Motorola Simulcast

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Distinguished MTS
System Architecture/System Design
Why Simulcast?

- Wide Area Coverage
- Improved Channel Efficiency
- Increased In-Building Penetration
- Simple User Operation
Why Motorola Simulcast?

- 4th Generation System Design
- Single Point Optimization
- The Clear Leader in Installed and Working Systems
  - Nearly 400 simulcast systems installed in the last eight years.
- Clear Audio
Specifications Make the Difference in Simulcast Overlap!!!!

New System

“POPS” Similar to Single Site Multipath

Older System

Frequency and Duration of “POPS” Increase
System Configurations

- Analog
  - Conventional
  - Trunked (SZ, SZOL, SN)
- Digital
  - Conventional
  - Trunked (SZ, SZOL)
  - Modulations
    - Wide Pulse (C4FM with proprietary tx filtering)
    - Linear (P-25 CQPSK)
    - Narrow Pulse (P-25 C4FM)
- Mixed Mode
- Frequency Bands
  - High Band
  - 380 MHz Fed LMR
  - UHF
  - UHF Shared TV
  - 700 MHz PS + Guard Band
    - Dual 700/800 sites
  - 800 MHz
  - 900 MHz
  - Low Band
    - Special Situations
- Simulcast & rcvr voting available
## Simulcast Site Separation

<table>
<thead>
<tr>
<th>Widepulse</th>
<th>Linear</th>
<th>Narrowpulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 kHz</td>
<td>12.5 kHz</td>
<td>12.5 kHz</td>
</tr>
<tr>
<td>~ 21 miles*</td>
<td>~ 14 miles*</td>
<td>~7 miles*</td>
</tr>
<tr>
<td>Analog &amp; Digital</td>
<td>Digital Only</td>
<td>Analog &amp; Digital</td>
</tr>
</tbody>
</table>

*Digital Only recommended

* Dependent on system design
Motorola GPS Simulcast System Theory

- Many variations in RF bands supported, modulation type and equipment used, but basic operation is identical in all cases.
Motorola GPS Simulcast System Theory

- Audio/voice data is collected at a single point.

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Motorola GPS Simulcast System Theory

- Audio is GPS time stamped with the time the audio should be launched from each site.
- Audio is sent out to the sites.
Motorola GPS Simulcast System Theory

- Links from prime to remote sites are of unequal length resulting in different propagation times across each link.
Motorola GPS Simulcast System Theory

- Audio arrives at “closer” sites before arriving at “distant” ones.
Motorola GPS Simulcast System Theory

- Audio is held until the time is exactly right for it to be launched simultaneously from each site.
Motorola GPS Simulcast System Theory

- When the previously stamped time matches the current and actual GPS time, the audio is launched from all transmitters at exactly the same time.
Motorola GPS Simulcast System Theory

- Having the delay element at the remote site allows the path “length” from prime to remote site to change without system impact.

- Technician can measure and adjust path delay on each link using PC and built-in-test functionality on ASTRO-TAC comparator.
Motorola GPS Simulcast System Theory

- If the link delay is greater than the maximum anticipated at installation (time to launch has passed when audio arrives) an alarm will be generated to NM equipment.

Alarm to Network Management
Motorola GPS Simulcast System Theory

- The “Delay” block is actually done by different equipment between analog and digital system configurations.

- DSM II Channel Bank Card for Analog
- Internal Base Station functionality for ASTRO Digital
Motorola GPS Simulcast System Theory

- The fact that the delay is done internally to the base station allows digital simulcast with low density sites to be done without channel banks using inexpensive 4-wire leased lines.

TRAK 9100 GPS Freq Std.
Motorola GPS Simulcast System Theory

- Analog simulcast and high-density digital sites use TeNSr Channel Banks.

