The Case for LMR Simulcast Coexisting with FirstNet

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Understanding FirstNet LTE

• LTE – Long Term Evolution
• Commercial 4G technology – FirstNet Uses LTE
• LTE Coverage
  o Minimum channel 1.25 MHz – greater noise bandwidth
  o 700 MHz public safety spectrum
  o 4X or more sites for equivalent VHF coverage
  o Added to Specification: ‘LTE Lite’
    - 180 KHz Channel, 60 to 100 kpbs
    - Downlink OFDMA, Uplink FDMA/GMSK
    - 15-20 dB improved link budget (coverage)
    - For the ‘Internet of Things’

• LTE Push-to-talk
  o LTE is a 4G digital broadband specification
  o Push-to-talk specification locked down in Release 13
  o Uses a one-to-many trunking-like broadcast mode
  o Low call setup time promised…
  o Still must consider the sleep/wake battery limitations
Universal Mobile Telecommunications System (UMTS); LTE;
Functional architecture and information flows to support mission critical communication services;
(3GPP TS 23.179 version 13.0.0 Release 13)
FirstNet MCPTT Push-to-Talk Group Call Flow

Figure 10.6.2.3.1.1.2-1: Pre-arranged group call setup
FirstNet MCPTT LMR-to-LTE Interface in Release 14

Figure 7.3.1-1: Functional model for application plane
Understanding FirstNet LTE

- **FirstNet RFP**
  - Aimed at Cellular Operators
  - Commercial Users OK with Public Safety Priority
  - Single Nationwide System
  - Award in November 2016 – 25 years
  - May Start Service by Sharing Existing Cellular System
  - Has Coverage Goals
    - May be insufficient for portable rural coverage
  - Can be ‘Monetized’
  - Disincentive Payments for Insufficient Sign-up of Public Safety Users
    - 70% Minimum - $125M to $178M payment if not met
    - Could end up as free or reduced cost service to public safety?

- **FirstNet Mission Critical Push-to-Talk (MCPTT)**
  - First MCPTT in service around 2019
  - LMR Interface in release 14 planned
  - Practical Use in 2020-2021?
  - Widespread urban use by 2025?
  - Widespread rural use by 2030?
Understanding FirstNet LTE

- FirstNet ‘Talkaround’
  - Called ‘Proximity Services’
  - Direct Radio-to-Radio Communication (‘UE to UE’)
  - Part of Release 12
  - Uses Uplink – Network Must Control the Power
  - Potential Problems Compared to Existing Talkaround Use
    - Problem in FirstNet LTE coverage areas
    - The on-scene fireground scenario
Harris Portable with Integrated LTE and WiFi Hotspot
P25 Rural Simulcast Issues to Consider

• P25 Site Spacing in Rural Areas
  o Typical rural site spacing 7 to 15 miles
  o P25 25 uSec practical simulcast tolerance
  o Terrain can make for significant challenges
  o Site spacing beyond 5 miles can be difficult

• P25 Simulcast Modulation Methods for Narrowband
  o C4FM
  o LSM (Linear Simulcast Modulation)
    ▪ Sharper shaping of symbols
    ▪ Allows for increased simulcast site spacing
  o 800 MHz can use 25 KHz P25 simulcast – greater site spacing

• P25 Subscriber Unit Compatibility
  o Demodulation of P25 simulcast signal across manufacturers
  o Demodulation of P25 simulcast signal by legacy units
  o Consistent programming across manufacturers and platforms

• Fire Pass-Alert and Other Audio Issues
  o P25 vocoder performance
Analog vs. Digital Audio Quality and Coverage

An FM analog signal will start to have some noise before a digital signal, but an FM analog signal will still be useful when a digital signal is completely gone.
The Solution: Analog Simulcast until FirstNet LTE

• Operate Analog Simulcast until FirstNet is Practical
  o Matching Coverage – LTE Requires 4X the number of VHF Sites
  o 2025 – 2030 Timeframe for Rural Areas
  o Use LTE to LMR Interface for Smooth Migration
  o No Mobile, Portable or Pager Upgrades Required
  o Cost Effective, 10 Year Life
Rural County Analog Simulcast Migration Strategy

2016
Install an Analog Simulcast Radio System for LMR Coverage

Put System into Service

2020-2021
Is Public Safety LTE with Push-to-Talk Practical for Rural Counties for by 2025-2029?

2020-2021
Has the FCC Mandated the Next Generation 6.25 KHz Narrowband, and LTE will not be ready by 2025-2029?

Continue with Analog FM until the Transition to LTE

Upgrade System to P25 Phase I. More sites will be required

Upgrade System to P25 Phase II. More sites may be required

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Summary – Simulcast by Communications Service

• Minimize the Variables
  o Non-Variable Reliable Backhaul – IP Microwave
  o Keep Identical Audio Response Over Time – System Components
  o Eliminate Time Delay Changes – Account for Maximum IP Time Delay
  o Advantages over Self-Adjusting Systems

• Simplified Design and Optimization
  o Motorola MLC 8000
  o Motorola GGM 8000 Router and 2610-24 Managed Switch

• Motorola Quantar and GTR8000
  o GTR 8000 has the Same Analog Simulcast Baseband Input as the Quantar
  o Cannot Mix Quantar and GTR 8000 on the Same Channel

• System Staging Before Field Deployment
  o Full System Staging at a Single Location
  o Including Microwave