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Application Series

SunSet xDSL: Installing ADSL Circuits with ATU-R Emulation

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INTRODUCTION

ATU-R emulation provides a quick and thorough method for installing ADSL circuits. The SunSet xDSL ATU-R module connects to the DSLAM and can obtain results within seconds. It not only verifies service and connectivity to the central office DSLAM, but also provides vital performance measurements like line rate, line capacity, attenuation, and achieved signal to noise margin. This offers a major benefit over "plug and play" installations with an actual ATU-R module, since it can identify borderline circuits and potential pitfalls. For example, a quick check of the line's noise margin and capacity could uncover an unstable connection and prevent the need for a repeat visit.

SETUP

There is one configuration setting for ATU-R mode: DMT profile. As this determines the handshaking procedure used for link turn-up, the ATU-R profile must match the profile set at the central office DSLAM.

The evolution of ADSL DMT has created three flavors commonly used in systems: ANSI full rate, G.DMT full rate, and G.lite. ANSI full rate refers to ANSIT1/E1.413 Issue 2 specification for DMT full rate. G.DMT full rate refers to ITUG.992.1 specification for DMT full rate. G.DMT differs primarily in the implementation of a standardized handshake procedure per ITU G.994.1 (G.hand-shake). G.lite per ITU G.992.2 specification is based on DMT, using 128 tones and an interleaved profile to offer a maximum rate of 1536 kbps downstream/512 kbps upstream. A POTS splitter is not required at the CPE for G.lite systems. In its place, distributed microfilters are typically used for improved performance.

To change the profile:
1. Press the MODULE key.
2. Enter SETUP.
3. Select the proper profile to match the setup at the central office DSLAM.
4. If you've changed the setting, press the RETRAIN (F4) key to retrain the modem with the new profile.

OPENING THE LINK

As soon as the xDSL is powered on, the ATU-R attempts to synchronize with the far end by constantly sending an activation tone towards the ATU-C. This is depicted by the "ATTEMPTING TO OPEN LINK" message at the top of the display. While the set is attempting to open the link, the xTU-R LED should be blinking red. Upon acknowledgment of the tone by the ATU-C, an "INITIALIZING" message appears. This indicates to the user that the two modems are in the process of setting the parameters required for synchronization. If there is a successful connection with the ATU-C, the message shows "Link Open" and the xTU-R LED lights solid green.

As soon as synchronization occurs, a detailed Link Turn-Up Results screen will automatically appear. Refer to Figure 1. Important parameters are verified at a glance, including achieved line rate, line capacity, achieved signal to noise margin, and line attenuation. This screen shows the parameters at the time of link turn-up. Real time updates of these parameters can be viewed in the General Status Screen.

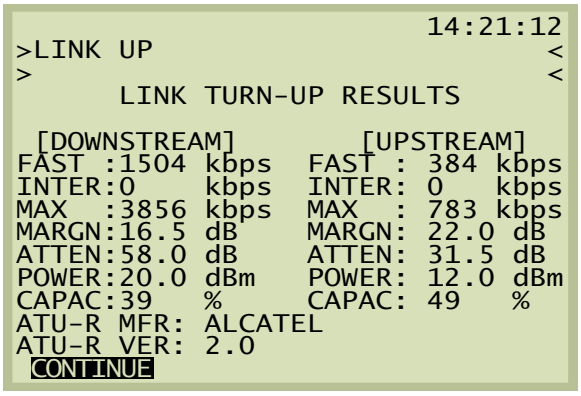

Figure 1 Link turn-up results

The left column displays the downstream results, indicating the direction from the DSLAM to the customer. The right column shows the upstream results from the customer to the DSLAM. For each direction, the following information is provided:

- FAST: Displays the Fast Path bit rate. This is the actual bit rate between the ATU-R and ATU-C (when fast path is used).
- INTER: Displays the Interleaved bit rate. This is the actual bit rate between the ATU-R and ATU-C (when the interleaved path is used). Interleaving adds some additional flow control and error correction- by adding delay to the data.

Note: Current Alcatel implementation allows for fast path only or interleaved path only profiles. This is set in the DSLAM. Dual latency is not supported. Therefore, you should see a bit rate only in 1 of these fields.

- MAX: Displays the maximum attainable bit rate that the circuit will support.
- MARGN: Indicates the realized Noise Margin. This is the margin above the signal to noise ratio required to support the bit rate. Noise margin is an important measurement of circuit performance and stability. A high margin means that future interferers can be introduced without affecting service. A circuit with

a low margin is less stable and there is the potential that the link could drop with future interferers. A commonly used standard margin is 6 dB. However, interpreting your noise margin result will differ for rate adaptive and fixed rate circuits. Since rate adaptive circuits try to use all the possible bandwidth, the noise margin will typically be very close to 6 dB (or the minimum value).

