Distributed Transmission — FCC Enabling Rules

A Presentation for
Federal Communications Commission Staff
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Agenda

- ✓ What Are Distributed Transmission (DTx) Systems?
- ✓ Why Use Distributed Transmission?
- ✓ Background of Distributed Transmission
- ✓ Broadcaster Support
- ✓ Prerequisites for DTx Operation
- ✓ System Examples
- ✓ Enabling FCC Rules
- ✓ Conclusions

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What Are Distributed Transmission Systems?

- ✓ Multiple Transmitters Covering an Area (SFN)
  - ✓ On-Channel Repeaters (successor to "Boosters")
  - ✓ Distributed Transmission
- ✓ Variety of Purposes
  - ✓ Gap Fillers (Filling in Shadows)
  - ✓ Service Maximization (Extending Service)
  - ✓ Creating Stronger Signals (Indoor Reception)
  - ✓ Transmitter Diversity (Helps Indoor Reception & New Techniques)

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Why Use Distributed Xmsn?

- ✓ Spectrum Efficiency
  - ✓ Like Translators, But Without Another Channel
- ✓ Stronger Signals, Less Interference
  - ✓ Shorter Distances Need Less Fade Margin
  - ✓ Greatest Power Needed for "Last Mile"
  - ✓ Shorter Interference Zones
  - ✓ More Uniform Signal Levels

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Why Use Distributed Xmsn? (2)

- ✓ Tests Show More Signal Power Is Needed
  - ✓ NAB / MSTV
  - ✓ Especially for Set Top Reception
- ✓ Transmitter Diversity
  - ✓ Fills Holes in Difficult Propagation Channels
  - ✓ Helps Set Top Reception
  - ✓ Helps Pedestrian & Mobile Reception
- ✓ But, More Difficult for Receiver Equalizers
  - ✓ Similar to Difficult Reception Locations Using Single Xmtrs
  - ✓ DTx Offers Possibility to Overcome Many Such Difficulties

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Background of Distributed Transmission

- ✓ Introduced in FCC Advisory Committee in 1991
  - ✓ Commission Then Sought Input
  - ✓ Never Acted
- ✓ Other Systems Adopted SFN Techniques
  - ✓ DVB-T (Europe)
  - ✓ ISDB-T (Japan)
  - ✓ Used Lack of SFN to Sell Their Systems Against ATSC System
    - ✓ In Brazil, for example
    - ✓ ATSC had no SFN methods

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Background of Distributed Transmission (2)

- ✓ DTx Introduced to ATSC VSB Enhancement Process in 2000
- ✓ DTx Recommended by FCC Spectrum Policy TF – Nov., 2002
- ✓ ATSC Standard Adopted – July, 2004
  - ✓ Defines Synchronization of Transmitters (A/110)
- ✓ ATSC Recommended Practice Adopted – September, 2004
  - ✓ Explains Design of Multiple Transmitter Networks (A/111)
- ✓ FCC Adopted DTx "In Principal" in 2nd DTV Periodic Review
  - ✓ Promised "Fast Track" NPRM – September, 2004
- ✓ ATSC Forum Now Using DTx As Argument In Its Favor

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Background of Distributed Transmission (3)

- ✓ Multiple DTx Systems Built in U.S.
  - ✓ State College, PA – On Air Since July, 2003 Serving Public
    - ✓ Experimental License – 2 Transmitters On Air, 2 More Planned
  - ✓ Reading, PA – On Air Since September, 2007 Serving Public
    - ✓ STA Under FCC Interim Policy – 8 Transmitters On Air, System Complete
  - ✓ New York City – On Air During 1st Half of 2008 for Testing
    - ✓ Experimental License – 5 Transmitters on Each of 3 Channels
- ✓ Field Tests Conducted in State College & NYC
  - ✓ Filed with Commission in Docket
  - ✓ Showed DTS Works Well

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Broadcaster Support

- ✓ NAB President Eddie Fritts – March 30, 2004
  - ✓ "We need to provide services that exploit all the advantages of over-the-air transmission-and reach the greatest audience possible with a reliable, received signal. For example, ATSC's work on a standard for distributed transmission is commendable. The idea of synchronized multiple transmitters has the potential to help increase the reliability of over-the-air broadcast service."
    - ✓ Speech at ATSC Annual Meeting

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Broadcaster Support (2)

- ✓ "The undersigned 32 organizations … jointly urge the Commission to authorize quickly use of Distributed Transmission techniques in Digital Television (DTV) broadcast operations."
- ✓ Letter to FCC from 32 Organizations – June 4, 2004

✓ NAB	✓ Entravision	✓ Media General	✓ Reading
✓ Tribune	✓ Cox	✓ Allbritton	✓ Winston
✓ Liberty	✓ Emmis	✓ Meredith	✓ Southern Oregon
✓ Paxson	✓ Penn State	✓ Clear Channel	✓ Longmont Chnl 25
✓ Pappas	✓ Sinclair	✓ Bahakel	Axcera
✓ WB Network	✓ Pegasus	✓ Cascade	Harris
✓ LIN	✓ Morgan Murphy	✓ Holston Valley	Thales

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Prerequisites for DTx Operation

- ✓ Transmitter Outputs Must Be Synchronized
  - ✓ Same Emitted Symbols for Same Data Input
  - ✓ Precise Frequency Control of Transmitters
  - ✓ Allows Treating Alternate Signals as Echoes
  - ✓ Allows Controlled Network Output Timing
- ✓ Capable Receiver Adaptive Equalizers
  - ✓ Must Treat Alternate Signals as "Echoes"
  - ✓ Must Handle Strong Leading Echoes
  - ✓ Wide Equalization Range (Pre- & Post-Cursor)

