ASSIA

Case Study

Case Study:
DSL Expresse Power Management

A major DSL service provider in Central Europe implemented the Power Management feature of DSL Expresse with the goal of reducing power, while at the same time improving the customer experience with a more reliable DSL connection.

Customer Goals:

- Reduce energy costs for a 2.4M line DSL network
- Maintain or improve stability of broadband connections
- Support heterogeneous DSLAMs (multiple vendors)
- Minimize additional hardware investment

ASSIA professional services helped the provider in the first phase of deploying power management for a 2.4M line network delivering ADSL1 and ADSL2+ services. The first phase included DSLAM and line card configurations from Alcatel-Lucent achieving energy savings of 900,000 kWh per year. The provider has engaged ASSIA professional services to investigate extending the deployment to DSLAM equipment from Huawei.

Reduce Energy Consumption

As early as 2010, ASSIA's customer recognized the importance of implementing a "green" DSL solution to help reduce energy consumption. The company engaged ASSIA to conduct a study estimating the energy cost savings from deploying DSL Expresse Power Management across a subset of approximately 430,000 representative DSLs. These lines were running on DSLAMs from both Alcatel-Lucent and Huawei. The deployment included ADSL1 and ADSL2+ based services delivering capped (or tiered) residential rates, for example up to 1.3Mbps, 2.5Mbps, 7.5Mbps, 12.5Mbps, and higher. As the basis of the study, ASSIA professional services determined the transmission power of each DSL before and after implementing Power Management. Averaged across the 430k DSLs, ASSIA evaluated a drop in average transmission power from 15.8dBm per line (38.0mW) to 10.6dBm per line (11.5mW) using Power Management. Figure 1 shows the distribution of transmission power across "green lines" (running Power Management) versus "non-green lines" (not running Power Management). The two sets of green and non-green lines represent comparable populations of DSLs (based on factors including service product, loop length, DSLAM equipment, CPE equipment).

The next phase of analysis involved using the "transmission power" savings to

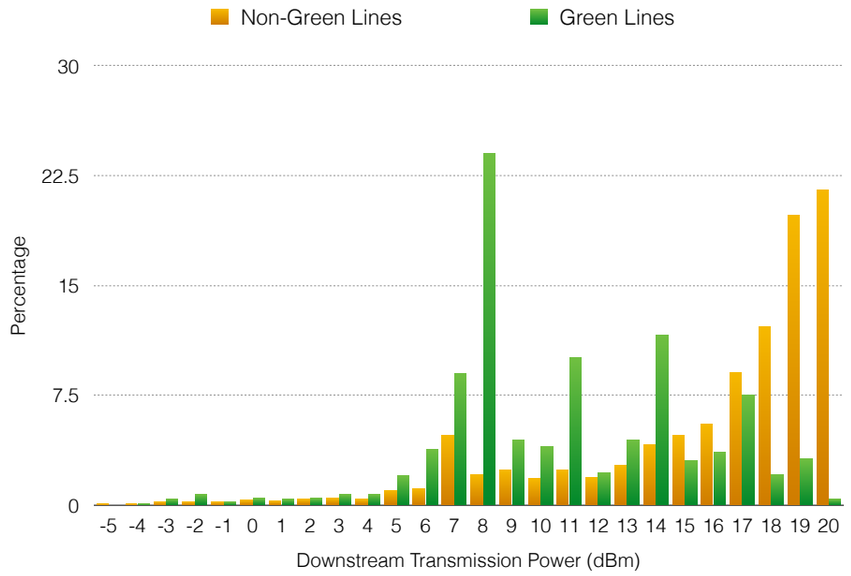

Figure 1 - Reduction in transmission power with DSL Expresse Power Management (Green Lines).

calculate the corresponding power reduction for each DSLAM. In order to calculate the power savings at the DSLAM, ASSIA considered two additional factors: (1) the power conversion efficiency of the DSL line drivers as well as (2) related power "overhead" as described below.

Each DSLAM has several components that consume energy, including one or more processors, disks, cooling fans, and line cards. For this analysis, ASSIA's customer focused on the power reduction of the line cards, and more specifically the line card component more directly impacted by power management: the line driver.

The line driver is an amplifier circuit that boosts the strength of the DSL transmission signal in order to increase the quality of the DSL connection over a longer distance of telephone wire. Different line driver designs, or classes, have different measures of efficiency. Several studies have documented this efficiency, reporting the amount of input power required to generate a given output power. Figure 2 shows one such study.

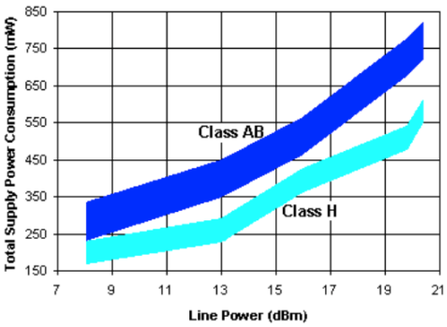

Figure 2 - Power consumption for ADSL line drivers. ("Low Power ADSL CO Line Drivers: Where do we go from here?" by Bruce Petipas, Analog Devices Inc.)

Using the chart in Figure 2, ASSIA estimated the reduction in supply power to the line driver corresponding to a reduction in transmission power from 15.8dBm to 10.65dBm. Based on the Class H curve, this change in transmission power corresponds to a reduction in power consumption from approximately 375mW to 200mW – a difference of 175mW per line saved as a result of DSL Expresse Power Management.

