Simulcast Optimization Techniques

Simulcast Forum XII
Las Vegas, Nevada
February 28, 2008
Agenda

Simulcast Optimization Technique
Timing Offset Using C/I Plots
Timing Offset Using Time Delay Software
Simulcast Optimization Technique
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Suggested Test Equipment

- Digital Storage Oscilloscope
- Differential Scope Probes
- Monitor Receiver
- TIMS for Audio Generation
- Optimization Panel
- Remote Transmitter Keying Panel
Digital Storage Scope – Tektronix 3012B
Differential Probe – BK Precision
Monitor Receiver

- Audio Output (speaker)
- Discriminator Output (for PL/CTCSS)
Convex TIMS Test Set
Optimization Panel

- Audio Output (speaker from Monitor Receiver)
- Discriminator Output from Monitor Receiver (for PL/CTCSS)
- PL/CTCSS Reference (Spectracom PL Board at Co-Located Site)
- Audio Injection Point for All Simulcast Transmitters
Optimization Panel – Remote Transmitter Keying
Optimization

• Setting PL
  • Monitor Receiver Discriminator Audio and Scope
  • Use Service Monitor to Set Desired Deviation on Scope
  • Set all Spectracom PL Levels During Same Session
  • Requires Technician at Each Site for Spectracom PL Method

• Setting Audio Levels
  • Monitor Receiver Speaker Audio and Scope (filters out PL)
  • Use Service Monitor to Set Desired Deviation on Scope
  • Set all levels During Same Session using Intraplex
  • Requires Single Site Hear All Simulcast Transmitters

• Setting Delay
  • Automatic for SynchroCast Sites
  • Co-Located Site uses Stand-Alone Multiplexer
  • Check at low (400 Hz) and high (2500 Hz) frequencies

• Setting PL Phase Reversal Timeout
  • Transmitter Keying Goes Through Spectracom CTCSS
  • Factory Default at 150 ms
Setting PL (CTCSS)

- Channel 1 is reference (yellow)
- Channel 2 is Discriminator Audio of co-located site from the monitor receiver (blue)
  - Set PL deviation of co-located site to desired value
Setting PL (CTCSS)

- Key-up Remove Simulcast Site
- Check for Phase Reversal. Invert pair if necessary
- Key up back/forth between co-located and remote site to check PL level
- Set PL of remote site to match co-located site on scope
Setting Audio: Co-located Site

- Channel 1 is reference (yellow)
- Channel 2 is filtered audio of co-located site from the monitor receiver (blue)
  - Set transmit deviation of co-located site to desired value
  - Reference is 144.5 degrees = 0 degrees (co-located site)
Setting Audio – Remote Site

- Set transmit deviation of remote site to match co-located site on scope (Harris Mux)
  - 1 degree of delay @ 1000 Hz = 2.78 uSec/degree (= 1/1000/360)
  - Check Delay: 176.7 – 144.5 = 32.2 degrees. 32.2 degrees * 2.78 uSec/degree = 89.5 uSec
    - 89.5 uSec / 5.4 uSec/mile = 16.7 miles (actual 16.8 miles)
Timing Offset using C/I Plots
Caledonia/Rio

Communications Service
Portage • La Crosse • Madison
Caledonia/Rio

- Blue line is best estimate of equal signal strength area
Caledonia/Rio

- Set site with less coverage to delay launch of simulcast: \( d_1 - (2 \times d_2) \)
- 16.7 miles – (2 * 5 miles) = 6.7 miles. 6.7 miles * 5.4 uSec/mile = 36 uSec

Communications Service
Portage • La Crosse • Madison
- Set site with less coverage to delay launch of simulcast: \( d_1 - (2 \times d_2) \)
- 20.6 miles – (2 * 7.3 miles) = 6.0 miles. 6.0 miles * 5.4 uSec/mile = 32 uSec
Timing Offset using Time Delay Software
Signal Strength Plot

- ComStudy 2 Software
- ‘Stoplight’ Scale: Grey/Green Best, Yellow Marginal, Red Poor
Geography
**ComStudy Software**

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- AND -

Only signals above this level will be checked for time delay.

Difference in timing between two signals must exceed this value to be shown. In this example:

40 μSec = 14 degrees @ 1000 Hz

40 μSec = 28 degrees @ 2000 Hz

The signal strength difference between any two signals must be less than this value to be shown. Equal to a Carrier-to-Interferer ratio, FM capture effect.
ComStudy Software

Set the relative time delay for an individual site in the Site Information of each individual site.

Set a bright color that is not used in the signal strength plots to display time delay.
No Time Delay

- No Sites have any launch time offset
With Time Delay

• Cambria and Rio Set to Launch with 10 uSec Delay
With Time Delay

- Cambria and Rio Set to Launch with 20 uSec Delay
With Time Delay

- Cambria and Rio Set to Launch with 30 uSec Delay
With Time Delay

• Cambria and Rio Set to Launch with 40 uSec Delay
With Time Delay

• Cambria and Rio Set to Launch with 50 uSec Delay
With Time Delay

- Cambria with 32 uSec and Rio with 36 uSec Launch Delay
Simulcast Summary: Minimize the Variables

- Identical Non-Variable Backhaul
  - *Keeping Backhaul Inside Overall System*
  - *Digital Licensed T1 Microwave*
- Identical Audio Response
  - *Motorola Quantar*
  - *Harris Multiplexers including co-located site*
  - *Relay Keying to Eliminate Tone Keying Filters*
  - *No Phase Reversal – Checked During Optimization*
  - *Audio Equalization Not Required*
- Eliminating Time Delay Changes
  - *Harris SynchroCast*