800 MHz Plan Development and Submission Requirements in Response to NPSPAC Rebanding

Regional Planning Committee Workshop

February 12-13, 2009

LeGrande Technical and Social Services, LLC

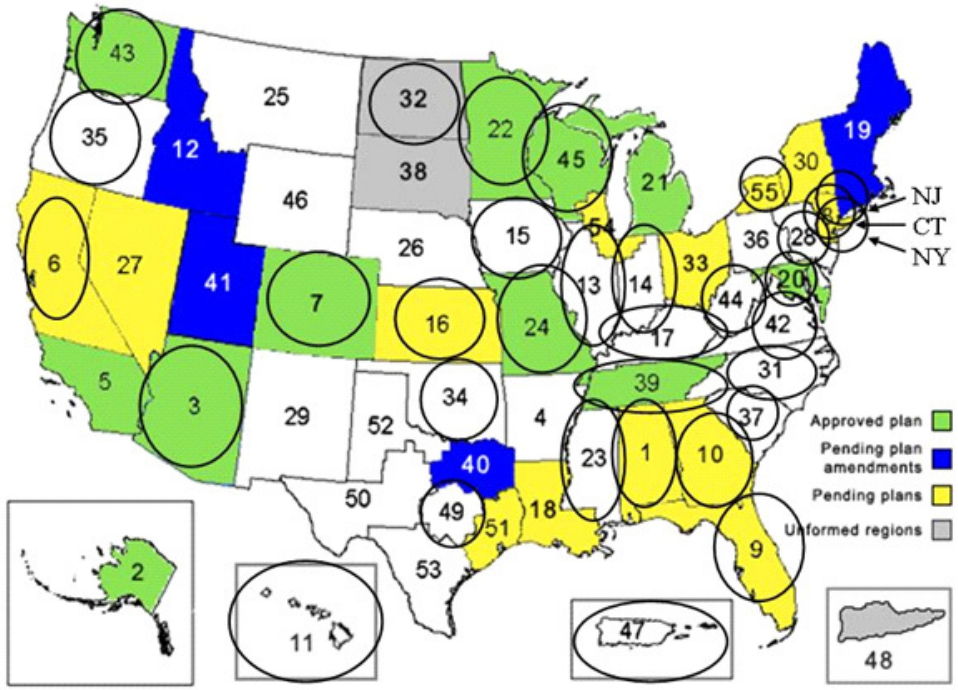
Session 1: APCO-AFC
800 MHz Regional Planning Committee Workshop

Rick Burke,
Managing Partner
Televate, LLC

February 12, 2009

LeGrande Technical and Social Services, LLC

Regional Planning Committee Workshop Representatives



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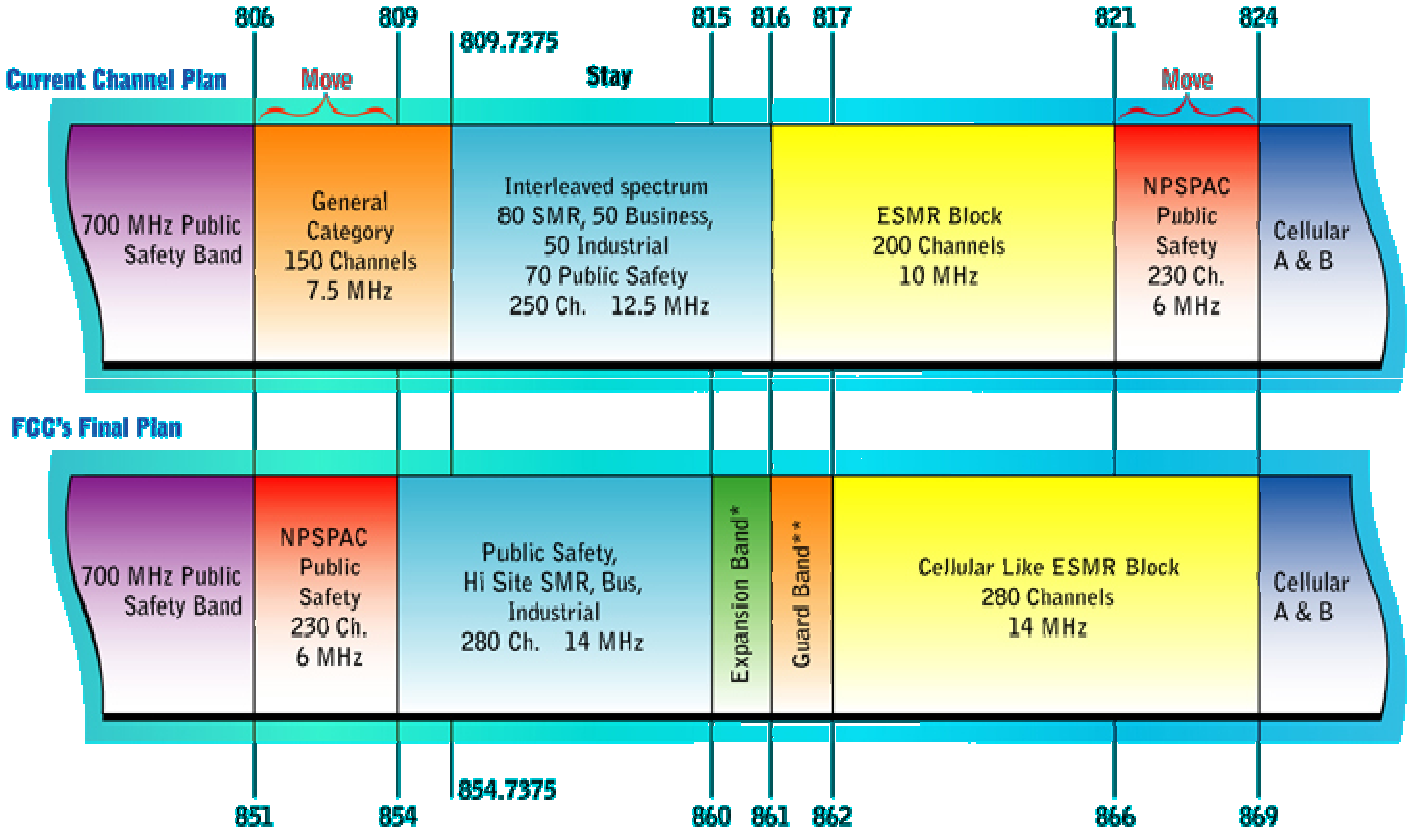
800 MHz Rebanding: "Before and After"



***No public safety system will be required to remain in or relocate to the Expansion Band, although they may do so if they choose**

****No public safety or CII licensee may be involuntarily relocated to occupy the Guard Band.**

Workshop Overview and Purpose

Introduction

- Introduction of speaker and attendees
- Opening comments

Purpose

- Provide a forum for RPC representatives to share insight and lessons learned
  - 800 MHz Rebanding
  - Regional 800 MHz channel coordination and interoperability strategies
  - Items of interest within the framework of the workshop

Overview

- Opportunity to gain insight into regulatory and operational issues and requirements affecting 800 MHz network operations
  - Updating the RPC 800 MHz Plan
  - The Rebanding landscape
  - Interoperability strategies during the 800 MHz reconfiguration
  - Radio network operational quality management in the new NPSPAC
  - Filing for released 800 MHz channels
  - Strategies for extending the life of the current network if 700 MHz narrowband P-25 is delayed

Workshop Agenda

Day 1
Introduction to the Workshop •Speakers &Attendees •Purpose •Items of interest •Overview of 800 MHz Plan development and submission requirements in response to NPSPAC Rebanding
NPSPAC history overview
RPC formation and operations
800 MHz Plan submissions, production process and lessons learned
FCC: Regulatory discussion on the 800 MHz Plan, status of US border Rebanding and coordination, others — Jeannie Benfaida
Region 7 Representative: The 800 MHz Rebanding experiences of the State of Colorado — Dennis Kalvels
Presentation of a 800MHz Plan template to support the new filing
Possible enhancement to existing plans, including new technologies
Strategies to maintain radio interoperability during NPSPAC Rebanding
Region 24: Presentation on Computer Assisted Pre-Coordination Resource and Database System (CAPRAD) —Steve Devine

Workshop Agenda

Day 2
Recap Day 1 800 MHz Plan materials and action items
FCC Presentation Part II: RPC Administrative Requirements — Jeannie Benfaida
APCO-AFC: Licensing strategies to pursue 800 MHz spectrum vacated by Sprint Nextel— Farokh Latif
Transition Administrator: Heading to the Finish Line – Rebanding Status and Update — Brian Jagan
Radio channel assignment strategies and process
Logistics of repacking the 800 MHz regional spectrum: resource and related cost-benefit considerations
APCO –AFC RPC Operational Techniques, Methods and Standards
800 MHz Rebanding Plan Comments and Q&A
Preparing jurisdictions for broadband wireless
Closing Remarks

Getting to Know You

How many RPC Chairs/Co-Chairs in attendance?

Do you have neighbors and colleagues in the workshop?

Do you hold monthly, quarterly, bi-annual, annual RPC meetings?

Host a RPC web site? How is it updated? How often?

Do you think a RPC web site is required?

Are you familiar with the Incident Command System (ICS)? Have developed ICS Form 205 Radio Plans?

Who has attended ICS training?

Who is ISC certified? Any COMLs in the group?

How many have technical radio knowledge? What level? Design? Operations?

Any channel coordinators in attendance?

Is your RPC governance charter current and effective?

How many have 800 MHz channel shortage within the RPC?

How many channels are needed?

How many RPC regions have 700 MHz narrowband installations?

How many have 700 MHz procurements in progress?

Session 2: FCC Regulatory Environment Presentation

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Session 3: NPSPAC and 800 MHz Plan History & Post Rebanding Frequency and Channel Shift

Rick Burke,
Managing Partner, Televate, LLC

February 12, 2009

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NPSPAC Overview Agenda

- NPSPAC history overview
- RPC formation and operations
- Original and updated 800 MHz Plan submissions
- Technical parameters for channel assignment and coordination
- Plan production process and lessons learned
- NPSPAC radio channel and frequency offset Rebanding changes

The Public Safety National Plan and NPSPAC

December 1983
U.S. Congress directs the FCC to establish a communications plan to meet the needs of public safety, including a nationwide frequency allocation.
Prior to this directive, the FCC had begun proceedings to assign 800 MHz spectrum for commercial cellular operations

September 19, 1986
The FCC allocates 6 MHz of spectrum for public safety use in the 821-824 and 866-869 bands. The adjacent location of these bands to the current frequencies used by public safety provides for interoperability.

December 1986
FCC establishes the National Public Safety Planning Advisory Committee (NPSPAC) to identify, develop, and make recommendations for public safety communications and frequency use. The NPSPAC is also responsible for defining regional boundaries (the Regional Planning Committee boundaries).

May 15, 1987
FCC issues proposed rulemaking for the national plan.

The Public Safety National Plan and NPSPAC

FCC General Docket No.87-112

- **Adopted on November 24, 1987 as FCC General Docket No. 87- 112**
- **Objectives:**
  - Facilitate interoperability between communications systems of local, state, and federal agencies
  - Ensure the efficient use of the 800 MHz spectrum allocated for public safety
  - Provide guidance on the use of new spectrum by public safety and construct a framework for regional planning

Objectives of a national plan

- **What is the purpose of a national plan?**
  - Serve as an umbrella for regional development plans
  - Establish who is eligible for assignments in the new public safety frequencies
  - Adopt and establish regional boundaries
  - Define the minimal technical standards for regional planning
  - Define the contents of regional plans

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The Public Safety National Plan and NPSPAC

Who is eligible to operate in the 821-824/866-869 bands?

- Public Safety Radio Services and the Special Emergency Radio Services are eligible to operate within the frequencies.
- Priority is given to organizations within each region that most fundamentally involved in protection of life and property.

Who determines what organizations take priority?

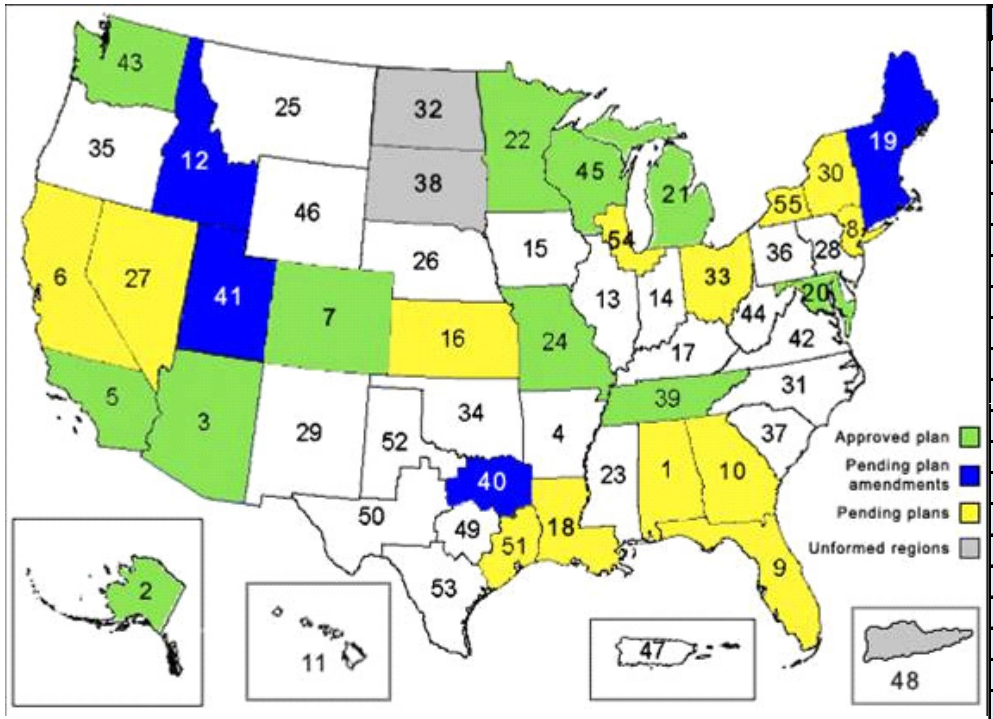
- The FCC and NPSPAC declare that each regional committee will make the determinations that are most appropriate for their respective regions.

Regional Boundaries

- Initial recommendations were made by the NPSPAC to create 54 regions (Regional Planning Committee)
- The FCC finalized the NPSPAC recommendations and created 48 RPCs covering all land area of the United States, including Puerto Rico and the Virgin Islands. Today we have 55 RPCs
- Each region must establish a Regional Planning Committee (RPC) to create and execute a regional communications plan
- The Association of Public Safety Communications Officers, Inc (APCO) was given the responsibility of initiating the planning process and appointing a convenor in each region

Are these RPC boundaries still functional?

Regional Planning Committee Map



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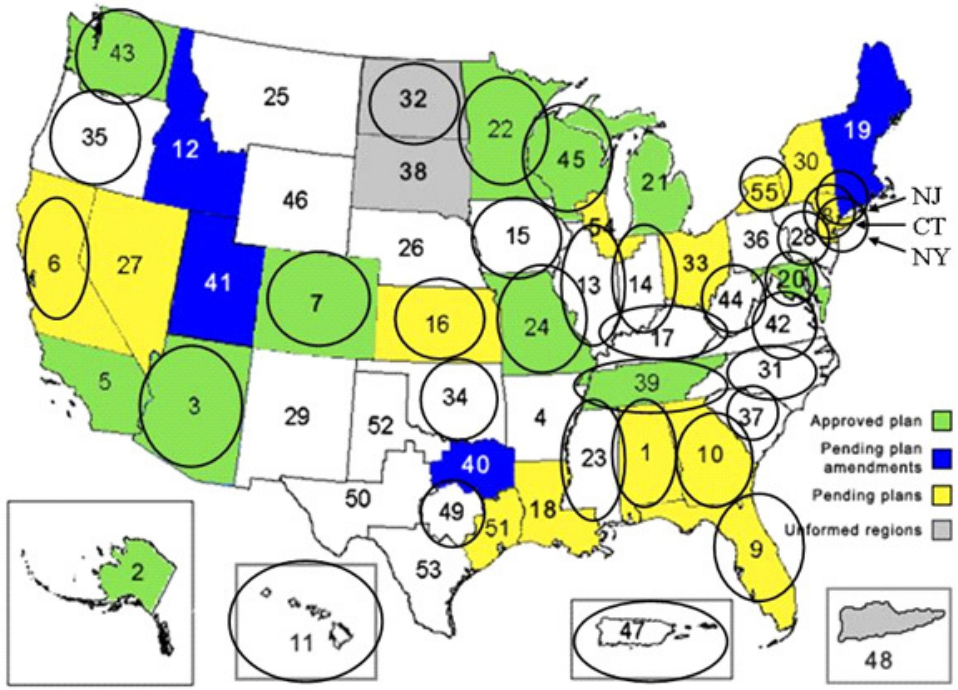

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Development and Implementation of a Public Safety National Plan

Minimum Technical Requirements:

1. Establish the Channeling Plan as a 25 kHz offset channeling plan
2. Mutual aid channels for interoperability
3. Require the use of trunked systems by licensees with more than 4 channels
4. Maintains traditional loading standards for the 800 MHz band

- **Technical parameters guiding coverage and interference protection to be discussed later in the workshop**
- **Future 800 MHz narrowband channels will impact 800 MHz Planning**

Development and Implementation of a Public Safety National Plan

Minimum Technical Requirements (cont'd):

1

- **Channeling Plan: 25 kHz offset channeling plan**
  - The FCC adopted the 25 kHz offset channeling plan from NPSPAC recommendations because it provided for interoperability with existing 800 MHz public safety systems
  - Technical standards for transmitters are established in conjunction with this plan in order to reduce adjacent channel interference

Development and Implementation of a Public Safety National Plan

Minimum Technical Requirements (cont'd)

2

- **Mutual Aid Channels for Interoperability**
  - Five national mutual aid intercommunication channels for local, state and federal access and coordination
  - One channel is designated as the National Public Safety Calling Channel, four channels are designated as tactical channels
  - NPSPAC outlines three requirements for use and operation of the channels:
    - All mobile and portable radios be equipped to operate on all five channels
    - Channel assignments adjacent to the five mutual aid channels be spaced no closer than 25 kHz
    - The five channels will operate in conventional mode with tone coded squelch at a standard frequency of 156.7 H
  - Regional plans must identify the specific operations and management of the 5 mutual aid channels

Are these channels being programmed into your radios?
How are mutual aid channel base transmissions coordinated?
Do you regularly allocate these channel for incident management?

National Mutual Aid Channels

800 MHz

MOBILE TRANSMIT	MOBILE RECEIVE	FUTURE MOBILE TRANSMIT	FUTURE MOBILE RECEIVE	LABEL	DESCRIPTION
821.0125	866.0125	806.0125	851.0125	ICALL	National Calling
821.5125	866.5125	806.5125	851.5125	ITAC-1	National Tactical
822.0125	867.0125	807.0125	852.0125	ITAC-2	National Tactical
822.5125	867.5125	807.5125	852.5125	ITAC-3	National Tactical
823.0125	868.0125	808.0125	853.0125	ITAC-4	National Tactical

UHF

MOBILE TRANSMIT	MOBILE RECEIVE	LABEL	DESCRIPTION
458.2125	453.2125	UCALL	National Calling
458.4625	453.4625	UTAC-1	National Tactical
458.7125	453.7125	UTAC-2	National Tactical
458.8625	453.8625	UTAC-3	National Tactical

VHF

CHANNEL (MHz)	LABEL	DESCRIPTION
155.7525 base/mobile	VCALL	National Calling
151.1375 base/mobile	VTAC 1	National Tactical
154.4525 base/mobile	VTAC 2	National Tactical
158.7375 base/mobile	VTAC 3	National Tactical
159.4725 base/mobile	VTAC 4	National Tactical

***Note: PL Code 156.7 Hz is recommended for all frequencies**

Development and Implementation of a Public Safety National Plan

Minimum Technical Requirements (cont'd)

3

- **Trunking**
  - Trunked systems should be used to improve spectrum efficiency
  - Small entities may use conventional systems that are of 4 channels or less
  - Systems that are more than 4 channels must be trunked
  - The FCC does not adopt mandatory standards for trunked systems, but suggests that trunked systems be based on queuing theory
  - All trunked systems are required to operate in a conventional and compatible mode on the mutual aid channels.

Development and Implementation of a Public Safety National Plan

Minimum Technical Requirements (cont'd)

4

- **Loading Standards**
  - At the time of the adoption of FCC General Docket 87- 112 and 87- 359, the FCC declared it would maintain the existing loading standards of the 800 MHz band to the new public safety channels in the 821-824 and 866-869 MHz bands
  - Current channel loading: 70 subscriber for conventional; 100 for trunked
  - Previous channel loading requirements listed below

Emergency Usage		Non-Emergency Usage	
Channel Assigned	Subscribers per Channel	Channel Assigned	Subscribers per Channel
1 - 5	70	1 – 5	80
6 – 10	75	6 – 10	90
11 – 15	80	11 – 15	105
16 - 20	85	16 - 20	120

Development and Implementation of a Public Safety National Plan

Framework for Regional Plans

Informational Guidelines

1. Cover page that identifies regional plan for the identified region
2. Name of Regional Planning Chairman (mailing address and telephone contact)
3. Names of members of the regional planning committee, including organizational affiliations, mailing addresses, and telephone contacts
4. Summary of the major elements of the plan
5. Provide a general description of how the spectrum is to be allotted among the various eligible users within the region
6. Explain how the requirements of all eligible entities were considered and met to the degree possible
7. Explain entities prioritized in areas where not all can receive licenses
8. Explain how the plan has been coordinated with adjacent regions
9. Provide a detailed description of how the plan puts the spectrum to the best possible use through system design, frequency assignment, and technical and engineering efficiency
10. Contain the signature of the Regional Planning Chairman

Are you familiar with your current 800 MHz Plan?
Have you been involved with recent updates to the plan?

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RPC Status and Involvement on the 800 MHz Plan and Channel Coordination

- Common RPC practices for developing the 800 MHz Plan and coordinating radio channel assignment are detailed within each RPC plan – FCC Report and Order 87-112
  - Chairperson (Convenor) election process
  - Regional Planning Committee membership
    - Selection process
    - Regular meetings
    - Voting privileges

RPC Status and Involvement on the 800 MHz Plan and Channel Coordination

Have you been involved in the original/modification development of your regional 800 MHz Plan? The 700 MHz Plan?

- Are any of the original authors still engaged?
- Was the plan developed/updated by a committee?
- What are your plans to update the current 800 MHz plan?
  - Internal efforts lead by the Chairperson? The Planning committee? Outside support?
  - Do you feel you have sufficient information, support, regulatory guidance, capability to proceed with updating the Plan based on the impact of Rebanding?
- How are you currently coordinating radio channel allocation?
  - Is the process effective? Is there general consensus that the process is timely and effective?
  - Best governance practice overview

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800 MHz Plan Shared Experiences

We have had the opportunity to study Regional 800 MHz Plans that have been updated in the past 3-8 years?

- Including but not limited to the following:
  - Region 39 – Tennessee – May 2002
  - Region 43 – Washington State – September 2005
  - Region 6 – Northern California – April 2001

Overview of experience of those recently developing updated Plans and/or 700 MHz Plans

- Discussion on production experience
- Discussion on lessons learned
- Recommendations to the RPC community
- Input to the regulatory bodies
- Input to the APCO to assist in supporting the future updating of the Plans and in managing channel coordination
- Others

Template Review

We will review 800 MHz Plan templates to support your individual efforts to update the Plan and seek methods to standardize and simplify the overall coordination process

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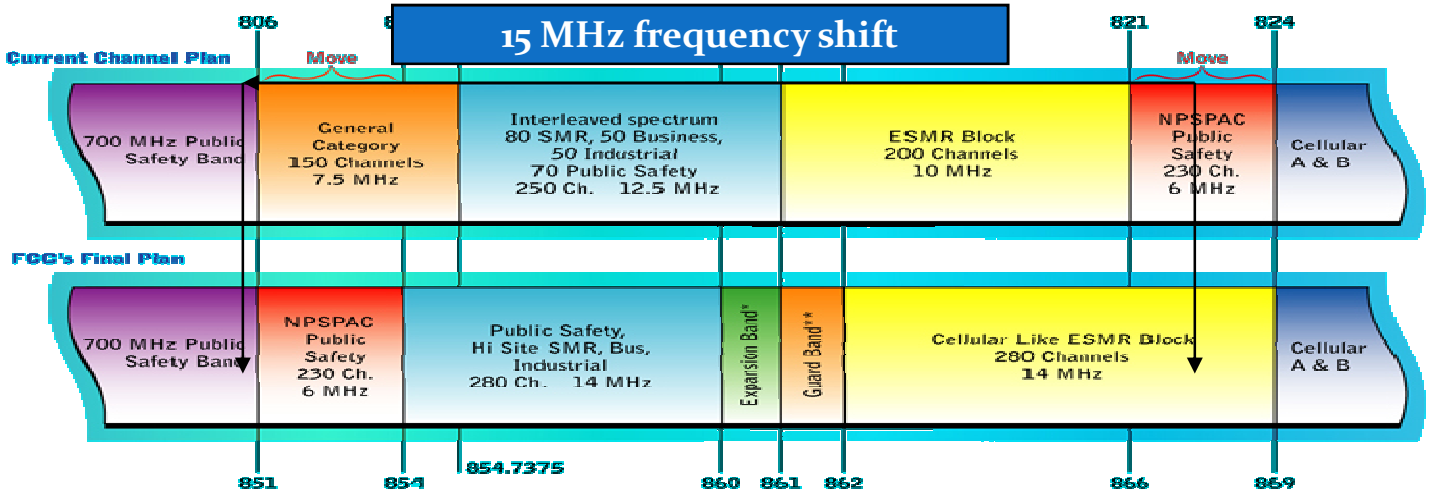
NPSPAC Post Rebanding
Radio Frequency and Channel Number Changes

- Post Rebanding impacts on NPSPAC radio spectrum and channel numbers need to be reflected in the RPC 800 MHz Plan
  - NPSPAC frequency "left shifts" 15 MHz
  - Radio channel number "shift down" 600
  - While all RPC 800 MHz channels will eventually move equal frequency distance there are considerable issues to manage during the reconfiguration
  - All jurisdictions will not reband on the same schedule
  - All RPC will not reband on the same schedule
- Migration can have considerable impact on regional interoperability
- Increased potential for inter and intra RPC interference both between public safety and between public safety and Sprint Nextel



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Pre-Post NPSPAC Channel Assignments

CHANNEL PLAN PRE-DECISION 02-55				CHANNEL PLAN POST- DECISION 02-55			
CH. #	REPEATER TX	MOBILE TX	CATEGORY	CH. #	REPEATER TX	MOBILE TX	CATEGORY
1	851.0125	806.0125	GC	1	851.0125	806.0125	NPSPAC - MA
2	851.0375	806.0375	GC	2	851.0375	806.0375	NPSPAC
3	851.0625	806.0625	GC	3	851.0500	806.0500	NPSPAC
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400	860.9875	815.9875	PS	400	858.2375	813.2375	PS
401	861.0125	816.0125	SMR	401	858.2625	813.2625	PS
402	861.0375	816.0375	SMR	402	858.2875	813.2875	B/ILT
.	.			.		.	.
.	.			.		.	.
.	.			.		.	.
828	868.9625	823.9625	NPSPAC	828	868.9375	823.9375	ESMR
829	868.9750	823.9750	NPSPAC	829	868.9625	823.9625	ESMR
830	868.9875	823.9875	NPSPAC	830	868.9875	823.9875	ESMR

Note variance between original lower 120 channel 25 kHz channel spacing and post Rebanding 12.5 kHz channel spacing

Display detailed channel allocation tables

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NPSPAC Post Rebanding
Radio Frequency and Channel Number Changes

	ORIG FCC CH NUMBER	ORIG FREQ		OLD CAT	CURR FCC CH NUMBER	CURR FREQ	NEW CAT	NEW FCC CH NUMBER
MA Call	601	866.0125	---->		1	851.0125		1
			guard		1.5	851.0250		guard
	602	866.0375	---->		2	851.0375		2
	603	866.0500	---->		2.5	851.0500		3
	604	866.0625	---->		3	851.0625		4
	605	866.0750	---->		3.5	851.0750		5
	606	866.0875			4	851.0875		6
	607	866.1000	---->		4.5	851.1000		7
	608	866.1125	---->		5	851.1125		8
	609	866.1250	---->		5.5	851.1250		9
	610	866.1375	---->		6	851.1375		10
	611	866.1500	---->		6.5	851.1500		11
	612	866.1625	---->		7	851.1625		12
	613	866.1750	---->		7.5	851.1750		13
	614	866.1875	---->		8	851.1875		14
	615	866.2000	---->		8.5	851.2000		15
	616	866.2125	---->		9	851.2125		16
	617	866.2250	---->		9.5	851.2250		17
	618	866.2375	---->		10	851.2375		18
	619	866.2500	---->		10.5	851.2500		19
	620	866.2625	---->		11	851.2625		20
	621	866.2750	---->		11.5	851.2750		21
	622	866.2875	---->		12	851.2875		22

EXAMPLE: Existing NPSPAC channel 620 (866.2625 MHz) will relocate 15 MHz down to 851.2625 MHz which is currently General Category channel 11. The new channel number would be 20

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Session 4: Colorado Statewide Digital Trunked Radio System

Dennis Kalvels
Region 7– State of Colorado Representative

Dennis Kalvels
Project Manager
CCNC

February 12, 2009

Colorado Statewide Digital Trunked Radio System (DTR)

Consolidated Communications Network of Colorado
(CCNC)
800+ Agencies

CCNC
Consolidated Communications Network of Colorado Inc.

System Description

- 700/800 MHz P25 Smartzone Trunking System
- System Growing & Evolving Since 1990's
  - DTR Requirement & Operational Plan –1995
  - Local Government Partnerships – 1997
  - DTR RFP – 1998
  - Initial DTR Equipment Contract signed – 1999

CCNC
Consolidated Communications Network of Colorado Inc.

System Description

- 3 Zone Controllers
- 28000+ Subscribers
- 122 Sites (FRA) 40 more STA sites
- 690+ Channels
- 19 ITAC's
- Analog Systems

CCNC
Consolidated Communications Network of Colorado Inc.

