

Motorola Simulcast



John Gilbert
Distinguished MTS
System Architecture/System Design

Motorola General Business Information, APCO 03 Motorola Seminar.ppt, Rev 0

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Why Simulcast?

- Wide Area Coverage
- Improved Channel Efficiency
- Increased In-Building Penetration
- Simple User Operation

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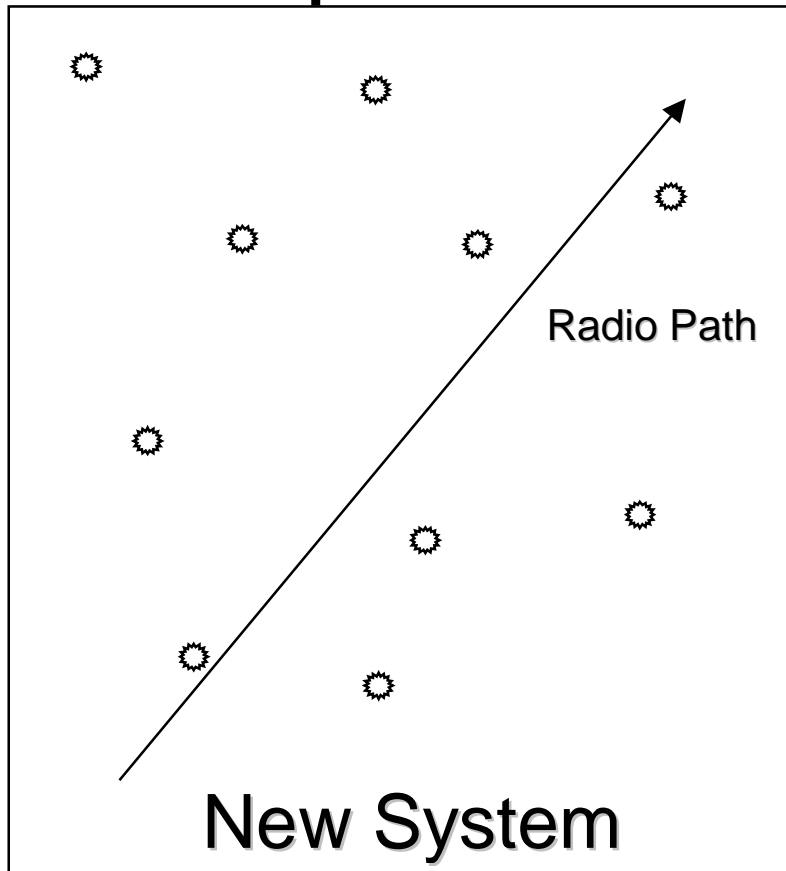
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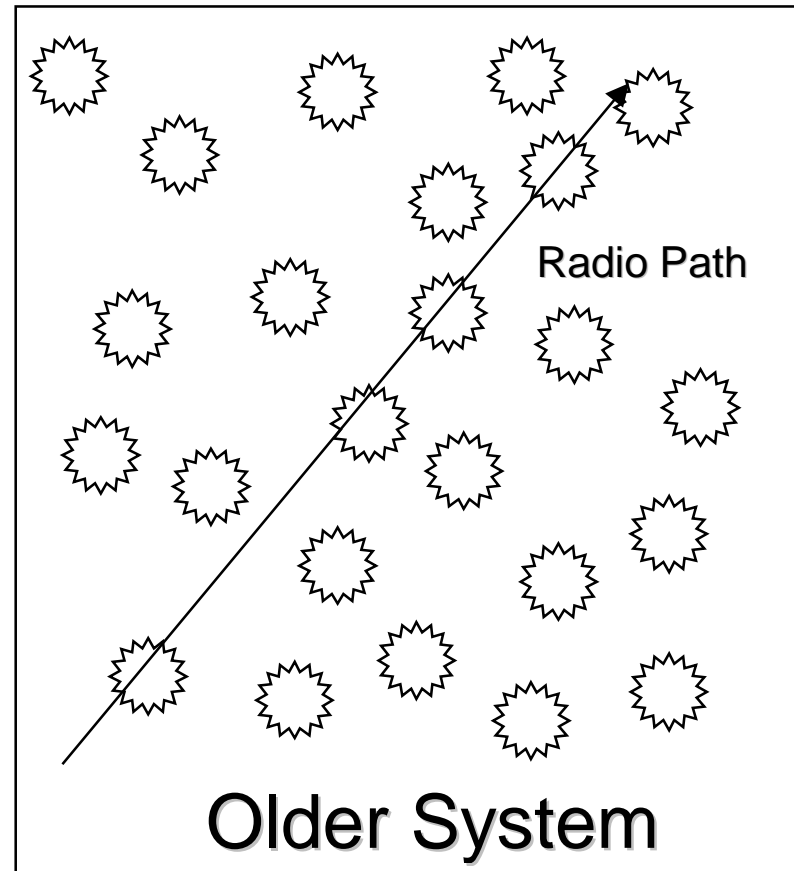
Why Motorola Simulcast?

- 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!!!!



“POPS” Similar to Single Site Multipath



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

Widepulse

- 25 kHz
- ~ 21 miles*
- Analog & Digital

Linear

- 12.5 kHz
- ~ 14 miles*
- Digital Only

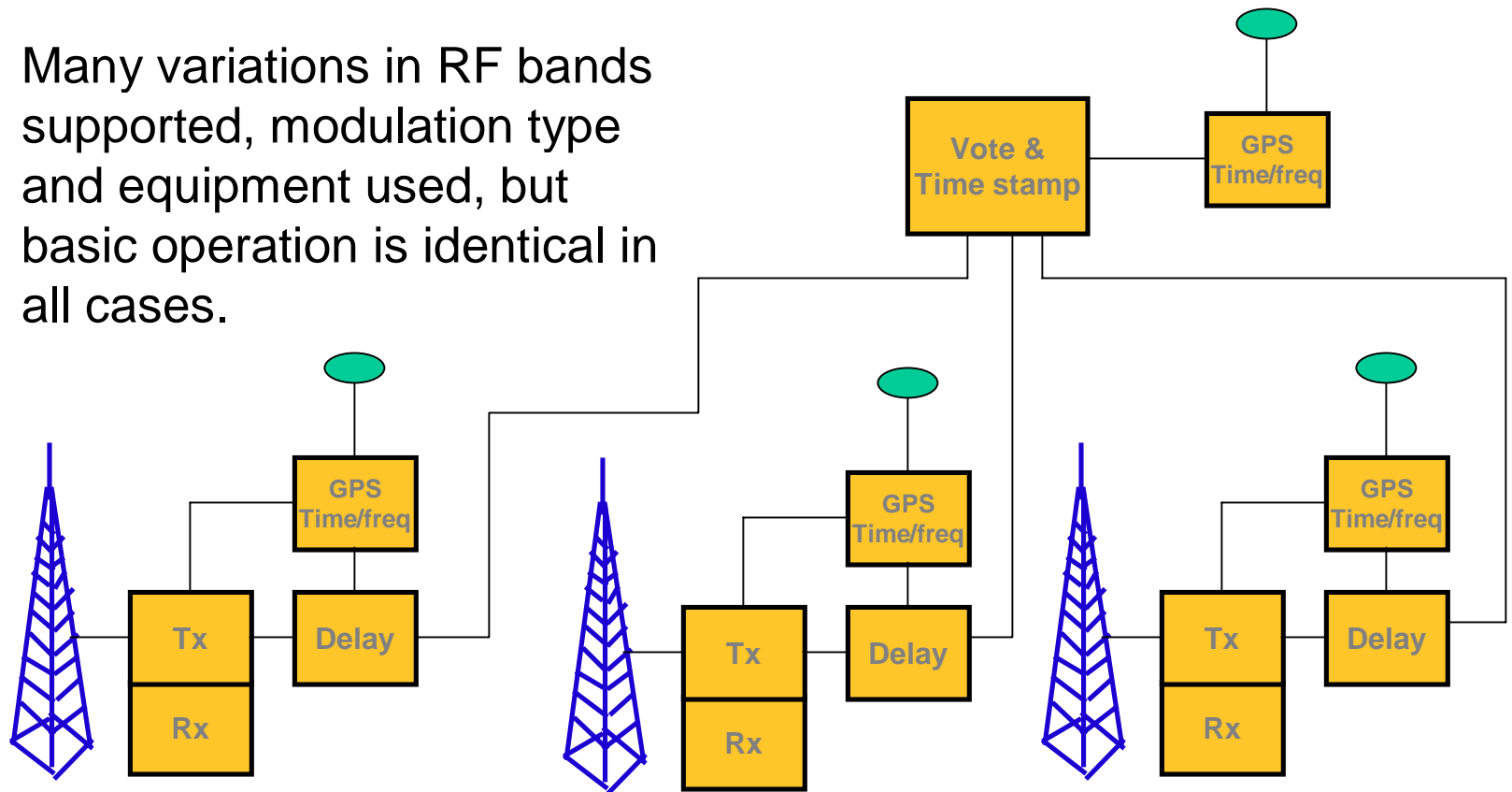
Narrowpulse

- 12.5 kHz
- ~7 miles*
- Analog & Digital
- Digital 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.



