TDR traces with FlexaNet xDSL

This application note describes how to use to FlexaNet xDSL to diagnose and locate faults on a copper pair.

It illustrates some common problems found with copper pairs, and their corresponding TDR traces.

Application Note ANFlexxDSL 04

Testing the World's Digital Networks

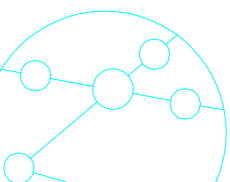
TrendCommunications

This Application Note briefly describes how to use the TDR function of FlexaNet xDSL to diagnose and locate problems on a copper pair.

The manual test described may be part of a test procedure following the reporting of a problem by a customer and a subsequent automatic test performed by FlexaNet xDSL. The TDR enables you to diagnose and locate the problem on the pair.

A TDR works on the principle that a pulse that is transmitted into a line will be reflected back to the source. The time between the pulse being transmitted and the reflection being received can be measured. If the speed of the pulse is known, the distance the pulse has travelled can be calculated. The speed of the pulse depends on the insulation separating the conductors.

Interpreting TDR traces is not straigtforward, it is a skill that is developed over time and practice. This Application Note illustrates common faults and their corresponding TDR traces.



TESTING THE COPPER PAIR

To display FlexaNet xDSL Fault Manager:

1. Double-click on the FlexaNet xDSL Fault Manager icon on the PC desktop.
   The FlexaNet xDSL window is displayed.

This window enables you to start an automatic test (**Test Line**) or to perform a **Manual** test.

1. Type the **Customer Ref** for the line you want to test.
2. Choose **Manual**.
   The **FlexaNetxDSL** manual window is displayed.

   You can only perform a copper test if the xDSL layer is down. If the xDSL layer is active you must first deactivate it. If the xDSL layer is already down you do not need to perform the next two steps:

3. Choose the **xDSL** button.
4. Choose the **xDSL Deactivate** button.
5. To display the copper testing tab, choose the **Copper** button.
6. Choose the **TDR** tab.
7. To start the test, choose **Start**.

   While you make a measurement you can change the test conditions, you can change the range the measurement is made over (**Begin** and **End**), the velocity factor (**Velocity%**) and the **Gain** used. This is useful if you

want to look in detail at one area of the TDR curve. To change one of the values:

1. Put the cursor in the setting you want to change and enter a new value.
2. Move the cursor to another setting.
   The TDR curve is redrawn for the new setting.

LOOKING AT THE TEST RESULTS

By inspecting the TDR trace faults on the line can be seen and their position from the Test Head estimated. Some common faults are illustrated below.

Gauge Change

Many different cable types, with conductors of different gauges or diameters, are suitable for telephony and xDSL applications. While different gauges are in themselves not a problem, mixing different gauges in cable runs can cause impairments which affect the line's ability to carry xDSL services. This is because of the effect of the gauge changes. The characteristic impedance of line pairs depends on many factors, including the diameter of the conductors. So wherever there is a change of gauge there is a change of characteristic impedance, and this will result in mismatching and reflections.

Gauge changes result in high return loss and insertion loss; they may cause degradation of xDSL services. The illustration below shows the decrease in impedance caused by a larger gauge conductor.

