JDSU

Application Note

Turning Up Bonded DSL Service Requires a Bonded Modem Design Test Tool

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Background

ITU G.998.2 specifies an Ethernet-based multi-pair bonding technology. While more than two pairs can be bonded as defined in the standard, typical practice in the field is to bond two copper cable pairs to increase rate and reach for a Digital Subscriber Line (DSL) service. This concept enables increased rate reach performance, but not a full doubling of performance over a single pair due to loop differences and even more significantly the impact of crosstalk between the pairs. Single pair turn-up and testing is insufficient.

Test Considerations

The basic concept of DSL turn-up testing discussed here is to validate that all of the issues related to proper service turn-up are known and within specified limits, meeting established thresholds for key performance metrics. The very nature of the bonded service technology requires accomlishing true dual loop evaluation by testing both pairs simultaneously with a dual-modem-designed test tool to emulate the real bonded customer premises equipment (CPE) implementation.

Service Provisioning

Validation of proper provisioning is standard for any turn-up procedure and becomes even more critical in a bonded service environment, because the provisioning process is more complex. Also, misprovisioning can be confusing in the field and difficult to detect. Bonding groups must be specifically provisioned, for example, pair bonding requires reconfiguration of these virtual local area network (VLAN) assignments:

- Preassigning single-port VLANs based upon slot and port.
- Pair bonding uses a single VLAN per group.
- Creating a bonding group requires reconfiguration of VLAN assignment to a logical master Ethernet in the first mile (EFM) port rather than to individual very high speed DSL (VDSL2) ports.
- Deleting a bonding group requires reprovisioning of default VLAN assignments for individual VDSL2 ports.
- Requires establishing profile details for upstream and downstream minimum rates and such and adding profiles correctly to a given bonded group configuration.
- Requires setting a bonding timer, which is the maximum time the system will wait for the second pair to achieve show time after the first pair has reached that state.
- Of course, it requires provisioning of the specific digital subscriber line access multiplexer (DSLAM) ports as being in a specific bonded group.

Testing one pair at a time will not detect improper provisioning because it does not exercise the bonded configuration.

Note: This complexity indicates a high chance for an improper provisioning to occur.

Bonded Service Initialization

The initialization sequence typically includes several parts:

- Training ports to determine the line's capacity using the maximum attainable rates. This phase is also used to determine if the CPE is capable of bonding and that the two bonded group lines are connected to the same CPE. Also, this phase is used to clear the discovery and aggregation registers in the CPE.
- Splitting the group's bit rates between two lines proportional to the line's capacity and measuring them in phase one. Typically, staggering the two line's training sequence will establish the corresponding line connection between the DSLAM and CPE ports. The line enters show time and the bonding group is brought into service, assuming the minimum group parameters can be achieved.
  - Testing one line at a time will not establish actual line rates as the impact of crosstalk will not be included. Rates may give a false positive because they may show a higher rate without crosstalk noise.
  - Testing one line at a time will not exercise the bonded timer threshold setting.
  - Testing one line at a time will not validate that each line is wired to or configured for the same bonding group as it will never exercise the group condition. This issue could even be more confusing when testing one line at time, where one line which reaches a different bonded port and then automatically resets to a single-line mode. The connection to a different bonded group would not be detected.
  - Group metrics will fail to establish making it unable to measure the Group Minimum rate and such.
  - Lack of Group Metrics will affect alarm programming as well as built around bonded metrics.
  - Testing each line individually will also fail to identify the condition where each line is connected to two different bonding groups. Each single line test may indicate a connection, but this split condition cannot be reliably identified.

