Broadcaster Relocation Planning

August 2016

Constructing an approach

Any approach to repacking must leverage lessons learned from past efforts and apply consistent policies and procedures to create a regional management structure that builds into a nationwide plan while minimizing risks

Basis of our approach

Lessons learned

By understanding the complications of relevant previous spectrum relocations, due in part to financial, regulatory, and logistical challenges, any approach must leverage the leading practices from those initiatives to mitigate the potential risk factors

Processes and procedures

Standardized processes and procedures, influenced by past relocation efforts, should inform a series of clear time-bound steps for broadcasters to follow in a transparent manner relevant to industry stakeholders while accounting for daisy chain impacts

Our approach

Regional management

Our approach identifies the daisy chain impacts and areas of easy decoupling, and manages the process by aggregating those locations

Nationwide plan

Our nationwide plan builds upon the regional management model, by using sub-regions to decouple daisy chain impacts and assigning super regions for effective management and transparency, while preventing delays across regions

Key assumptions

Our approach is based on a series of technical assumptions to create a sequenced national repack plan

Key assumptions underlying our vision for the broadcaster relocation:

- Clearing target of 126 MHz (which can be adjusted as needed)
- Assumed repacking of 1,026 UHF stations nationwide (excluding auction winners, transfers to VHF, and designated 600 MHz encumbering stations)
- Regions chosen to minimize cross-region dependencies and with boundaries correlated to PEAs where possible
- Sites over 1,000 feet used as proxies for beacon sites and not incorporated into analysis (instead highlighted to give perspective on effort required to support repack)
- Canada and Mexico addressed in a parallel effort
- Assumed that all stations can complete engineering studies and submit cost estimates within the 90-day FCC deadline
- Transition planning attempts to minimize time on auxiliary or temporary transmission facilities
- Installation difficulty to be estimated based on antenna height

Lessons Learned

Analysis of past relocation efforts revealed different understandings applicable to the current 600 MHz repack

Past efforts

Three key past efforts highlighted detrimental factors including: project delays, insufficient cost estimates, non-standard processes, conflicting priorities and resource management, lengthy negotiations, revenue losses, and relocation avoidance

800 MHz

AWS-1

DTV Transition

Lessons leveraged

The following key lessons should be applied to the 600 MHz transition:

Successful transitions involve flexible, dynamic stakeholder coordination

Large, complex relocation exercises require realistic time and cost estimations

Risks can be mitigated through clear planning for each project milestone

Lessons learned: 800 MHz

Initial plans often underestimate the budget and resources required for planning

Key lessons can be extracted from the 800 MHz reconfiguration of the land mobile radio band, which was the largest public safety spectrum relocation ever conducted:

Project delays due to logistics and weather	Project changes arose from licensees filing waivers for deadline extensions due to major events like the 2011 Super Bowl in Dallas and the 2012 Democratic National Convention in Charlotte, or extreme weather events like Hurricane Katrina[1]
Conflicting priorities and resource management	Stakeholders did not fully appreciate programmatic impact of daisy chain dependencies between licensees and therefore required additional planning[2]
Lengthy negotiations	Contract negotiations, approval processes with the many state and local government agencies, negotiations with Canadian and Mexican stakeholders, and challenges in regional coordination all produced further delays[3]

Sources: (1) FCC-800 MHz Band Reconfiguration Handbook, pp. 32, 127 (2) Ibid, p. 17 (3) Ibid

Lessons learned: AWS-1

Nationwide spectrum relocation during AWS-1 was an expensive, time-consuming process due to multiple operational and management issues

The AWS-1 federal spectrum relocation, in the 1710-1755 MHz band, exposed a number of challenges that must be considered for the forthcoming 600 MHz relocation:

