Columbia Institute
for Tele-Information

Economics of the Digital Transition

Digital Cliff Effects and Mapping of Troubled Reception Areas

Presentation to

CITI Economics of the Digital Transition Event

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Summary The Gap

There is a gap between the government's promise and reality

- The basic message communicated from the government is

  If you get analog OTA TV ok now all you need is a converter box or a new DTV after Feb'09

- However DTV signals are more *fragile* than analog TV and in most cases OTA consumers will lose access to stations post Feb'09 unless they make significant additional investments in new outdoor antenna
- The FCC based OTA DTV coverage analysis on unrealistic assumptions
  - — An outdoor antenna about 30' above the ground
  - —A high performance directional antenna that can be pointed to each station of interest as needed
  - —No consideration of additional impairments due to multipath

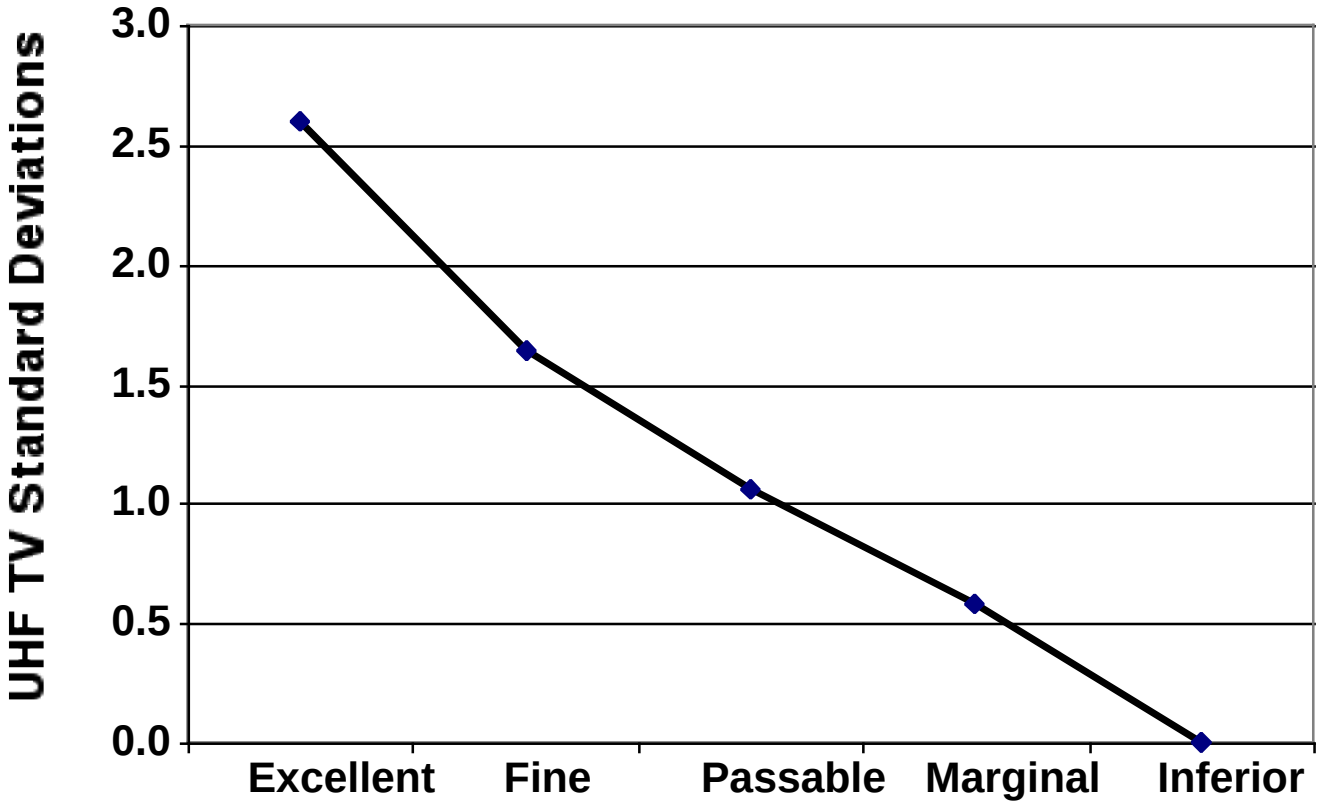
Summary

Our research suggests some important realities are unrevealed

- A combination of the DTV field strength threshold criteria and multipath impairments suggests many households will need to do more than just insert a converter box between their current antenna and their existing analog TV
- At a minimum, some percentage the of 75%+ of households with indoor antennas will likely need to install outdoor antennae and many households with outdoor antennas will need to upgrade.
- Installing or changing an antenna is non-trivial effort and cost
- We estimate that on a nationwide basis, some 9.2 million OTA households (out of 17.4 such households) are located in physical areas where it will only be possible to receive fewer than 5 broadcast stations using simple roof-top antennas.

