# MARKET VARIABILITY PRESENTATION

Wireless License Availability with TV Stations in the 600 MHz Band

March 11, 2015

# Questions Investigated

- Does the “not more than 20% of weighted pops impairment standard” limit spectrum and market variability?
- What would a plan that meets the 20% standard look like? Does it yield a “near Nationwide Plan”?
- Are TV stations more likely to be placed in uplink or downlink? Which approach permits a higher spectrum clearing target or creates fewer wireless impairments?

# Approach

- Assumed 126 MHz initial spectrum clearing target
- Looked at markets where variability is likely to occur
  - East coast corridor markets (Boston, NY, Philadelphia and Washington DC)
  - Los Angeles/San Diego markets in Southern California
  - San Francisco market (Just added)
- Also looked at US/Canada border region:
  - Assumed a small number of U.S. TV stations may have to stay on existing channels (Buffalo/Toronto corridor)
- Used FCC ISIX approach to determine wireless impairments
  - F(50,50) curves
  - Estimated number and population in PEAs with greater than 50% impairments (*i.e.*, PEAs where channel blocks can't be sold)
- Did **not** permit TV in duplex gap

**ANALYSIS STILL A WORK IN PROGRESS**

# Does FCC Impairment Approach Lead to a “Near Nationwide” Plan?

# Initial Spectrum Clearing Target and Determining Impairments

- Proposed **Initial Spectrum Clearing Target** is "*highest possible clearing target*" based on broadcaster participation
  - Non-participating stations may be assigned to 600 MHz band where necessary
- To limit market variation, impairments limited to 20% of (weighted) population on nationwide aggregated basis
- Under this proposed approach, there is a high probability that when participating stations do not accept offered bids some stations will be placed in 600 MHz band

# ISIX *Uplink* Impairment Calculations and Impacts by Channel Block

# Northeast Corridor Scenario

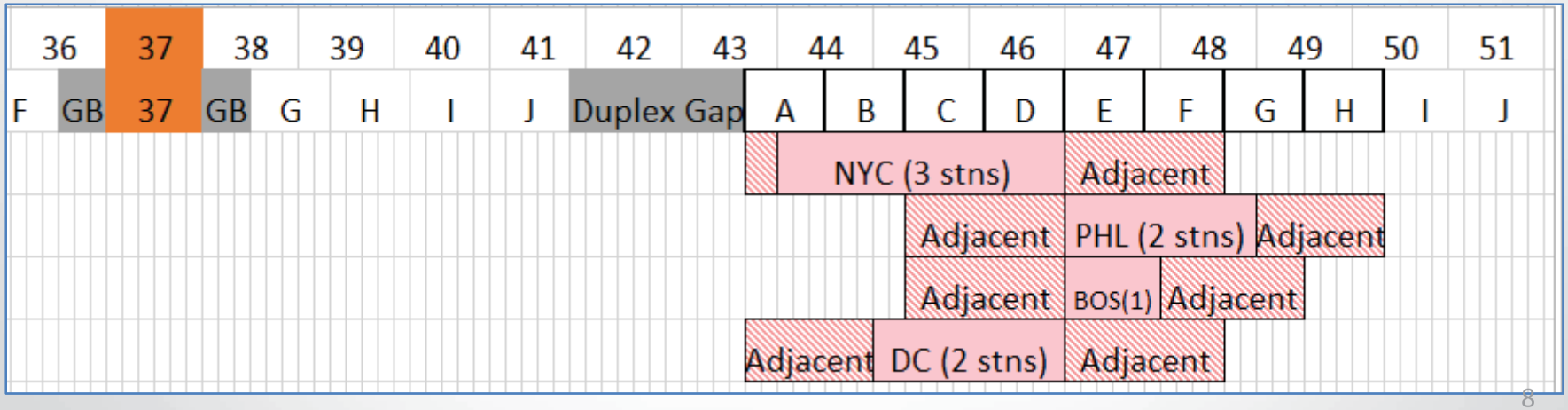
| Market | Total UHF Stations | Stations in 600 MHz * |
|---|---|---|
| New York | 24 | 3 |
| Philadelphia | 23 | 2 |
| Boston | 20 | 1 |
| Washington (Baltimore) | 20 (7) | 2 |

* Stations can be placed in 600 MHz as part of initial clearing target or by dropping out of the auction

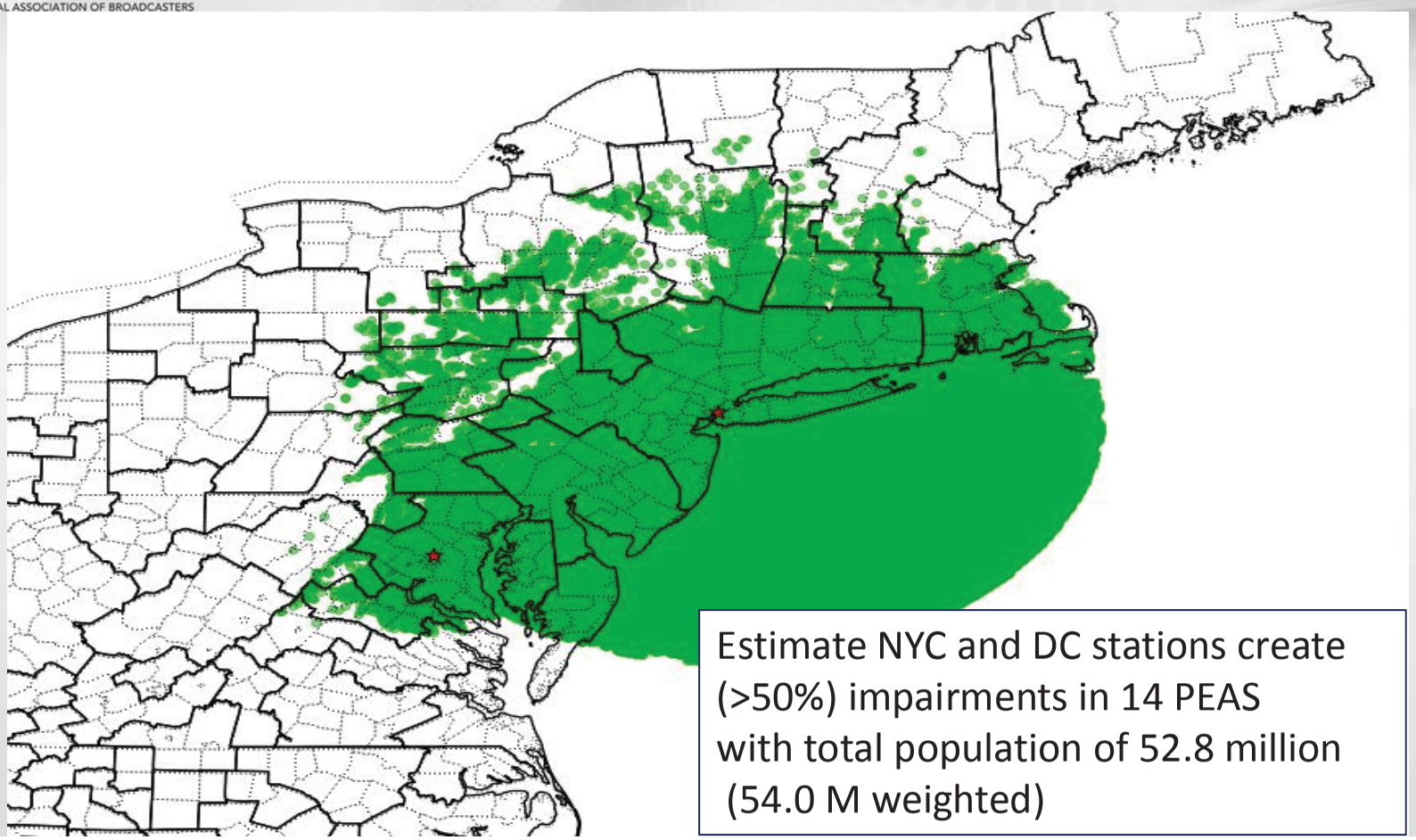
# Assumed Impairments (NE Corridor)

## (Uplink - 126 MHz Recovery Target)

- Repack to minimize the number of TV channels needed and wireless blocks impaired to accommodate TV stations in impairment scenario
  - 3 NYC Stations (Channels 44, 45, 46)
  - 2 PHL Stations (Channels 47, 48 – cannot be co-channel with NYC stations)
  - 2 DC Stations (Channels 45, 46 – cannot be co-channel with PHL stations)
  - 1 BOS Station (Channel 47 – cannot be co-channel with NYC stations)