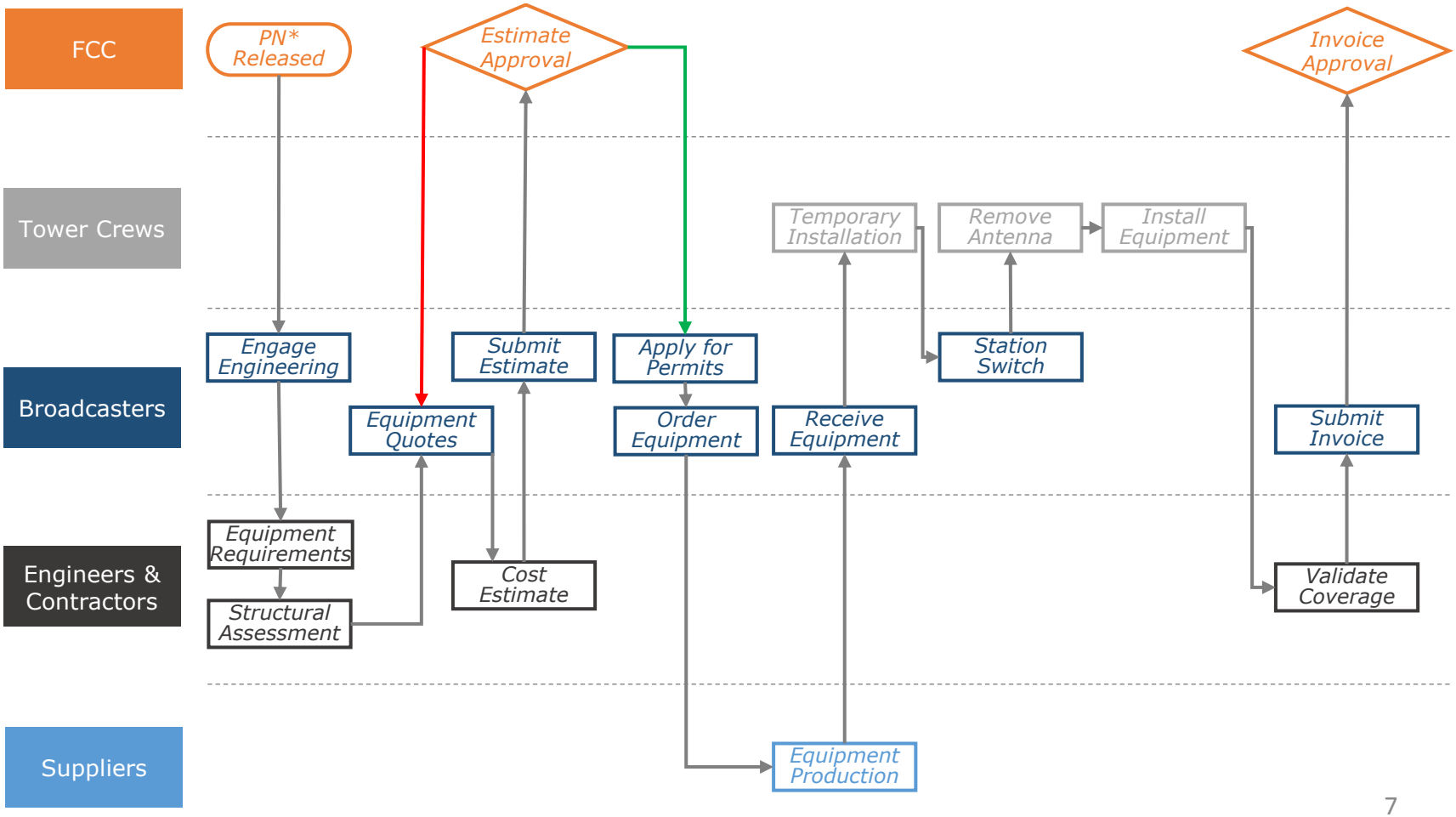
Project delays	Delays in civil construction, contracting, administrative coordination, and logistical interruptions resulted in approximately 50% of the participating stakeholders failing to achieve their target capability levels within the given timeframe[1]
Insufficient cost estimates	Disbursement fund payments exceeded the $1.01 billion spectrum relocation fund by 55% to date; general disagreements arose over relocation schedule estimates[2]
Non-standard processes	Different priorities and levels of knowledge within government entities regarding the relocation contributed to inconsistent approaches to quantify time and cost estimates[3]

Sources: (1) Commercial Spectrum Enhancement Act (CSEA) Annual Progress Report, 2015, p. 3 (2) Ibid, p.4 (3) Spectrum Policy in the Age of Broadband: Issues for Congress, 2013, p. 11

Processes and procedures

The average broadcaster subject to repacking will be required to take specific steps to complete the relocation process

Broadcaster relocation process



* PN = FCC Public Notice

Standard Sequence Action | Cost Estimate Approved | Cost Estimate Denied

Processes and procedures

Our daisy chain methodology analyzes key implications for determining repack priorities and regions

Daisy chain methodology

A comprehensive daisy chain analysis is needed to proactively manage broadcasters' exposure to repacking challenges; such an analysis should function as the fundamental building block of regional management and the expanded national framework