The Cliff Effect

As analog signals degrade so does the user experience-- gracefully



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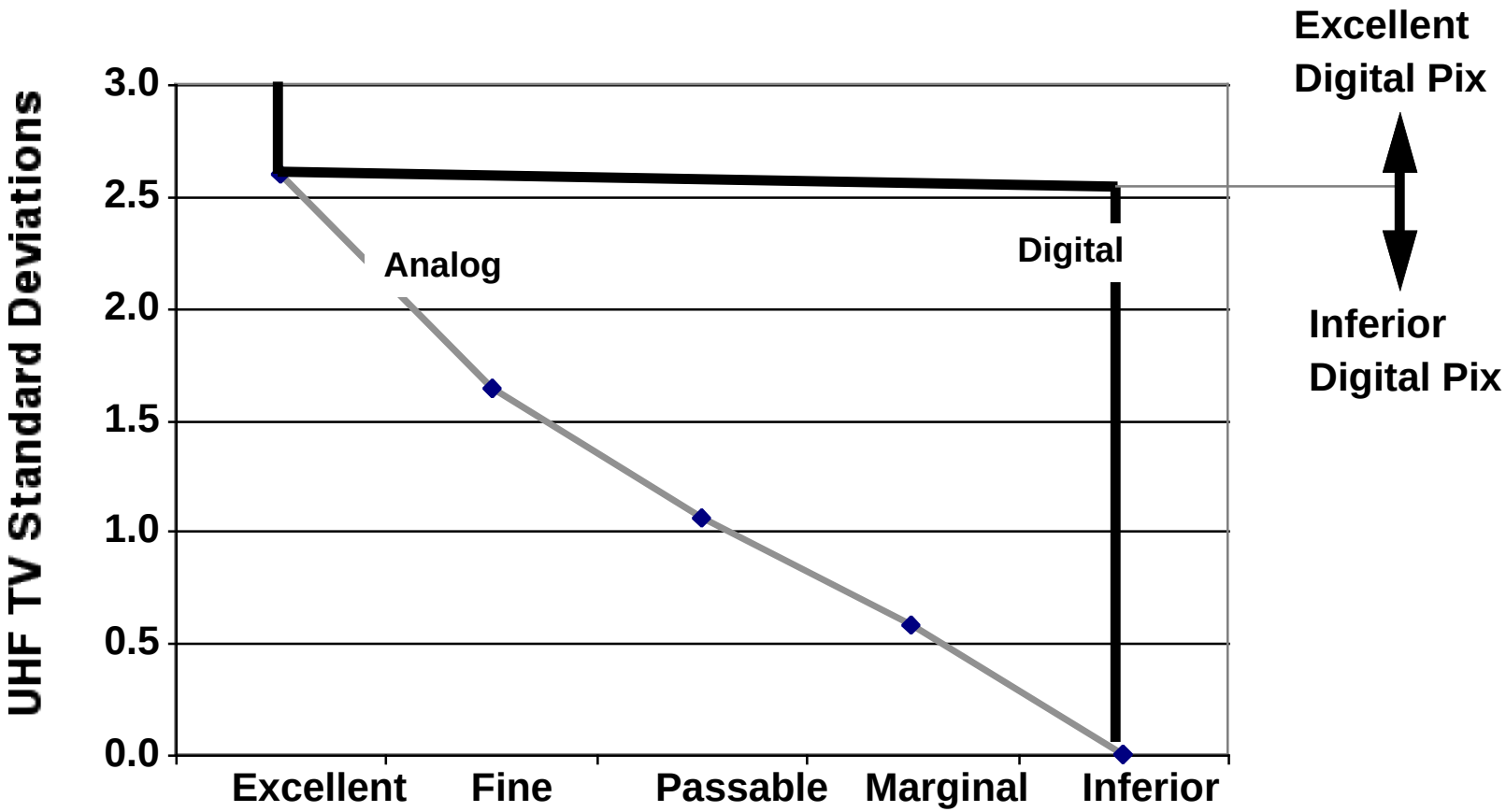
The Cliff Effect

