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SOURCE¹: VOCAL Technologies Ltd. (<http://www.vocal.com>)

TITLE: G.hs: Diagnosis of failed xDSL Modem Connections

ABSTRACT

The deployment of xDSL modems requires telephone company plants and facilities coordination with the customer's modem. As human resources can be very consumed at a high rate over large number of installations, it is a very critical goal to minimize truck roll and require as little installation support as possible, to let the customer initiate the entire procedure once the line has been provisioned at the Central Office. We believe that the primary reason for additional installation support is when the modems fail to connect. Secondary would be inadequate performance when the modems do connect.

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1. Introduction:

The deployment of xDSL modems requires telephone company plants and facilities coordination with the customer's modem. As human resources can be very consumed at a high rate over large number of installations, it is a very critical goal to minimize truck roll and require as little installation support as possible, to let the customer initiate the entire procedure once the line has been provisioned at the Central Office. We believe that the primary reason for additional installation support is when the modems fail to connect. Secondary would be inadequate performance when the modems do connect.

2. Diagnosis of failed xDSL Modem Connections:

With proper consideration to the connection procedures, provisions can be embedded into the operation of G.dmt or G.lite modems to aid with automatic diagnosis of failed connections and poor quality connections. We propose several simple such additions to aid with this diagnosis.

2.1 Connection Scenario:

We suggest the following scenario for the establishment of Central Office-based modem services:

Installation:

- Customer buys an ATU-R modem and order service installation.
- Telephone operating company provisions customer line with ATU-C.
- If the ATU-C is powered first and did not receive responses to its tone transmission, then it waits for tones from the ATU-R.
- If the ATU-R is powered first and did not receive responses to its tone transmission, then it waits for tones from the ATU-C.
- Connection either succeeds or fail.
- If connection succeeds, if data rate is adequate, no more installation effort is necessary.
- If connection succeeds, but data rate is inadequate, need to evaluate performance.
- If connection fails, need to diagnose connection.

Diagnose Connection

- The Central Office equipment, ATU-C can have access to additional information to aid in this procedure such as internal state and parameters of the ATU-C modem.
- If basic communications (through G.hs) with the ATU-R is possible, additional information can be requested from the ATU-R.
- Analysis of information from both the ATU-C and the ATU-R can identify possible problem scenarios.
- Additional line quality information can be requested using the G.hs facilities for probing of specified frequency bands or frequency specific power level probing.
- A diagnostic mode "connection attempt" could be performed which would intentionally fail and the information related to this particular connection attempt would be available to the ATU-C.
- This information can be requested from the ATU-R using G.hs communications.

Evaluate performance

- The Central Office equipment, ATU-C can have access to additional information to aid in this procedure such as internal state and parameters of the ATU-C modem.
- If since complete communications with the ATU-R is possible, additional information can be requested from the ATU-R.
- Analysis of information from both the ATU-C and the ATU-R can identify possible problem scenarios.
- Additional line quality information can be requested using the G.hs facilities for probing of specified frequency bands or frequency specific power level probing.
- A diagnostic mode “connection attempt” could be performed which would intentionally fail and the information related to this particular connection attempt would be available to the ATU-C.
- This information can be requested from the ATU-R using G.hs communications.

2.2 Information Retrieval

The procedure for determining on the cause of a failed connection and the type of diagnosis to perform would obviously depend on the point where the connection could not proceed beyond. For aiding this diagnosis, we propose the addition of new G.hs messages to request the retrieval of the ATU-R internal state and parameters. This needs to be accommodated in G.hs as the connection may not have yet established negotiations ability in G.dmt/G.lite. We suggest the inclusion of the following list of parameters of the ATU-R to be reportable:

frequency measurement of C-REVEILLE
amplitude measurement of C-REVEILLE
stability of observed C-REVEILLE (first/second order slews)
(others)

The procedure for performing a diagnostic connection that would intentionally result in a failed connection would allow for alternate probing signals be sent in place of the normal echo canceller training signal in C-ECT. The ATU-R should have sufficient memory to save at least a portion of the signal received in this phase sampled in time at some sample rate. In a subsequent G.hs, the sampled received alternate probing signal be transmitted to the ATU-C for analysis. For this reason, we suggest the inclusion of additional G.hs messages to request the retrieval of this sampled signal in the ATU-R. The response would include:

sample rate used
number of samples
array of time domain samples

2.3 Diagnosis Methods

The procedure for determining the cause of a failed connection and the type of diagnosis to perform would obviously depend on the point where the connection could not proceed beyond. For aiding this diagnosis, we propose the addition of new G.hs messages to request the retrieval of the ATU-R internal state and parameters. This needs to be accommodated in G.hs as the connection may not have yet established negotiations ability in G.dmt/G.lite. We suggest the inclusion of the following partial list of parameters of the ATU-R to be reportable:

frequency measurement of C-REVEILLE
amplitude measurement of C-REVEILLE
stability of observed C-REVEILLE (first/second order slews)
(others)

The procedure for performing a diagnostic connection that would intentionally result in a failed connection would allow for alternate probing signals be sent in place of the normal echo canceller training signal in C-ECT. The C-ECT segment is suggested as the ATU-R's receiver should be functioning to at least some nominal performance level and will be synchronized with the ATU-C from the preceding segments. The ATU-R should have sufficient memory (as the full

functions of the receiver are not yet operating) to save at least a portion of the signal received in this phase, sampled in either time or frequency domain. In a subsequent G.hs, the sampled received alternate probing signal be transmitted to the ATU-C for analysis. For this reason, we suggest the inclusion of additional G.hs messages to request the retrieval of this sampled signal in the ATU-R. This signal could be recorded directly in the time domain or as frequency-based DFT coefficients.

The observations of ATU-R parameters can related to predictable impairments on the telephone line. Crosstalk from ISDN or T1/E1 lines can be observed by frequency instability observed in C-REVEILLE as can pickup of AM radio stations, etc.

The procedure for determining on the cause of a failed connection and the type of diagnosis to perform, would obviously depend on the point where the connection could not proceed beyond. For aiding this diagnosis, we propose the addition of a new G.hs messages to request the retrieval of the ATU-R internal state and parameters.

3. Summary:

1. This paper should be present in the G.hs agenda.
2. We proposed that the G.hs include this algorithm for diagnosis of failed xDSL Modem Connections.