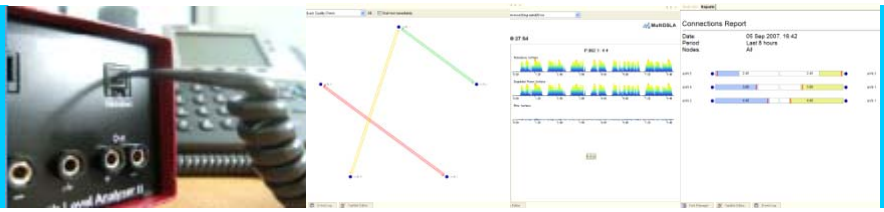
MultiDSLA Application - Drive Test

A new generation of network and equipment test system delivering professional standards of measurement across a wide range of applications.

Malden Electronics



MultiDSLA predicts end-to-end user experience

THE IMPORTANCE OF PREDICTION

What influences wireless users' perceptions of the service provided by the network operator? Whilst customer service and tariffs undoubtedly play their part, it is the grade of communication which carries most weight. Poor or erratic speech quality is disruptive to conversation and dropped calls quickly give rise to dissatisfaction.

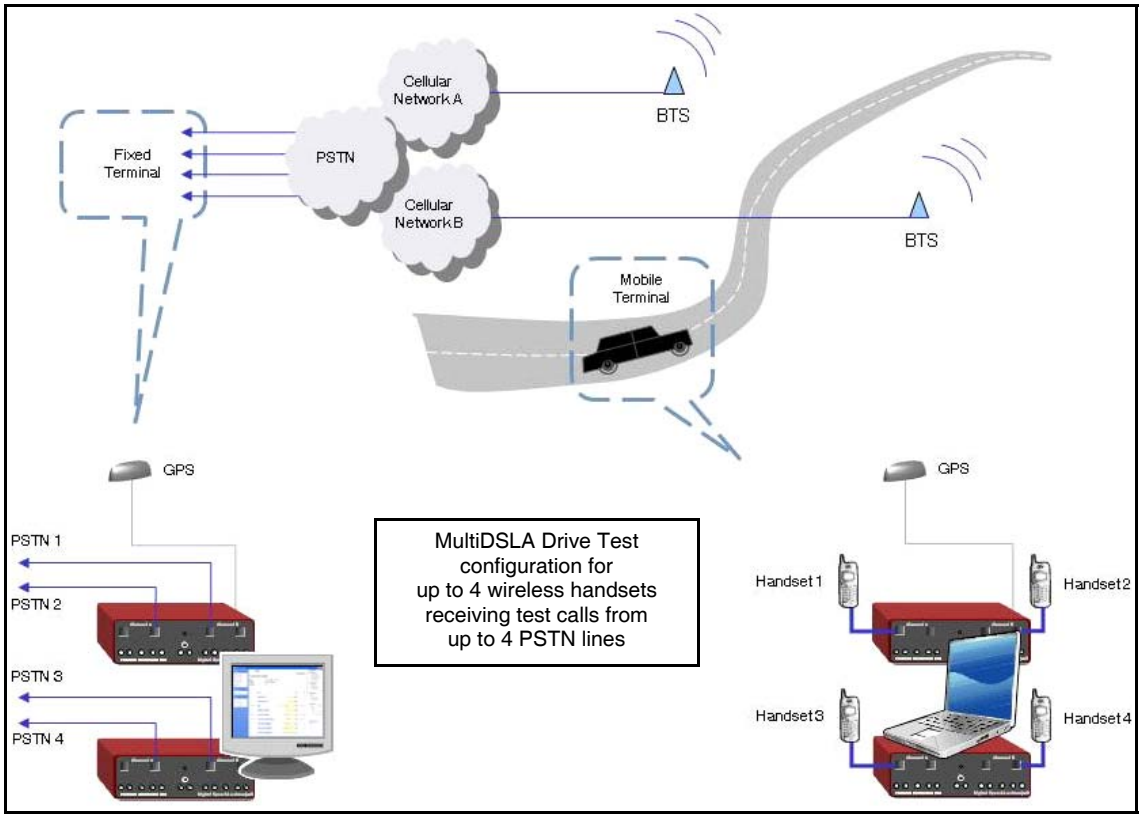
Handset and infrastructure manufacturers and network operators have a critical interest in network performance optimisation.