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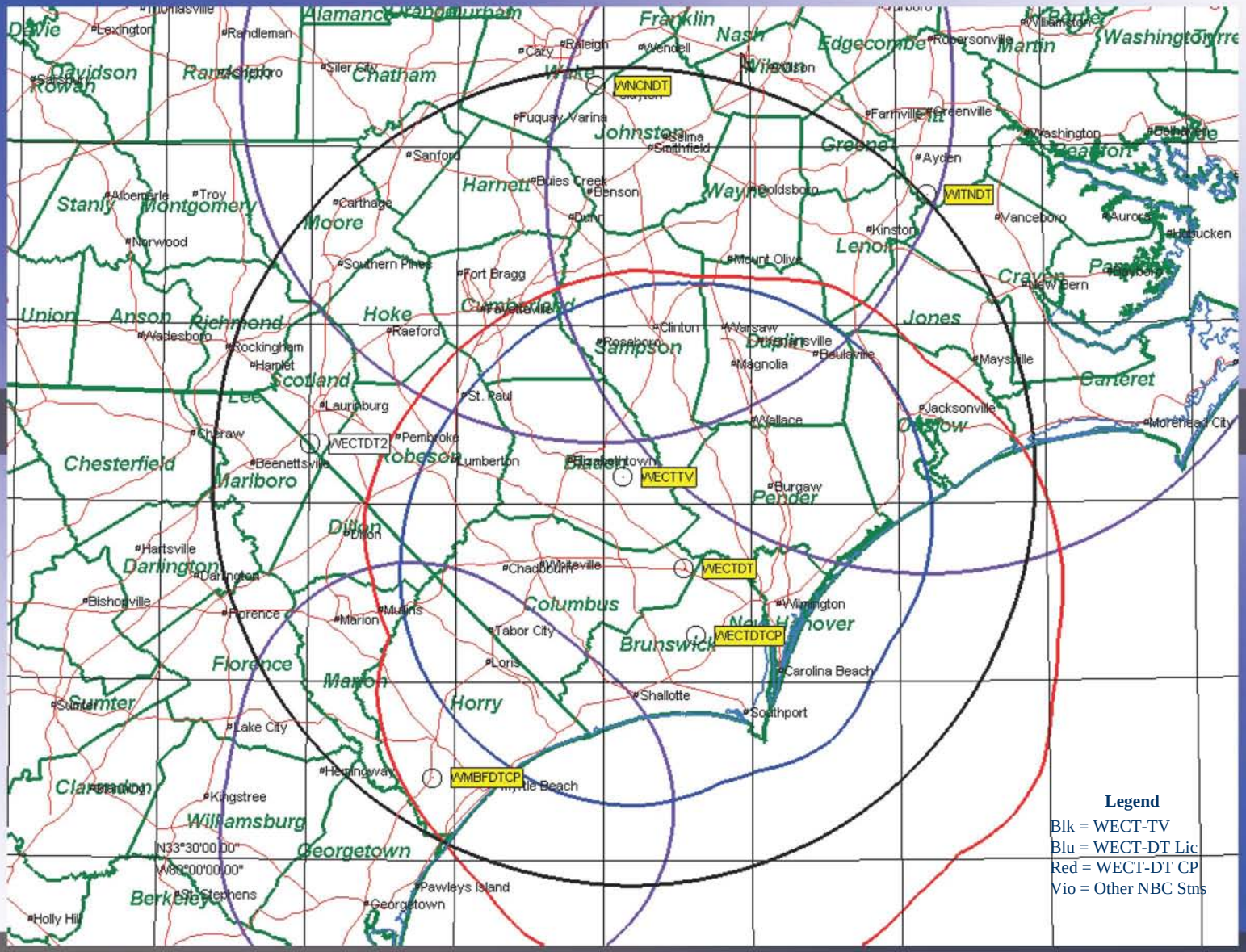
Example: Wilmington, NC Limitation



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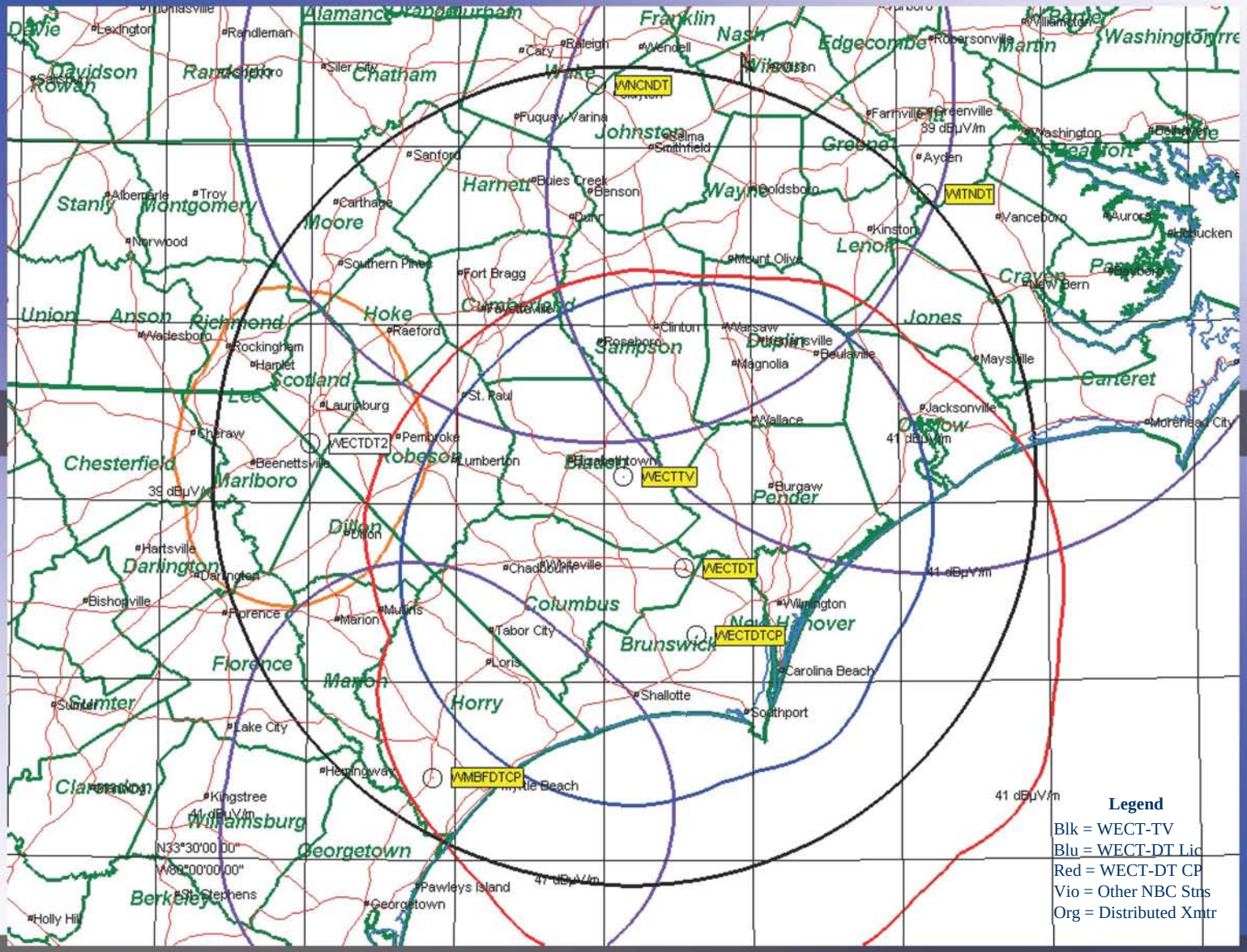
Example: Wilmington, NC Extension



