Project Recaps

Fond du Lac County and Adams County Wisconsin

Lessons Learned

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Simulcast Forum XV  
Las Vegas, Nevada  
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Communications Service

Portage  •  La Crosse  •  Madison

La Crosse  •  Adams County
Portage
Madison  •  Fond du Lac County
Agenda

Fond du Lac County, Wisconsin

Adams County, Wisconsin

Lessons Learned
Suppliers

- Motorola Quantar Transceivers
- Harris Intraplex SynchroCast
- Harris TRuepoint 6 GHz and 10 GHz Microwave
- GE MDS LEDR 950 MHz Licensed Microwave
- Raytheon SNV-12 Voters
- Spectracom GPS Master Oscillators
- TXRX Filtering
- RFS Antennas and Cables
- Motorola MCC 5500 Dispatch Console
Fond du Lac County
Fond du Lac County Radio System

- Northwoods
- City/County Building
- Tower Road
- Brandon
- Oakfield
- Waucousta
System Coverage

Forward Link (Talk-Out) – Simulcast Transmit

- **Pink or Red**: Portable Coverage less than 95%
- **Yellow**: Outdoor portable radio coverage
- **Green or Grey**: Indoor portable radio coverage (12 db or greater)
System Coverage

Reverse Link (Talk-Back) – Voted Receive

Pink or Red: Portable Coverage less than 95%
Yellow: Outdoor portable radio coverage
Green or Grey: Indoor portable radio coverage (12 db or greater)
Fond du Lac County Radio System
Fond du Lac County Radio System - Channels

- **FDLSHF** – Fond du Lac Sheriff (7-site voted/simulcast)
- **EVENT** – Shared Channel
  - Standard Analog (7-site voted/simulcast)
  - P25 Digital (voted from 6 sites, transmit site select)
- **PAGING** – County Wide Paging (7-site simulcast)
  - Transmit Only – simulcast from all sites (all except Waupun)
- **COFIRE** – County Fire (7-site voted/simulcast)
- **HIGHWAY** – County Highway Department
  - Voted and Simulcast from 6 sites (all except Waupun)
Simulcast Block Diagram

Tower Road

Audio Splitter

Harris Intraplex

Harris Microwave

Spectracom GPS Master Oscillator

Spectracom CTCSS

Harris Syncrocast

Motorola Quantar Transceiver

Spectracom GPS Master Oscillator

Spectracom CTCSS

Harris Microwave

Harris Microwave

Harris Microwave

Spectracom GPS Master Oscillator

Motorola Quantar Transceiver

Spectracom CTCSS

Tower Road

Spectracom GPS Master Oscillator

Motorola Quantar Transceiver

Spectracom CTCSS

Motorola Quantar Transceiver

Spectracom CTCSS
**Time Delay**

**Not Optimized:** All sites launch at the same time

**Pink:** > 60 uSec Delay, 10 dB or less Carrier/Interferer
**Time Delay**

**Optimized:** Delay from 0 usec to 70 usec

*Pink*: > 60 uSec Delay, 10 dB or less Carrier/Interferer
Tower Road Main Site
Adams County
System Coverage

Forward Link (Talk-Out) – Simulcast Transmit

<table>
<thead>
<tr>
<th>Color</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue/Grey</td>
<td>Excellent indoor and outdoor coverage</td>
</tr>
<tr>
<td>Dark Green</td>
<td>Good indoor and outdoor coverage</td>
</tr>
<tr>
<td>Light Green</td>
<td>Some indoor and good outdoor coverage</td>
</tr>
<tr>
<td>Yellow</td>
<td>Poor indoor and marginal outdoor coverage</td>
</tr>
<tr>
<td>Pink</td>
<td>No indoor and poor coverage</td>
</tr>
<tr>
<td>Red</td>
<td>No coverage</td>
</tr>
</tbody>
</table>
System Coverage

Reverse Link (Talk-Back) – Voted Receive

Color
- Blue/Grey
- Dark Green
- Light Green
- Yellow
- Pink
- Red

Performance
- Excellent indoor and outdoor coverage
- Good indoor and outdoor coverage
- Some indoor and good outdoor coverage
- Poor indoor and marginal outdoor coverage
- No indoor and poor coverage
- No coverage
Adams County Radio System - Channels

- Adams Sheriff (7 site voted/simulcast)
- Adams Paging (7 site voted/simulcast)
- Adams EG (7 site voted/simulcast)
- Adams Highway (7 site voted/simulcast)
Time Delay

Not Optimized: All sites launch at the same time

Pink: > 40 uSec Delay, 10 dB or less Carrier/Interferer
Time Delay

Optimized: Delay from 0 usec to 70 usec

Pink: > 40 uSec Delay, 10 dB or less Carrier/Interferer
Highway Shop Main Site
Lessons Learned
Simulcast Optimization: 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*
Lessons Learned

• System Staging
  • *Stage entire system if possible at a single location*
  • *Test Harris Intraplex remote access*

• Raytheon SNV-12 Operation
  • *SNV-12 has a lowest noise mode and a signal/noise mode*
  • *Signal/noise mode inferior to noise-only mode for FM*
  • *Loss of link or audio failure mode*
    - Use Line Fault Timer – 10 seconds (no audio detected)
    - Use 3 Minute Timer Overall Timer (some audio noise detected)
    - Use of multiplexer alarms to disable SVM cards
Lessons Learned

- Strobe Tower Lighting at VHF
  - Night strobes cause buzz
  - Changed to incandescent
  - Avoid night strobes at VHF

- Monitor Receiver Antenna
  - Used to set simulcast amplitude and check phase
  - Do not use antenna close to test site transmit antenna
  - Overload of monitor receiver has inaccurate amplitude
  - Minimum 50 db isolation recommended
Lessons Learned

• Loss of Coverage from Moving a Site
  • *Any time you move an existing site, expect complaints*

• Avoid Low 2-Tone Paging Tones
  • *Avoid tones below 400 Hz*
  • *Roll-off below 400 Hz may have insufficient deviation*

• Mixing Harris SynchroCast II / SynchroCast III
  • *Have different closed-loop timing*
  • *Ask Harris for the single page instructions*

• Take Care with Hanging System Documents
  • *Don’t let them get sucked into the power supply fan!*
Changes for Next Simulcast System Designs

- Use of Convex 2241
  - *All mixing and transmitter control in one box*
  - *Combination of PL/CTCSS at baseband, PL built-in*
  - *Pre-emphasis Filter for Motorola Quantar*
  - *Allows all optimization from the master site*
- Harris Intraplex VF-40 Card
  - *5 Hz to 3000 Hz response*
  - *Simplified Transmitter Keying*
- Motorola Quantar
  - *Use of baseband audio input for combined audio*
  - *Baseband audio input has no limiting or pre-emphasis!*
  - *Last order date for the Quantar is September 2011*