However digital signals have a steep threshold



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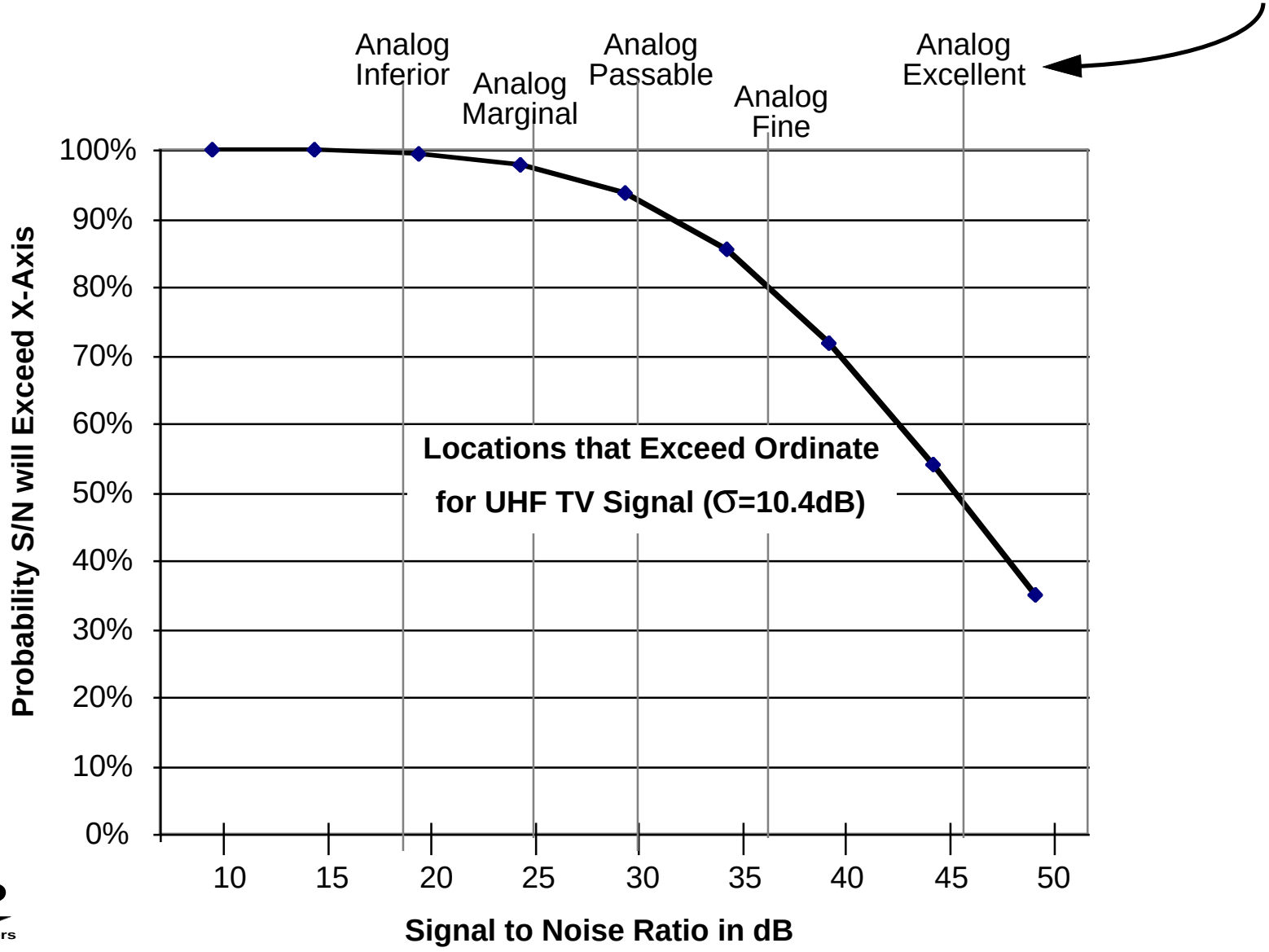
The Cliff Effect

Assume the digital signal is set to match the analog excellent level



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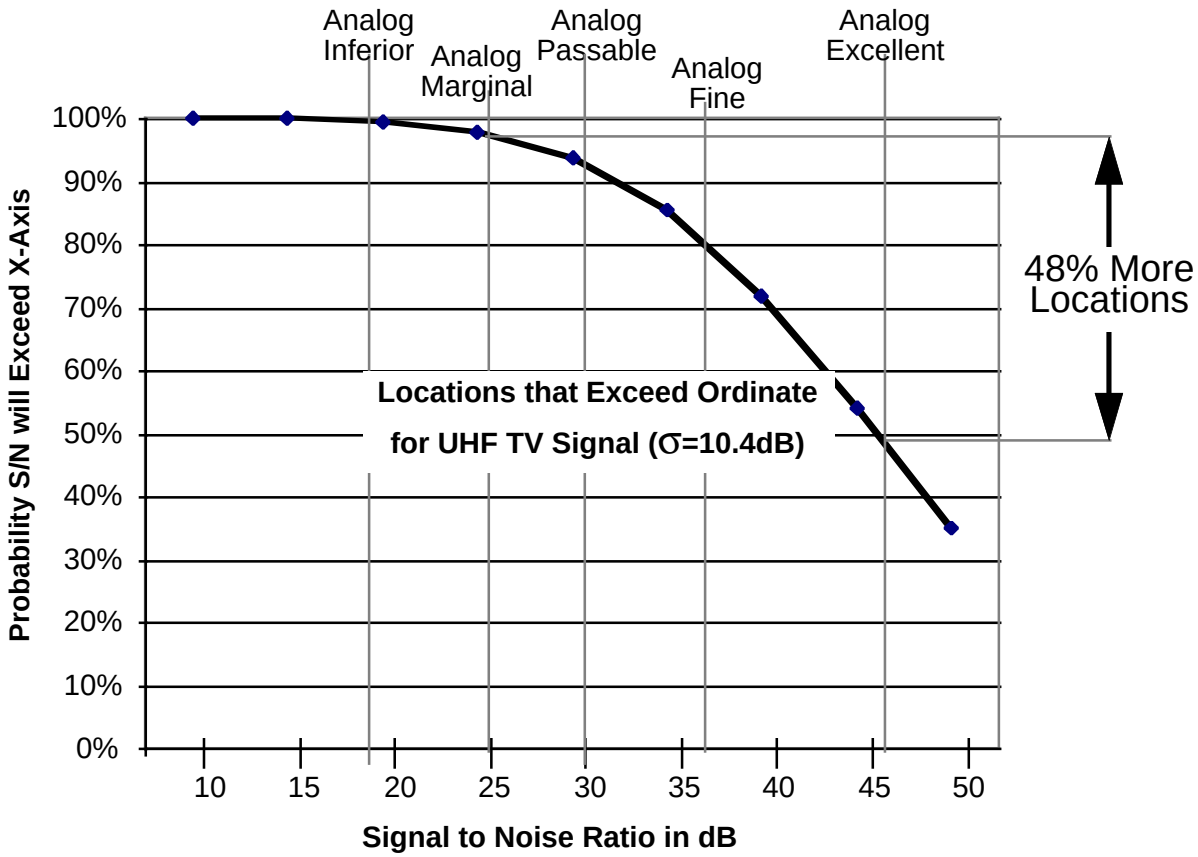
The Cliff Effect

If the digital signal is set to match the analog excellent signal, then



- Assume, for example, that the digital signal level is set to equal an analog level of excellent at 50% of the locations in an area
- Then 80% of the households will have an analog signal of fine or better
- Also 92% of the households will have an analog signal of passable or better
- Also 98% of the households will an analog signal of marginal or better

BUT!

