



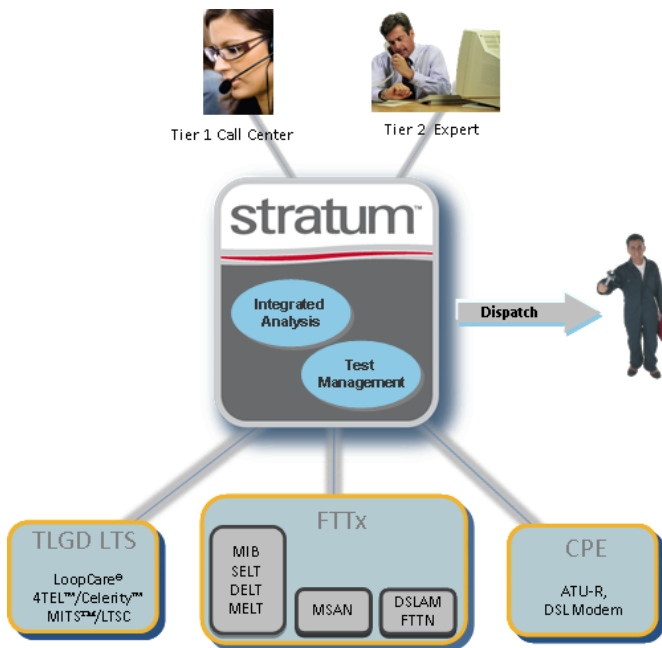
DSL Service Assurance

Line Test and DSLAM MIB

stratumTM *by tollgrade*



Introduction



Tollgrade's **Stratum** platform is a flexible solution for end-to-end broadband DSL service diagnostics that enables significant cost reductions and increased customer satisfaction for service providers in their customer care, field repair, and installation operations.

Stratum DSA (DSL Service Assurance) uses a combination of best-in-class copper loop measurements from existing Tollgrade systems along with DSL service performance data available via the DSLAM MIB (Management Information Base), as input data to its Expert System analysis layer to provide fault identification and dispatch segmentation of the end-to-end DSL service.

With Stratum DSA dispatch analysis, call center agents and field personnel can quickly determine whether a problem exists in the access network, where it is located, and what specific next steps are required to successfully restore the customer's service.

Category	DSL Copper Loop	DSL Link and Network
Test Functions	<ul style="list-style-type: none"> ▪ Confirm copper is Test OK: ▪ Identify DSL service-affecting faults <ul style="list-style-type: none"> - <i>imbalances: capacitance, series-resistance</i> - <i>unstable resistive faults</i> ▪ Identify presence of CO splitters ▪ Identify faults likely to cause noise or make line susceptible to noise 	<ul style="list-style-type: none"> ▪ Confirm DSL Link is Test OK: ▪ Identify DSL equipment faults – xTU-C or xTU-R ▪ Identify DSLAM to ISP/ATM link failures ▪ Confirm customer's DSL service profile ▪ Identify noise disturbers on line (via DELT) ▪ Confirm performance history
Analysis	<ul style="list-style-type: none"> ▪ Identify fault condition ▪ Identify Test OK or dispatch segment (Loop, DSLAM, MDF, Premises) ▪ Plain language result for Tier 1 user dispatch ▪ Detailed parametric results for Tier 2 diagnostics 	

Stratum's approach utilizes the concept of "line test plus DSLAM MIB" for testing mass-market consumer DSL services and does not rely on a costly test access matrix:

Stratum DSL Service Assurance Test Functions

Stratum's DSL service assurance solution offers analysis of DSLAM MIB data that can be used independently or combined with physical line test results for improved dispatch segmentation. Line test results are provided via existing Tollgrade 4TEL or LoopCare systems and embedded MELT tests from the network element. Optional SELT and DELT capabilities can be added to this suite of tests to support specific needs.

Embedded DSL test capabilities include DSLAM MIB data, single/dual ended line testing (SELT/DELT), and metallic line testing (MELT), which are all standards-based capabilities supported on most DSLAMs today.

The following summarizes the main functional components of the Stratum DSA solution:

Copper Line Testing

Stratum integrates existing Tollgrade Line Test Systems, which provide physical testing of copper pairs for pre-qualification, provisioning, and in-service fault isolation. On splintered DSL lines, access is achieved via the voice switch test bus without the need for a Test Access Matrix (TAM). In addition, metallic loop testing via TAM and integrated DSLAM access is also supported where this is deployed under LoopCare or 4TEL.