Handover is a critical aspect of performance – a separate Application Note addresses this.

What are the limits of user acceptance? What constitutes "good" performance? Subjective testing provides accurate answers to these questions, but is a lengthy and expensive process. What is needed is a technique which predicts user acceptability by algorithmic means.

The ITU has standardised one such algorithm – ITU-T Rec. P.862, Perceptual Evaluation of Speech Quality (PESQ). When combined with a high quality instrumentation system, PESQ provides data relating directly to customers' experience.

These techniques are valuable at all stages in the design and test of wireless infrastructure because they provide reliable and repeatable numeric indicators of performance. They can be used to advantage during installation, commissioning and acceptance testing of wireless networks and in operational networks.



MultiDSLA Drive Test configuration for up to 4 wireless handsets receiving test calls from up to 4 PSTN lines

Drive Test Applications

Two MultiDSLA systems with GPS are used in a drive test configuration to provide a full range of measurements of mobile voice service, including the key performance indicators, speech quality, speech level, noise level and delay. MultiDSLA works with almost any mobile handset type and with any wireless technology including hybrid networks such as GSM/UMA.

Speech quality drive testing ensures that the true end to end performance of the mobile network is assessed, delivering results which correspond to the experience of customers. Using MultiDSLA, operators can readily fulfil all of these drive test requirements:

- Handset comparison – any number of handsets may be used simultaneously, with separate reporting for each one. Side by side comparison over an extended period, in near identical radio coverage and network conditions allows very effective analysis of handset performance in both uplink and downlink paths.
- Competitive network comparison – in which any number of networks may be involved. Identical handsets are normally used, in order to give a direct comparison of network coverage and general performance. It is often useful to perform such tests at different times of day, so that the performance of the networks can be studied at the busy and off-peak times.
- Detailed network performance analysis – typically within a single network and with a reference handset. The objective may be to study network behaviour in particular circumstances, to investigate customer complaints or to confirm performance following a network upgrade or maintenance work.
- Fixed line to mobile – the usual mode of testing. The fixed line is normally analogue.
- Mobile to mobile – occasionally it is useful to investigate network coverage by performing a drive test in which cellular handsets make a continuous call between themselves, with continuous testing. This particular application requires only the mobile terminal, since no fixed lines are involved.

LAB
- Interactive test creation
- Fully flexible test design
- Highest accuracy
- Extensive analysis
- Immediate feedback
- Scenario testing
- Test automation

ENTERPRISE
- Management Reports
- Unattended operation
- Small learning curve
- Alerts on problem
- Standard tests
- Affordable and scalable
- NMS integration

NETWORK
- NMS integration
- Central scheduling
- Central maintenance
- Multi-tier user support
- Quick and easy to use
- Web reports

ON THE ROAD
- GPS for location and synchronisation
- Low power requirement
- Interface to cell phones
- Support for missing control network

MANUFACTURING
- Repeatable testing
- No training to run a test
- Database of all tests
- End of day reports
- TCL/Perl/Python remote access control

DELAY AND DELAY VARIATION

Measurement of average one-way delay, round-trip (end-to-end-to-end) delay and delay variation are all possible in a MultiDSLA system.

Accurate measurement of one-way delay requires that the fixed and mobile terminals be synchronised. This can be achieved by connecting suitable GPS receivers to the terminals. A test script is constructed which begins the test process at the same time (t_0) at both the fixed and mobile ends. A test is typically composed of a number of stages; each stage is timed to proceed a defined time after t_0, ensuring correct co-ordination, even though there is no control channel linking the fixed and mobile ends.

The GPS receivers must be models providing both a serial data output and a separate pulse per second output. Guidance on compatible types and interconnections is available on request.

Measurement of end-to-end-to-end delay can be accomplished without the use of GPS. A speech sample is sent from one terminal and then captured and recognised by the other terminal. The capturing terminal responds by sending another speech sample to the originating end. Since the response time is accurately known, the network round-trip delay can be calculated. In the absence of GPS synchronisation, the round-trip delay is halved as an estimate of one-way delay.

Delay variation is a feature of packet transmission and arises when a gateway jitter buffer is re-sized. The effect on speech quality can be minimal if this occurs in a silence interval but can be detrimental if it occurs during active speech. The PESQ algorithm measures the time offset between the reference speech samples and the captured degraded samples, and does this for each speech utterance individually. Thus MultiDSLA reports the maximum, minimum, mean, median and standard deviation of these measurements, providing a thorough analysis of delay variation.