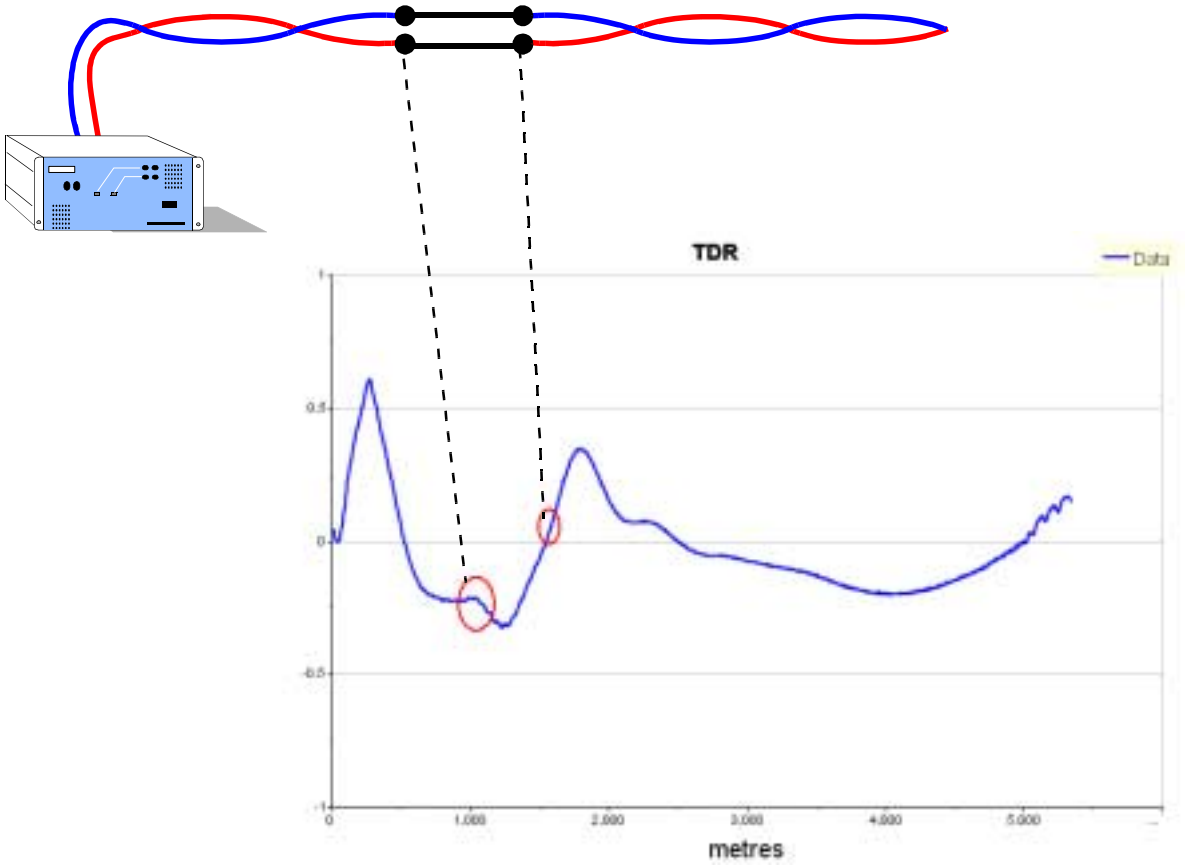


Figure 1 Gauge change detection with Flexanet xDSL.

Open

An open circuit shows up as an upward pulse on a TDR trace. This is caused by the sudden increase in the impedance of the copper:-

