DSL Access Technology

- Slow channel change
- Noise fluctuation

Adaptive

- Data rate
- Forward Error Correction
- Spectrum

Configurable
Before Dynamic Spectrum Management

- Unaware of long-term variations
- Unaware of impact of neighboring lines

Adaptive only at the transceiver

- Fixed based on crude rules
- Changed only after customer complaint

Fixed configuration
Static DSL Management

Conservative
- Speeds are restricted based on the loop length
- Many customers do not qualify for service

Aggressive
- Operate at the highest speeds possible
- Many customers experience unstable service

Adaptive Spectrum and Signal Alignment, Inc
With Dynamic Spectrum Management

Collect
• management data from all lines;
• store for long period.

Analyze
• recent data and history;
• detect problems.

Act
• reconfigure lines to improve speed/stability;
• report faults.

Backbone Network

DSL infrastructure

DSL line

Modem

DSL management

Adaptive Spectrum and Signal Alignment, Inc
Line Optimization

Gather management data

Choose best profile

Evaluate line stability

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Benefits for Conservative Provider

Stability Distribution

Before:
- 61% CV ≤ 50 & Retrain = 0
- 29% CV ≤ 250 & Retrain ≤ 1
- 3% CV ≤ 1000 & Retrain ≤ 2
- 3% CV ≤ 5000 & Retrain ≤ 3
- 5% Others

After:
- CV ≤ 50 & Retrain = 0
- CV ≤ 250 & Retrain ≤ 1
- CV ≤ 1000 & Retrain ≤ 2
- CV ≤ 5000 & Retrain ≤ 3
- Others

Downstream Rates

Below 5.7M
- 1%

5.7~7M
- 13%

7~10M
- 11%

10~12M
- 14%

12~14M
- 13%

Above 14.5M
- 19%

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Benefits for Aggressive Operator

Stability Distribution

Before
- CV<=50 and Retrain=0: 6%
- CV>50 or Retrain=1: 20%
- CV>250 or Retrain=2: 5%
- CV>1000 or Retrain=3: 10%
- CV>5000 or Retrain>3: 12%

After
- CV<=50 and Retrain=0: 58%
- CV>50 or Retrain=1: 20%
- CV>250 or Retrain=2: 5%
- CV>1000 or Retrain=3: 3%
- CV>5000 or Retrain>3: 10%

Downstream Rates

Before
- 0~2.1M: 12%
- 2.1M~4M: 17%
- 4M~6M: 17%
- 6M~8M: 17%
- 8M~12M: 39%
- 12M~16M: 10%
- Above 16M: 6%

After
- 0~2.1M: 12.7%
- 2.1M~4M: 17%
- 4M~6M: 17%
- 6M~8M: 36%
- 8M~12M: 39%
- 12M~16M: 10%
- Above 16M: 5%
DSM Level 2

Crosstalk couples lines
- Requires joint line optimization

Multi-line approach required
- Must have cable/crosstalk information

Must find best balance among users
- Must know user priorities

Adaptive Spectrum and Signal Alignment, Inc
Crosstalk cancellation
Performance trade-offs among customers
Management system to set priorities

DSM Level 3

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Conclusions

Huge improvement for DSL from Dynamic Spectrum Management

• Long-term observation of line
• Selection of best configuration

Advances from crosstalk mitigation and cancellation

• External management system needed