Automated Copper Loop Testing

Automated Copper Loop Testing for Broadband and Voice Services Support

Advances in voice and data transmission technologies have significantly changed the telecommunications industry. However, efficiently maintaining the copper plant is still one of the primary business concerns for telecom service providers. The deployment of new services such as IPTV and VoIP, and transmission technologies such as DSL, place even more stringent transmission requirements on the network's copper segment.

The cost associated with maintaining the copper plant is among the largest service providers face. The aging plant, and the need to carry ever more complex services over the existing copper, requires significant field-related efforts. Simultaneously, competitive pressures continue to drive down the per-line revenue for voice and data services, increasing the importance of reduced maintenance costs. Voice and data services maintenance must also address increasing competitive and regulatory pressures to reduce repair times and increase quality of service (QoS).

Services Testing Solutions

While copper loop testing has improved considerably, many service providers still rely on built-in switch testing and field-based testing using hand-held instruments. These methods are generally effective, but they are inherently time consuming, require extensive expertise and often fail to identify the root cause of problems.

New service offerings like IPTV and increasing data rates require testing solutions that are effective for current services and capable of supporting new ones. A centralized, automated test system such as Tollgrade's 4TEL and LDU 50 address these issues while reducing cost and repair time and increasing QoS.

4TEL/Celerity Benefits

Testing:

- Service assurance traditional PSTN/broadband
- Broadband qualification for service speeds (1.5 Mbps/4 Mbps) or service types
- Broadband provisioning
- Identify DSL-specific signatures

Operational:

- Shorter call handling times
- Fewer repeat calls
- Increased dispatch/repair efficiency
- Accurate broadband qualification
- Real time service provisioning verification

Users:

- Natural language dispatch statements
- Detailed measurement results
- Service qualification summaries
- OSS integration

One Touch

When responding to a consumer trouble report, the service provider's primary goal is to resolve the problem in "one touch". Any subsequent need for the consumer to contact the service provider, or to be passed along to another individual or department, only creates dissatisfaction, delay, and additional cost.

Traditional trouble-handling procedures often require multiple touches by the consumer before their problem is resolved. With Tollgrade's 4TEL, a test can be initiated at the consumer's first point of contact, giving the Tier 1 representative the information to quickly verify any problems. The consumer can then be given a definitive statement for resolution with just "one touch".

One Test Head

The 4TEL system includes a compact measurement head—the LDU 50—which is installed in any host or remote exchange. This test head, deployed throughout the network, has the capability to support on-demand, reactive testing as well as pro-active routining for early trouble identification or bulk qualification.

The LDU 50 accesses each copper loop via the test access facilities of the switch or through a Test Access Matrix (TAM). Each LDU 50 is capable of performing the necessary measurements to support broadband deployment and service assurance as well as traditional voice service assurance.

Scalable Solution

In addition to the LDU 50, the 4TEL system includes the Test System Controller (TSC). The TSC is an industry standard platform that provides interfaces for the service provider's support personnel and Operations Support Systems (OSS). Each TSC supports testing and results analysis and archival for up to one million assigned lines. For larger networks, multiple TSCs seamlessly network together for total test coverage.

Testing throughput can be optimized by utilizing multiple LDUs within the same exchange. This allows multiple, simultaneous demand tests to be performed, reducing or eliminating test blockage in larger exchanges and decreasing the time required to routine the entire exchange for broadband qualification or pro-active trouble identification.

4TEL RT	4TEL XT	4TEL II	Celerity XS	Celerity SP	Celerity SQ
Routining Capabilities	Extended Tier 2 Testing	Rule-based Expert System Dispatch	DSL Signature Detection	Service Performance Testing	Bulk Prequalification
4TEL DT					
Metallic Faults | Cable Balance | Basic Equipment Signatures | Electronic Detection | Enhanced ROH Detection					

4TEL Tests

DT – Demand Test

4TEL DT is a comprehensive suite of tests that characterize the line from the exchange to the premises terminations. Measurements are made between each leg of the pair, from each leg to ground and from each leg to office battery. Specific measurements include:

- Parametric Measurements
  - AC and DC Volts
  - Resistance (metallic faults)
  - Capacitance
- Admittance, including Conductance and Susceptance
- Cable Length
- Cable Balance
- Line Terminations
  - Electro-mechanical Ringers
  - Electronic Ringers
  - Other Premises Equipment
  - Receiver Off Hook
- Basic Equipment Signatures

Results are presented in a natural language dispatch statement that provides an easily understood, high-level test summary. The dispatch is available quickly, allowing call center personnel to verify customer-reported problems immediately, and includes the information necessary to schedule repair activities. If unusual conditions are present, detailed measurement data is available for use by a technical expert to further analyze the problem.