- ATTEN: Total attenuation; this is the measured difference in dB between the power transmitted at the near end and received at the far end.
- POWER: Indicates the aggregate power level. This specifies the maximum aggregate power level allowed at the transmitter. For the downstream, the ATU-C has a maximum power level of 20 dBm. For the upstream, the ATU-R has a maximum level of 13 dBm. The maximum levels are specified at the DSLAM. The modems will use the appropriate power level to achieve the bit rate over a given distance. A longer distance will require a higher power output than a shorter distance for the same bit rate.
- CAPAC: Indicates the Capacity. This measurement is an indication of line capability. It is a ratio of (achieved line rate/attainable line rate) x 100. For example, a CAP reading of 85% means the modem has the capability to transmit 15% more line rate if required.

FIXED RATE VS. RATE ADAPTIVE CIRCUITS

There are two operating modes for ADSL DMT: Fixed Rate and Rate Adaptive. The mode is set and controlled by the central office DSLAM. They determine how the link will manage the bit rate delivered to the customer. A fixed rate circuit specifies an exact data rate for the customer. This rate never changes and if the line rate drops below this specified rate, the link will drop. Rate adaptive circuits specify a minimum and maximum data rate for the customer. They try to attain the maximum data rate while maintaining a minimum noise margin. If the delivered line rate drops below the minimum specified rate, the link will drop.

Fixed Rate Circuits

If you are testing a Fixed Rate service, look at the following measurements. Fixed rate service specifies an exact data rate for the customer.

1. Fast Rate: The majority of circuits will be provisioned using the Fast path only. For those circuits, make sure that the FAST value equals the fixed rate set for this circuit, in both the upstream and downstream directions. For example, if the circuit under test is configured for 384 downstream/128 upstream, you should see Downstream Fast at 384 and Upstream Fast at 128.
2. Noise Margin: Check to make sure the noise margin complies with your company's requirements. A common standard is 6 dB. Higher values can provide more room for any introduced noise in the future.
3. Capacity: A high capacity value (85%, for example) has less room for increases in noise. This noise can be caused by additional interferers- like HDSL or T1- added in the same or adjacent binder group.

Rate Adaptive Circuits

If you're testing a Rate Adaptive service, you should check for the following. Rate adaptive circuits specify a minimum and a maximum data rate for the circuit, and try to attain the maximum rate set by the DSLAM.

1. Fast: The Fast value should be between the minimum and maximum thresholds set for the circuit.
2. Noise Margin: The Noise margin value also needs to be above the minimum allowable margin. A commonly used industry standard for target noise margin is 6 dB; your noise margin should be 6 dB or higher. Since rate adaptive circuits try to use all the possible bandwidth, the noise margin will typically be very close to 6 dB (or the minimum value).
3. Capacity: The capacity value will typically be high (around 95%). This is because rate adaptive circuits use as much bandwidth as possible.

OTHER ADSL MEASUREMENTS

In addition to the link turn-up results, the SunSet xDSL offers other tests to help you assess circuit quality.

Link Measurements

The Link Measurements screen provides long term analysis capability. CRC-8 error events are reported on the basis of block error rate. Refer to Figure 2. Common parameters such as errored seconds, severely errored seconds, & unavailable seconds are reported to help the user assess the overall transmission quality of the line.

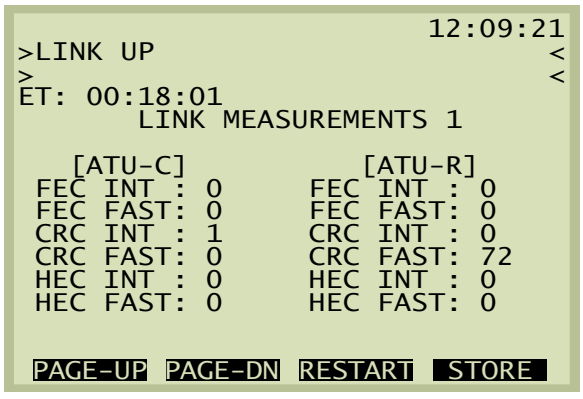

Figure 2 Link Measurements

Alarm Status

The Alarm Status screen provides a summary on the current and history alarm conditions. The alarm information is given for: loss of signal, loss of frame, loss of power, loss of cell delineation, and loss or margin.

General Status

The General Status screen provides a live report on the modem status and is constantly updated. The Link Turn-up Results shows the measurements at the time of link turn-up.

Measurement Thresholds

The SunSet xDSL's Measurement Threshold feature allows you to set specific thresholds for the downstream margin, capacity, and fast rate. Refer to Figure 3. Whenever your link drops below these values, a warning message will pop up on the screen. For example, if you set your capacity threshold for 75% and at some point during your testing the achieved capacity is greater than 75%, a warning message will appear.

