corporate web site www.itexinc.com for a complete listing of IADT support.

IADT verifies functionality

Different from the traditional modem that uses QAM (quadrature - amplitude modulation) which encodes the data by only one single carrier. The DMT (Discrete Multi-Tone) modulation used by ADSL is a multi-carrier scheme which pumps up to eight megabits per second of video, data, image and voice signals over today's existing one pair copper wiring³. It utilizes the bandwidth of the copper line between the 4KHz voice band and the upper spectrum of 1.1 MHz. As a tool, IADT provides all the parameters for monitoring the line rate, SNR (Signal-to-Noise Ratio), and channel bit loading. It also provides sophisticated monitoring software so that the user can estimate overall performance including power spectral density as well as the detail parameters of each sub-channel.

IADT operates at the full-bandwidth ADSL spectrum and provides parameter monitors for upstream as well as full-bandwidth downstream. The SNR and bit loading show the individual sub-channel performance. The line rate and net rate (without overhead, which usually consumes 10 percent of the line rate) along with the loop attenuation indicates the overall performance. The detail functional tests results are described as below:

- Upstream line rate (Kbps)
- Upstream net rate (Kbps)
- Upstream average bit loading (bits)
- Upstream average SNR (dB)
- Upstream loop attenuation (dB)
- Downstream line rate (Kbps)
- Downstream net rate (Kbps)
- Downstream average bit loading (bits)
- Downstream average SNR (dB)
- Downstream loop attenuation (dB)
- Overall performance index for upstream compared with reference modem
- Overall performance index for downstream compared with reference modem
- Estimated SNR for the modem under test (dB)
- Target SNR for the reference modem (dB)

³ QAM modulates signal phase and amplitude to transfer a discrete binary pattern, it encodes a single channel with as much as 50K bits per second (bps) in the downstream direction (downstream is assumed CO transmitting to CPE). DMT modulation, on the other hand, divides the frequency range of 30 khz to 1.1 Mhz into 256 discrete subchannels, then modulates them independently.

The above parameters are obtained during the hand-shaking process providing a complete diagnosis of data pump function at the remote site. IADT provides another feature to test the ATU-R (ADSL Transceiver Unit – Remote) equipment. It monitors the spectrum of the signal transmitted by the ATU-R. This feature allows the user to easily diagnose the analog circuitry at the remote side. IADT can send a single or multiple tones to the remote site. With a spectrum analyzer connected to the remote site, the user can measure the analog circuitry performance in order to determine the “health” of the hybrid or filters, etc.

IADT Verifies Interoperability

Since ITeX ADSL chipset have proven interoperability with chipsets used by all of the major DSLAM vendors, the IADT can become the ITeX standard for interoperability testing. IADT customers can utilize the IADT to quickly verify if their ADSL modem interoperates with all of the major DSLAMs. The IADT provides functional diagnosis monitoring for different connections for T1413 issue 2, G.dmt and G.lite⁴.

Initialization Procedure:

T1413 issue 2 handshaking and G.hs. The handshaking log file provides detail sequence record for the handshaking process.

Basic Data Transmission:

IADT users can set the parameters for fixed data rate, with or without FEC (forward error correction), latency, framing mode, bearer channel, tone ordering, maximum number of bits per sub-channel. The user can also monitor the parameters such as data transmission performance measured by CRC, RS error, LOS (Loss of Signal), LOF (Loss of Frame), BER (Bit Error Rate) with the sophisticated monitoring software included with the IADT.

ADSL Overhead Control (AOC) Channel and Bit Swap:

Both the IADT and ATU-R may exchange bit allocations and adjust gain scales to equalize the bit error rate of each sub-channel. AOC log file records the detail sequence information.

Embedded Operations Channel (EOC):

The IADT is able to read information from the CPE side such as SNR margin and line attenuation. The IADT acts as the master initiating the process. EOC log file records the detail sequence information.

⁴ Due to current competitive environment, IADT is only open to interop with ITeX products (Apollo, SAM and external solution). We apologize for the inconvenience and will open the interoperability function in the near future.

ATM Cell Synchronization and Transmission Convergence (TC):

Provides the information such as HEC (Header Error Control) and cell delineation.