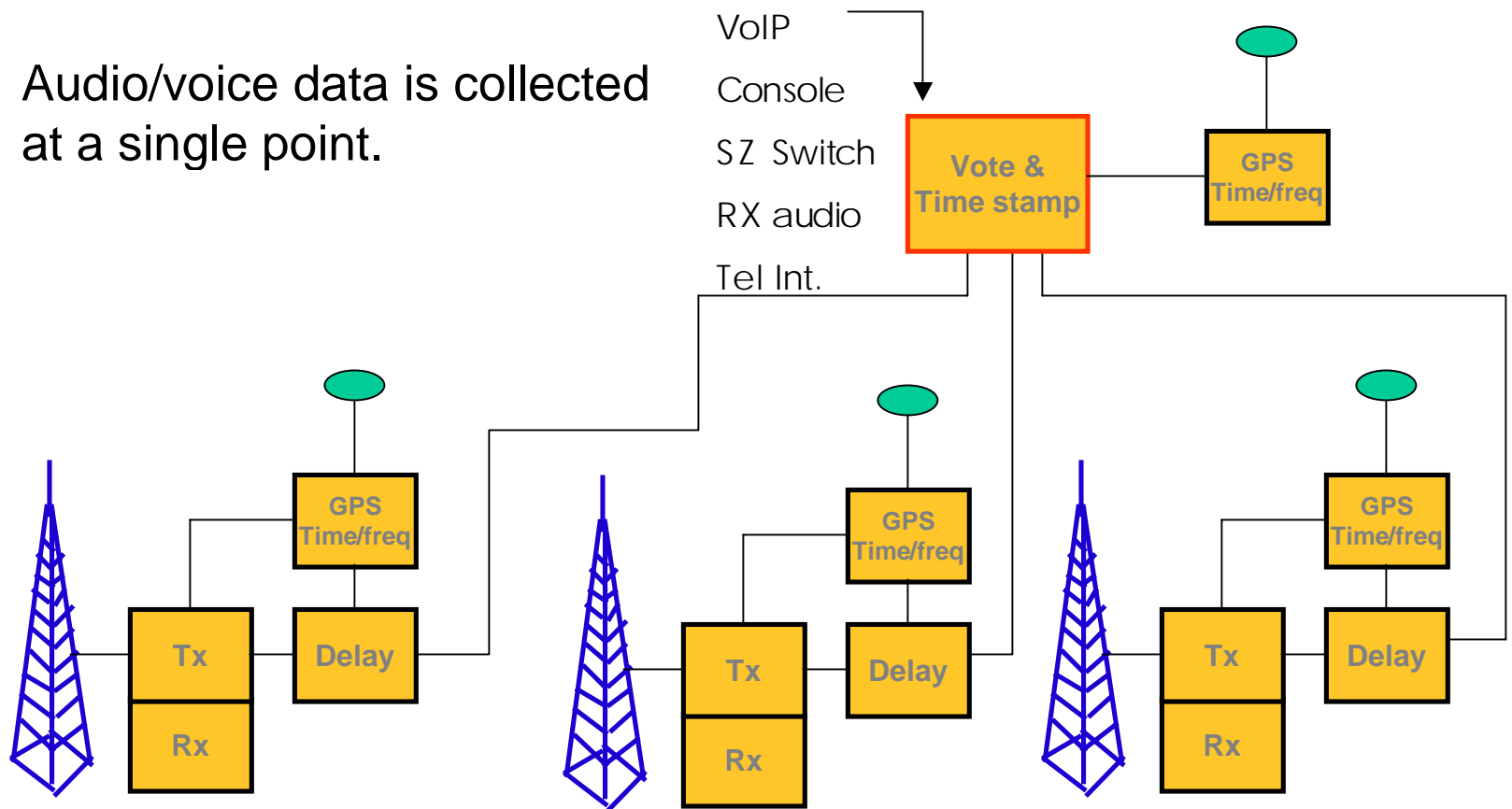
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Motorola GPS Simulcast System Theory

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



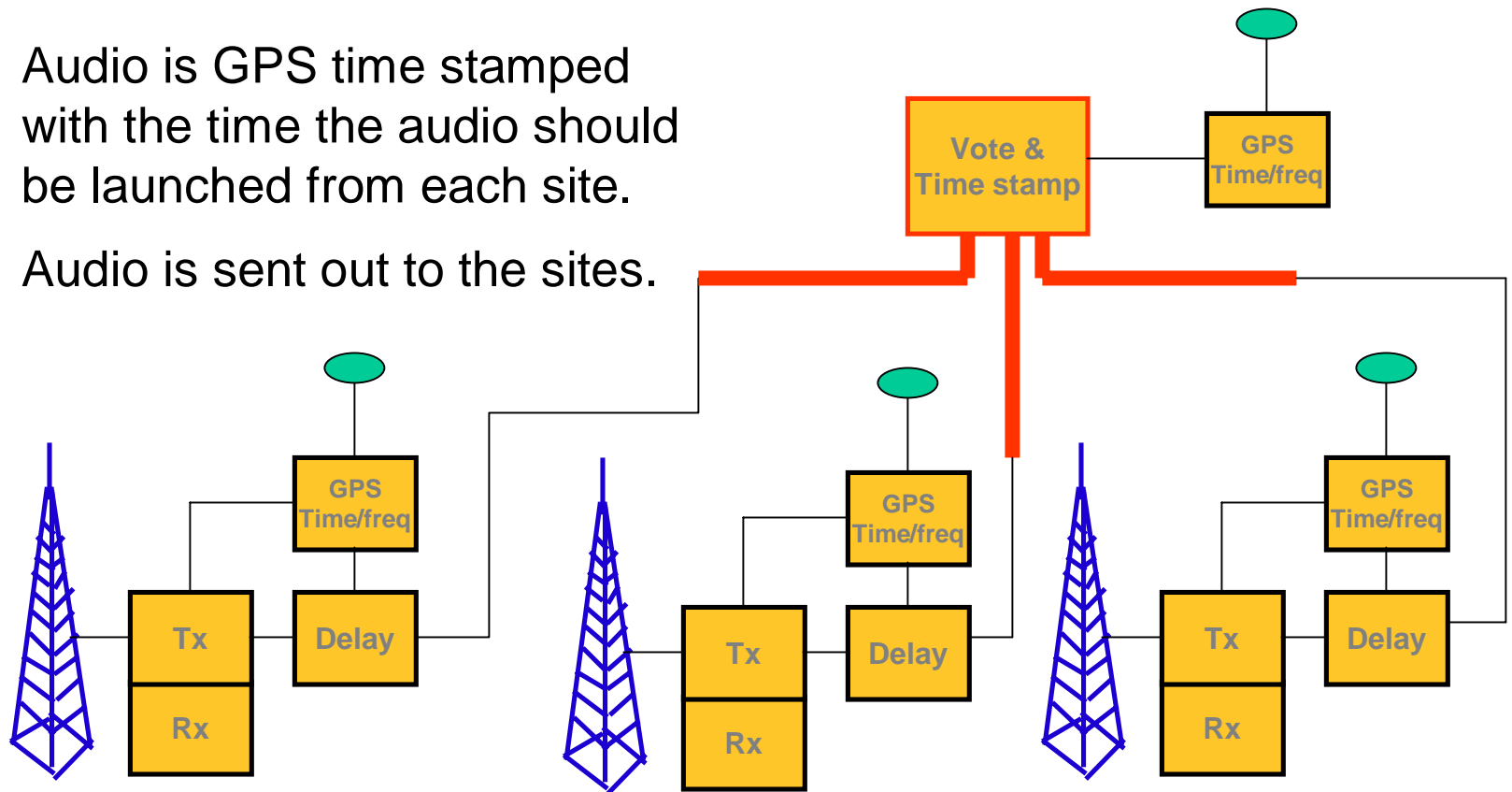
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Motorola GPS Simulcast System Theory

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



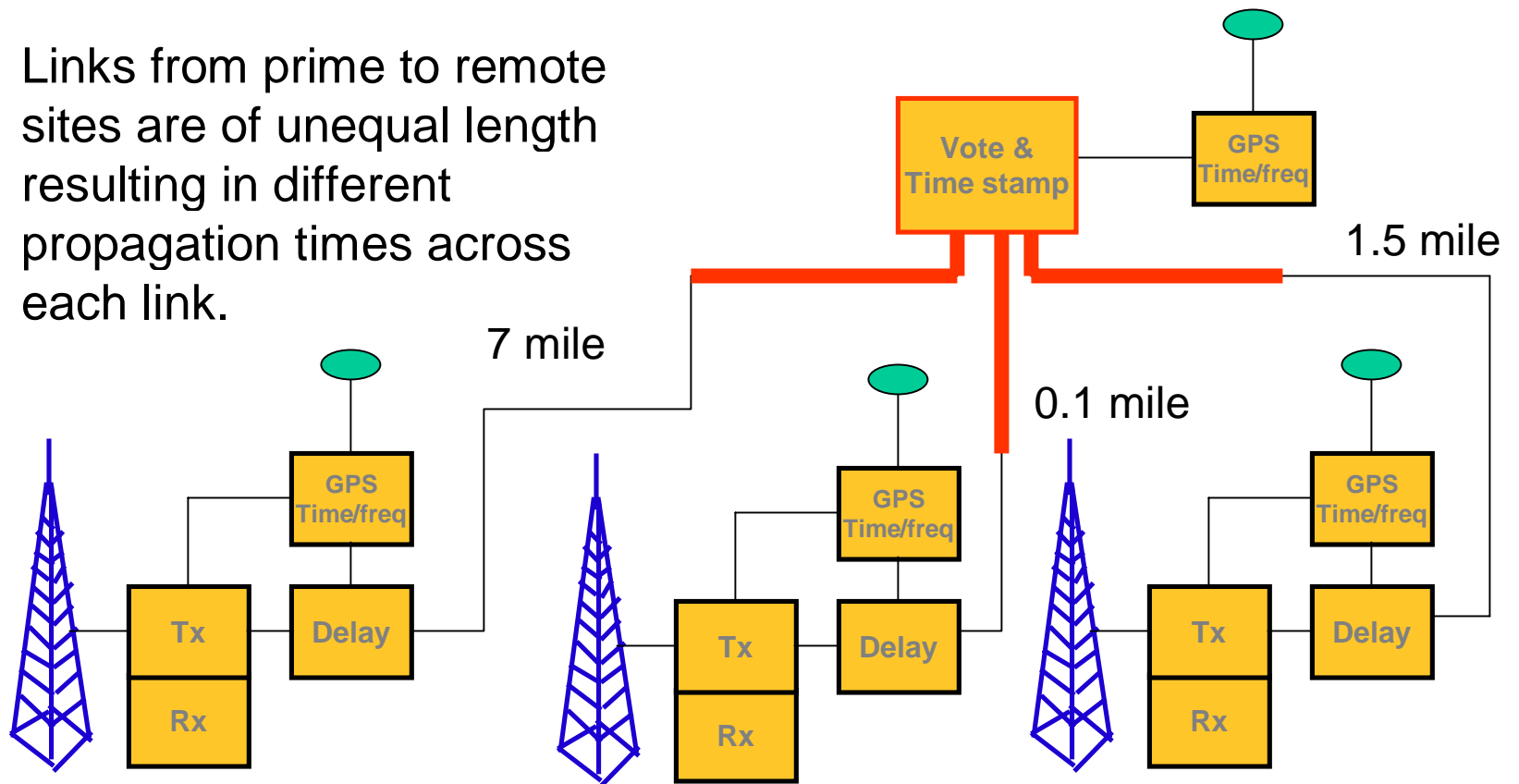
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Motorola GPS Simulcast System Theory

