New Coverage Prediction Methodology for ATSC DTV

CBC Radio-Canada

CCBE 2009 – September 18, 2009 4:30 p.m.

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Summary

- New Standard = New Rules
  - Contour Definitions
  - Interference Ceilings
- Improved Predictability
  - Frequency Adjustment
  - Directional Receiving Antenna
  - Terrain-sensitive Methods

New Standard = New Rules

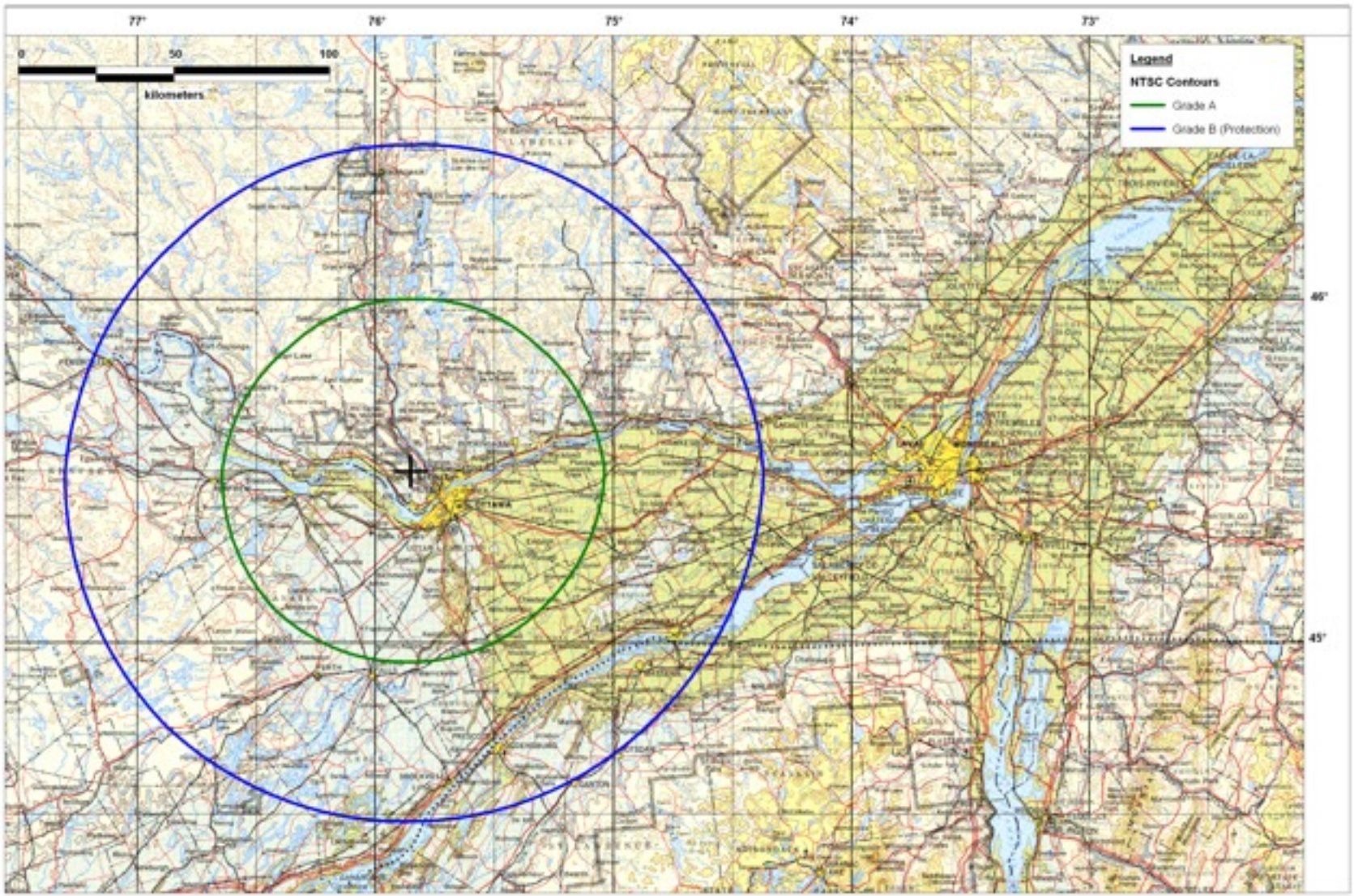
- Contour Definitions
- Interference Ceilings