In calculating total power savings, ASSIA also factored in additional energy "overhead" associated with DSLAM energy consumption. Marketing report MR-204 published by the Broadband Forum highlights how every Watt saved in equipment power equates to a total power savings of 2.41W after accounting for associated conversion, distribution, and cooling costs (as shown in Figure 3).

Figure 3 - Additional Energy Costs Associated with Central Office Equipment. [Broadband Forum MR-204]

Applying this factor to the average 175mW per line power savings that DSL Expresse Power Management achieves at the line driver, the total power savings (including overhead) becomes 175mW/line * 2.41 = 422mW/line.

Results of Initial Energy Savings Study

Based on the estimations above, ASSIA calculated the total expected cost savings associated with DSL Expresse Power Management as shown below:

Average Power Savings per DSL		422mW/line
Total Annual Energy Savings per DSL		
Average Power Savings per DSL		422mW/line
Hours per year	x	8760 hours
		3.70 kWh
Total Energy Cost Savings per million DSLs per year		
Annual Energy Savings per 1M DSLs		3,700,000 kWh
Regional Cost of Energy	x	€0.095/kWh
		€351,500

Power Management Deployment Results

Based on the results of the study, ASSIA's customer began the deployment for DSL Expresse Power Management on Alcatel-Lucent DSLAMs. So far the provider has achieved an estimated energy savings of 900,000 kWh per year (based on 2013 year), not including the 2.41x uplift described above (for energy overhead). Assuming an average annual energy consumption of 5,000kWh for a household of four, this energy savings for the first phase alone represents the energy requirements of 180 homes!

Improve Stability of Broadband Connections

By implementing the Power Management feature of DSL Expresse, ASSIA's customer found that the stability of the network improved slightly, with a higher percentage of stable and very stable lines (versus unstable and very unstable) – see Figure 4.

	Before DSL Express Power Management (%)	After DSL Expresse Power Management (%)
Very Stable	85.4	85
Stable	10.2	11.7
Unstable	2.9	2.1
Very Unstable	1.5	1.3

Figure 4 - Stability tests measured across a representative sample of 1910 DSLs.

These results addressed the provider's question whether reducing the power on a DSL may increase the instability of the line. The provider had a concern that a lower transmission power would lead to a lower signal-to-noise ratio and a weaker connection. However, the Power Management feature ensures the stability of the line by enforcing a minimum noise margin to accommodate fluctuations in the amount of interference on the line.

As a result, Power Management reduces transmission power only for those lines that qualify with sufficient noise margin. And the reduced transmission power on those lines also reduces the interference they cause on other lines. Less power means less electromagnetic radiation (noise) for other DSLs, and so in fact with Power Management the overall stability of the network improves. Lines under power management create less interference and greater stability overall.

About DSL Expresse Power Management

ASSIA offers Power Management as optional software module to DSL Expresse to help reduce power consumption (and energy costs). The Power Management module adds transmit power management as a factor in optimizing the DSL profile (in addition to factors such as stability and rate). The Power Management module requires ASSIA DSL Expresse Profile Optimizer and Performance Evaluator.

DSL Expresse Power Management identifies DSLs with a larger noise margin than necessary to support the subscriber's service product. This capability is most applicable for service providers with tiered, or capped, service products (e.g., products with speeds up to 3Mbps, 6Mbps, or higher) where a subscriber has purchased a service level well below the capability of the DSL link. For instance, shorter loop lengths typically require lower transmission power to achieve the required throughput.

The Power Management module ensures that the line card in the DSLAM (the termination point for the phone line coming from the home) transmits at a power level sufficient to deliver the speed to which the consumer has subscribed, with sufficient stability to minimize potential interrupts. For tiered DSL service without power management, line cards typically transmit at power levels much higher than necessary. To ensure the highest stability and performance of the network, DSL Expresse Power Management will decrease transmit power only if the line is stable, working at the maximum rate for the service product, and has enough margin.

About the Customer

ASSIA's customer is a regional service provider supporting triple play services (voice, data, and video) over a network of over 2.4 million DSLs. The provider has implemented ADSL1, ADSL2+, VDSL2 and GPON technologies delivering reliable broadband connections up to 300Mbps.

Power Management Benefits: "Green" DSL

- Lower utility costs
- Improved stability of broadband connections
- Fewer equipment overheat alarms
- Adherence to regulatory guidelines or mandates

United States
333 Twin Dolphin Drive, Redwood City, CA 94065
Tel: 1-650-654-3400 · Fax: 1-650-654-3404

Europe
Calle Maria Tubau 3, Madrid 28050, Spain
Tel: +34 914842940 · Fax: +34 913446182

China
Suite 470, F/4, Beijing Sunflower Tower No.37, Maizidian Street
Chaoyang District, Beijing 100125, P. R.China
Tel: +86 10 85276788 · Fax: +86 10 85276488

© 2014 ASSIA, Incorporated. All rights reserved.

ASSIA, the ASSIA logo, and DSL Expresse are registered trademarks of ASSIA, Incorporated. All other product names, company names, logos, and trademarks are used herein for identification purposes only and are the property of their respective companies.

Rev 102010 P/N MC-W1-0115-01-00