- Only 50% of households will get a perfect digital signal and the other 50% will get nothing

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The Antenna Web Analysis* Overview

We took advantage of an NAB/CEA tool

- NAB and CEA developed and operate the antennaweb.com website as a resource to allow consumers to estimate post DTV transition access to over the air (OTA) TV broadcasts
- AntennaWeb reception estimates are computed from a model based on physics and unlike the FCC's model used for regulatory purposes, AntennaWeb takes into account factors that are more local to specific pathway between the broadcaster and the geo-coordinates of a specific household and makes recommendations on the type of antenna needed to receive specific stations
- Because AntennaWeb makes assumptions that are more specific to the actual pathway versus the FCC data that averages across a wide geographic area; AntennaWeb can be assumed to generally give a better estimate for reception at a specific household

* The Antenna Web analysis work as reported here was performed by IP Action Partners under a subcontract on behalf of Centris

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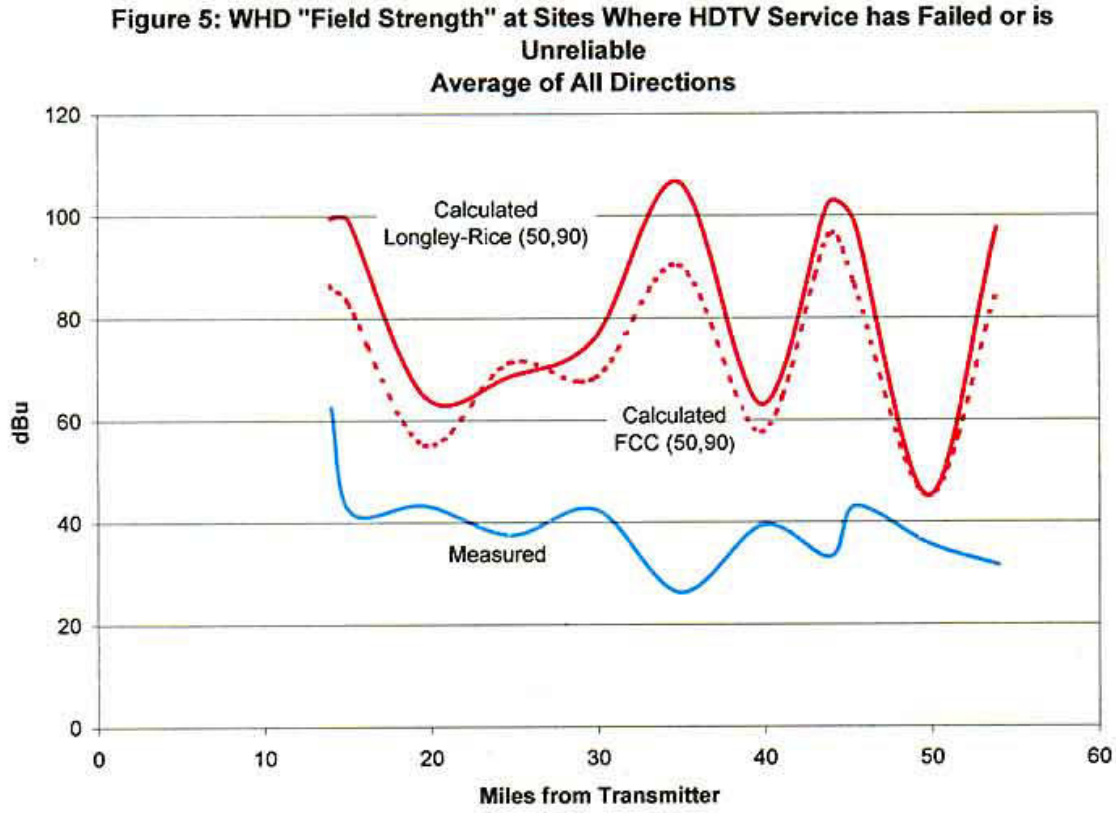
The Antenna Web Analysis Limitations

Based on field measurements studies In Charlotte, NC and in Washington, D.C. reported by Bendov, our analysis is even more optimistic than that of the FCC



Source: DTV coverage and service prediction, measurement and performance indices
Bendov, O.; Browne, J.F.X.; Rhodes, C.W.; Wu, Y.; Bouchard, P.
Broadcasting, IEEE Transactions on
Volume 47, Issue 3, Sep 2001 Page(s):207 - 217

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The Antenna Web Analysis Methodology

FCC Data and Antenna Web were used together as follows:

- We extracted the largest digital TV coverage area from the FCC model—this was a 60 miles radius Philadelphia's TV towers, 75 miles from TV towers in St. Louis and Las Vegas
- We identified all of the Census Block Groups (CBGs) that fell inside the three TV market areas
- We then exercised the AntennaWeb model to determine how many broadcast stations could be received in CBGs. with a small or medium omnidirectional roof-top antenna in five mile increments from the towers.
- We assumed that over-the-air reception would be inadequate if consumers could not receive all of the five major broadcast networks—ABC, CBS, Fox, NBC, PBS.
- Maps were overlaid with estimates of over-the-air households by CBG and by zip code—this will make it possible to assess potential impact of poorer reception areas.