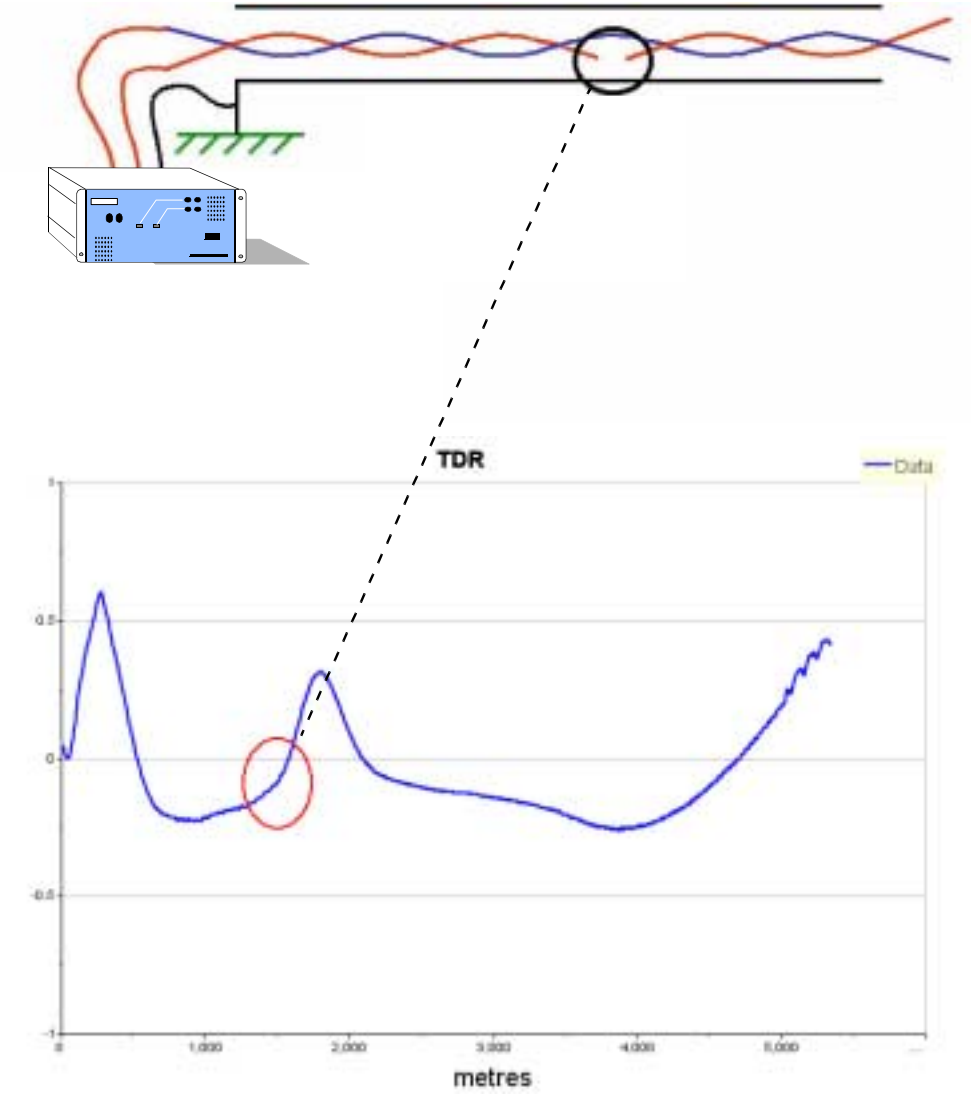


Figure 2 Open circuit detection with Flexanet xDSL.

Short

A downward pulse indicates a short circuit. This is caused by the sudden decrease in the impedance of the copper:

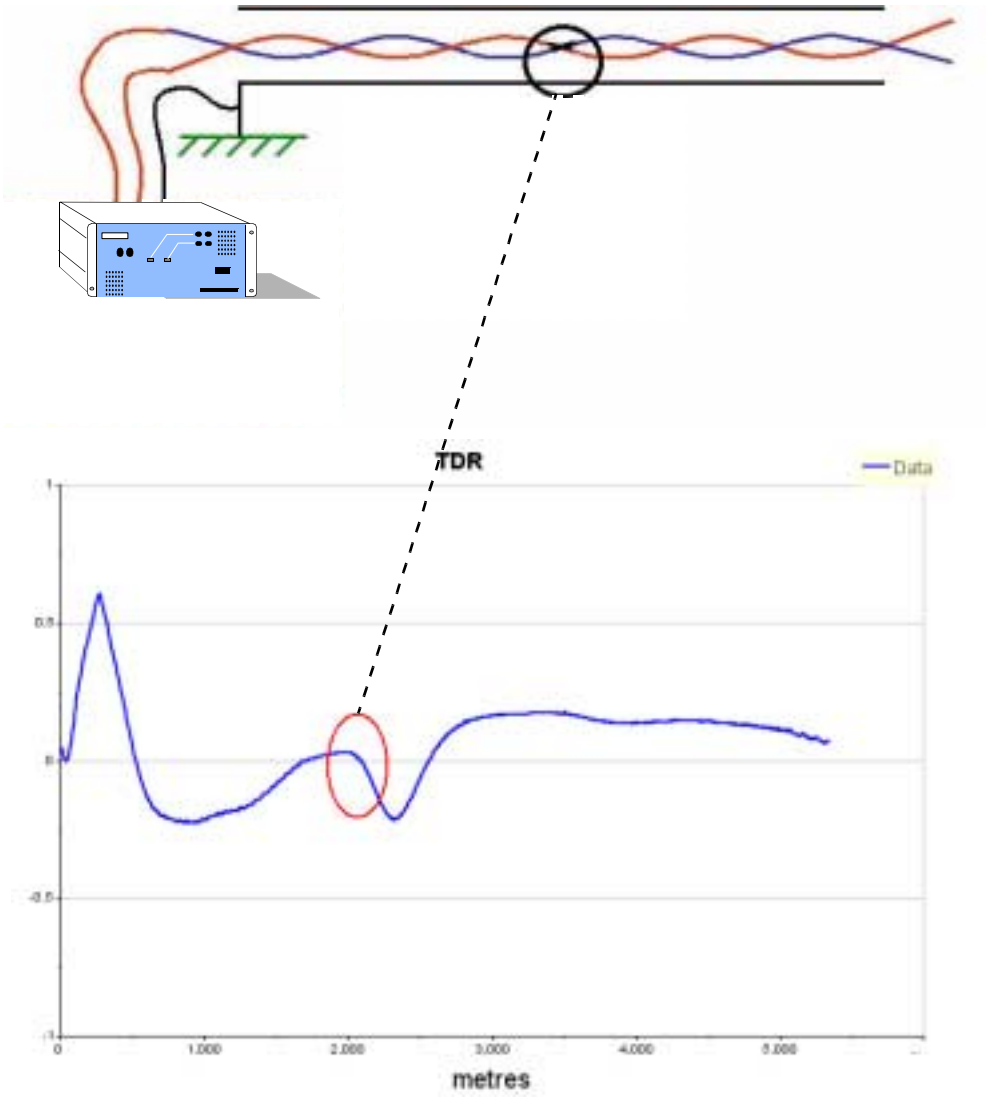


Figure 3 Short circuit detection with Flexanet xDSL.

