Objectives

1. Understand P25 Phase II TDMA Technology
2. Understand Interoperability aspects of P25 Phase II
3. Review deployments of P25 TDMA Phase II Subscriber equipment
Understanding P25 Phase II TDMA Technology

Project 25 Phase I:

- **P25 Phase I FDMA**
  - Frequency Division Multiple Access (FDMA) technology to separate talk paths.
  - One Voice Channel per 12.5 KHz Bandwidth
  - Operates at 9,600 bits per second (bps)
  - Occupies 12.5 KHz of bandwidth (1 voice channel/ 12.5 KHz)
  - Vocoder operates at 7200 bps
Understanding P25 Phase II TDMA Technology

Project 25 Phase II:

• P25 Phase II TDMA
  • Time Division Multiple Access (TDMA) technology to separate talk paths
  • Two Voice Channels per 12.5 KHz Bandwidth
  • Operates at 12,000 bits per second (bps)
  • Occupies 12.5 KHz of bandwidth (2 voice channels / 12.5 KHz)
  • 6.25 KHz Equivalent Bandwidth
  • Vocoder operates at 3600 bps
Understanding P25 Phase II TDMA Technology

Differences Between Phase I and Phase II:

- **Technology Improvements**
  - Phase II Modulation is more efficient – Higher Bit Rate
  - Increased Bit Rate is split into two voice channels
  - Additional Bit Rate required for signaling
  - Enhanced Half Rate Vocoder
  - Improved Forward Error Correction
Differences Between Phase I and Phase II:

### Project 25 Phase I – 9600 bps

<table>
<thead>
<tr>
<th></th>
<th>Voice Channel 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Rate Vocoder</td>
<td>Control/Sync 2400 bps</td>
</tr>
<tr>
<td>7200 bps</td>
<td>Control/Sync 2400 bps</td>
</tr>
<tr>
<td>Voice Data</td>
<td>FEC 2800 bps</td>
</tr>
<tr>
<td>4400 bps</td>
<td>Control/Sync 2400 bps</td>
</tr>
</tbody>
</table>

Efficiency Improvement gained in Phase II = 2400 bps

### Project 25 Phase II – 12000 bps

<table>
<thead>
<tr>
<th></th>
<th>Voice Channel 1 (Slot 0)</th>
<th>Voice Channel 2 (Slot 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half Rate Vocoder</td>
<td>Control/Sync 2400 bps</td>
<td>Half Rate Vocoder 3600 bps</td>
</tr>
<tr>
<td>3600 bps</td>
<td>Control/Sync 2400 bps</td>
<td>Control/Sync 2400 bps</td>
</tr>
<tr>
<td>Voice Data</td>
<td>FEC 2450 bps</td>
<td>Voice Data 2450 bps</td>
</tr>
<tr>
<td>2450 bps</td>
<td>Control/Sync 2400 bps</td>
<td>Control/Sync 2400 bps</td>
</tr>
<tr>
<td></td>
<td>FEC 1150 bps</td>
<td>Control/Sync 2400 bps</td>
</tr>
<tr>
<td></td>
<td>Control/Sync 2400 bps</td>
<td>Control/Sync 2400 bps</td>
</tr>
</tbody>
</table>
Regulatory Issues Relevant to Phase III:

- FCC Mandated 6.25 KHz Equivalent Technology for 700 MHz
  - 700 MHz No new 12.5 KHz Licenses after 2005
  - 700 MHz 6.25KHz Equivalent by January 2017
  - FCC has indicated 6.25KHz mandates to other bands would be forthcoming
  - FCC has granted waivers to the 2017 deadline
  - It remains to be seen what the regulatory environment will bring
Understanding P25 Phase II TDMA Technology

Why Should You Consider Phase II?