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



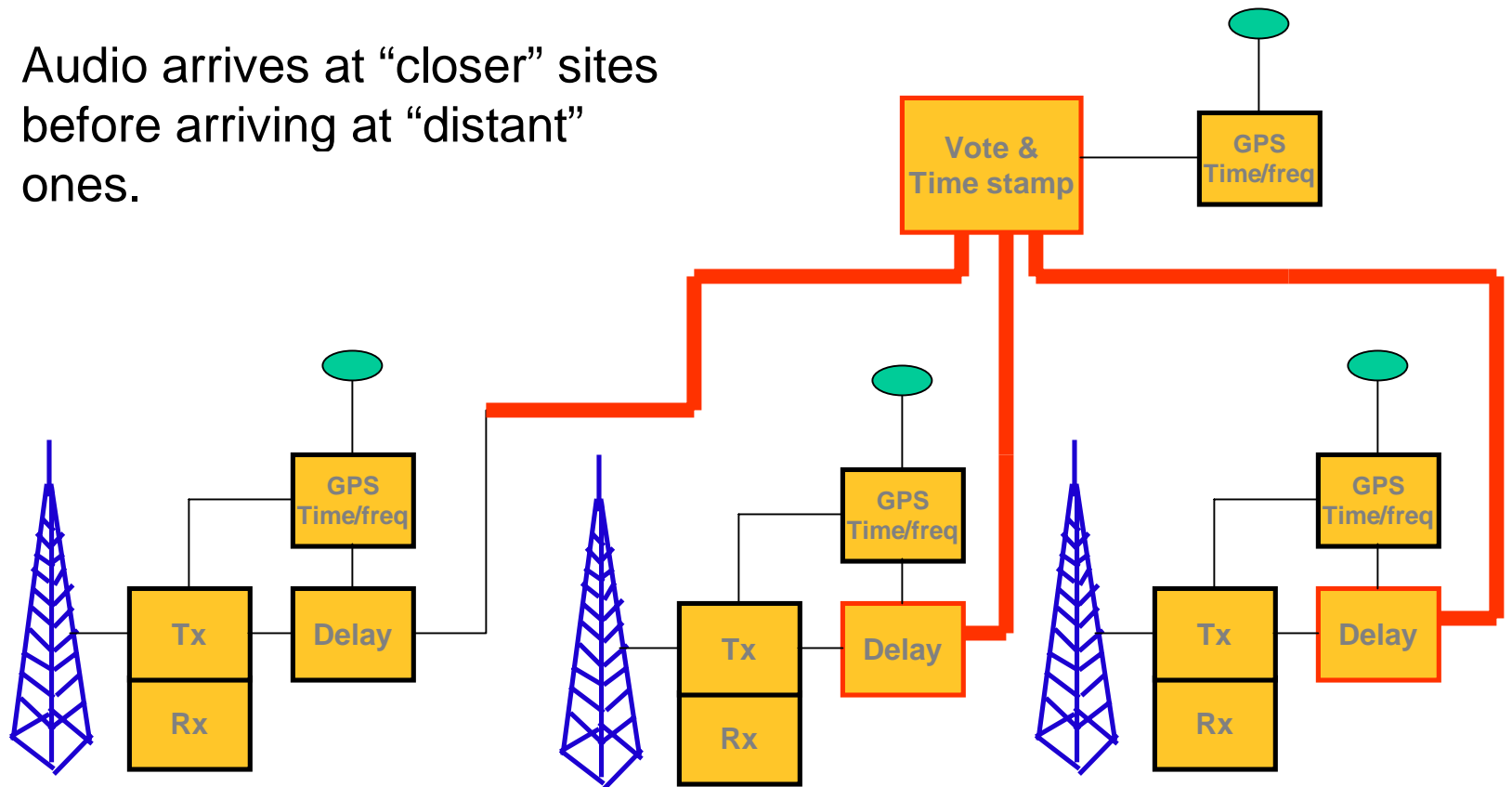
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Motorola GPS Simulcast System Theory

- Audio arrives at “closer” sites before arriving at “distant” ones.



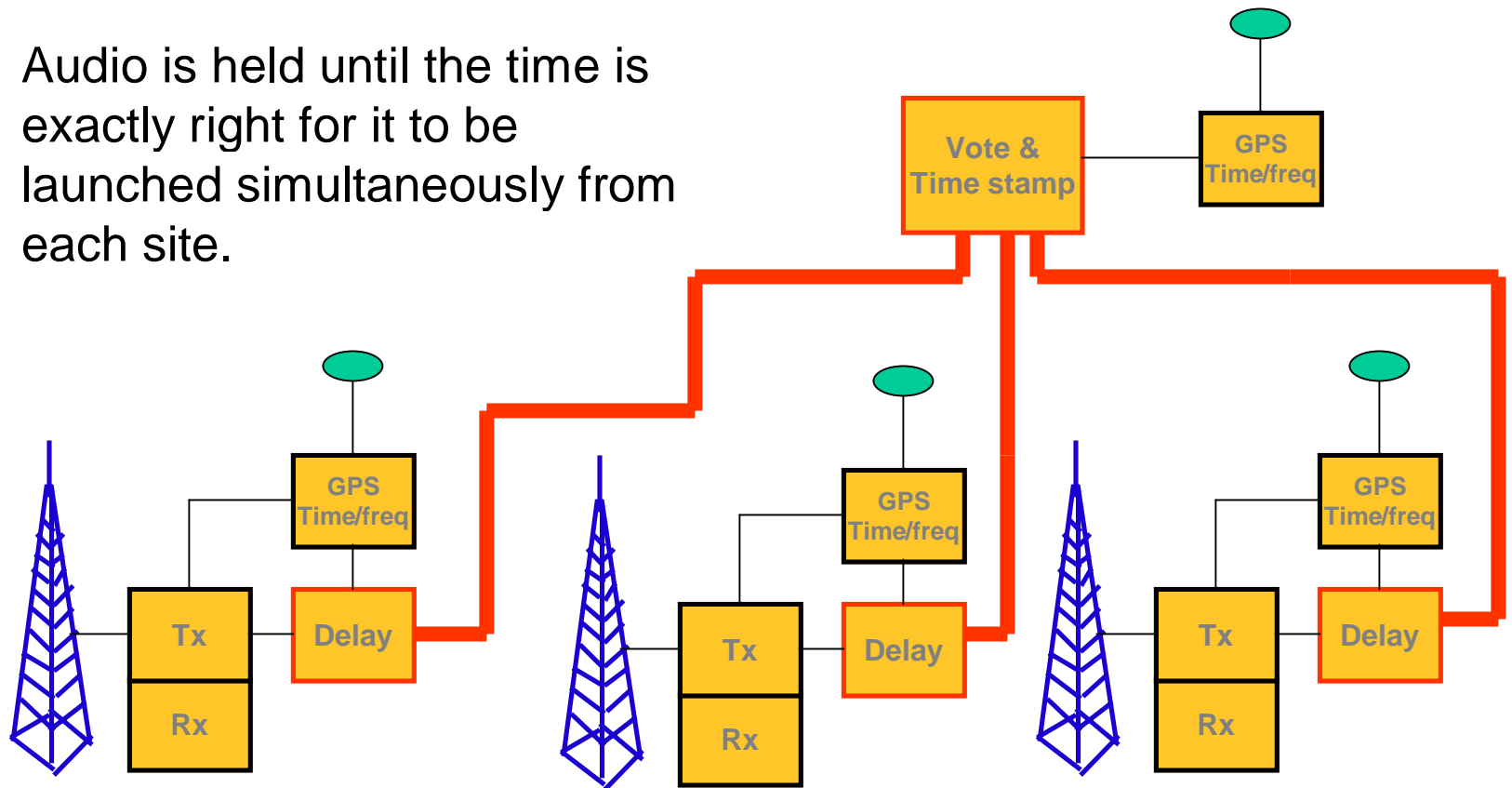
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Motorola GPS Simulcast System Theory

- Audio is held until the time is exactly right for it to be launched simultaneously from each site.