Split Pair

When jointing multiple pairs in a cable it is common for mistakes to be made and for one conductor of a pair to become separated from the other conductor.

So long as the stray conductor is matched up with its original twin before the end of the cable run, continuity is maintained and the line

will be perfectly good for telephony application. But split pairs of this type result in serious degradation of xDSL service. Firstly the characteristic impedance of the section where the pair is split will be different from the rest of the line, resulting in mismatching, reflections and high insertion loss. Secondly the pair is no longer twisted which means that it will be susceptible to induced noise and will radiate and cause crosstalk into other pairs in the cable. Not only is the pair not twisted, but each conductor is twisted together with a conductor of another line, creating a high degree of coupling with that line and a high level of crosstalk with the service running in the other line.

Split pairs result in noise, crosstalk, radiation and high insertion loss in xDSL applications and generally need to be located and rectified before a line can be used.

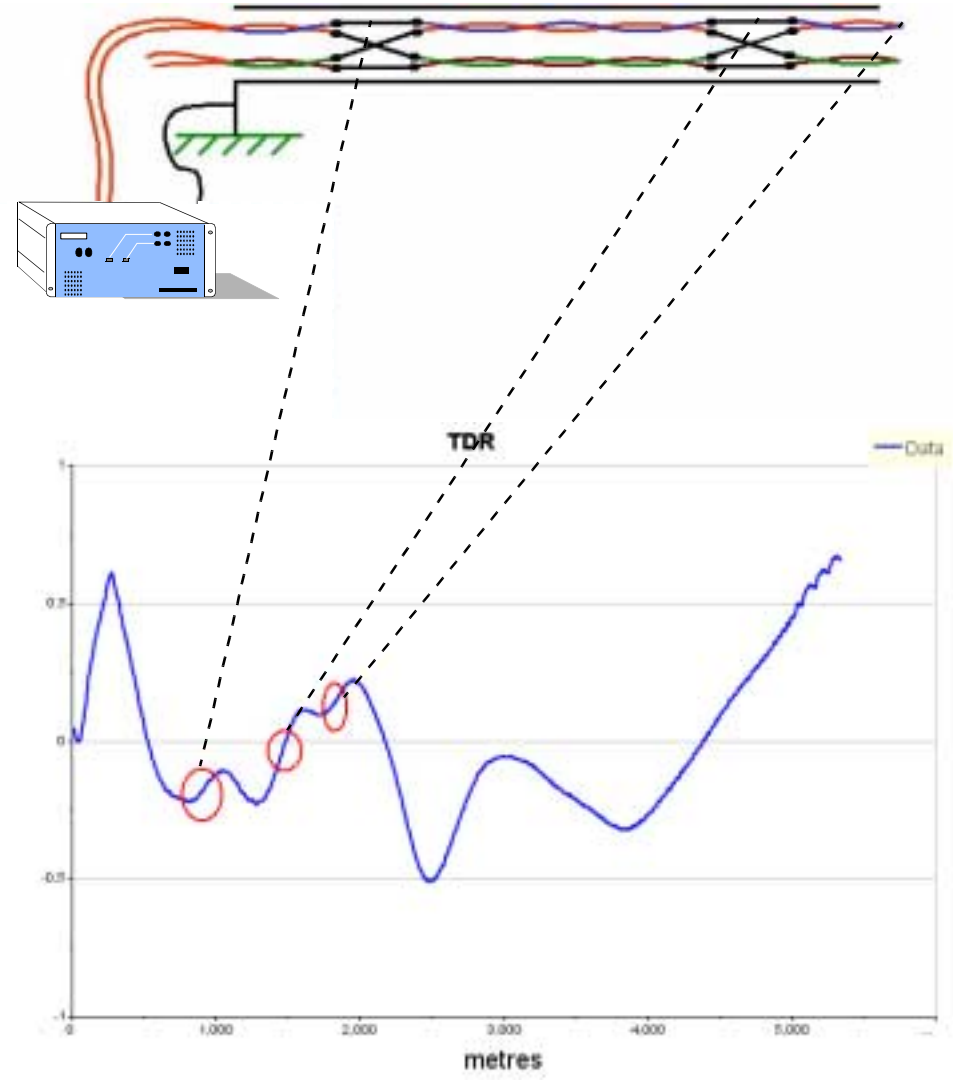


Figure 4 Split pair detection with Flexanet xDSL.

