Motorola P25 Simulcast

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“Hi, I’m Rick Pollak and I’m a radio geek!”
Five Olympic Rings

What do you think of when you see the Olympics logo?
Five Olympic Rings

A police officer might think of five doughnuts
Five Olympic Rings

I think of a five-site P25 simulcast system
Sports Fan’s View

Fencing
Radio Geek’s View

Fencing
Sports Fan’s View

Relay
Radio Geek’s View

Relay
Sports Fan’s View

Synchronized swimming
Radio Geek’s View

Synchronized transmitting
Radio Geek’s View

Clear audio, seamless roaming, and simple operation
A Winning Combination

Clear audio, seamless roaming, and simple operation
Motorola P25 Simulcast

Here’s what we’ll be talking about today

Top 5

LSM

Phase 2

Stamford

Backhaul
Top Five Reasons for P25 Simulcast

Leaders

1. Frequency efficiency
2. Better coverage
3. Full capacity everywhere
4. Clear audio throughout the network
5. Multiple sources for subscribers

Why select P25 simulcast over multicast?
1. Frequency Efficiency

Wide-area coverage with limited frequencies
1. Frequency Efficiency

Multicast may need more frequencies than you have
2. Better Coverage

Tight synchronization keeps signals in phase
2. Better Coverage

Signals combine in overlap zones to improve coverage
2. Better Coverage

Overlap means better coverage for first responders
3. Full Capacity Everywhere

Do you know where your next 911 call will come from?
3. Full Capacity Everywhere

Simulcast gives you full capacity for emergencies
4. Clear Audio Throughout the Network

Clear audio in single-site capture area
4. Clear Audio Throughout the Network

Clear audio and seamless roaming in overlap areas
5. Multiple Sources for Subscribers

P25 simulcast is open architecture
5. Multiple Sources for Subscribers

You can buy radios from multiple manufacturers
Top Five Reasons for P25 Simulcast

Leaders
1. Frequency efficiency
2. Better coverage
3. Full capacity everywhere
4. Clear audio throughout the network
5. Multiple sources for subscribers

Why select P25 simulcast over multicast?
Top Five Reasons for P25 Simulcast

What’s the most important reason for your system?
The Most Important Reason

First responders need mission critical performance
Motorola P25 Simulcast

Top 5

Stamford

P25 simulcast network in Stamford, Connecticut
Stamford, Connecticut

Multicast to simulcast – improved operations
Stamford, Connecticut

Suburb of NYC, 37.7 square miles – 117,000 people
Existing Stamford System

Analog multicast system from early 1990s
New Simulcast Network in 2008

Digital simulcast – 4 sites with 10 channels everywhere
Stamford Simulcast Network

Prime site

Remote sites

Microwave connectivity from prime site to remotes
Remote Site Configuration

800 MHz stations
GPS interface
Routers

Simple remote site configuration – no site controller
Prime Site Configuration

- 800 MHz stations
- Comparators
- Redundant prime site controller
- GPS interface
- Routers

Prime site has RF, controllers, and comparators
Audio Processing

Comparator votes the strongest received signal
Audio Processing

Comparator routes audio to sites with appropriate delays
User Benefits

Clear audio, seamless roaming, and simple operation
Lower Total Cost of Ownership

P25 simulcast design saves Stamford money
Lower Total Cost of Ownership

Fewer sites because of additive overlap coverage
Lower Total Cost of Ownership

Compact stations mean smaller shelters
Lower Total Cost of Ownership

Lower maintenance costs with digital simulcast
Motorola P25 Simulcast

Top 5

Stamford

LSM

Linear simulcast modulation
Linear Simulcast Modulation

Why would you need linear simulcast modulation?
Linear Simulcast Modulation

Developed to increase site spacing with 12.5 kHz channels
Linear Simulcast Modulation

P25 Phase 1 uses C4FM modulation
Linear Simulcast Modulation

Linear simulcast uses CQPSK modulation
Linear Simulcast Modulation

“Dibit” pairs mapped to phase changes in RF carrier
Linear Simulcast Modulation

How does that increase site spacing?
Linear Simulcast Modulation

How does that increase site spacing?
Linear Simulcast Modulation

C4FM

CQPSK

Dwell

Dwell

LSM has a longer dwell in the signal eye pattern
Linear Simulcast Modulation

What if one signal arrives a bit late?
Linear Simulcast Modulation

We want all of the signals to get a gold medal
Linear Simulcast Modulation

Arrival times can be further apart with CQPSK
C4FM Simulcast Modulation

Non-linear site spacing is 8 miles maximum at 12.5 kHz
CQPSK Linear Simulcast Modulation

Site spacing increases with linear simulcast modulation
CQPSK Linear Simulcast Modulation

LSM means lower initial and ongoing costs
Linear Simulcast Modulation

CQPSK linear from infrastructure to subscriber
Linear Simulcast Modulation

C4FM non-linear from subscriber to infrastructure
Linear Simulcast Modulation

You can buy radios from multiple manufacturers
Linear Simulcast Modulation

Radios can decode C4FM and CQPSK
Onondaga County, New York

Longer path lengths:
- 10.19 miles
- 11.24 miles
- 11.39 miles
- 12.27 miles

15-site, 15-channel UHF linear simulcast system
State of Rhode Island

Longer path lengths:

10.4 miles
12.4 miles
14.3 miles

24-site, 3-cell linear simulcast at 800 MHz
Linear Simulcast Modulation

Longer path lengths mean lower costs
Motorola P25 Simulcast

Backhaul requirements for P25 simulcast
Flexible Backhaul Design

End-to-end delay determines backhaul design
IP Simulcast

Channel banks are not required for IP simulcast
IP Simulcast

Channel banks are not required for IP simulcast
Traditional Microwave

Traditional microwave has the lowest latency
Motorola PTP Series Microwave

PTP series is an alternative to traditional microwave
Motorola PTP Series Microwave

Alternative to line of sight microwave networks

LOS

nLOS

NLOS
Flexible Backhaul Design

Many options available for simulcast backhaul
Motorola P25 Simulcast

Top 5

LSM

Phase 2

Stamford

Backhaul

Project 25 Phase 2
P25 Phase 2 Simulcast

TDMA gives you more capacity without adding channels
I thought you couldn't simulcast TDMA
P25 Phase 2 Simulcast

You can have your cake and eat it too!
Phase 2 simulcast will use HDQPSK linear modulation
P25 Phase 2 Simulcast

Will the performance be the same as CQPSK?
P25 Phase 2 Simulcast

Our engineers are busy analyzing the data
P25 Phase 2 Simulcast

We’ll be using performance enhancing antennas
P25 Phase 2 Simulcast

Don’t worry, you won’t have to P25 in a cup!
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First responders need mission critical performance
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P25 simulcast gives you mission critical performance