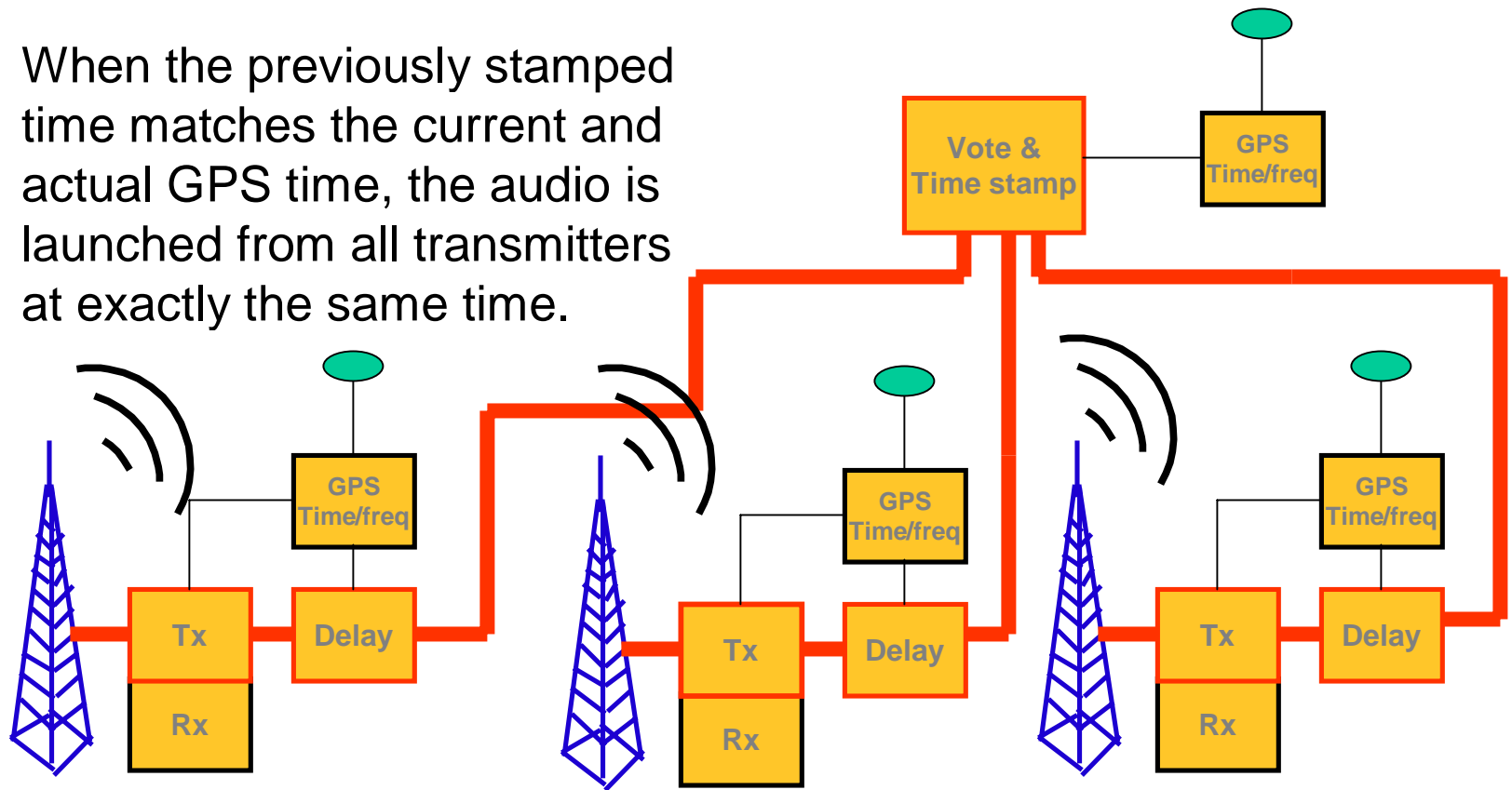
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Motorola GPS Simulcast System Theory

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



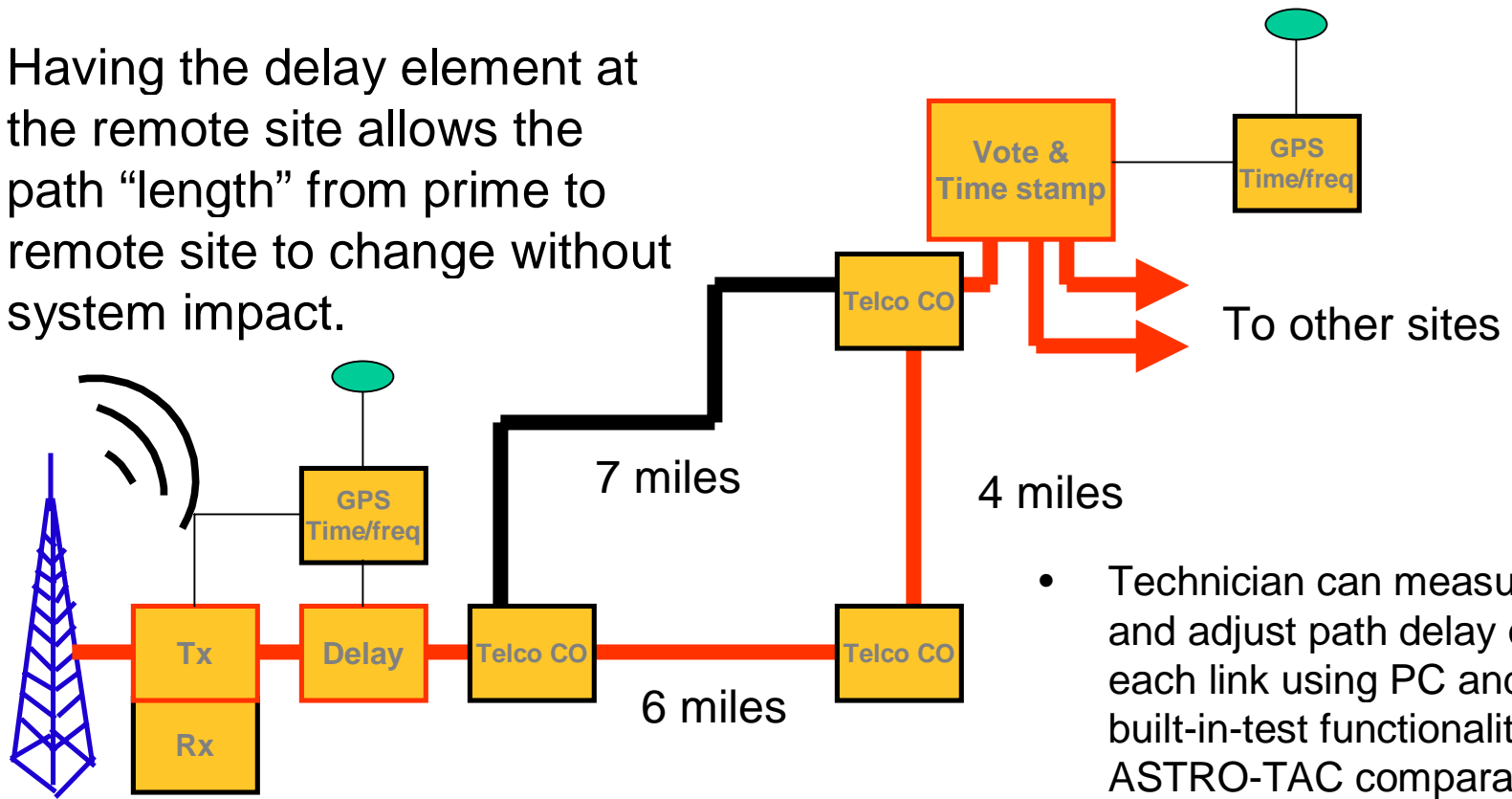
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Motorola GPS Simulcast System Theory

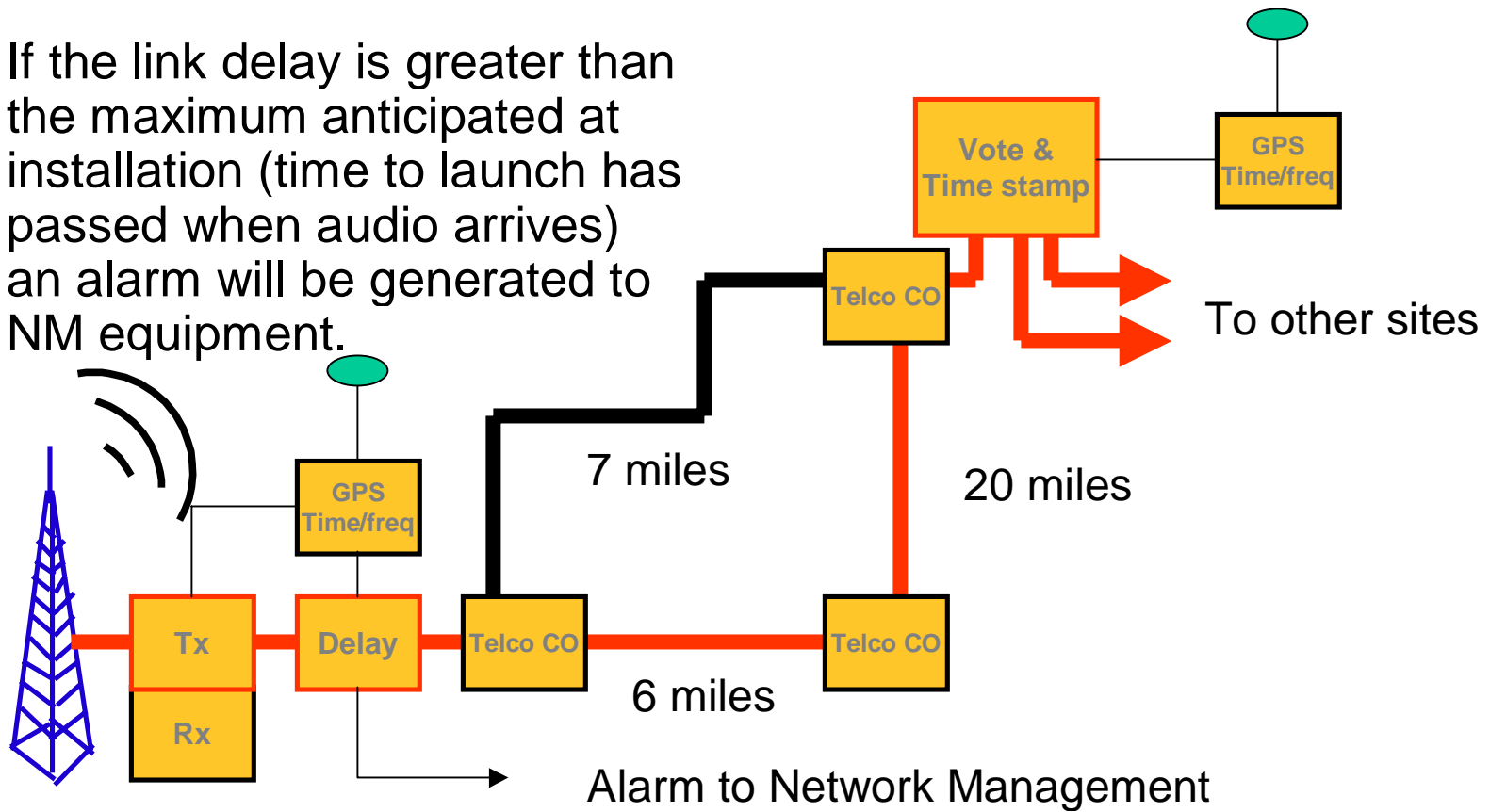
- Having the delay element at the remote site allows the path “length” from prime to remote site to change without system impact.



- 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.