Stratum accesses embedded metallic line tests (MELT) available on latest generation chipsets within MSANs and DSLAMs. Stratum supports both the ITU G.11 MELT standard, plus an enhanced Tollgrade tests suite compatible with current 4TEL and LoopCare measurements, and available on Zarlink next gen chipsets.

MIB Data Retrieval and Analysis

Stratum collects DSL performance data available from the DSLAM MIB via the EMS or internal telco platforms and applies DSL-specific analysis to identify service-impacting conditions and recommended actions. MIB data retrieval is non-intrusive to the DSL service and is done in typically <10 seconds to support fast test times for Tier 1 operators.

Combinational Expert System Analysis

Stratum uses this MIB data for call center and field technician applications by integrating with other test data such as loop tests, and applying expert system analysis for dispatch. By integrating the analysis of test capabilities across the physical and service layers, Stratum provides an economical single platform for DSL Service Assurance and provides a unified interface to users.

Stratum DSL MIB data retrieval

MIB-retrieval provides a fast synopsis (in about 1-2 seconds via SNMP and 8-10 seconds via TL1) of the operating condition of the DSL service, which are impacted by factors such as the operating condition of the DSL service packs, customer or DSLAM equipment, loop conditions, etc. With MIB-retrieval, this DSL operating data is retrieved and analyzed through a Simple Network Management Protocol (SNMP) or Transaction Language 1 (TL1) interface to the Element Management System. The test results are returned to the user (via the GUI or the API) and a DSL-specific result output format is used to report error conditions and dispatch recommendations.

DSL test:

- POTS test (4TEL or SLIC)
- DSLAM MIB data
- analysis
- VER code
- Action
- Dispatch
- Measured / MIB data

Stratum currently supports MIB retrieval and analysis of digital service parameters for ADSL and ADSL2+ services, with VDSL2 on the Tollgrade roadmap. The currently supported DSLAM interfaces include:

- Alcatel-Lucent Stinger, ASAM 7300 and 7301, ISAM 7330 and 7302
- Huawei MA5600, UA5000
- Adtran TA 5000, 1100, 1200 series

The Stratum platform is designed for multi-vendor support, with additional equipment interfaces continually being developed and added to Tollgrade's library over time. Typical lead time for new interfaces is 8 to 12 weeks.

Stratum Fault Analysis using MIB + line test integration

Using the combinational data inputs of physical line test measurements and DSL performance data, fed in to a rules-based expert system, Stratum is able to identify the following broadband service affecting fault conditions:

DSL Service Condition	Line test capability
CO wiring error	<ul style="list-style-type: none">• Identifies the presence or absence of the CO splitter• Identifies the presence or absence of cable beyond the splitter• Using length, footprint, splitter detection, open detection, fault detection and dial tone detection, the expert system can detect most CO mis-wiring cases
ATU C/R faults	<ul style="list-style-type: none">▪ Modem data from the MIB, including data rate, noise margin, line attenuation and ATU C/R sync status identifies the state and performance of the modems and DSL link
Noise	<ul style="list-style-type: none">• Balance measurement indicates line susceptibility to noise• Modem noise measurements help identify noise issues due to interference from neighboring pairs, etc. (FEXT using DELT)• When compared to measured loss, MIB bit loading map (DELT) identifies crosstalk and impulse noise (RFI)
Line Faults	<ul style="list-style-type: none">• Measurements of length, loss, DC resistance, capacitance and voltage identify physical line faults. Longitudinal line balance measurements identify imbalanced lines.
Incompatible equipment	<ul style="list-style-type: none">▪ Load coils, pair gain equipment and incompatible terminations are detected and reported and the absence or presence of phones.
Tested OK	<ul style="list-style-type: none">▪ Line and modems 'OK' can be reported to customer and service provider

Benefits of Stratum DSA

One-touch Customer Care: The Tollgrade platform delivers a plain language dispatch recommendation to reduce maintenance costs while increasing customer satisfaction. Putting more effective capabilities into hands of non-technically skilled customer service representatives reduces unnecessary dispatches and escalations to Tier 2 (Back Office diagnostics).