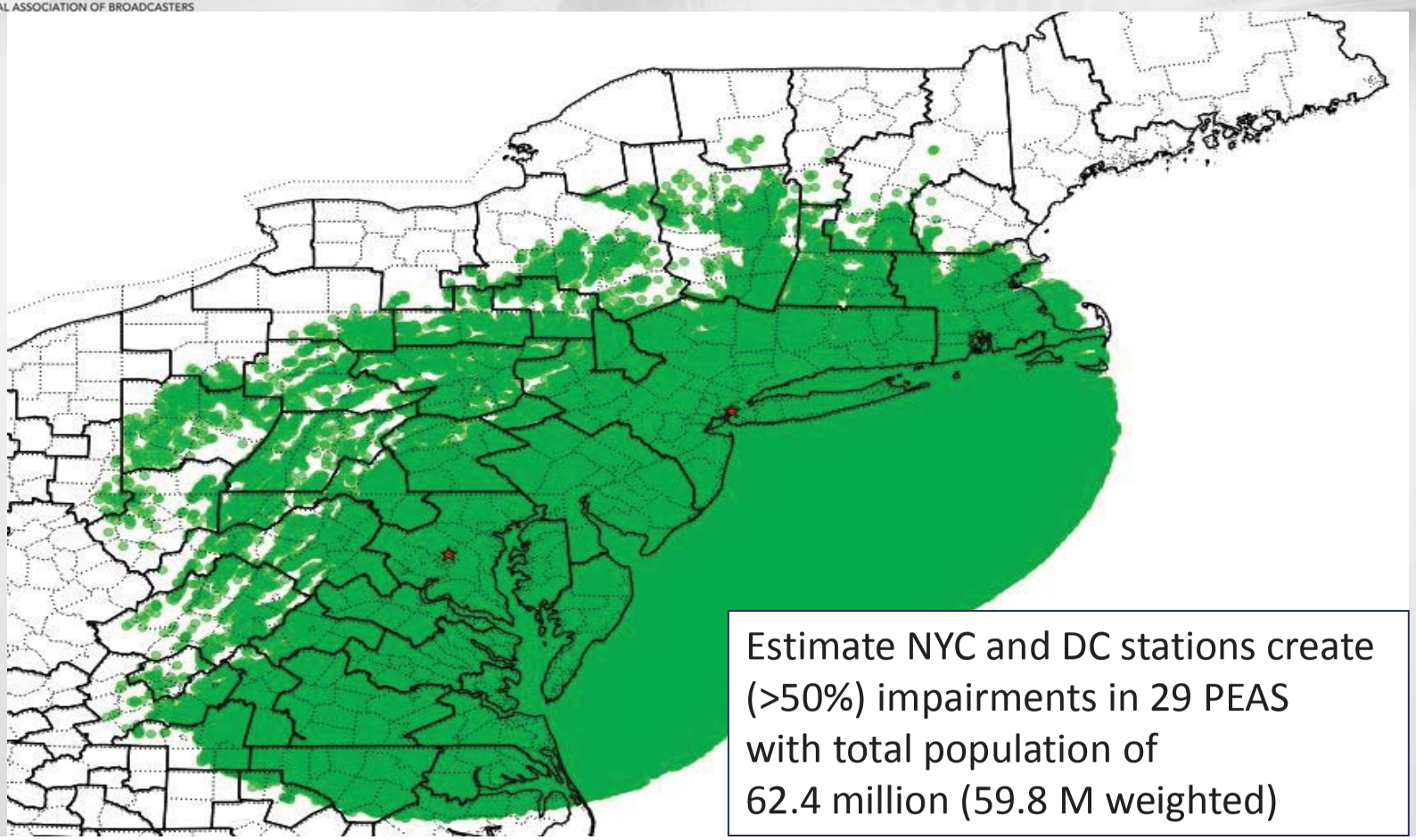


# A Block (Uplink) Impairments



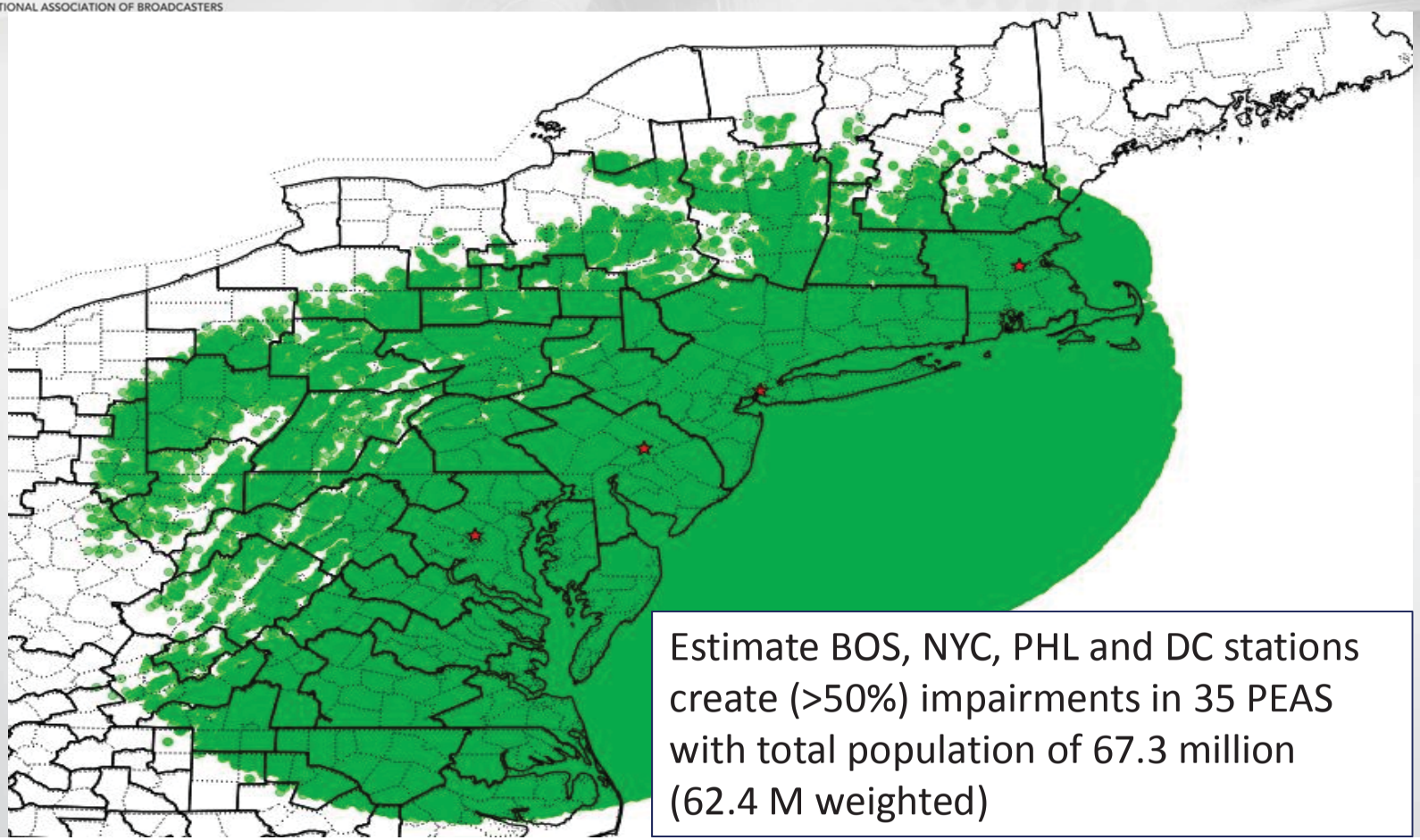
Estimate NYC and DC stations create (>50%) impairments in 14 PEAS with total population of 52.8 million (54.0 M weighted)

# B Block (Uplink) Impairments



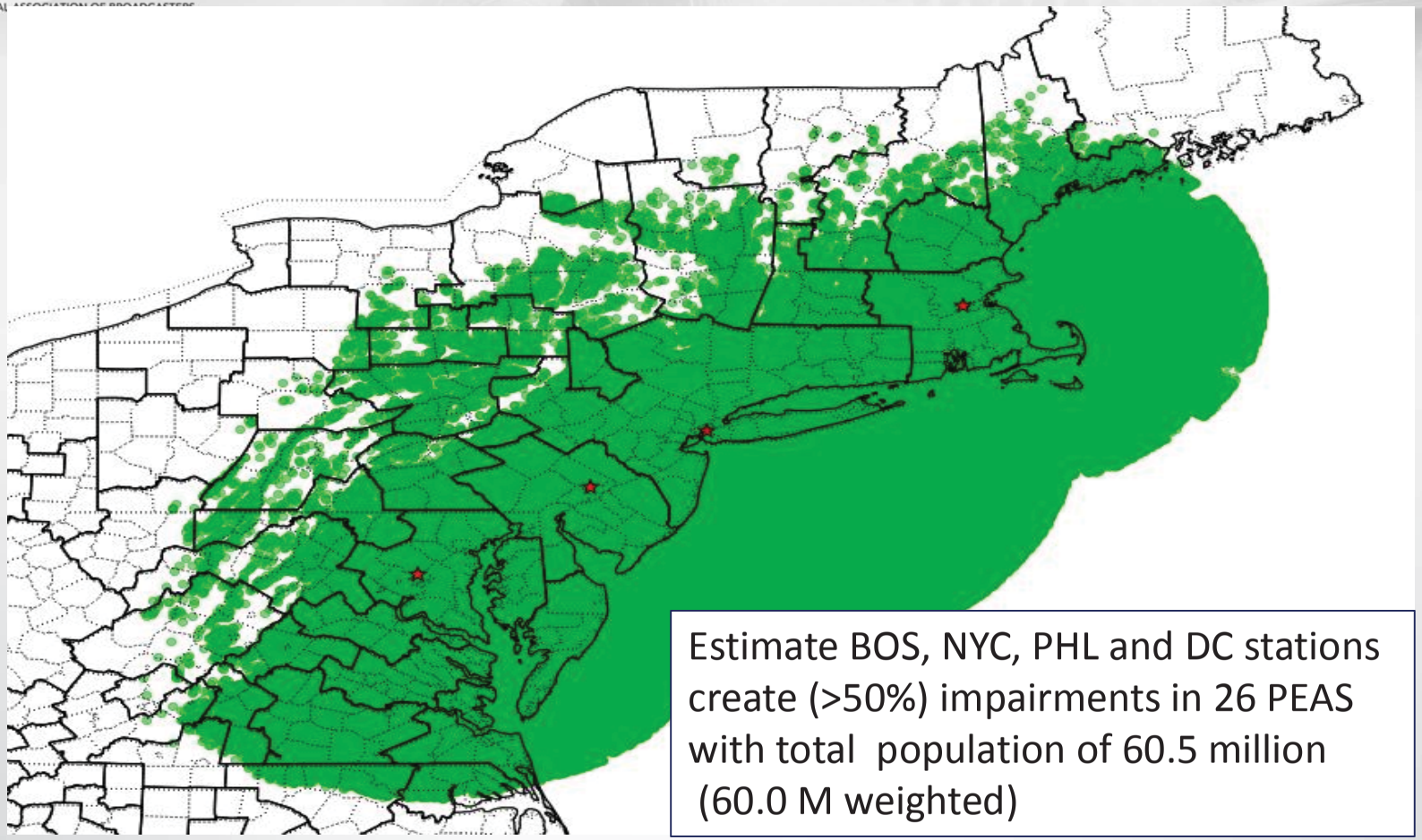
Estimate NYC and DC stations create (>50%) impairments in 29 PEAS with total population of 62.4 million (59.8 M weighted)

# C Block (Uplink) Impairments



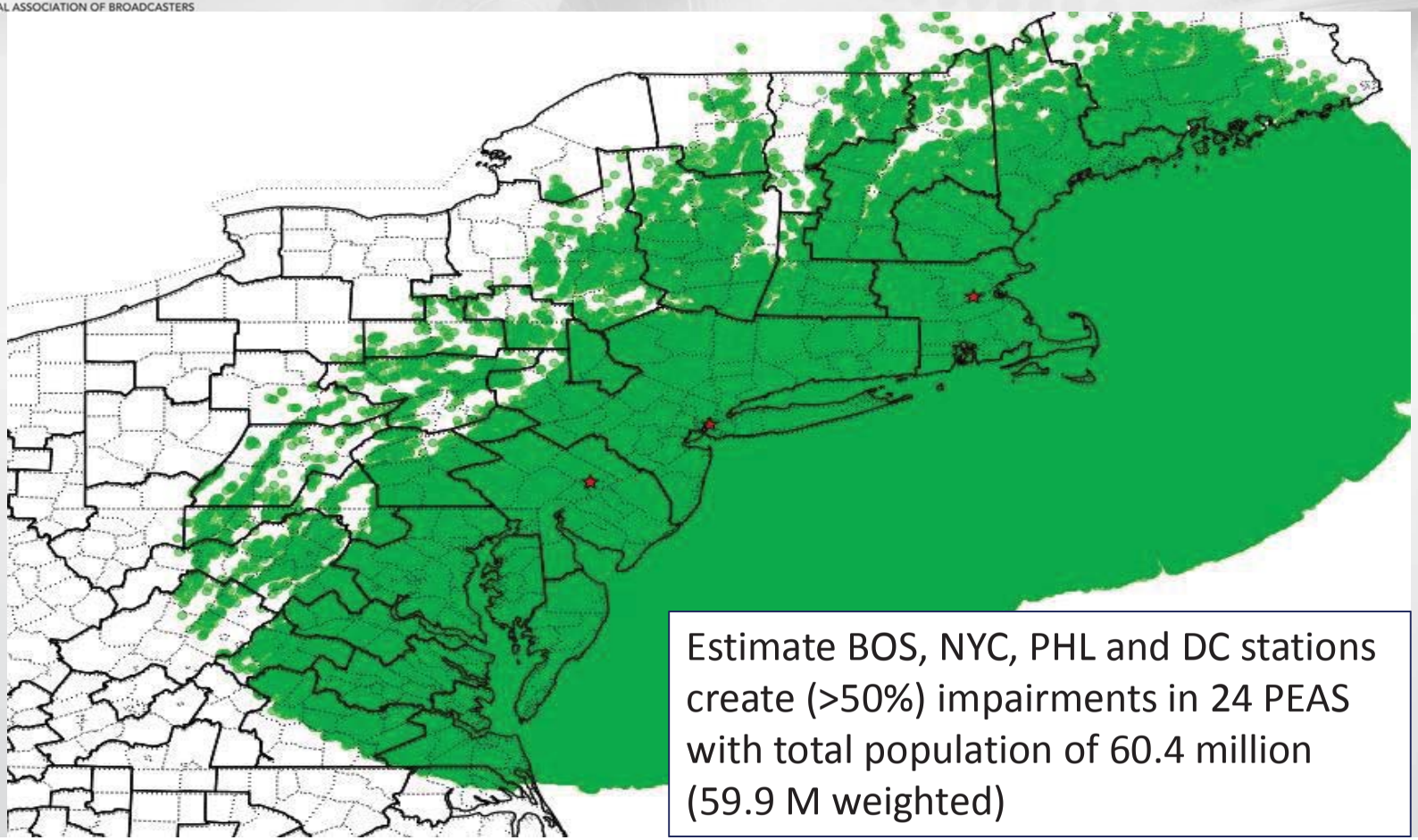
Estimate BOS, NYC, PHL and DC stations create (>50%) impairments in 35 PEAS with total population of 67.3 million (62.4 M weighted)