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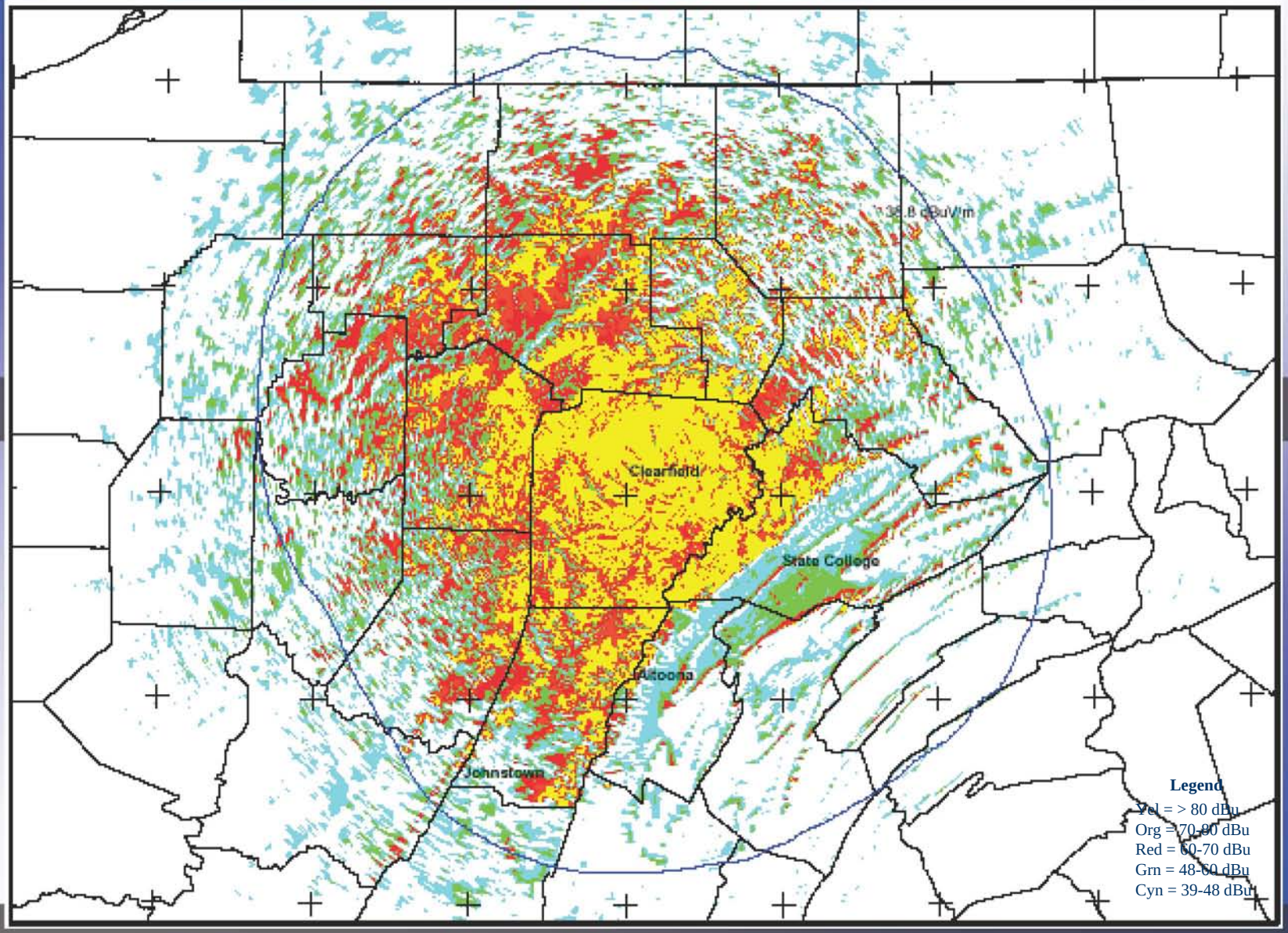
Example: Terrain-Obstructed w/Single Xmtr



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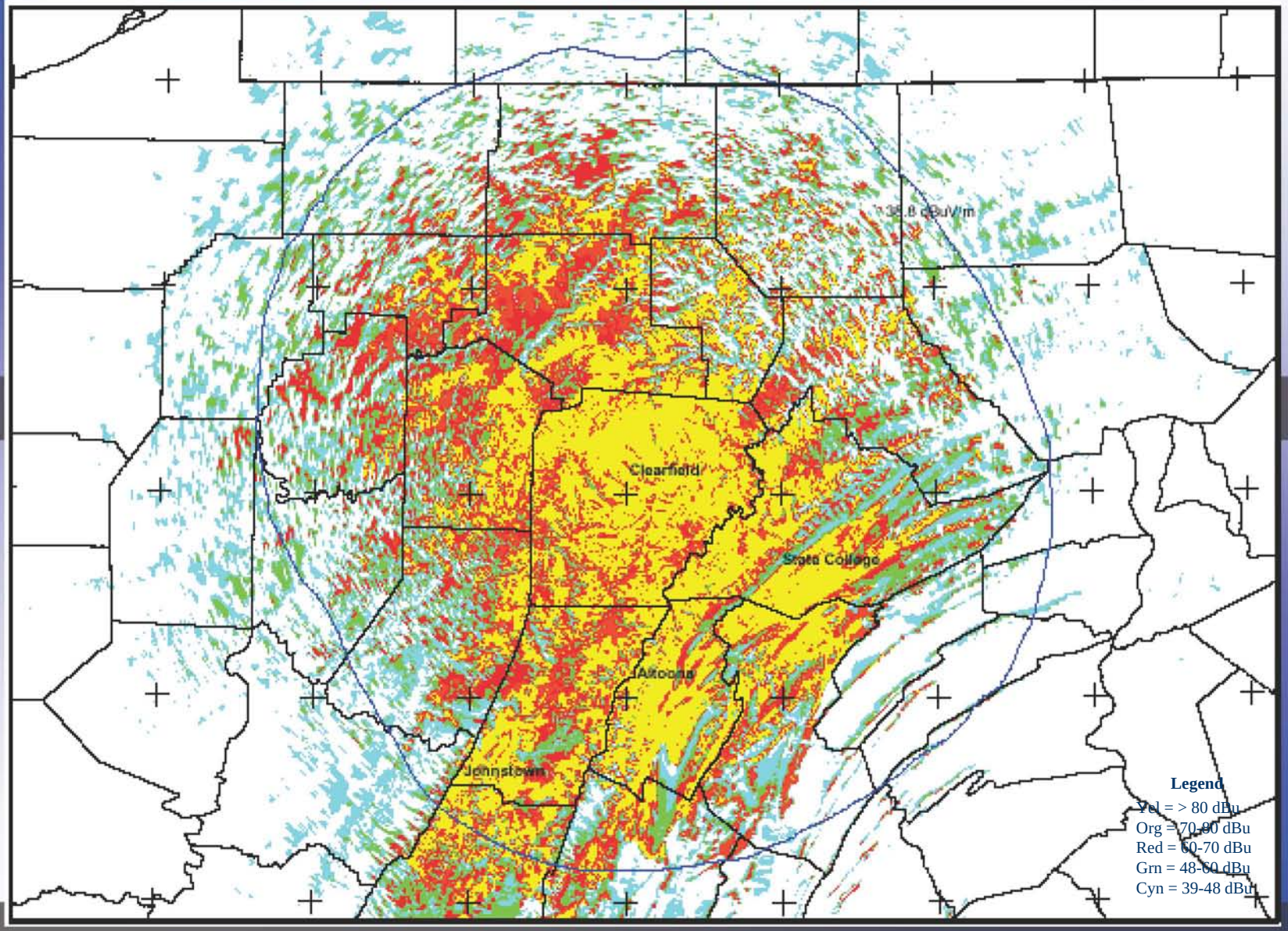
Example: Distributed Transmitters Added