(1) Auction simulation	Run simulations to provide realistic post-auction scenario identifying stations remaining on air (excluding winners and encumbered stations)	(2) Pairwise constraint	Use FCC-published Domain and Interference Files to generate pairwise interference constraints
(3) Monte Carlo	Apply interference constraints with Monte Carlo simulation software	(4) Order priorities	Identify repack order priorities based on interference restrictions between post-repack channel and pre-repack assignments
(5) Create regions	Correlate regions and sub-regions to PEAs as best possible, identifying constraints, daisy chain impacts, and pairwise interference	(6) Priority data	Use prioritization script to create prioritization data including channel information, FCC facility ID, location, interference dependencies, and repack priority

Managing daisy chain impacts

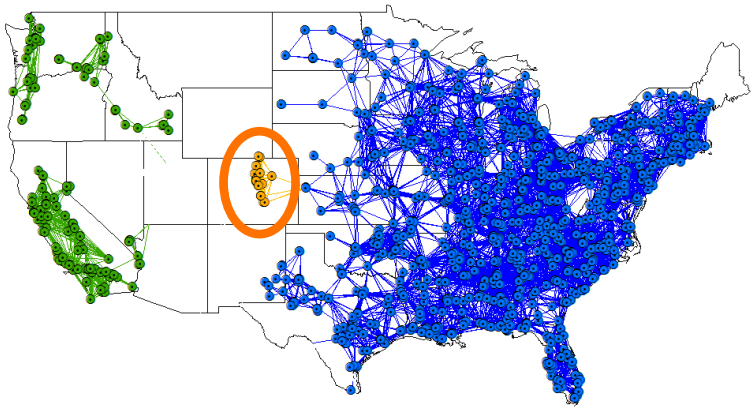
Our approach recognizes that daisy chains require effective logistics management measures to anticipate and mitigate risks

Daisy chain management will require stakeholder coordination, infrastructure planning, regional approaches, and logical prioritization

The proposed repack approach should feature a list of final dates, reporting requirements, and implications up and down the stack

Denver case study

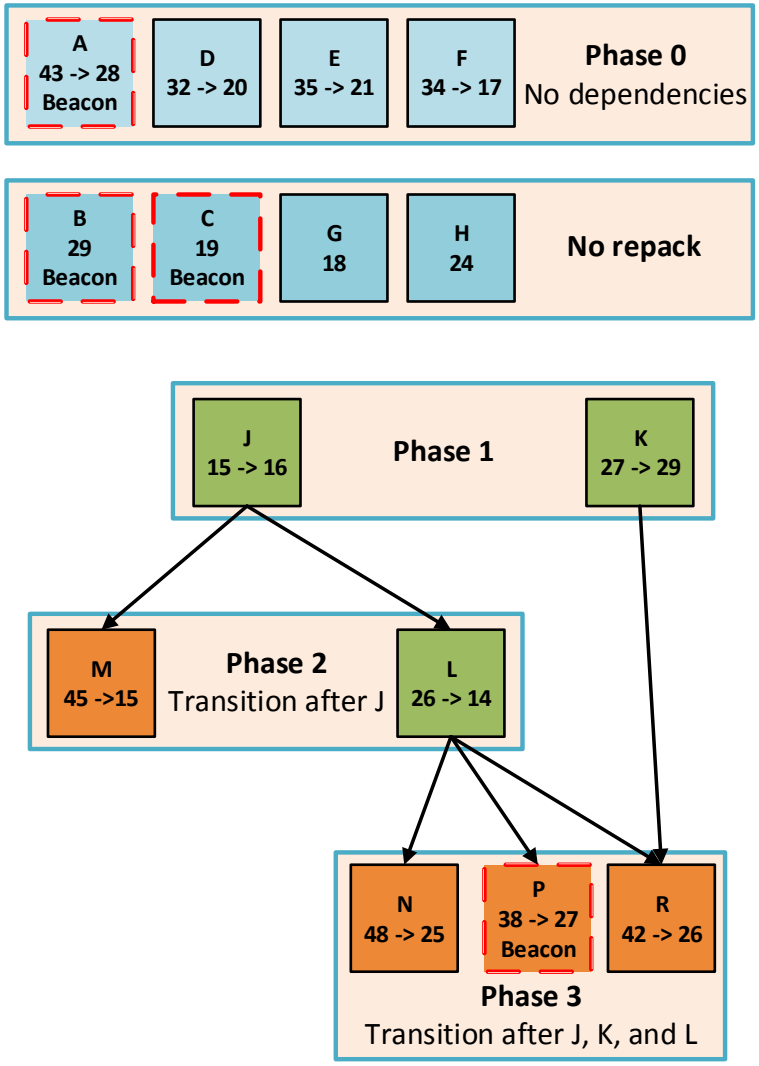
- A case study of the Denver market provides insights on likely problems and scenarios to consider while developing the nationwide repack strategy
- The Denver market was used because of its isolation and representativeness of potential interference dependencies between 15 stations; it allowed development of a daisy chain process that could be extrapolated to other sub-regions
- The Denver area was chosen because it is small enough that optimization could be validated by hand
- Resources to be deployed to clear phases while Phase 0 stations will be used to balance resource loading



