Simulcast Project Recaps in Wisconsin

Steve Dubberstein
General Manager and Engineer, Communications Service Wisconsin LLC

Simulcast Forum 20
Las Vegas, Nevada
March 24, 2016
Agenda

Marquette County, Wisconsin
Monroe County, Wisconsin
City of Tomah, Wisconsin
Suppliers

- Motorola GTR8000 Transceivers
- Motorola MLC8000 Analog Simulcast Timing and Voting
- Motorola GGM8000 Router and HP 2610-24 Managed Switches
- Aviat Eclipse 6 & 11 GHz Licensed Microwave
- Exalt 4.9 GHz Microwave (with licensing)
- Spectracom SecureSync GPS Master Oscillators
- TXRX Filtering
- RFS Antennas and Cables
The Motorola MLC 8000
The Motorola GTR 8000

- Analog FM
- P25 Phase I Digital
- P25 Phase 2 Digital
- Backward Compatible to Quantar
- No Mix and Match Quantar and GTR8000 in Simulcast
**SpectraCom SecureSync**

**Programmable TTL Output**
The Programmable TTL Output option module card provides four (4) programmable square wave outputs for the SecureSync platform.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>4</td>
</tr>
<tr>
<td>Signal Type and Connector</td>
<td>TTL (BNC into 50 ohms)</td>
</tr>
<tr>
<td>Programmable Period</td>
<td>100 ns to 1,000,000,000 ns in 5 ns steps</td>
</tr>
<tr>
<td></td>
<td>100 µs to 60,000,000 µs in 1 µs steps</td>
</tr>
<tr>
<td>Pulse Width Range</td>
<td>20 ns - 900 ms in 20 ns steps</td>
</tr>
<tr>
<td>Rise Time to 90% of Level</td>
<td>&lt; 40 ns</td>
</tr>
<tr>
<td>Maximum Number of Cards:</td>
<td>6</td>
</tr>
</tbody>
</table>

**Ordering Information**
1204-17: Programmable TTL output module
IP Microwave

• Separate LAN or VLAN for Radio-Only Traffic
  o ‘Dedicated’ bandwidth for radio-only traffic
  o All other traffic on separate LAN/VLAN with a maximum bandwidth

• Exalt EX-4.9i Microwave (4.9 GHz)
  o All indoor unit
  o No hot standby

• Aviat Eclipse Microwave (6 GHz and 10/11 GHz)
Wisconsin South Central Public Safety Radio Systems

- **JACKSON**: 10 site analog simulcast
- **MONROE**: 9 site analog simulcast under contract
- **LA CROSSE**: 6 site analog simulcast
- **Vernon**: 6-site analog, simulcast system planned
- **CRAWFORD**: 4 site analog simulcast
- **Richland**: multi-site analog
- **SAUK**: 11 site analog simulcast
- **WISCOM P25**: 7 site analog simulcast
- **WOOD**: 6 site analog simulcast
- **PORTAGE**: Simulcast under construction
- **WAUPACA**: 6 site analog simulcast
- **WAUSHARA**: 6 site digital simulcast
- **MARQUETTE**: 4 site analog simulcast
- **GREEN LAKE**: 4 site analog simulcast
- **DANE**
- **COLUMBIA**: 9 site analog simulcast
- **WAUPACA**: 6 site analog simulcast
Marquette County
Marquette County – Simulcast System Installed in 2004

Westfield

Montello

Endeavor

Princeton
Marquette County – Simulcast Upgrade – 3 Channels

- Springfield
- Westfield
- Montello
- Neshkoro
- Princeton
- Endeavor
- Oxford
- Buffalo
- Briggsville
Four (4) Site Simulcast System Coverage

- Montello
- Westfield
- Endeavor
- Princeton

Grey: Excellent portable and pager coverage
Dark Green: Good portable and pager coverage
Light Green: Marginal portable and pager coverage
Yellow: No portable or pager coverage, marginal mobile coverage
Red: No mobile coverage
9-Site Simulcast System Coverage

- Montello
- Westfield
- Endeavor
- Princeton
- Buffalo
- Briggsville
- Neshkoro
- Oxford
- Springfield

