



Troubleshooting Upstream RF Noise Issues at the Headend

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- Noise Classification
- Impulse Noise Measurement
- Instrumentation
- Survival Techniques





• AWGN

- Additive Gaussian White Noise

- Varies over Frequency

Statistically Uniform over Time

Statistically Uniform over Time & Frequency

Ingress Noise

• Amplitude

• Amplitude

- Center Frequency
- Width

Impulse Noise - Varies over Time

- Amplitude
- Duration
- Period

AWGN – Additive White Gaussian Noise

• Mitigated by:

Reed-Solomon Forward Error Correction (FEC) Choice of Modulation Type Increase CM Transmit Power







Mitigated by: Vendor Proprietary Mechanisms (e.g., Digital Notch Filter)







- Mitigated by: ATDMA Interleaving + FEC or: SCDMA Symbol Spreading + FEC
- DOCSIS 2.0 has paid much attention to Impulse Noise







• Mitigated by: ATDMA Interleaving + FEC or: SCDMA Symbol Spreading + FEC







- Elements of Accurate Measurement
 - Stop Return Path Data Transmission
 - Passband Filter Noise
 - Time-Domain Analysis
 - Statistical Sampling (Long Period)



Modulation Error Ratio (MER)

- Includes CM noise
- Time-Averaged (Blind to Both Ingress and Impulse Noise)
- Requires CM Traffic

Network-Embedded Spectrum Analyzers

- Multiple Nodes in Upstream Path (Fault Isolation)
- Frequency Domain Measurements
- May Require Moving CMs to Different Channel

CMTS-Embedded Spectrum Analyzers

- Scheduled Idle CM Traffic Intervals
- Optional Passband Filtering
- Time & Frequency Domain Measurements



- But: Excess Channel Capacity may exist
 - By design
 - Off-Peak Hours
 - Different Noise Type was Anticipated

• Carefully Chosen Modulation Profile Change

- Based on Accurate Quantification of Noise Characteristics
- Software Tools are Available for:
 - Matching Modulation Profile to Noise Characteristics
 - Forecasting Resulting Packet Error Rate



ATDMA Interleaving Hazard



Analysis Tools are Valuable

Intelligent Channel Optimizer - *Cap/Demo.cap 4/0/0:0 12:18:58 8/10/2006	¥ X 🗙
<u>File O</u> ptions <u>C</u> harts <u>T</u> ools Debug Tests <u>H</u> elp	
😂 📓 🧕 🎯 Logon PER: 0.01 🖃 SNR Source: Impulse 🖃 Margin: 1 💌 dB Pktsize: 1518 💌 by	tes Display: 0-81.92 💌 MHz
Host Capture Reps Channel Passband: dBmV CwER .000 % MIB: 13.2 dB SNR: 17*	▼ dB Upstream: 4/0/0.0 0 atdma * ▼
Impulse Noise: Spectrum Constraints Noise Floor Rate Timing	
Net SNR: _8.5 dB 🗌 Bitrate 🖸 PktRate 🗹 PER Pktlen: 8000 💌	
Impulse Power: 5.5 J dBmV Packet Error Rate vs Packet I	_ength
Duration: 8.300781 v usec	to
Period: 0.578231 T msec	
Channel	
Type:	5
Frequency: 20 V MHz	
Width: <u>3.2</u> MHz H .10	
MiniClot: 1	1.500 Packet Size (bytes)
	IUC=11 Goal
Eloor Noise Suggest Profile Tune FEC Analy	yze Upload
Tatawal Chan Kod Due Dif FFC FFC Son May Cuan I Son Bidma DueaSodma	
Usage Type Len Enc CW amb Bur Time C amb Int Int mble TCM Int Sp Sub	
Code En Len Seed Siz Size S En Depth Block Type En Size En Cod PktSz	Mbps PER
1 request atdma qpsk 64 F 7 16 338 0 8 F T 1 60 qpsk1 6	0.768 0.000000
3 initial atdma qpsk 640 F 6 34 338 0 48 F T 1 92 qpsk1 34 4 station atdma qpsk 384 F 6 34 338 0 48 F T 1 92 qpsk1 34	
9 a-short atdma g16 104 F 15 168 338 84 8 T T 1 396 gpsk1 500	7.619 0.002262
10 a-long atdma g16 104 F 10 220 338 0 8 T T 0 2048 gpsk1 1518 11 a-ugs atdma g8 104 F 7 151 338 0 8 T T 0 2048 gpsk1 300	9.122 0.003886 6.000 0
Conture Completed #Con/Dome.con/21/60_4/0/0/0Channel = 2.2 MHz @ 20.0 MHz12/10/50_0/4/0/2005_Con-20/20_	▼ 20/0/0
Capitale Completeur - Capitolemotrap.21703 4700.0 Channel - 3.2 Mm2 @ 20.0 Mm2 - 12.10.38 8/10/2006 Sel=20/20 (Tem	20/0/0



Thank You