RT – Routine Test Option

4TEL RT pro-actively tests each line in the network on a regular basis. Known as routining, this allows service providers to schedule automated testing for the lines in an exchange. By adding routining capabilities to the 4TEL DT measurement and analysis platform, all lines or a subset of lines in each exchange can be scheduled for testing. Routines can be configured to start and stop at times to avoid other testing activities, so that results will be available for analysis when needed.

By regularly testing all lines in the network, service providers can pro-actively identify faults and degrading lines. Routing results can be used to identify multiple faults in common network equipment. Regular, timely identification of copper loop problems can reduce costs by increasing repair efficiency, and early identification of problems can increase customer satisfaction. Test results are archived on the TSC and are used to create advisory reports, which identify lines requiring attention.

XT – eXtended Test Option

4TEL XT extends the capabilities of the basic demand test by giving the user an additional level of troubleshooting tools. The Tier 2 or field technician can now perform diagnostic testing that identifies service impairments that normally can't be addressed by a single demand test. These types of impairments often occur with degrading or intermittent line conditions or can be a result of consumer equipment problems. 4TEL XT adds the following capabilities to those available with the demand test:

- Repeat Testing
- Pair ID Tone Generation
- Continuous Testing
- Inward Dial Testing
- Station (Equipment) Testing
- Ring/Talk Monitor

The 4TEL XT option also includes batch testing capability. Batch testing allows a specific set of lines to be scheduled for demand tests. Batch testing is often used to verify copper loop integrity after significant network changes have occurred; for example, when a cable cut has been repaired or a new carrier system deployed.

4TEL II Option

4TEL II performs advanced expert system analysis on demand test results to increase dispatch effectiveness. Multiple sources of information are evaluated to help guide the right repair craft to the right locations, including:

- Repair information (close-outs) from millions of historical tests
- Customer Trouble Report (CTR) symptoms
- Known good "foot print" reference for line under test

4TEL and Celerity Testing

Celerity — DSL Qualification, Provisioning, and Testing

Celerity XS – eXtended Signature Option

Celerity XS identifies the line's DSL-specific characteristics, such as the physical equipment attached to the line and the line's transmission characteristics. These 'signatures' provide basic indicators of the line's DSL-readiness. Exchange splitter detection aids in the provisioning of broadband service by verifying the correct installation of the device. Load coil identification allows pro-active scheduling of grooming activities as well as verification of non-loaded status as service provisioning activities are completed. Celerity XS also looks for broadband service impacting transmission characteristics by analyzing the measured cable construction for the effects the loop make up will have on higher speed services.

Celerity SP – Service Performance Option

The Celerity SP test provides a real time broadband performance qualification. Line performance is evaluated against service speed(s) or service type(s). Celerity SP analysis uses measurements of the line's broadband transmission capability (e.g., signal loss, susceptibility to noise) as well as the impact of existing premises wiring to determine the qualification status for the line. This option can significantly benefit the broadband sales, provisioning and service assurance processes, allowing new service commitments, for specific service speeds or types, to be made with confidence. And the line's performance can be conveniently verified prior to and after service turn up, as well as at any future time where the performance characteristics are in question.

Celerity SQ – Service Qualification Option

Celerity SQ uses the qualification analysis of the service performance test to determine the broadband capability of every line served by the exchange. Scheduled routining allows for bulk testing during off-peak hours while ensuring that all lines are regularly tested to identify changes. Celerity SQ provides a network-wide view of service qualification, making possible targeted marketing of service speeds or types, and cost-effective equipment deployment.

Configuration Guidelines

Tollgrade's 4TEL product scales to support millions of access lines. Each TSC supports up to 50 simultaneous tests for 1 million defined access lines, in up to 200 separate exchanges. LDUs are typically deployed as one per 5,000 lines for service assurance applications, or one per 25,000 lines for qualification purposes.

System Interfaces

Voice Response System

The 4TEL Voice Response System (VRS) provides field technicians with dial-up access to the testing system using a DTMF handset or cell phone. Complete demand testing and interactive fault location is provided for directing the technician to the location of faults. VRS can also be used to generate a pair ID tone on the line under repair to help identify that specific pair in the field.

Test Interface Library (TIL)

Tollgrade's TIL is used extensively in deployed systems as a convenient machine-to-machine interface for service provider OSS integration.

Standards Compliant Open Interfaces

4TEL also supports commonly used open interfaces, such as CORBA. For users who prefer web browser access into the system, a web services interface is also available.

Professional Services

4TEL products can be delivered as turnkey solutions. The software is backed by a world-wide professional services organization offering pre-sales support, installation, project management, helpdesk support, customization, and on-going system management and improvement through software maintenance.

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