Managing daisy chain impacts

Our daisy chain analysis identifies an optimal decision methodology for repacking stations following the auctions

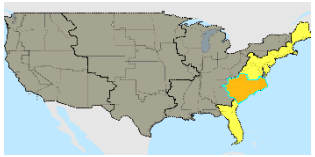
- **Unencumbered stations:** Stations A, D, E, and F (Phase 0) can move to their new channels without impacting other stations, while stations B, C, G, and H do not move and have no dependencies
- **Beacon stations:** A, B, C are identified as complex sites, sites over 1,000 feet, or sites with cumbersome processes, and most likely to transition late in the repack (an optimized plan will attempt to minimize moves of these stations)
- **Dependent stations:**
  - Stations J and K (Phase 1) should move early in the process due to downstream station moves that depend on J and K clearing their current assignments
  - Station L (Phase 2) is a precursor to the moves of N, P, and R
  - Station M (Phase 2) moves after J.
  - Station P is a beacon site requiring immediate planning
  - Moves of stations N, P, and R (Phase 3) occur after J, K, and L transition to new assignments



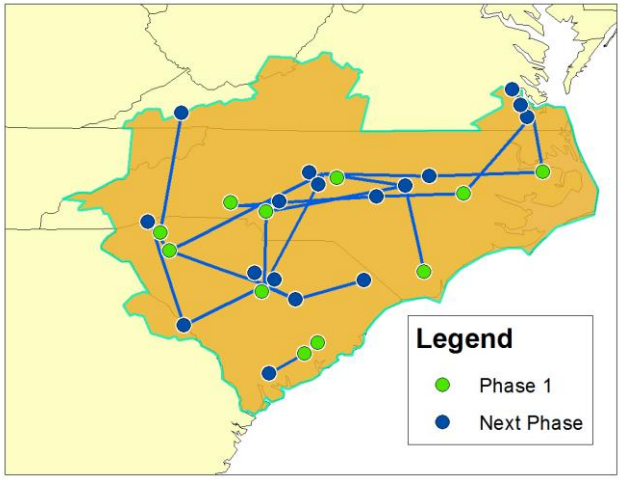
Number under station name represents initial channel and proposed channel

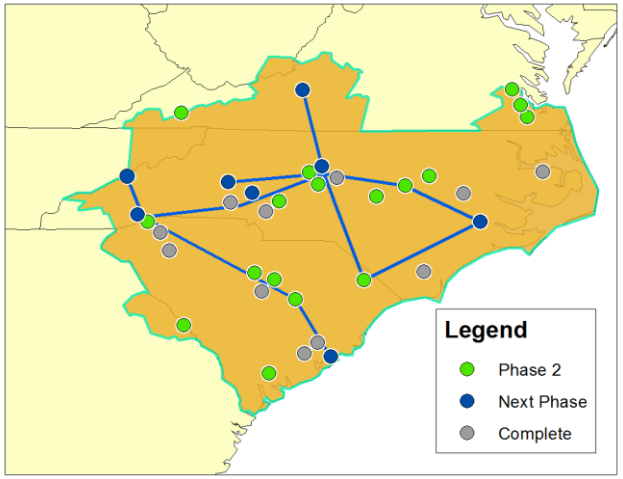
Regional management

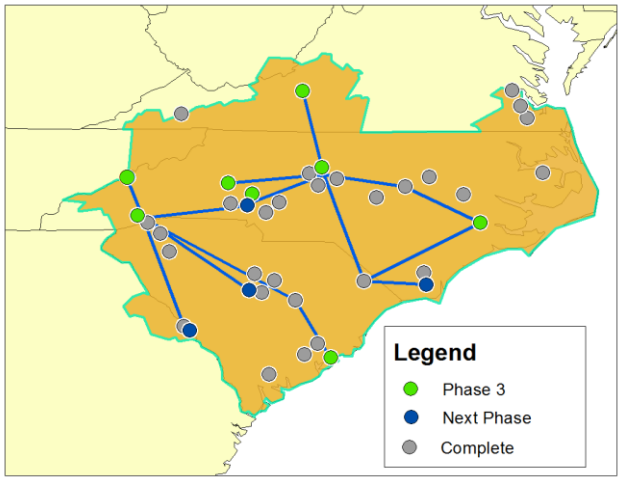
Extrapolated daisy chain methodology applied to one sub-region