The Antenna Web Analysis Assumptions

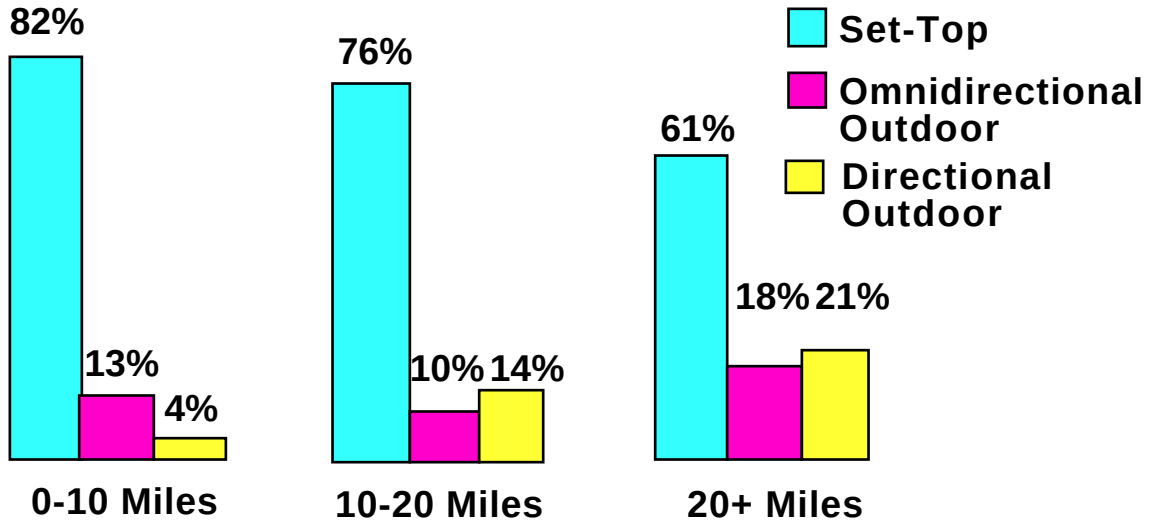
- Assumed that over-the-air reception would be perceived as inadequate by consumers if they could not receive all of the five major broadcast networks—ABC, CBS, Fox, NBC, PBS.
- Assumed that consumers had a roof-top antenna on the second story—in some instances this may be overly optimistic. Census estimates that 32% of US homes are single-story.
- Assumed that consumers had a small or medium roof-top omni-directional antennae. In fact, surveys show that 75%-83% of consumers have indoor set-top antennas; 10%-12% have omni-directional and 10%-12% have directional antennas.
- Going forward, we will be estimating the models using an antenna mix that shifts to more sensitive antennas based upon distance to the tower.
- Maps shown here were based upon very recent updates to the AntennaWeb model that reflects stations moving to full power as of 2/17/09.

The Antenna Web Analysis Assumptions

Although we assumed an outdoor 30' antenna, this was generous

- It is clear from these data that as the distance from the tower increases, antennas shift from indoor or set top antennas to omni-directional and directional antennas. However, most consumers still use indoor antennas (depending upon local terrain).

Antenna Distribution by Distance from Broadcast Towers



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In the maps shown on the following pages we have indicated

- Areas that appear to have poor quality reception and
- Areas that have good quality reception

Findings Areas of Poor Quality Reception

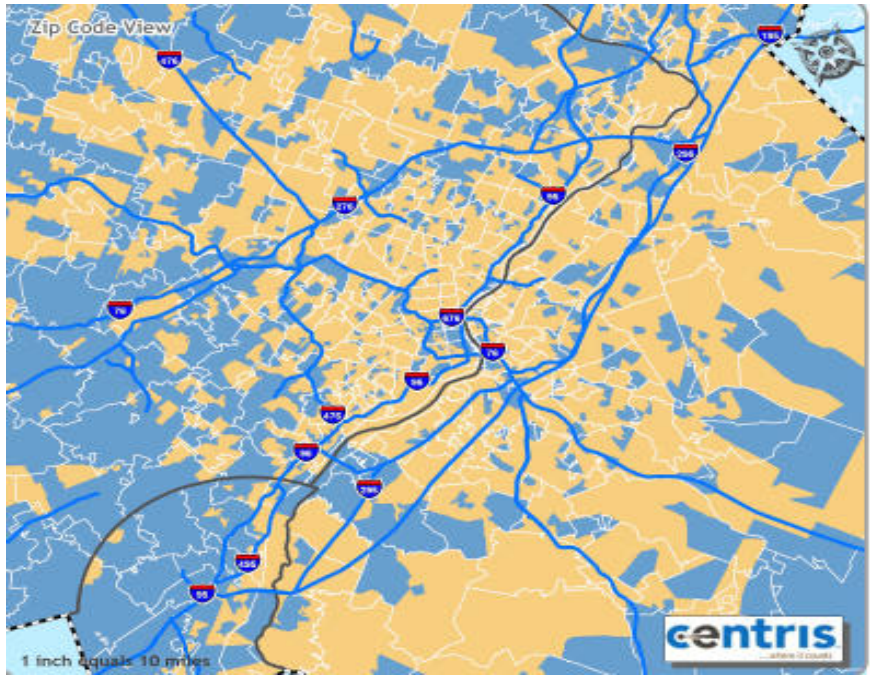
- These areas represent locations that are likely to only be able to receive four or fewer broadcast stations using a small or medium omnidirectional roof-top antenna mounted on the second story.
- According to the design of the model that predicts this reception, 10% of households in these locations will experience this kind of reception difficulty.