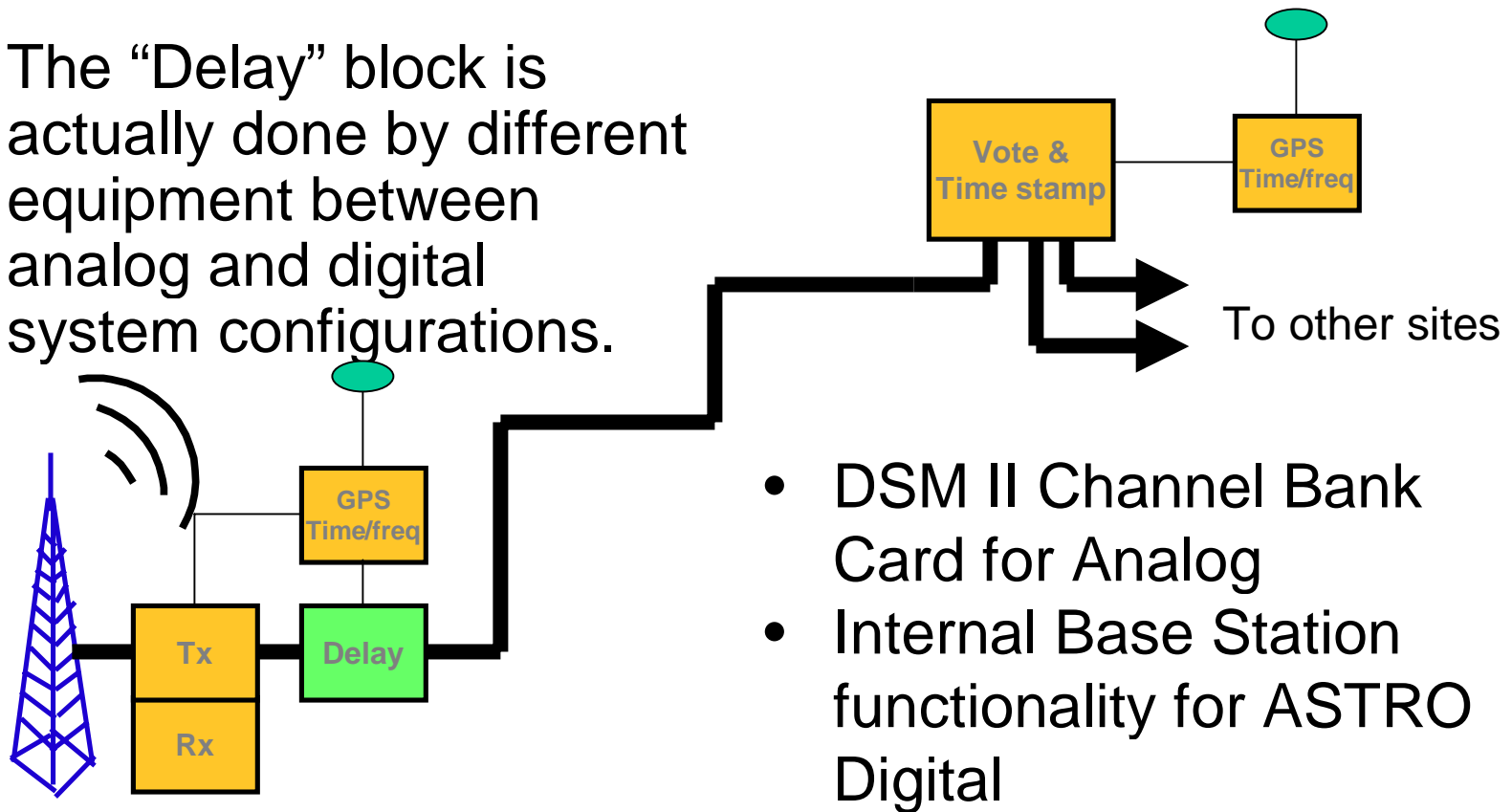
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Motorola GPS Simulcast System Theory

- 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

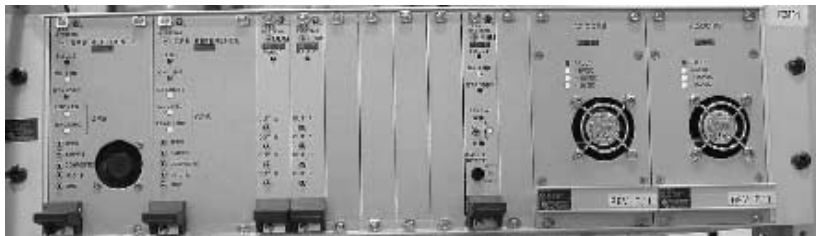
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Motorola GPS Simulcast System Theory

- 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.

Quantar Station with 4-Wire Modem



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Motorola GPS Simulcast System Theory

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



Quantar Repeater

TeNSr/800 Channel Bank



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Analog vs. Digital Equipment

ANALOG

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

Common to Analog & Digital

- **Quantar Repeater (VHF/UHF/800)**
- **Rb Standard/GPS Receiver (TRAK 9100)**

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

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.



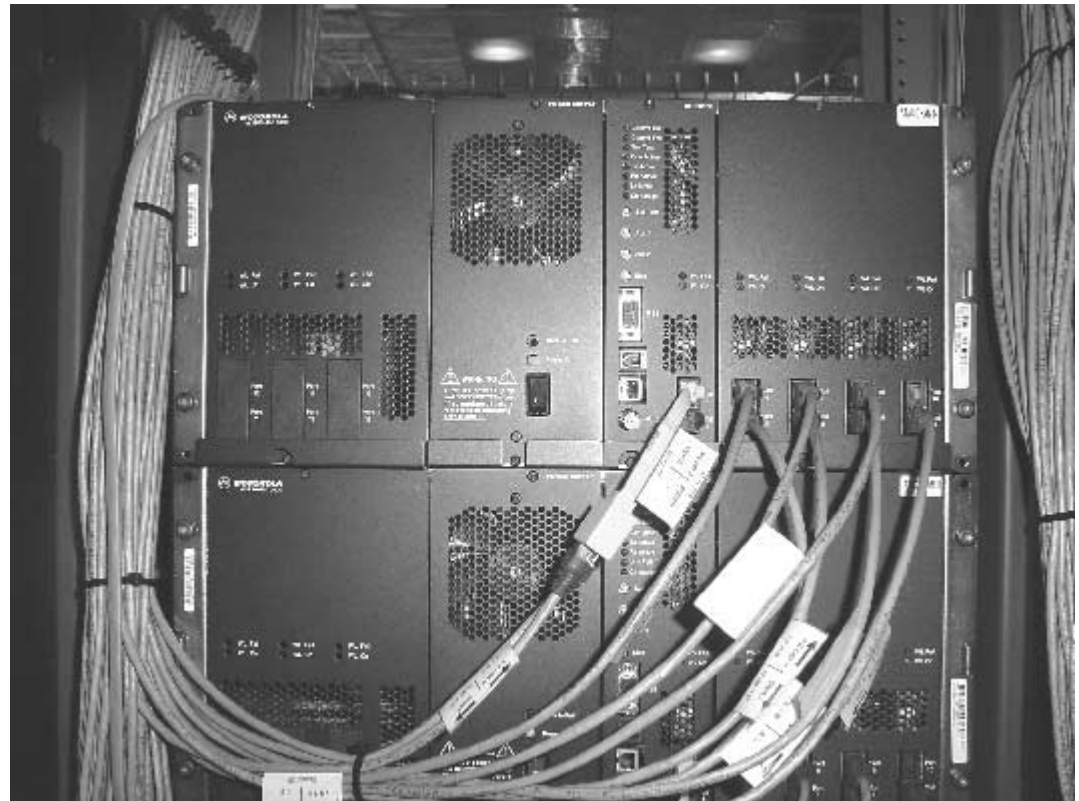
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Motorola GPS Simulcast Components

- 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



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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.



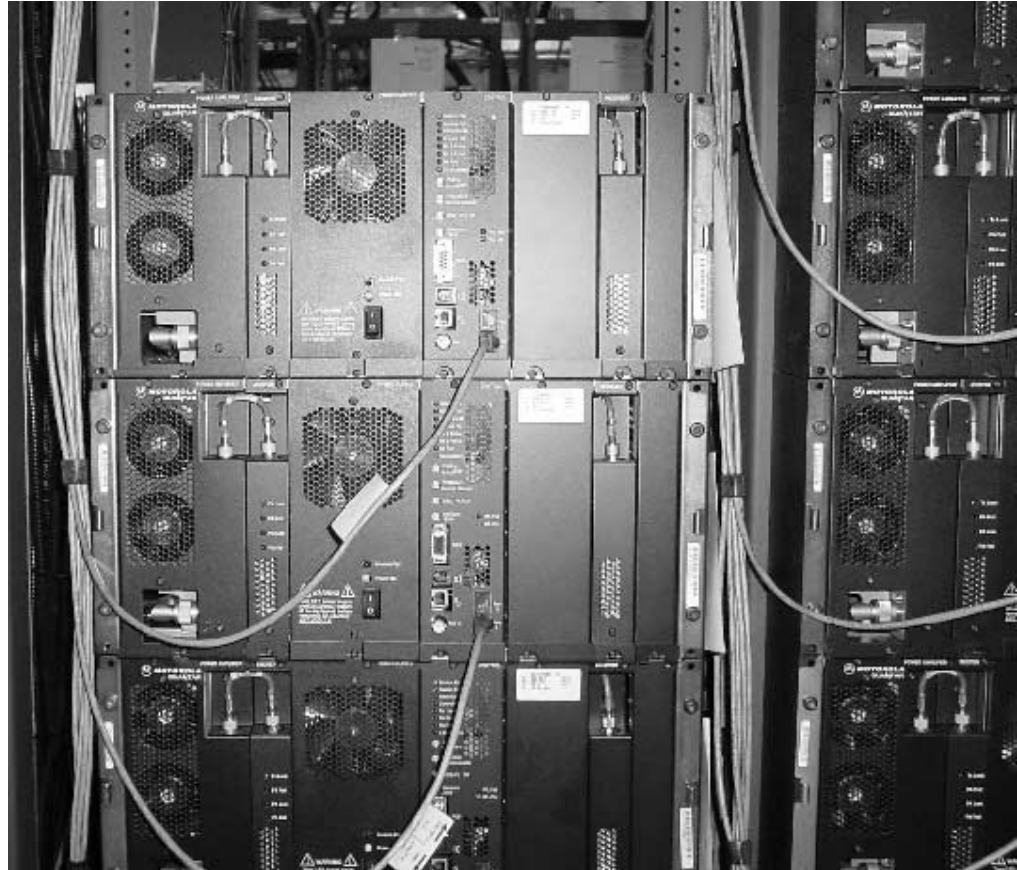
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Motorola GPS Simulcast Components

- 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.