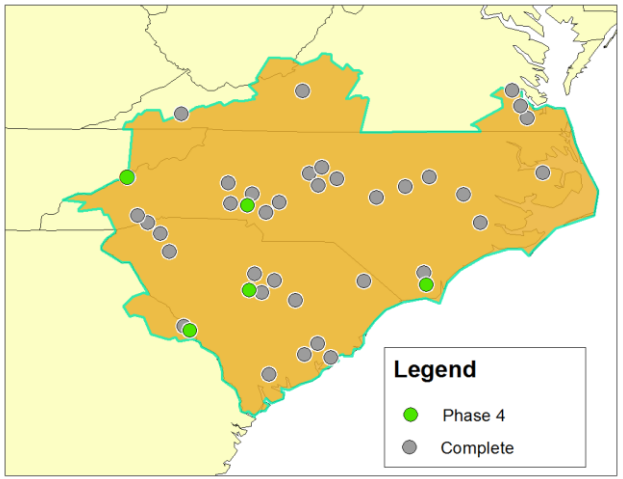


Our approach requires that each active phase (green dots) is completed prior to moving to the next phase (blue dots) which clear interference dependencies between adjacent phases (blue lines)



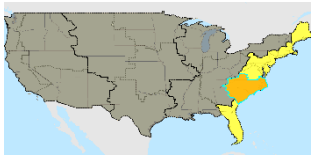




