Narrowband Analog Simulcast Workshop

APCO/Philadelphia
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Ed O’Connor – Simulcast Solutions LLC / Fairport, NY
Lou Albert - RF Design & Integration / Philadelphia, PA
Alan Pugh - AM Pugh Assoc / Shavertown, PA
• FCC requires 12.5 kHz channels by 1/1/2013
Your Towers Aren’t Able to Reach Everyone

• Some long standing “holes” still need to be filled

• Consolidation has resulted in a larger geography than the past
This Afternoon’s Workshop Topics

• Simulcast Parameters & Narrowband “Coverage”

• System Providers & Available Products

• Race the FCC

• MONOC NJ System Recap – Lou Albert

• Wyoming County, PA System Recap - Alan Pugh

• Open Discussion of Participant Systems
Simulcast

• Contraction of simultaneous broadcast

• Broadcast the same modulation on the same frequency from multiple transmitters at the same time
25kHz Simulcast Technical Challenges for Intelligible Overlap (+/- 10dB)

• Carrier Accuracy
  +/- 0.1Hz @800/450/150MHz

• Audio and CTCSS Alignment
  +/- 30 degrees (= +/- 70usec)

• Modulation Adjustment – Recovered Audio
  +/- 0.2dB
12.5kHz Simulcast Technical Challenges for Intelligible Overlap

- Carrier Accuracy – same as 25kHz
- Audio and CTCSS Alignment – “more critical” than 25kHz
- Modulation Adjustment – Recovered Audio – “more critical”

Capture effect less pronounced (approx +/- 15 to 20dB)
Narrow IF filters do not handle impulse noise as well
Signal to noise ratio may adversely affect audio recovery
12.5kHz Simulcast

- Make sure 12.5 mobiles and portables selected do not have reduced hum, distortion or performance specifications.

- Older test equipment may not have good resolution for narrowband deviation measurements (it is not as easy to measure 2.5 kHz deviation on scales of 2, 6, 20, or 40kHz).

- Narrowband area coverage decreases resulting from reduced audio quality and signal-to-noise ratio are approximately equivalent to a 3 dB decreased power level. Range is reduced because it takes a higher signal level to provide the same voice quality. The actual received RF signal levels stay the same.
Radio Manufacturers who Provide Turn-key Conventional Simulcast

- Conventional Simulcast
  - Harris PSPC
  - Motorola
  - Tait Radio Communications
Simulcast Systems
Installed by Radio Dealers or Self-Integrating End Users

- Require specialized equipment
  - GPS Master Oscillators
  - Audio Delay
  - Voters
- Simulcast Capable Base Stations
Voting

- A shelf handles up to 12 remote receivers
- Idle tones of 2175Hz, 1950Hz or E&M
- Transmitter keying E&M (or EIA tones)

- Model SNV-12 from Raytheon
Frequency Control

- GPS / OCXO Master Oscillator
- Precisely match carrier frequency
- Synchronize outgoing CTCSS (=PL = CG)
- GPS / Rb available for longer holdover
- SecureSync from Spectracom
Audio Delay

- rf linked
  - Manual
- hub and spoke digital uwave (not MDS 900S)
  - Manual
- loop digital uwave
  - M (2 values)
    - Dynamic
- Telco T1
  - Dynamic
- GE-MDS 900S-FT1
  - Dynamic
- SONET
  - Dynamic
- IP (VLAN, not public internet)
  - Dynamic
- Telco 4-wire (not recommended)
  - Man or Dyn
    - (NO)
- Analog uwave
Manual Audio Delay

Talk-Out
Audio Delay - Manual
Audio Delay – Dynamic

- Remote Delay Line
- For paging and rf linked two way systems
- Local RS232 control
- DTMF remote control
- Individually addressable on common channel

- Model VDL-RS from Convex
Dynamic Audio Delay

Talk-Out
Audio Delay - Manual
Audio Delay – Dynamic

- For single VF channels (no VoIP channels)
- Cost-efficient for a few channels
- Control Timing Unit is installed at Main Site
- Requires a GPS Master Oscillator at all sites
- Automatic Delay Line (ADL) from Convex
Dynamic Audio Delay