System Description

- DTR Sys. subscriber units as of 1-11-07

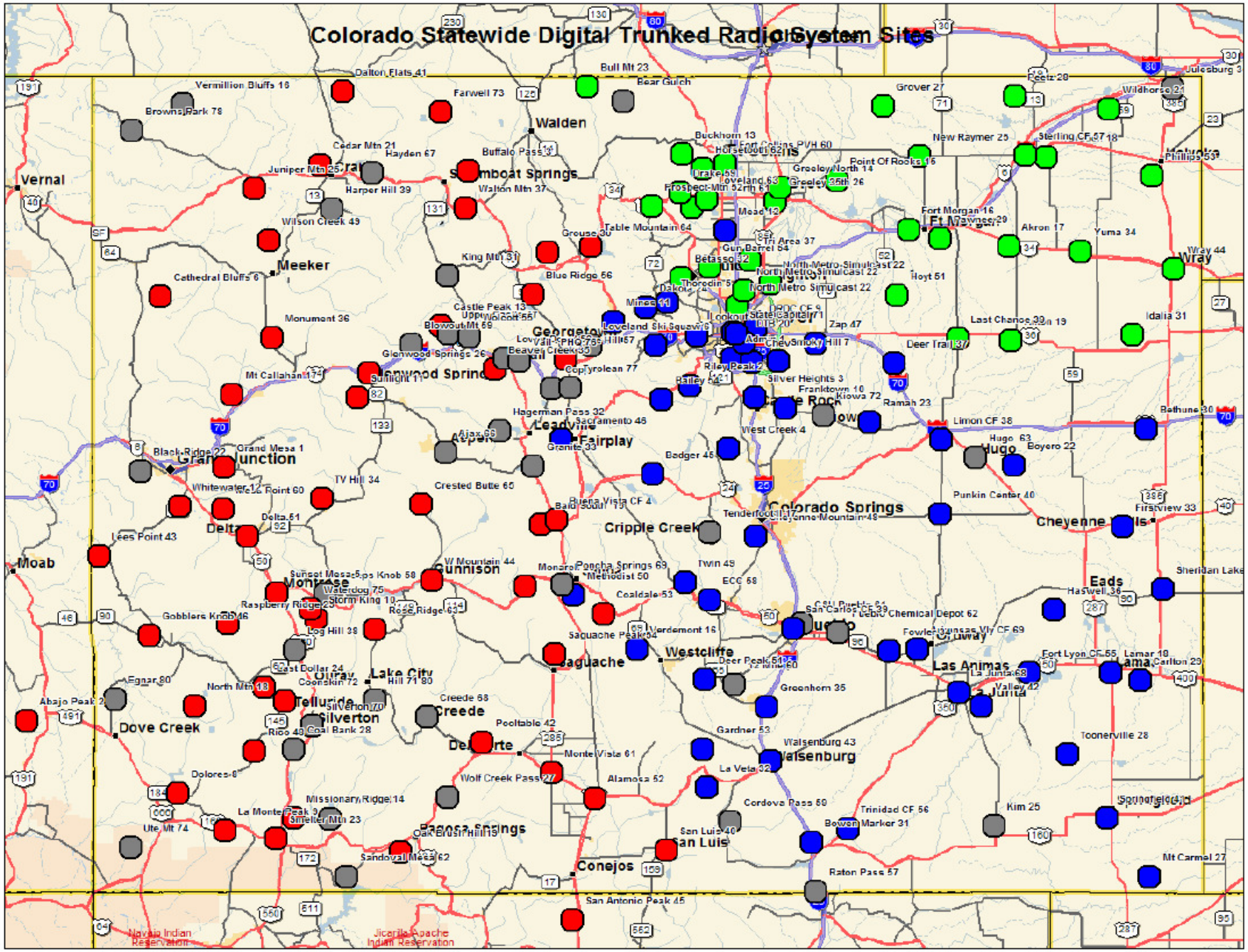
ADCOM	2221
Arapahoe Co	3361
Douglas Co	2040
Jefferson Co	2390
Weld Co	1836
NE Region	794
NCRCN	2113
NW Region	384
PPRCN	20
San Luis Valley	1073
SE Region	1767
SW Region	730
State of Colorado	8792
Federal	118
Tribal	33
Total	27672

CCN
Consolidated Communications Network of Colorado Inc.

System Evolution

- 122 Sites (FRA) 40 more STA sites
- Currently 176 sites
- Funded 186 sites

CCN
Consolidated Communications Network of Colorado Inc.



Data use subject to license.

0 16 32 48 64 80 mi

Rebanding

- User agencies
  - 800+
- Intergovernmental Agreement (IGA)
  - 15 Licensees

CCNC
Consolidated Communications Network of Colorado Inc.

Licensees

Licensees	
Arapahoe County	Boulder County
Douglas County	Moffat County
Jefferson County	City of Greeley
Weld County	City of Montrose
Baca County	City of La Junta
Huerfano County	City of Boulder
NCRCN	Larimer County
State of Colorado	

CCN
Consolidated Communications Network of Colorado Inc.

Rebanding

- Reconfiguration Planning - Motorola
  - Completed Fall 2006
- Frequency Reconfiguration Agreement (FRA)
  - Negotiation Oct 2006 – Apr 2007
  - FRA signed Apr 2007
- Reconfiguration Implementation – Motorola
  - 3 Subcontractors

CCNC
Consolidated Communications Network of Colorado Inc.

Rebanding Schedule

• Subscriber Flash	5/7/07 – 9/17/07
• Sites	9/20/07 – 3/31/08
• BDA's & ITAC's	9/20/07 – 12/21/07
• Subscriber Reprog.	2/26/08 – 6/29/08
• Mobile Rptrs	?
• ITAC Removal	5/22/09 – 5/30/09

CCNC
Consolidated Communications Network of Colorado Inc.

Rebanding

- Change Orders 10+
  - STA's - 2
  - Spare radios
  - EFJ radios
  - Discovery & Quantity Change
  - Replace combiners
  - ITAC's
  - Mobile repeaters
  - Mobile radio antennas

CCNC
Consolidated Communications Network of Colorado Inc.

Issues

- Schedule - Weather
- FCC schedule not TA schedule
- Contracts w/ Sprint Nextel, w/vendor
- Freeze - Special Temporary Authorization (STA)
  - Currently 60+ STA's
- ITAC's – Back to Back
- Frequency Availability
- Itinerant frequencies not eligible – mobile rptrs

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Consolidated Communications Network of Colorado Inc.

Highs

- Got it done
  - 28,000 subscribers
  - 162 sites

CCN
Consolidated Communications Network of Colorado Inc.

Lessons Learned

- Communicate, Communicate, Communicate
- Inform your folks – Users, Legal, Contracts, Budget, Decision Makers, etc
- Take action – Don't wait on FCC, TA, SN
- Have licenses up to date and accurate
- Retain outside legal Counsel
- Have solid implementation plan

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Consolidated Communications Network of Colorado Inc.

Questions?

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CCN
Consolidated Communications Network of Colorado Inc.

Session 5: 800 MHz Plan Template to Support the New Filing

Iris Zhu
Design Engineer
Televate, LLC

February 12, 2009

LeGrande Technical and Social Services, LLC

800MHz Plan Components (1)

Cover Page

Checklist (optional)

Table of Contents

Executive Summary (optional)

Plan Development Section

- Introduction
- Purpose
- Summary of RPC Activities (optional)
- Summary of Revisions to the Plan (optional)

Implementation and Procedures Section

- Authority
  - Regional Planning Committee
  - Planning Committee Formation
  - National Inter-relationships
  - Federal Interoperability
  - Regional Review Committee

800MHz Plan Components (2)

Implementation and Procedures Section (cont'd)

- General Protocols for Application
  - Timetable for System Implementation (optional)
  - Frequency Recall (optional)
  - Reassignment of Frequencies (optional)
  - License Application Requirements (optional)
  - Application Filing Window and Criteria for Agency Prioritization (optional)
  - Appeal Process
  - Channel Distribution (optional)

Initial Spectrum Allocation Section

- Frequency Sorting Methodology

Spectrum Utilization Section

- Region Defined
- Region Profile
- Usage Guidelines
- Technical Design Requirements for Licensing
  - Definition of Service Area
  - Definition of Coverage Area
  - System Coverage Limitations
  - Determination of Coverage

800MHz Plan Components (3)

System Loading and Implementation Requirements

- Conventional Systems
- Trunking Systems
- Channel Loading
- Simplex Operations (optional)
- Itinerant Operations (optional)
- Operation Aboard Aircraft (optional)
- Systems Designed to Serve Limited Area of Operation (optional)
- Annexations and Other Expansions (optional)
- Coverage Area Description (optional)
- Give Back Frequencies
- Adjacent Region Considerations

800MHz Plan Components (4)

Interoperability

- National Mutual Aid Channels (pre/post rebanding assignments)
- National Statewide Tactical Channels (optional and as applicable)
- Criteria (optional)
  - Primary Users
  - Secondary Users
  - Shared Trunked System
  - Channel Counting
- Channel Assignments
  - ICALL
  - Remaining Calling Channels
  - State Tactical Channels (optional and as applicable)
  - Channel Usage

800MHz Plan Checklist

1. Cover page – identifying the region
2. Chairperson – name, address, phone # and signature
3. List of committee members – name, organizational affiliation, address, phone #s
4. TOC summarizing the major elements of the plan
5. General description of how spectrum is allotted among the users
6. Explanation of how the requirements of all eligible applicants are considered and met
7. Explanation of how eligibles are prioritized in areas where not all eligibles may receive licenses
8. Explanation of how the plan has been coordinated with adjacent regions
9. Description of how the plan puts spectrum to best possible use by:
    a. Requiring system design with min. coverage areas
    b. Assigning freq. so that max. frequency reuse and offset channel use may be made
    c. Making use of trunking
    d. Requiring small entities with minimal requirements to join together on a single system where possible

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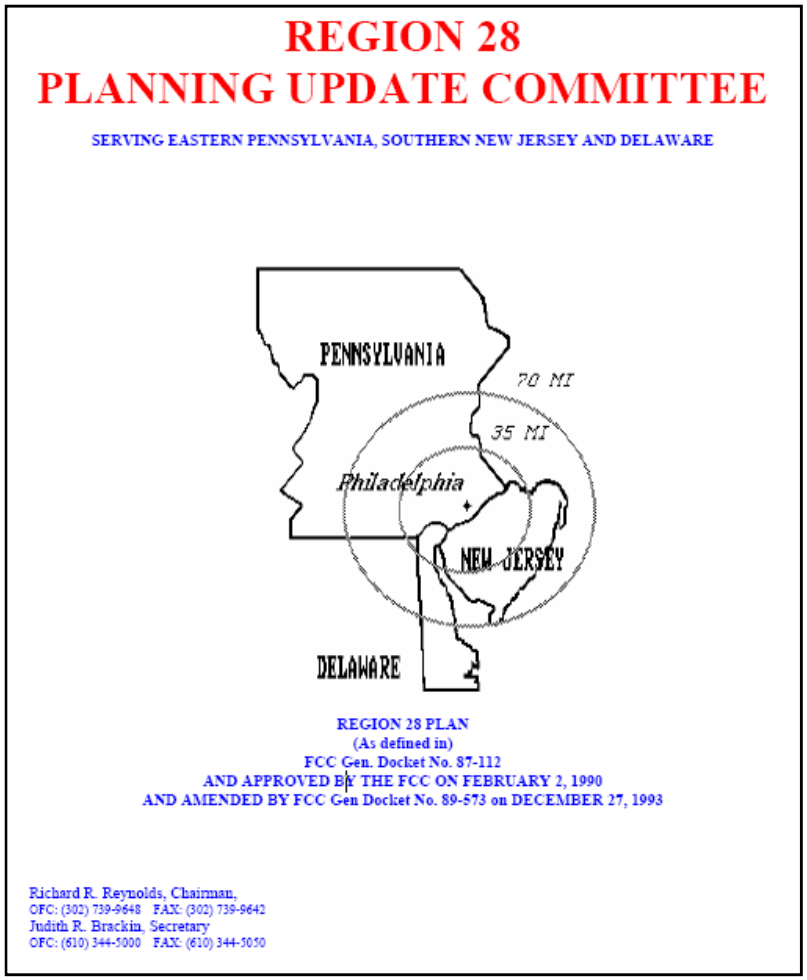
800MHz Plan Checklist

10. Explanation of how interoperability channels are managed
11. "Slow Growth" language
12. Does the plan refer to Give-Back freq? If yes, give page #
13. Use the APCO sorting program
14. Appeal Process
15. Does the plan provide for regional mutual aid channels in addition to the five (5) common channels. If so, are there guards bands for these channels?
16. Similar to the Generic Plan describe the formation of the committee:
    a. Advertising – copy should be attached to legal notice, letters to the industry, etc
    b. Who could vote and what procedures were used after first meeting?
    c. How was the final plan adopted? Was it by members attending a meeting or mail ballots? _____

Sample Cover Page

- ☑ Title
  - ☑ Sample: Regional NPSPAC 800MHz Public Safety Radio Communications Plan for Region __ (State)
- ☑ State Map (optional)
- ☑ FCC General Docket No.
- ☑ Amendments Dates of Plan (as applicable)
- ☑ Chairperson Name and Contact Info
- ☑ Website Link



Plan Development

Scope

- Introduction
  - Background of the Public Safety 800 MHz Radio Communications Plan
- Purpose
  - Develop a plan to allow all levels of public safety/public service agencies utilizing radio communications for their daily operations to suffer less interference, noise and over-crowding of the radio network.
- RPC Activities (optional)
- Plan Revisions (optional)

Implementation and Procedures

Authority

- Regional Planning Committee
- Planning Committee Formation
  - Process and Details Committee Membership
  - Include as an Appendix (optional)
- National Inter-relationships
  - If a conflict exists between the Regional Plan and the National Plan, the judgment of the FCC will prevail.
- Federal Interoperability
  - During emergency situations which calls for additional mutual aid channels beyond the 5 National MA Channels, licensee may allow Federal use of a non-Federal communication system.
  - Channel requirements can increase up to 2% in mobile units provided that written documentation from Federal agencies support that # of increased units
- Regional Review Committee
  - Requests submitted here. Committee records and tracks any changes to the Regional Plan

Implementation and Procedures (1)

General Protocols for Application

- Timetable for System Implementation (optional)
  - Achieving certain formal construction deadlines and loading requirements w/in 1 year of receiving FCC license are defined in the FCC licensing process, not under RPC's control
- Frequency Recall (optional)
  - If RPC becomes aware that required construction and loading milestones are not being met, RPC has option of notifying the FCC so that consideration to return some or all of the channels to allow other eligible licensees a chance to receive frequencies
- Reassignment of Frequencies (optional)
  - Applicants with 800MHz frequencies covered in the Plan are encouraged to return VHF and UHF frequencies, as applicable, currently used by applicant back to the FCC to allow them to reassign to agencies awaiting channels in the lower frequency bands
  - If applicant must retain these VHF and UHF channels, as applicable, applicants must include their reuse and state how applicant will not use for intended purpose w/in 24 months that the channels will be surrendered

Implementation and Procedures (1)

General Protocols for Application (cont'd)

- License Application Requirements (optional)
  http://wtbwww05.fcc.gov/HelpDoc/instr601s.html
  - Form 601 - Instructions to complete the 601 form:
    http://wtbwww05.fcc.gov/HelpDoc/instr601s.html
  - Appropriate Public Safety Frequency Coordinator Forms:
    - Example, for APCO it's APCO FDR 3 Form found here:
      http://www.apcointl.org/frequency/downloads/fdr2000.pdf
  - Computer generated propagation maps showing field strength contours
    - Wizard, Radiosoft
    - Coordination Fee
    - Frequencies to be released and schedule for release
    - **Comprehensive** justification for the number of channels requested
    - Implementation schedule
    - Proof of funding

Implementation and Procedures (2)

General Protocols for Application (cont'd)

- Application Filing Window and Criteria for Agency Prioritization
  - Applications reviewed at the Committee meetings, submit > 5 days in advance
  - Criteria
    - Need to protect human life
    - Functional Aspect of how the frequencies will be used (interoperability)
    - Technical Aspect of how the frequencies will be used (system loading)
    - Number and ability to reassign or reuse the turn back channels
    - Implementation Schedule
      - Degree of funding support
      - Time table for constructing the communication system

Appeal Process

- If an application is rejected, go to RPC for review then to FCC

Channel Allocations

- List of Channel Assignments (attach as an appendix)

Initial Spectrum Allocation

Frequency Sorting Methodology

- Determined by a computerized frequency sorting process performed by APCO
  - Assignments must result in high degree of spectrum efficiency
  - Assignments must result in low probability of co-channel and adjacent channel interference
  - Main factors taken into consideration:
    - Geographic area
      - The procedure is to gather maps of sufficient detail, outline the areas to be defined, determine the coordinates and radius of the circles which define each area, and tabulate the data
    - Blocked Channels (optional)
      - The five National MA Channels are blocked from reassignment and is used as input into the computer program
    - Transmitter Combining (optional)
      - Provides a minimum frequency separation between any two channels assigned to the same eligible at the same site.
      - This separation is provided in order to enable more efficient combing of multiple transmitters to a single antenna.
    - Protection Ratios (optional)
      - Two interference protection ratios:
        - Co-channel ratio – 35 dB Desired/Undesired signal ratio
        - Adjacent ratio – 15 dB Desired/Undesired signal ratio

Spectrum Utilization (1)

Region Defined

Region Profile (Demographic Information)

- Creativity Shines! (optional)
  - Ex.: Have a state map, population density map, etc
- Geographical Description
- State Population and Expected Growth %

Usage Guidelines

- Systems having >=5 channels will be required to be trunked
- Systems having <=4 channels may be conventional
  - Exceptions permitted if applicant can show that alternative technology would be at least as efficient as trunking or that trunking would not meet operational requirements
  - If the system does not meet FCC loading standards, it will be required to share the frequency on a non-exclusive basis

Spectrum Utilization (2)

Technical Design Requirements for Licensing

- Definition of Service Area
- Definition of Coverage Area
- System Coverage Limitations
- Factors that determine Coverage
  - Received signal strength
  - ERP
  - Environment type
    - Urban
    - Suburban
    - Quasi-Open
    - Open
  - Antenna design
  - Low level sites
  - Frequency reuse
  - Adjacent Channel Design
  - Absolute Mileage Separation
  - Base-to-Mobile Units
  - Mobile-to-Base Units
  - Trunking Requirement
  - Transmitter Standards
  - Coded Squelch

System Loading and Implementation Requirements (1)

Conventional Systems

- An agency requesting a single frequency and turning back a frequency for reassignment will not be required to meet loading requirements to obtain the new frequency
- If the single frequency is not loaded w/in the time constraints established by the FCC, the channel will be available for assignment on a shared basis
- conventional systems:
- For purposes of determining compliance with conventional system loading requirements in Part 90.633 of the FCC Rules, the loading requirement is to have seventy (70) mobile stations per each channel authorized.

Trunking Systems

- Refer to Usage Guidelines (slide 13) for the requirements
- The loading requirement for trunked systems is to have one hundred (100) mobile stations per channel. For purposes of determining compliance with trunked system loading requirements in Part 90.631 of the FCC Rules, the term “mobile station” includes vehicular and portable mobile units and control stations.

Channel Loading Requirements

Loading tables

Traffic Loading Study

System Loading and Implementation Requirements (2)

- Simplex Operations (optional)
- Itinerant Operations (optional)
- Operation Aboard Aircraft (optional)
- Systems Designed to Serve Limited Area of Operation (optional)
- Annexations and Other Expansions (optional)
- Coverage Area Description (optional)
- Give Back Frequencies
- Adjacent Region Considerations

List Neighbors and its unique characteristics

Interoperability (1)

National Mutual Aid Channels

FCC pre-rebanding frequencies

Channel	Frequency Pair	Frequency Designation
601	821/866.0125 MHz	National Calling Channel ICALL
639	821/866.5125 MHz	National Mutual Aid Channel ITAC-1
677	822/867.0125 MHz	National Mutual Aid Channel ITAC-1
715	822/867.5125 MHz	National Mutual Aid Channel ITAC-1
753	823/868.0125 MHz	National Mutual Aid Channel ITAC-1

FCC post-rebanding frequencies

Channel	Frequency Pair	Frequency Designation
1	806/851.0125 MHz	National Calling Channel ICALL
39	806/851.5125 MHz	National Mutual Aid Channel ITAC-
77	807/852.0125 MHz	National Mutual Aid Channel ITAC-
115	807/852.5125 MHz	National Mutual Aid Channel ITAC-
153	808/853.0125 MHz	National Mutual Aid Channel ITAC-

National Statewide Interoperability Channels (optional)

An example below shows the recommended frequency assignment

Channel	Frequency Pair	Frequency Designation
116	807/852.5375 MHz	Tactical, Primarily Fire/EMS STATEOPS-1
118	807/852.5625 MHz	Tactical, Primarily Law Enforcement STATEOPS-2
120	807/852.5875 MHz	Tactical, Primarily Local Gov't, Others STATEOPS-3
122	807/852.6125 MHz	Tactical, Primarily Fire/EMS STATEOPS-4
124	807/852.6375 MHz	Tactical, Primarily Law Enforcement STATEOPS-5

Interoperability (2)

Criteria for Interoperability Requirements Section (optional)

- Primary Users
  - An agency that operates on >=5 channels or a trunking system
  - Required to operate a control station to provide 24 hour monitoring and rendering assistance on the Calling Channel
  - Suggested guideline for number of required Calling Channel is one Calling Channel for each four trunking channels
- Secondary Users
  - An agency that operates a non-trunking system on <=4 channels
  - At a minimum, shall operate a control station or a base station for continuous monitoring of the National Calling Channel
- Shared Trunked System
  - If two or more agencies agree to share a trunking system, as a group they must meet all the requirements for a Primary User
  - Each individual agency must, at a minimum, meet the Secondary User requirements
- Channel Counting
  - Outside of 806-808/851-853 MHz band applying for a frequency(s) w/in 806-808/851-853 MHz band, the 800 MHz trunking channel will be counted to determine if an applicant for a channel is a Primary User or a Secondary User

Interoperability (3)

Channel Assignment

- National Calling Channel (ICALL)
- National Working Channels (ITAC-1 through ITAC-4)
- State Tactical Channels (optional)
  - STATEOPS-1 through STATEOPS-
- Channel Usage
  - Plain English
  - Paging, alerting, and other means of signaling are prohibited
  - Use of Calling Channel for intra-system normal dispatch and routine agency operations is ***strictly*** prohibited
  - Channels are subject to a priority usage concept:
    - Priority 1 – Disaster and extreme emergency operations
    - Priority 2 – Emergency and urgent operations involving imminent danger to the safety of life and property
    - Priority 3 – Special event control activities
      - Priority 3a – Drills, tests, and exercises of a civil defense or disaster nature
    - Priority 4 – Single agency secondary communications (only applies to states that have statewide tactical mutual aid channels – StateOPS channels)

Interoperability (4)

Requirement for Channel Capability

- All agencies that license frequencies from the Region's 800 MHz Plan, are required to implement at a minimum all of the National MA Channels in their mobile and portable radios in full repeat mode so the radio can access any of these channels if a repeater is available in the area.
- States with National Statewide Tactical Channels will implement their mobile and portable radios in simplex mode on the repeater output frequency (xxx MHz) as this will provide a common simplex communications path for any 800 MHz radio used in the Region. (optional and as applicable)

Session 6: 800 MHz Plan Enhancement Considerations and Options

Rick Burke,
Managing Partner
Televate, LLC

February 12, 2009

LeGrande Technical and Social Services, LLC

800 MHz Plan Enhancement Agenda

- The balance of information, time and benefit
- Why not consolidate the vast information developed regarding Interoperable Communications?
- Common operational practice considerations
- Overview of common and advanced technology considerations
- Investment strategies including collaboration and grants
- Communications plans
- Open discussion to expand the list of what RPCs are currently including and others of interest

The Balancing Act

- Decisions to integrate additional information into the 800 MHz plan must be balanced against some common considerations including:

Common Considerations	
What data makes the best sense to include?	Who is responsible for collecting and integrating it into the plan?
What is the balance between the FCC regulatory requirement and the benefit to the regional end users?	Do we have time and resources to support the effort?
Some of that data is recorded elsewhere, why should we include it here?	We all know this information, these practices, these technologies, why should we included it?
Is that data too sensitive to include into public documentation?	Is that solution too vendor specific to include?
Who has the data, where do we derive it from?	What benefit does this information have to the region?

- Maybe APCO can help? Maybe the DHS Technical Assistance program can help? Maybe fellow RPC can help? Who else?

Interoperability Communication Data Consolidation

- RPCs, States, UASI Regions and other jurisdictional groups all have various interoperable communications documents that could be incorporated/referenced into the Plan
  - 800 MHz Plan
  - 700 MHz Plan
  - Tactical Interoperable Communications Plan (TCIP)
  - State Communications Interoperability Plan (SCIP)
  - National Incident Management Systems (NIMS)
  - National Incident Command System (ICS)
  - State/Region/County Emergency Plan
  - State/Region/County Preparedness Plan
  - Critical Infrastructure Plan
  - Regional Communications Plans
  - Others

- Important communications aspects of these plan/documents could be integrated into the 800 MHz Plan and/or some aspects of the radio communications can be integrated into each – would be nice to consolidate some of these plans where possible
- What about developing one combined 700-800 MHz Plan?

Common operational practices?

- The 800 MHz Plan is a valuable information source document – why not include:

Data interoperability capabilities and initiatives	Radio talkgroup and fleetmap design and management	Radio cache management and application information
Location, status and contacts for national, state and regional mutual aid channel facilities	Future expansion planning: What new systems/sites are in development locations and ongoing status	Statement of regional/state Best Practices and Standard Operational Procedures (SOP)

All jurisdictional radio network data – the data that would also be included into CASM (Communication Assets Survey and Mapping Tool) →

- Of course, since this data is also sensitive, maybe not wise to incorporate into a public document
- Balance between detailing data of value to radio manager and the sensitive nature of the data
- This data facilitates advanced interoperability planning

Radio Technology

- General rule for documenting technology includes:
  - Data to enhance interoperability
  - Information that may benefit a fellow regional neighbor
- Type of technical information
    - Mobile data networks and technologies
    - Radio interoperability gateways
    - Microwave backbones
    - 4.9 GHz technologies and applications
    - Public Safety WiFi hubs
    - Project 25 network deployment and operational considerations
    - Satellite and other commercially available back-up communications solutions
    - Data interoperability, options and practices
    - Closed Circuit Television (CCTV) systems
  - What enhancements are you currently implementing in your Region?
  - What other options of interests?

Funding the Plan Enhancement

- This critical information is worth the effort to capture & report
- Various collaboration and funding models available

RPC collaboration

- Region members agree to share available data
- Regions agree to form committees to discuss and generate data
- National RPCs meet quarterly and share information of interest
- Joint collaboration and sharing with other Public Safety organizations

Grant programs and funding

- Urban Area Security Initiative (UASI)
- State Homeland Security Program (SHSP)
- Public Safety Interoperability Communications (PSIC)
- Other state, local, federal and association based grant programs

Communications Plans

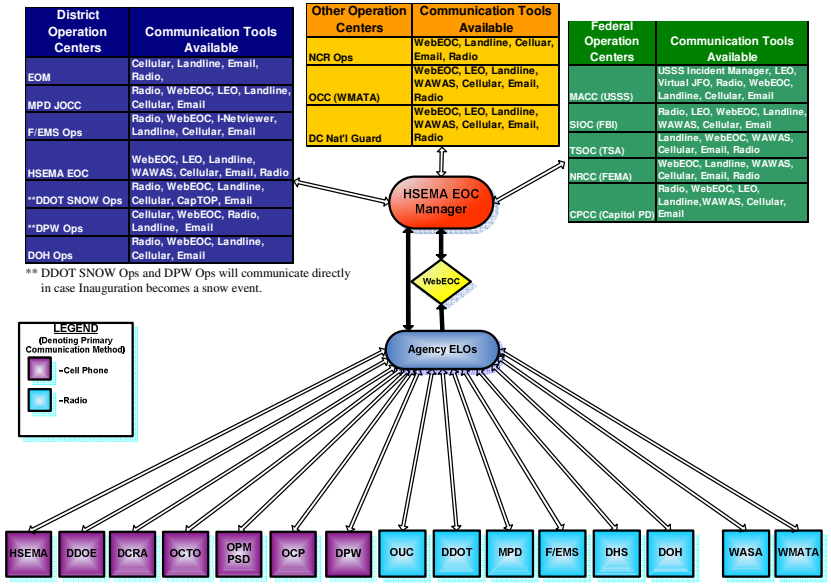
- Communications Plans: document repeatable event communications
  - Radio communications (ICS-205)
  - Alert notification systems
  - Data communications
  - Ops center (fixed & remote)
  - Commercial systems
- Critical contacts
- O&M and escalation contacts
- Document all event Comm data of importance to the flow of event information

District Operation Centers	Communication Tools Available
EOM	Cellular, Landline, Email, Radio,
MPD JOCC	Radio, WebEOC, LEO, Landline, Cellular, Email
F/EMS Ops	Radio, WebEOC, I-Netviewer, Landline, Cellular, Email
HSEMA EOC	WebEOC, LEO, Landline, WAWAS, Cellular, Email, Radio
**DDOT SNOW Ops	Radio, WebEOC, Landline, Cellular, CapTOP, Email
**DPW Ops	Cellular, WebEOC, Radio, Landline, Email
DOH Ops	Radio, WebEOC, Landline, Cellular, Email

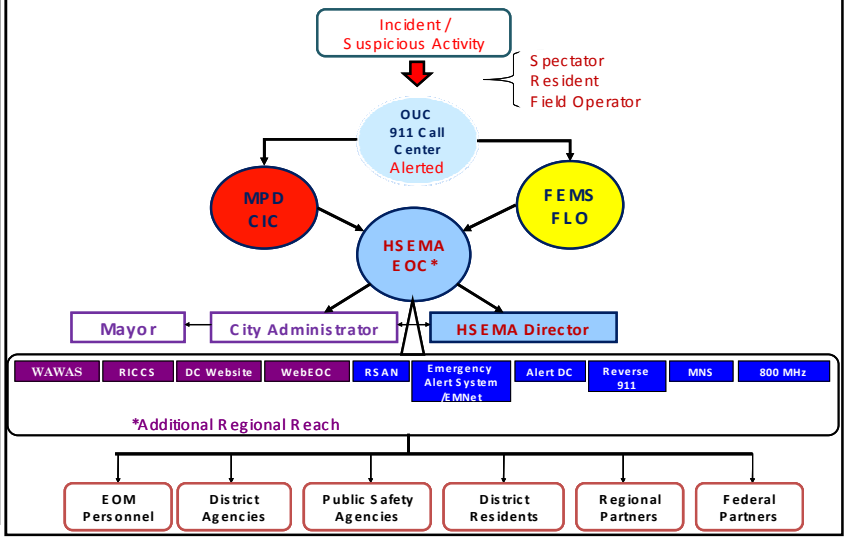
** DDOT SNOW Ops and DPW Ops will communicate directly in case Inauguration becomes a snow event.

Other Operation Centers	Communication Tools Available
NCR Ops	WebEOC, Landline, Celluar, Email, Radio
OCC (WMATA)	WebEOC, LEO, Landline, WAWAS, Cellular, Email, Radio
DC Nat'l Guard	WebEOC, LEO, Landline, WAWAS, Cellular, Email, Radio

Federal Operation Centers	Communication Tools Available
MACC (USSS)	USSS Incident Manager, LEO, Virtual JFO, Radio, WebEOC, Landline, Cellular, Email
SIOC (FBI)	Radio, LEO, WebEOC, Landline, WAWAS, Cellular, Email
TSOC (TSA)	Landline, WebEOC, WAWAS, Cellular, Email, Radio
NRCC (FEMA)	WebEOC, Landline, WAWAS, Cellular, Email, Radio
CPCC (Capitol PD)	Radio, WebEOC, LEO, Landline,WAWAS, Cellular, Email



Operational Alert Overview



- National Information Management System (NIMS)
  - Common Operating Picture
  - Common Comm Standards
- Incident Command System (ICS)
  - COMLs in the region
  - Best practices
  - Formal processes and forms

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Radio Interoperability Capabilities

LEGEND	
	Indicates radio interoperability over various "patched" District, Federal, NCR and National channels
X	Direct Communication Link Exists
X	WMATA cannot transmit back to MPD. By Inauguration, WMATA will be able to transmit back to MPD
X	Only on HSEMA Executive and Senior Radios
X	SPEV3 and AR SPEV4 during inauguration. In a snow event, DPW and DDOT will communicate directly via the RIZ DC - UCC3 channel at the discretion of the COML
X	OUC and UCC personnel can communicate with anyone via dispatch console.

Note*
All District, Federal and regional agencies acquire interoperable radio communications over Coordination Network channels.