# D Block (Uplink) Impairments



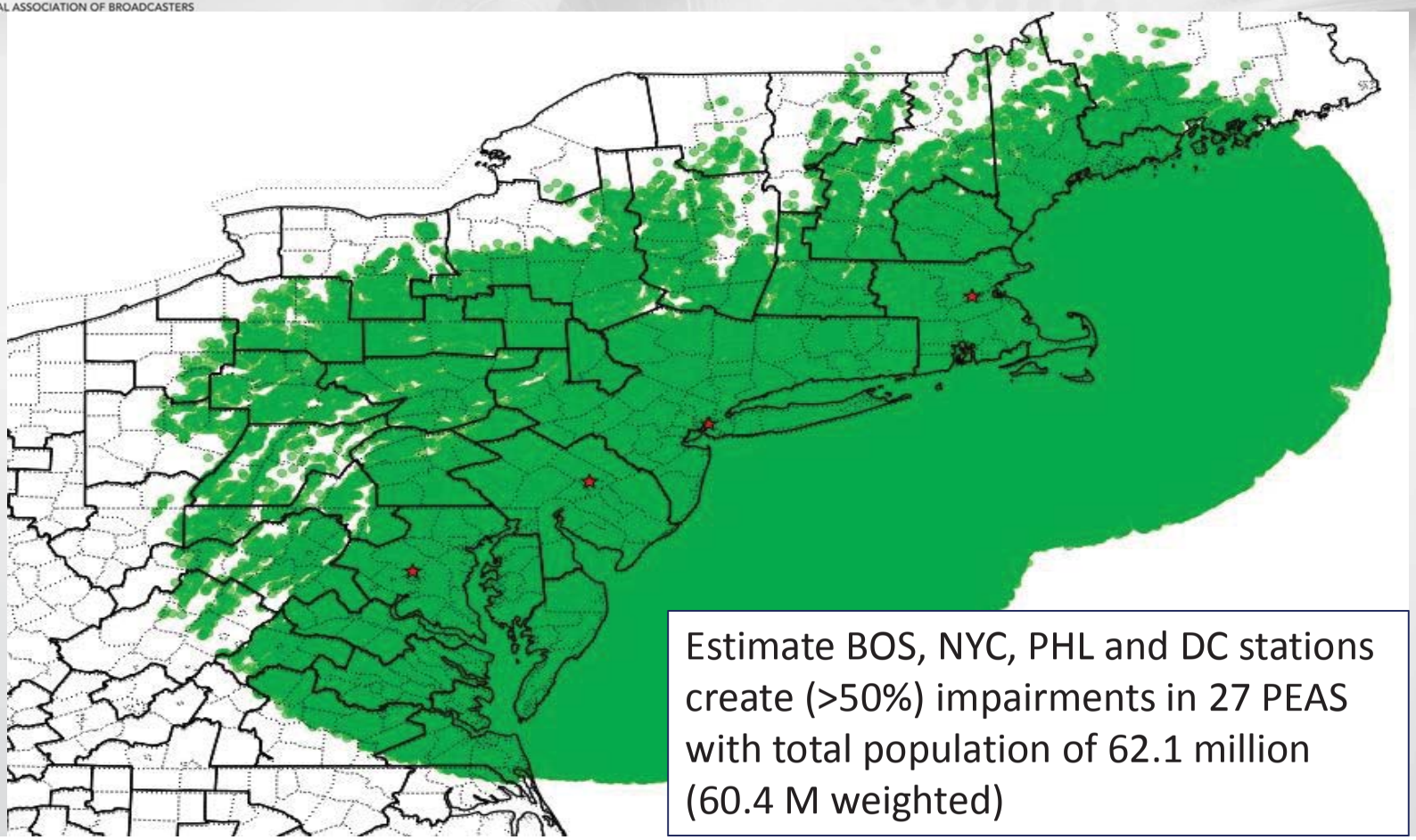
Estimate BOS, NYC, PHL and DC stations create (>50%) impairments in 26 PEAS with total population of 60.5 million (60.0 M weighted)

# E Block (Uplink) Impairments



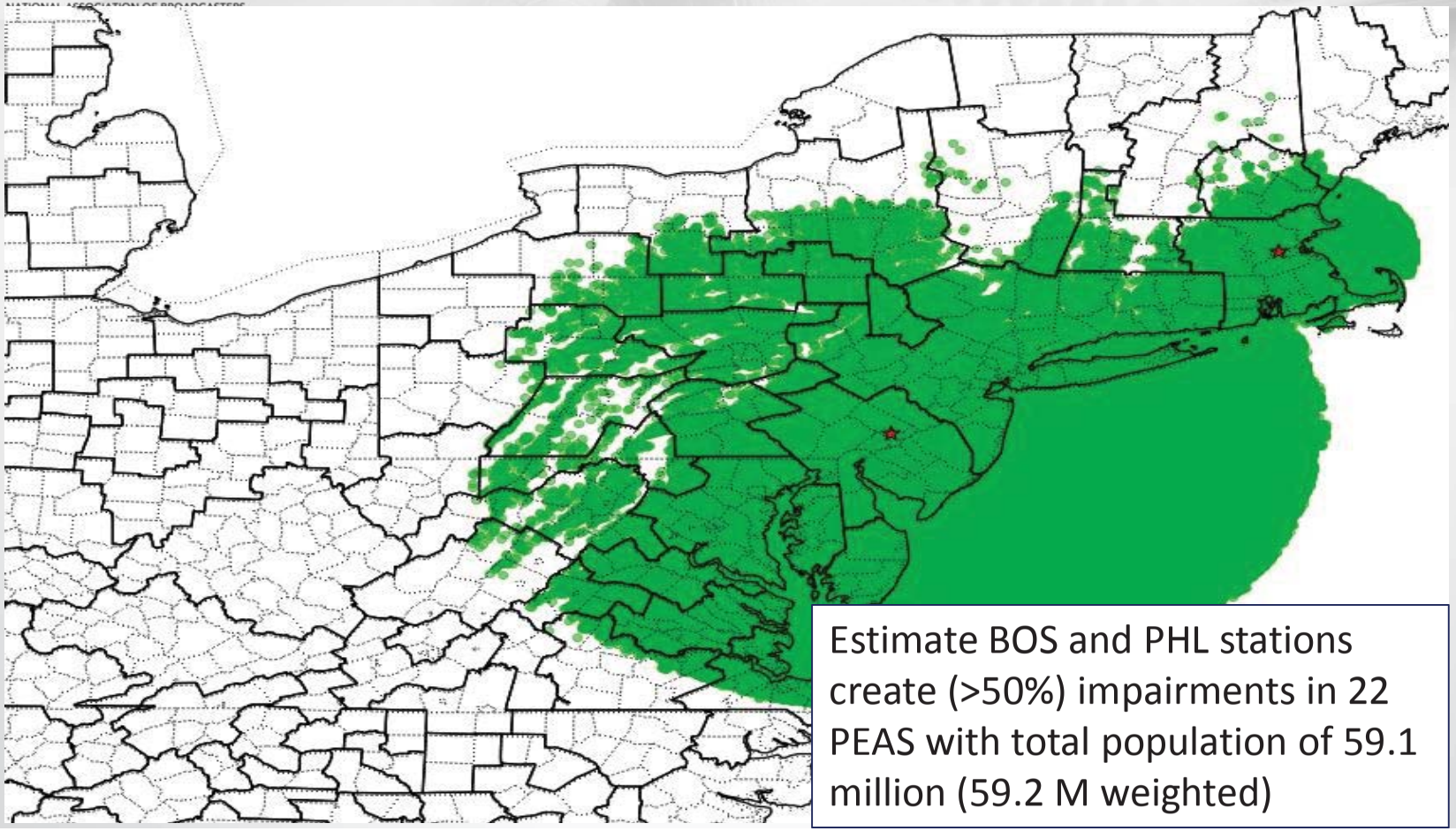
Estimate BOS, NYC, PHL and DC stations create (>50%) impairments in 24 PEAS with total population of 60.4 million (59.9 M weighted)

# F Block (Uplink) Impairments



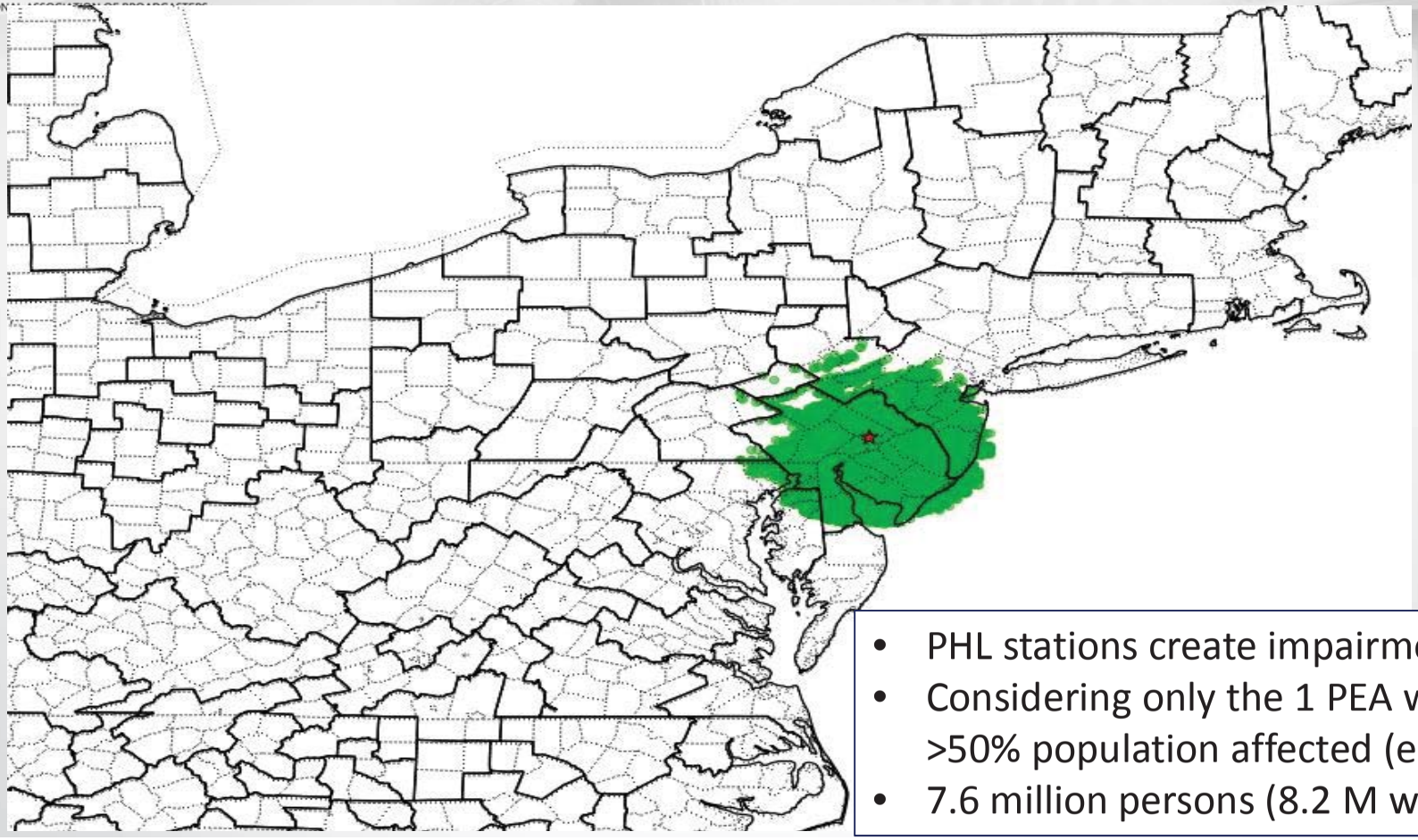
Estimate BOS, NYC, PHL and DC stations create (>50%) impairments in 27 PEAS with total population of 62.1 million (60.4 M weighted)

# G Block (Uplink) Impairments



Estimate BOS and PHL stations create (>50%) impairments in 22 PEAS with total population of 59.1 million (59.2 M weighted)

# H Block (Uplink) Impairments



- PHL stations create impairments
- Considering only the 1 PEA with >50% population affected (estimate)
- 7.6 million persons (8.2 M weighted)

# Total Uplink Impairments
## (NE Corridor, 126 MHz recovery target)

| Block | PEAs with >50% Impairment | Weighted Pops (M) Impaired | Percentage of Weighted US Population |
|---|---|---|---|
| A | 14 | 54.0 M | 23.2% |
| B | 29 | 59.8 | 25.7% |
| C | 35 | 62.4 | 26.8% |
| D | 26 | 60.0 | 25.8% |
| E | 24 | 59.9 | 25.8% |
| F | 27 | 60.4 | 26.0% |
| G | 22 | 59.2 | 25.5% |
| H | 1 | 8.2 | 3.5% |
| I, J | 0 | 0 | 0 |
| Total | | 423.9 Million | 18.2% (9.1 % w/ 50% Uplink discount) |

# Uplink Channel Pair Availability

- Total of 9.1% of "weighted" population impaired
  - Well below 20% impairment threshold for reduction in recovery target
- Only 2-3 of 10 "paired" wireless channels are available in all major northeast corridor markets

| TV in Uplink Band | PEA | Block A | Block B | Block C | Block D | Block E | Block F | Block G | Block H | Block I | Block J |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | NYC | X | X | X | X | X | X | X | √ | √ | √ |
| | PHL | X | X | X | X | X | X | X | X | √ | √ |
| | WAS | X | X | X | X | X | X | X | √ | √ | √ |
| | BOS | X | X | X | X | X | X | X | √ | √ | √ |