- For IP, T1 microwave, telco T1, or SONET
- Cost-efficient for multiple channels
- Special mux “simulcast” control cards
- Requires a GPS Master Oscillator at all sites
- SynchroCast3 from Harris Broadcast
Audio Booster Limiter

• Amplifies low volume, does not overdrive channel
• Does not boost noise floor
• Designed for LMR, strips out 2175 and 1950 before DSP and then reinserts tones after DSP
• Voice Optimizer Model NBL-4
Downloadable from
www.simulcastsolution.com

Project Recaps from annual Simulcast Forums
Technical Details
  Manuals / Data Sheets
  Bid Specification Templates
Application Notes
Budgetary Pricing
• Narrowband Planning Tool developed by ADCOMM Engineering / Seattle WA

• Outlines the Conversion Process Steps

• Audience: Executives, Boards, Project Managers
Steps to Narrow Band

• ~15 steps
• Some agencies may have simple process
  – Limited coverage area and existing coverage very good
  – New equipment
• Some agencies may have difficult process
  – Large coverage area and existing coverage has poor areas
  – Old equipment

• Will you hire a consultant or additional resources?
Steps To Narrowband

- Raise awareness
- Planning funds
- Plan, determine current state
- Evaluate radio system
- Implementation funds, system changes
- Transition plan
- Subscriber funds, order
- Coverage & sites

- Engineering, new sites
- Order infrastructure
- FCC licensing
- Rehearse transition plan, install infrastructure & subscriber units
- Tune, time, test & train
- Cut over
- System maintenance
Coverage

- It will likely change
Playing the “Game”

6 Develop Transition Plan
   Calculate & secure funding for narrowband conversion

7 Help User agencies secure $$ for radio replacement
   Order mobiles, portables and required other parts (mounts, batteries, etc.)

Board Meeting!
Roll a die and ADD 1 if you hired a Consultant.
If your total is:
1-2: Sorry, Board needs more time before approval. Advance the calendar 1 extra quarter, then continue with Task 3.
3-7 Great Presentation! Continue with Task 7.
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MONOC Narrowband Simulcast
Wideband Portable Indoor Talk in Coverage
Narrowband Portable Indoor Talk in Coverage
One of these plots is Wideband the other is Narrowband - can you tell the difference?
Reference the outline circles
Which is Wideband and which is Narrowband
UHF Wideband Indoor Portable Talk-in coverage

UHF Narrowband Indoor Portable Talk-in coverage
Wideband Portable Indoor Talk out Coverage
Narrowband Portable Indoor Talk out Coverage
Coverage losses mostly in the same areas with less occurrence
Talkout Portable coverage (Wideband Left) (Narrowband Right)
TDI Plot  Brown spots indicate a value greater then 36us of time difference
Wyoming County NB Simulcast

Alan Pugh
A M Pugh Associates / Shavertown, PA
The Challenge:

Utilize existing equipment for Narrowband simulcast as possible.

Determine Radio coverage changes.

Test for performance to determine upgrade requirements.
Coverage at 25kHz
Coverage at 12.5 kHz
Our 2-Site 1-Channel Narrowband Test

- Aviat microwave radios
- Harris ACS-163 Multiplexers
- Spectra-Tac voter comparator
- Spectracom GPS Master Oscillators
- Motorola MTR-2000 Transmitters
- All Equipment was Existing
MTR-2000’s radios had various software versions. (Previous test have proven this is unsuccessful with Quantar's)

Existing system uses manual timing.

Best results obtained by using the same service monitor at all sites, recalibrating each time and completing final tuning in one day.

Compared all available MTR-2000 radios and grouped by software versions.

Some code plugs were updated as needed.

Final coverage tests performed and compared to Wideband.
Other conversion experiences

Excerpts from Joe Blaschka’s email

Experience of workshop participants
Discussion about your systems and challenges ....
If We Can Help Solve Some of Your Comm Problems ….

For information on simulcast hardware visit www.simulcastsolutions.com, call 585-223-4927 or email ed@simulcastsolutions.com

For the narrowband planning tool visit www.adcomm911.com, or email j.blaschka@adcomm911.com