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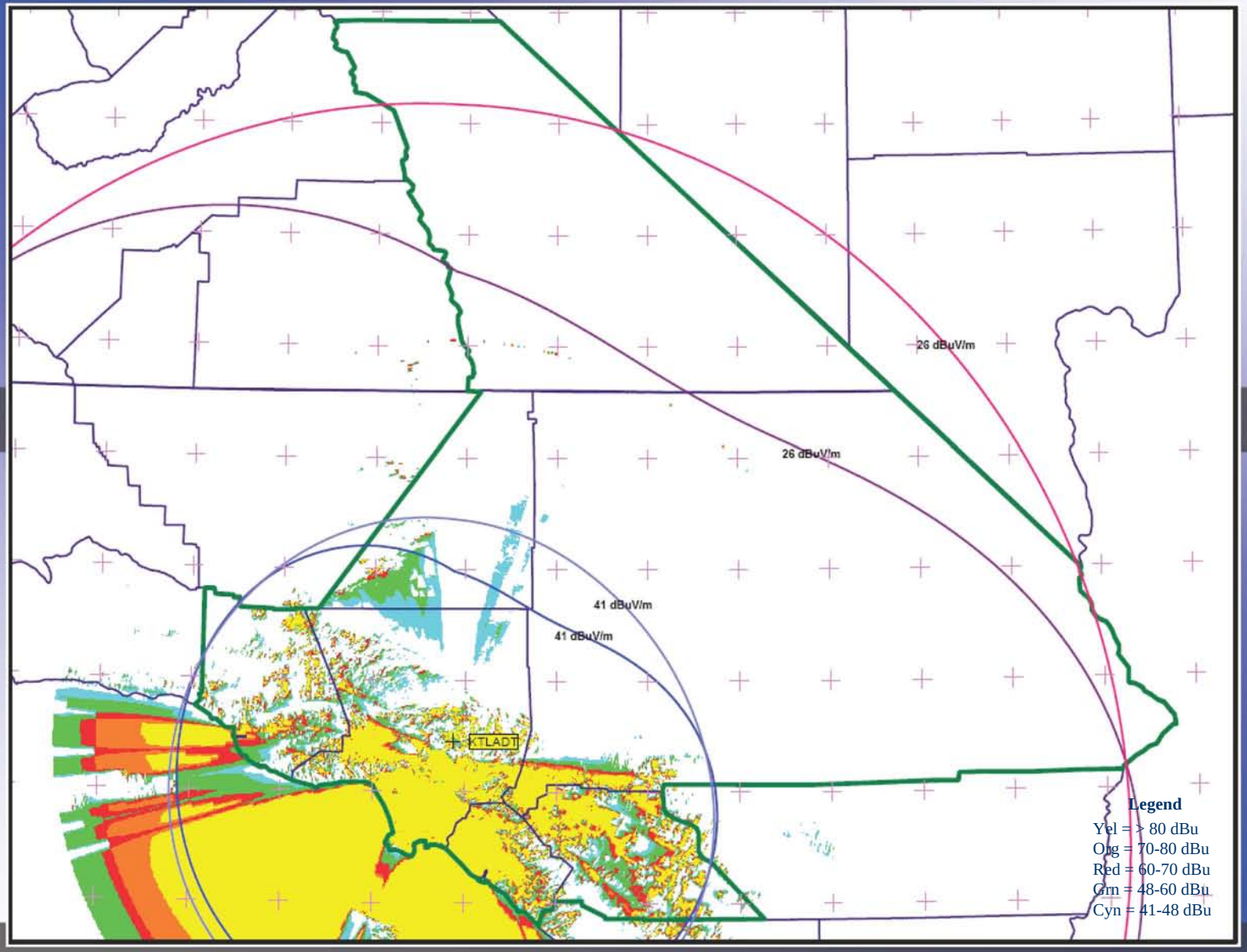
Example: Los Angeles High Desert Unserved



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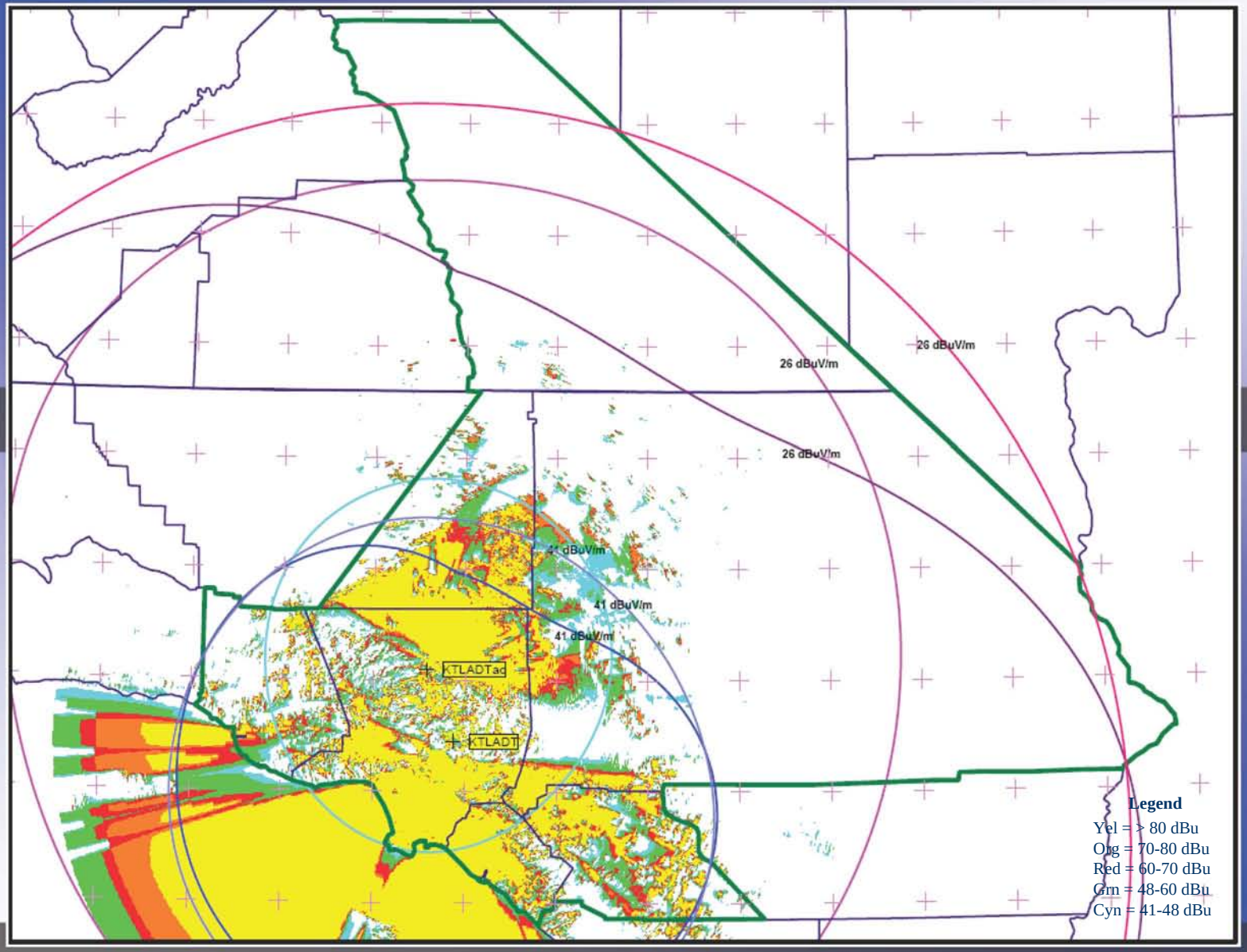
Example: Los Angeles w/High Desert Service