Stratum overlay: The solution leverages the investment in the existing line test platform, 4TEL, LoopCare or LTSC, for broadband DSL service assurance, DSL pre-qualification and provisioning testing.

Minimize CAPEX

- MIB data can be acquired from existing EMS (or directly from the DSLAM equipment)
- No Test Access Matrix required
- Test head can be shared for Voice and DSL testing
- Existing OSS interfaces can be expanded

Maximize Operational Efficiencies

- Call Handling times remain low
- Line Tests can be performed non-intrusively to DSL
- Dispatch accuracy remains high
- Escalations to Tier 2 remain low

Key Features	Description
User presentation	<ul style="list-style-type: none"> Web browser GUI in local language or web services northbound OS interface
Dispatch statement	<ul style="list-style-type: none"> Fault summary and severity for loop faults extended to include DSL equipment and network connection
Fault/VER codes	<ul style="list-style-type: none"> ATU-C/R modem, DSLAM failure, DSLAM network-side interface, ATM VC, noise interference, service profile error
Line termination detection	<ul style="list-style-type: none"> Includes CO splitters, xDSL modem, phones (standard and electronic ringer)
Other line conditions	<ul style="list-style-type: none"> Length, Line Imbalance, Noise, downstream/upstream speed
Parametric data	<ul style="list-style-type: none"> AC/DC measurements, SNR, power, modem status, network transport status, channel status
MIB Access	<ul style="list-style-type: none"> Via Stratum platform or customers' EMS interface using TL1 or SNMP typically - acquires data, applies DSL fault analysis and then forwards for combinational expert system analysis of service affecting faults.

Stratum Features

The following table summarizes the key components and features of Stratum DSA:

Stratum Specification for DSL MIB Parameters and Analysis Output

The ADSL status data retrieved via the MIB retrieval test request is presented in a common output format, which typically includes the following parameters:

Current Operating Status	Data Rate Parameters
<ul style="list-style-type: none"> Service Type Current ATU-C and ATU-R Status Line Coding Line Status ATM Status Admin Port Status 	<ul style="list-style-type: none"> Up/Downstream Rate Adaptation Mode Up/Downstream Configured Data Rate Up/Downstream Operating Data Rate Up/Downstream Max Attainable Data Rate Up/Downstream Line Utilization
Noise Margin Parameters	Signaling / Transmission Parameters
<ul style="list-style-type: none"> Up/Downstream Minimum Noise Margin Up/Downstream Maximum Noise Margin Up/Downstream Target Noise Margin Up/Downstream Observed Noise Margin 	<ul style="list-style-type: none"> Up/Downstream Signal Attenuation Up/Downstream Signal Power Up/Downstream Interleave Delay Up/Downstream Maximum Interleave Delay Up/Downstream CRC Block Size
Current 15 Minute and 1 Day Interval Line Performance History Data	
<ul style="list-style-type: none"> Time Elapsed Errored Seconds Loss of Frame Events Loss of Link Events 	<ul style="list-style-type: none"> Loss of Signal Events Loss of Power Events Line Initializations

Note: The Stratum common output format includes parameters that are not returned by all models of DSLAM.

The analysis output of the DSL MIB-retrieval testing includes over 30 VER codes with associated Summary Messages, Category, and recommended Dispatch Statements as shown in the following examples:

VER Code	Summary Message	Dispatch Statement	Category
0	TEST OK	No action	Pass
EP	LOOP TERM EQUIPMENT SLOT EMPTY	Dispatch In / Check DSLAM Line Card	Fail
NT	UNSUPPORTED LTE CARD TYPE	No action / Test not supported for this DSL type	Fail
WN	DSLAM PORT NOT ENABLED	Enable DSLAM port / Retest / If repeat, dispatch in	Fail
WV	ATM VC OUT OF SERVICE	Dispatch In / Check status of ATM virtual channel	Fail
WU	xTU-C MODEM IN UNKNOWN STATE	Wait & retest / If reoccurs repeatedly, dispatch to DSLAM site	Inconclusive

Tollgrade Communications, Inc.
 493 Nixon Road
 Cheswick, PA 15024 USA
 + 412 820 1400 | 800 878 3399
www.tollgrade.com

©2009 Tollgrade Communications, Inc. All rights reserved. Specifications are subject to change without notice. All marks are trademarks or service marks of Tollgrade Communications, Inc. STRAT-08262009