Grey: Excellent portable and pager coverage
Dark Green: Good portable and pager coverage
Light Green: Marginal portable and pager coverage
Yellow: No portable or pager coverage, marginal mobile coverage
Red: No mobile coverage
Marquette 4.9 GHz Frequency Plan: Final
Marquette County – Lessons Learned

• Management of a Simulcast IP Network
  o GGM8000 Script-Based Router
  o IP Traffic Management – Use of IT Tools such as Pingplotter
  o IP Settings – Ethernet Auto Speed vs. set at 100 Mbps

• Spectracom SecureSync
  o Single or Multiple Units Suddenly Lost Satellite Sync
  o Fixed with a Firmware Upgrade – Good Response from Spectracom
  o SecureSync Programmable TTL Board Works Well with Motorola
    5 MHz Composite Signal Requirement

• Motorola MLC8000
  o Alarming Available on MLC8000
  o Some Settings Would Not Take – Addressed with Service Bulletin
  o Consider Remote Site Transmit Inhibit for Simulcast Optimization
  o Wimpy Wireline Input – Protect if using Leased Lines

• New Tower Implementation Delays
  o Blue Butterflies
  o Native American Clearance
Marquette County – Pingplotter from Main Site
Monroe County
Monroe County 10 Site Simulcast System (Final Design)
Monroe County Simulcast System – Aviat Microwave System

6 GHz loop
6 GHz
class b2
class b2
dishes non-
dishes non-
hot standby
hot standby
## Monroe County – Channel by Channel Description

<table>
<thead>
<tr>
<th>Sheriff</th>
<th>Sheriff</th>
<th>Sheriff</th>
<th>Sheriff</th>
<th>Sheriff</th>
<th>Sheriff</th>
<th>Sheriff</th>
<th>Sheriff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ridgeville</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
</tr>
<tr>
<td>US Cell Sparta</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>US Cell Cataract</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
</tr>
<tr>
<td>Warrens Water Tower</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Dairyland Oakdale</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>US Cell Kendall</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>US Cell Cashton</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>US Cell Wilton</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>US Cell Norwalk</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>simulcast/voted</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>
Monroe County VHF Frequencies - Changes

- Monroe County had Licenses for All Frequencies Considered
- Locations had to be added – Letters of Concurrence Required
- Issues with LOC’s from Agencies with Pagers
- No DPL Used on Simulcast Transmit Frequencies
- Change of PL or DPL Due to Tropospheric Skip Interference

<table>
<thead>
<tr>
<th>Channel</th>
<th>Channel Name</th>
<th>Mobile Receive (Base Transmit)</th>
<th>Mobile Receive (Base Transmit) PL/CTCSS</th>
<th>Mobile Transmit (Base Receive)</th>
<th>Mobile Transmit (Base Receive) PL/CTCSS DPL/DCS</th>
<th>Type</th>
<th>FCC Emission Designator</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHERIFF</td>
<td>MOSHF</td>
<td>155.625</td>
<td>PL 5A 156.7 HZ</td>
<td>158.910</td>
<td>DPL 532</td>
<td>NARROWBAND</td>
<td>11K2F3E</td>
</tr>
<tr>
<td>FIRE CH 1</td>
<td>MOFIRE</td>
<td>154.400</td>
<td>PL WB 79.7 HZ</td>
<td>158.985</td>
<td>DPL 465</td>
<td>NARROWBAND</td>
<td>11K2F3E</td>
</tr>
<tr>
<td>FIRE CH 2 FIRE MAIN / PAGE</td>
<td>MOPAGE</td>
<td>154.235</td>
<td>PL 5A 156.7 HZ</td>
<td>159.240</td>
<td>PL YZ 82.5 HZ</td>
<td>NARROWBAND</td>
<td>11K2F3E</td>
</tr>
<tr>
<td>COUNTY 4 EMS</td>
<td>MOEMS</td>
<td>155.925</td>
<td>PL ZA 94.8 HZ</td>
<td>153.905</td>
<td>PL ZA 94.8 HZ</td>
<td>NARROWBAND</td>
<td>11K2F3E</td>
</tr>
<tr>
<td>HIGHWAY</td>
<td>MOHWY</td>
<td>154.115</td>
<td>PL M4 225.7 HZ</td>
<td>159.090</td>
<td>PL M4 225.7 HZ</td>
<td>NARROWBAND</td>
<td>11K2F3E</td>
</tr>
<tr>
<td>COUNTY 3 GOVERNMENT</td>
<td>MOCORD</td>
<td>155.085</td>
<td>PL YB 88.5 HZ</td>
<td>153.785</td>
<td>PL XA 71.9 HZ</td>
<td>NARROWBAND</td>
<td>11K2F3E</td>
</tr>
</tbody>
</table>
Monroe County – Current Radio Coverage (Ridgeville)

