

Line Test Systems Controller

Multi-user Test Systems Suite

Microprocessor-based Telecommunications Line Testing Platform

Tollgrade's Line Test Systems Controller (LTSC™) is a hardware/software package with multi-tasking capabilities that can either stand alone or become an integrated software module to an existing Operations Support System (OSS) in order to provide a line testing platform. The system, designed with an open architecture, provides client/server access to the N(x)Test™ system deployed within the network for subscriber loop testing. In addition, the LTSC system can interface with a telephone company's existing fault administration system to perform automated line testing and control functions that are presently performed manually.

Key Features

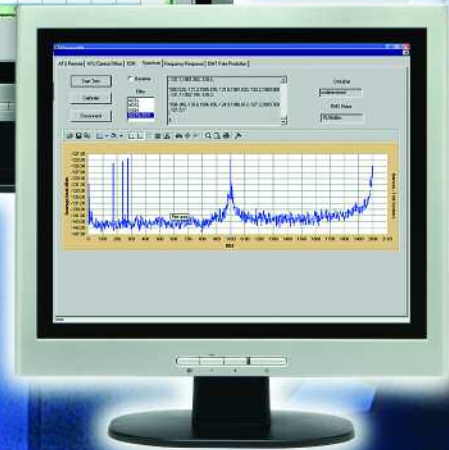
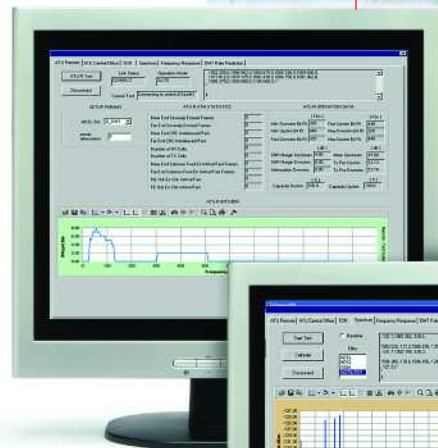
Features of Tollgrade's LTSC include:

- Interoperability across platforms and vendors;
- Standards in upstream and downstream communications protocols;
- Well-defined interface points;
- Ease in vendor-to-vendor connectivity;
- Standards in analysis (Telcordia® GR844); and
- Standards in hardware/software conventions.

**Tollgrade
is everywhere
your broadband
network needs
to be.™**

tollgrade
Network Assurance
Simplified.™

*Providing client/
server access
for subscriber
loop testing in
stand-alone or inte-
grated systems*



LTSC Interfaces and Functionality

Basic Configuration

The basic MITS® LTSC configuration consists of hardware platform-sized accordingly to support multiple test sessions over a X.25 or Ethernet LAN utilizing TCP/IP. The system has three methods of interfacing with the user:

Computer-to-Computer Interface

The LTSC system can operate in a Computer-to-Computer mode where the user, through an existing trouble ticketing system, can issue commands directly to the test head.

In this configuration, a user workstation connected to the existing database trouble ticketing system is permitted access to the fault module of the trouble ticketing system, allowing them to create a trouble ticket on a subscriber's line when a complaint is received. Once the complaint is entered, the trouble ticketing system transmits a defined set of information and the type of test to be performed to the LTSC through the Computer-to-Computer Interface. The LTSC, upon receipt of the test request, establishes a line test session with any relative Tollgrade test head.

Once communication is established, the LTSC transmits to the test head the number to be accessed and the tests to be performed. The test head accesses, requests tests and transmits the raw results back to the LTSC. When the test data of the subscriber's line is received back from the test head, the LTSC analyzes the raw data in accordance with Telcordia GR844, formats the results and forwards the information to the trouble ticketing system via the Computer-to-Computer Interface. As a minimum, the data sent through the interface consists of a dispatch VER code and Summary Message, both of which are translated by the trouble ticketing system.

The trouble ticketing system, upon receiving the information from the LTSC system, consolidates the analyzed data as part of the trouble ticket screen. The process is completed when the combined trouble ticket and test data is transferred to a dispatch or Workforce Management System to begin the repair process.

Audio Response Test System Interface

The LTSC system also supports an interface to the Audio Response Test System [N(x)ARTS™]. This enables the N(x)ARTS to take advantage of all test access set-up and test analysis files present in the LTSC system. The physical interface should be through the common interface point (normally a TCP/IP LAN).

External Interface

Off-site access is provided through a Wireless Application Protocol (WAP)-based client or web-based interface, allowing customer help desk and field technicians to utilize the troubleshooting features of the LTSC from a remote location, a wireless phone, laptop computer or the Internet.

Line Testing

The LTSC system can provide user-definable, subscriber-line test sequences for both demand, interactive and Automated Line Testing (ALT) requests. All test results produced either through the Computer-to-Computer Interface, the Advanced Tester Interface or N(x)ARTS are stored on the system in the RDBMS' relational database (for a user-definable period of time) for report generation.