		District Agencies																Regional Partners				Federal Partners								Other Partners
	Agencies → / Agencies ↓	EOM	HSEMA	F/EMS	MPD	DOH	DDOT/ SNOW	DCRA	OPM	DHS	WASA	WMATA	OCP	OCTO	DPW	DDOE	OUC_UCC	NCR	VDEM	MEMA	NOVA	DC Nat'l Guard	US-CP	FEMA	US-SS	US-MSL	US-ATF	US-FBI	US-TSA	
District Agencies	EOM		X														X													
	HSEMA	X		X	X	X	X	X	X	X	X	X					X	X				X	X	X	X			X	X	Regional Ops Centers
	F/EMS		X		X												X													DC Hospitals; Regional Hospitals; MWAA; MTGM. FD; ALX FD; ARL FD; FFX FD
	MPD		X	X								X					X	X	X	X	X		X		X	X	X	X		PG Hyattesville; PG Landover; PG Suitland; PG Oxon Hill; FIT - OPR; OIA; Harbor Patrol; Other LE Agencies/Divisions
	DOH		X				X		X	X	X						X													City Council Personnel
	DDOT/SNOW		X			X		X							X		X													
	DCRA		X														X													
	OPM		X		X	X											X													
	DHS		X			X			X								X													
	WASA		X			X											X													
	WMATA		X		X												X													
	OCP																X													
	OCTO																X													
	DPW						X										X													
	DDOE																X													
	OUC_UCC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	
Regional Partners	NCR		X		X												X													
	VDEM				X												X													
	MEMA				X												X													
	NOVA		X		X												X													
Federal Partners	DC Nat'l Guard		X														X													
	US-CP		X		X												X													
	FEMA		X														X													
	US-SS		X		X												X													
	US-MSL				X												X													
	US-ATF				X												X													
	US-FBI		X		X												X													
	US-TSA		X														X													

Incident Command Structure 205 Form

INCIDENT RADIO COMMUNICATIONS PLAN Interagency & LE Coordination	1. Incident Name 2009 Presidential Inauguration	2. Date/Time Prepared 01.13.09 at 17:00 hours	3. Operational Period Date/Time 01.20.09 from 04:00 hours to 01.21.09 04:00 hours

4. Basic Radio Channel Utilization

Radio Type/Cache	Channel	Function	Frequency/Tone	Assignment	Remarks
DC 800 MHz DC 460 MHz 8CALL90R DC DOJ IO-1 **ALL PATCHED**	DC UCC1 MPD UCC1 8CALL90R DC IO-1	Coordination Net	DC UCC1 (800 MHz) MPD UCC1: Port. Radios 8-8 Mobile Radios 7-12 8CALL90R 866.0125 MHz CTCSS 156.7 DC IO-1 159.15 MHz NAC 653	Non-securewide-area event coordination channel patched to multiple paths	Main voice information-sharing channel between HSEMA EOC; MACC; TSOC, All Ops Centers, Mobile Command Posts, Surrounding EOCs, select field supervisors, US Park PD and COML. Also may be used to request additional assets from partner EOCs and request tactical communications solutions from event leadership
DC 800 MHz	DC UCC2	DC DOH SOD Branch & RFK Division	DC UCC2	DC DOH SOD Branch & RFK Division Coordination	See page 5 of 11 of this plan for more specifics
DC 800 MHz	DC UCC3	DC DOH North & South Parade Divisions	DC UCC3	DC DOH North & South First Aid Station Coordination	See page 5 of 11 of this plan for more specifics
DC 800 MHz	DC UCC4	Tactical	DC UCC4	Tactical as needed	Add'l TG to be used at the discretion of the COML
DC 800 MHz DC 460 MHz 8TAC91R DC DOJ IO-2 **All PATCHED**	DC MA 1 MPD 1-9 CW-2 8TAC91R DC IO-2	Main Parade Route Law Enforcement	DC MA 1 (800 MHz) MPD 1-9(460 MHz) 8TAC91R 866.5125 MHz CTCSS 156.7 DC IO-2 168.875 MHz NAC 653	Main Law Enforcement channel along the parade route patched to multiple paths	Used for DC MPD CDUs; Cordon Detail; Prisoner Control Detail, Commissary Detail; and general information sharing such as pedestrian crossover points. All mutual aid LE supervisors will be placed on this channel via 8TAC91 Repeat or DC MA 1 *Post Parade*: Commissary Detail; CDU Detail; Prisoner Control Detail will continue to use this TG after parade

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Incident Command Structure 205 Form

INCIDENT RADIO COMMUNICATIONS PLAN DC DPW & Preplanned Wilson Bridge Incident Coordination & Add'l Backup and M/A Assets	1. Incident Name 2009 Presidential Inauguration	2. Date/Time Prepared 01.13.09 at 17:00 hours	3. Operational Period Date/Time 01.20.09 from 04:00 hours to 01.21.09 04:00 hours

4. Basic Radio Channel Utilization

Radio Type/Cache	Channel	Function	Frequency/Tone	Assignment	Remarks
Regional Interservice 2	RINS 2R	Multidiscipline	RX 866.8375 MHz TX 821.8375 MHz CTCSS 156.7	Local area repeated resource in and around Mall for emergency use	Local area repeated resource in and around Mall for emergency use for 800 MHz radios. Repeater is OFF unless COML needs it.
Regional Interservice 5	RINS 5R	Multidiscipline	RX 866.8625 MHz TX 821.8625 MHz CTCSS 156.7	Local area repeated resource in and around Mall for emergency use	Local area repeated resource in and around Mall for emergency use for 800 MHz radios. Repeater is OFF unless COML needs it.
Arlington County P25 800 MHz	AR SPEV 3	DC DPW	AR SPEV 3	Towing/traffic support	DPW main operational channel and crane ops
Arlington County P25 800 MHz	AR SPEV 4	DC DPW	AR SPEV 4	Solid Waste Removal	DPW Snow, Sanitizing & Solid Waste cleanup. In a snow event DC DOT will coordinate on this channel with DC DPW
Alexandria 800 MHz PGFD Channel 8	Alex FD TG 2 Ida Alex PD AX CH3 PGFD Ch. 8	Wilson Bridge Incident	Alex FD TG 2 Ida Alex PD AX CH3 PGFD UHF-T Ch. 8	Predetermined talk group and frequency between Alexandria, VA & PG, MD	All Incidents Occurring on the Woodrow Wilson Bridge or Associated Ramps
VHF FMARS	FMARS 1	PSCC Requests	154.295 MHz	COG Fire PSCC to PSCC	Alternate mutual aid resource request medium and emergency console-patching solution
UHF PMARS	PMARS	PSCC Requests	866.3625 MHz CTCSS 156.7	COG Local & Federal Law Enforcement PSCC to PSCC	Regional Law Enforcement PSCC coordination and resource request frequency

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Session 7: Regional Rebanding Interoperability Coordination

Rick Burke,
Managing Partner
Televate, LLC

February 12, 2009

LeGrande Technical and Social Services, LLC

Regional 800 MHz Rebanding Interoperability Coordination

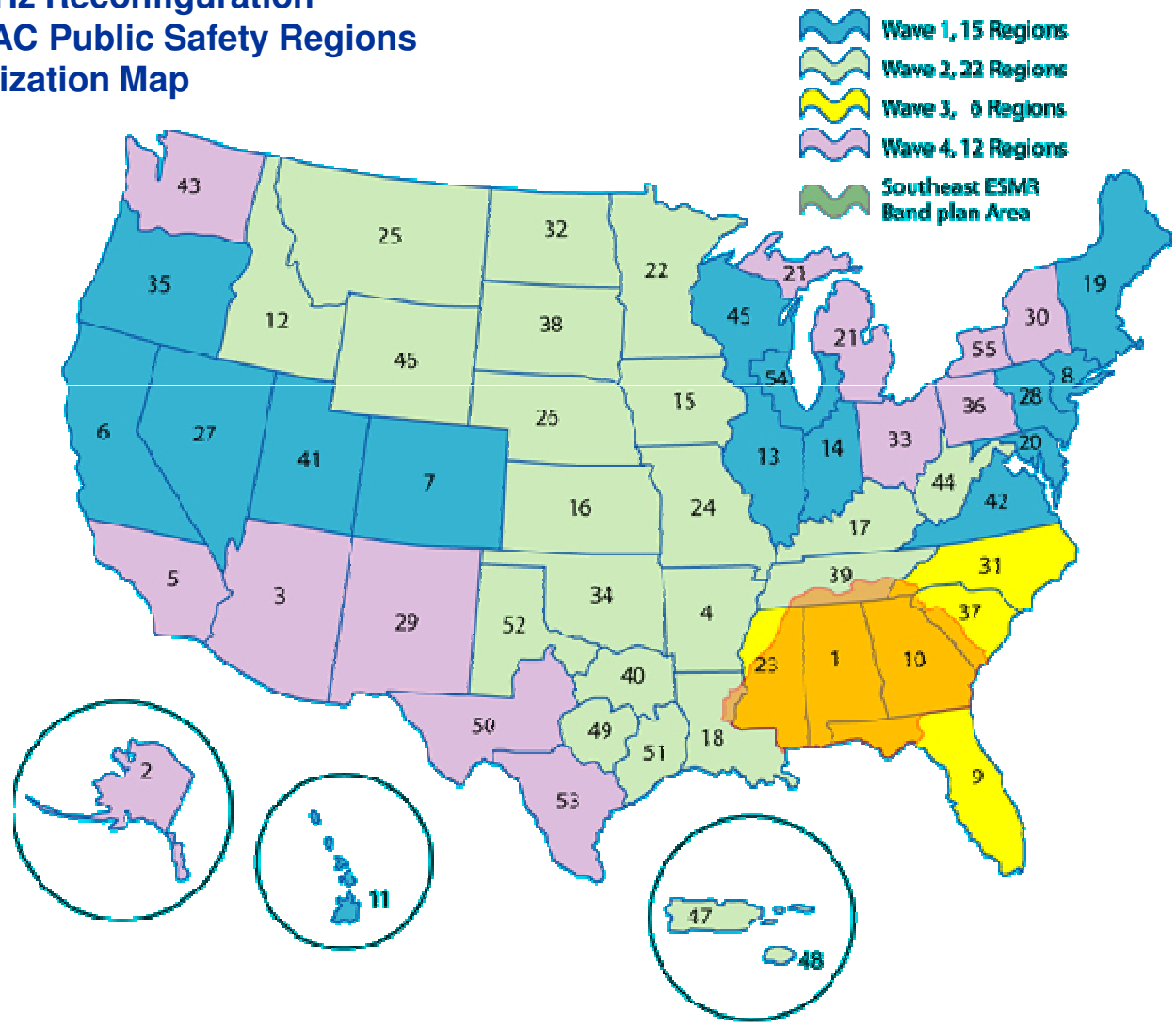
- Agenda
  - Overview of Rebanding regional interoperability
  - Why and how to achieve regional Rebanding interoperability coordination
  - Jurisdictional input to regional Rebanding
  - Typical regional Rebanding coordination and planning activities
  - Regional coordinator's responsibilities
  - Technical data requirements to support program
  - Regional assessment strategy and requirements
  - Sample market experiences and discussion
  - Regional Rebanding process considerations

Why Regional Rebanding Coordination

- Essential to maintain regional interoperability during the 800 MHz reconfiguration process
- Leverages a dedicated regional program approach to plan, document and facilitate cross jurisdictional Rebanding
- NPSPAC frequency retunes have the potential to cause considerable disruptive impact on internal and regional operations and interoperability
- Ensure that regional channel retunes are synchronized across the region to minimize impact on operations
- Program focus on maintaining critical inter-jurisdictional interoperability
- Mechanism to ensure timely and accurate information exchange
- Natural extension of regional radio committee support to Rebanding
- Fully supported by Sprint Nextel, the TA and APCO

Region Wave Assignments

800 MHz Reconfiguration
NPSPAC Public Safety Regions
Prioritization Map



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Input to Regional Rebanding

- Procedural steps to support the efforts to pursue a regional coordinated approach
  - Select a lead jurisdiction to manage the Sprint Nextel (SN) negotiations and vendor contact management
  - Develop a regional interoperability committee and chairperson to guide and provide oversight
  - Select the desired coordinator vendor relationship or determine how best to support the effort with internal FTE personnel
  - Detail the activities and costs and prepare and submit the proposal to support the coordination
    - The program will required that essential rebanding information from each jurisdiction be assembled and shared
    - Each jurisdiction will have time and associated costs in supporting the planning and eventual execution of the program – this time and cost needs to be quantified
    - Prepare, submit and negotiate the final requirements with SN
  - Kick-off meeting and get busy
- Stakeholder commitment and input to the process
  - Regular meeting attendance and strategy discussion support
  - Provide radio and infrastructure data
  - Be responsive to information requests and inputs to the decision making process
  - Manage jurisdiction rebanding vendors to be cooperative
  - Share jurisdiction status with the region
  - Share progress internally

Typical Rebanding Coordination Plan

- Individual regional jurisdictions will plan and execute an 800 MHz reconfiguration program
  - Focus on individual jurisdiction program requirements and activities
  - Ensure that radios and infrastructure are successfully rebanded
- 800 MHz radio operations are highly interoperable
  - Mutual aid agreements and national mutual aid channel deployment
  - System and radio IDs common in region radios
  - Jurisdictions capable of using one another's radio network
- Regional rebanding coordination plan is fundamental
  - Maintain regional interoperability all through rebanding
  - Coordinate jurisdictional reconfiguration activities
  - Schedule rebanding to overall regional benefit

Regional Coordinator's Primary Responsibilities

- ☑ Create and manage a master regional cutover plan and schedule
- ☑ Coordinate the sequence and execution of tasks across the region
- ☑ Facilitate all necessary communications and information exchanges among jurisdictions and vendors with regard to the regional elements of the reconfiguration
- ☑ Complete all required paperwork for the regional portions of the project
- ☑ Identify and itemize all current shared system, shared channel and other interoperable configurations
- ☑ Develop a reconfiguration plan that maintains all currently shared resources and interoperable capabilities
- ☑ Review all reconfiguration changes to verify that the current capabilities will be maintained after transition
- ☑ Communicate, communicate, communicate
- ☑ Negotiate, negotiate, negotiate

Typical Information Required to Develop Regional Coordination Plan

- Key contacts (government and vendors)
- Standard licensee call sign data
- Base Station Data
  - Equipment vendor data
  - BS locations
  - System configuration
  - # of channels/frequencies
    - Common
    - Mutual aid (national, state and regional)
  - Pre and Post channel allocation
- Radio equipment types and numbers
  - Radio fleetmaps
- Interoperability configurations

Regional Coordination Initial Information Sheet

Primary Rebanding Contact Information

Jurisdiction:_____ Title:_____

Name:_____ Telephone:_____

Address:_____

City:_____ State:_____ Zip Code:_____

Email:_____

System and Subscriber Summary

Number of Subscriber Units:_____ Number of Transmitters/Sites:_____/_____

System Type:_____ Number of Control Stations:_____

System Call Signs: _____ _____ _____

_____ _____ _____

List All Jurisdictions and External Agencies which are interoperable with your subscribers by department::

Jurisdiction	Police	Fire	EMS	Other (list)	Othe (list)

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Regional Interoperability Configuration Assessment Requirements

- Identify common intersection of interoperability between all regional operators
  - Common network programming
  - Common radio programming
  - Mutual aid channel programming (national, state, regional)
  - Gateway configurations

Region Entity	O County	OO County	S County	OPSC	City M	City W	City R	V County	B County	L County	I County	S County	M County	City A	Non-Region
O County		II, III	II, III	I, II, III	I, II, III	I, II, III	II, III	III	III	III	III	II, III	III	II, III	Polk County
OO County	II, III		II, III	II, III	III	III	II, III	III	III	III	III	III	III		P County
S County	II, III	II, III		II, III	II, III	II, III	II, III	III	III	III	III	III	III	II, III	
OPSC	I, II, III	II, III	II, III		I, II, III	I, II, III	II, III	III	III	II, III	III	III	III	II, III	
City of M	I, II, III	II, III	II, III	I, II, III		I, II, III	II, III	III	III	III	III	III	III	II, III	P County
City of W	I, II, III	III	II, III	III	I, II, III		III	III	III	III	III	III	III	II, III	
City of R	II, III	II, III	II, III	II, III	III	II, III		III	III	III	III	III	III	II, III	
V County	III	III	III	III	III	III	III		III	III	III	III	III	III	
B County	III	III	III	III	III	III	III	II, III		III	II, III	III	III	III	
L County	II, III	III	II, III	II, III	III	III	II, III	III	III		III	III	III	II, III	M County, P County
I County	III	III	III	III	III	III	III	III	II, III	III		III	III	III	
S County	II, III	III	III	III	III	III	III	III	III	III	III		III	III	
M County	III	III	III	III	III	III	III	III	III	III	III	II, III		III	PB County
City A	II, III	II, III	II, III	III	III	III	II, III	III	III	III	III	III	III		

System Level IO	Level I
Common Radio Programming	Level II
Mutual Aid Channels Level of IO	Level III
Gateway only	Level IV

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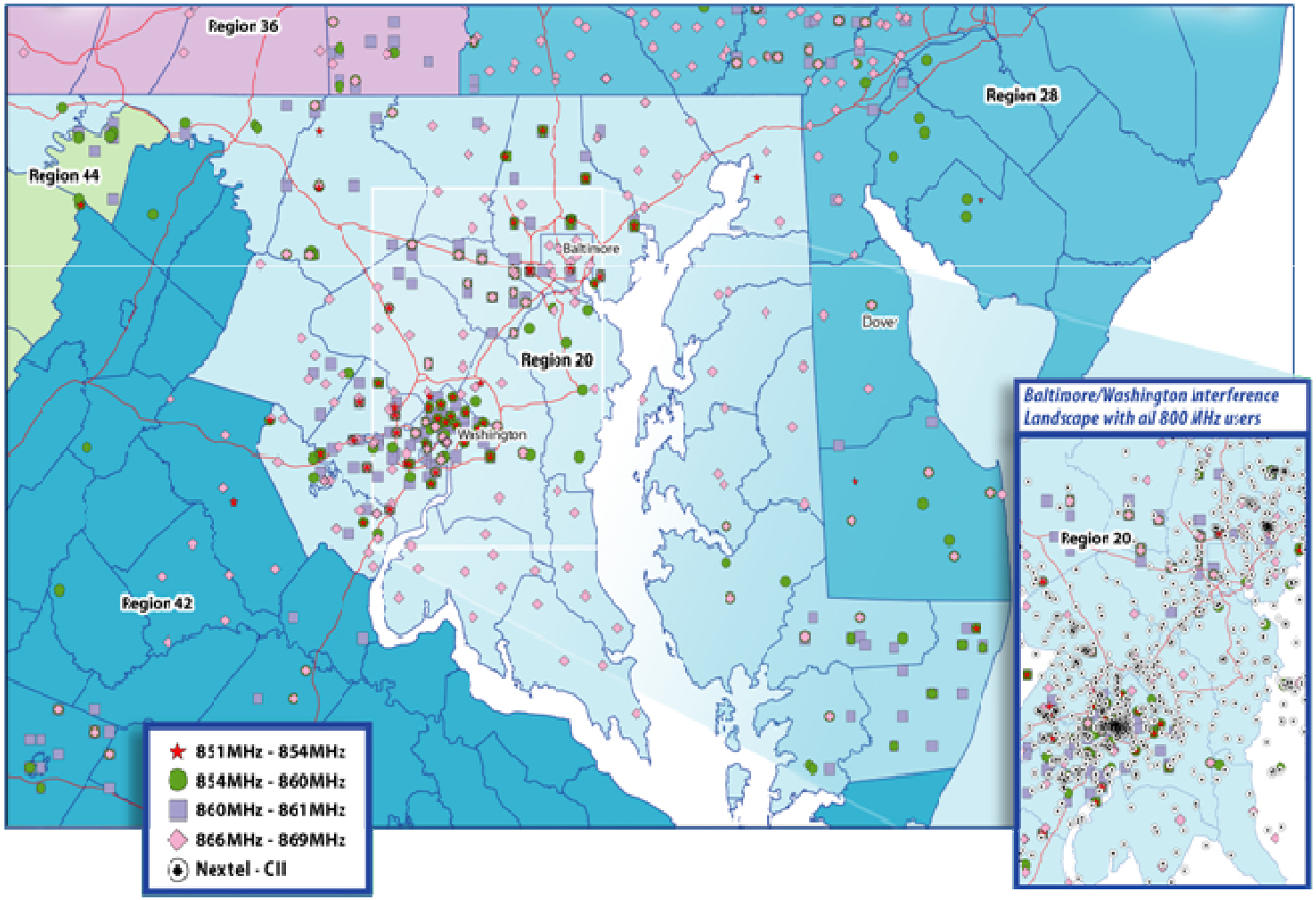
Region 20 Overview

Location of all licensed Public Safety, Nextel and CII base stations



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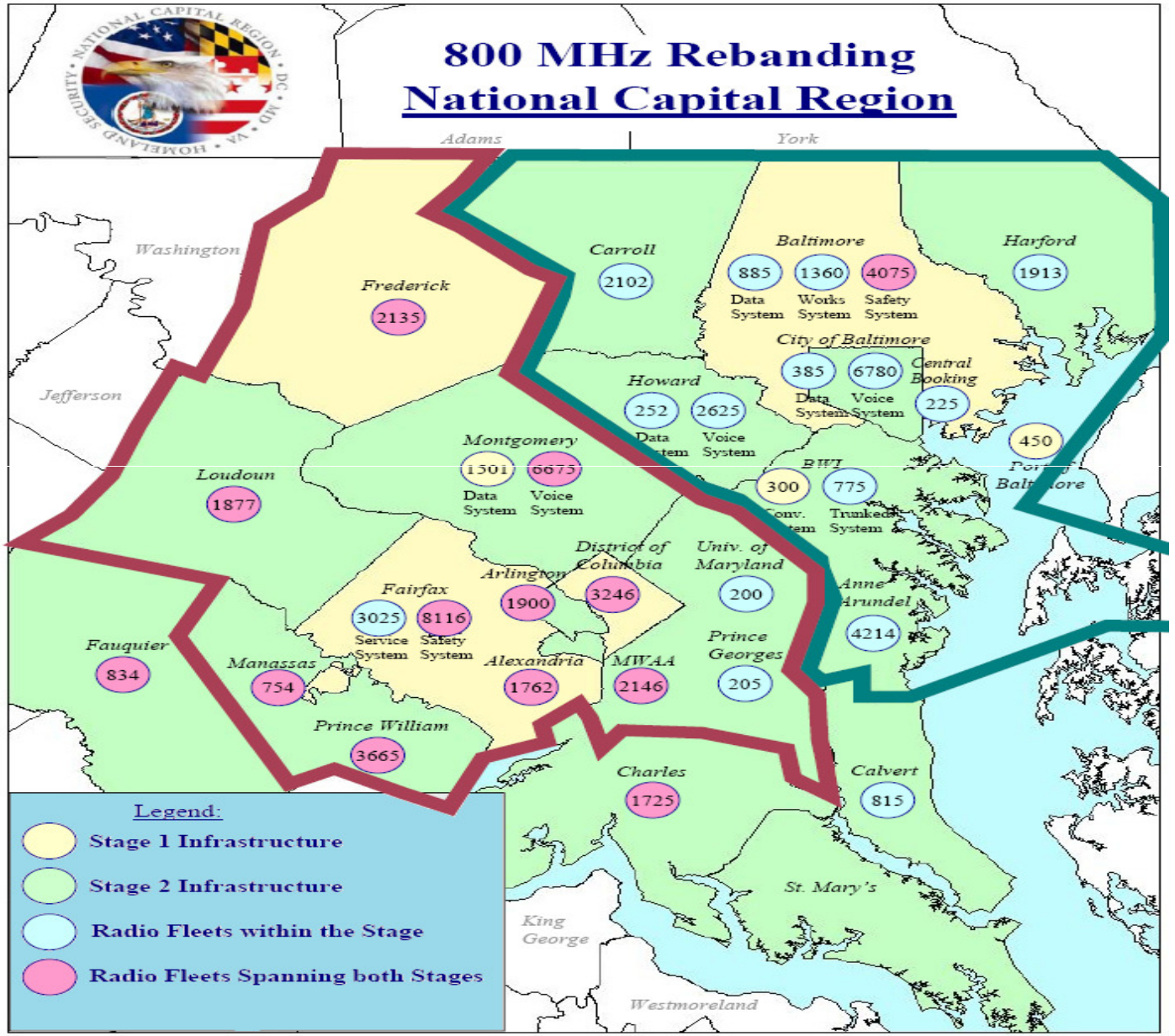

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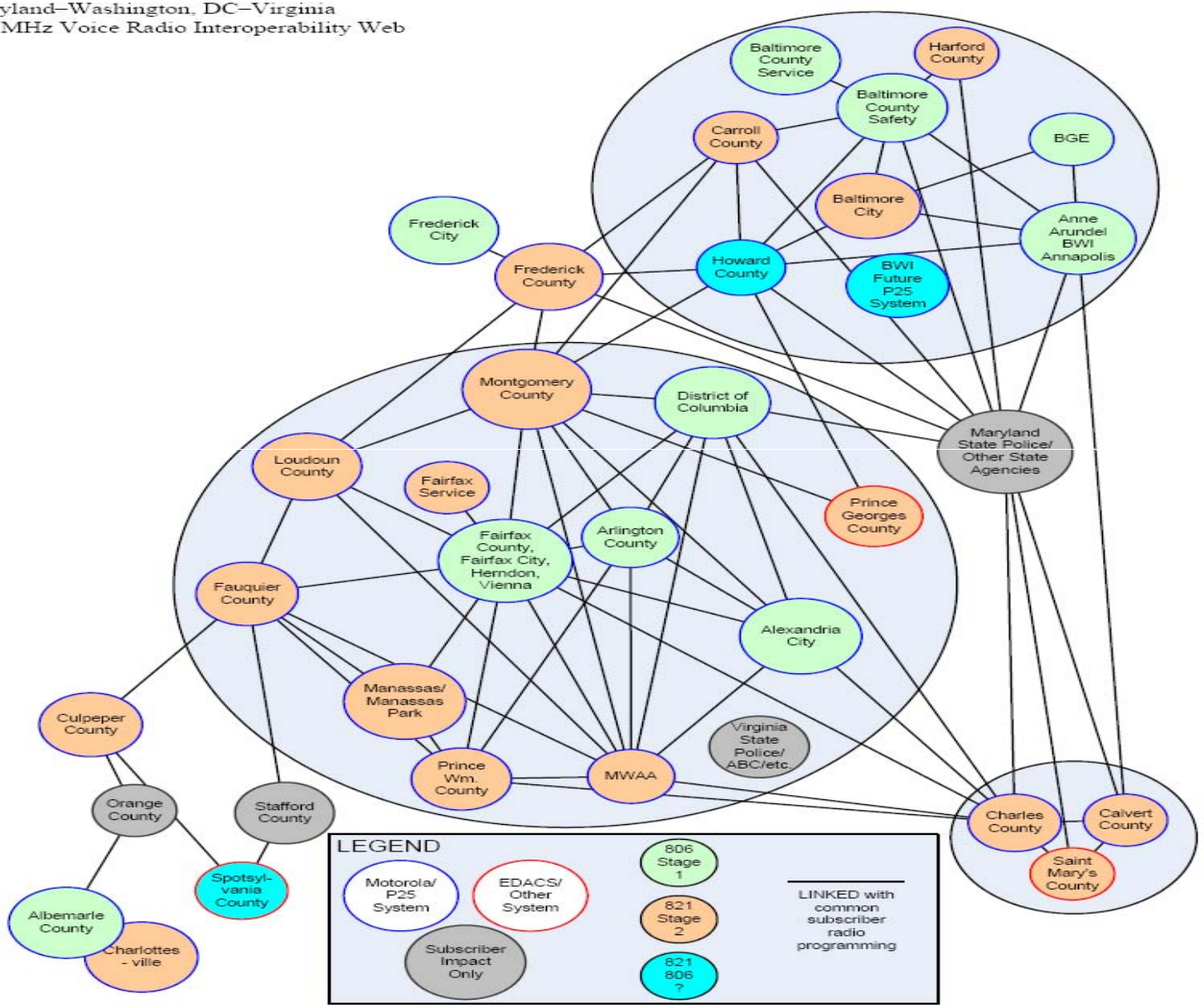
Maryland–Washington, DC–Virginia
800 MHz Voice Radio Interoperability Web



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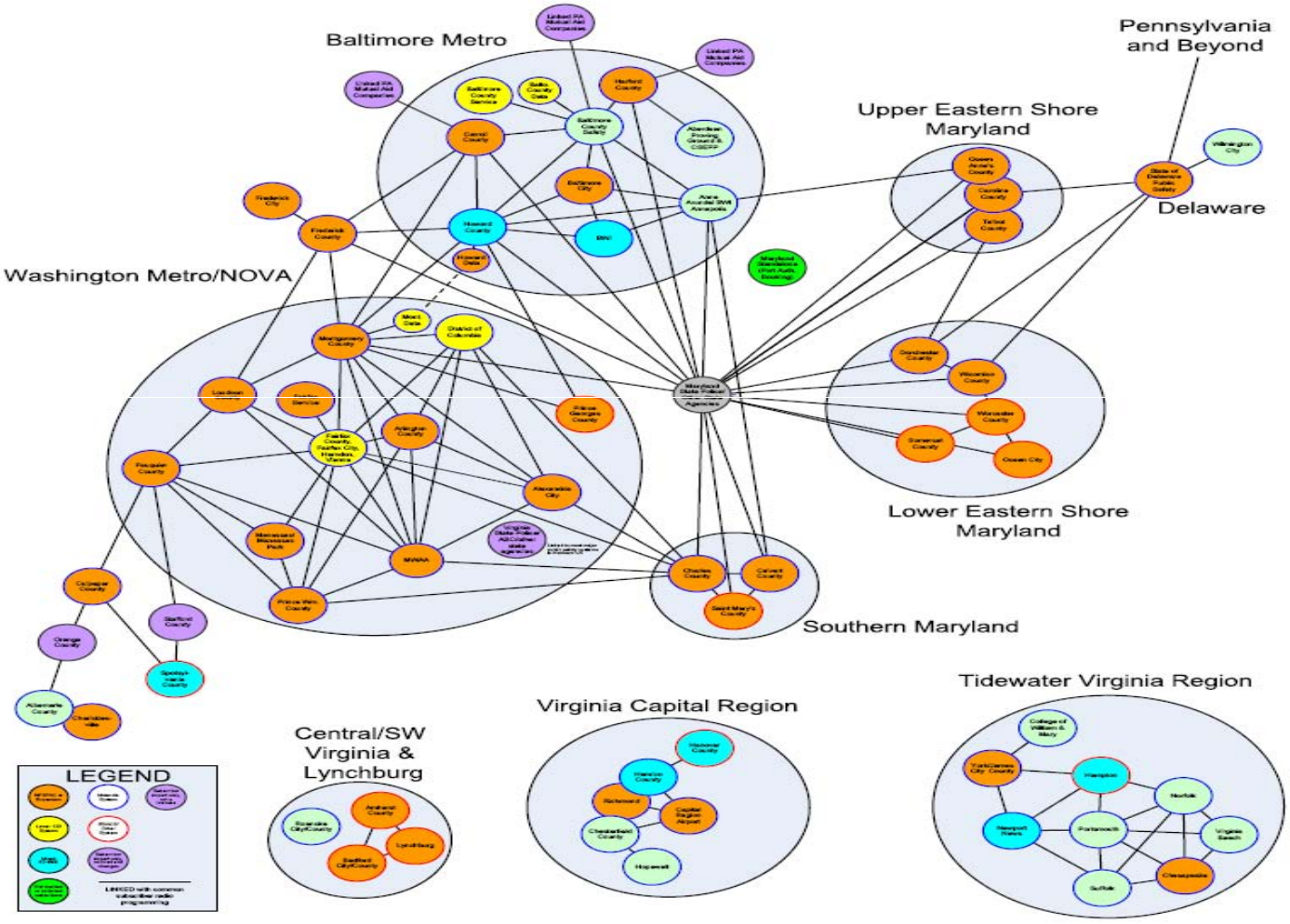
Maryland–Washington, DC–Virginia-Delaware 800 MHz Voice Radio Interoperability Web



NOTE: Technically, all the the 800 MHz subscriber radios used in the systems listed above are interoperable, even if not explicitly programmed for direct trunked system access. Each 800 MHz radio has access to the five 800 MHz National Mutual Aid Channels, making it possible to achieve on-the-scene interoperability for virtually any type of public safety incident.