• Greater Operational Flexibility
  • 2 to 1 Improvement in Voice channel availability
  • Free existing voice channels for use as data channels
  • Graceful migration from Phase I to Phase II
Operational Impact

Understanding P25 Phase II TDMA Technology

Phase I = 1 Control Channel 4 Voice Channels

Phase II = 1 Control Channel 8 Voice Channels

Phase II Provides Twice the Voice Channels as Phase I
Understanding P25 Phase II TDMA Technology

Operational Impact

**FDMA Control Channel**
- Phase I FDMA Voice Channel
- Phase I FDMA Voice Channel
- Phase I FDMA Voice Channel
- Phase I FDMA Voice Channel

**Enhanced FDMA Control Channel**
- Phase II TDMA Voice Slot 0
- Phase II TDMA Voice Slot 1
- Phase II TDMA Voice Slot 0
- Phase II TDMA Voice Slot 1
- Project 25 Data Channel
- Project 25 Data Channel

**Phase I** = 1 Control Channel
- 1 Voice Channel

**Phase II** = 1 Control Channel
- 4 Voice Channels
- 2 Data Channels

Phase II Provides Twice the Voice Channels as Phase I
Understanding Interoperability Aspects of Phase II

Backwards Compatibility:

- Phase II Equipment is Compatible with Analog and Phase I
  - Analog Conventional Operation
  - P25 Phase I Conventional Operation
  - P25 Phase I Trunked Operation
  - Encrypted AES/DES/Other Operation
Understanding Interoperability Aspects of Phase II

Phase II was Designed with Migration in Mind:

- Phase II is Based on the Need for Migration
  - Phase II Utilizes the Phase I Control Channel
  - Concurrent Operation of Phase I and Phase II
  - Phase II Coverage is Similar to Phase I
  - Enhanced Dual Rate Vocoder - Phase I and Phase II
  - Maintain Encrypted Operation
Understanding Interoperability Aspects of Phase II

Graceful Migration:

• Utilize System Features to Manage Phase II Migration
  • New Subscriber Purchases Should Support Phase II
  • Phase II Systems Allow:
    • Dynamic Dual Mode Operation
    • Phase II by Talkgroup
    • Phase II by Site
    • Phase I to Phase II Interoperation

• Migrate Your System to Phase II as Time and Budget Allow
Understanding Interoperability Aspects of Phase II

System Issues in a Phase I/Phase 2 Environment:

• Configured for Phase I Operation Only
  • Phase I and Phase II Subscribers Will Operate as Phase I

• Configured for Phase II Operation Only
  • Only Phase II Subscribers can Operate
  • Phase I Subscribers ‘Out of Range’
Understanding Interoperability Aspects of Phase II

System Issues in a Phase I/Phase 2 Environment:

• Configured for Dynamic Dual Rate Operation
  • Phase II Capable Infrastructure Determines Phase I or Phase II
    • If All Registered/Affiliated Radios are Phase II
      • Call is Phase II
    • If A Given Site Has a Registered/Affiliated Phase I Radio
      • Call is Phase I

• Site or System Wide?
  • Some Infrastructure Vendors Support Dynamic Rate Across Sites
    • Some Sites Operate Phase I while Others Operate Phase II
Deployments of Phase II Subscriber Units

RELM Wireless Phase II Subscriber Deployments:

- Single County Simulcast System
- Multi-County Simulcast/Non-Simulcast System
- Statewide System
Deployments of Phase II Subscriber Units

Single County Phase II TDMA System:

- Virginia
- 6 Site Simulcast System
- 800 MHz, 10 Channel
- Phase II From the Start
- Talkgroups all TDMA
Deployments of Phase II Subscriber Units

Multi-County Phase II TDMA System:

- Texas
- 700 MHz and 800 MHz Channels
- Simulcast and Non-Simulcast Sites
- Channel Density from 5 to 22 Channels per Site
- Migrating from APCO 16 to P25 to P25 Phase II
- FDMA Only, TDMA Only and Dynamic Talkgroups
Deployments of Phase II Subscriber Units

State Wide Phase II TDMA System:

- Southeast US
- Only 700 MHz Channels
- Over 125 Sites - Simulcast and Non-Simulcast Sites
- Channel Density from 5 to 12 Channels per Site
- Built as Phase II – Initial Subscriber Deployment Phase I
- FDMA Only, TDMA Only and Dynamic Talkgroups
Thank you for participating!

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