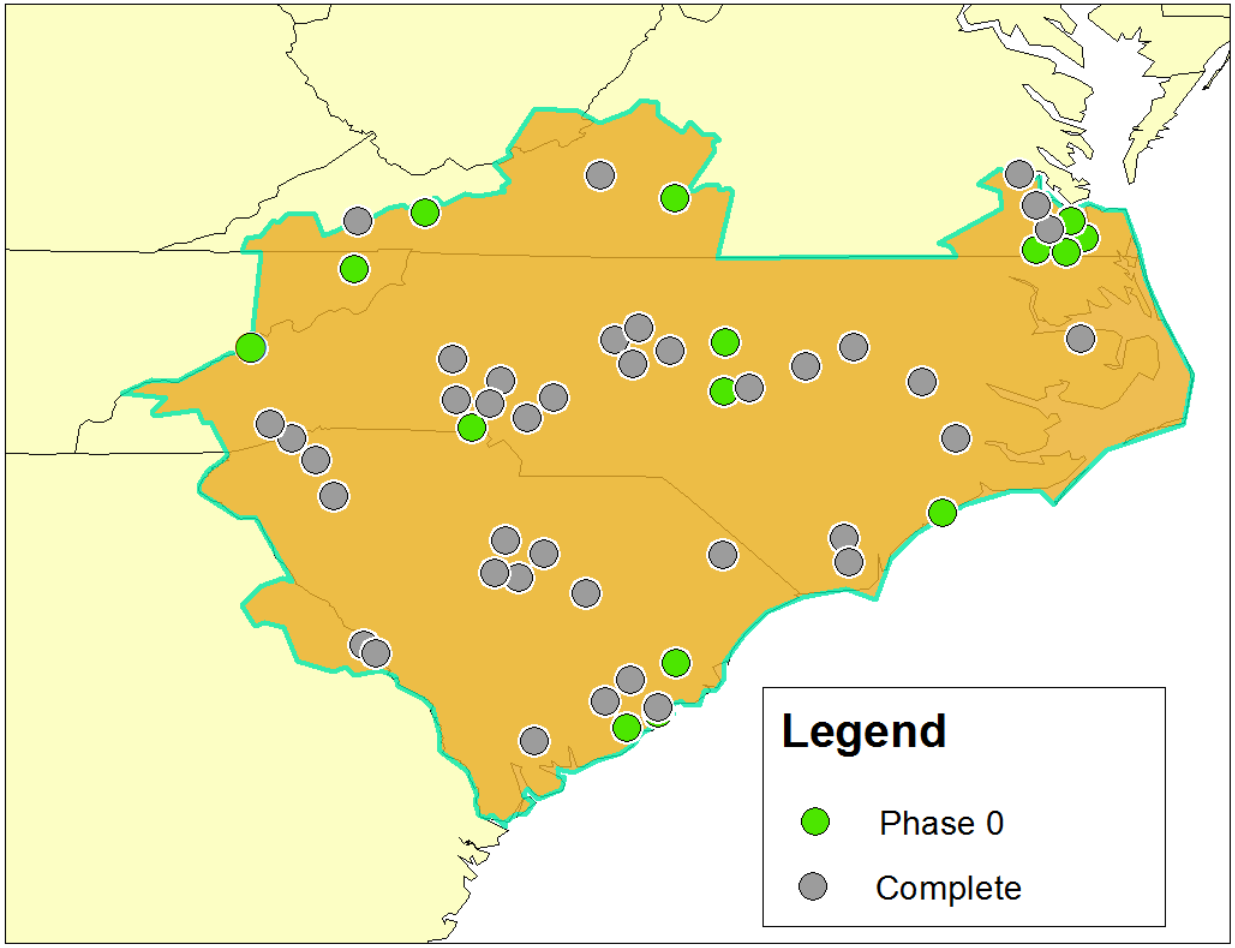


Regional management

Extrapolated daisy chain methodology applied to one sub-region



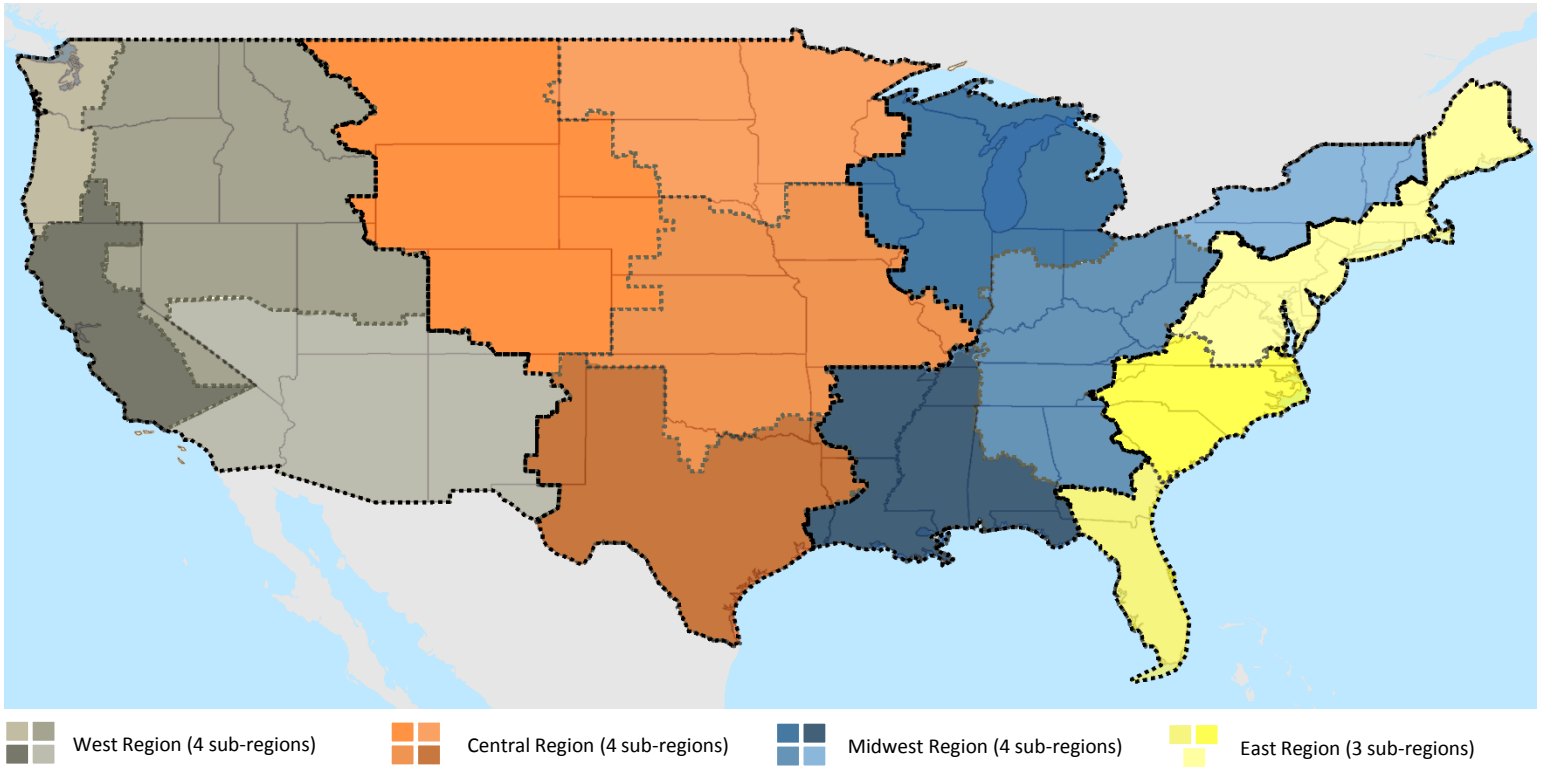
The "Phase 0" sites displayed below do not face interference constraints, and are therefore able to be scheduled to balance resource loading