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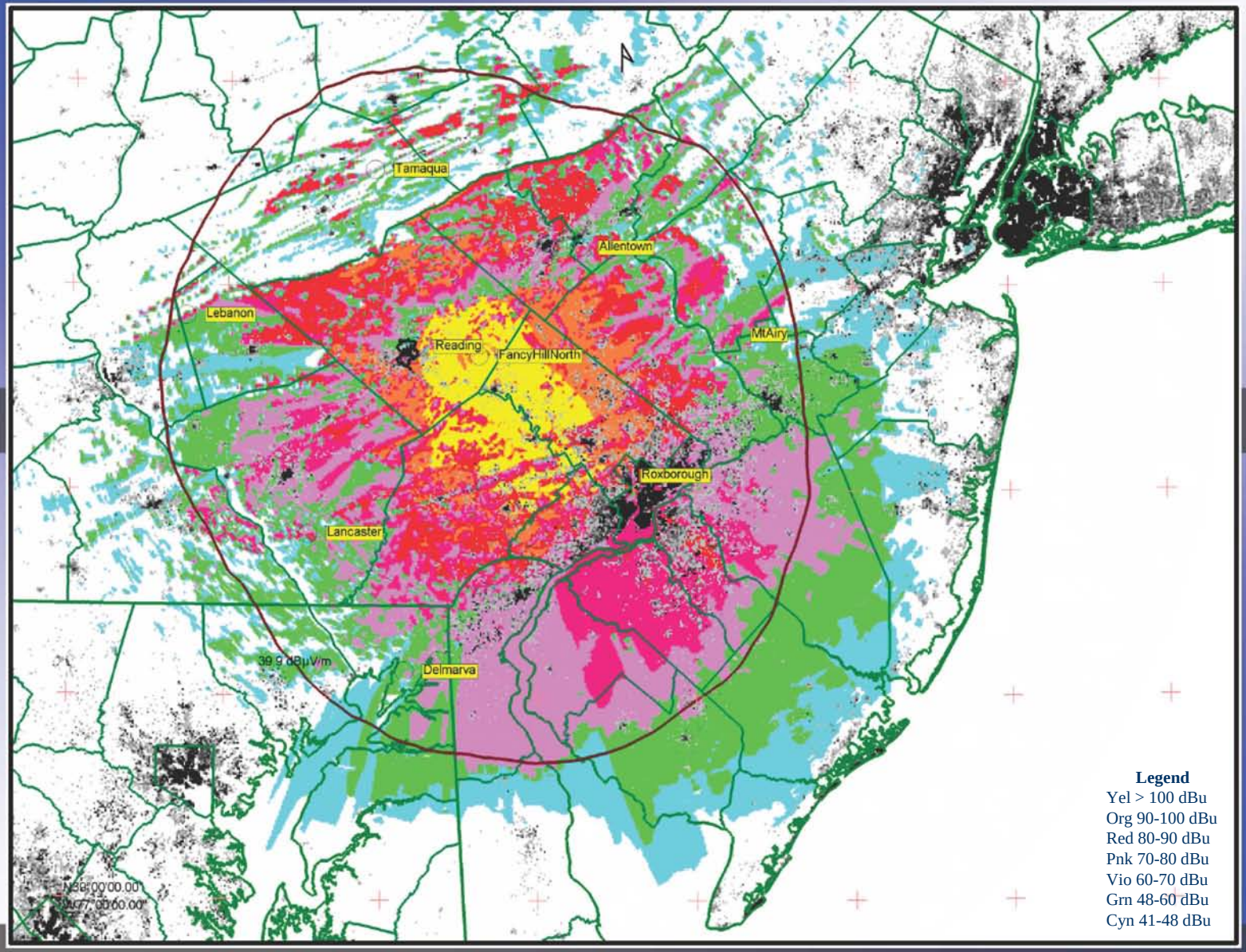
Example: Philadelphia Single High-Power Tx



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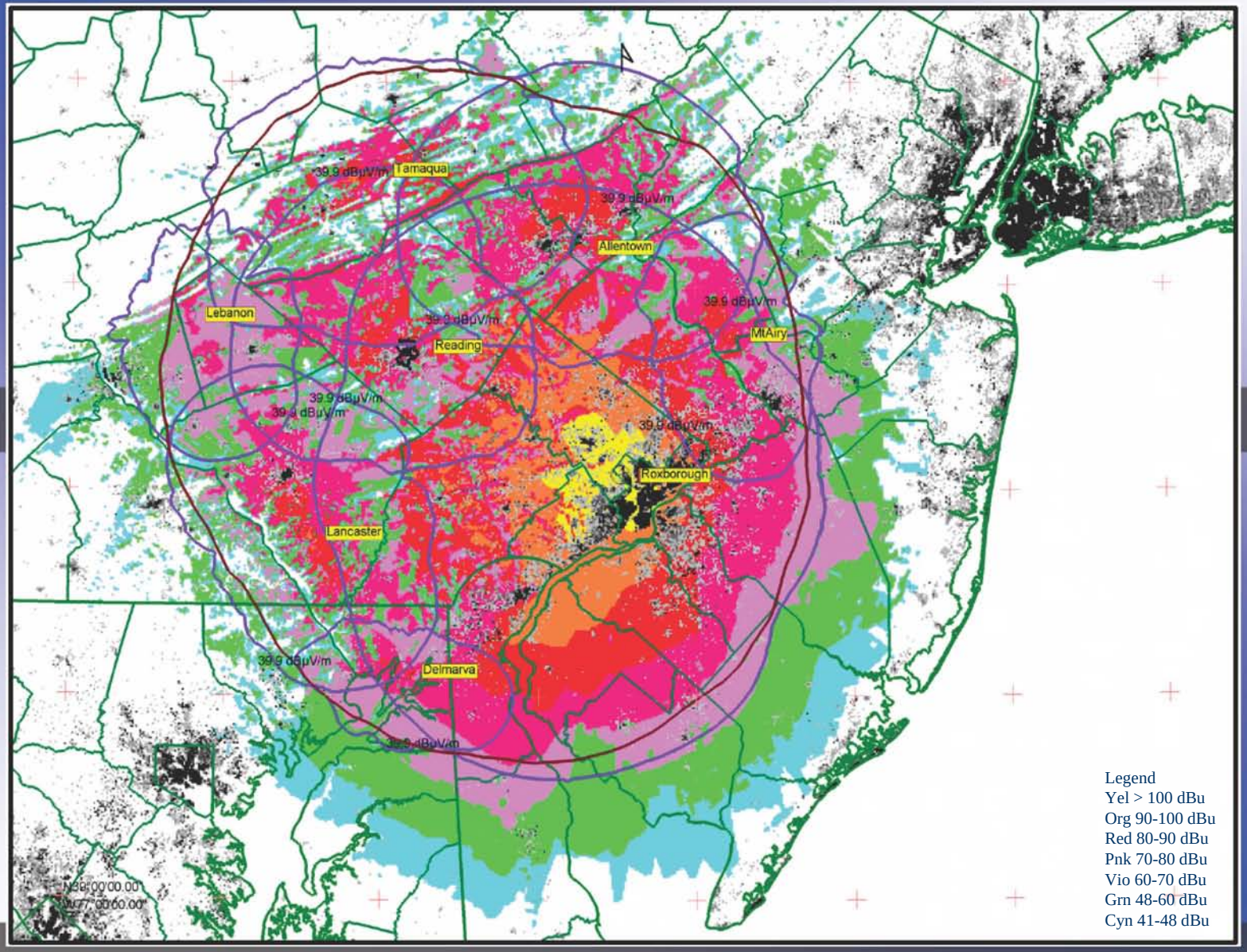
Example: Philadelphia Multiple Low-Pwr Txs