Blue/Grey: Excellent portable and pager coverage
Dark Green: Good portable and pager coverage
Light Green: Acceptable portable and pager coverage
Yellow: Poor portable and pager coverage
Red: No portable or pager coverage, poor mobile coverage
Monroe County – Current Radio Coverage (2 Towers)

Blue/Grey: Excellent portable and pager coverage
Dark Green: Good portable and pager coverage
Light Green: Acceptable portable and pager coverage
Yellow: Poor portable and pager coverage
Red: No portable or pager coverage, poor mobile coverage
Monroe County – 9 Site Radio Coverage

Blue/Grey: Excellent portable and pager coverage
Dark Green: Good portable and pager coverage
Light Green: Acceptable portable and pager coverage
Yellow: Poor portable and pager coverage
Red: No portable or pager coverage, poor mobile coverage
Six Mile Boundaries

Figure 3: Six-Mile Boundaries for Monroe County Rural Fire Departments

Monroe County RFP, page 99, Figure 3
Monroe County – 9 Site Radio Coverage - CSW

Blue/Grey: Excellent portable and pager coverage
Dark Green: Good portable and pager coverage
Light Green: Acceptable portable and pager coverage
Yellow: Poor portable and pager coverage
Red: No portable or pager coverage, poor mobile coverage
Monroe County - Analog Simulcast

9 Sites, Simulcast Time Delay 70 usec, C/I 10 db or less
Monroe County – P25 Simulcast

9 Sites, Simulcast Time Delay 25 usec, C/I 10 db or less
Monroe County – System Notes

• PL Modifications to Avoid IM products
  o Use of DPL on Input Frequencies
  o Change of PL or DPL Due to Tropospheric Skip Interference

• FCC Frequency Coordination Issues
  o No New Frequencies Licensed
  o New Towers Caused Contour Overlaps
  o One (1) Letter of Concurrence denied – ERP Lowered
  o One (1) Site/Frequency Rejection from FCC – ERP Lowered

• 6 GHz Microwave Flexibility
  o Use of Class B2 Antennas
  o Flexible Dish Sizes
  o Workable in Rural Areas

• Leased Towers and Tower Loading Studies
  o The Uncertainty of Tower Loading Studies
  o Delays and Requirements from Lessors
  o Use of 10 Feet of Tower Space – TXRX Filtering Considerations
Tomah Police Department
City of Tomah, Wisconsin

• Small Wisconsin City
  o Population 9,328
  o Reasonably Flat Terrain
  o Dedicated Police Department Dispatched on its Own Channel
  o In Monroe County, Wisconsin

• Indoor Coverage Problems
  o Single Site at Police Department
  o Added Voting Site – Now had Downlink Problems
  o Unbalanced Uplink/Downlink Depending on Location

• Small System Simulcast Solution
  o Expand to add a 3rd Site
  o Exalt 4.9 GHz MW Backhaul
    - Tried DSL modems on leased lines but failed
  o Simulcast and Voted from All Three (3) Sites
  o Motorola GTR8000 and MLC8000 – No Routers
  o Spectracom SecureSync
  o Affordable for a City Budget
City of Tomah PD Original System
City of Tomah PD Final Simulcast Voted System
City of Tomah Original Indoor Talk-Back from Portables
City of Tomah Final Indoor Talk-Back from Portables
City of Tomah Original Indoor Talk-Out to Portables
City of Tomah Final Indoor Talk-Out to Portables