NTSC Contours

- NTSC Coverage Prediction
  - F(50,50) propagation curves used for service contours prediction
  - 8 standard radials for HAATs[1] and ERP[2]
  - Non-directional antenna assumed in all rules and computation
- Grade A Contour
  - Signal strength sufficient in urban environment
- Grade B Contour
  - Signal strength sufficient in rural environment
  - Also the protected contour of the station

1: HAAT: Height Above Average Terrain
2: ERP: Effective Radiated Power

NTSC


77°
76°
75°
74°
73°
0
50
100
kilometers
Legend
NTSC Contours
Grade A
Grade B (Protection)
46°
45°

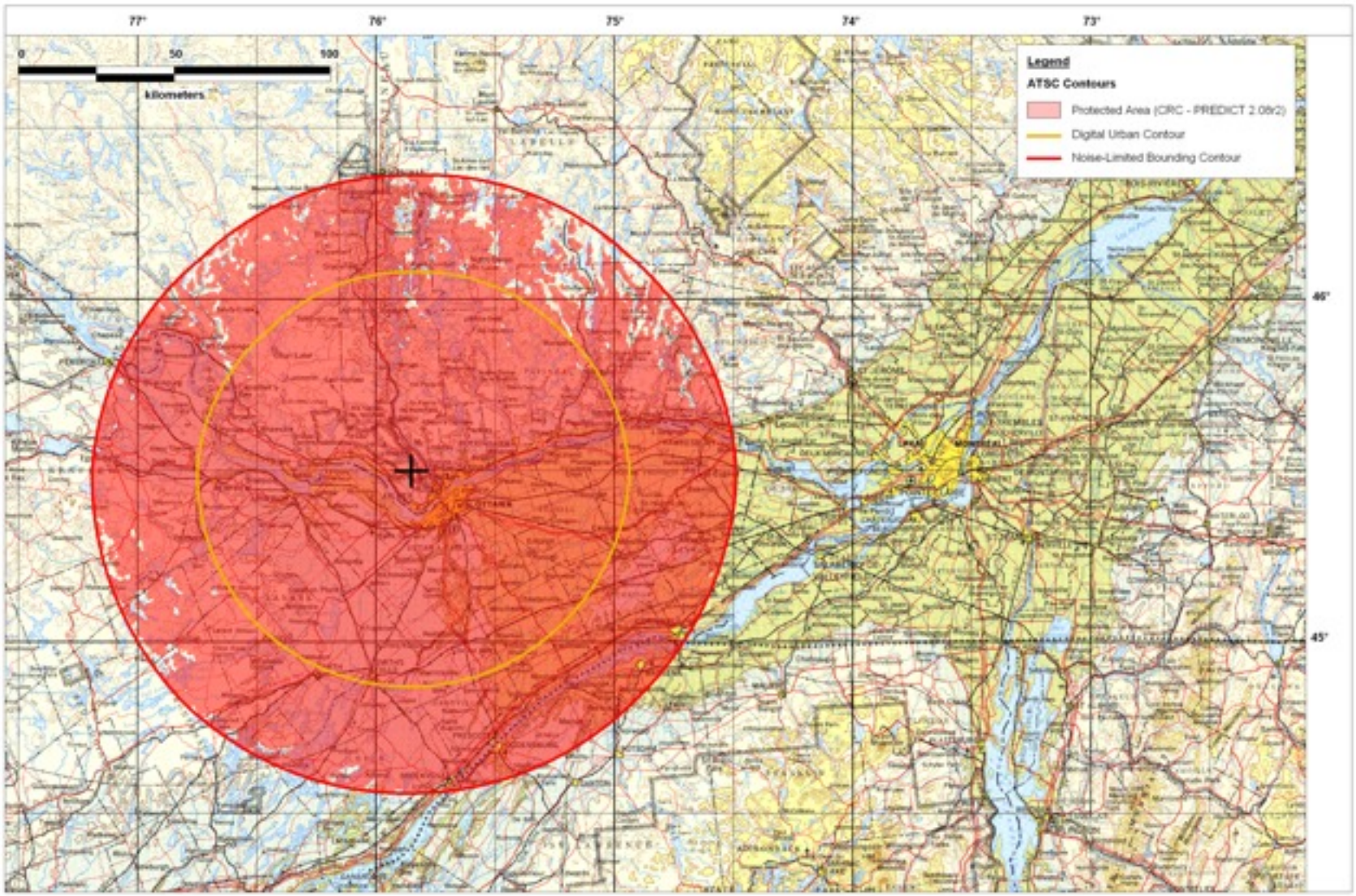
ATSC Contours

- Noise-limited Bounding Contour
  - F(50,90), every degree
    - 24 HAATs (15º), linear interpolation in between
    - 72 ERP (5º), linear interpolation in between
  - Similar to the NTSC Grade B
- Urban Digital Contour
  - F(50,90), every degree
    - 24 HAATs (15º), linear interpolation in between
    - 72 ERP (5º), linear interpolation in between
  - Similar to the NTSC Grade A contour

ATSC Contours

- Protected Area
  - Terrain-sensitive prediction inside the noise-limited bounding contour
  - Represents where the signal can be received in “ideal” conditions
- Coverage Contour
  - Under development, might be removed from the rules & procedures
  - Should represent where the signal can be received in “non ideal” conditions

ATSC


77°
76°
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74°
73°
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45°
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kilometers
Legend
ATSC Contours
Protected Area (CRC - PREDICT 2.08r2)
Digital Urban Contour
Noise-Limited Bounding Contour

