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SOURCE<sup>1</sup>: VOCAL Technologies Ltd. (<http://www.vocal.com>)

TITLE: G.hs: Loading Coil Location

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### ABSTRACT

xDSL modems are designed to operate between a Central Office and a customer premises. As such they use existing telephone network wiring between the Central Office and the subscriber. There are several modems in this class which function in generally similar manner. All of these modems transmit their signals usually above the voice band. As such, they are dependent on adequate frequency response above voice band.

The telephone lines which are already in place generally have not been tested for adequate response in the intended frequencies of operation. In particular, prior to ISDN deployment, use of loading coils on long telephone lines has been common. Their intended purpose was to equalize the voice band frequency dependent signal propagation. Their effect on xDSL modems however is drastic, because xDSL modems can not be expected to operate on loaded lines. We propose a technique to identify their location, to help the telephone company to locate and solve this problem.

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## **1. Introduction:**

xDSL modems are designed to operate between a Central Office and a customer premises. As such they use existing telephone network wiring between the Central Office and the subscriber. There are several modems in this class which function in generally similar manner. All of these modems transmit their signals usually above the voice band. As such, they are dependent on adequate frequency response above voice band.

The telephone lines which are already in place generally have not been tested for adequate response in the intended frequencies of operation. In particular, prior to ISDN deployment, use of loading coils on long telephone lines has been common. Their intended purpose was to equalize the voice band frequency dependent signal propagation. Their effect on xDSL modems however is drastic, because xDSL modems can not be expected to operate on loaded lines. We propose a technique to identify their location, to help the telephone company to locate and solve this problem.

## **2. Load Coil Location:**

The determination of loading coil location can be attempted on lines where loading coils may be detected. The essence of the algorithm uses time-domain reflectivity (TDR) to identify approximately where the loading coil is located. This may be performed by either modem, but preferentially, the central site modem should be responsible for this procedure. In TDR, a family of signal shapes, such as Gaussian, Sinc and chirp, can be used as a TDR probing signal. The signal is generated over a short period of time and propagates on the telephone line to the loading coil. There the signal is reflected back to the sending modem which is now monitoring for the responding echo. As signal propagation on a telephone wire is a characteristic of wire parameters (resistance, capacitance, inductance), the approximate location of the loading coil can be estimated. The time from signal generation to detection of echo can be translated using the signal propagation velocity into a distance from the Central Office. While this information may not be precise, it can lead a wire repair man to the approximate location for servicing by removal of the loading coil.

Loading coil location can be further enhanced by using the signal level measurements performed by the remote modem. Using particular frequencies that are partially reflected can refine the location estimate. Attenuation on a telephone line is primarily an exponential function of linear distance (assuming low loss at wire interconnection junctions). The relative attenuation of the G.hs carrier frequency to the detection frequency can provide an estimate of the proportion of energy being returned in the echo at the loading coil. The level of the echo received from the TDR probing signal of a frequency similar to the detection frequency can then be compared to the expected energy reflection at the loading coil. These measurements, in combination with an attenuation model for the line, can be used to further verify the predicted loading coil location.

The procedure of sending such TDR probing can be accommodated outside of the xDSL specifications when the modem is operating in a test mode. However, the specifications should provide for the ability to send the aforementioned detection frequency during G.hs and have the remote modem perform and report power measurements for these frequencies.

## **3. Summary:**

1. This paper should be present in the G.hs agenda.
2. We proposed that the G.hs include this algorithm to determine the location of loaded coils.