Basic Administration

Through the LTSC Administration Console and available via standard utility software, the LTSC system will allow the user to perform system backups, add or remove a test head or ports from service, administer password security and perform database functions. Configuration tables with parameters associated with capacitance, resistance and threshold limits are also configurable through this standard maintenance package.

Management Reports

The LTSC can store and produce management reports via a Graphical User Interface (GUI) reporting package.

A basic set of management reports is provided with the system. Custom reports can also be generated through the use of off-the-shelf report-writing packages.

The LTSC system can also provide productivity reports relative to the number of tests performed in a given time frame by:

- a given operator;
- a given test head;
- a given exchange;
- all operators; and
- all exchanges.

LTSC Software Modules

The LTSC Software is delivered in three parts:

- a base set of modules, which make up the system;
- a set of client interface modules; and
- a customer-specific set of modules, which provide the customization required for a particular customer.

The LTSC system requires modules from the custom set, such as the database interface process, to operate properly.

POTS and Pre-qualification Testing

LTSC, when used in conjunction with the N(x)Test Remote Test Unit (RTU), offers service providers a full range of network element diagnostics, including DSL pre-qualification.

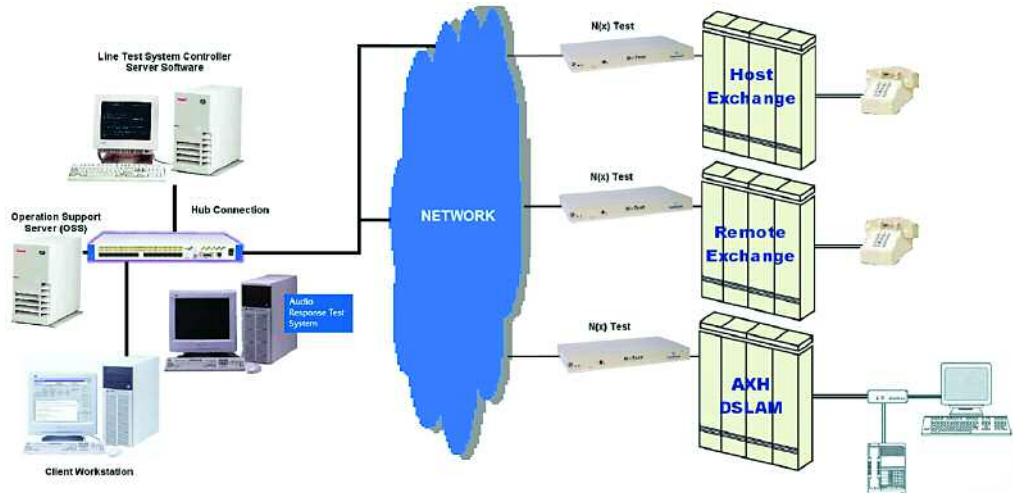
Tests can be conducted at timed intervals, without user action, or executed on-demand. Simply entering the customer's telephone number and selecting the type of test desired can initiate single-line testing. Routine ALT testing can recognize faults over large numbers of subscriber loops before they can impact customer satisfaction.

The LTSC feature set also permits the user to pre-qualify pairs to determine their suitability for DSL transport by detecting and locating load coils, predicting data rate, determining loop length and identifying wideband disturbers.

Advanced User Interface

The LTSC system can operate in a Terminal Server mode. Users can gain access to the LTSC System Controller by logging on to the controller and issuing commands directly to the test head through the common interface point without the need of a trouble ticketing system.

POTS and Pre-qualification Testing using N(x)Test



Single-line Testing

The LTSC system's Single Line Test GUI Application allows the user to test individual lines on a demand basis. The GUI is simple, with the only interaction being the customer's phone number and the type of test needed.

The system automatically finds the subscriber's network element, initiates the test commands and returns analyzed results to the user in an easy-to-read format.

Automated Line Testing

Using the ALT software module, the LTSC system can be programmed to test a series of lines on a routine basis at pre-set times and intervals, allowing the service provider to proactively analyze the network for loop faults before receiving customer com-

plaints. The ALT application also serves as a very powerful tool for loop qualification as it identifies and reports loop characteristics critical to broadband transport. An additional report provides predictive data rate analysis displaying the DSL rate that a line is capable of supporting.

Test Reports

Test data recorded from the RTUs is compiled into an RMDBS database. Using the LTSC Reporting Client Tool, an overall test history can be produced by selecting a time period, a range of exchanges and switches, or the type of tests conducted.

A more detailed history can be generated using other criteria, such as the

primary and secondary cables, line pairs, line equipment numbers or a range of test IDs. In addition, reports can be dynamically generated using user-specified fields, allowing users to create their own report types.