Interference Ceilings

- Interference allowed without the impacted station's consent, 4 possible cases
  1. New station
     - Does not cause greater than 0.5% population service loss
  2. Modified use of planned allotment
     - Does not cause greater than 0.5% population service loss
     - If the 0.5% population service loss is already exceeded, no additional population service loss is allowed

Interference Ceilings

3. Protection of vacant allotment
   - Any proposal can cause up to 5% additional population service loss
   - If the vacant allotment loss of population service is already at 20% or more, no additional population service loss is allowed
4. New vacant allotment (addition to the plan)
   - No additional population service loss is allowed

Improved Predictability

- Frequency Adjustment
- Directional Receiving Antenna
- Terrain-sensitive Methods

Frequency Adjustment

- Each UHF channel has its own contour level
  - More precise than a unique value for the whole band as in NTSC

NTSC Grade B vs ATSC Noise-Limited Bounding Contour

Frequency Band	**Channel**	**NTSC Grade B**	**ATSC Noise-Limited Bounding Contour**
		dBuVm 50% Locations 50% Time	dBuVm 50% Locations 90% Time
Low VHF	2-6	47	28
High VHF	7-13	56	36
UHF	14-51	64	**41-20*log(615/f)**

f = Channel central frequency in MHz

Directional Receiving Antenna

- Directional receiving antenna is a major change in the prediction's computations
  - May discriminate between an interfering signal and a desired signal
- Adds complexity to the computations
  - Near side and far side cases
  - In between cases are even more complex
  - Fortunately, computers can take care of the added complexity