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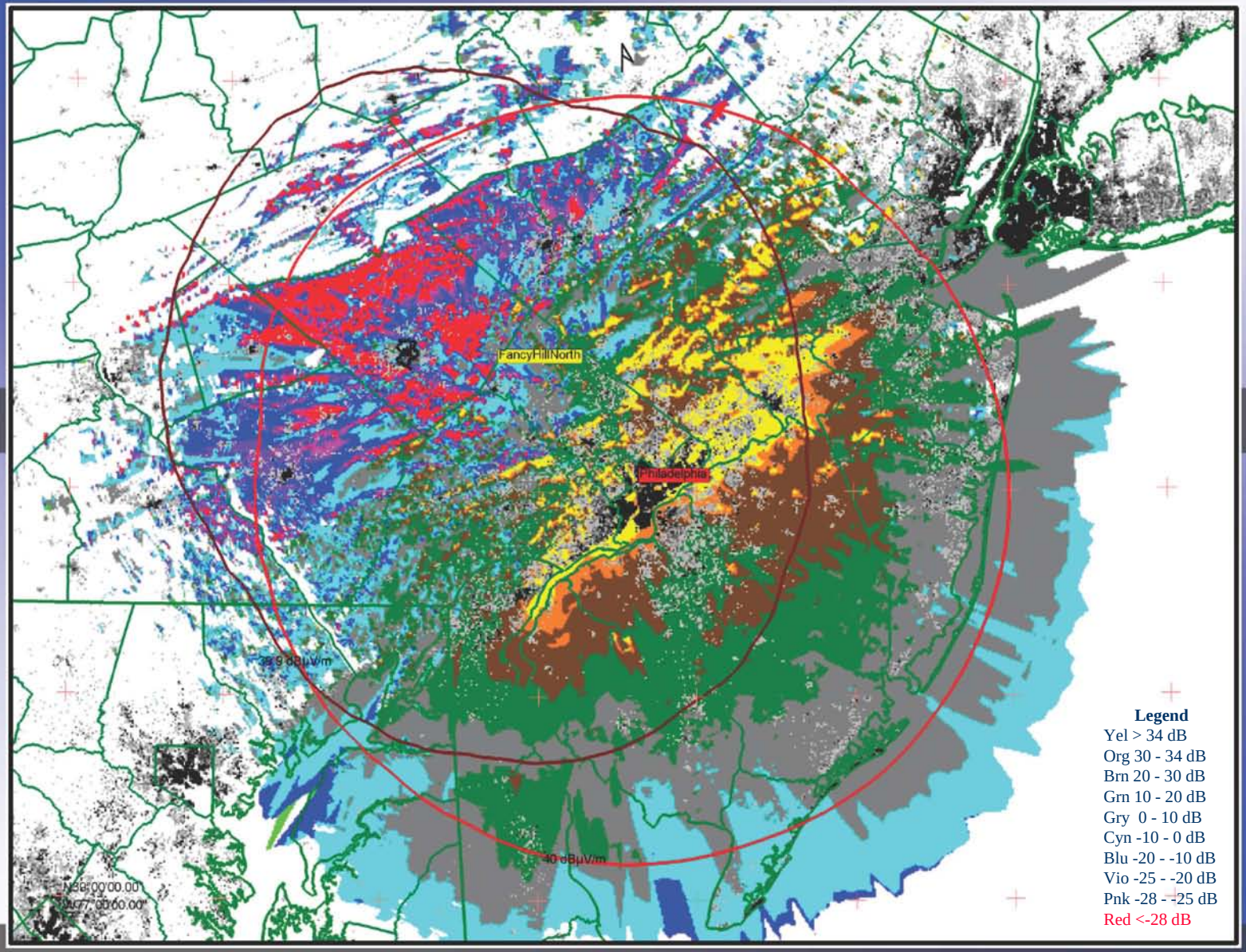
Example: Philadelphia IX to Adjacent Chnl



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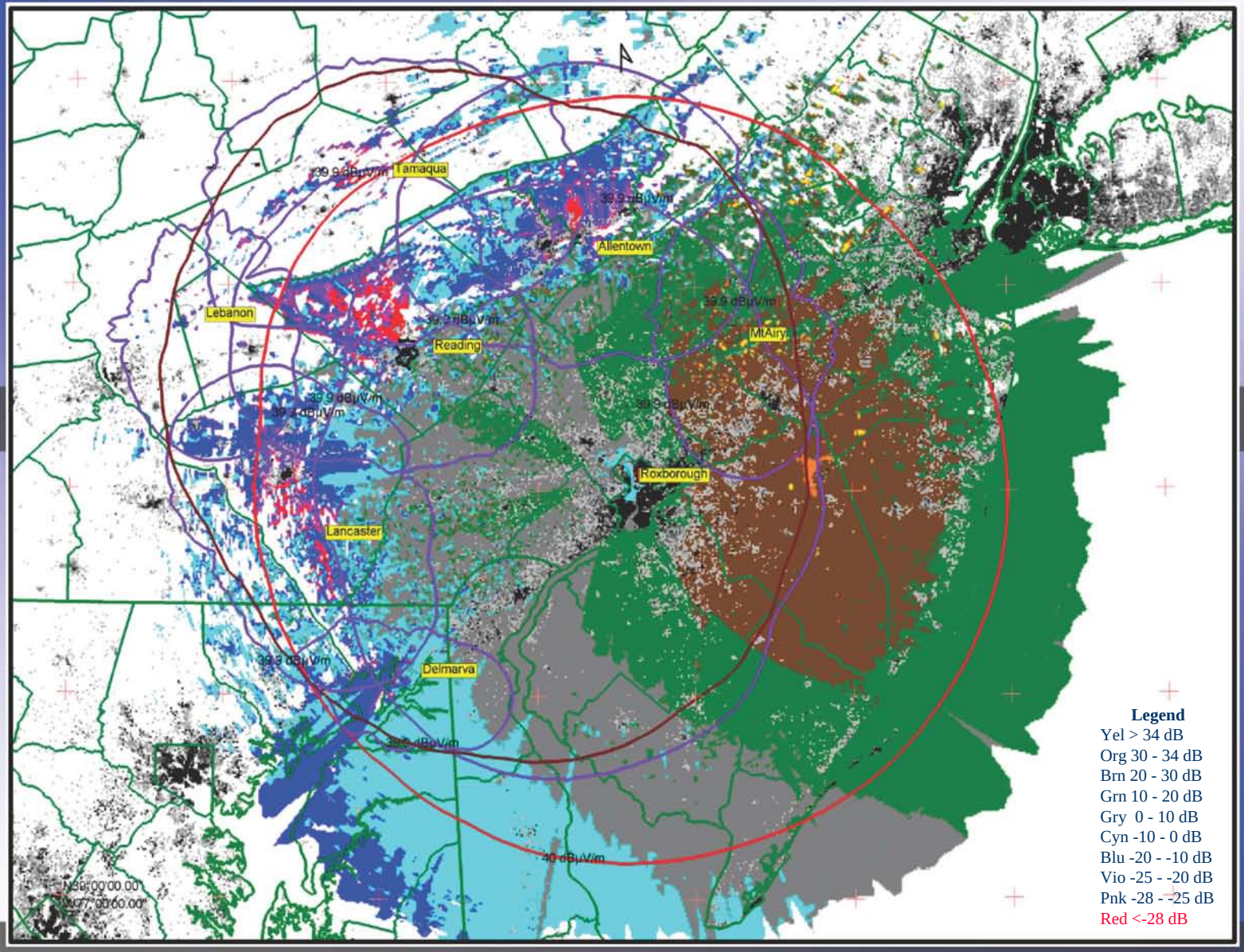
Example: Philadelphia DTx IX to Adj Chnl