The LTSC Reporting Client also benefits DSL service providers by calculating stored DMT test data and predicting data rates over chosen line pairs.

LTSC Reporting Client

Telephone Number	VPI Code	Description	Qualification Code	Primary Code	Primary Pair	Secondary Code	Secondary Length
952400001	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400008	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400016	0	DSL-DMT	Qualified for ADSL	0110	2001	0110	1300
952400024	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400032	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400040	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400048	0	DSL-DMT	Qualified for ADSL	0110	2001	0110	1300
952400056	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400064	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400072	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400080	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400088	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400096	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400104	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400112	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400120	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400128	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400136	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400144	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400152	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400160	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400168	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400176	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400184	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400192	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0
952400200	0	DSL-DMT	Qualified for ADSL	0110	2001	0100	0

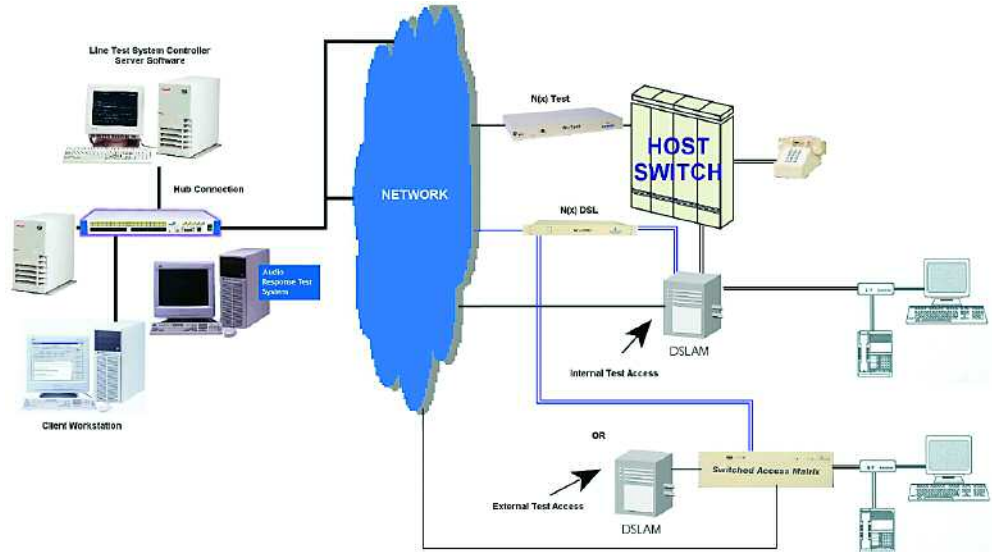
N(x)Test™ and N(x)DSL™

While the LTSC system can work with legacy RTU and test heads, such as the T-9/X and the T-9/SX, the functionality of the LTSC system is greatly expanded with the latest RTUs—N(x)Test and N(x)DSL.

The combination of the LTSC system, N(x)Test and N(x)DSL RTUs delivers powerful diagnostics for any service provider's next-generation broadband network. Controlled by the LTSC through the TL1 protocol, the N(x)Test can perform broadband assurance through on-demand or interactive tests, as well as OSS-controlled ALT batch processing on multiple subscriber loops. And, while the N(x)Test can perform loop pre-qualification for DSL services, the N(x)DSL Broadband RTU increases the feature set of the LTSC by emulating hardware on the last loop between the central office (with the ATU-C modem) and end user (with the ATU-R module).

Designed to measure frequency response and perform Time Domain Reflectometry (TDR), the N(x)DSL also utilizes noise measurements, DMT assessments for full-rate ADSL and G.Lite service verifi-

Next-generation Broadband Testing using N(x)Test and N(x)DSL



cation, Longitudinal Balance testing, and Power Spectral Density tests to further aid in the installation, maintenance and troubleshooting of copper cable.

Support all the Way from the End User to the IP Layer

With the N(x)DSL's ATU modems, the service provider can effectively support the user from the customer's modem to the provider's DSLAM, then to the ATM servers and all the way to the network. This greatly improves the resolution of customer issues with DSL connection, authentication and routing.

The ATU-R contains a host of common network commands, such as Ping and Traceroute, that can be used from the N(x)DSL. These commands, and

the location flexibility of the N(x)DSL, can provide an accurate view of connection issues from the customer's perspective.