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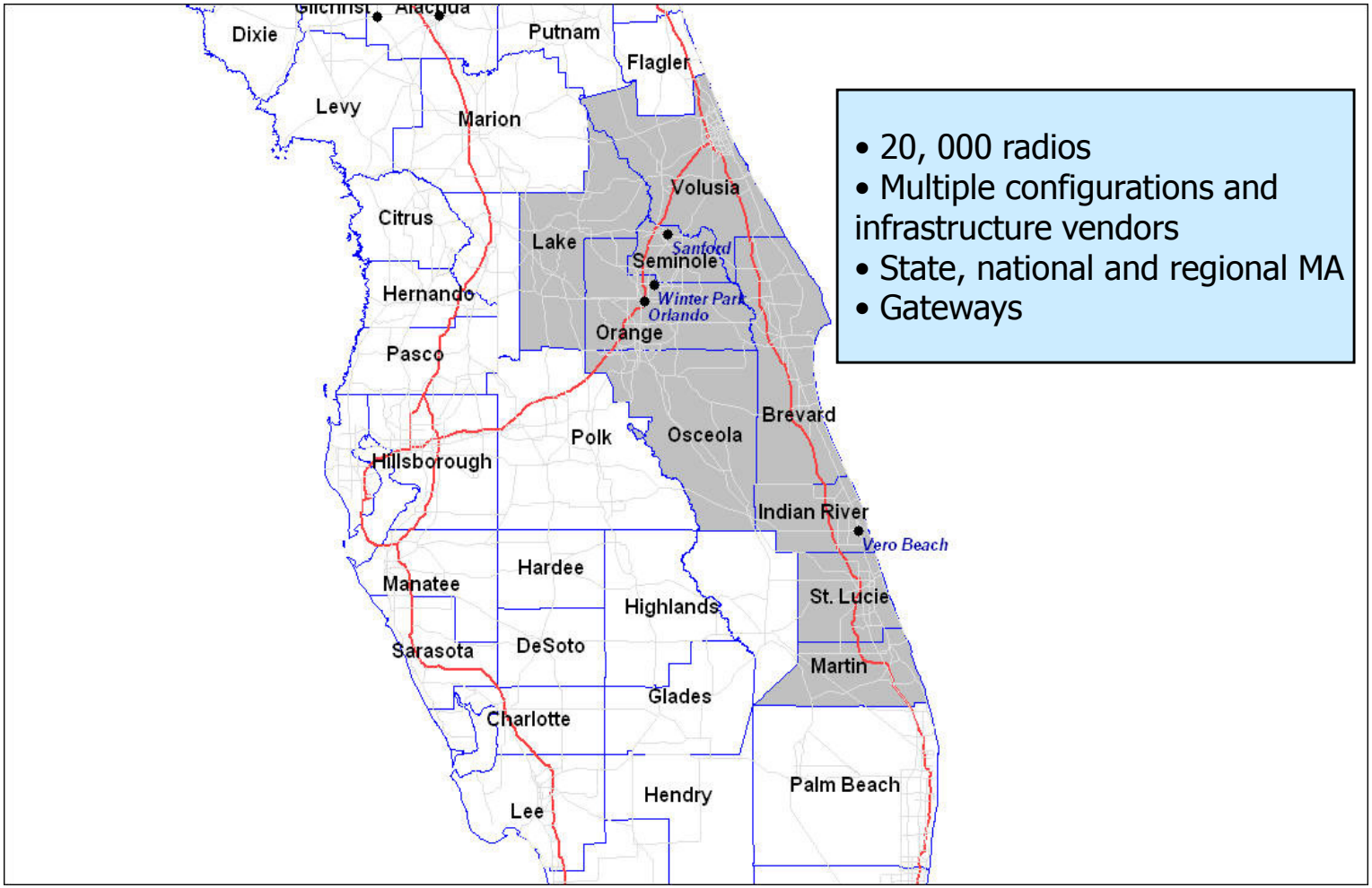
Greater Central Florida Region Five



- 20, 000 radios
- Multiple configurations and infrastructure vendors
- State, national and regional MA
- Gateways

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Regional Rebanding Process

Step 1

- Thorough documentation of interoperability relationship between all regional networks, radios and gateways
- Finalize regional mutual aid channel modifications
- Verify all control channel modifications
- Coordinate with state mutual aid channel schedule
- Freeze radio template/fleetmap changes

Step 2

- Program regional radios
- Important Motorola radio Rebanding software program consideration impacting operations
  - Post Rebanding software supports automatic affiliation of pre and post rebanding channels in trunked and simulcast configurations
  - Convention channels not duplicated in the Rebanding software
    - Pre and Post Rebanding National, State, Regional and neighbor convention channels need to be programmed into new radio template/code plugs
    - This situation creates potential for operational errors and mandates that the end users be fully aware of the when Rebanding has been finalized and when to use new talkgroups and where the Post Rebanding talkgroups are located on the radio

Step 3

- Base station reconfiguration

Session 8: Computer Assisted Pre-Coordination Resource and Database System (CAPRAD)

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Region 24 – State of Missouri Representative

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LeGrande Technical and Social Services, LLC

Recap of Day One 800 Mhz Presentation Materials and Action Items

LeGrande Technical and Social Services, LLC

Session 9: FCC Presentation Part II

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Session 10:
VACATED SPECTRUM LICENSING PROCEDURES

800 MHz Regional Planning Workshop

Farokh Latif
Director, AFC, Inc.

February 12-13
Orlando, Florida

AFC INC
A Subsidiary of APCO Intl., Inc.

Background

- In July 2004, FCC ordered the reconfiguration of 800 MHz band- known as “rebanding”
- As part of rebanding plan, FCC provided that spectrum vacated by Sprint in the “Interleaved Band” (809-815/854-860 MHz) would be available for licensing Exclusively to PS and C/I entities
- Licensing is limited to PS entities “exclusively” for the first three years AND to PS & C/I entities for the following two years
- After fifth year, any remaining channels will revert to their original frequency pool

Information Regarding Available Channels

- Sprint has cancelled or modified a majority of its outstanding site-based & Economic Area (EA) – based licenses
- FCC released PN on 12/29/08 (DA 08-2810) announcing application & licensing procedures
- Channels available in 809-809.5/854-854.5 MHz band (channels 231-250). 20 channels in General Category
- Not all 20 channels available in all regions since some NPSPAC regions include both border and non-border areas
- Example: Region 6- Northern California – Counties not included Pima, Pinal, Santa Cruz, Yuma, and several more (refer to PN for complete list)
- Channels available only in non-border areas

Information Regarding Available Channels

- To identify available channels for licensing, consult the Vacated Channel Search Engine (VCSE): http://wireless2.fcc.gov/UlsApp/UlsSearch/searchLicense.jsp
- If a channel is available, VCSE will specify 1/28/2009 as the availability date in “Channel Availability” field
- Refer to http://www.fcc.gov/oet/info/maps/bea/ to access EA maps and list of counties

Information Regarding Available Channels

- A channel is available, if Sprint has cancelled/modified both site and EA-based licenses
- Exceptions include area where Sprint did not hold an EA-based license
- Examples: Washington-Baltimore, Rapid City, Western Oklahoma, etc…..

Application Procedures

- Coordinators may file applications beginning on 1/28/2009
- Applicants must file applications through certified frequency coordinators
- Pre-coordination procedure must be followed by all coordinators to eliminate conflicts between applications
- Only five channels per “fixed site” will be permitted

Frequency Coordination

- All applications submitted to FCC must include a certification statement that states the coordinator has searched VCSE and FCC licensing database and has verified availability of the selected channel(s)
- The coordinators must confirm that the 22 dBu V/m F(50,10) contour of the proposed does not extend beyond the 22 dBu V/m F(50,10) contour of Sprint's originally licensed station.
- Sprint's contours based on 1000 watts of ERP for site HAAT below 305 meters (see 90.635(b)) AND the actual HAAT
- For EA-based channels, confirm 40 dBu contour of the proposed does not extend into an adjacent region where the channel is unavailable
- APCO will inspect both options to ensure best available choice
- Coordinators are not required to submit contour analysis but should retain records for six months after application is granted

Pre-Coordination Procedures

- All participating coordinators have agreed to 5 business day notification procedures
- PN stipulated 1/14/2008 at 8:00 AM as commencement of notification process
- The goal is to avoid submitting mutually exclusive applications to FCC
- Each coordinator will notify other coordinators through electronic notification of applications prepared for coordination
- Each application will be date/time stamped when status changed to “Notify”
- If conflicts are found in case of MX applications, the application with earliest notification date/time stamp takes precedence
- MX channels must be deleted but can maintain priority for channels that have no conflicts.
- Applicants must notify Sprint on their intent to begin operations on vacated spectrum. Sprint must cease operation on the channels specified in the notice within 60 days. Sprint has set up an email box solely designed to receive 60-day notifications. **800mhzinterleavedspecctrum@sprint.com**
- New licenses granted pursuant to this PN will be conditioned on providing such notice to Sprint

Questions?

- For further information visit:

www.apcoafc.org

Thank you!

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Session 11: Radio Channel Assignment Strategies and Process

Part I - 800 MHz Coverage

Rick Burke,
Managing Partner
Televate, LLC

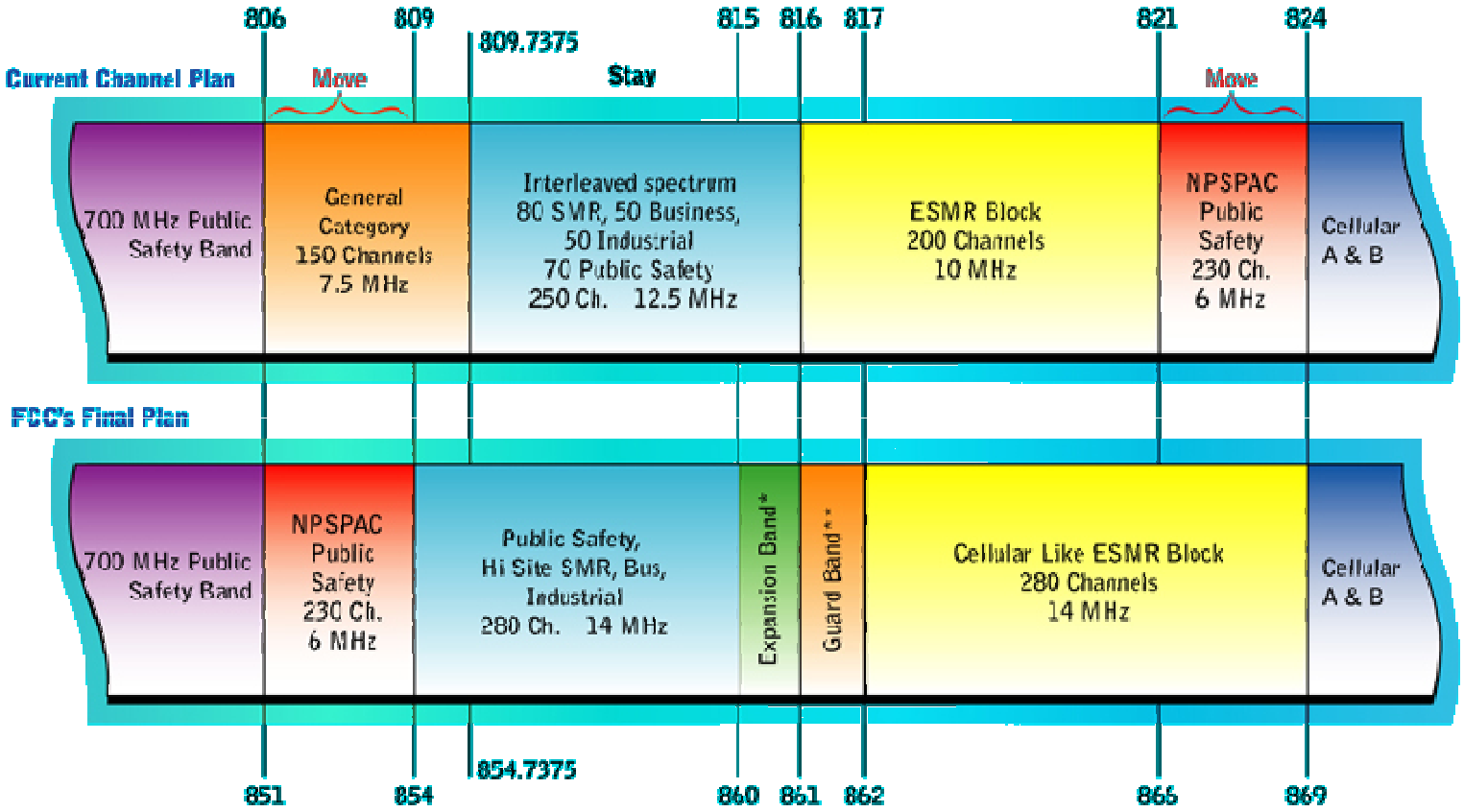
February 13, 2009

LeGrande Technical and Social Services, LLC

Overview

- 800 MHz Band Plan Review
- Part I – 800 MHz Coverage
  - FCC Rules for Coverage
    - Contours and Service Area Calculations
    - Application Requirements for Additional Frequencies
    - Prediction Modeling
  - Propagation Prediction Models
    - Limitations
    - Possible Solutions
  - Prediction vs. Drive Test

800 MHz Channel Band Plan



*No public safety system will be required to remain in or relocate to the Restricted band; although they may do so if they choose

**No public safety or CII licensee may be involuntarily relocated to occupy the Guard Band.

800 MHz Coverage – Contours

- FCC rules state site service area can be defined as 40dBuV/m contour and the proposed re-use site can be defined as 22dBuV/m contour
- Procedures to Calculate Service Area

Step 1

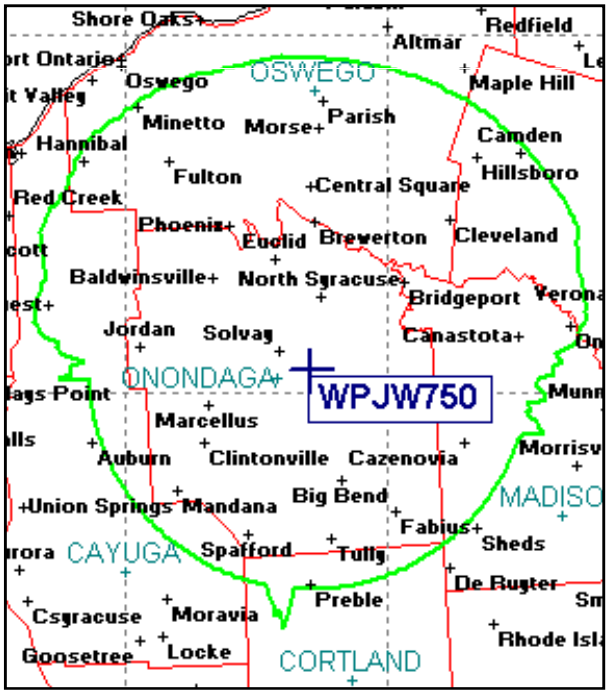
- Convert proposed base station power EPR to dB below 1 KW ERP
- Subtract converted value from 40dBu

Step 2

- From the look-up table, determine the two height columns that correspond most closely to proposed base station Height Above Average Terrain (HAAT)
- Interpolate between the listings under the two columns to determine where the value in step two falls
- Read from the Distance column, and this value is the radius of the proposed service area

Example

- Base station's ERP is 100 Watt with an antenna HAAT of 450 feet. The service area calculation would be:
- *P(dBk)= 10*log (100)–30 F(DbU)=40–(-10)*
  - *=10*2–30 =50 DbU*
  - *=-10*



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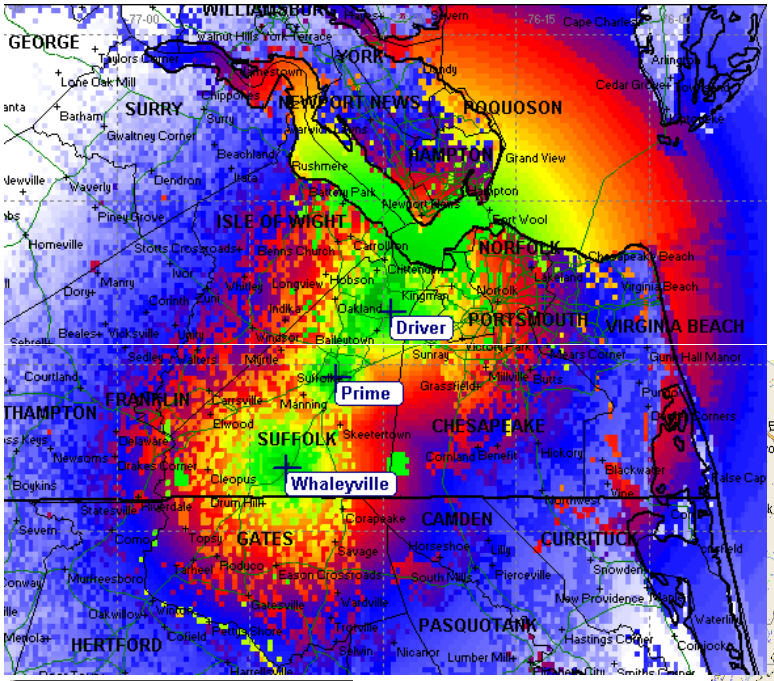
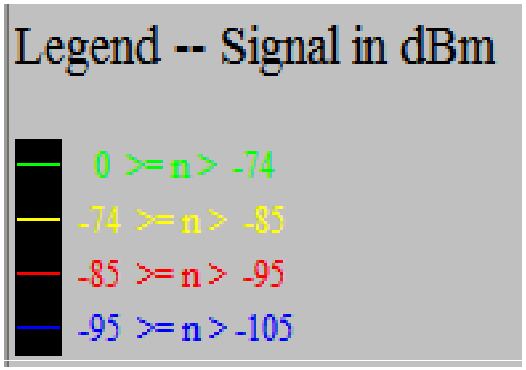
800 MHz Coverage – Prediction Modeling

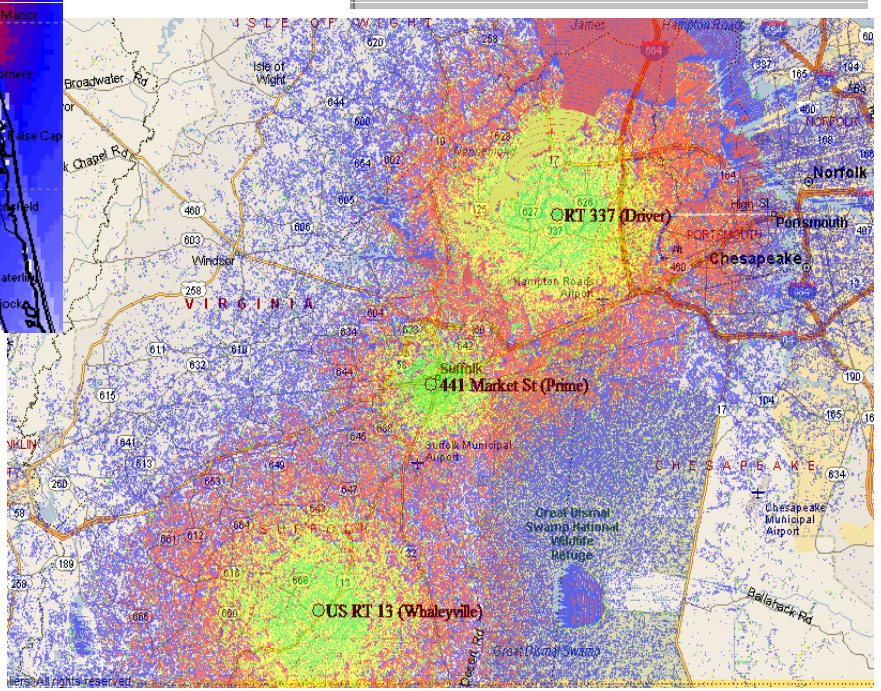
RadioSoft®



#	S	G	Clr	Level [dBm]
1	✓	●		-134.00
2	✓	●		-105.00
3	✓	●		-95.00
4	✓	●		-85.00
5	✓	●		-74.00

WIZARD™





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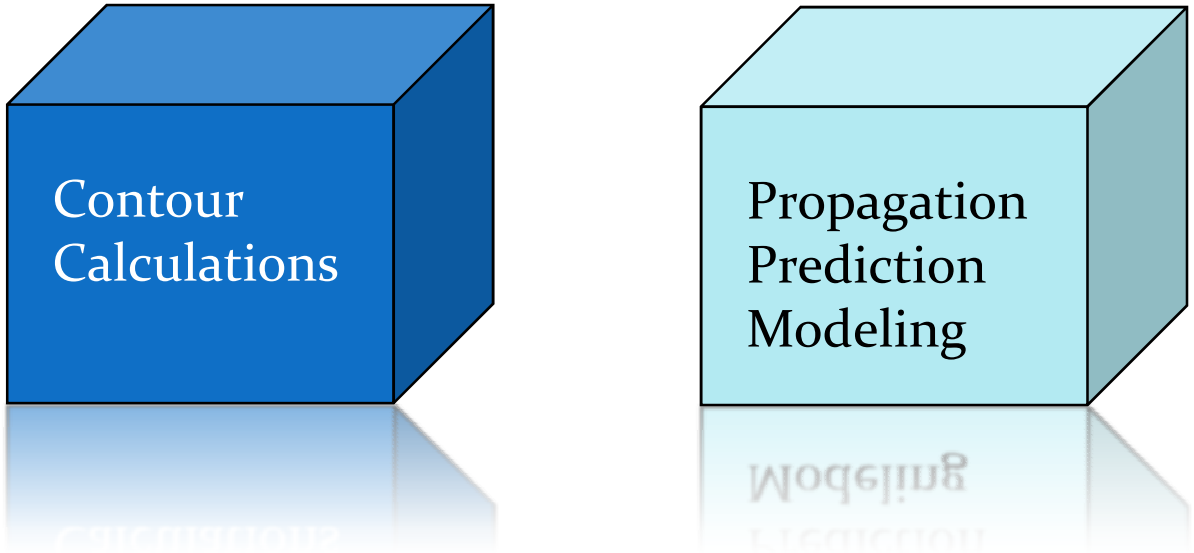
What's the Difference?

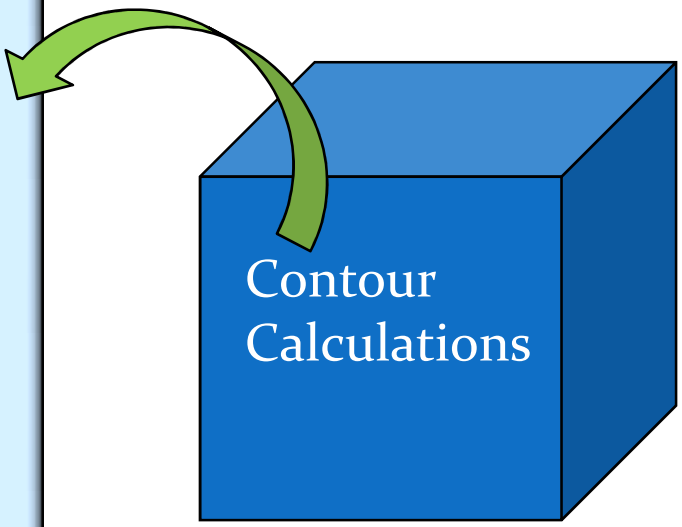


What's the Difference?

Required to comply with FCC Requirements

- Eight basic radials are computed along a 3 to 16 km line on a minimum of 50 intervals along the radials to compute an average height above average terrain (HAAT) along that profile
  - •Radials are computed at the "cardinal" azimuths of 0, 45, 90, 135, 180, 225, 270 and 315 degrees to generate a circular coverage depiction
  - •Base station output power computation parameters need to be included
  - •Coverage computed following a prescribed F(50/50) coverage table

- Contours are simple to administer & offer uniform market results



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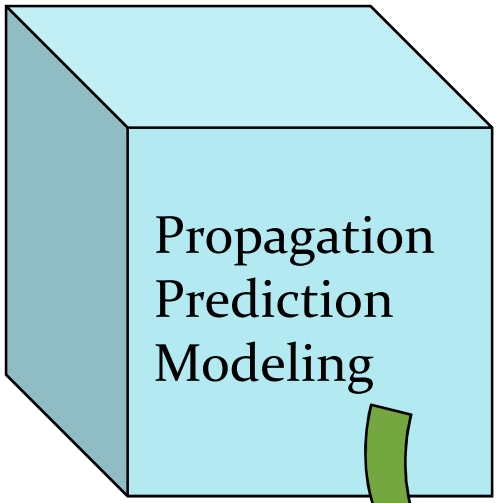
What's the Difference?



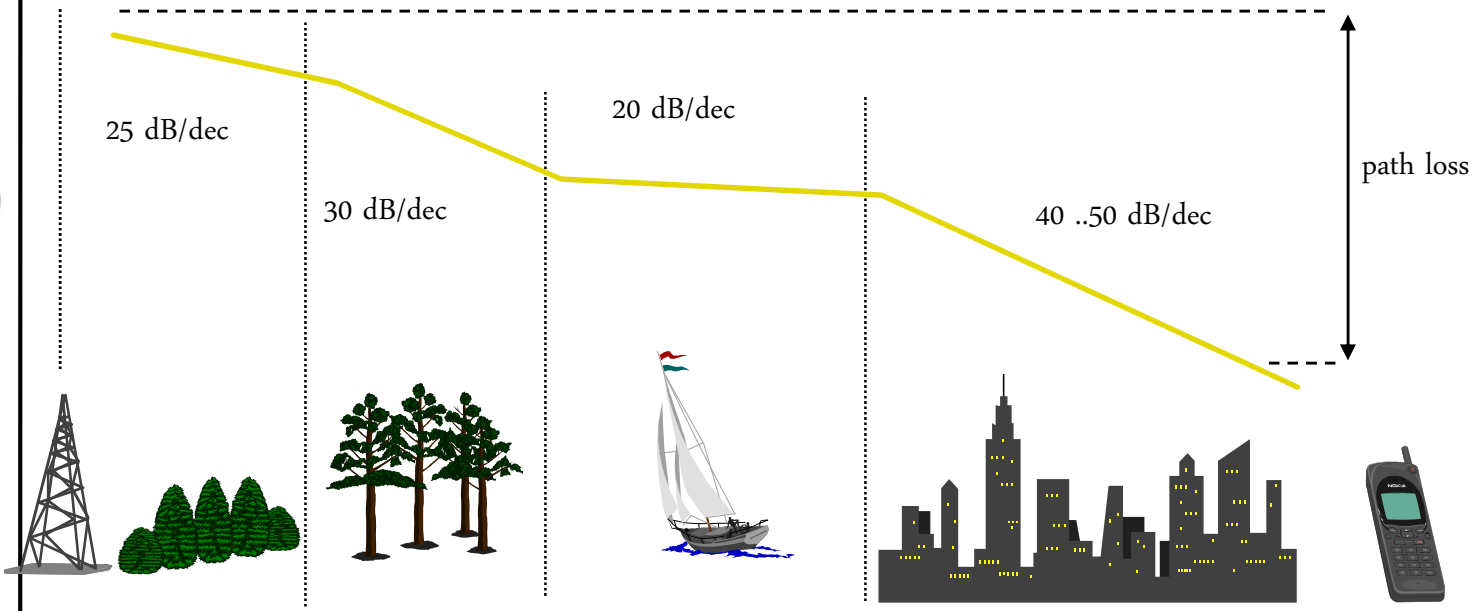
- Visualize predicted signal strength detail within the coverage area
  - Terrain computed within multiple variable size "bins" – morphology can also be added
  - Base station power computed within each bin based on environment loss
- Depicts different levels of coverage in various coverage environments
  - Mobile
  - Portable in car
  - Portable in building
- Offers flexibility in defining acceptable coverage thus providing more accurate results for the coverage boundary

Fundamental Radio Site Parameters Required to Compute Coverage

Computational Requirements	
Transmitter Output Power	Antenna centerline AGL (above ground level)
Type of cavities (duplexers, combiners, and isolators) including their insertion losses and all other associated losses	HAAT of antenna center line
Type of transmission line and associated loss (including jumpers)	ERP (effective radiated power)
Antenna model, gain, downtilt, and pattern plots	Additional "receiver only" locations, if applicable
Ground Elevation AMSL (above mean sea level)	CTCSS (Continuous Tone Coded Squelch System) coding information – not required to compute coverage but highly recommended to include for conventional system channel allocations