Findings Areas of Good Quality Reception

- These areas represent locations that are likely to be able to receive five or or more broadcast stations using a small or medium omnidirectional roof-top antenna mounted on the second story.
- According to the design of the model that predicts this reception, 90% of households in these locations should experience adequate quality of reception.

Findings Areas of Good Quality Reception/ Philadelphia

Blue areas show CBGs in Philadelphia where 4 or fewer digital stations can be received with a modest roof-top antenna while yellow areas can receive 5 or more digital stations



1.52 Million Households in the Philadelphia TV market area only have the potential to receive four or fewer digital stations over-the-air with a modest roof-top antenna—this is 52% of all households in the market.

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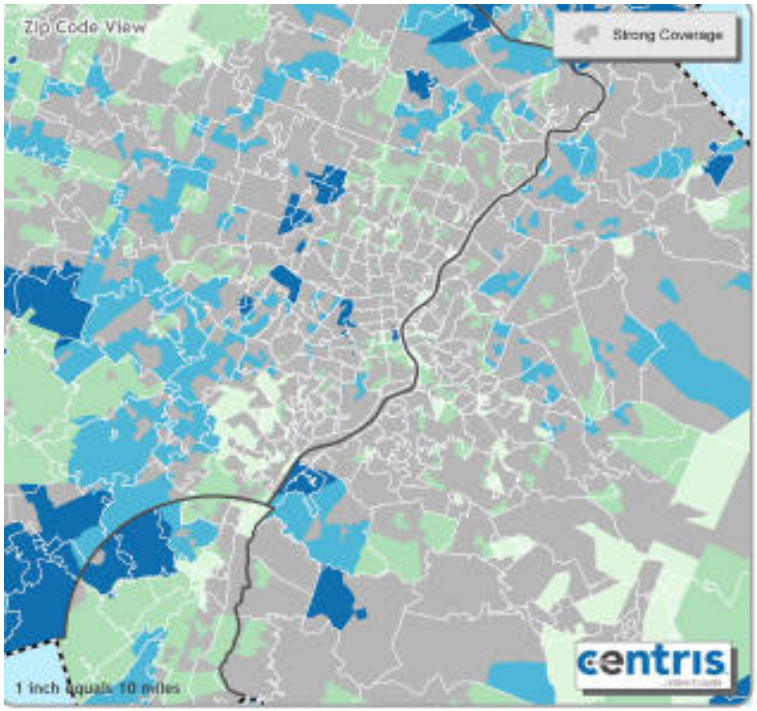
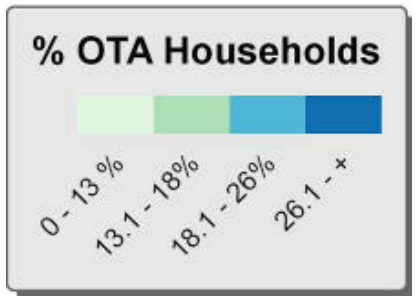
Findings Areas of Poor Quality Reception/ Philadelphia

Gray areas show CBGs in Philadelphia with adequate reception





There are 274,000 over-the-air households in poor reception areas—9.3% of all households in the market—such households may need to upgrade antennas to maintain over-the-air service

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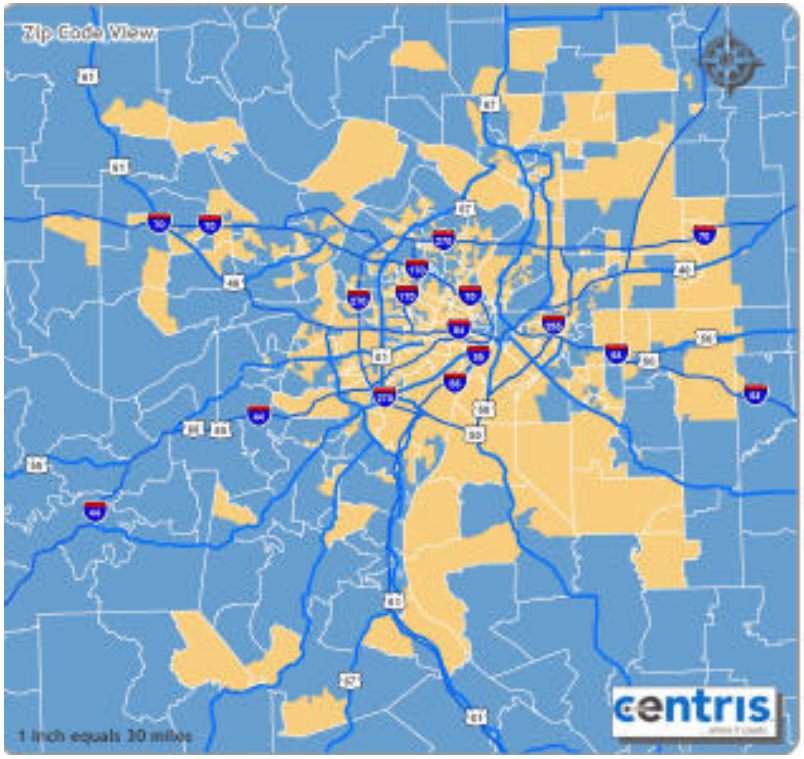
Findings Areas of Good Quality Reception/ St. Louis