Identifying Trouble where it Starts, before it Starts

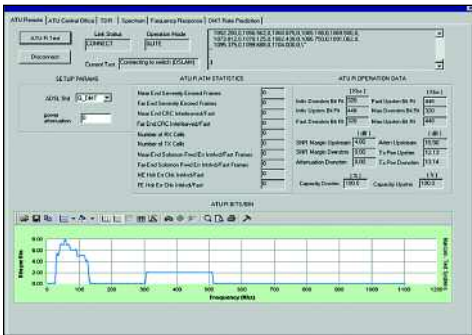
It is important to the service provider to identify and correct issues with the installation and support of high-revenue DSL services before it impacts customer satisfaction. A myriad of difficulties can occur with the installation and use of DSL service, from high impedance due to a load coil on a subscriber loop, to a sudden drop in bandwidth from crosstalk jamming the download frequency bands, or low signal-to-noise ratio from cable damage. With LTSC in control and

N(x)Test and N(x)DSL on the loop, the service provider can quickly and accurately determine the nature of the issue and isolate where the problem has occurred, thereby limiting downtime while increasing customer satisfaction.

Additional LTSC Functionality

Advanced Digital Testing

The position of the N(x)DSL RTU in the subscriber loop—just after the DSLAM and before the end user's modem—and the ability to emulate the Central Office and the Customer Premises Equipment provides the unique capability of testing ATM and IP Layer issues from inside the DSL loop.



Advanced Digital Testing

In addition to identifying faults in the local loop, N(x)DSL can troubleshoot non-account authentication issues through a multitude of protocols, DNS resolution errors, routing problems and speed issues, effectively allowing the support technician to see what the customer sees.

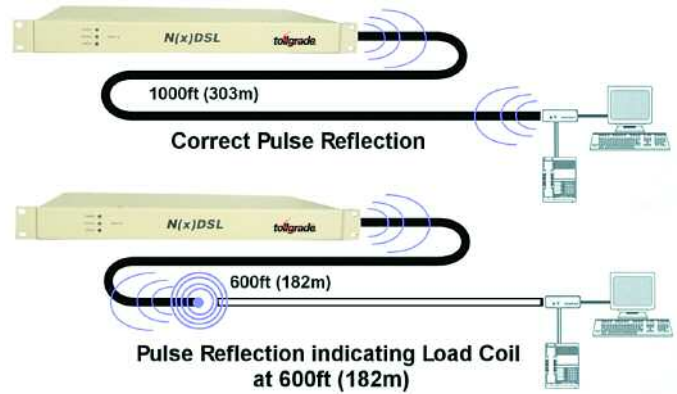
Time Domain Reflectometry

Another feature of N(x)DSL is Time Domain Reflectometry (TDR), a fault-finding technology that operates in the same fashion as SONAR. In a TDR test, the N(x)DSL transmits a pulse of voltage through the cable. When the pulse reaches the end of an open circuit or encounters problem

areas like heavy impedance, part or all of the pulse is reflected back to the TDR equipment. The TDR equipment meas-

ures the time it takes for the pulse to travel down the cable and reflect back from any impairment. Calculations are then made using the total pulse travel time and the cable's Velocity of Propagation (VOP)—based on the cable's size and material—to accurately determine the distance of the fault from the TDR equipment. The TDR equipment also recognizes any change in impedance caused by improper installation, cable damage, end of cable, load coils and bridged taps.

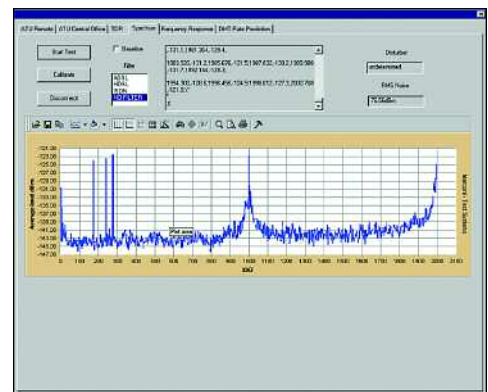
Time Domain Reflectometry



Spectrum Analysis

Outside interference from radio transmissions, bleed-over from nearby cables, or crosstalk caused by incorrect filter installation or line damage can produce disruptions into the ADSL frequencies assigned to upstream and downstream traffic, as well as POTS bands. High-intensity spikes can overwhelm the bins in the upstream and downstream bands, causing slowed speeds, incomplete downloads and connec-

tion errors that greatly impact customer satisfaction. The N(x)DSL RTU can perform Spectrum Analysis to detect noise in the POTS and ADSL bands and pinpoint the frequencies where spikes occur, providing the support technicians with the necessary details to rectify the issue.



Spectrum Analysis

LTSC System Specifications

Hardware

RISC System/6000®, DEC UNIX® server, SUN®, Intel® P3/P4

Networking

TCP/IP on Ethernet, X.25

Software

C, C++, Visual C++®

Operating Systems

LINUX®, IBM® –AIX, DEC UNIX, SUN Solaris™

User Interface

Windows®, GUI, Web-based, WAP-based

Database Systems

Oracle® Database Standard Edition 10g, minimum one CPU license*

*Oracle licenses are not included. Customer must acquire licensing separately from Oracle or an authorized Oracle reseller.

Ordering Information

Please contact your Tollgrade representative for ordering information.



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