# Southern California Scenario

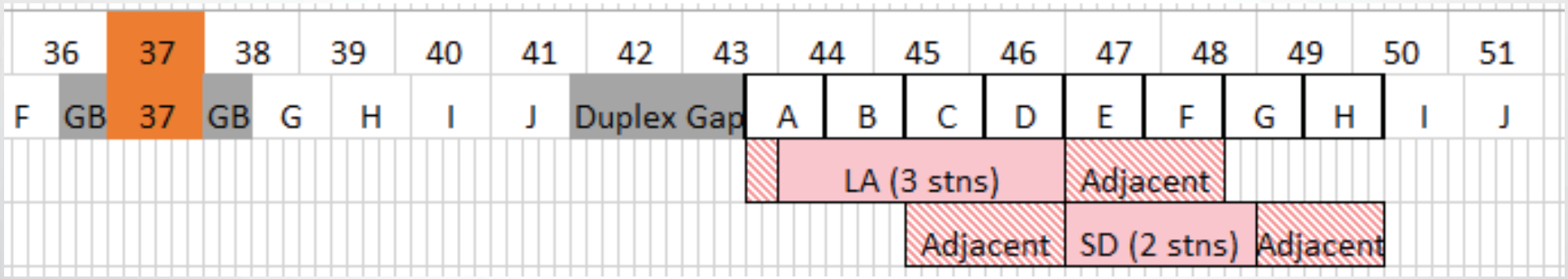
| Market | Total Stations | Stations in 600 MHz* |
|---|---|---|
| New York | 24 | 3 |
| Philadelphia | 23 | 2 |
| Boston | 20 | 1 |
| Washington (Baltimore) | 20 (7) | 2 |
| Los Angeles | 29 | 3 |
| San Diego | 8 | 2 |

* Stations can be placed in 600 MHz as part of initial clearing target or by dropping out of the auction

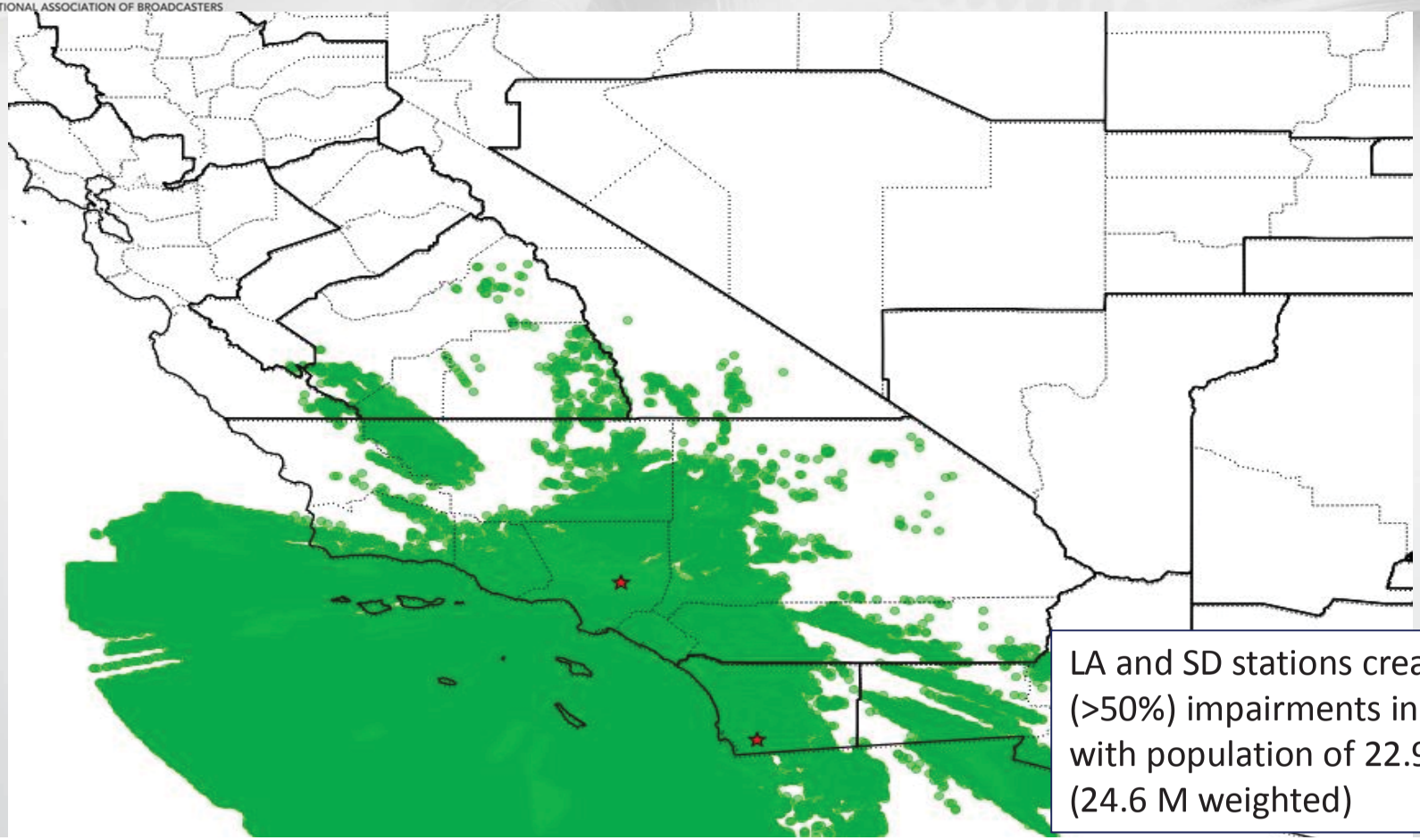
# Assumed Impairments (So Cal)

## (Uplink, 126 MHz Recovery Target)

- 3 LA Stations (Channels 44, 45, 46)
- 2 SD Stations (Channels 47, 48 – cannot be co-channel with LA stations)



# D Block (Uplink) Impairments



LA and SD stations create (>50%) impairments in 3 PEAS with population of 22.9 million (24.6 M weighted)

# Total Uplink Impairments

(So Cal, 126 MHz Recovery Target)

| Block | Pops Impaired (Weighted) | Fraction of Weighted US Population |
|---|---|---|
| A | 24.3 M | 10.4% |
| B | 24.3 | 10.4% |
| C | 24.3 | 10.4% |
| D | 24.7 | 10.6% |
| E | 24.3 | 10.4% |
| F | 24.3 | 10.4% |
| G | 24.3 | 10.4% |
| H | 3.3 | 1.4% |
| I, J | 0 | 0 |
| Total | 173.6 Million | 7.5% (3.7% w/ Uplink discount) |

# Uplink Channel Pair Availability

- Added 3.7% of "weighted" population impaired to 9.1% NE Corridor result for total impairment of 12.8%
  - Still below 20% impairment threshold for reduction in recovery target
- Only 2-3 of 10 "paired" wireless channel blocks available in Los Angeles and San Diego

| TV in Uplink Band | PEA | Block A | Block B | Block C | Block D | Block E | Block F | Block G | Block H | Block I | Block J |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Los Angeles | X | X | X | X | X | X | X | √ | √ | √ |
| | San Diego | X | X | X | X | X | X | X | X | √ | √ |

# US-Canada Border Scenario

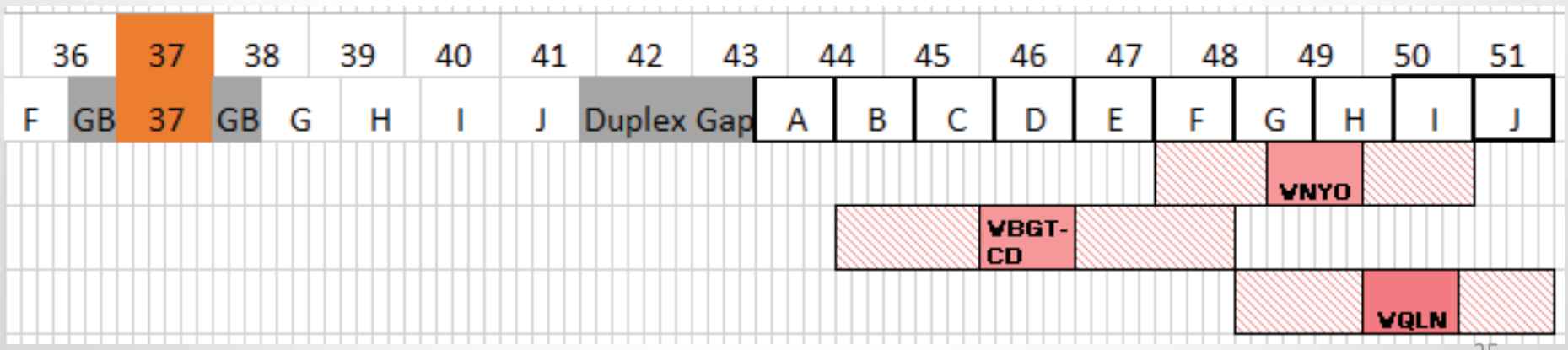
| Market | Total Stations | Stations in 600 MHz |
|---|---|---|
| New York | 24 | 3 |
| Philadelphia | 23 | 2 |
| Boston | 20 | 1 |
| Washington (Baltimore) | 20 (7) | 2 |
| Los Angeles | 29 | 3 |
| San Diego | 8 | 2 |
| Buffalo | 11 | 1** |
| Erie | 4 | 1** |
| Rochester | 5 | 1** |

**Border scenario assumes that stations are stranded on existing TV channels due to US/Canada treaty constraints

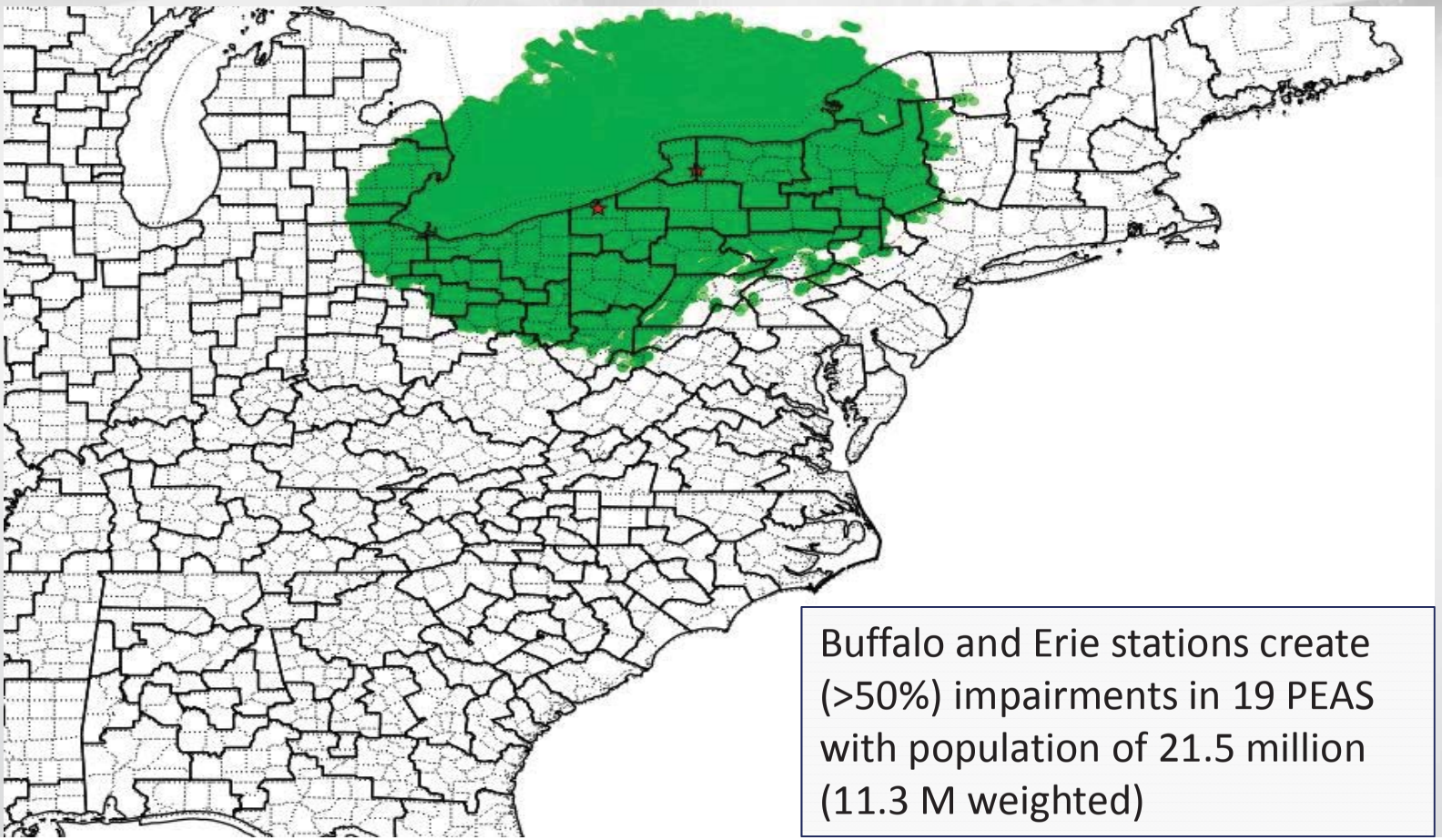
# Assumed Impairments (Canada Border)

(Uplink, 126 MHz Recovery Target)