Directional Receiving Antenna

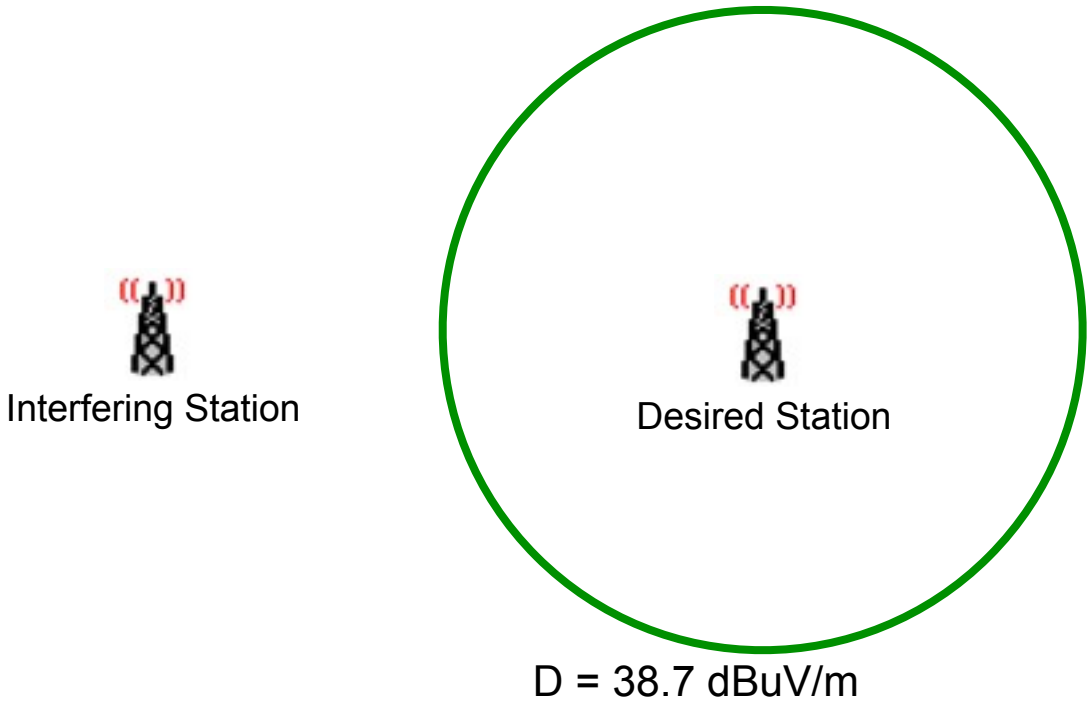
“Near Side” and “Far Side” cases for co-channel interference on channel 14