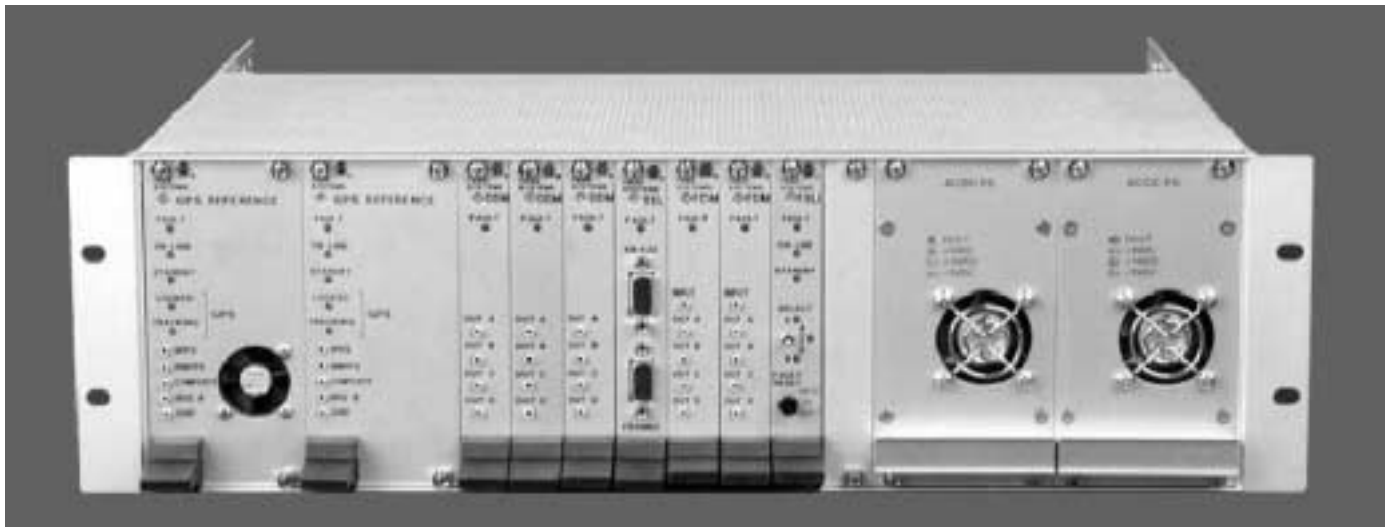
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Motorola GPS Simulcast Components

- 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

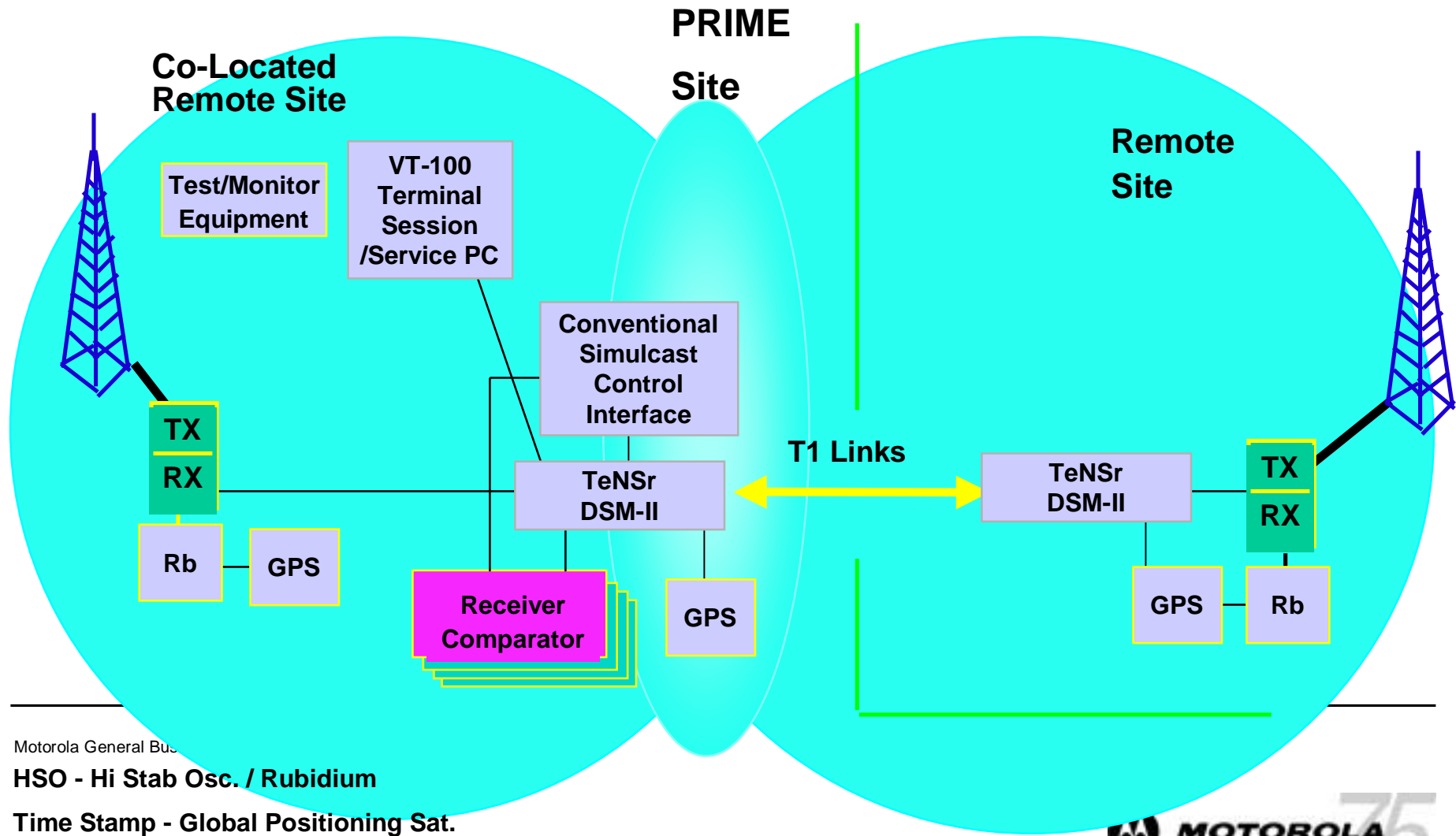


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Conventional Analog Simulcast Technology



Motorola General Bus

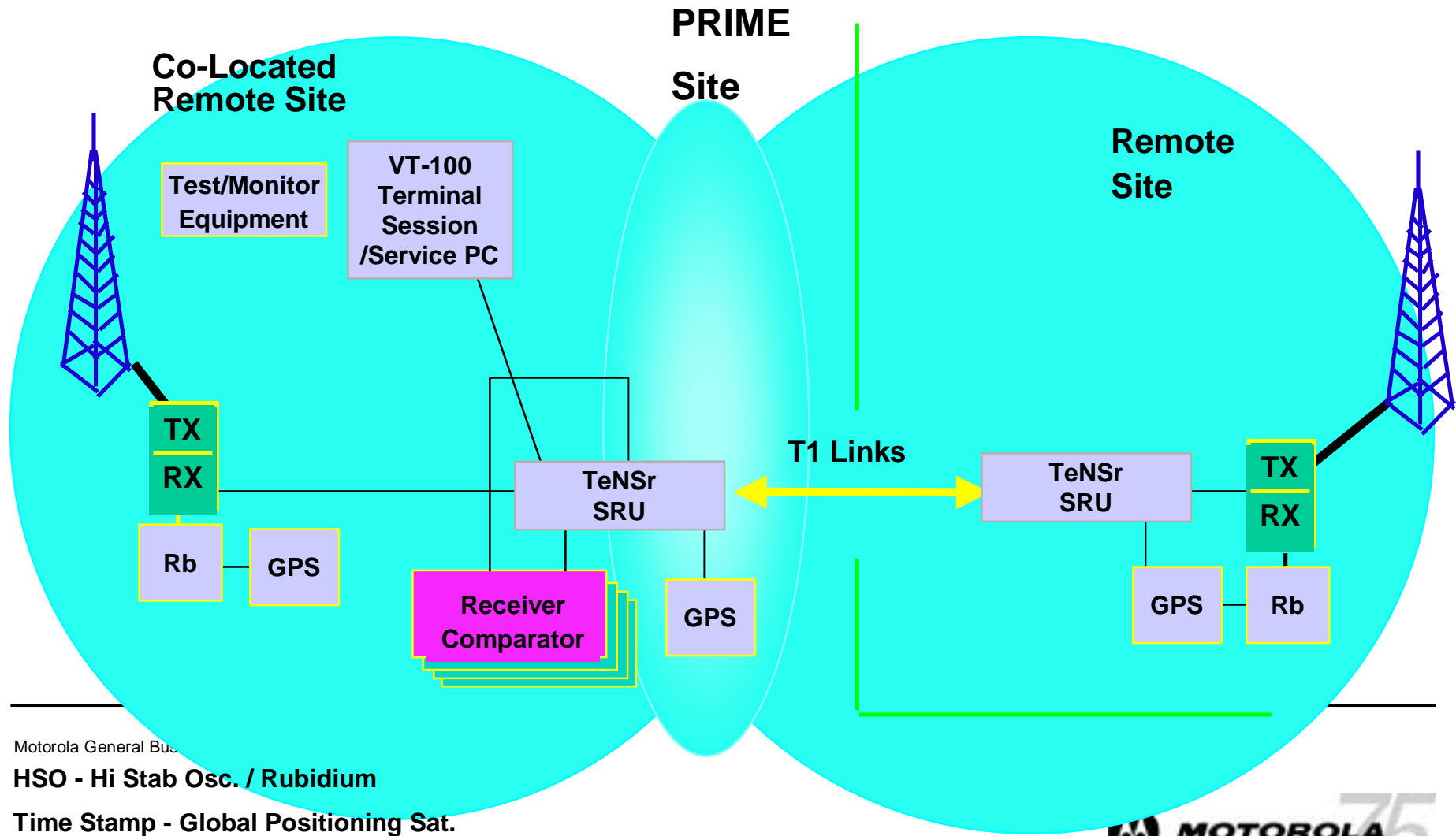
HSO - Hi Stab Osc. / Rubidium

Time Stamp - Global Positioning Sat.