- 3 “Stranded” Stations (Channels 46, 49, 50)
- Buffalo, Erie, Rochester



# H Block (Uplink) Impairments



Buffalo and Erie stations create (>50%) impairments in 19 PEAS with population of 21.5 million (11.3 M weighted)

# Additive Impact of Stranded Station Impairments (Canadian Border, 126 MHz Recovery Target)

| Block | Pops Impaired (Weighted) | Fraction of Weighted US Population |
|---|---|---|
| A | 0 | 0 |
| B | 0.5 M | 0.2% |
| C | 0.5 | 0.2% |
| D | 0.5 | 0.2% |
| E | 0.5 | 0.2% |
| F | 0.5 | 0.2% |
| G | 4.4 | 1.9% |
| H | 11.3 | 4.9% |
| I | 10.4 | 4.5% |
| J | 0.023 | 0.0% |
| Total | 28.5 Million | 1.2% (0.6% w/ Uplink discount) |

# San Francisco Scenario

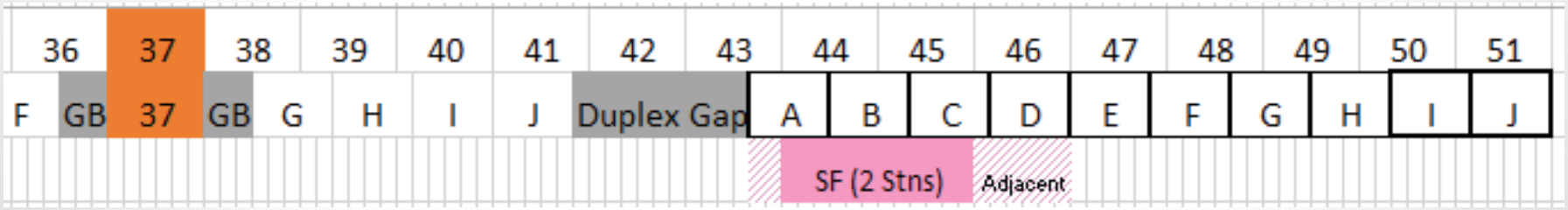
| Market | Total Stations | Stations in 600 MHz |
|---|---|---|
| New York | 24 | 3 |
| Philadelphia | 23 | 2 |
| Boston | 20 | 1 |
| Washington (Baltimore) | 20 (7) | 2 |
| Los Angeles | 29 | 3 |
| San Diego | 8 | 2 |
| Buffalo | 11 | 1** |
| Erie | 4 | 1** |
| Rochester | 5 | 1** |
| San Francisco | 23 | 2 |

**Border scenario assumes that stations are stranded on existing TV channels due to US/Canada treaty constraints

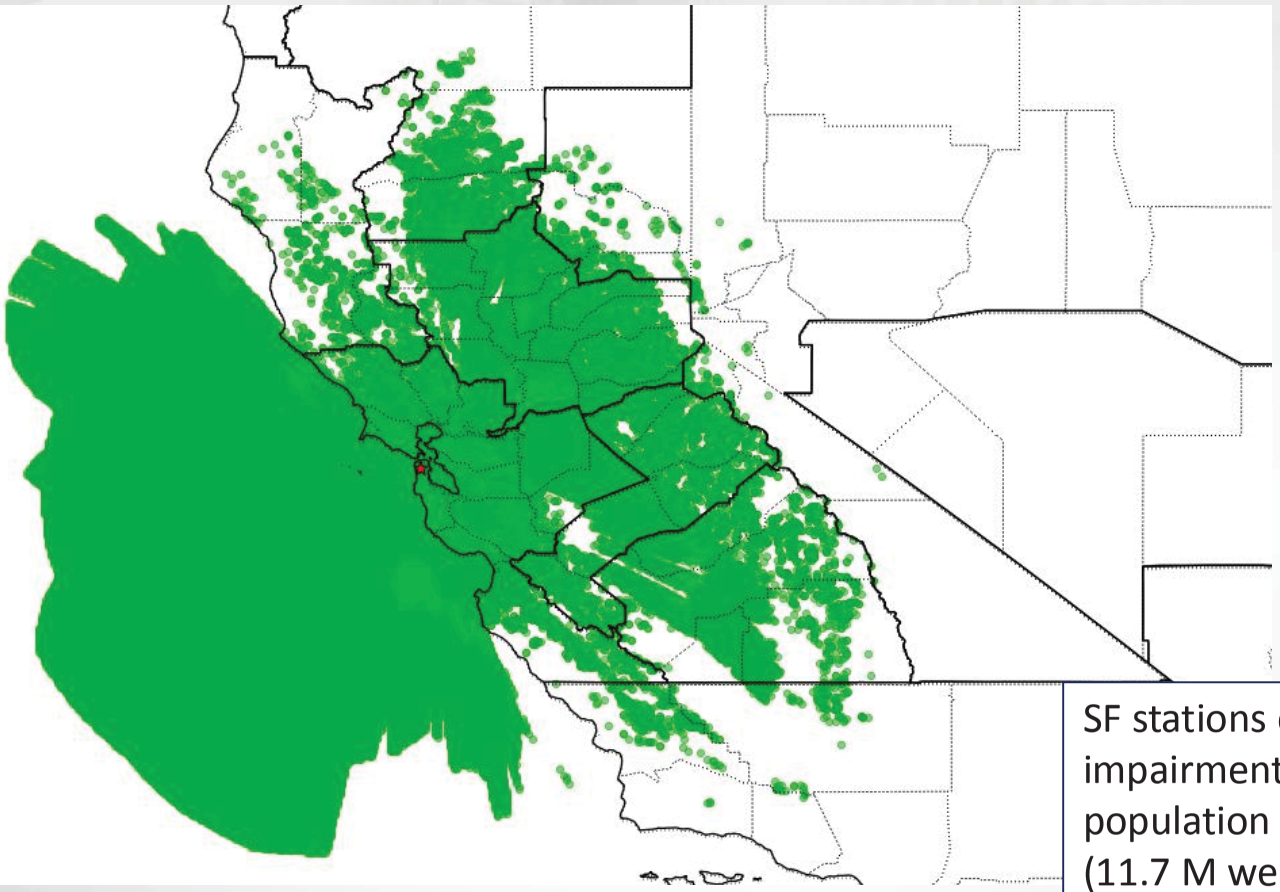
# Assumed Impairments (SF)

## (Uplink, 126 MHz Recovery Target)

- 2 SF Stations (Channels 44, 45)



# B Block (Uplink) Impairments



SF stations create (>50%) impairments in 4 PEAS with population of 12.5 million (11.7 M weighted)

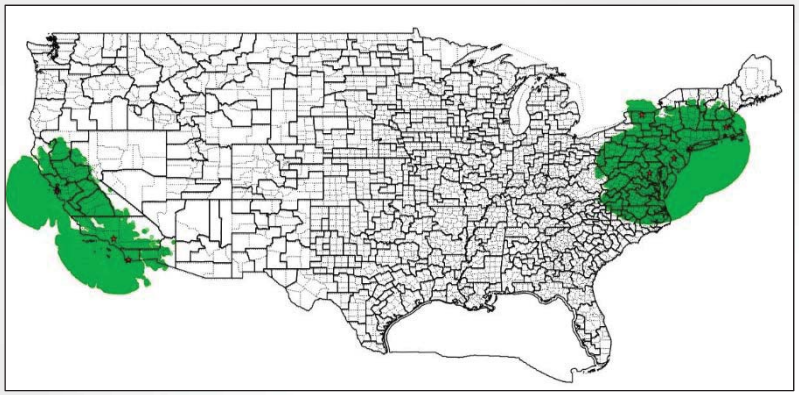
# Total Uplink Impairments

(San Francisco, 126 MHz Recovery Target)

| Block | Pops Impaired (Weighted) | Fraction of Weighted US Population |
|---|---|---|
| A | 11.7 M | 5.1% |
| B | 11.7 | 5.1% |
| C | 11.7 | 5.1% |
| D | 9.7 | 4.2% |
| E-J | 0 | 0 |
| Total | 45.0 Million | 1.9% (1.0% w/ Uplink discount) |

# Uplink Scenario Summary

**FCC "Near Nationwide" Plan (Block C shown)**



- Total "weighted pops" impairment is 14.4%
  - Northeast corridor (9.1%)
  - Southern California (3.7%)
  - US/Canada Border (0.6%)
  - San Francisco (1.0%)
- Additional 5.6% impairments possible and still meet proposed FCC 20% limit (TBD)
  - No uplink channels available in Miami equates to 1.2% impairment

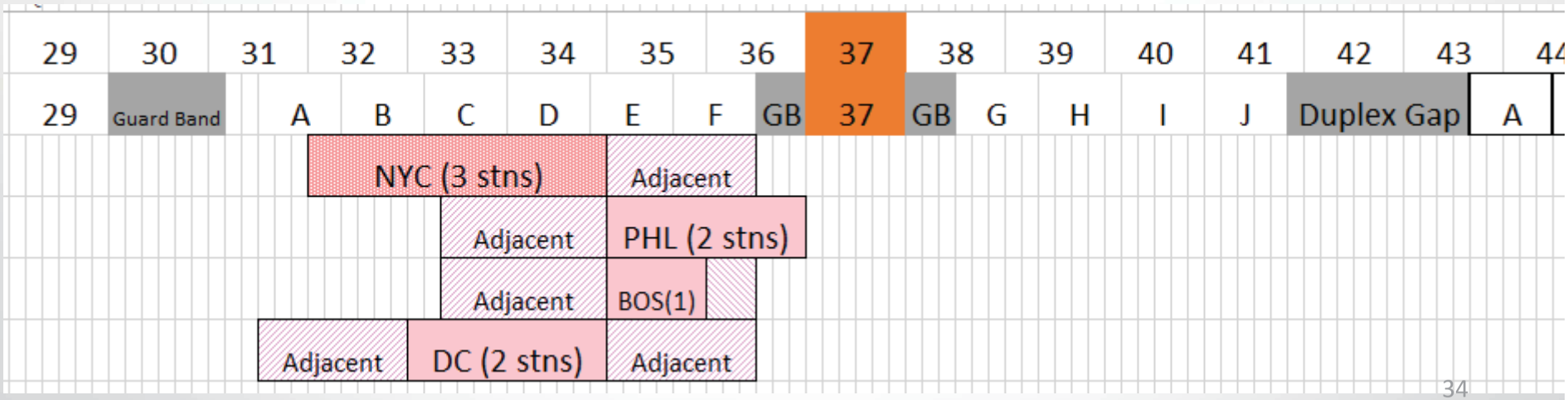
| Market | Total Unimpaired Wireless Channel Pairs Available |
|---|---|
| New York | 3 |
| Philadelphia | 2 |
| BOS | 3 |
| DC | 3 |
| LA | 3 |
| SD | 2 |
| Buffalo | 5 |
| Rochester | 7 |
| Erie | 8 |
| SF | 6 |

# ISIX *Downlink* Impairment Calculations and Impact by Channel

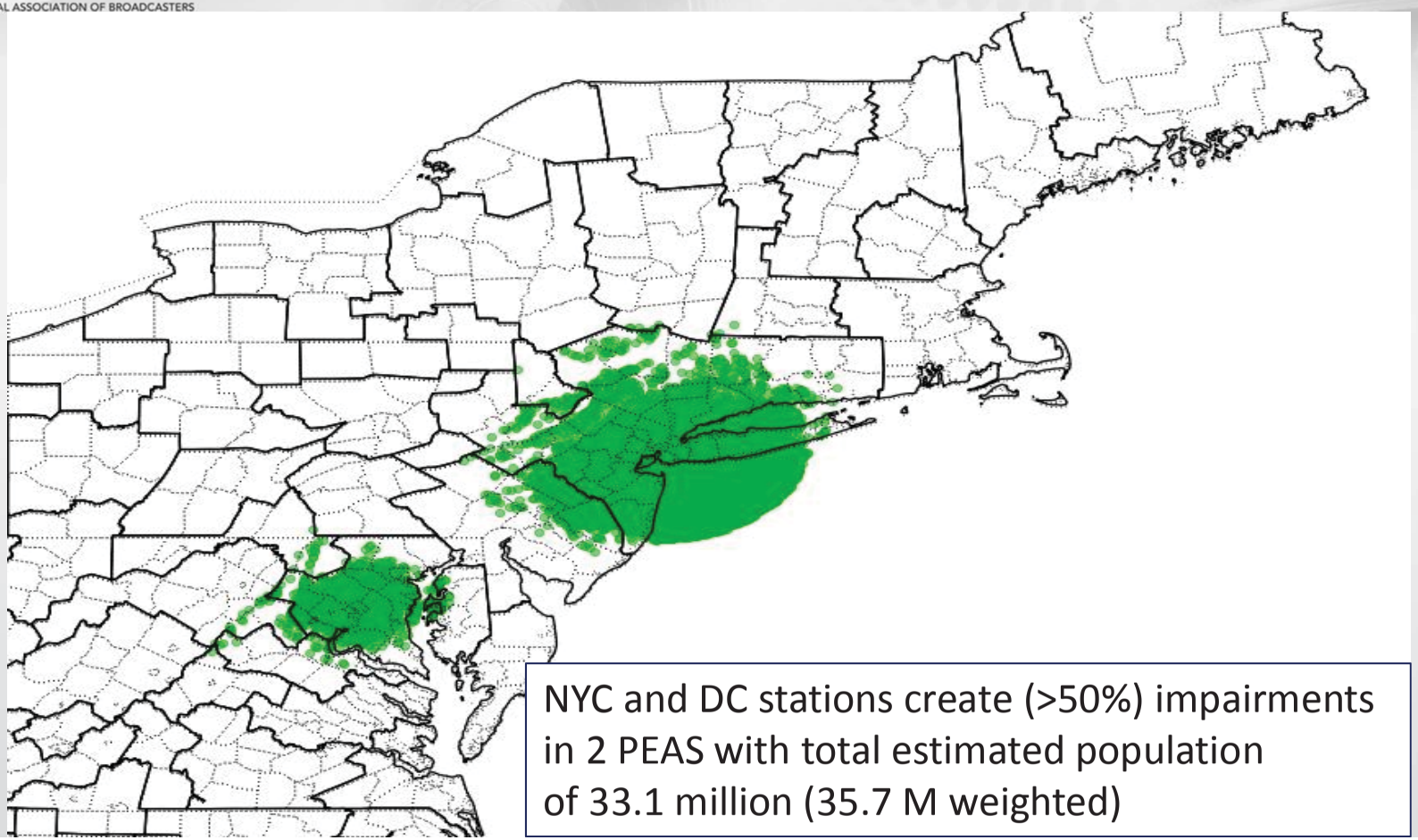
# Assumed Impairments (NE Corridor)