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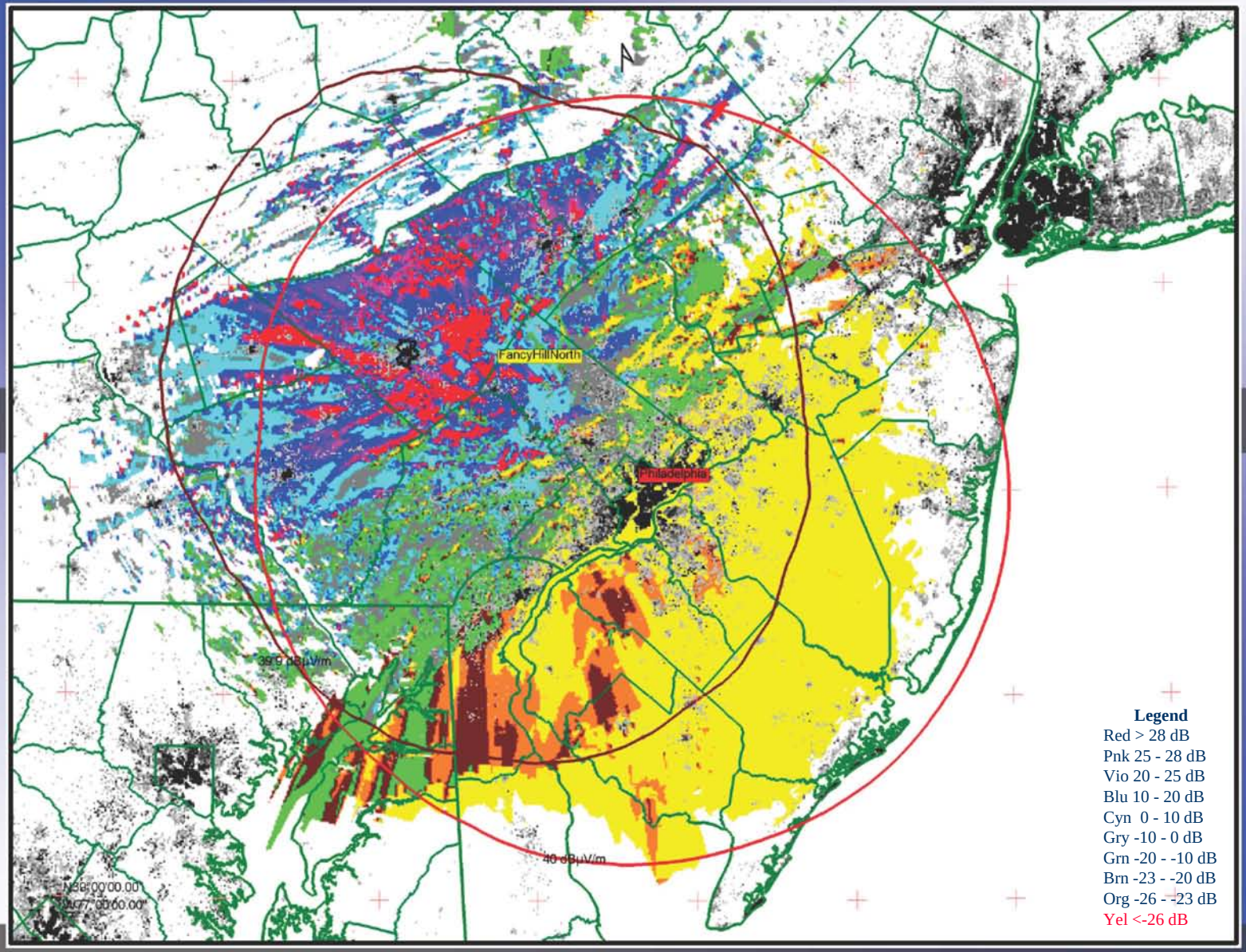
Example: Philadelphia IX from Adj Chnl



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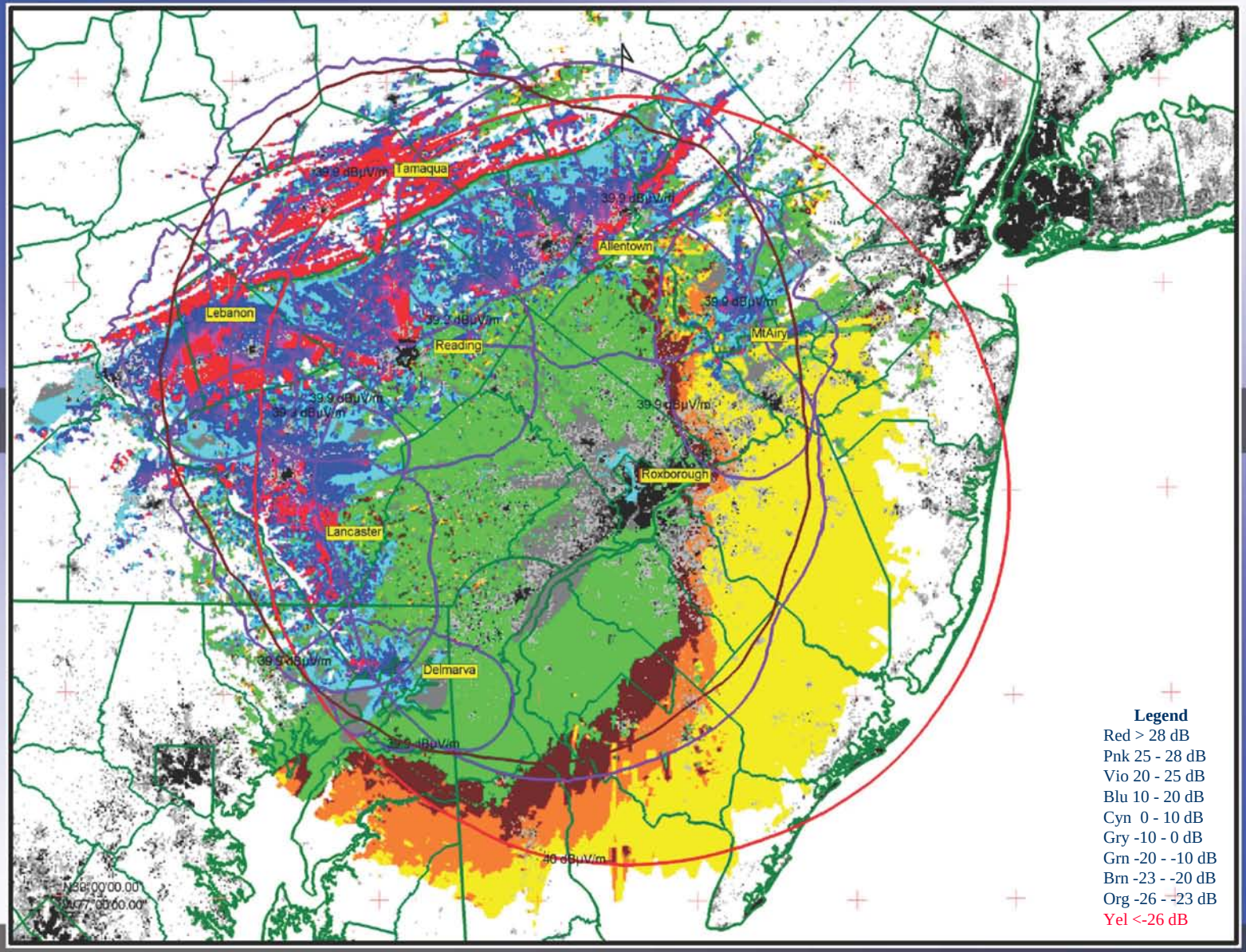
Example: Philadelphia DTx IX from Adj Chnl