Interfering Station

Desired Station

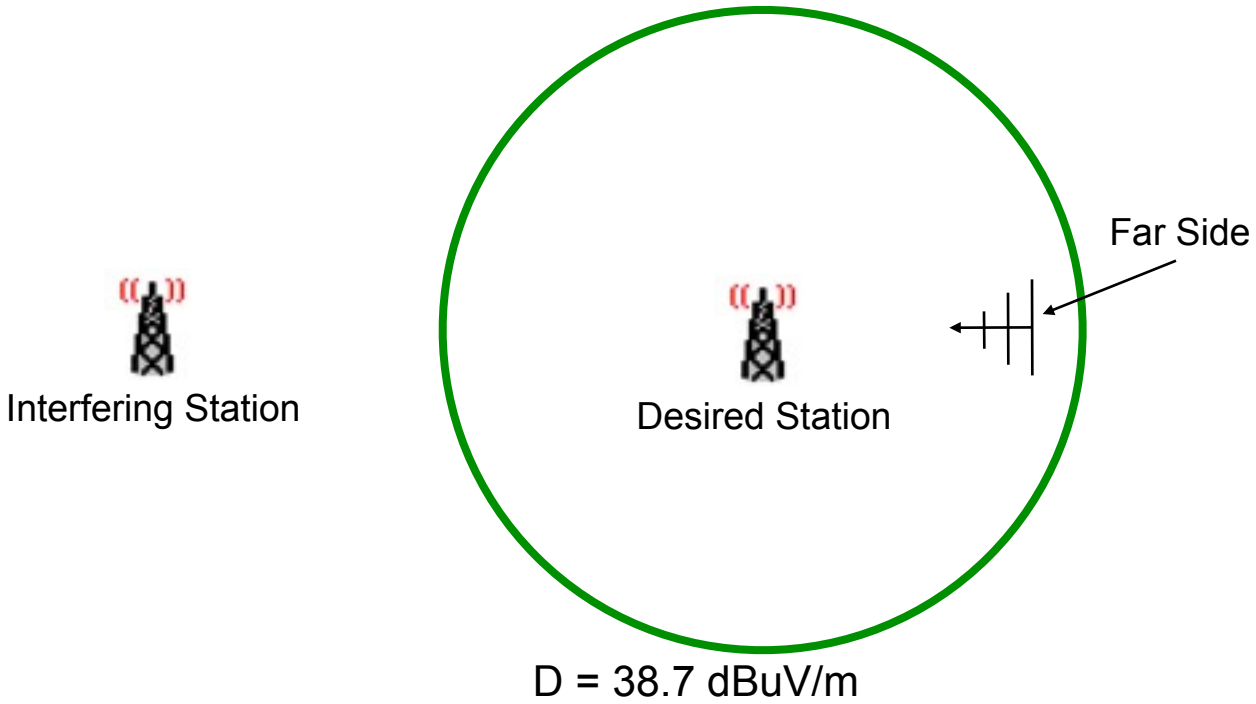
Directional Receiving Antenna

“Near Side” and “Far Side” cases for co-channel interference on channel 14



Directional Receiving Antenna