## (Downlink - 126 MHz Recovery Target)

- 3 NYC Stations (Channels 32, 33, 34)
- 2 PHL Stations (Channels 35, 36– cannot be co-channel with NYC stations)
- 2 DC Stations (Channels 33, 34 – cannot be co-channel with PHL stations)
- 1 BOS Station (Channel 35 – cannot be co-channel with NYC stations)

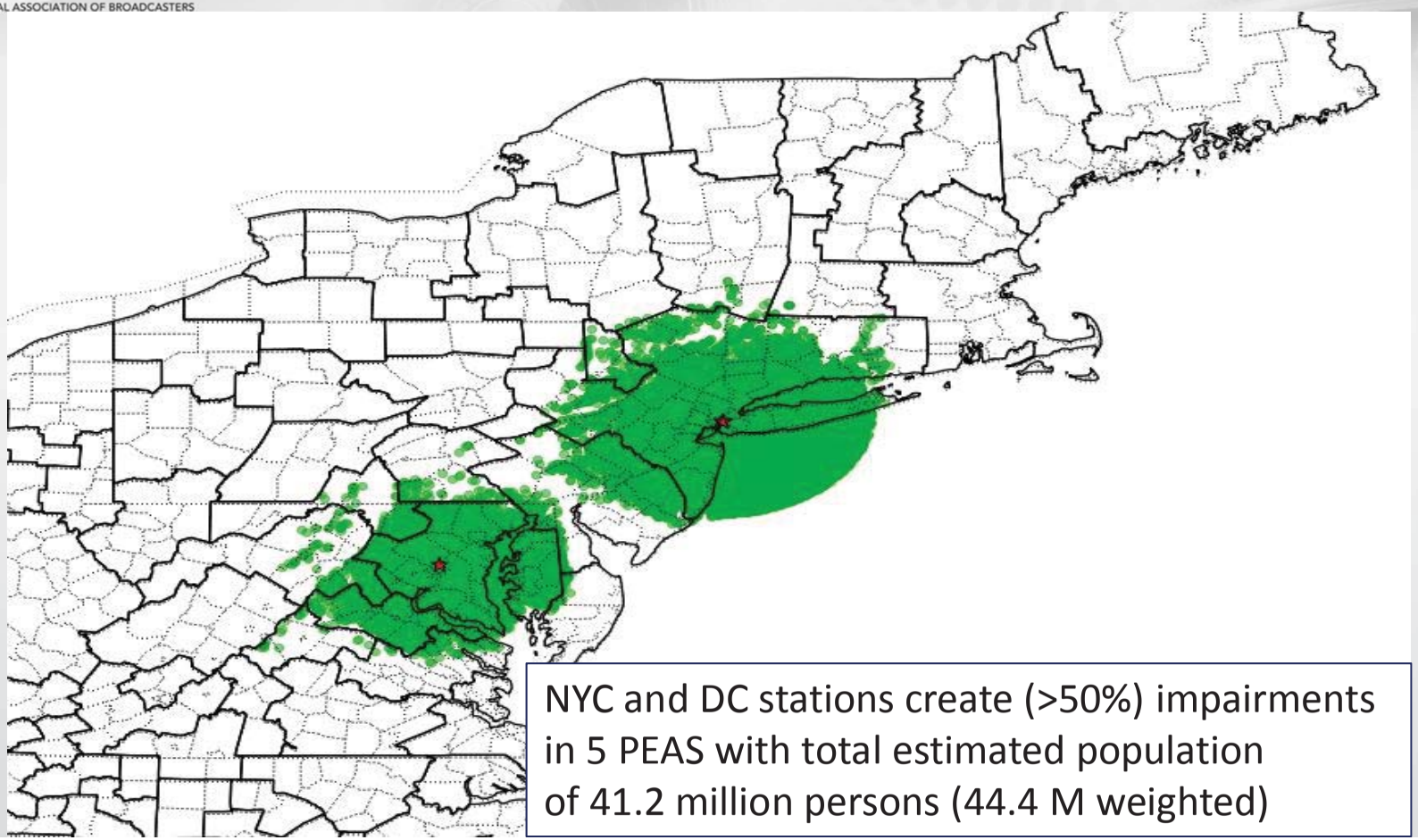


# A Block (Downlink) Impairments



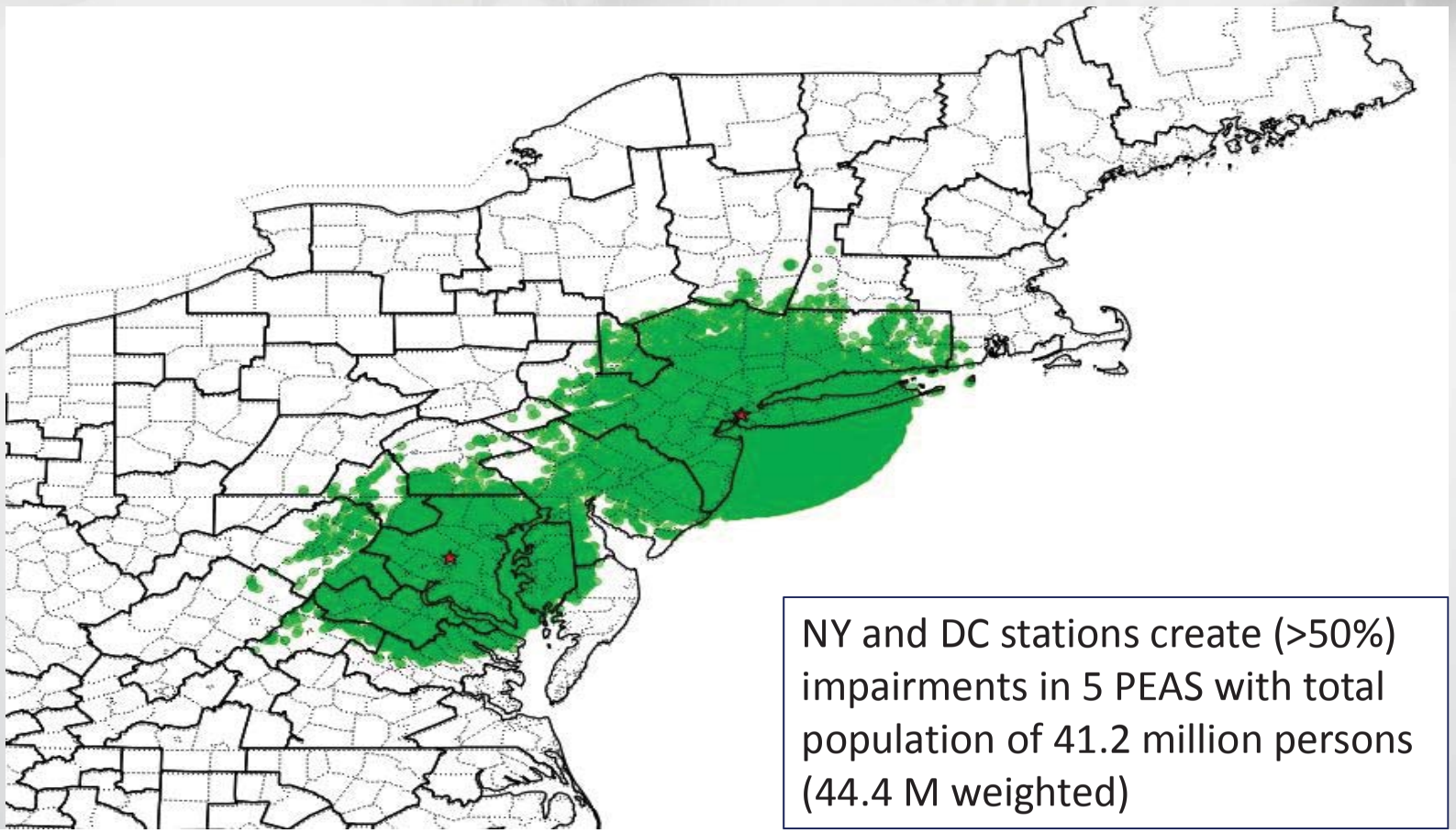
NYC and DC stations create (>50%) impairments in 2 PEAS with total estimated population of 33.1 million (35.7 M weighted)

# B Block (Downlink) Impairments



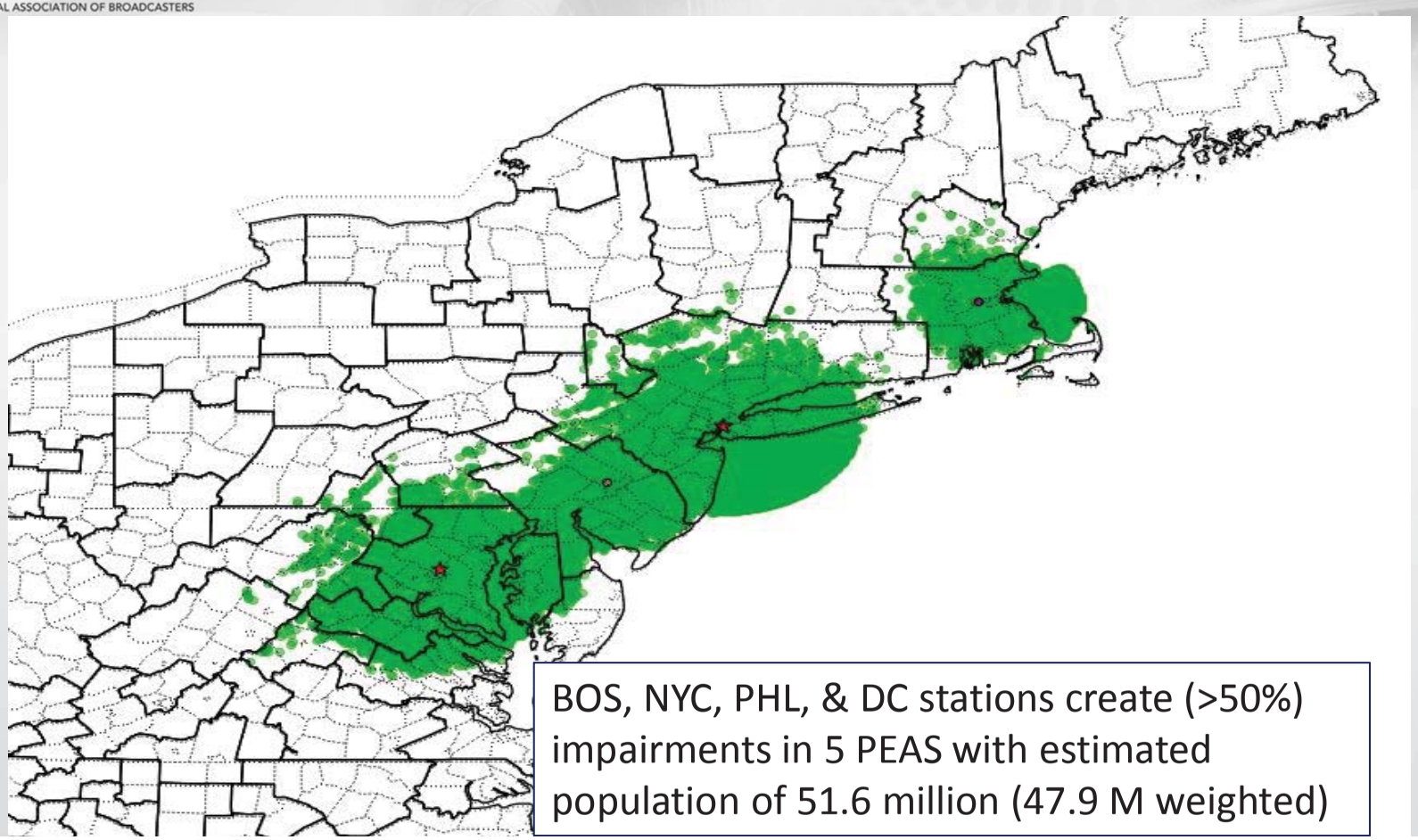
NYC and DC stations create (>50%) impairments in 5 PEAS with total estimated population of 41.2 million persons (44.4 M weighted)