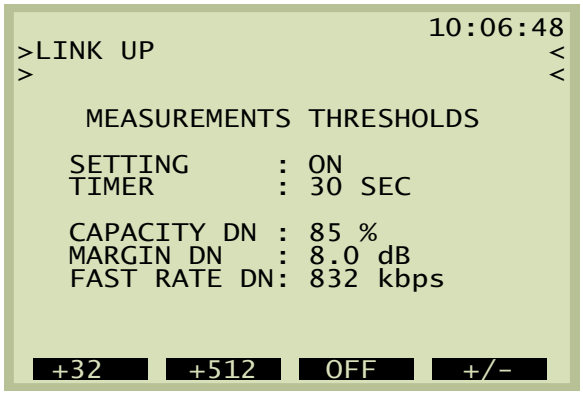

Figure 3 Measurement Thresholds

Closing the Link

After testing the ADSL circuit and reviewing the results, you should close the link with the SunSet before unplugging the signal. When you close the link, the SunSet sends a Close Command message to the DSLAM. Unplugging the signal without sending a close link command may cause alarms at the DSLAM.

1. Enter MODEM STATUS.
2. Enter CLOSE LINK.
3. Follow the screen instructions, and press ENTER.
4. The screen displays "Close Command Sent" when finished. Also note that the top message shows "Link Down."

BITS PER TONE

Second and third tier specialists require advanced modem measurements for comprehensive troubleshooting. An insightful measurement involves the bits per tone distribution used by the modem to transmit the desired rate. The bits per tone feature is a useful troubleshooting tool if the maximum rate at turn-up is lower than expected. It is an overview of the measured line conditions. Tones with high bit allocation have the higher signal to noise ratio. For example, if there is a significant drop off in the bit distribution around 772 kHz, there is a high possibility an interfering T1 source is affecting the DSL performance.

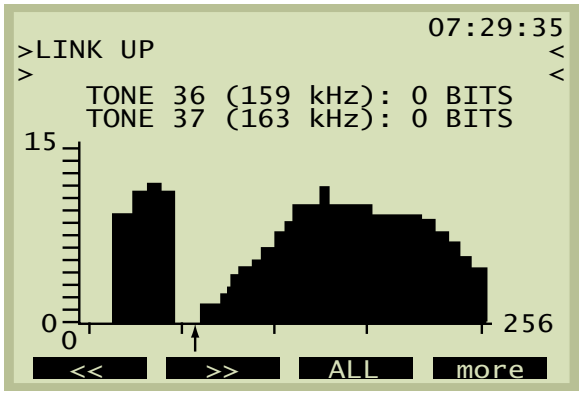

Figure 4 Bits per tone screen

The bits per tone feature measures the bits per tone distribution used by the modem to transmit the provisioned rate. It displays the number of bits assigned per tone in either a graphic or table format. During modem initialization, a signal-to-noise measurement is made for each tone; bit distribution is then optimized to meet the desired bit rate. Each tone can support a theoretical maximum of 15 bits. During operation, the bit distribution may be adjusted to optimize bandwidth. The modems constantly monitor the signal to noise ratio for each tone. If a tone degrades in quality, a bit swap command can be sent to adjust the amount of bits assigned to that particular tone. These bits may be added to a different tone or taken out completely. To view the bits per tone:

1. Enter MODEM STATUS.
2. Enter BITS/GRAPHIC. Refer to Figure 4. The carrier tones at the left of the screen (low frequency) represent the upstream signal. The highest frequency for the upstream should be 140 kHz. The group at the right (at the higher frequencies) represents the downstream signal. There can be anywhere from a 20 to 40 kHz buffer between the upstream and downstream frequencies. In Figure 4 the arrow is pointing at this buffer space. Note that

there are zero bits assigned to tones 36 and 37 (frequencies 159 and 163 kHz).
3. If you see another significant drop on bit allocation, check the frequency of that carrier tone to deduce if an interfering service is affecting ADSL performance. To learn the exact bit count at a specific tone, refer to the top two lines. They provide the bit count for the tones marked by the arrow. You can move the arrow to the desired carrier tone by pressing either the left and right arrow keys or using the << (F1) and >> (F2) keys.

TROUBLESHOOTING TIPS FOR UNSUCCESSFUL TURN-UPS

At times, the turn-up test will not be successful. The SunSet may not be able to communicate with the DSLAM or the link may open, but the performance & line rates are lower than expected. The SunSet xDSL offers comprehensive troubleshooting tools to determine why the link is failing. These tools are part of the ATU-R feature (like bits per tone) or the physical layer tests (like TDR, DMM) for full chassis units.