Blue areas show CBGs in St. Louis where 4 or fewer digital stations can be received with a modest roof-top antenna while yellow areas can receive 5 or more digital stations



641,000 households in the St. Louis TV market only have the potential receive four or fewer digital stations over-the-air using a modest roof-top antenna—this is 52% of all households in the market.

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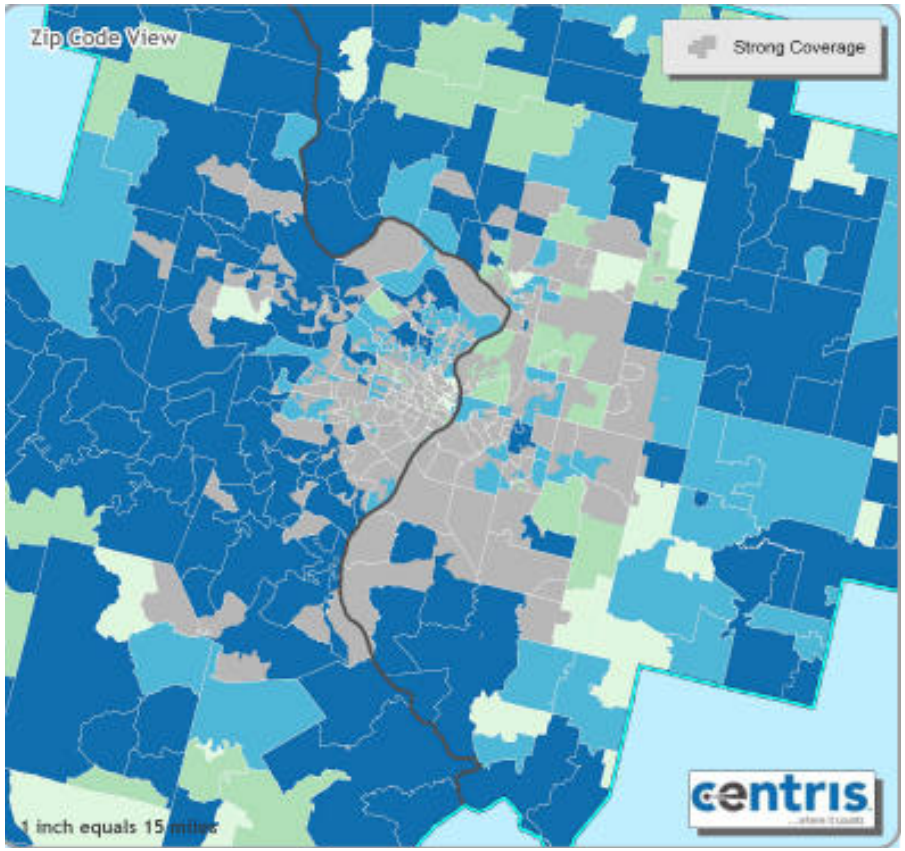
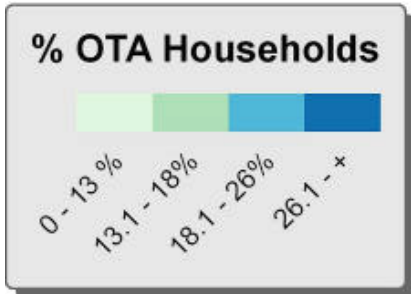
Findings Areas of Poor Quality Reception/ St. Louis

Gray areas show CBGs in St. Louis with adequate reception





There are 79,000 over-the-air households in poor reception areas—6.4% of all households in the market—such households may need to upgrade antennas to maintain over-the-air service

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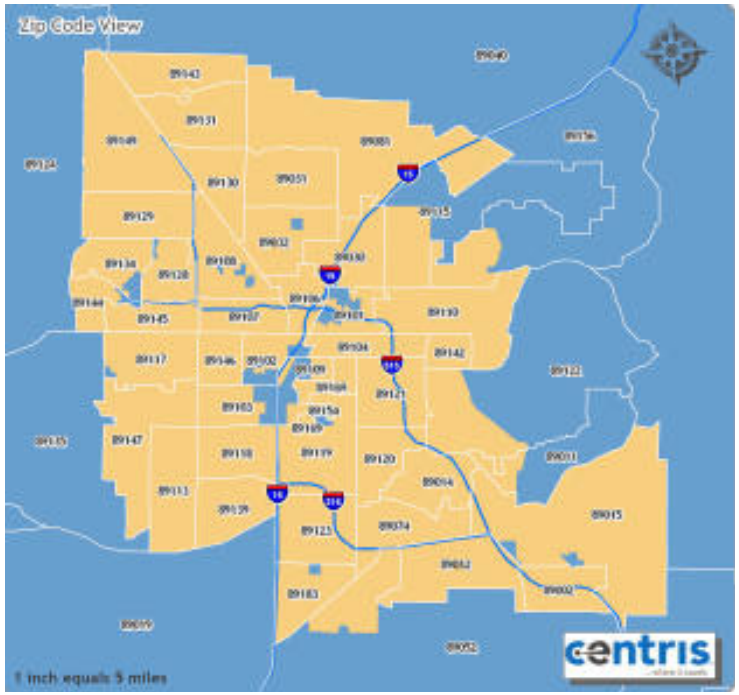
Findings Areas of Good Quality Reception/ Las Vegas