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Conventional ASTRO Digital Simulcast Technology (Channel banks)



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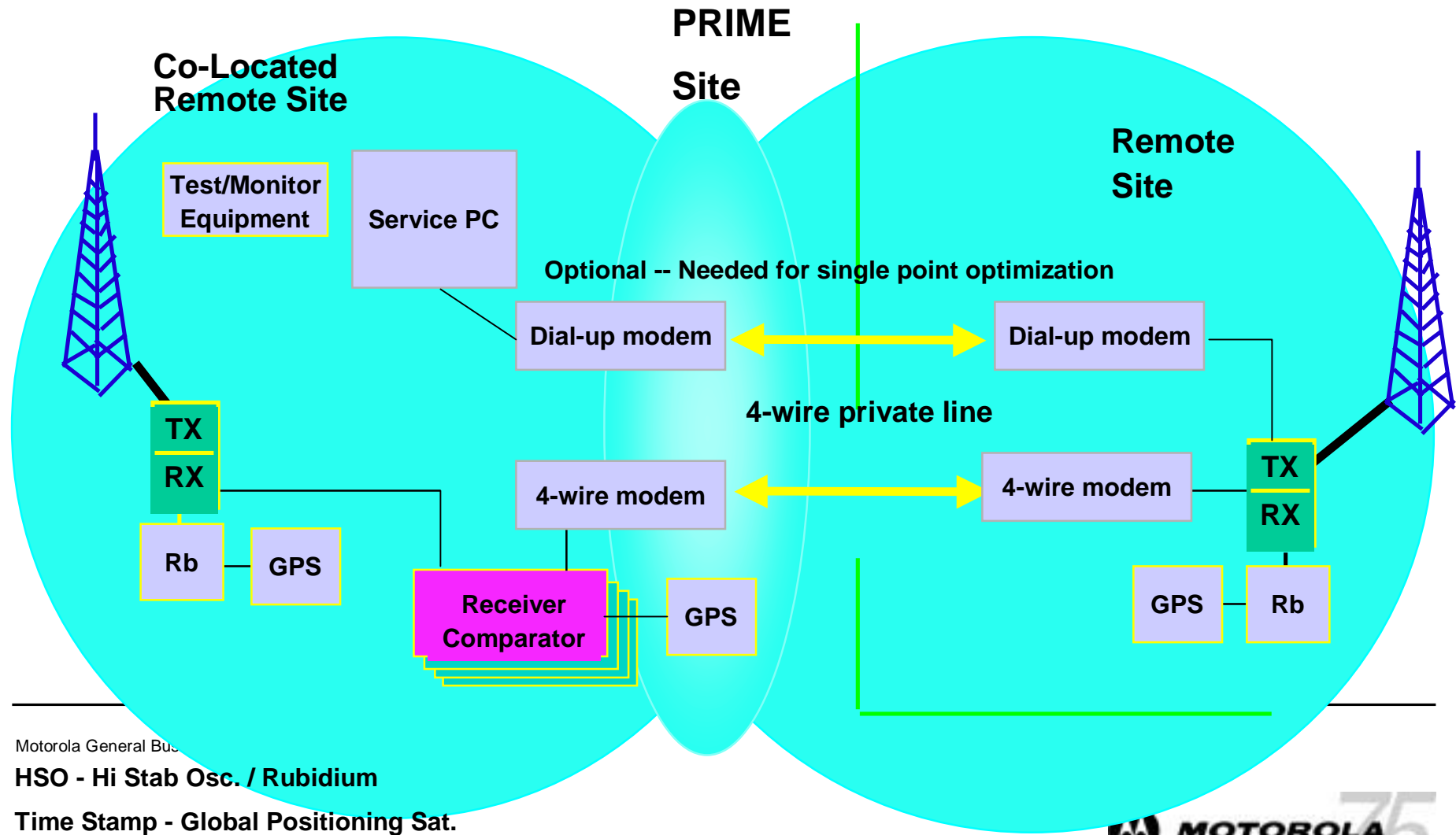
H50 - Hi Stab Osc. / Rubidium

Time Stamp - Global Positioning Sat.

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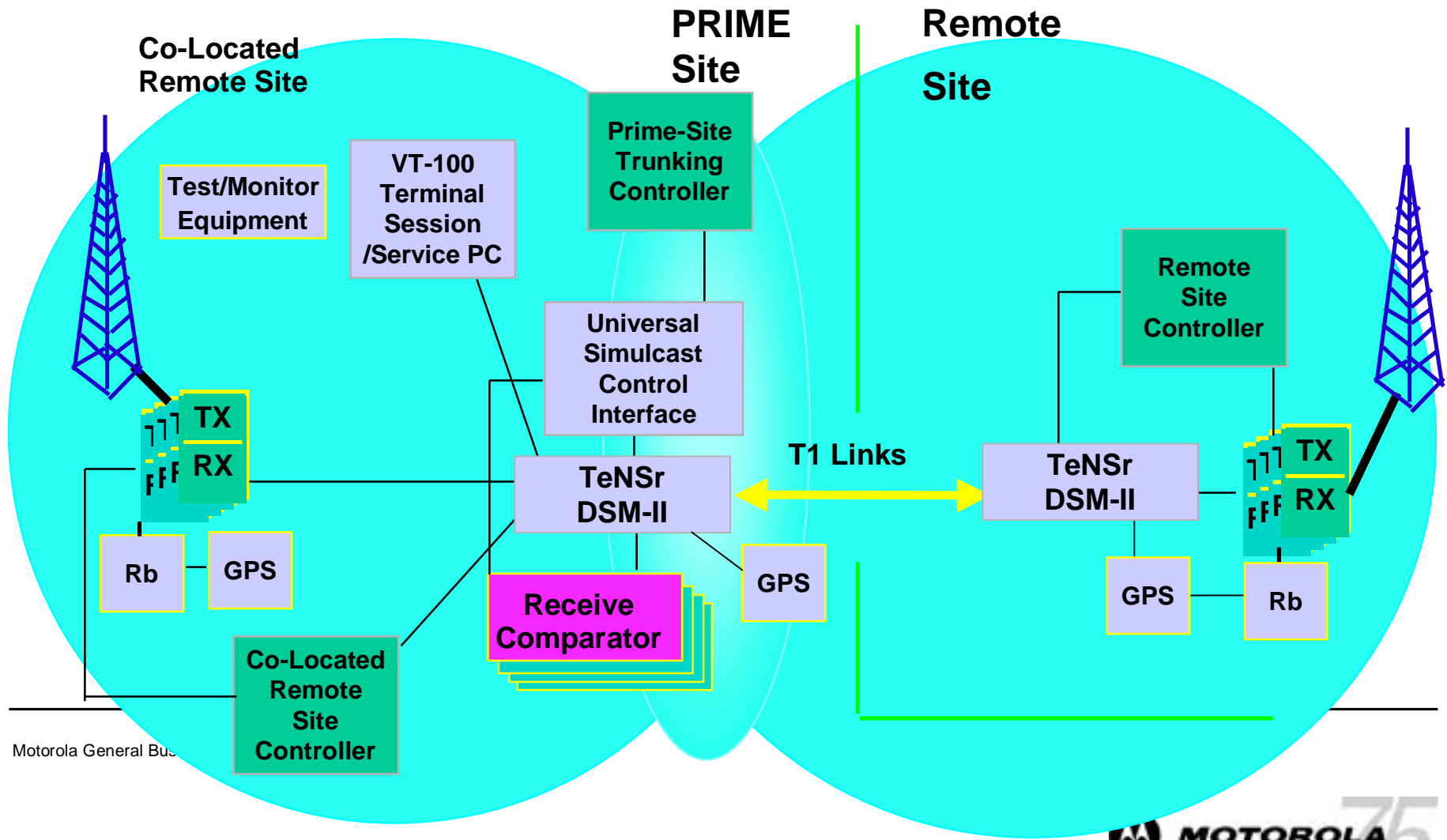
Conventional ASTRO Digital Simulcast Technology (4-wire modems)



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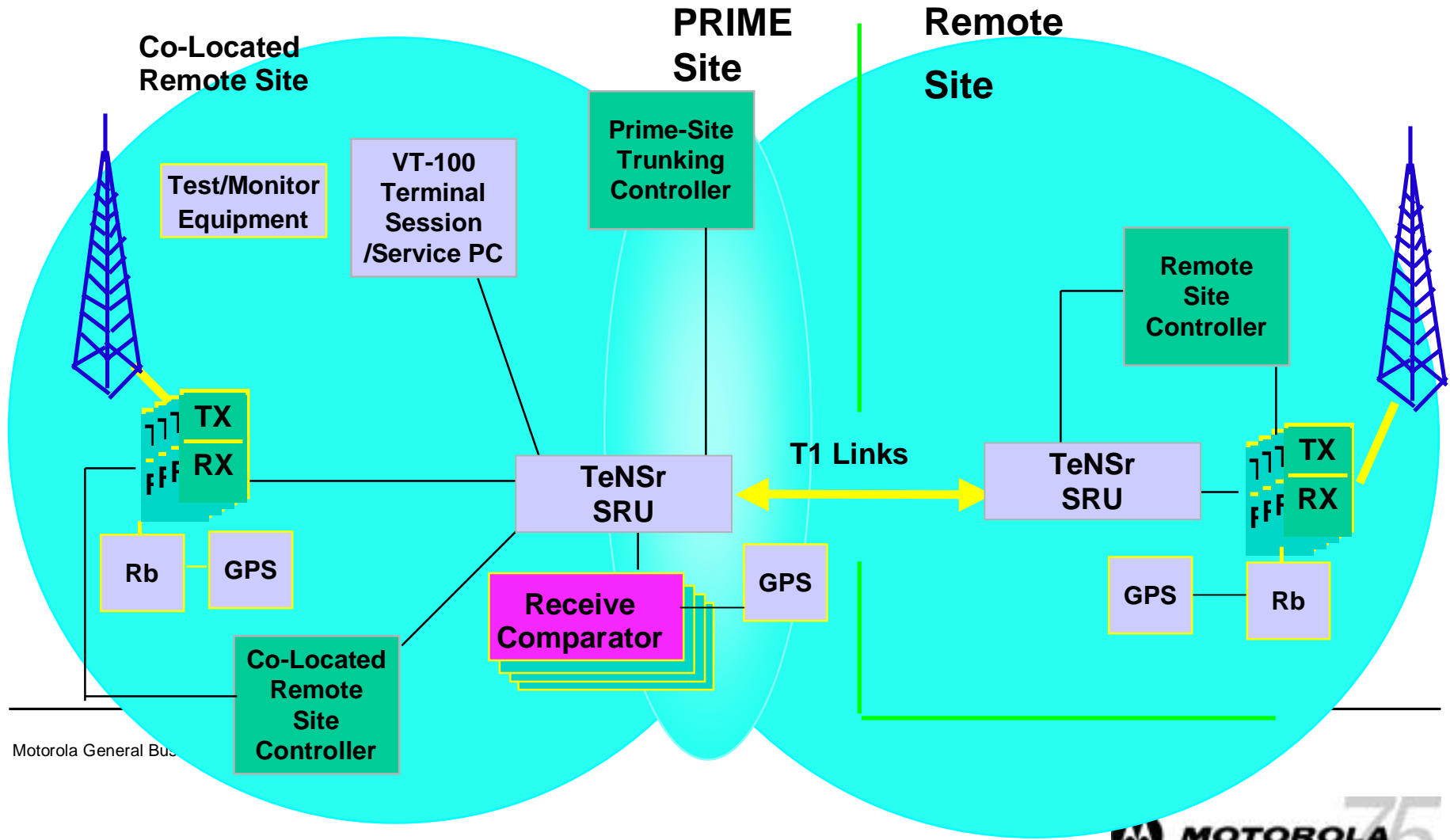