IADT is an educational and sales tool

In addition to its diagnostic capabilities, the IADT can be an excellent educational tool for R&D engineers, as well as a sales tool for the sales and marketing group to demonstrate end-to-end connection in trade shows or branch offices. A DSLAM plus ATM switch connection is too clumsy and expensive with very little accompanying test data retrieval. For IADT users, only a PC is required to simulate the CO and demonstrate the product in a live line environment with all the advanced graphic performance illustration of their ADSL product.

Conclusion

IADT is an aggressive product developed by ITeX. It is intended to solve the ADSL testing issue that has become a major obstacle for many ADSL CPE board vendors. It serves as a test equipment for a service provider to evaluate the line condition or monitor the customer premises equipment.

The IADT is a low cost, testing, learning, software-based central office emulation tool. It provides supports for live line testing, standard and protocol interoperability testing, diagnostics, hardware debug, and sales demonstration. The product demonstrates ITeX as leading ADSL solution provider.

Contact

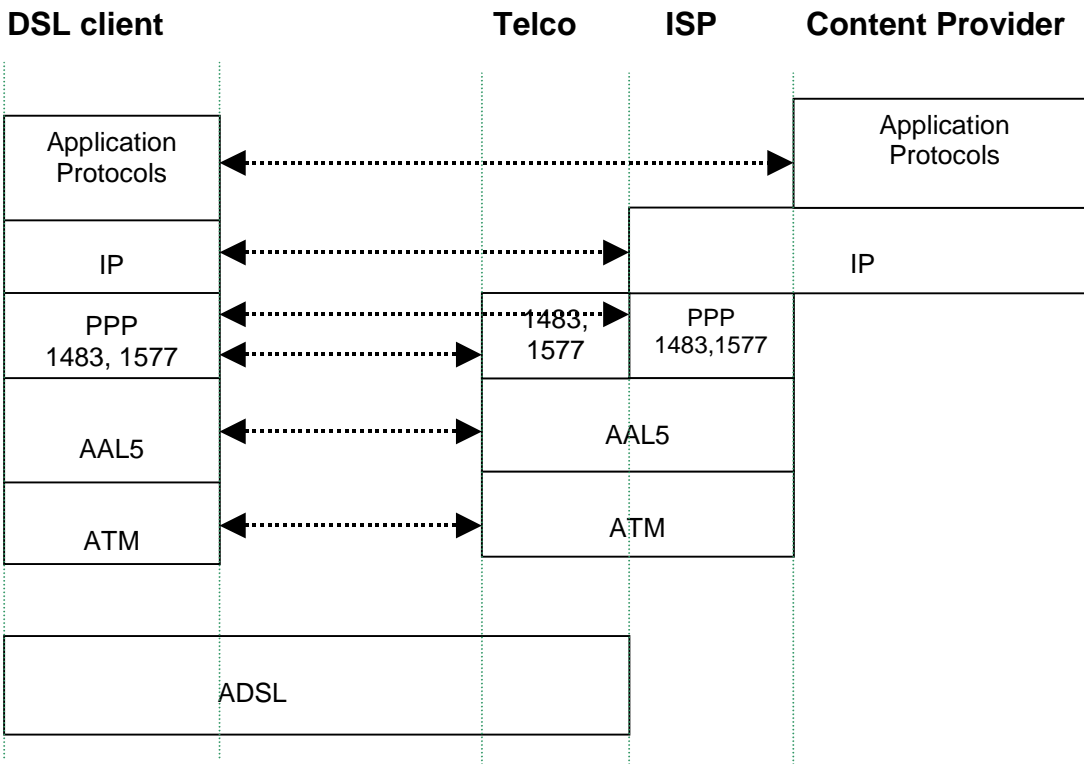
If you have any comments or suggestion of this white paper, please send your email to Charles.chang@itexinc.com

Appendix

ADSL Architecture

ITeX has been devoted to ADSL development for several years and our approach has been to provide the solution between the public network and the end users.

The following graph shows the ADSL architecture and related protocol layers.



In the network architecture, the IADT emulates a simplified Telco network and part of the ISP and content provider function. It is an excellent educational tool for customers who are not familiar with ADSL network behavior.

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