Blue areas show CBGs in Las Vegas where 4 or fewer digital stations can be received with a modest roof-top antenna while yellow areas can receive 5 or more digital stations



107,000 households in the Las Vegas TV market only have the potential receive four or fewer digital stations over-the-air using a modest roof-top antenna—this is 15% of all households in the market.

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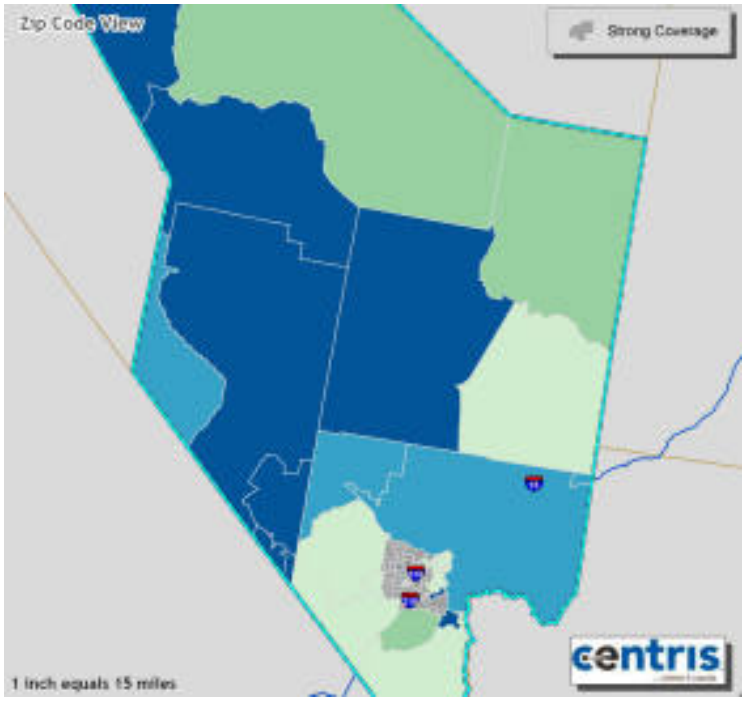
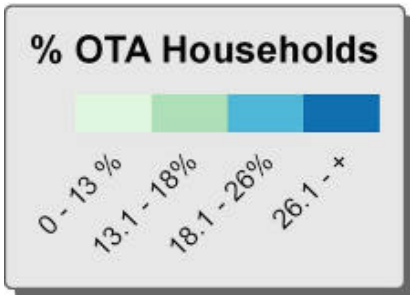
Findings Areas of Poor Quality Reception/ Las Vegas

Gray areas show CBGs in Las Vegas with adequate reception





There are 23,600 over-the-air households in poor reception areas—3.3% of all households in the market such households may need to upgrade antennas to maintain over-the-air service

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Findings Other Top Areas with Poor OTA Reception

The top ten metro areas by number of impacted OTA households with <4 stations

DMA		Nbr Poor HH	Total HH in DMA	Percnt Poor
501	New York	308,128	3,243,863	9%
506	Boston (Manchester)	297,834	1,480,369	20%
504	Philadelphia	275,970	1,450,705	19%
803	Los Angeles	220,279	1,959,407	11%
511	Washington, DC (Hagrstwn)	206,207	1,415,593	15%
819	Seattle-Tacoma	192,896	1,183,867	16%
807	San Francisco-Oak-San Jose	134,179	903,655	15%
613	Minneapolis-St. Paul	132,353	696,096	19%
524	Atlanta	126,405	1,754,048	7%
510	Cleveland-Akron (Canton)	126,393	799,500	16%

Findings Areas of Poor Quality Reception/Qualification

There are however several real-world conditions that contribute to more household experiencing a greater risk of these problems and therefore our findings are likely to be optimistic

- Households having antennas that are less sensitive than small or medium omnidirectional roof-top antennas (i.e., the have indoor antennas). This is true of most households in the US.
- Households having outdoor antennas mounted atop single story dwellings rather than at the level of a second story (32% of dwellings are only single story).
- Locations that are further from the broadcast towers (e.g. further from downtown areas)
- The existence of trees and tall buildings near a residence.

Summary Recap

Our research suggests some important realities are unrevealed

- A combination of the DTV field strength threshold criteria and multipath impairments suggests many households will need to do more than just insert a converter box between their current antenna and their existing analog TV
- At a minimum, some percentage the of 75%+ of households with indoor antennas will likely need to install outdoor antennae and many households with outdoor antennas will need to upgrade.
- Installing or changing an antenna is non-trivial effort and cost
- We estimate that on a nationwide basis, some 9.2 million OTA households (out of 17.4 such households) are located in physical areas where it will only be possible to receive fewer than 5 broadcast stations using simple roof-top antennas.