Signal Attenuation

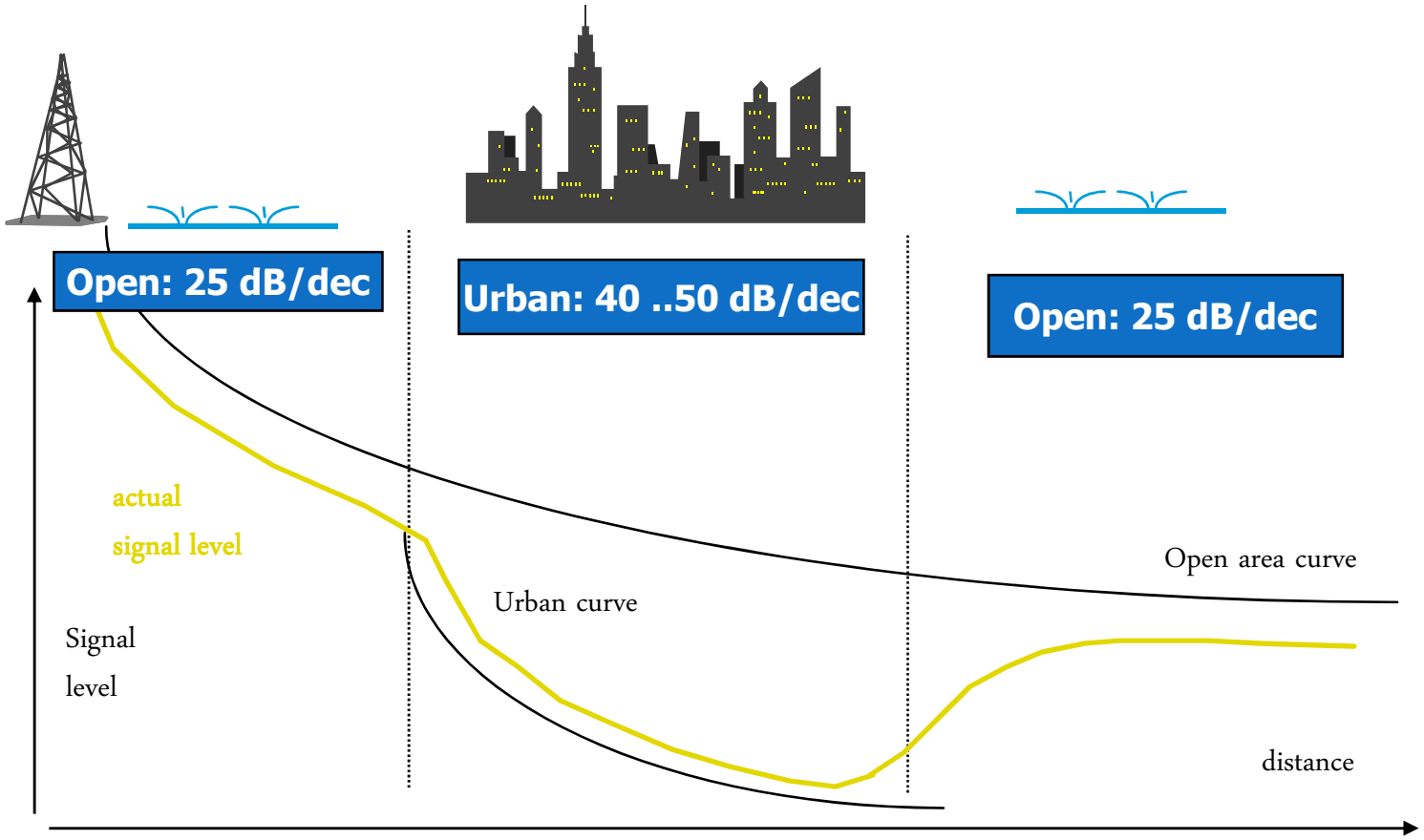
Mixed land usage types on propagation path



dec= decade

Mixed Path Loss

Path loss



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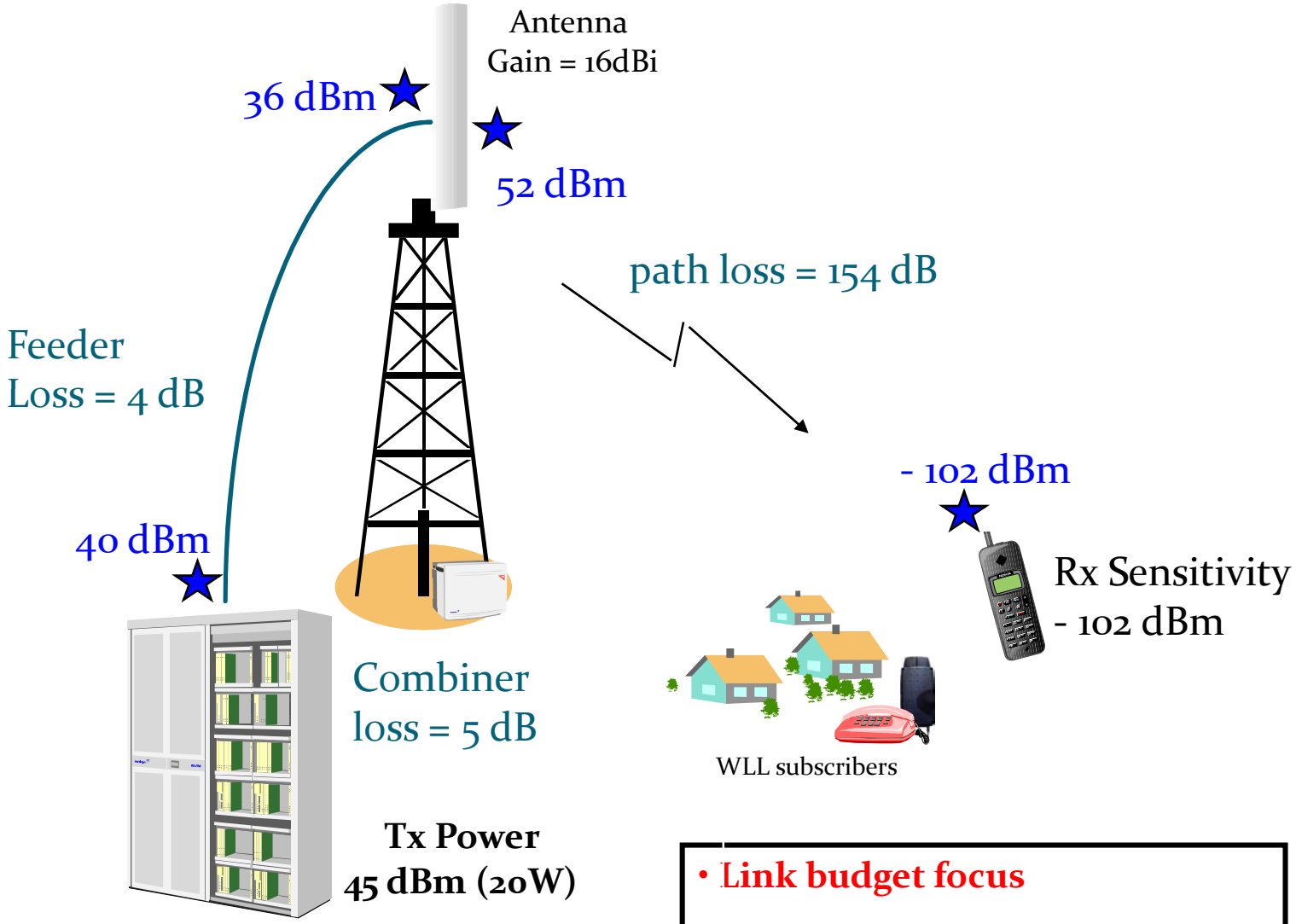
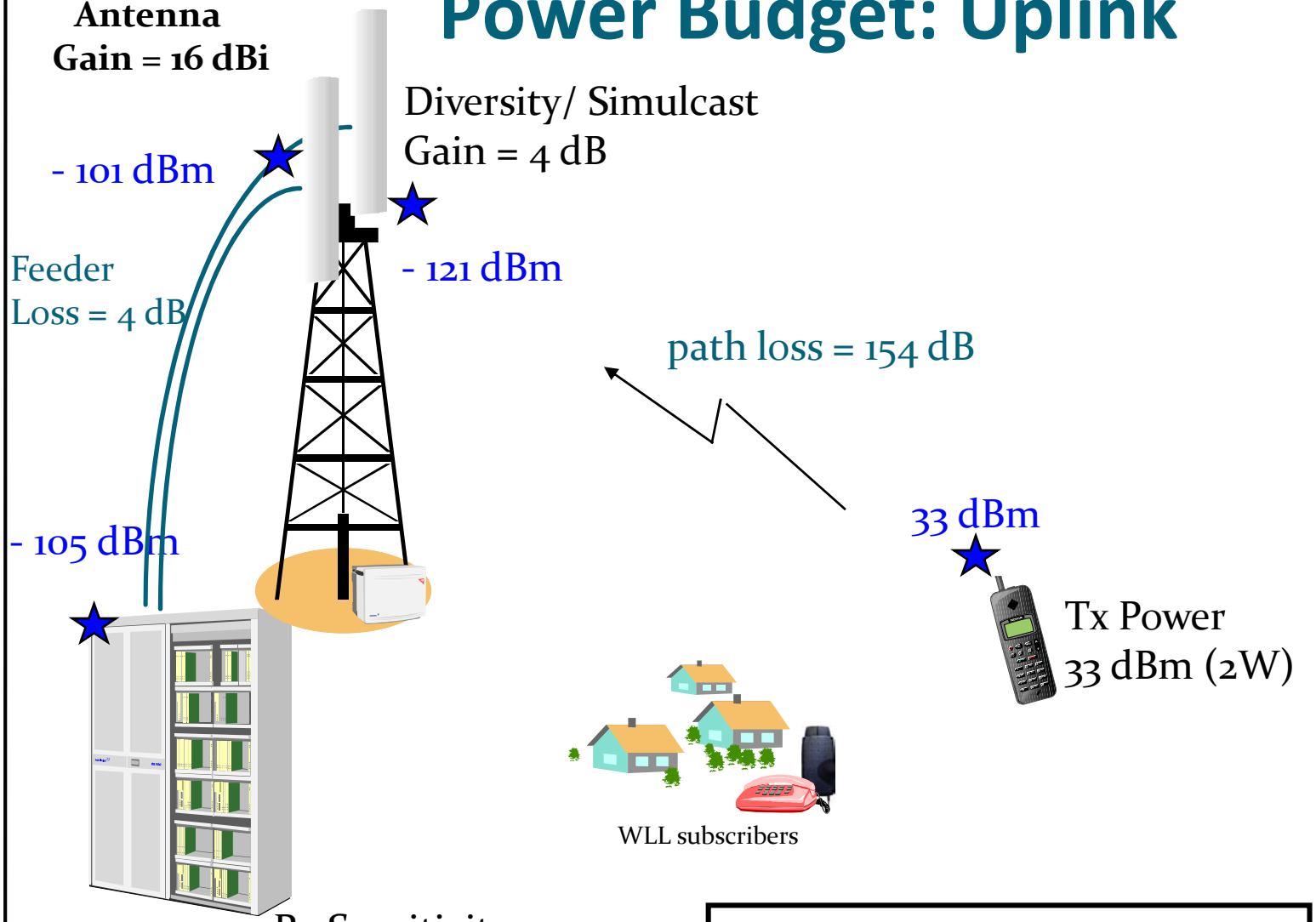
Power Budget: Downlink



- Link budget focus
- Balance of up and down links

Power Budget: Uplink



- **Link budget focus**
- **Balance of up and down links**

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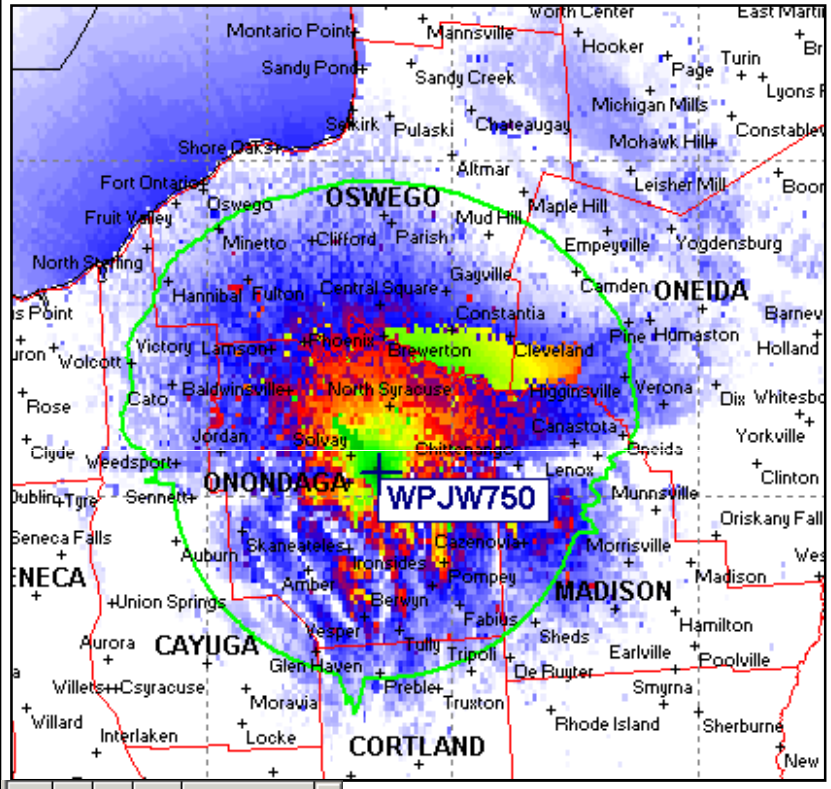
What Method To Use?

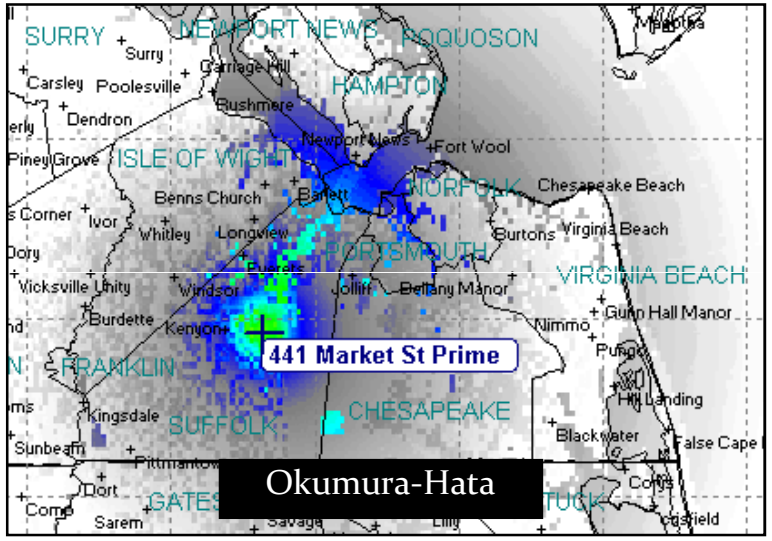


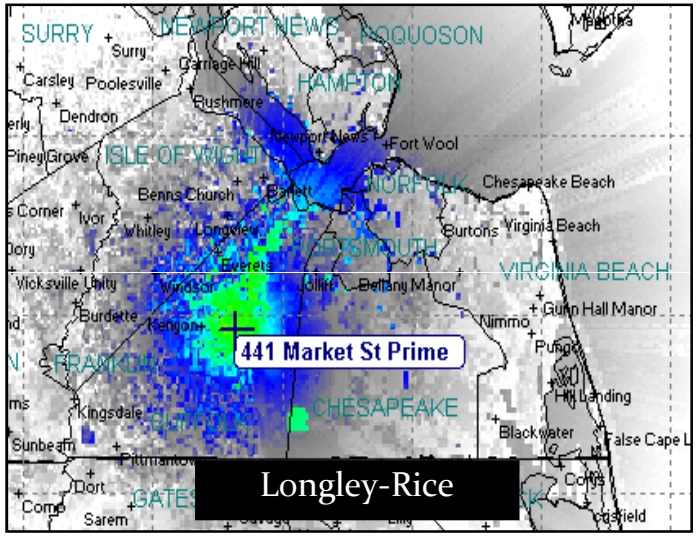
#	S	G	Clr	Level [dBm]
1	✓	●		-134.00
2	✓	●		-105.00
3	✓	●		-95.00
4	✓	●		-85.00
5	✓	●		-74.00

- Both!
- Use contour calculations to comply with FCC requirements
  - Note: Detailed propagation prediction are also viable
- Use propagation prediction modeling tools to assess and optimize existing coverage and interference and evaluate proposed radio site locations.

Propagation Modeling

- Among the industry accepted propagation models include:
  - Lee
  - Okumura-Hata
  - TIREM
  - Longely-Rice





- Industry accepted tools include APCO, RadioSoft®, NTIA-TIREM, WIZARD™, and many other providers
- Contain data on the current configuration of the network
- Rely on databases that include terrain (3 sec, 30 sec), antenna, clutter, etc.
- Enable RSSI and C/I prediction as well as FCC contours calculations

Prediction Limitations

- *Any* model has limitations
- Accuracy depends on:

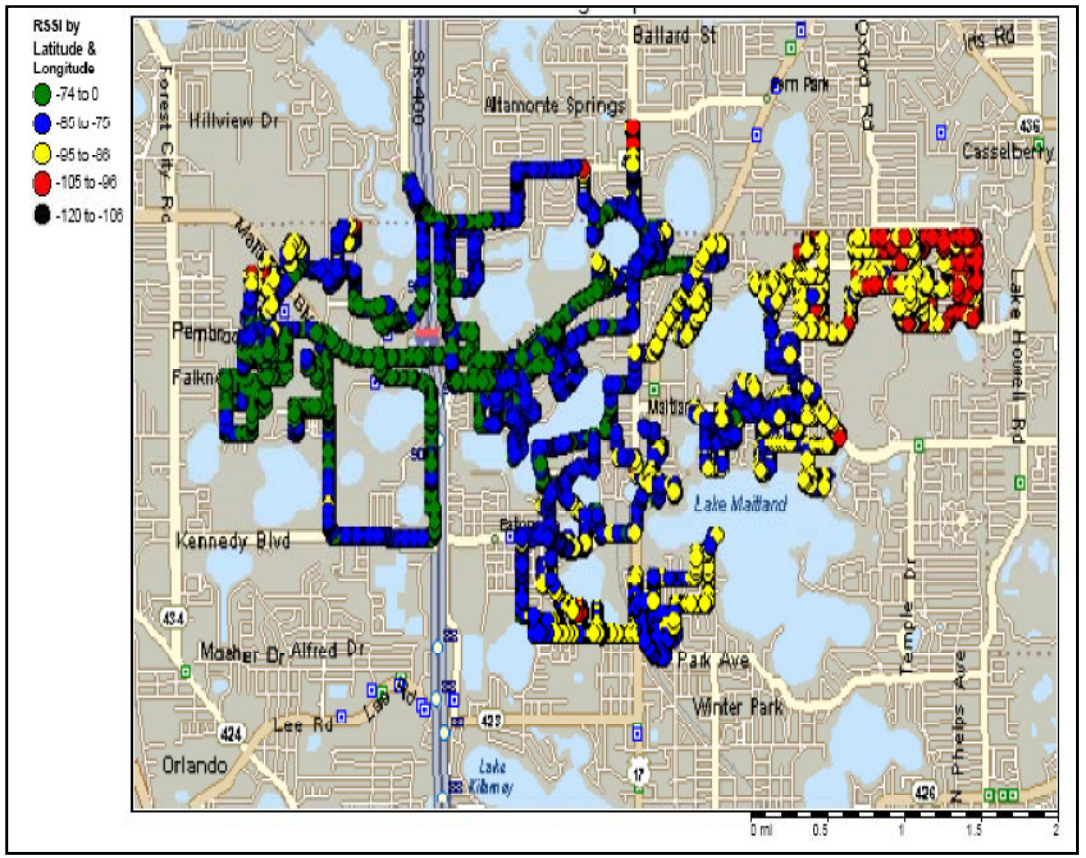
Prediction Variables
Terrain Resolution
Computation bin sizes
Environment: • Open Land • Water • Suburban • City
Availability and accuracy of morphology/clutter data
Seasonal (weather/foliage) variations
Accuracy of site data
Antenna database
Link balance
Propagation model programming performance
End user knowledge and experience

Technical Methods to Enhance Propagation Modeling and Analysis

- Conduct drive tests
  - Field measure data is the most accurate and reliable means to verify radio site coverage
    - Test transmitter can be installed prior to making the site location investment
  - Measure data can be integrated into the propagation model to refined and optimize model prediction and signal loss calculations (refine coefficients in model formulas)
  - Most reliable means to measure, capture and record system quality and reliability
  - Most reliable means to assess and resolve radio interference
- Rely on drive test data in hard-to-predict environment (close to the water, in tunnels, in-buildings, elevated highways and bridges, heavy urban areas)

Prediction vs. Drive Test

- Prediction
  - Requires less resources
  - Allows to predict coverage for the entire target area
  - Results depend on propagation model accuracy
- Drive test data
  - Offers objective results
  - Provides long term benefits



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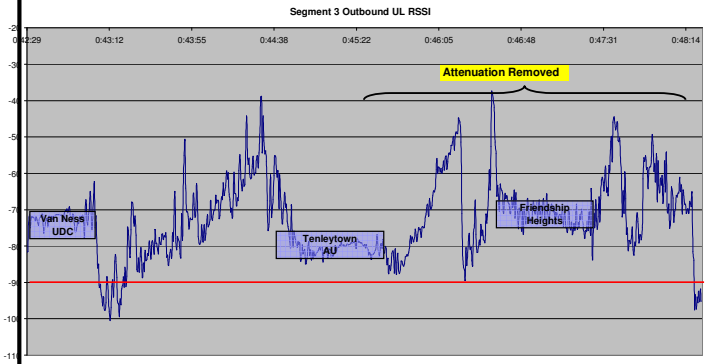
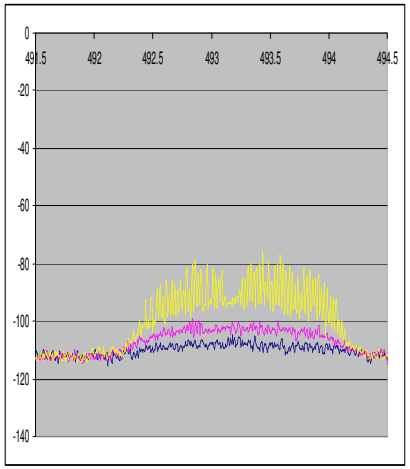
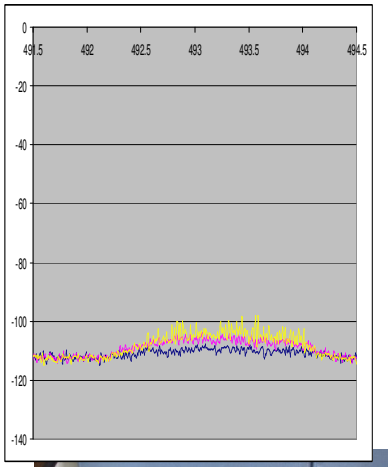
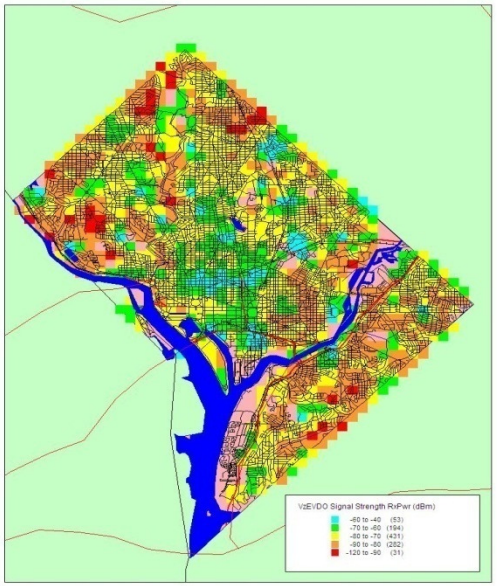
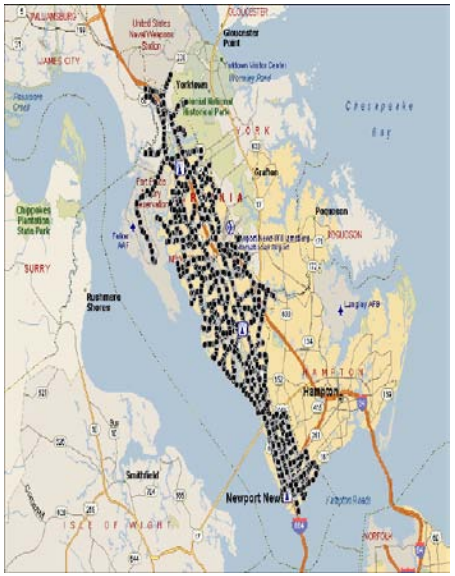
Various Drive Test Results











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Radio Channel Assignment Strategies and Process

Part II - Interference Protection

Rick Burke,
Managing Partner
Televate, LLC

February 13, 2009

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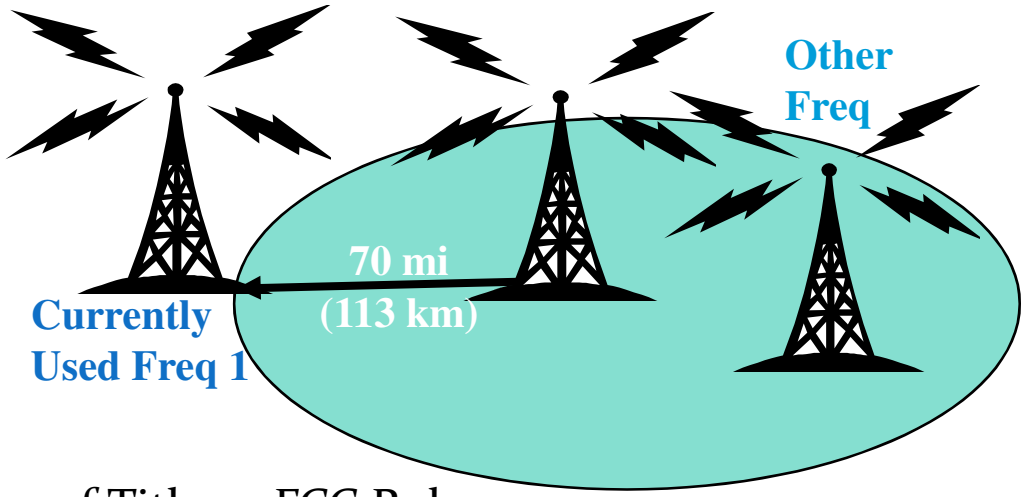
Overview

- Part II – Interference Protection
  - FCC Rules for Interference Protection
    - Procedures to Calculate Interference Protection
    - Co-Channel Separation Requirements
    - Short – Spacing Rule
    - DHAAT Calculation
  - Interference Analysis vs. Propagation Prediction Model
    - Distance Based vs. Predicted C/I
  - Quantifying Interference
  - C/I Dependency on Radio Type
  - FCC Rebanding Order Interference Protection Rules
  - Adjacent Channel Interference
  - Intermodulation Interference
    - IM Interference Always Harmful?
    - IM Analysis Beyond Rebanding
  - NPSPAC Channels Rebanding and Interference Analysis
    - Interference Tolerance
    - Interference Isolation
    - Interference Mitigation
  - Channel Repacking

800 MHz Interference Protection – FCC Rules

- Co-channel protection afforded solely on fixed distance separation basis
- Typical separation 70 miles
- Higher distance separation requirements for:
  - High locations in the state of CA and the state of Washington, as listed in FCC Pt. 90
  - DHHAT higher than 1500 ft
- Offset frequencies (US-Mexico border) considered co-channels with non-offset frequencies
- Special considerations for frequency assignments in US-Canada border areas



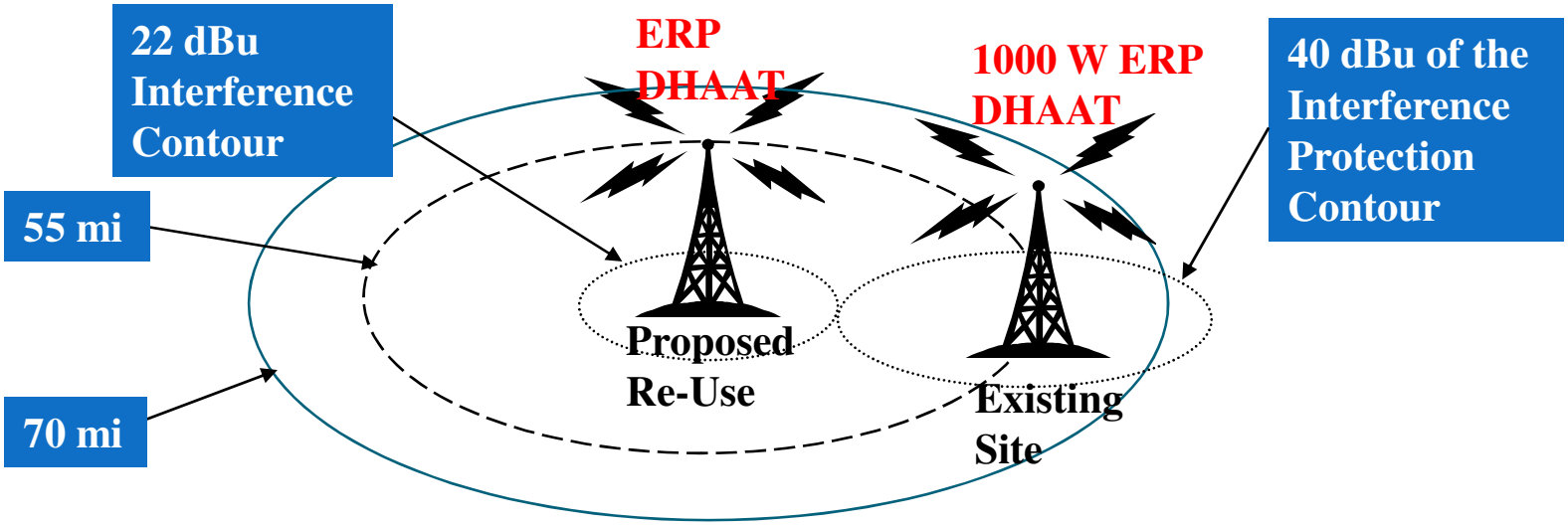
Reference Pt 90 of Title 47 FCC Rules

Exceptions to the Separation Rule

- Waiver
  - Requires an interference analysis based upon any of the generally-accepted terrain-based propagation models showing that co-channel stations would receive the same or greater interference protection
- Consent from the co-channel operators
  - Letters of concurrence indicating that the applicant and each co-channel licensee within the specified separation agree to accept any interference resulting from the reduced separation between their systems.
- Short-spacing rule

Short-Spacing Rule

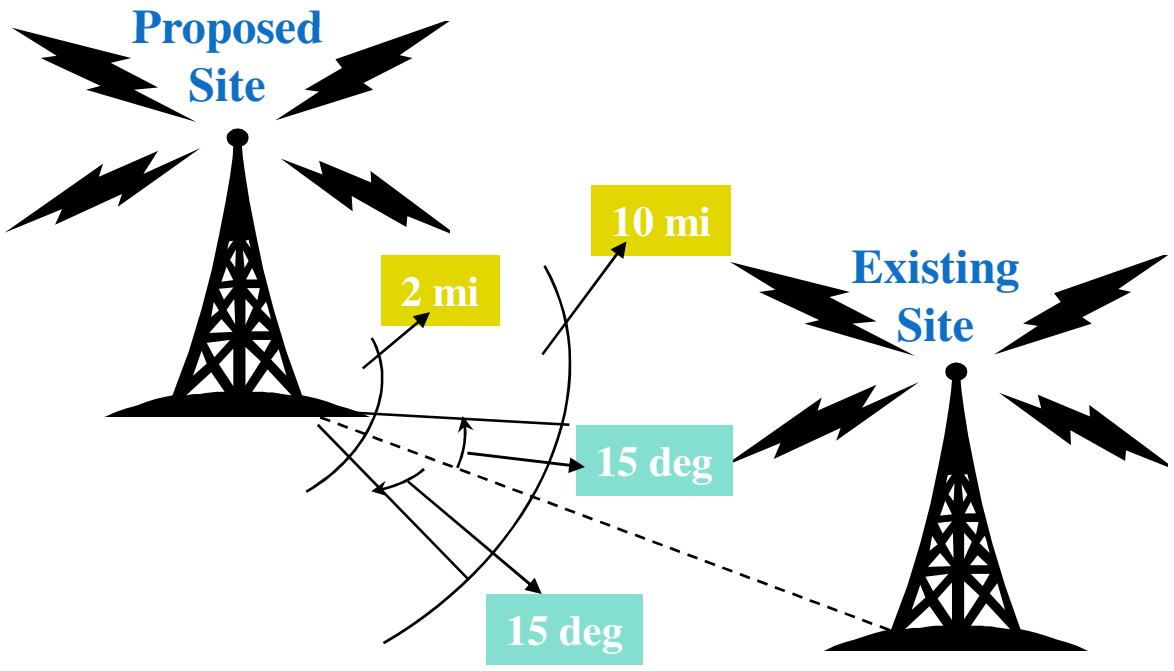
- Separations for stations in CA and the locations in the State of Washington, as identified by FCC Rules Pt 90, are 35 miles greater.
- Distances are based upon a non-overlap of the 22 dBu interference contour of the proposed station with the 40 dBu contour of the existing station(s).
- The minimum separation of stations is 55 miles.
- All existing stations are assumed to operate with 1000 watts ERP.



- Reference Pt 90.621 of Title 47 FCC Rules

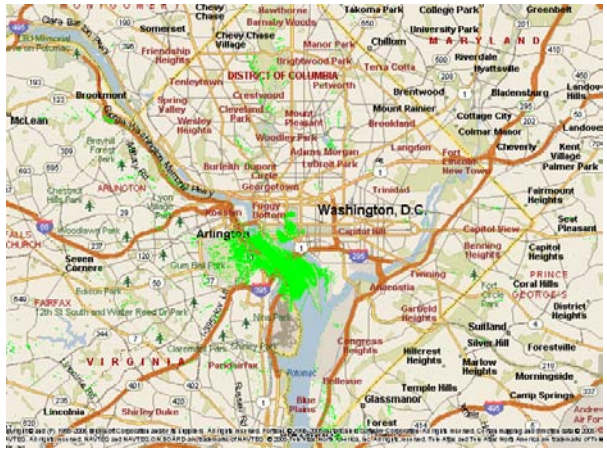
DHAAT Calculation

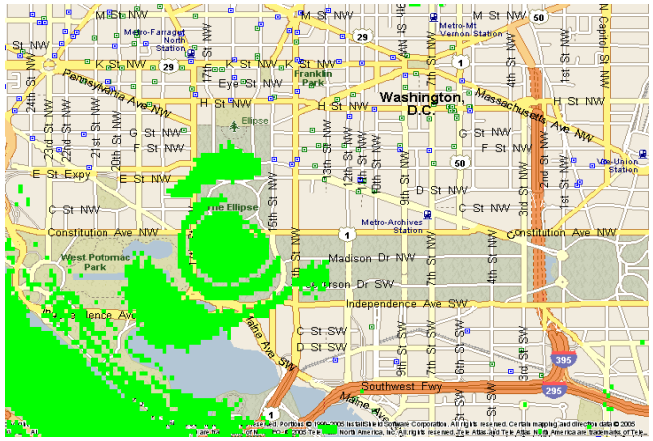
- Directional Height Above Average Terrain (DHAAT) is calculated from the average of the antenna heights above average terrain from 3 to 16 km from the proposed site to the along a radial extending in the direction of the existing station and the radials 15 degrees to either side of that radial.



Interference Analysis - Prediction

- As in coverage prediction, area is divided into multiple signal strength computational 'bins' throughout the radio site coverage area
- Signal from each of the sites using the same frequency is calculated
  - The combination of interfering radio signals is fundamental to the interference analysis
- The difference between the serving site (C) and interfering/reusing site (I) is presented as co-channel C/I ratio.