Trunked Analog Simulcast (3600)



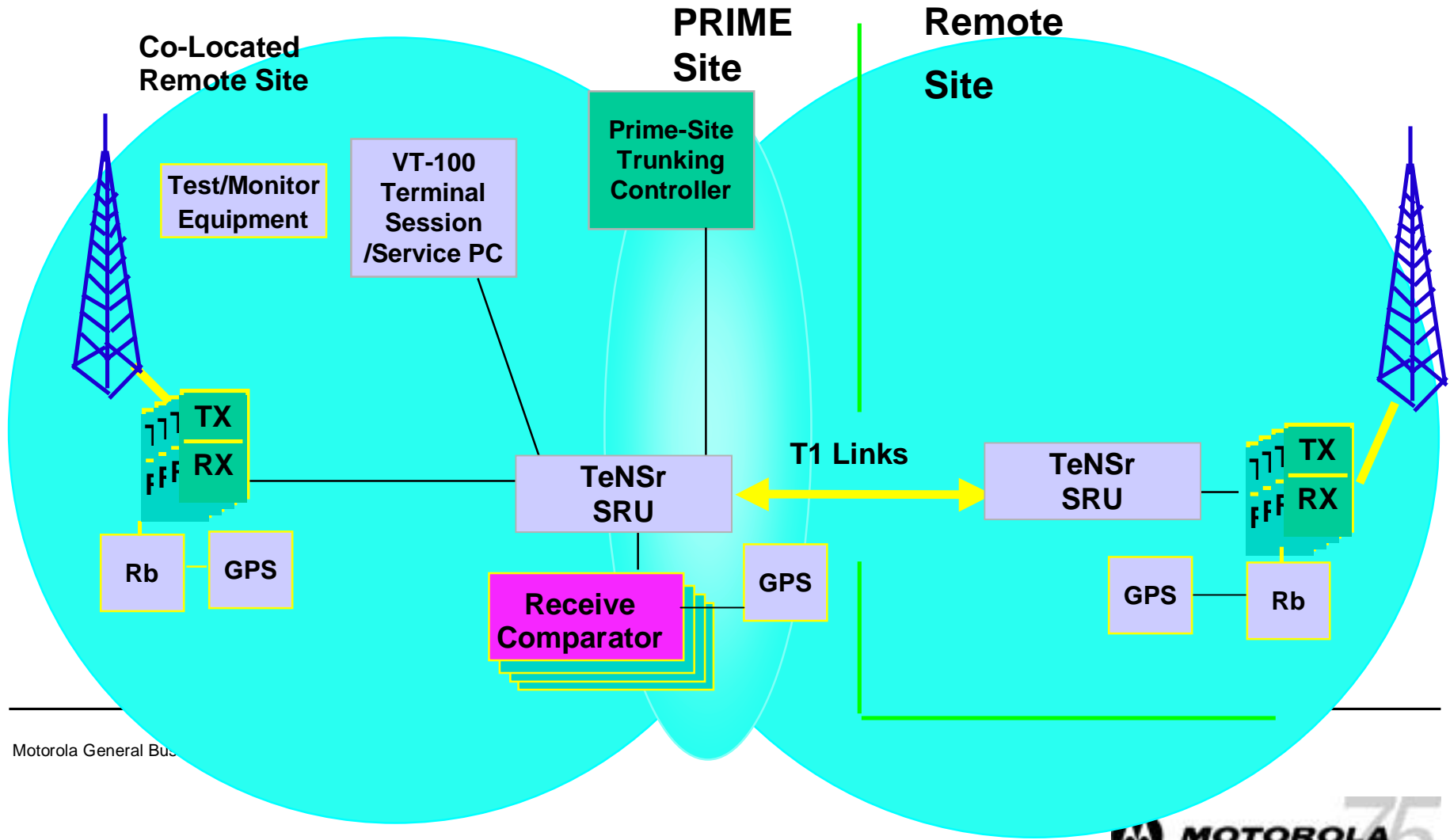
Motorola General Bus

ASTRO Trunked Digital Simulcast (3600)



Motorola General Bus

ASTRO 25 Trunked Digital Simulcast (9600)



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Motorola Simulcast

QUESTIONS?

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TeNSr Channel Bank

Various Options

INTER-FACE CARD	USER CARD1	USER CARD2	USER CARD3	USER CARD4	USER CARD5	USER CARD6	USER CARD7	USER CARD8
IF	E & M	FXO	DATA	SRU	ALARM	DSM II	DSM II	DSM II

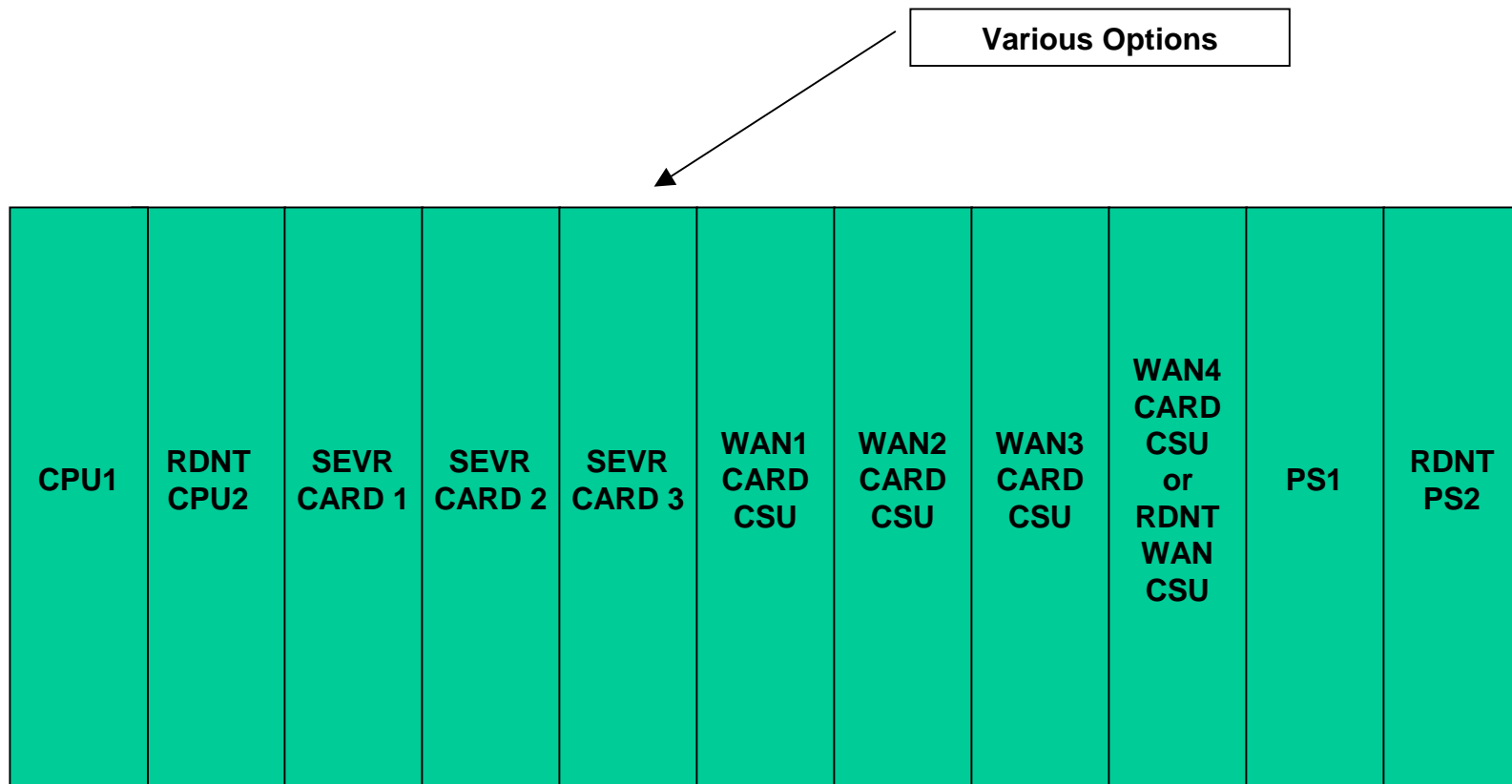
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TENSR - 800 SERIES REAR (Site) VIEW

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TeNSr Channel Bank



TENSR - 800 SERIES FRONT (Network) VIEW

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