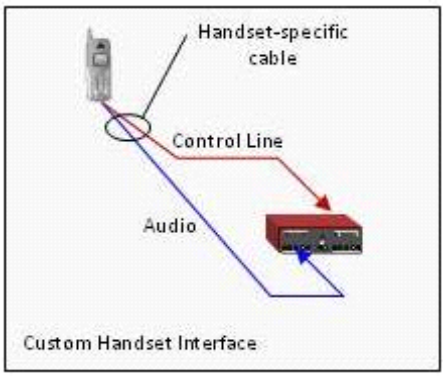
System Configuration

The MultiDSLA drive test configuration consists of two similar sets of equipment, one for the fixed terminal, one for the mobile terminal. Each set comprises:

- MultiDSLA Controller application and PC/laptop
- DSLAIIC analogue test instrument(s)
- Garmin GPS 18 LVC receiver or equivalent
- Hub/switch, if more than one mobile DSLAIIC is used

Handset Interface

Malden Electronics can supply cables to interface to a wide range of cellular handsets. The typical arrangement is shown here:



The cable carries microphone and earpiece audio signals between the handset and DSLAIIC. The Control Line connection allows the system to control the "push button" function of the handset hands free kit. In most models, this allows automatic answering of an incoming call. In some models limited call dialling is also possible, but the simplest solution is usually for the PSTN line to make the call to the mobile.

When ordering special cables for use with handsets, it may be necessary to supply a working handset sample if the model is not one for which Malden has already designed an interface.

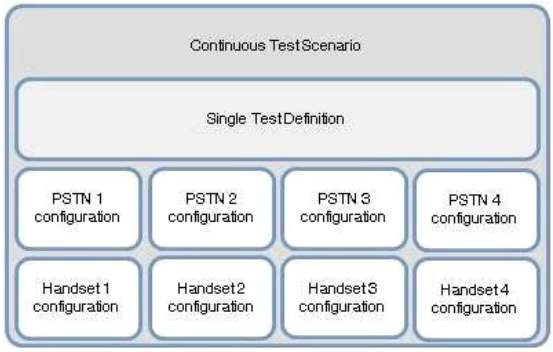
Synchronisation

Correct execution of the test process relies on the presence of a GPS signal at both the fixed and mobile terminals. Should the GPS signal be lost temporarily, the system will continue to operate for some time by using the internal clock of the GPS receiver. When the GPS signal is present, the system records GPS position and time data, and measures one-way speech delay. When the GPS signal is lost, the GPS position data is also lost and the accuracy of the one-way speech delay measurement is impaired. However, provided both terminals have been initialised with a GPS signal, it is possible to operate the drive test for several hours without a live GPS signal. Whenever possible, it is recommended to operate a drive test with GPS, since this will provide the optimum synchronisation and accuracy, and will ensure that position data is recorded.

Test Configuration

Although the drive test equipment consists of two independent systems, both are set up in the same way, as follows. Detailed instructions can be found in the MultiDSLA on-line Help file:

1. Configure the PSTN nodes at the fixed terminal and copy these configurations to the mobile terminal.
2. Configure the Handset nodes at the mobile terminal and copy these configurations to the fixed terminal.
3. Select the desired test (call duration, male/female voice content, etc). Identical tests are used at the fixed and mobile terminals.
4. Save the test and node configurations in a Scenario.
5. Execute the Scenario at both terminals – this will run continuously until stopped.



The Scenario file is a powerful feature which permits all the drive test configuration data to be stored in one place. This means that testing can follow a pre-defined process and, once set up, the system can be used with minimal learning time.

Reporting

Both the fixed and mobile terminals measure and record the properties of the received speech signals. The data may be viewed in one of four report types and exported in CSV, TXT and XML formats. Detailed graphical and numerical results are also available if required, for analytical and diagnostic purposes. Details of the reporting and display facilities can be found in the MultiDSLA brochure.

Other Applications

The analysis of wireless handover performance is described in a separate application note.

The study of the effects of packetised voice transmission on end-user perception is discussed in the side panel on this page.

Performance analysis in mobile radio networks, including TETRA, used by public safety services and others.

Although usually associated with road testing, Multi DSLA drive test is also used in railway GSM-R performance assessment.

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