Bridged Tap

As networks evolve, customer requirements change and modifications and repairs take place, parts of the line plant are often left connected but disused. For example a particular pair may develop a fault and rather than locate and repair the fault it may be more economical to use a different pair to service the customer. The customer end connection would be changed over to the new pair, but at the street cabinet or distribution frame the new pair may be bridged to the old pair without the old pair being disconnected.

The disused length of line is called a lateral, and is often left unterminated. Terminated and unterminated laterals create an impedance mismatch at the bridged tap, resulting in high return loss. Unterminated laterals also act as very efficient antennae, picking up noise from the environment and injecting it into the line. They also act as powerful transmitting antennae.

Bridged taps result in noise, return loss and radiation which can disqualify the bridged pair from use for xDSL.

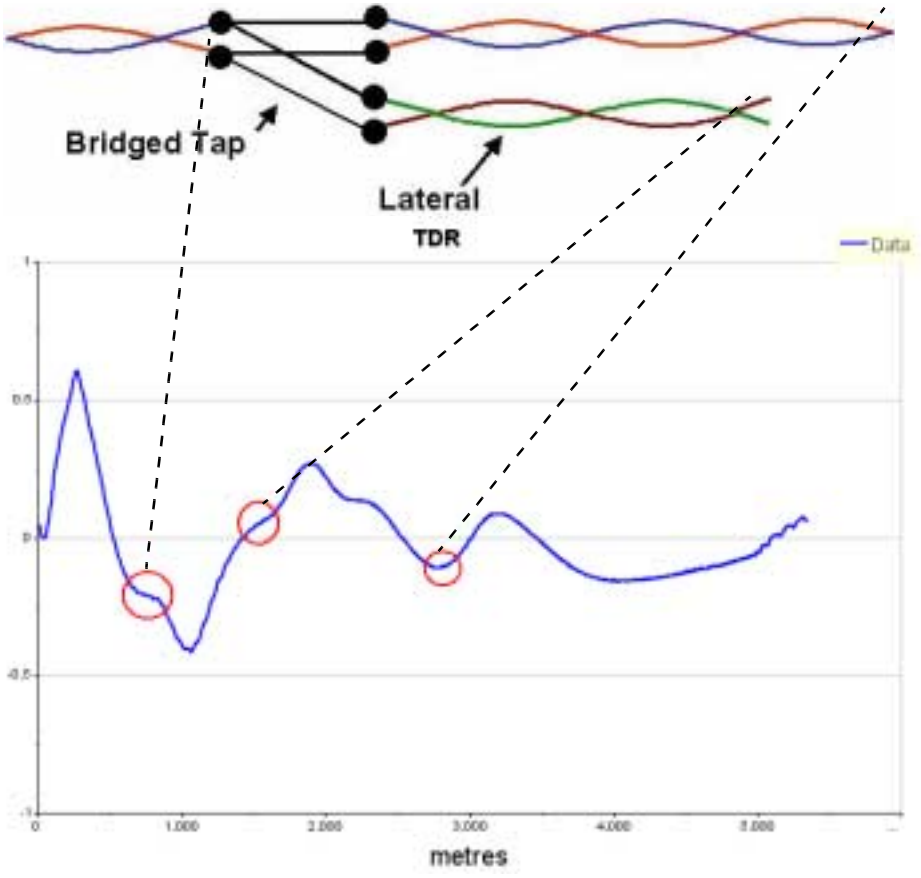


Figure 5 *Bridged tap detection with Flexanet xDSL.*

TrendCommunications

Trend Communications Ltd
Knaves Beech Estate
Loudwater, High Wycombe
Bucks HP10 9QZ UK
www.trendcomms.com
infoline@trendcomms.com

Trend Communications SL
Pujades, 60
08005 Barcelona
(Spain)

International: .... +44 1628 524977
España:..... 93 300 3313
Deutschland: 089 32 30 09 11
US: 256 461 0790

UK:..... 01628 524977
France: 01 69 35 54 70
India:..... 22 8597 463/4