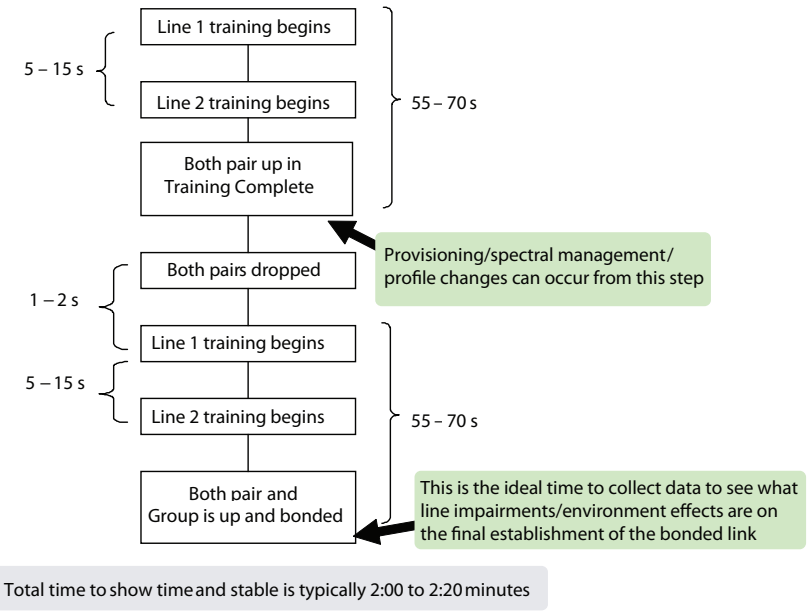


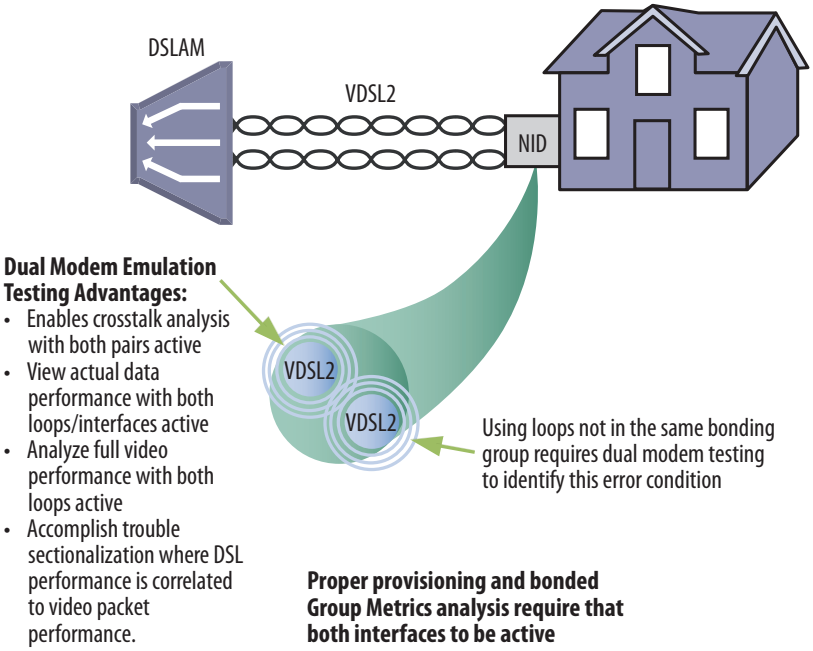
Diagram of the initialization sequence

Note: These conditions cannot be completed if the turn-up test is not conducted with a tool that supports a bonded service configuration. Testing each line individually will not produce accurate results.

Application-Level Testing

Application-level testing to validate connectivity and data throughput requires a bonded test interface/configuration to show actual performance. While service providers may not support testing at the VDSL interface today, the practice will become a meaningful process improvement for future consideration because:

- RTP packet loss correlation with DSL performance would not be available.
- Identification of loss due to the copper access plant vs network issues such as congestion would not be available.



Application-level testing

Summary

In summary, the absence of a true bonded modem test on the DSL line prohibits measurement of these key metrics:

- Group maximum upstream and downstream bit rate
- Group actual upstream and downstream bit rate
- Group capacity
- Lapsed time for both pairs to achieve show time
- Inability to show metrics for both pairs simultaneously to enable comparison of loop performance details.

Inability to validate provisioning or identify split bonded group loop connections to:

- validate that both pairs are in the same bonding group
- identify that pairs are each in a different bonding group
- identify that each pair did not fall back to a single-pair mode, but with acceptable minimum bit rate for the total group, thus giving a false indication of bonding success.

The risks associated with not using a bonded modem test tool are unwarranted for such high-value video service installations.

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