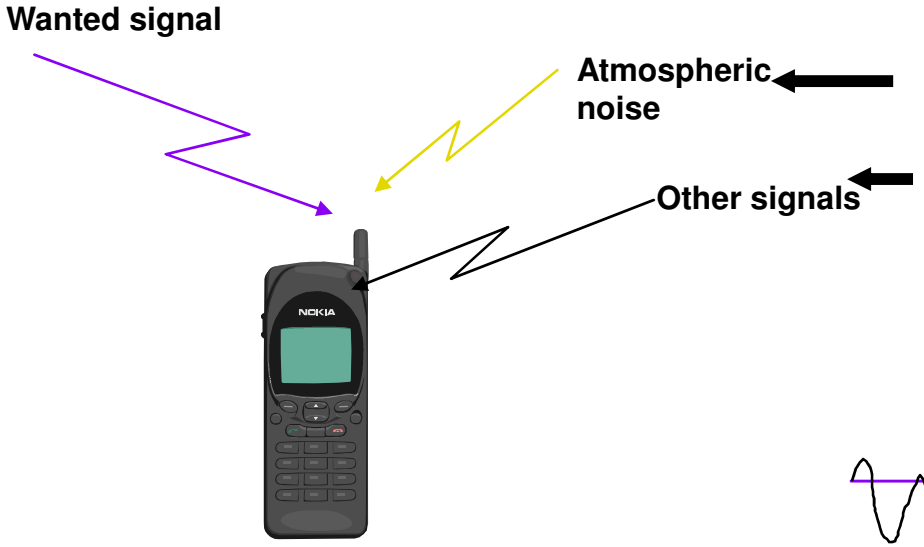




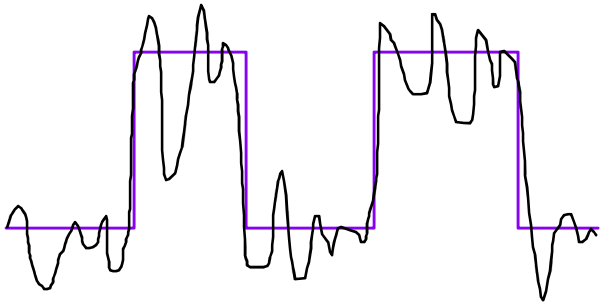
Radio Interference Overview

Signal quality =

$$\frac{\text{sum of all wanted signals}}{\text{sum of all unwanted signal}} = \frac{\textbf{carrier}}{\textbf{interference}}$$



Noise Limited Vs. Interference Limited



LMR specifications :

C / I >= 17 dB co-channel for nominal performance

How do we Quantify Interference?

- C/(I+N) is the general criteria for signal quality
- C = Signal Strength of the serving cell
- (I+N) = Sum of ALL interfering sources, including co-channel interference, adjacent channel interference, inter-modulation interference, and noise.

$$\frac{C}{I+N} = \frac{C_{Desired}}{\sum_{\text{All Co-channels}} I_j + \rho \sum_{\text{All Adjacent channels}} I'_j + I'' + N}$$

ρ: Adjacent Channel Rejection Factor

I'': IM interference

N: Noise

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Radio Interference Overview

- Degradation of signal quality
- Introduces bit errors
  - "Repairable" errors: Channel coding, error correction
  - Irreducible errors: Phase distortions (random FM noise)
- Interference situation is
  - Non-reciprocal: Uplink ≠ downlink
  - Unsymmetrical: Different situation at Mobile and Base
- Concept of "carrier-to-interference ratio" : C/I
- Common Sources of Interference
  - Internal or external co-channel or adjacent channel
  - Multi-path components (long echoes)
  - Inter-modulation

Difference Between Distance and Detailed Interference Prediction Methods?

FCC Interference Protection	Propagation Prediction Modeling	What Method to Use?

• Distance based co-channel and adjacent channel computation
• Required to comply with FCC requirements
• Offers uniform results between markets
• Based on simple to administer co-channel and adjacent channel distance separation look-up tables
	• Detailed interference analysis is conducted throughout the coverage environment of affected radio sites
	• Illustrates differing levels of Carrier/Interference or Desired/Undesired signal strength
	• Offers greater flexibility in defining acceptable interference
	  • Accept interference in areas where limited or no coverage is expected
		• Both!
		• Comply with FCC distance-based separation requirements
		• Use propagation prediction modeling tools to assess current interference environment and evaluate proposed frequency assignments/reuses
		  • Support radio channel repacking strategy
		  • Decrease co-channel and adjacent channel separation requirements

C/I Dependency on Radio Type

- The type and class of portable and mobile radios used may affect signal quality due to its potential different response to interference
- Full interference protection is only afforded for Class A radios

Class A portable receivers must have:	Class A mobiles must achieve:
Reference Sensitivity of <= -116dBm	Reference Sensitivity of <= -116dBm
Intermod Rejection => 70 dB	Intermod Rejection >= 75 dB
Adjacent Channel Rejection => 60 dB	Adjacent Channel Rejection => 60 dB

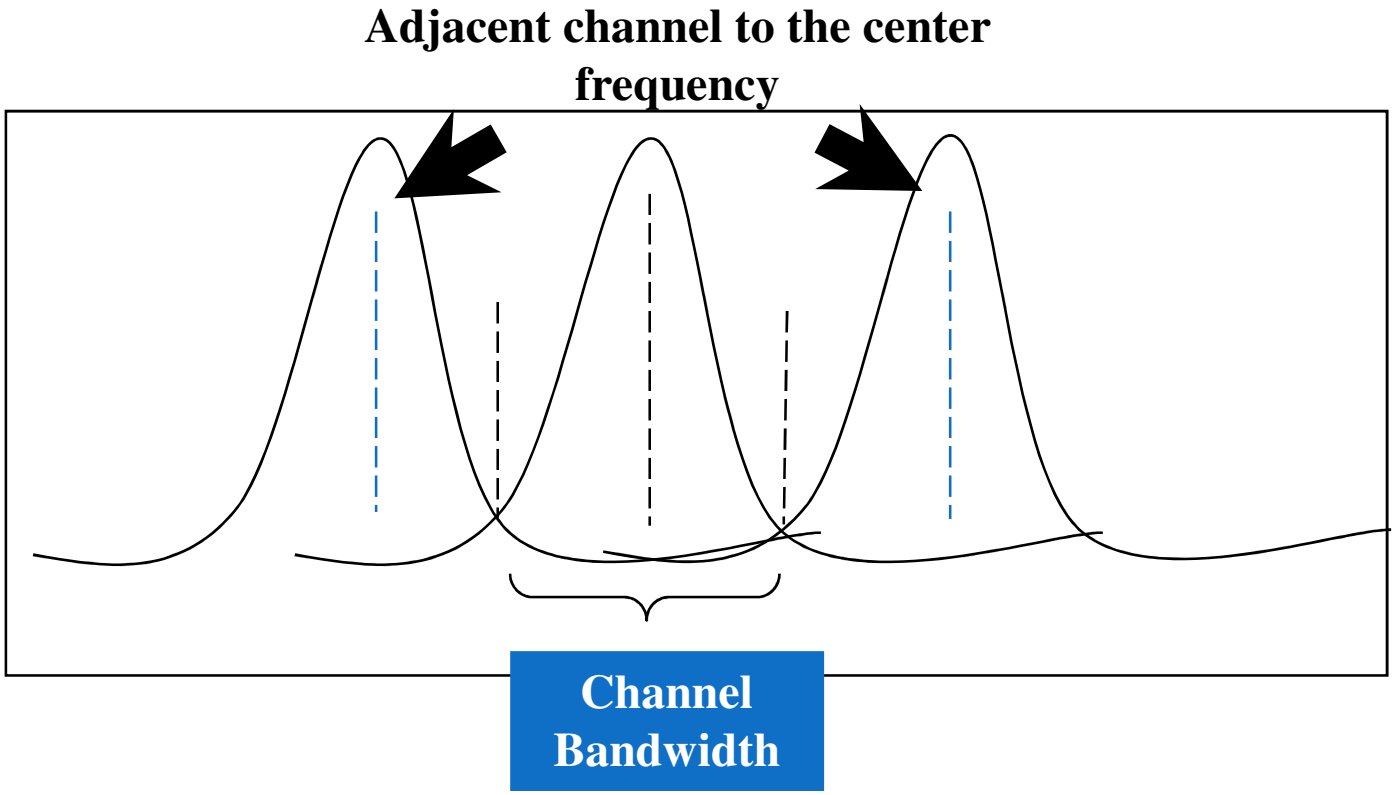
FCC Rebanding Order Interference Protection Rules

- The table below is a summary of the interference thresholds in order to protect public safety systems and private wireless operators at these signal levels during and after Rebanding
- In the interim, SN is providing interference protection to a smaller coverage area for the licensee to the level as weak as -102 dBm and -105 dBm for portables and mobiles respectively instead of -121 dBm and -124 dBm which is more difficult

Protection Thresholds and Timelines	The FCC Interim Standard	Post-Reconfiguration Standard
Minimum C/(I+N) for Voice Protection (dB)	17	20
Minimum C/(I+N) for Data Protection (dB)	Per Manufacturers recommendations	Per Manufacturers recommendations
Portable RSSI Protection Threshold (dBm)	-85	-101
Mobile RSSI Protection Threshold (dBm)	-88	-104
Protected Receivers	TIA Class A, Other classes to higher RSSI	TIA Class A, Other classes to higher RSSI

Adjacent Channel Interference

- Strong signal from adjacent channels could spill over into a desired channel



What is Intermodulation Interference?

- IM - result of two or more frequencies mixing together in a non-linear element.
- Typically present on all radio communication sites, including those of 800 MHz Public Safety, co-located or in close vicinity to other operations.

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Is IM Interference Always Harmful?

If a resultant IM frequency falls within a bandwidth of a susceptible receiver, it would contribute to interference thus lowering Signal-to-Interference plus Noise, C/(I+N), ratio.

The factors that determine if a transmitter would be a harmful IM producer include frequency, bandwidth, transmitting power level, and distance between operations.

Therefore, in accordance with the TA guidelines, IM analysis is required when the re-banded Public Safety receive antennas are co-located with, or are in proximity to, other transmit facilities.

Example: The following analysis returns multiple potential 3rd order IM hits to the UHF receivers:

468.07500=(1)(859.53750)+(-1)(854.63750)+(1)(463.17500)

468.17500=(1)(859.73750)+(-1)(854.63750)+(1)(463.07500)

800 MHz Reconfiguration Program: Intermodulation Interference Studies.
www.800TA.org

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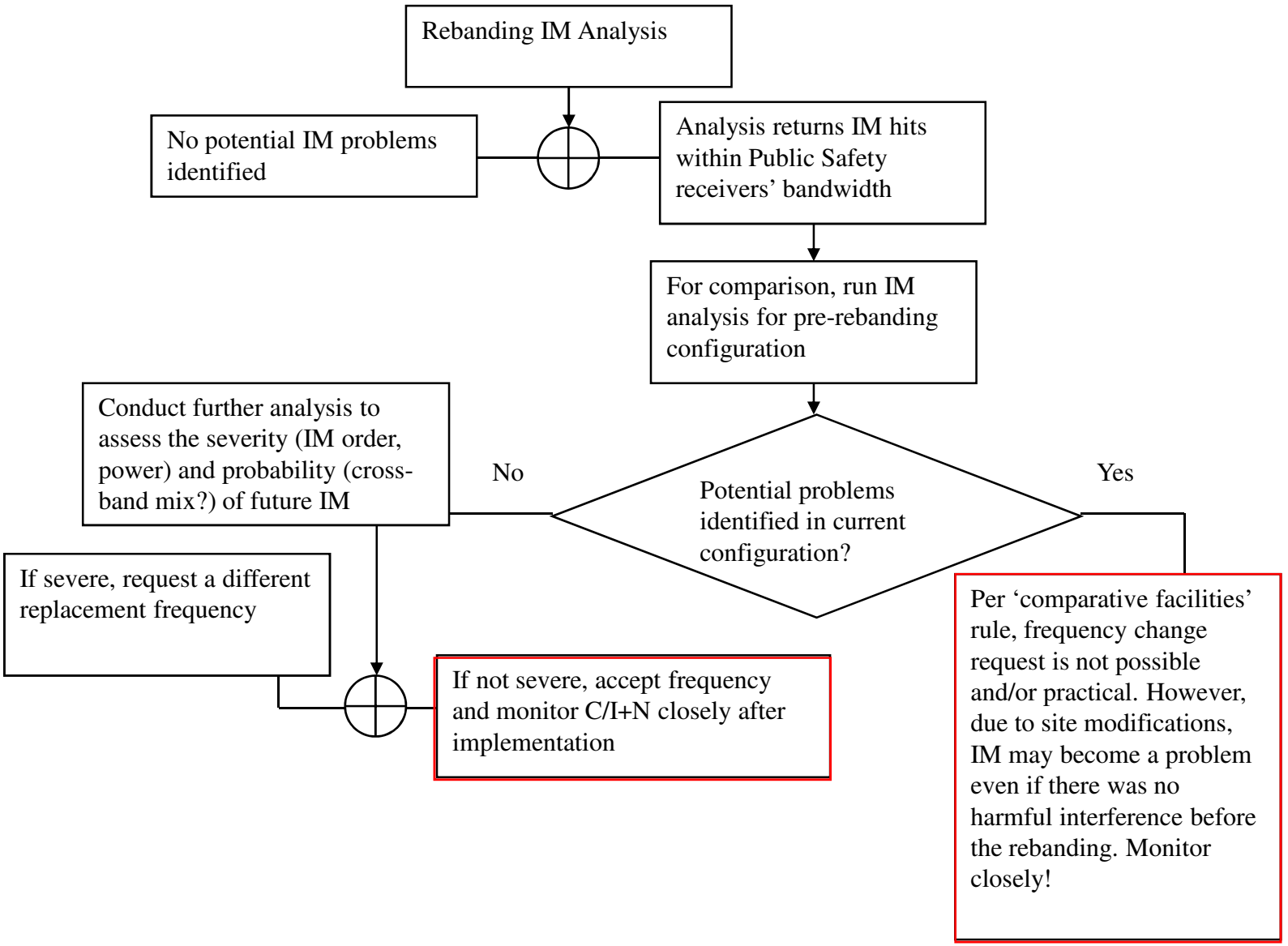
IM Analysis – Beyond Rebanding

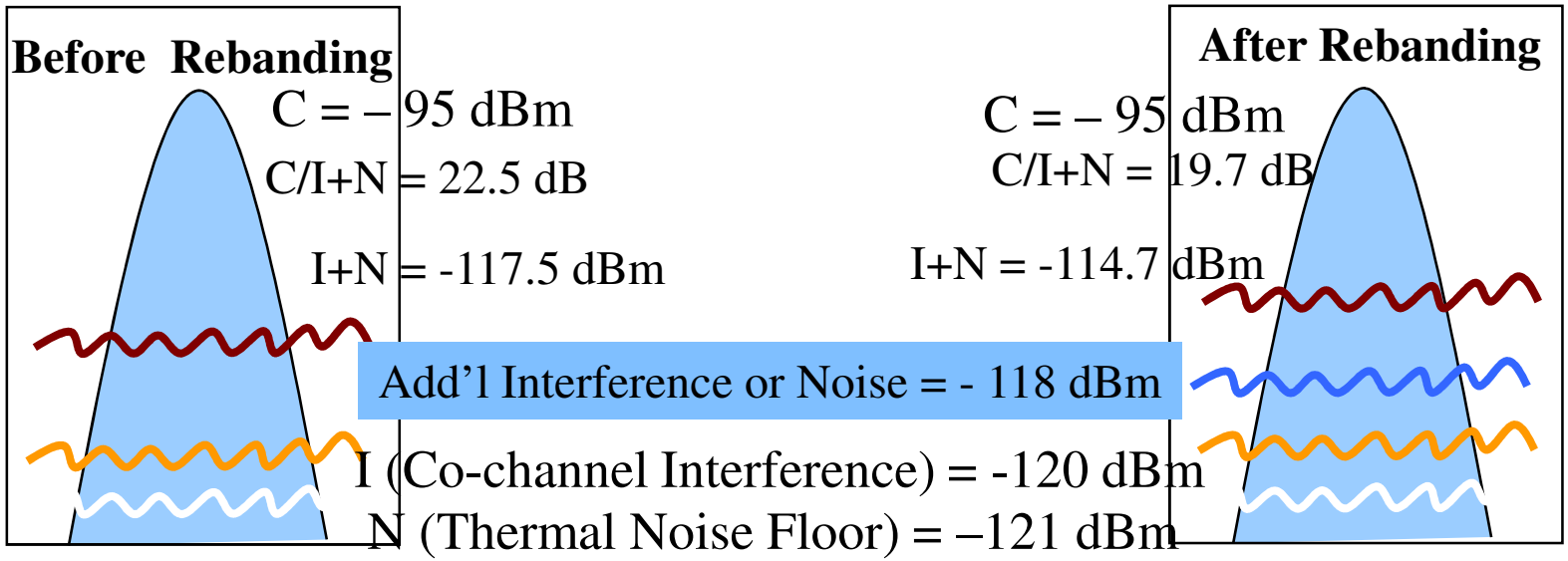


NPSPAC Channels Rebanding and Interference Analysis

Is co-channel analysis required for NPSPAC channels?	• No, because they are moving as a block and co-channel relationships are preserved
Is frequency analysis required for NPSPAC channels?	• YES!! Because frequency environment is changing, potentially increasing noise components of the (I+N)
Follow up/on-going interference monitoring is required after rebanding for ALL channels.	• All suspected SN interference should be reported • Drive tests are likely to be performed to verify source of interference

Interference Tolerance

- The example below shows how a change in frequency environment that introduces additional noise or interference (I.e. IM interference) decreases the interference tolerance level.
  - It is important to measure or calculate interference from ALL sources



Interference Isolation

- Isolate an interference source
  - Internal interference
  - External inference - interference to public safety radio transmissions from commercial operators or another public safety licensee
- Determine type of interference
  - Co-channel interference
  - Adjacent channel interference
  - Intermodulation
  - Receiver overload
  - Out of Band Emissions

Interference Mitigation

- Identify faulty equipment producing unacceptable out-of-band interference
- Employ physical separation to minimize IM problems
- Identify unacceptable interference from other co-channel providers (Legal action/agreement)
- Retune
- Other methods include site modifications, power adjustments, etc.
- Interference reporting mechanism is in place. www.publicsafety800mhzinterference - created as a result of the FCC's requirements in the 800 MHz Report and Order

Channel Packing

- Increase spectrum efficiency
- Allocate frequencies to ensure that acceptable quality standards are met
- Supports expanded channel capacity
- Minimize capital and operational cost

Will be discussed in greater detail later in workshop

Session 12: Heading to the Finish Line – Rebanding Status

Brian Jagan
Transition Administrator

LeGrande Technical and Social Services, LLC

Session 13: Radio Channel Repacking– Overview and Implementation Strategy

Rick Burke,
Managing Partner
Televate, LLC

February 13, 2009

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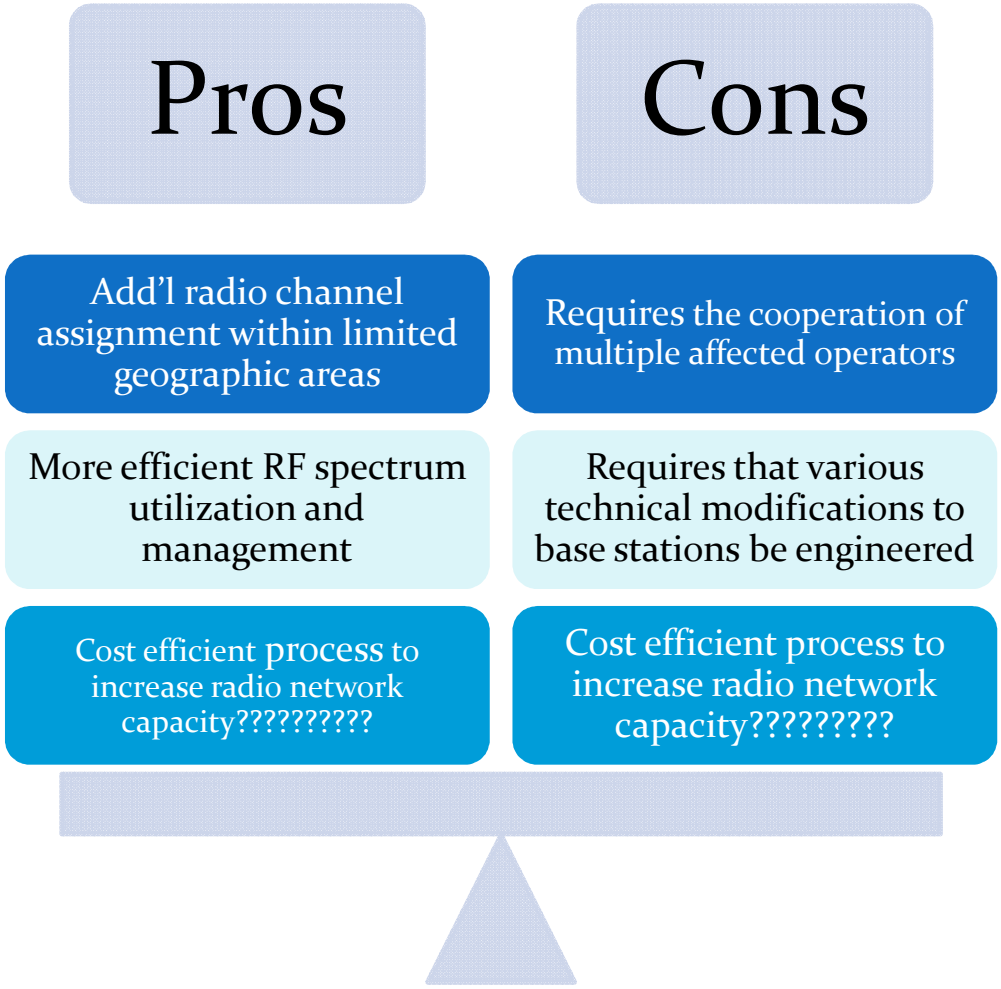
Radio Channel Repacking – An Overview

- What is Radio Channel Repacking?
  - Channel repacking is one of many ways of increasing the capacity of the radio network
  - Radio channels are limited resources that need to be carefully allocated. To increase network capacity, channel assignment can be exercised in various methods:
    - Short space co-channels to increase capacity and maintain channel quality and reliability
    - In TDMA configurations, split channel bandwidth - narrowband
- When can repacking be considered as a viable option to optimize 800 MHz radio channel allocation in a region?
  - In dense metropolitan areas where insufficient radio channels are available following standard co-channel and adjacent channel algorithms
  - Along nation borders with Canada and Mexico where insufficient radio channels are available to accommodate border jurisdictions on either side of the border
  - As a means of assigning additional radio spectrum in the event that 700 MHz assignment is delayed due to funding or regulatory reasons

Radio Channel Repacking – An Overview

- What are the pros and cons of Repacking?



Radio Channel Repacking – An Overview

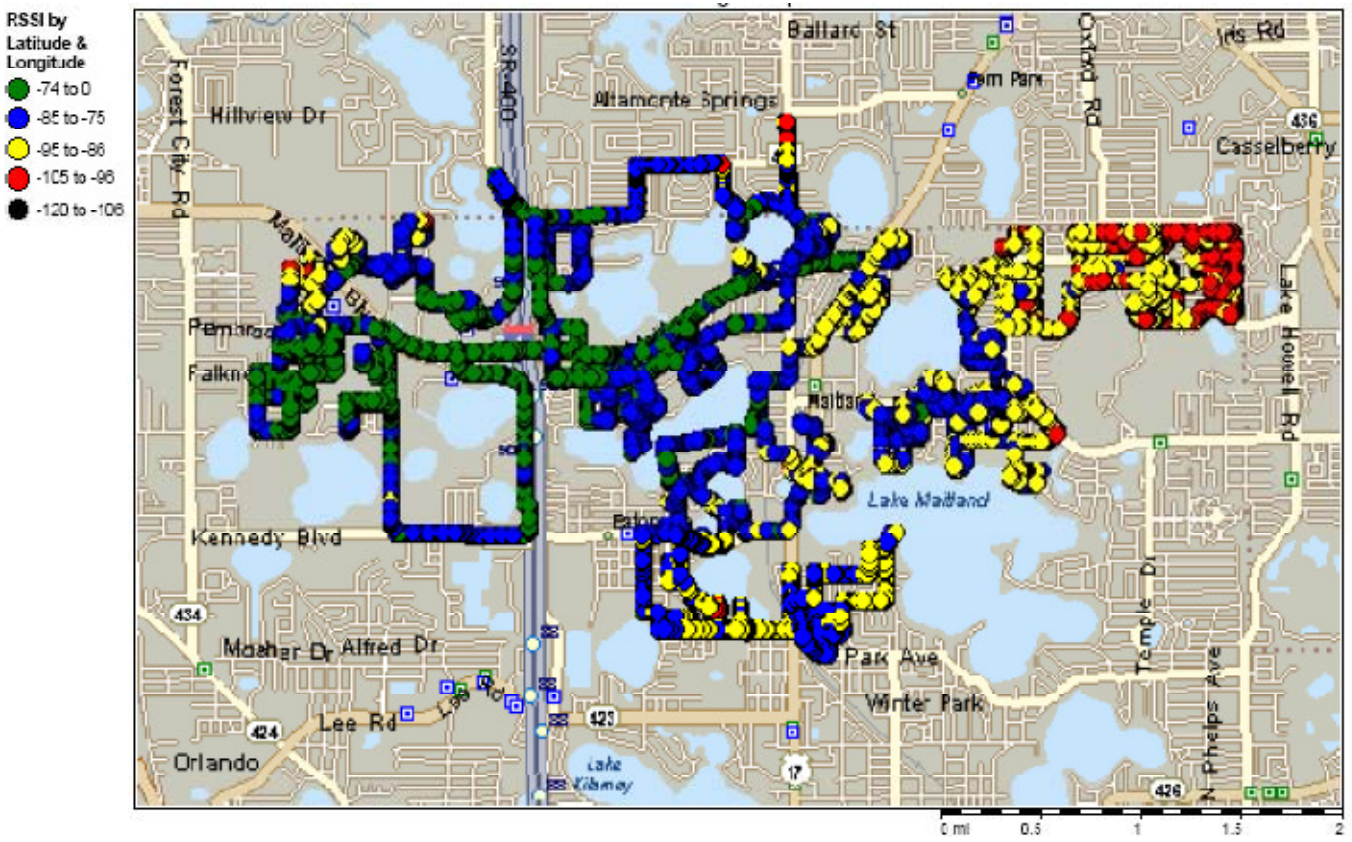
- What are the optimal regional, multi-regional and national scenarios for a Repacking program?
  - Near term need for additional 800 MHz radio channels
  - Border channel management requirements
  - Delay of new 700 and returned Sprint Nextel 800 MHz spectrum
- What is the potential impact of Repacking on the operational environment?
  - Repacking must be engineered to achieve optimal network performance with no noticeable degradation to radio quality and reliability
  - Repacking could result in various network modifications including but not limited to additional base station locations, BS cabinet expansions, prime control modifications and others
- Definition of regional requirements supporting Repacking
  - Regional support is fundamental to a Repacking program
  - The impact of Repacking on a wide area region will depend on the unique geographic area affected
  - Channel and radio retunes are likely beyond the prime area of channel expansion

Radio Channel Repacking – An Overview

- Existing 800 MHz channel licensing and allocation research
  - Essential to develop a comprehensive understanding of the regional LMR landscape
    - Regional radio channel allocation scheme
    - Co-channel and adjacent channel allocations
    - BS technical parameters with focus on channel bandwidth and combiner spacing
    - Radio fleetmaps and system affiliation
    - LMR system inventory
- Determine optimal radio channel requirements region wide

Radio Channel Repacking – An Overview

- Conduct detailed radio propagation and RF interference analysis region wide
  - Gather RF data via drive testing to optimize propagation model
  - Define optimal service and co-channel and adjacent channel interference protection criteria
  - Engineer optimal radio channel allocation based on vendor verified Carrier to Interference (C/I) criteria



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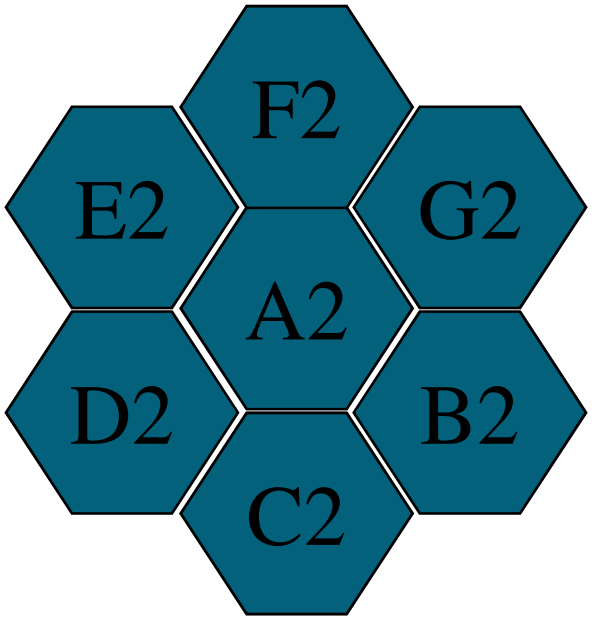
Radio Channel Repacking – An Overview

- Standardized channel allocation based on ratio channel reuse patterns
  - Standardized "cell reuse patterns" are more appropriate to consider as RF grids
- Deciding to implement the program – cost-benefit analysis
  - The cost benefit of Repacking is directly related to the scope of the program
    - How many affected channels, base stations, radios
    - How many jurisdictions involved
    - How many differing system configurations, vendors, gateways
    - The overall magnitude of the benefit in relationship to the cost of deploying a new higher capacity network

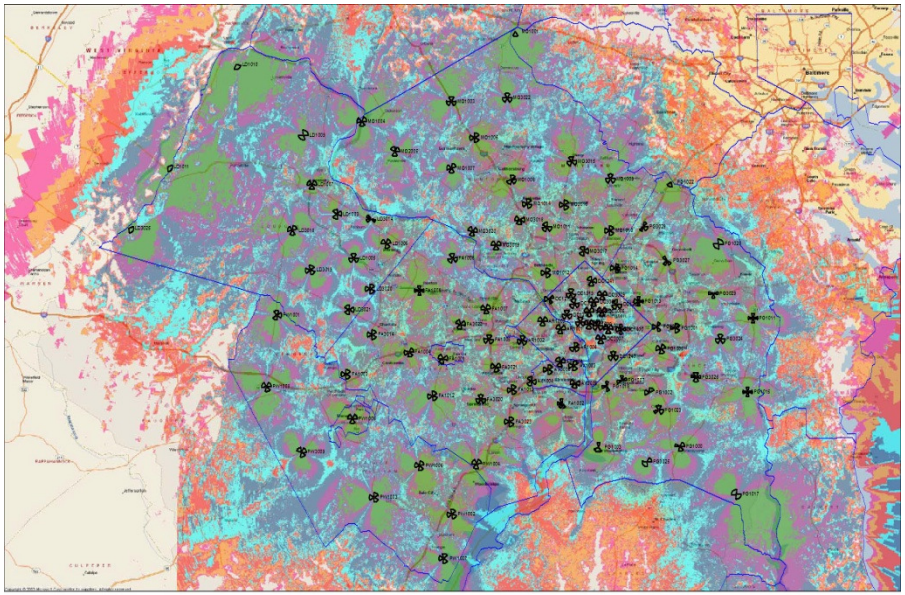


Radio Channel Repacking – An Overview

- Regional governance models supporting a Repacking program
  - Channel repacking programs have the potential of benefiting a wide area of operators or simply one or a few – either way, all affected jurisdictions have to be supportive
  - Cost sharing models may be less burdensome in some situations but may be more difficult to get approved in others
  - Repacking does have some potential residual benefits for all/most affected operators including
    - Touch radios to enhance interoperability with updated radio templates
    - Optimize coverage and interference management
    - The good neighbor factor!!!!