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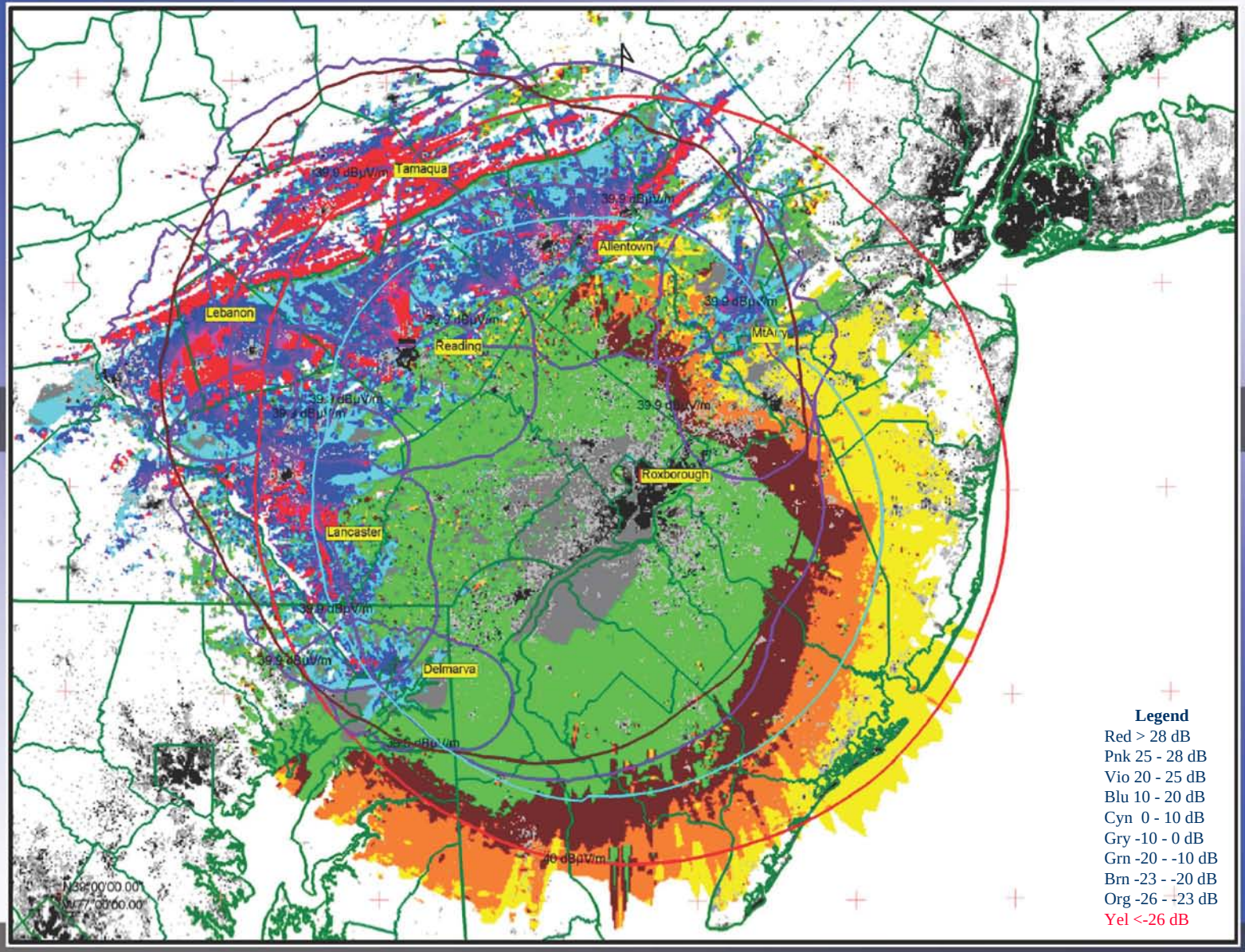
Example: Philadelphia DTx Improved IX



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FCC Interests in Setting DTx Rules

- ✓ FCC Interest in Maximizing Spectrum Efficiency (SPTF)
- ✓ Allowing Stations to Expand Service Areas
  - ✓ Maximizing Spectrum Efficiency by Delivering Greatest Service
  - ✓ Simultaneously Minimizing Additional Interference
- ✓ Permitting Broadcasters to Compete with Cable
  - ✓ Requires Set Top Reception, Hence Strong Signals
  - ✓ Requires Signals Delivered Wherever Carried on Cable
  - ✓ Service Limited by Smallest Aggregated Footprint of Stations
  - ✓ Current Rules Require Must-Carry Throughout DMA

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FCC Interests in Setting DTx Rules (2)

- ✓ Market Sizes Vary Across the Country
  - ✓ Generally Smaller in the East
  - ✓ Generally Larger in the West
- ✓ Broadcasters Concerned About Adjacent Market Encroachment
  - ✓ Could Occur with Large Service Area & Small DMA
- ✓ Optimum Balance is Maximum Service within Station's Market
  - ✓ Permit Maximization with Minimal Constraints
  - ✓ Limited by Market Boundaries (DMA)
  - ✓ Limited by Interference to Other Stations

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Required / Proposed Rule Changes

- ✓ Primary Treatment of Distributed Transmitters
  - ✓ Inclusion in Part 73 vs Part 74 in most instances
    - ✓ No Additional Spectrum Allotment Required
  - ✓ Protect Distributed Xmtr Service Area Same as Main Service
  - ✓ When Distributed Xmtrs Provide Part of Main Service
    - ✓ Filling Gaps in Coverage, Creating Hot Spots
    - ✓ Maximizing Service Area and Population
- ✓ Permit DTV Coverage Area Extensions
  - ✓ More Effective Service Maximization
  - ✓ Proposal for 50% Extension In Each Direction
  - ✓ Distributed Xmtrs Located Within Reference Contours
  - ✓ Population Increase Limited Outside Licensee's DMA

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Required / Proposed Rule Changes (2)

- ✓ Limits for Main Stations Apply to Distributed Xmtrs
  - ✓ Power
  - ✓ Antenna Height
  - ✓ *de minimis* Interference Analysis Serves as Constraint
    - ✓ Same As Single-Tx Facilities After Freeze Is Lifted
- ✓ Locations of Distributed Transmitters
  - ✓ Within Hypothetical Maximized Service Contour
  - ✓ Within Designated Market Area (DMA)
  - ✓ Whichever Extends Farther in Any Given Direction

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Required / Proposed Rule Changes (3)

- ✓ Service Areas Permitted
  - ✓ Always Limited by *de minimis* Rules
  - ✓ Four Choices Provided in Filed Comments
    - ✓ Limitations of Service Contours
    - ✓ Maintain Interference Contours Within Hypothetical IX Contour
  - ✓ Avoiding Encroachment Into Neighboring DMAs
  - ✓ More Than ½ of Population Served Must Be Within DMA
    - ✓ Evaluated for Each Distributed Transmitter
    - ✓ When Extending Outside Hypothetical Maximized Service Contour

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Required / Proposed Rule Changes (4)

- ✓ Eliminate Constraints of Analog Service Rules
  - ✓ Analog Booster Rules Required Contours within Contours
    - ✓ Before Modern IX Analysis Methods Were Available
- ✓ Interference Analysis Methods Extended
  - ✓ Modifications to Current Techniques / Software
  - ✓ Addition of Single Field to FCC Database Records
  - ✓ FCC Software Supplier Involved in Developing These Extensions

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