# C Block (Downlink) Impairments



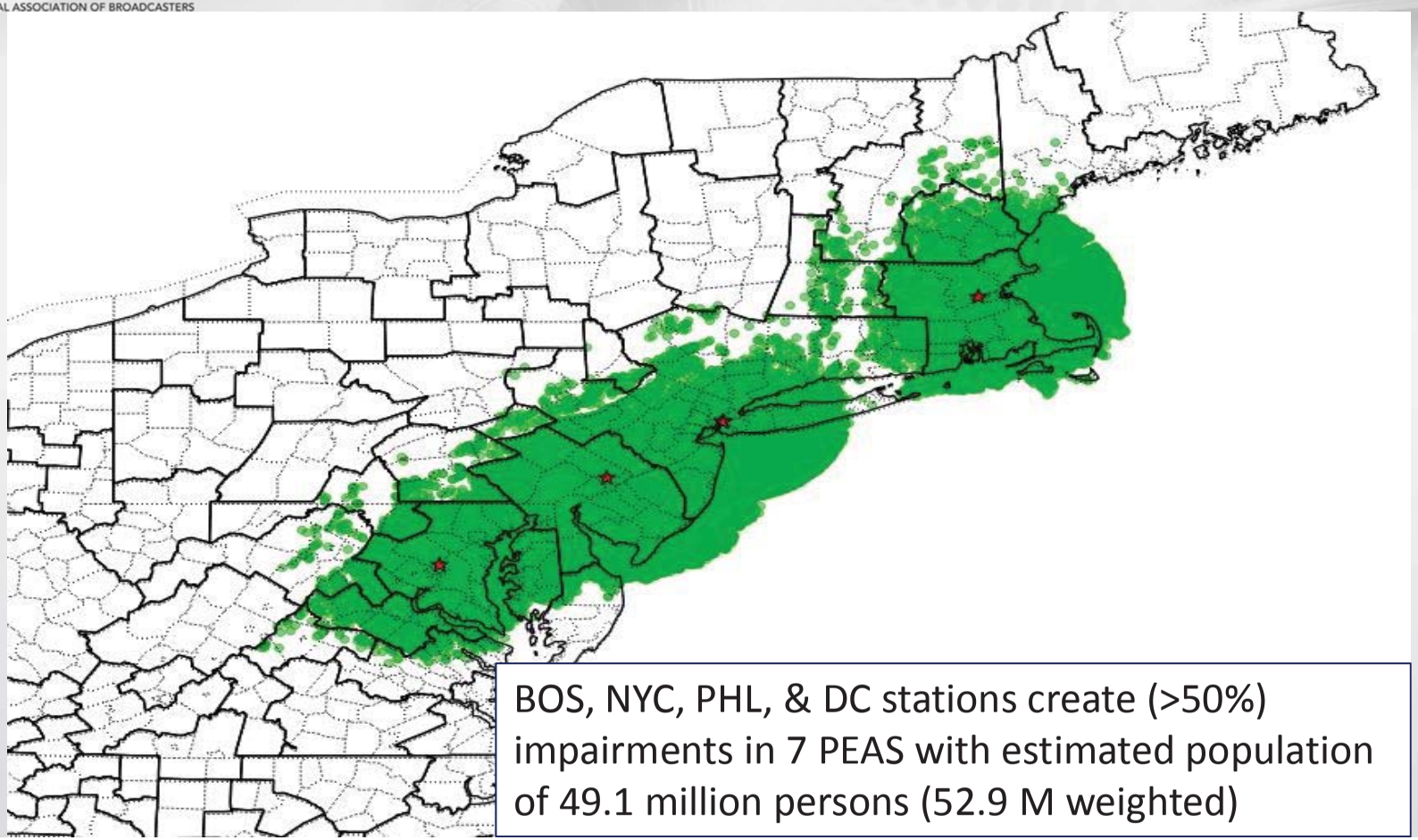
NY and DC stations create (>50%) impairments in 5 PEAS with total population of 41.2 million persons (44.4 M weighted)

# D Block (Downlink) Impairments



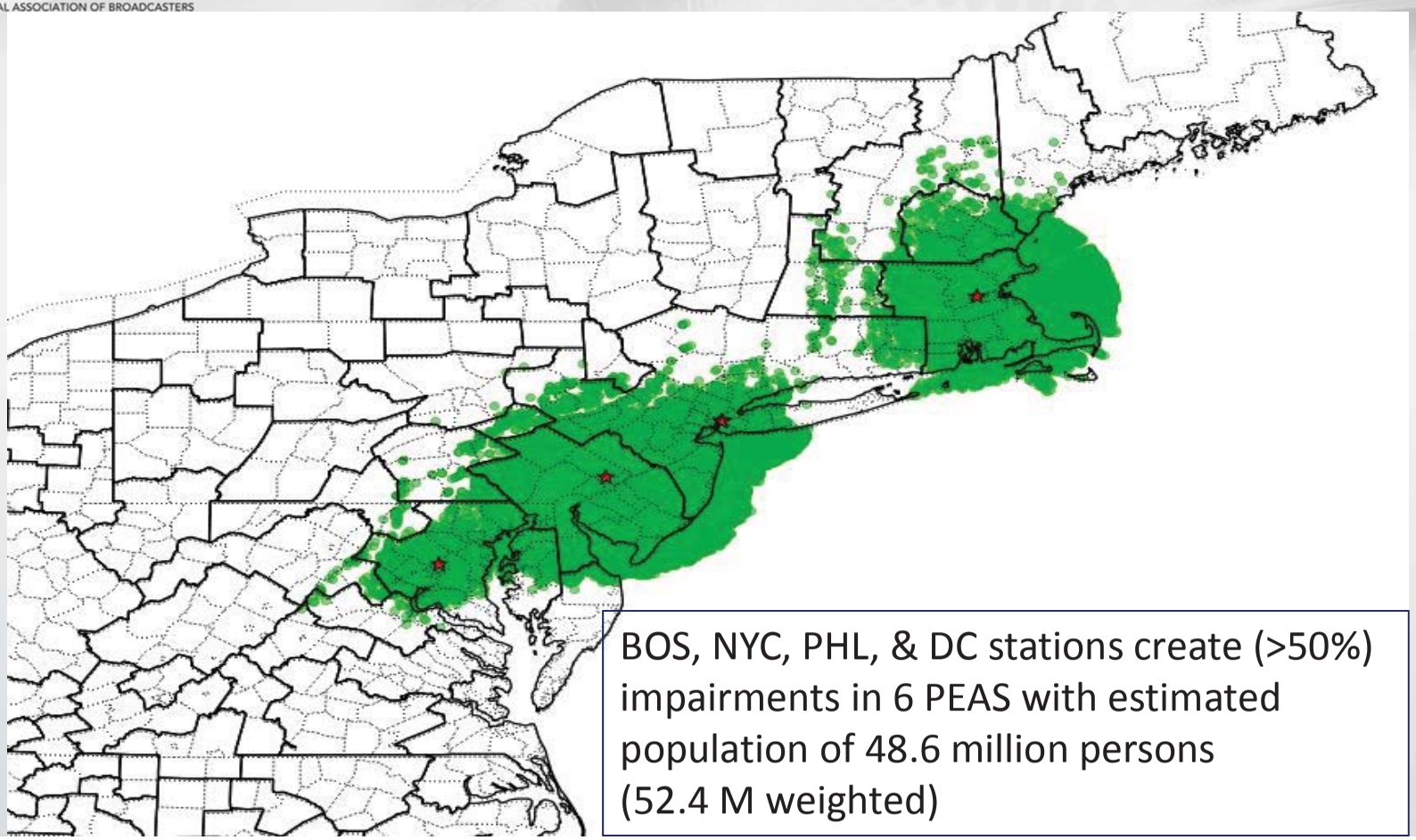
BOS, NYC, PHL, & DC stations create (>50%) impairments in 5 PEAS with estimated population of 51.6 million (47.9 M weighted)

# E Block (Downlink) Impairments



BOS, NYC, PHL, & DC stations create (>50%) impairments in 7 PEAS with estimated population of 49.1 million persons (52.9 M weighted)

# F Block (Downlink) Impairments



BOS, NYC, PHL, & DC stations create (>50%) impairments in 6 PEAS with estimated population of 48.6 million persons (52.4 M weighted)

# Total Impact of Downlink Impairments

(Northeast Corridor, 126 MHz Recovery Target)

| Block | PEAs with >50% Impairments | Weighted Pops (M) Impaired | Percentage of Weighted US Population |
|---|---|---|---|
| A | 2 | 35.7 | 15.3% |
| B | 5 | 44.4 | 19.1% |
| C | 5 | 44.4 | 19.1% |
| D | 5 | 51.6 | 22.2% |
| E | 7 | 52.9 | 22.7% |
| F | 6 | 52.4 | 22.5% |
| G - J | 0 | 0 | 0 |
| Total | | 281.5 Million | 12.1% |

# Downlink Channel Pair Availability

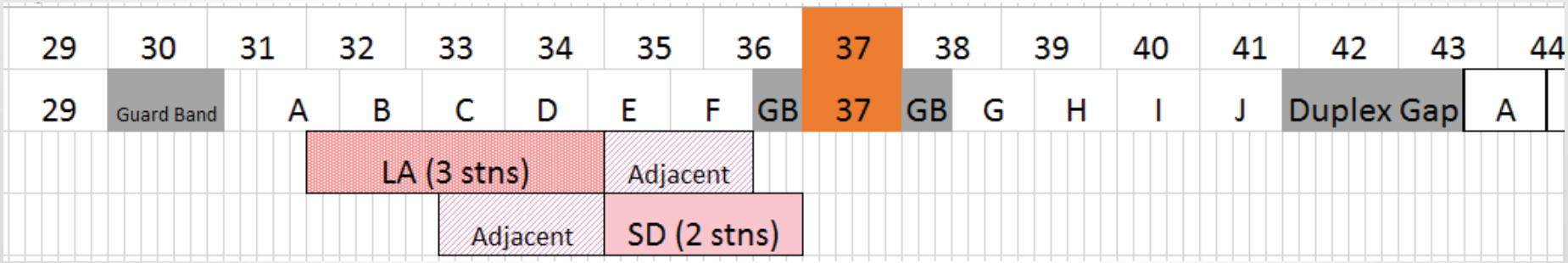
- Total of 12.1% of "weighted" population impaired
  - Well below 20% impairment threshold for reduction in recovery target
- Only 50% wireless channel blocks are available in four major northeast corridor markets
  - Maximum of 4-6 channels available

| TV in Downlink | PEA | Block A | Block B | Block C | Block D | Block E | Block F | Block G | Block H | Block I | Block J |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | NYC | X | X | X | X | X | X | √ | √ | √ | √ |
| | PHL | √ | X | X | X | X | X | √ | √ | √ | √ |
| | WAS | X | X | X | X | X | X | √ | √ | √ | √ |
| | BOS | √ | √ | √ | X | X | X | X | √ | √ | √ |