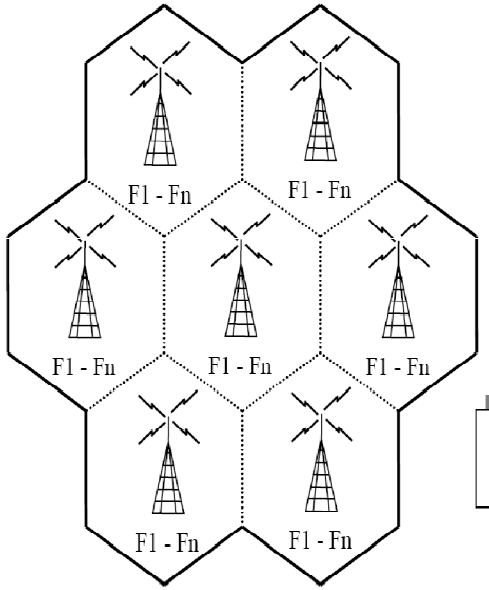
Radio Channel Repacking – Approach

- Typical factors impacting the complexity and budget of a Repacking Program include:
  - Market geographic environment: natural and man made
  - The number of service operators in the study area
  - The total number of frequencies required to satisfy particular operator requirements and the total number of radio channels being analyzed
  - The outright complexity of the Repacking, i.e., how many frequency assignment changes are required across the region to obtain the optimal Repacking plan
  - Responsiveness of regional operators to inquiries for channel licensing verification and other technical operational information



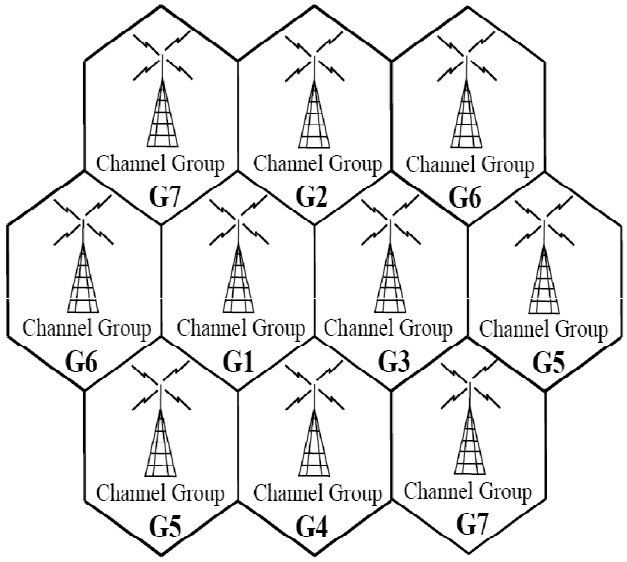
- Cooperation and responsiveness of LMR equipment vendors
- Location of the market and time to travel to and from
- The magnitude and costs of infrastructure upgrade requirements

Common LMR Frequency Planning



Channels **F1 - Fn** have coverage over the entire service area.

Exhibit 4 Frequency Layout of a Seven-Site Simulcast LMR System



Channels **F1 - Fn** are divided into 7 groups (G1-G7). Each site is assigned a frequency group different from adjacent sites to minimize co-channel interference.

Simulcast Frequency Plan

Multicast Frequency Plan

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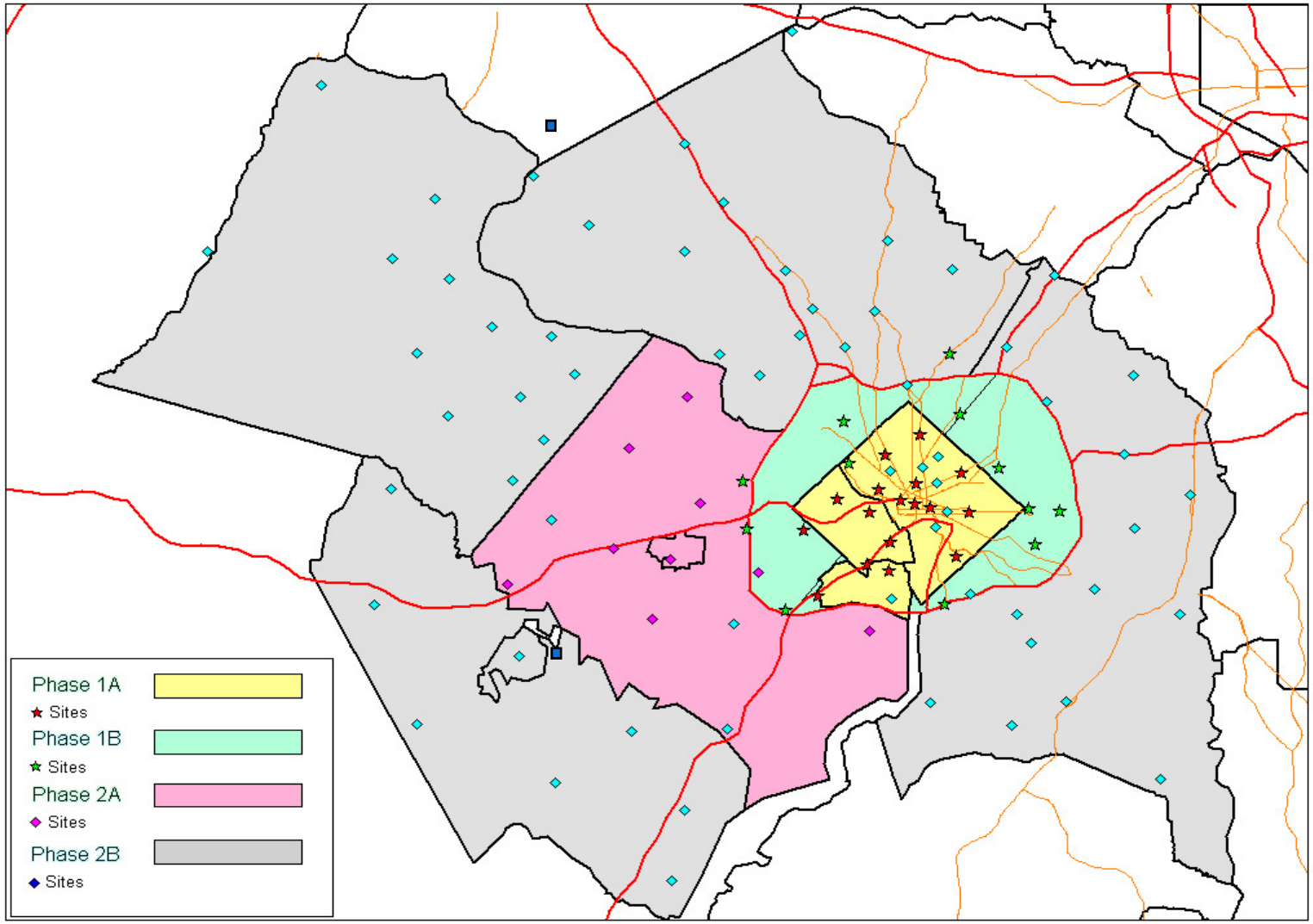
National Capital Region Area



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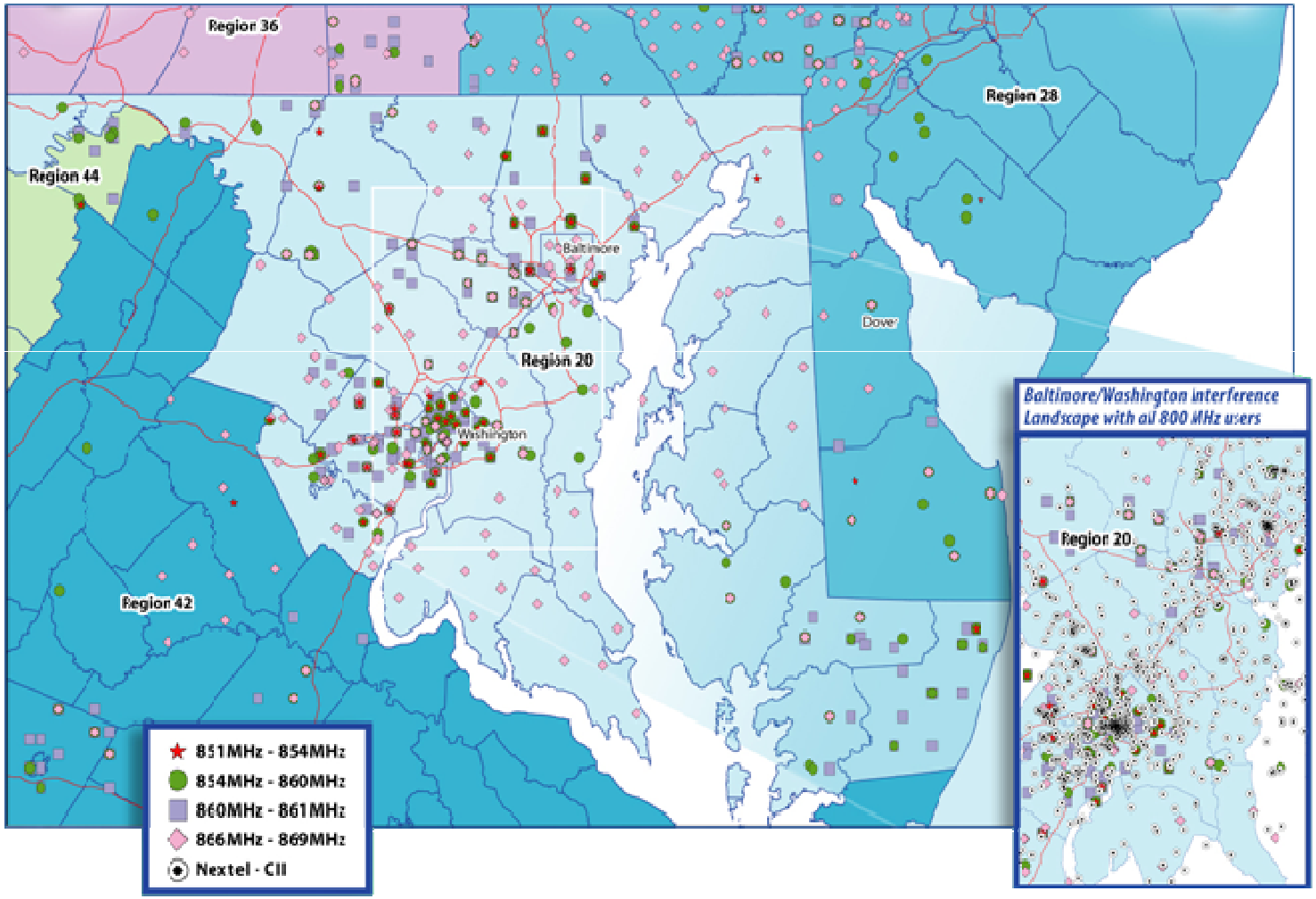
Region 20 Overview



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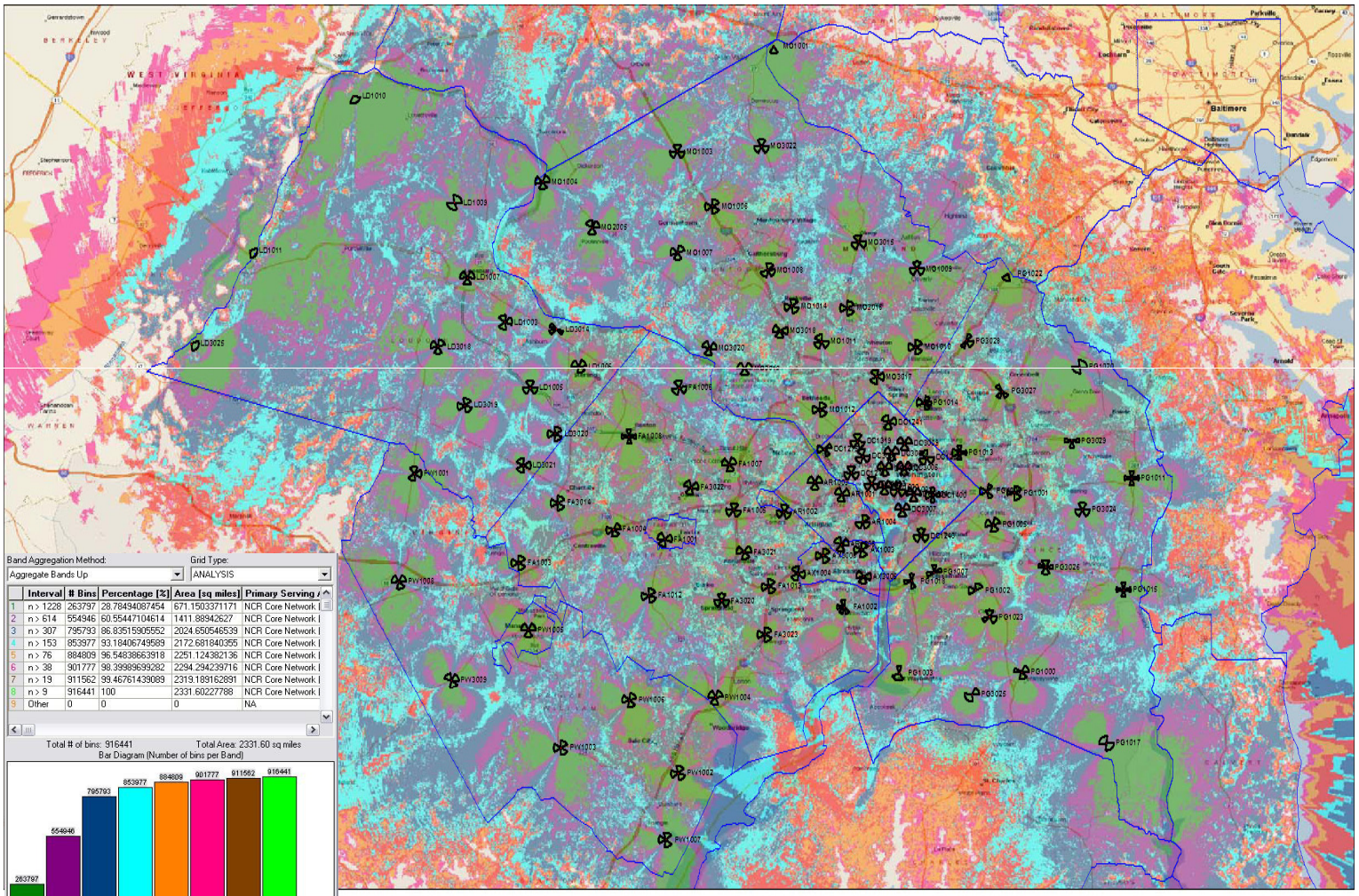
Wide Area Radio Propagation Coverage



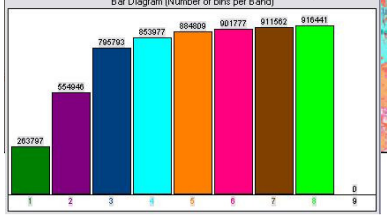
Band Aggregation Method: Aggregate Bands Up

Grid Type: ANALYSIS

	Interval	# Bins	Percentage [%]	Area [sq miles]	Primary Serving A
1	n > 1228	263797	28.78494087454	671.1503371171	NCR Core Network |
2	n > 614	554946	60.55447104614	1411.88942627	NCR Core Network |
3	n > 307	795793	86.83515905552	2024.650546539	NCR Core Network |
4	n > 153	853977	93.18406749589	2172.681840355	NCR Core Network |
5	n > 76	884809	96.54838863918	2251.124382136	NCR Core Network |
6	n > 38	901777	98.39989699282	2294.294239716	NCR Core Network |
7	n > 19	911562	99.46761439089	2319.189162891	NCR Core Network |
8	n > 9	916441	100	2331.60227788	NCR Core Network |
9	Other	0	0	0	NA

Total # of bins: 916441 Total Area: 2331.60 sq miles

Bar Diagram (Number of bins per Band)



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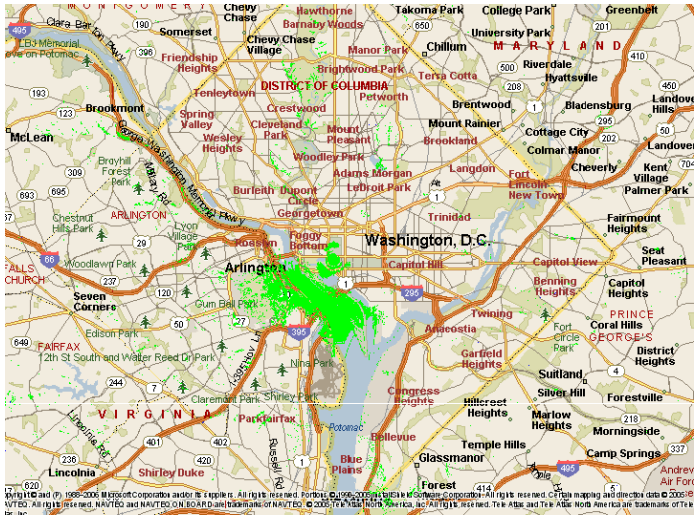
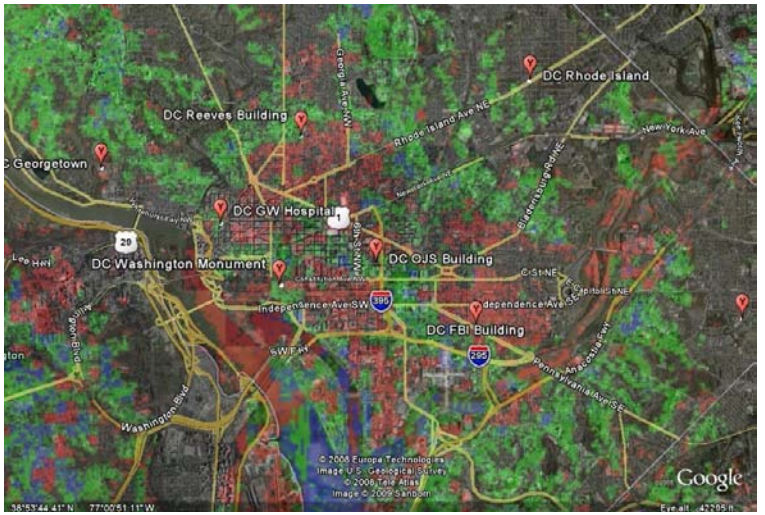
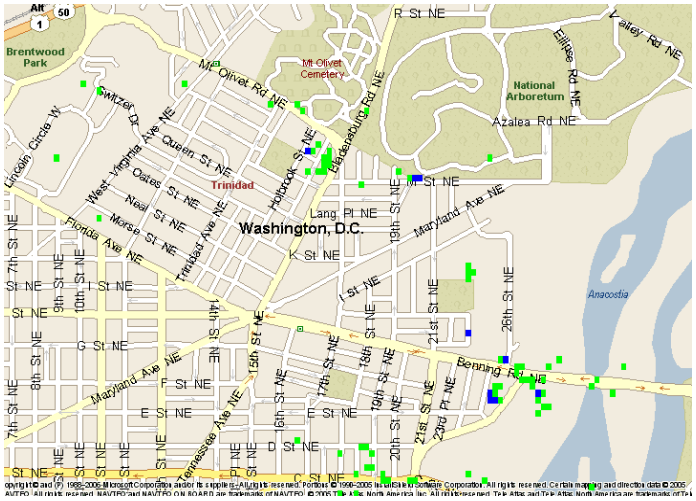
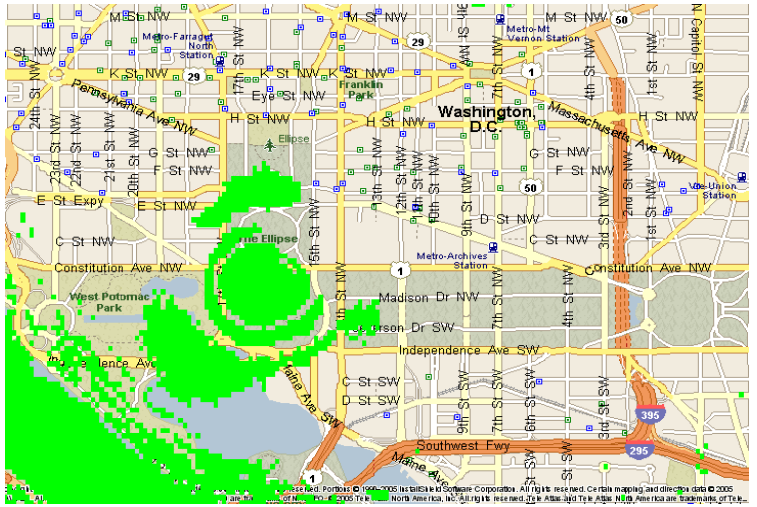
Coverage and Interference Plots









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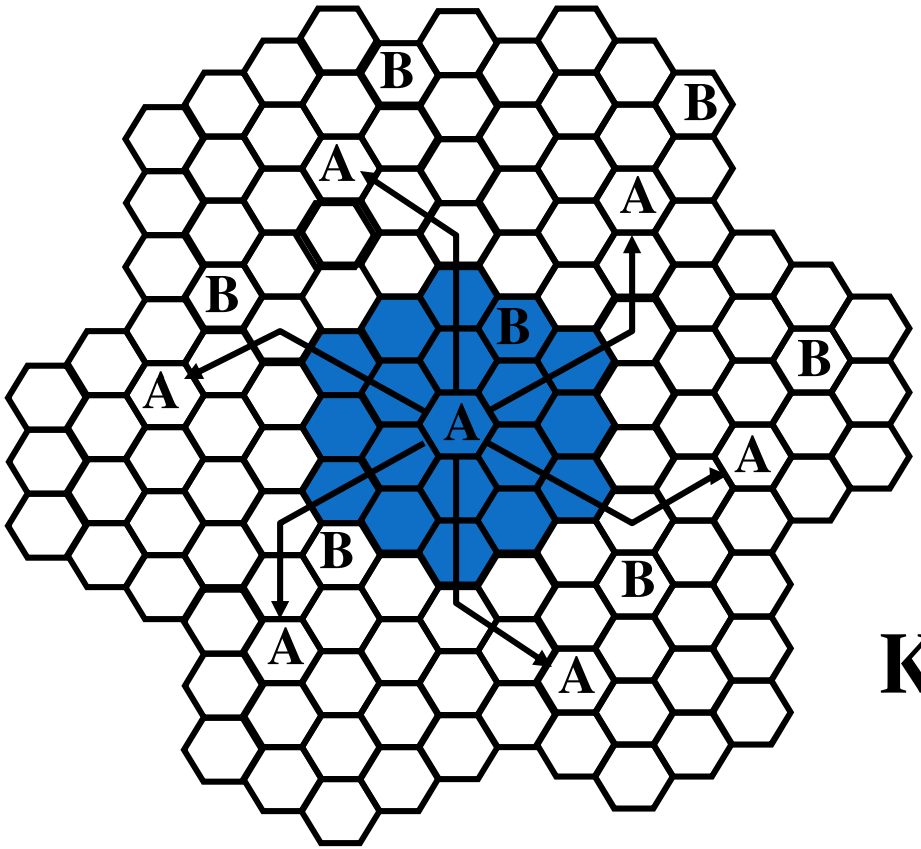
N-cell Reuse Pattern

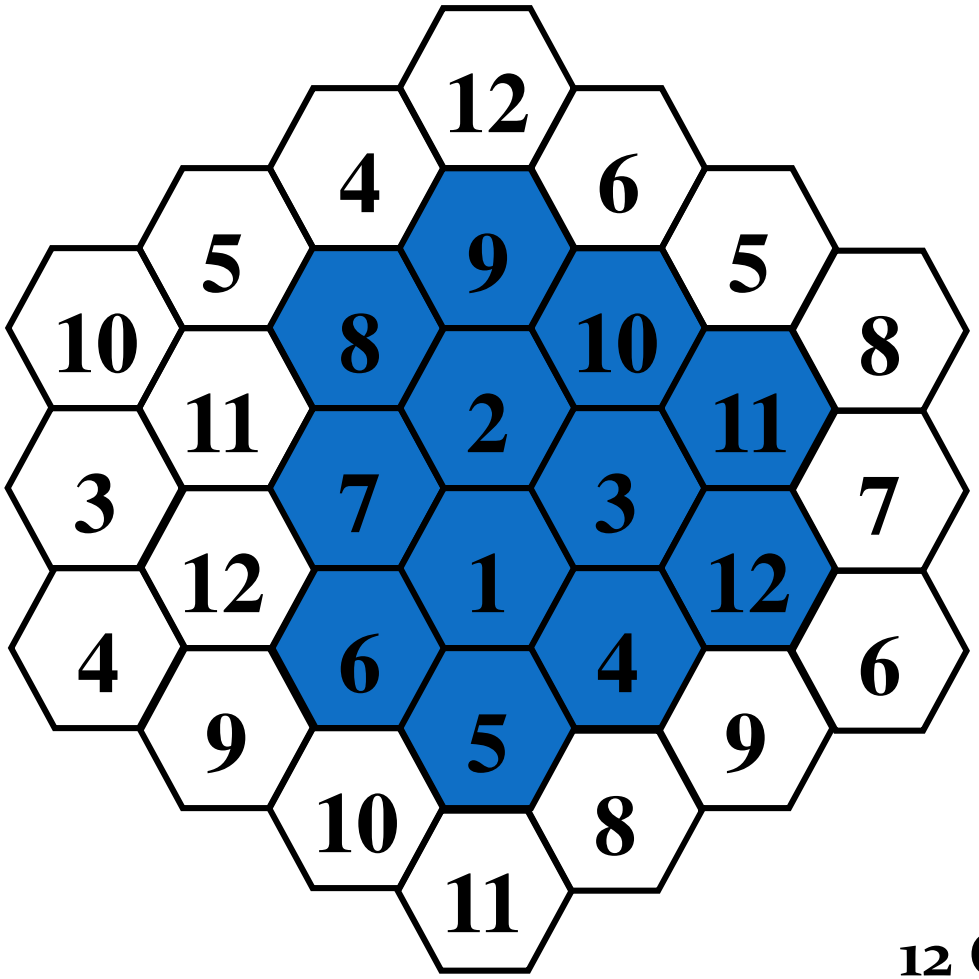


- Standardized frequency reuse engineering strategy is fundamental to interference management
- RF grids are more representative of the actual radio environment

$$K=i^2+ij+j^2=19$$

Shift parameter i=3, j=2

12-Cell Omni-Directional Reuse Pattern

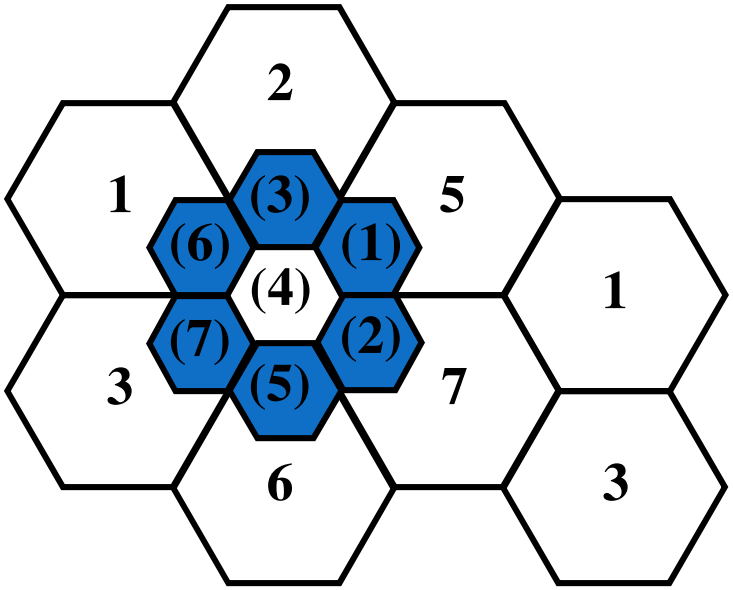


D/R=6

K=12

12 Cell reuse pattern

Cell Splitting



Growing by Splitting Cell 4 into Cells of Small Size

- In dense interference limited radio system architectures with very high capacity requirements such as commercial cellular network, cell splitting is a near daily activity
- Cell splitting engineering strategies support reasonable interference management
- In CDMA/OFDM, these strategies are less common

Region 6 NPSPAC Repacking Engineering Report

Region 6 NPSPAC Repacking Report, Motorola, Inc., September 9, 2005, Revision1

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Repacking Engineering Strategy

- **Repacking requirements gathering and kick-off meeting**
- **Define Coverage Area and conduct FCC license research and analysis** – develop a comprehensive list of market operator frequency license assignment and determine unassigned channels
- **Conduct Direct System Frequency Allocation Verification** – developed questionnaire and provided to each network operator to verify frequency assignment, LMR network technical and operational details
- **Engineering of Repacking Plan** – conduct a comprehensive engineering of optimal Repacking options based on requirements and preparation of report
- **Presentation of Repacking Plan and Proposal**
- **Radio channel and FCC Licensing Research**
- **Radio Coverage and Interference Analysis**
- **Optimize system engineering and design**

Session 14: APCO-AFC RPC Operational Techniques, Methods and Standards

RPC Administration Considerations

Rick Burke,
Managing Partner
Televate, LLC

February 13, 2009

LeGrande Technical and Social Services, LLC

Agenda: Operational Techniques, Methods and Standards

- Overview of RPC administrative obligations
- Discussion on RPC organization structure, governance, committees, sub-committees, etc.
- Information development, processing, posting, approval for filings
- Participation in RPC neighboring and national activities, meetings and events

RPC Administrative Obligations

- List of internal RPC management obligations
  - What are your general administrative obligations?
  - Who is responsible for leading and administering?
  - How is it funded?
  - Are you successful in maintaining the pace? Are you ready to increase the pace?
- List of cross RPC 800 MHz radio coordination obligations?
- List of neighboring RPC coordination obligations?
- List of FCC filing and reporting obligations?
- List of Rebanding obligations?
- Others?

RPC Organization Structure, Governance, Committees, Sub-committees

- Do you maintain a formal RPC organization?
  - Hold regular meetings? Communicate with members?
  - Maintain formal governance documentation and processes?
  - Maintain and publish processes to RPC members?
    - Maintain a web site to post information?
    - Send out regular correspondence?
    - Post regular meeting notifications?
    - Other notifications?
    - Provide written direction on the coordination process?
    - Provide other administrative documentation?
  - Are your members satisfied with RPC administration?
  - What recommendations to enhance the process?
  - Where can standards support the effort?