Regional management

Regional boundaries correlate to PEA boundaries wherever possible

Below is a geographic display of our high level proposed regional and potential sub-regional assignments



Regional Approach

A unified nationwide approach will expose the entire repack to risks and delays; a regional plan will mitigate risks and help manage factors that could cause delays

Daisy chain management

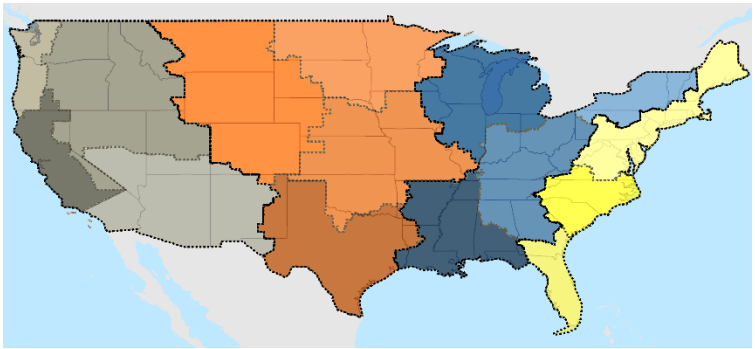
- Account for impact on multiple tower users[1]
- Carefully track moves to manage potential for interference
- Incorporate logistics management measures to anticipate and mitigate risks during the repack

Regional management

- Address urban and rural PEAs to balance risk
- Considering seasonal efficiencies and threats
- Address localized regulatory issues[2]

Emphasis on border zones

- Border zones to be addressed with careful planning and consideration of daisy chain impacts
- Border zone coordination with international regulatory authorities needed to ensure smooth transition
- Cross-border interdependencies require extensive planning and collaboration