TeNSr/800 Channel Bank

Quantar Repeater

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Analog vs. Digital Equipment

**ANALOG**

- DIGITAC Comparator
- USCI/CSCI
- TeNSr Channel Bank
  - DSM II Card

**DIGITAL**

- STR-3000 Repeater (700/800 MHz)
- ASTRO-TAC 3000 or 9600 Comparator
- TeNSr Channel bank
  - SRU (data) Card
- 4-Wire leased-line modem
  - Internal Quantar ASTRO Modem
  - External Paradyne Modem

**Common to Analog & Digital**

- Quantar Repeater (VHF/UHF/800)
- Rb Standard/GPS Receiver (TRAK 9100)
Motorola GPS Simulcast Components

- DSM-II (analog simulcast) cards in center.
  - 1 pps on BNC.
  - Analog audio on 50 pin telco connectors
  - 4 duplex repeater channels per card.
  - E&M signaling.
  - Wide band, Passes PL/DPL/low-speed data.
Motorola GPS Simulcast Components

- ASTRO-TAC Voting Comparators
  - 15 Site trunked capability.
  - 64 Site conventional capability.
  - P-25, Analog capable
  - GPS timestamp capability for digital
  - Ports support V.24 digital, Internal modem and 4-wire analog
  - VoIP interface on ASTRO-TAC 9600
Motorola GPS Simulcast Components

• STR-3000 Linear Simulcast Station
  – 700/800 MHz capability
  – 6 channels per rack
  – 100 W per channel
  – Ethernet connection for software download, service, and alarms.
  – P-25 digital.
  – V.24 digital interface to prime-site comparator.
Motorola GPS Simulcast Components

- Quantar Stations
  - VHF/UHF/800/900 MHz capability
  - 25-350 W (depending on RF band and options)
  - RS232/Ethernet connection for software download, service, and alarms.
  - Analog/P-25 digital capable.
  - 4-wire/V.24 digital interface to prime-site comparator.
Motorola GPS Simulcast Components

- **Trak 9100 Time/frequency standard**
  - GPS Disciplined rubidium oscillator, double oven crystal back-up.
  - Redundant GPS receiver and antennas
  - Standard reference outputs include 10 MHz, 5 MPPS, 1 PPS
  - Off-line A/B switching in each distribution module, no signal point of switch failure
  - Ethernet with Network Time Protocol Server (NTP) and Telnet capability
Conventional Analog Simulcast Technology

Co-Located Remote Site

VT-100 Terminal Session /Service PC

Conventional Simulcast Control Interface

TeNSr DSM-II

Receiver Comparator

GPS

Rb

Test/Monitor Equipment

Remote Site

PRIME

Site

T1 Links

RX

TX

GPS

Rb

TeNSr DSM-II

Remote Site

VT-100 Terminal Session /Service PC

Conventional Simulcast Control Interface

TeNSr DSM-II

Receiver Comparator

GPS

Rb

GPS

Motorola General Business

HSO - Hi Stab Osc. / Rubidium

Time Stamp - Global Positioning Sat.

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Conventional ASTRO Digital Simulcast Technology (Channel banks)

Motorola General Business
HSO - Hi Stab Osc. / Rubidium
Time Stamp - Global Positioning Sat.

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Conventional ASTRO Digital Simulcast Technology (4-wire modems)
ASTRO Trunked Digital Simulcast (3600)

Co-Located Remote Site

Test/Monitor Equipment

VT-100 Terminal Session/Service PC

Prime-Site Trunking Controller

Remote Site

Controller

GPS

Rb

TeNSr SRU

Receive Comparator

Remote Site Controller

T1 Links

TeNSr SRU

GPS

Rb

VT-100 Terminal Session/Service PC

Prime-Site Trunking Controller

GPS

Rb
Motorola Simulcast

QUESTIONS?
TeNSr Channel Bank

Various Options

<table>
<thead>
<tr>
<th>INTERFACE CARD</th>
<th>USER CARD1</th>
<th>USER CARD2</th>
<th>USER CARD3</th>
<th>USER CARD4</th>
<th>USER CARD5</th>
<th>USER CARD6</th>
<th>USER CARD7</th>
<th>USER CARD8</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF</td>
<td>E &amp; M</td>
<td>FXO</td>
<td>DATA</td>
<td>SRU</td>
<td>ALARM</td>
<td>DSM II</td>
<td>DSM II</td>
<td>DSM II</td>
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# TeNSr Channel Bank

![Diagram of TeNSr Channel Bank](image)

<table>
<thead>
<tr>
<th></th>
<th>CPU1</th>
<th>RDNT CPU2</th>
<th>SEVR CARD 1</th>
<th>SEVR CARD 2</th>
<th>SEVR CARD 3</th>
<th>WAN1 CARD CSU</th>
<th>WAN2 CARD CSU</th>
<th>WAN3 CARD CSU</th>
<th>WAN4 CARD CSU or RDNT WAN CSU</th>
<th>PS1</th>
<th>RDNT PS2</th>
</tr>
</thead>
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