Status Line

The first clue can be found on the status lines at the top of the screen. They display the status of the handshaking procedure between the ATU-R and ATU-C during link turn-up. During a successful turn-up, the messages exhibit the following sequence:

1. "Attempting to open link" This indicates that the SunSet is attempting to synchronize with the far end by sending an activation tone to the ATU-C.
2. "Initializing" Upon acknowledgment of the tone by the ATU-C, an "INITIALIZING" message appears. This indicates that the two modems are in the process of setting the parameters required for synchronization. The initializing stage should occur within 10 seconds after attempting to open the link. If the message never shows "Initializing" and stays with "Attempting to open link," this means the SunSet xDSL cannot communicate with the DSLAM at all.
3. "Link Up" This indicates that the link is open between the SunSet and ATU-C.

Message stays at "Attempting to open link"

If the status message never progresses from "Attempting to open link" to "Initializing," this means the SunSet xDSL cannot communicate with the DSLAM. This indicates a major cable fault between the SunSet and the DSLAM that is preventing the transmission of the DSL signal. Another possibility is the DSLAM is not connected and operating. The following steps should be taken:

1. Verify that the DSLAM is connected to the cable pair you're testing and that it is functioning.
2. Run a Coil Detection (found under the LINE menu) test to check for load coils. Load coils severely attenuate the DMT spectrum and will prevent DSL service from running. Therefore, it is critical to remove all load coils before trying to deploy DSL. If the xDSL's Coil Detection screen reveals any load coils, you should use the TDR to find their location for removal.
3. Run DMM measurements to check for major cable faults like grounds, opens, shorts. If the DMM measurement shows any of these faults, use a TDR to find their location.

Message shows "Bit rate requested cannot be supported"

If the status line shows "Bit rate requested cannot be supported," this means that the SunSet can communicate with the ATU-C. However, the link cannot meet the minimum rate set in the DSLAM. You can safely eliminate major cable faults (shorts, opens, grounds) and load coils. Some possible causes are:

1. Loop length - Check the distance to the DSLAM. The distance may be too long to support the minimum bit rate. The loop resistance measurement should be used if a central office technician can place a short at the central office (found under LINE, CONTROLLER). If the far end cannot be shorted, use the capacitance measurement to estimate distance (found in DMM). If the loop is too long, the only solution is to lower the minimum data rate and offer a slower speed to the customer.
2. Noise interference from other services could be affecting DSL performance and limiting the supported data rate. Interference could be from other digital services like T1, HDSL, or ISDN found in the same or adjacent binder groups. Run a PSD DMT measurement and check for any noise spikes (found in LINE). Because ADSL DMT uses such a wide frequency spectrum, it is especially susceptible to interference from outside services. The templates provided in the PSD DMT screen can help you determine what type of service is affecting the DSL. If there is significant interference from another service, change cable pairs, or if possible, change cable binder.
3. Interference from AM radio could also be affecting service. You should run a PSD DMT to check for noise. If AM interference proves to be the culprit, check the binding on the cable and make sure the cable binder is properly grounded.

4. A bridge tap or multiple bridge taps between the ATU-R and ATU-C may be lowering the achievable data rate. The signal reflected from the end of the bridge tap is a noise source to the main signal and impairs its ability to carry data. A bridge tap close to (1,000 feet) either modem is especially harmful to the signal. You should run a TDR to check for any bridge taps.
5. Another possibility is a faulty ATU-C line card with low transmit power. To check for this, run the ATU-R turn-up test with the ATU-R modem in the central office. For example, if you turn up the link 500 feet from the DSLAM, the link should be able to achieve about 8 Mb. If the SunSet shows a significantly lower data rate (like 1 Mb), there is most likely a problem with the line card.

Other Status Messages

- "Unable to lock with ATU-C": The test set can't lock with the ATU-C.
- "Requested Bit rate Too High": The bit rate requested by the ATU-C cannot be supported by the ATU-R.
- "A failure occurred during the initialization process": There was a protocol error during the turn-up process.
- " A message received from the ATU-C was invalid": A CRC error was detected during the turn-up procedure.

If you see any of these messages, check for bridge taps, noise, or faulty line cards as described above.

Link Turns up with a Low Bit Rate & Noise Margin

In this scenario, the ADSL link turns up between the ATU-C and the SunSet. However, the bit rate is much lower than expected. The following factors could be reducing the achievable bit rate:

1. There may be a bridge tap(s) between the SunSet and the ATU-C. Run a TDR to check for any bridge taps and remove them.
2. Noise: Interfering noise from other digital services or from AM radio may be interfering with the DSL signal. The xDSL's PSD DMT background noise test can detect any interfering noise source.
3. Length: The length between the SunSet and the ATU-C may be limiting the data rate. Use the capacitance and loop resistance measurements to determine the distance.

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