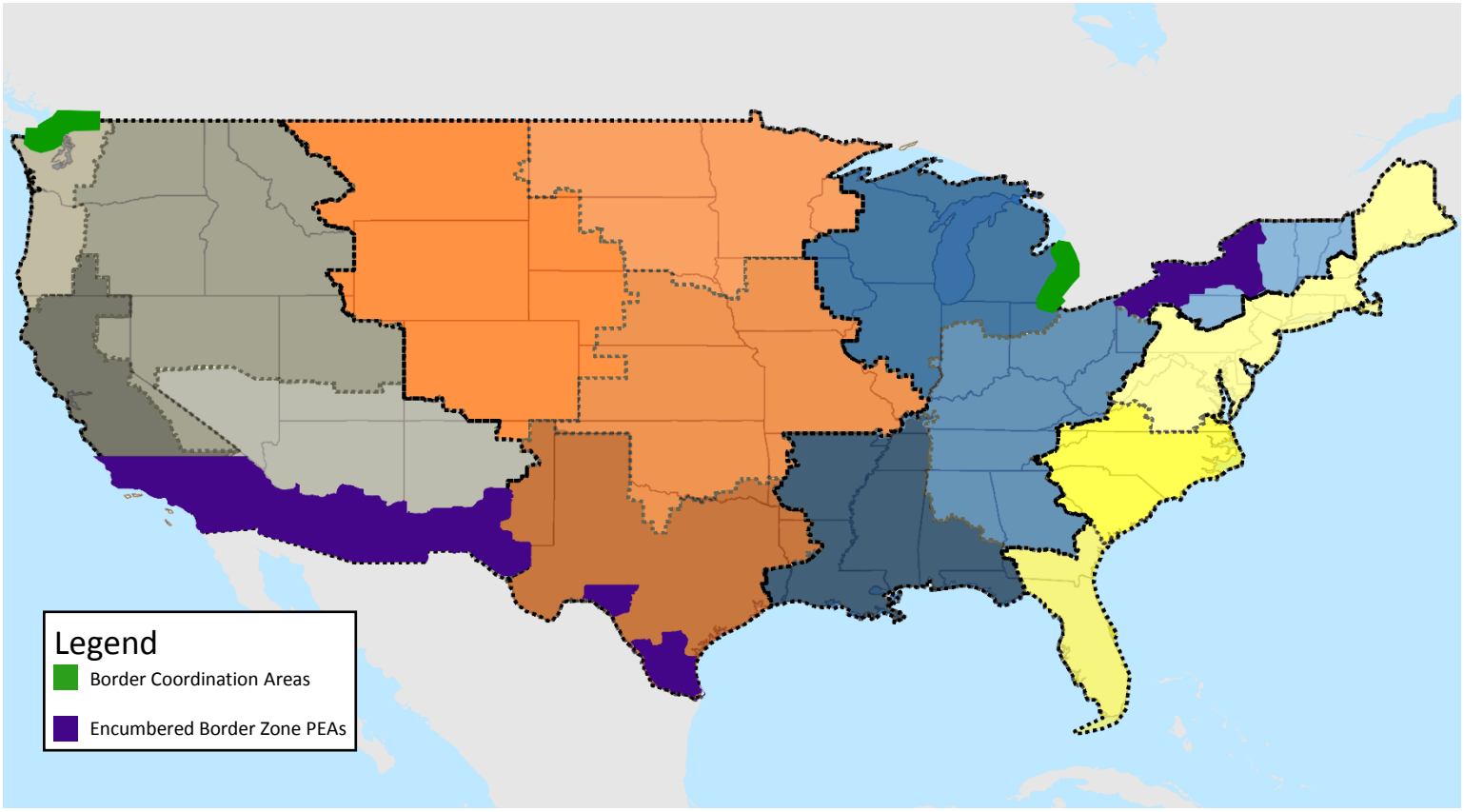
Sources: (1) American Tower "Incentive Auction" 2015 Report, p. 15 (2) Ibid, p. 9

Border zone management

International border zones feature unique interdependencies and risk factors, and should be factored into the regional approach

Repacking of the border zones could take the longest, but careful planning and consideration of the daisy chain impacts should be done within regional analyses; some border zones can likely be cleared through coordination, others will likely remain encumbered until Mexico and Canada effectively repack

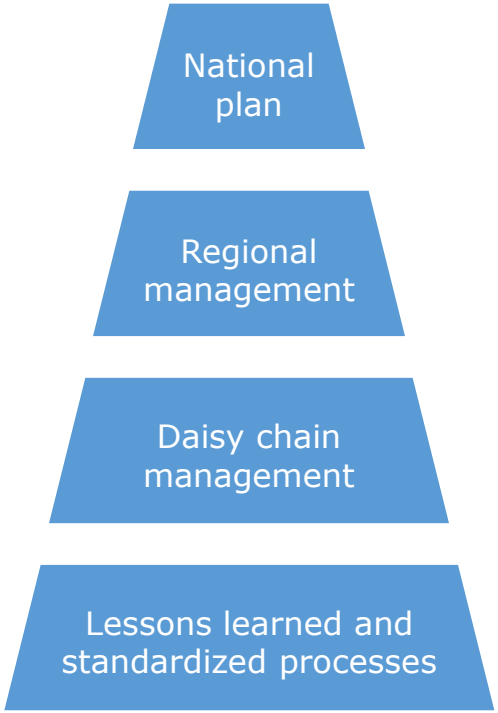
Plan should include process for additional cross-border communications and agreements



Application of our approach

Our approach is comprised of components that combine to form a comprehensive nationwide plan

Our proposal focuses on large urban PEAs linked to rural areas and addresses the complications of borders. This framework features a comprehensive regional management approach that seeks to mitigate risks and facilitate the success of the repack process



Our nationwide plan is the rolled-up application of our regional management approach to a successful spectrum relocation

A logical regional relocation management approach will help to avert risks leading to delays and unforeseen costs while minimizing interference

Effective daisy chain management will require stakeholder coordination, infrastructure planning, regional approaches, and logical prioritization

Lessons learned and standardization of processes and procedures form fundamental elements of our regional management approach