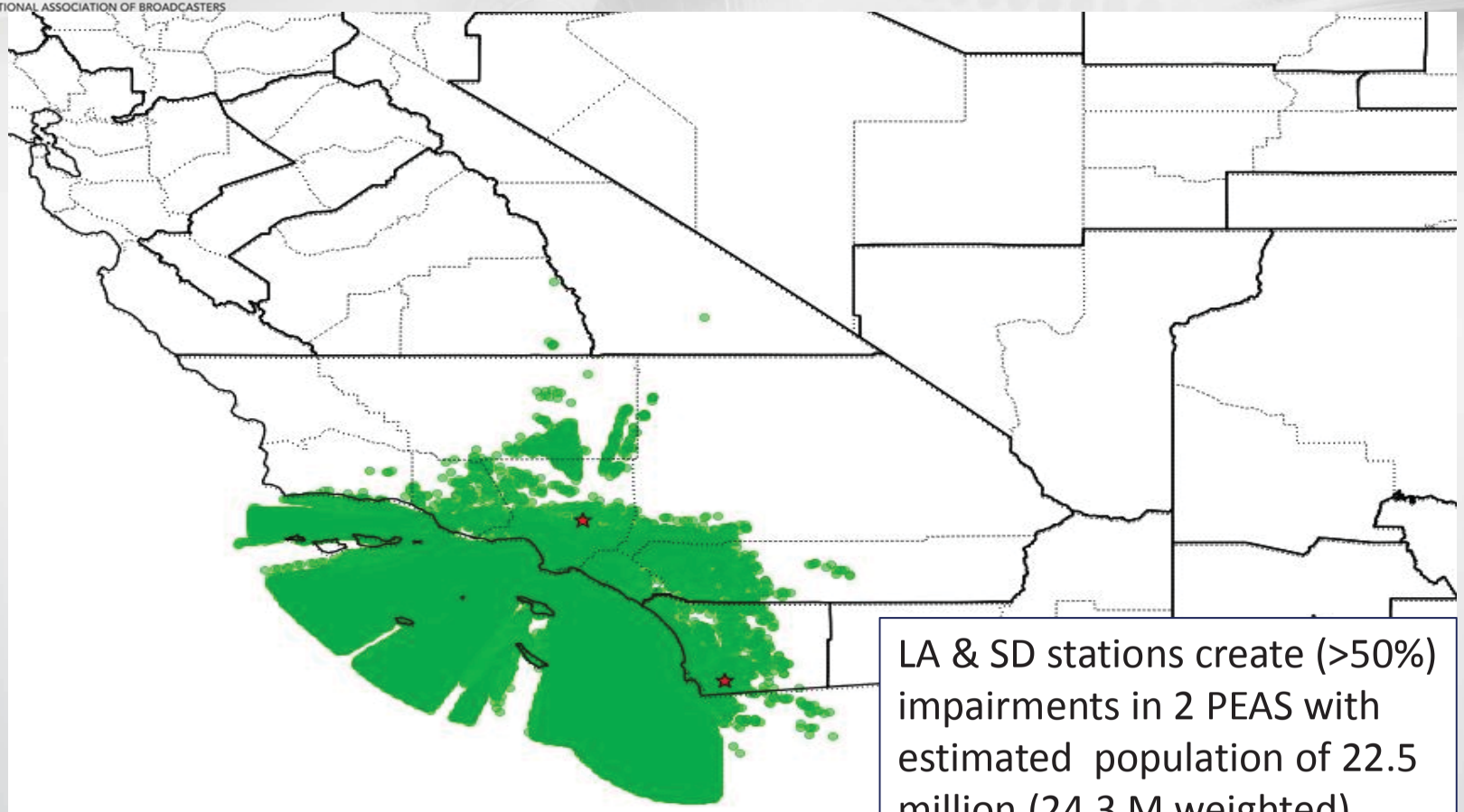
# Assumed Impairments (So Cal)

## (Downlink - 126 MHz Recovery Target)

- 3 LA Stations (Channels 32, 33, 34)
- 2 SD Stations (Channels 35, 36 – cannot be co-channel with LA stations)



# D Block (Downlink) Impairments

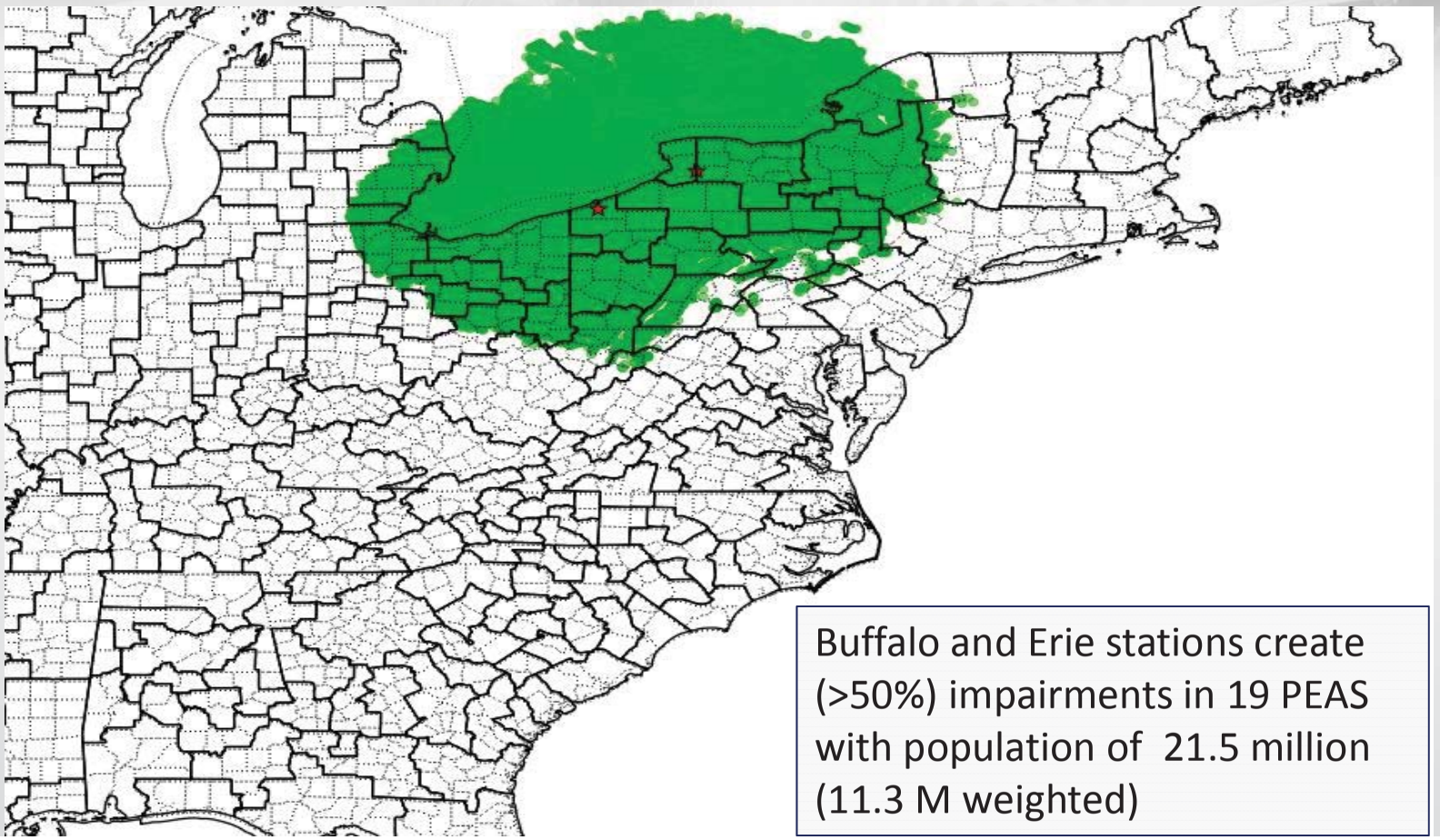


LA & SD stations create (>50%) impairments in 2 PEAS with estimated population of 22.5 million (24.3 M weighted)

# Additive Impact of Modest Downlink Impairments (So Cal, 126 MHz Recovery Target)

| Block | Pops Impaired (Weighted) | Percentage of Weighted US Population |
|---|---|---|
| A | 24.3 M | 10.4% |
| B | 24.3 | 10.4% |
| C | 24.3 | 10.4% |
| D | 24.3 | 10.4% |
| E | 24.3 | 10.4% |
| F | 24.3 | 10.4% |
| H-J | 0 | 0 |
| Total | 145.6 Million | 6.3% |

# H Block (*Uplink*) Impairments



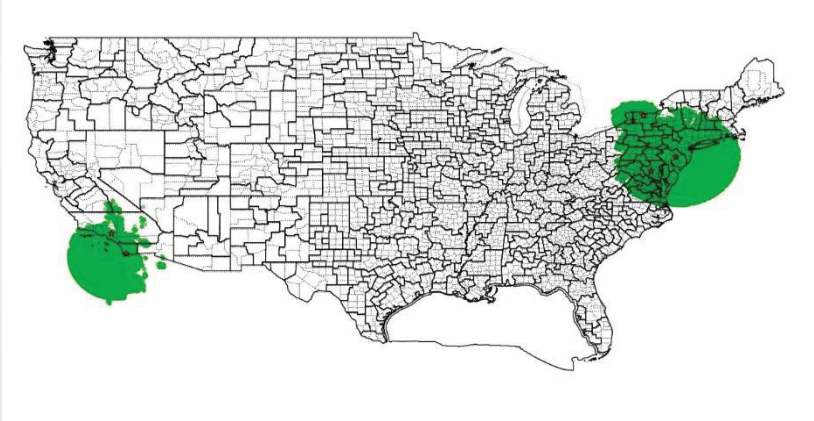
Buffalo and Erie stations create (>50%) impairments in 19 PEAS with population of 21.5 million (11.3 M weighted)

# Border Scenario

- Uplink ISIX calculations result in larger areas/weighted population than downlink
  - Total uplink impairment (prior to 50% discount) was 1.2% (28.5M weighted pop)
- Estimate US/Canada border downlink impairment to be less than 1% due to smaller interference area and population covered
  - Actual ISIX calculations to be completed

# Downlink Summary

## FCC "Near Nationwide" Plan



- Total "weighted pops" impairment of about 19%
  - Northeast corridor (12.1%)
  - Southern California (6.3%)
  - US/Canada Border (<1%)
- Downlink scenario still meets proposed FCC 20% limit

| Market | Total Unimpaired Wireless Channel Pairs Available |
|---|---|
| New York | 4 |
| Philadelphia | 5 |
| BOS | 7 |
| DC | 4 |
| LA | 4 |
| SD | 4 |
| Buffalo | (5) TBD |
| Rochester | (7) |
| Erie | (8) |

# Availability of Wireless Channel Pairs

**TV in Uplink ***

| PEA | Block A | Block B | Block C | Block D | Block E | Block F | Block G | Block H | Block I | Block J |
|---|---|---|---|---|---|---|---|---|---|---|
| NYC | X | X | X | X | X | X | X | √ | √ | √ |
| PHL | X | X | X | X | X | X | X | X | √ | √ |
| WAS | X | X | X | X | X | X | X | √ | √ | √ |
| BOS | X | X | X | X | X | X | X | √ | √ | √ |

**TV in Downlink**

| PEA | Block A | Block B | Block C | Block D | Block E | Block F | Block G | Block H | Block I | Block J |
|---|---|---|---|---|---|---|---|---|---|---|
| NYC | X | X | X | X | X | X | √ | √ | √ | √ |
| PHL | √ | X | X | X | X | X | √ | √ | √ | √ |
| WAS | X | X | X | X | X | X | √ | √ | √ | √ |
| BOS | √ | √ | √ | X | X | X | √ | √ | √ | √ |

* Downlink channels can be sold in "X" channel blocks in TV in Uplink chart

# Bottom Line

- FCC should maximize amount of **unimpaired** spectrum cleared
  - Truly near-nationwide clearing target
  - Eliminate Dynamic Reserve Pricing
- Such an approach would
  - Maximize forward auction proceeds
  - Maximize broadcaster prices and participation
  - Maximize useable paired wireless channels
  - Minimize future inter-service interference issues
- For example, an **unimpaired** plan (vs. impaired 120 MHz uplink scenario studied) actually provides **more** channels in 6 of the top 10 markets:
  - 4 additional paired channel blocks in NYC, Washington, Boston, Los Angeles and San Francisco
  - 5 additional paired channel blocks in Philadelphia and San Diego
  - Generates **more** revenue, **higher** prices and **maximizes** usable paired spectrum

# Comparison of Channel Availability

**TV in Uplink Band**

| PEA | Block A | Block B | Block C | Block D | Block E | Block F | Block G | Block H | Block I | Block J |
|---|---|---|---|---|---|---|---|---|---|---|
| NYC | X | X | X | X | X | X | X | √ | √ | √ |
| PHL | X | X | X | X | X | X | X | X | √ | √ |
| WAS | X | X | X | X | X | X | X | √ | √ | √ |
| BOS | X | X | X | X | X | X | X | √ | √ | √ |

**Unimpaired Plan**

| PEA | Block A | Block B | Block C | Block D | Block E | Block F | Block G | Block H | Block I | Block J |
|---|---|---|---|---|---|---|---|---|---|---|
| NYC | √ | √ | √ | √ | √ | √ | √ | X | X | X |
| PHL | √ | √ | √ | √ | √ | √ | √ | X | X | X |
| WAS | √ | √ | √ | √ | √ | √ | √ | X | X | X |
| BOS | √ | √ | √ | √ | √ | √ | √ | X | X | X |