Information Development, Processing, Posting, Approval for Filings

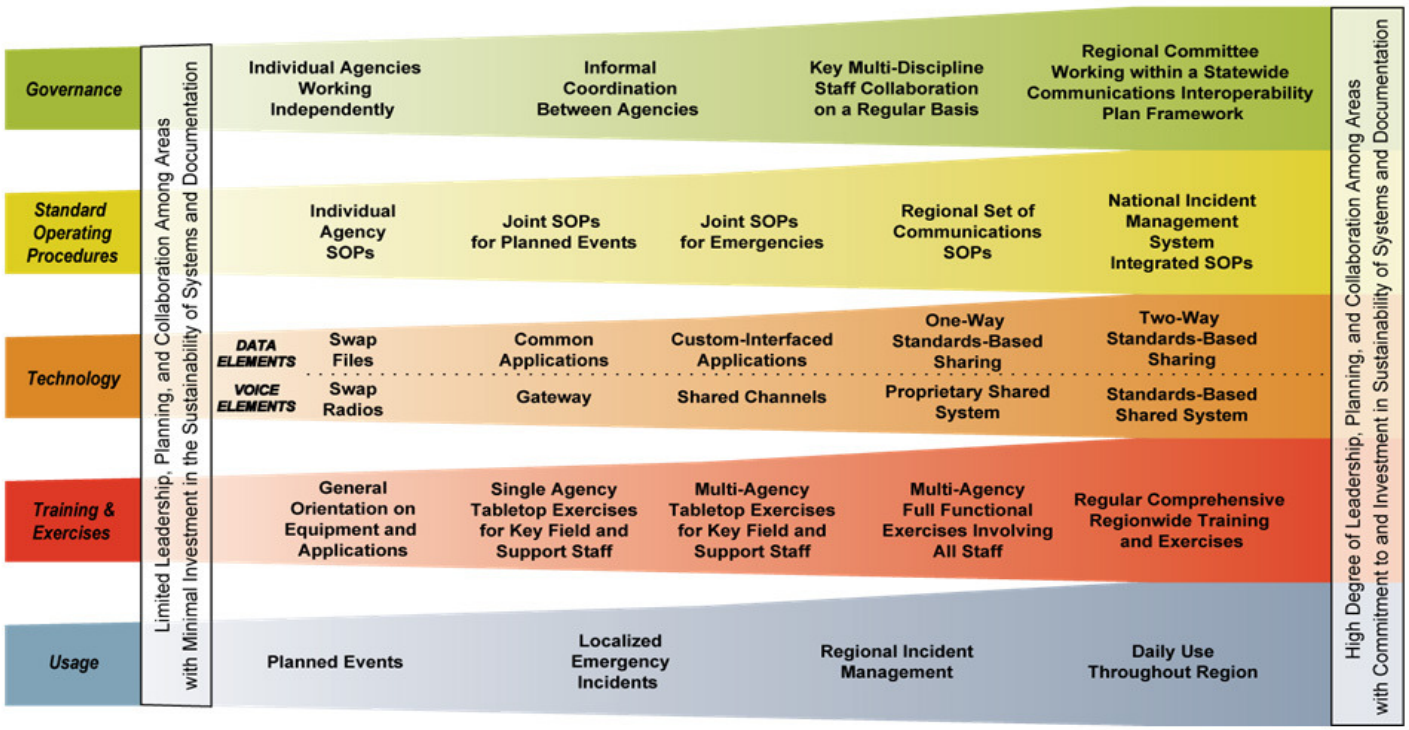
- What is your process for radio channel requests, coordination, approval and submission for formal coordination?
- What about the RPC Rebanding process?
- Does your process provide timely response for information and coordination within the RPC and with RPC neighbors?
- Does the FCC provide fair and reasonable processing support?
- Does Sprint Nextel and the Transition Administrator provide fair and reasonable processing support?
- Discussion on best practices and areas for improvement

- How can we advance national RPC initiatives and interaction?
- How can national and regional associations support RPC initiatives and interaction?
- How can the Federal government support RPC initiatives and interaction?
- Close with the Interoperability Continuum

The Interoperability Continuum

Homeland Security

Interoperability Continuum



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Closing 800 MHz Rebanding Plan Comments and Q&A

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Session 15: Preparing for Wireless Broadband Communications

Robert LeGrande
CEO
LeGrande Technical and Social Services

February 13, 2009

LeGrande Technical and Social Services, LLC

Wireless Broadband Vision

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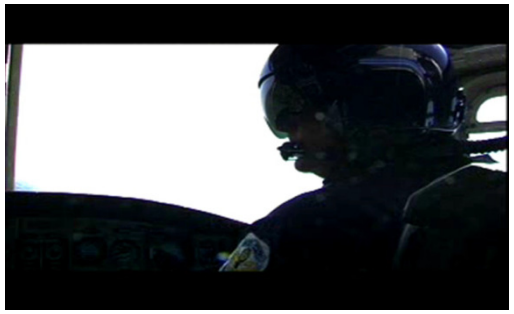
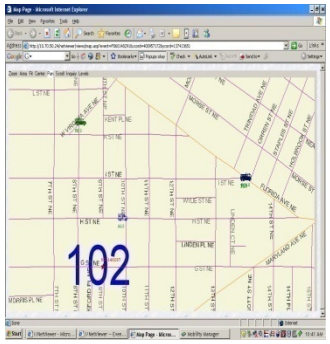
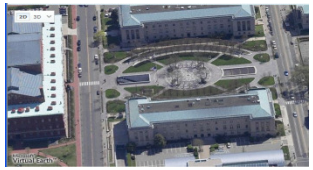
Public Safety Wireless Application Examples

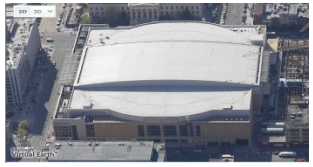
Helicopter Video



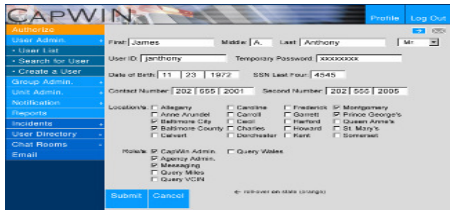
AVL, 3D GIS and Aerial Photography





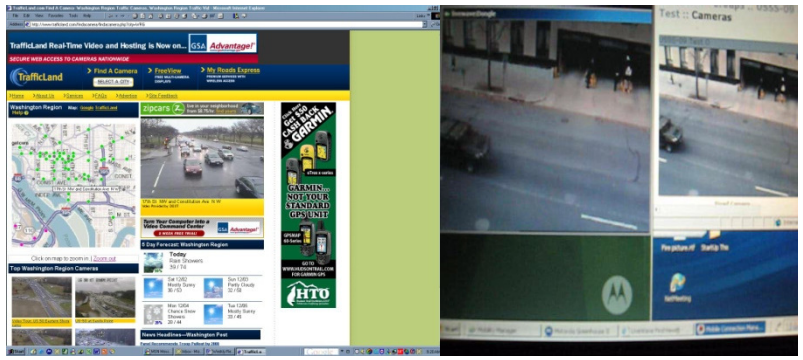


Graphics Rich Web Sites



CBRNE System

Surveillance and Tactical Video



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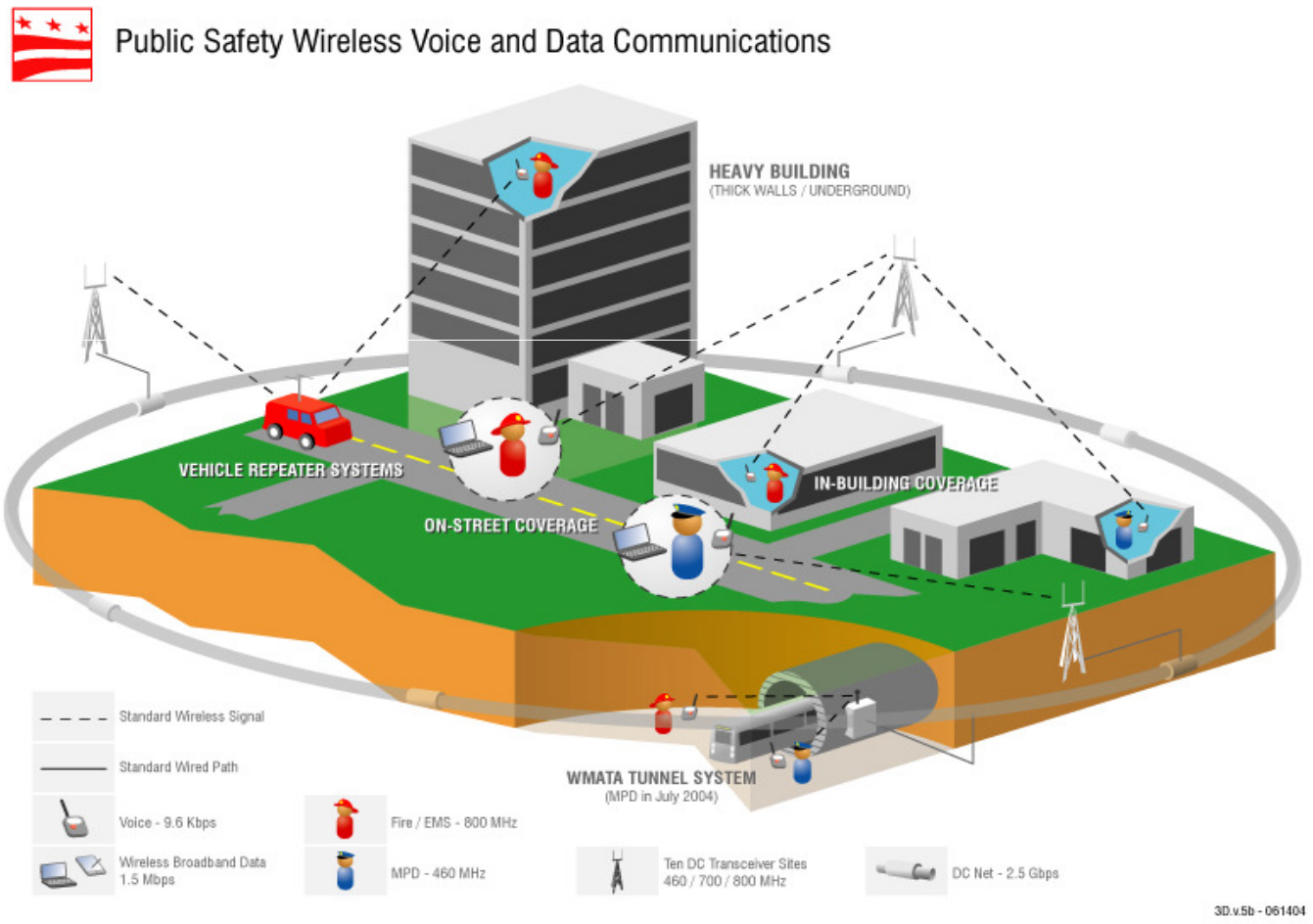
Overview: The District's Public Safety Wireless Broadband Data Network



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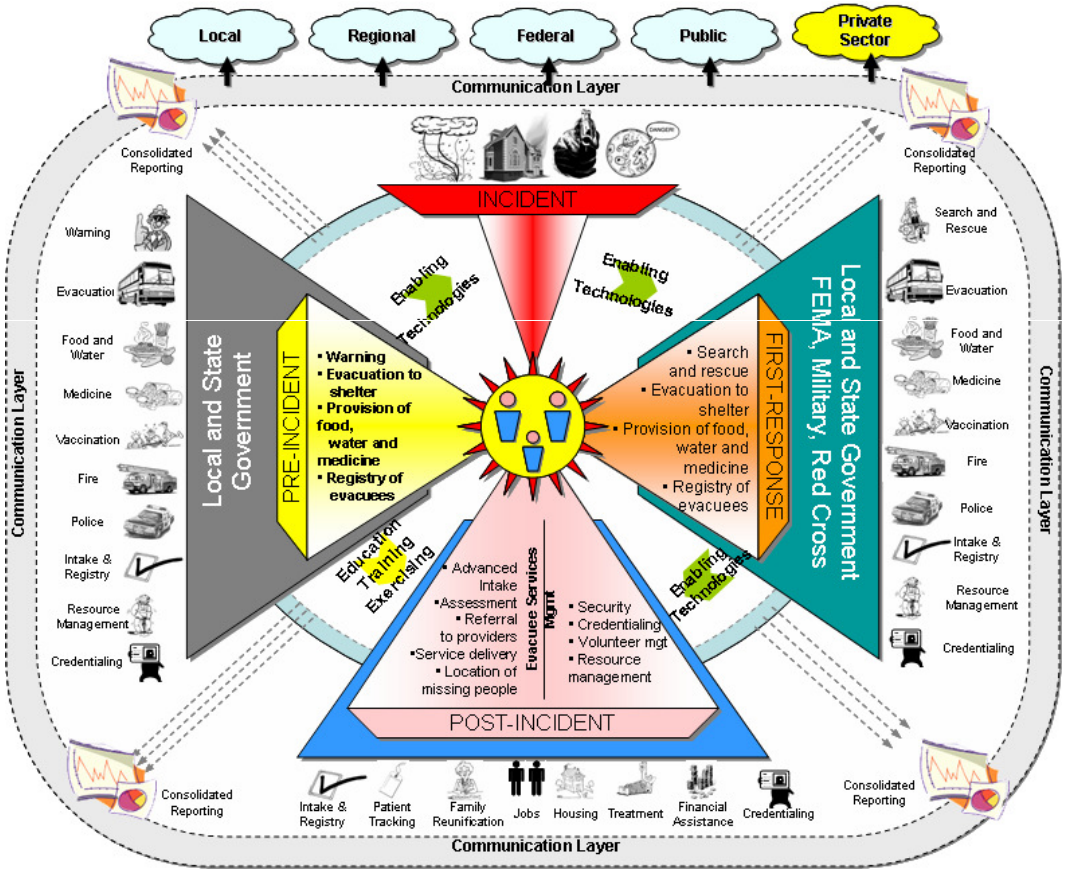
Incident Management Concept of Operations Using Wireless Broadband



How do we leverage wireless broadband in daily and catastrophic events?

- Pre-incident
- Incident
- First-response
- Post-Incident

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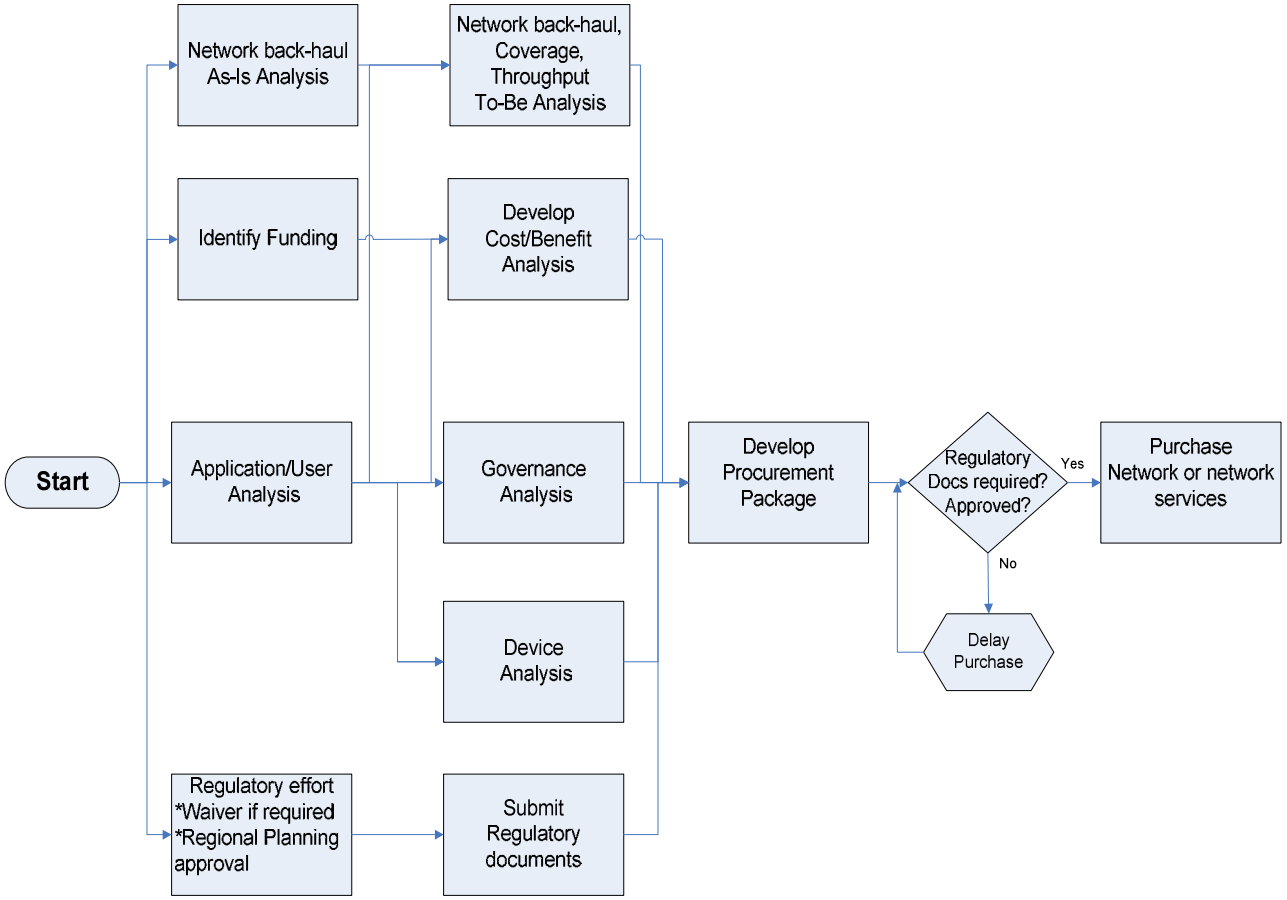
Regulatory Status

Conclusion: Broadband wireless is not coming… It is already here… and whether you build your own network or procure network services, you must prepare before you start!

Preparing for Wireless Broadband Communications



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Preparing for Wireless Broadband Communications

Start

- Before you start, you must establish a partnership between the CTOs/CIOs and user groups within a region. That partnership should consist of the following:
  - Shared vision of what problem you are solving
  - Clear understanding of:
    - Which group will lead the effort?
    - Public Safety users are the “Chief Customers”
  - Develop Executive and Programmatic organization
  - Establish a reporting structure that keeps everyone informed of the progress, spending and results of analysis developed throughout the program

Preparing for Wireless Broadband Communications

Application/User Analysis

- This is a critical step for determining costs, network back-haul, and device requirements.
  - Who are the Users?
  - What are the User priorities?
  - What do we want to do with wireless broadband?
  - What can't we do now that we want to do?
  - What will we want to do in the next 5-10 years?

Preparing for Wireless Broadband Communications
User Analysis Example

Municipality / Jurisdiction	Type	Police ESF 13	Fire ESF 4	Transportation ESF 1	EMS ESF 4/8	EMA ESF 5	Public Works & Engineering ESF 3
Alexandria, VA	City		✓		✓		
Arlington County	County	✓	✓		✓	✓	
Fairfax County, VA	County	✓	✓		✓	✓	✓
Fairfax, VA	City		✓	✓	✓	✓	✓
Falls Church, VA	City	✓		✓		✓	✓
Federal Government	Federal	✓					
Frederick County, MD	County			✓		✓	
Greenbelt, MD	City	✓					
Loudoun County, VA	County	✓	✓	✓	✓	✓	✓
Manassas, VA	City	✓	✓		✓	✓	✓
Montgomery County, MD	County	✓	✓	✓	✓		✓
Prince George's County, MD	County	✓	✓		✓		✓
Prince William County, VA	County	✓	✓		✓		
Rockville, MD	City	✓					
Takoma Park, MD	City	✓					
The State of Maryland	State			✓			
Washington, DC	State	✓	✓	✓	✓	✓	

Table 1: ESFs and Jurisdictions Interviewed by the RWBN-AA team

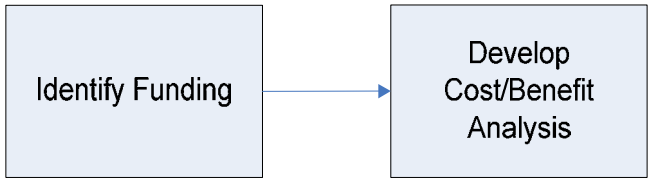
Preparing for Wireless Broadband Communications Application Analysis Example

- The most desired wireless use is for Video, Digital Imaging, Wireless Report Management System, Mapping / Geographic Information System, and Automatic Vehicle Location.
- Survey demand of broadband applications
  - **94%** requested digital imaging
  - **97%** requested mapping/GIS
  - **91%** requested streaming video

Application	Question	Yes	No	Total	Yes %	No %
Automatic Vehicle Location	Use	16	21	37	43.24%	56.76%
	Use Wirelessly	8	24	32	25.00%	75.00%
	Want Wirelessly	28	5	33	84.85%	15.15%
Computer Aided Dispatch	Use	27	10	37	72.97%	27.03%
	Use Wirelessly	3	21	24	12.50%	87.50%
	Want Wirelessly	12	10	22	54.55%	45.45%
Digital Imaging	Use	29	8	37	78.38%	21.62%
	Use Wirelessly	3	32	35	8.57%	91.43%
	Want Wirelessly	31	2	33	93.94%	6.06%
E-mail	Use	33	4	37	89.19%	10.81%
	Use Wirelessly	20	15	35	57.14%	42.86%
	Want Wirelessly	33	4	37	89.19%	10.81%
Mapping / Geographic Info. System	Use	28	8	36	77.78%	22.22%
	Use Wirelessly	8	19	27	29.63%	70.37%
	Want Wirelessly	30	1	31	96.77%	3.23%
Remote Database Access / Data Entry	Use	22	15	37	59.46%	40.54%
	Use Wirelessly	12	22	34	35.29%	64.71%
	Want Wirelessly	25	6	31	80.65%	19.35%
Report Management System	Use	20	11	31	64.52%	35.48%
	Use Wirelessly	0	26	26	0.00%	100.00%
	Want Wirelessly	17	8	25	68.00%	32.00%
Text Messaging	Use	32	6	38	84.21%	15.79%
	Use Wirelessly	26	11	37	70.27%	29.73%
	Want Wirelessly	32	4	36	88.89%	11.11%
Video	Use	17	20	37	45.95%	54.05%
	Use Wirelessly	4	31	35	11.43%	88.57%
	Want Wirelessly	31	3	34	91.18%	8.82%

Table 4: Technology Deployment and Demand

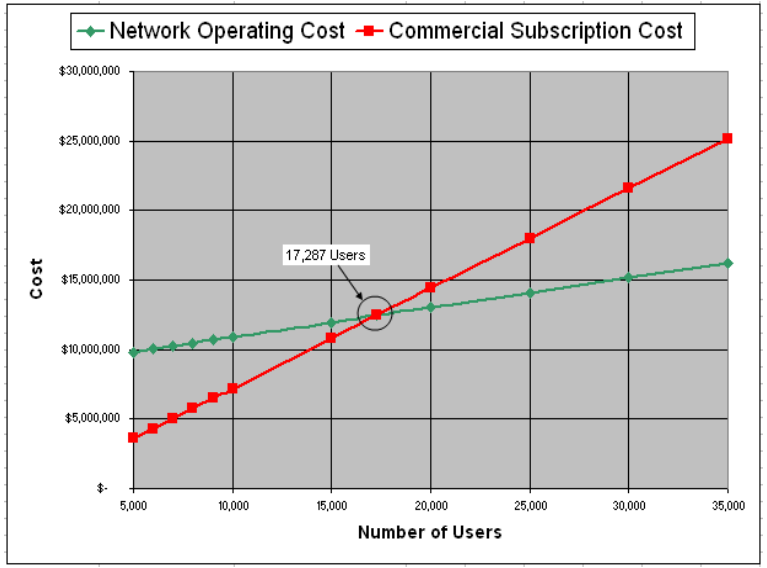
Preparing for Wireless Broadband Communications



- Identify funding sources
  - UASI funding
  - Additional region communications grants
- Develop a Cost/Benefit analysis
  - Compare commercial costs of users vs. annual operational cost of the network. This is critical to making go/no-go decisions.

Preparing for Wireless Broadband Communications Cost/Benefit Example

- Today there is slightly over **35,000** First Responders in the NCR.
- Annual RWBN operations is estimated at **$16.2 million**. Commercial '**data only**' services for the same number of devices (35,000) equals **$25.2 million** annually.
- Breakeven subscribers equal **17,288**.
- NCR has spent an estimated **$267 million** ($134M in network infrastructure and $133M in radios) on Public Safety Land Mobile Radio (LMR) networks. Conversely, the RWBN is estimated to cost approximately **$53 million**, which includes infrastructure and 35,000 subscriber devices to build out the network in the NCR.
- Revenue from State, Federal and Authority users can supplement RWBN operations and maintenance fees. There is an estimated **30,000** Public Safety Federal agents in the NCR today.



Yearly Operational Cost for 700 MHz Public Safety Networks - 106 Sites & 1 Redundant Core

		Total/Year
1	Base Stations Depreciation/Year	$ 1,167,197.80
2	Core Networks Depreciation/Year	$ 535,712.90
3	Base Stations Spares/Year	$ 408,519.23
4	Core Network Spares/Year	$ 187,499.52
5	Generators & UPS Depreciation/Year	$ 199,284.60
6	Generators & UPS Spares/Year	$ 69,749.61
7	Antennas Depreciation/Year	$ 227,900.00
8	Antennas Spares/Year	$ 16,324.00
9	Site Lease/Year	$ 1,472,000.00
10	Site Utilities/Year	$ 763,200.00
11	Backhaul/Year	$ 890,400.00
12	Microwave Depreciation/Year	$ 92,750.00
13	Microwave Spares	$ 32,462.50
14	Devices Technology Depreciation/Year	$ 5,468,750.00
15	Devices Spares/Year	$ 765,625.00
16	Network Operations & Maintenance	$ 1,832,193.00
17	Customer Operations Personnel - 0.5 Person per Operating Organization	$ 400,000.00
20	Software Upgrade	$ 100,000.00
22	Training	$ 150,000.00
23	Other Contract Support	$ 200,000.00
24	Roaming Fees (25% of Subs - 20% of Time)	$ 1,260,000.00
	Total	$ 16,239,568.16

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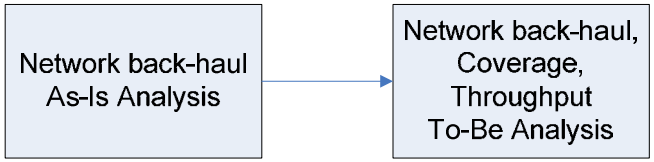
Preparing for Wireless Broadband Communications



- Back Haul as-is & to-be analysis is essential to determining:
  - Additional capital and ongoing operational costs for network upgrade
  - Ensuring that there are no bottlenecks in network back-haul traffic

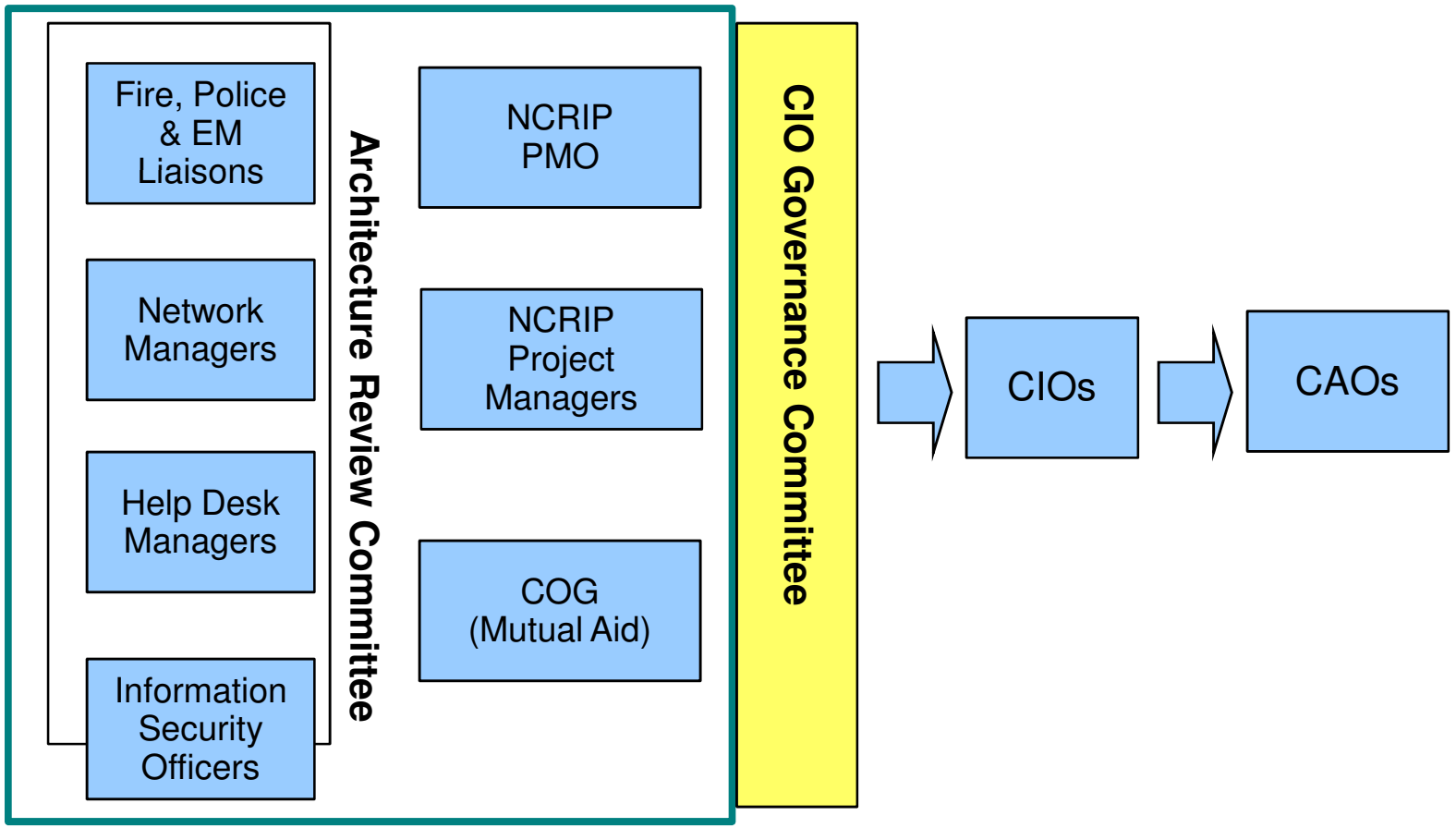
Preparing for Wireless Broadband Communications

Governance Analysis

- You must be able to answer these questions:
  - Who makes the decisions on the network use, i.e. priority?
  - Who makes the decisions for technology upgrades?
  - Who sets the policy for data sharing and reuse?

Preparing for Wireless Broadband Communications Governance Example

NCR Organizational Framework Working Group



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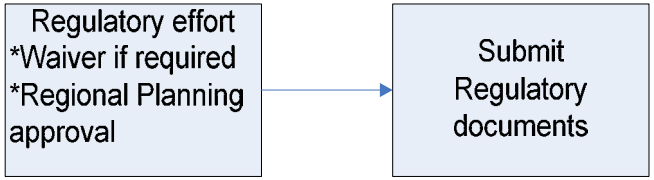
Preparing for Wireless Broadband Communications

Device Analysis

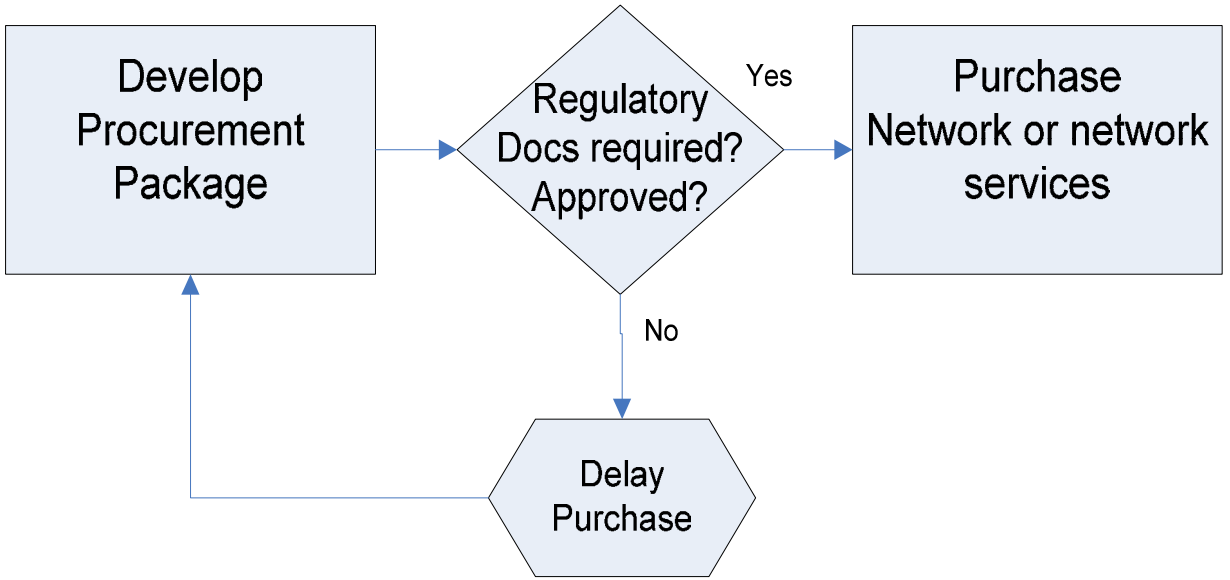
- Based on the planned applications, uses and user groups, and interoperability requirements (with other private networks and commercial networks) you must define the desired device types.

Preparing for Wireless Broadband Communications



- Develop and present required changes to Regional Plans
- Apply for required licenses
- Achieve concurrence with surrounding RPCs

Preparing for Wireless Broadband Communications



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Preparing for Wireless Broadband Communications: Exercise

- Let's build a Regional Wireless Broadband network
  - *Instructor will:*
    - Separate participants into 4 groups (Regions)
    - Give each Region a different number of Government Users
    - Provide Capital to build the network
    - Provide the Commercial and Operating costs estimates
    - Provide the types of Government users (In groups)
  - *Groups (Regions) will:*
    - Develop high level application requirements
    - Develop User priority profiles
    - Develop high-level Governance model
    - Develop a high-level cost benefit analysis comparing the ongoing operating costs of commercial services vs. deployment and operational costs from regional network
    - Provide a Go/No-Go decision on network construction based on costs

Closing Remarks

THANK YOU!

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Appendix I: RPC 800 MHz Plan Links & FCC Docket Numbers

Appendix II: Pre & Post 800 MHz Frequency and Channel Numbering Plan

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