“Near Side” and “Far Side” cases for co-channel interference on channel 14



Directional Receiving Antenna

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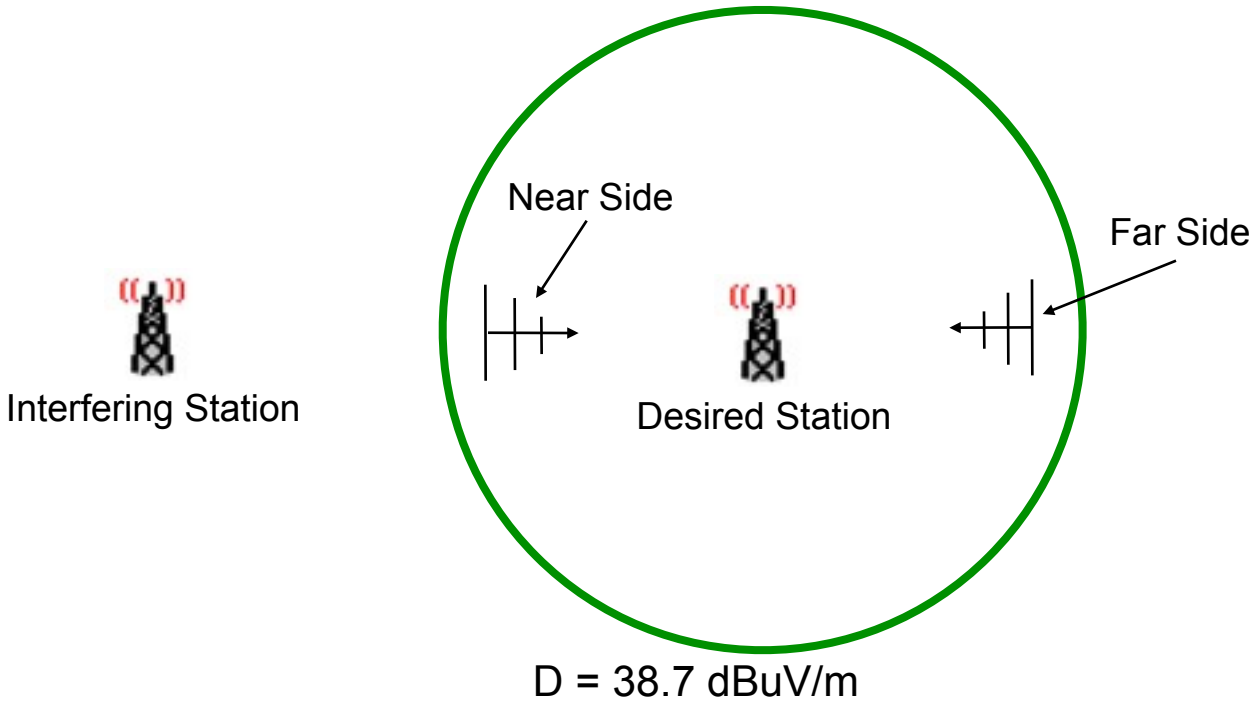
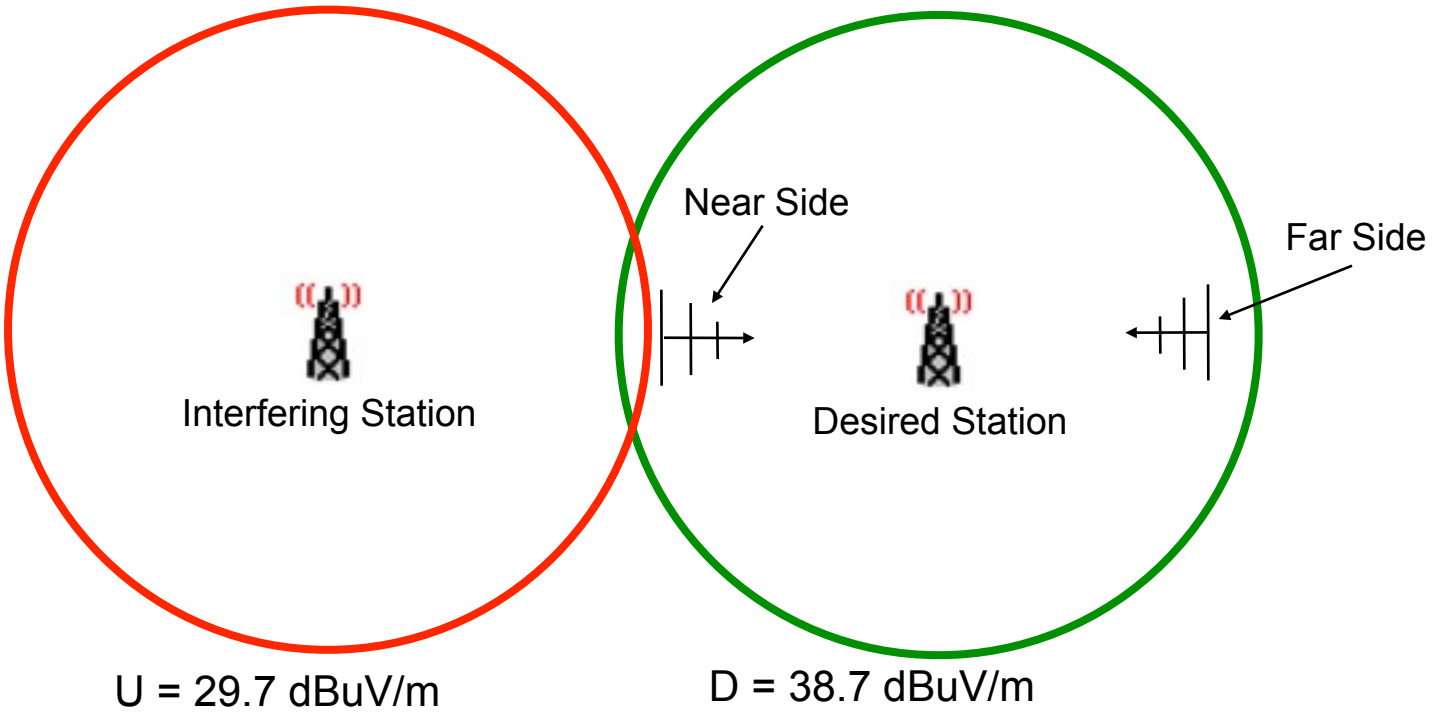


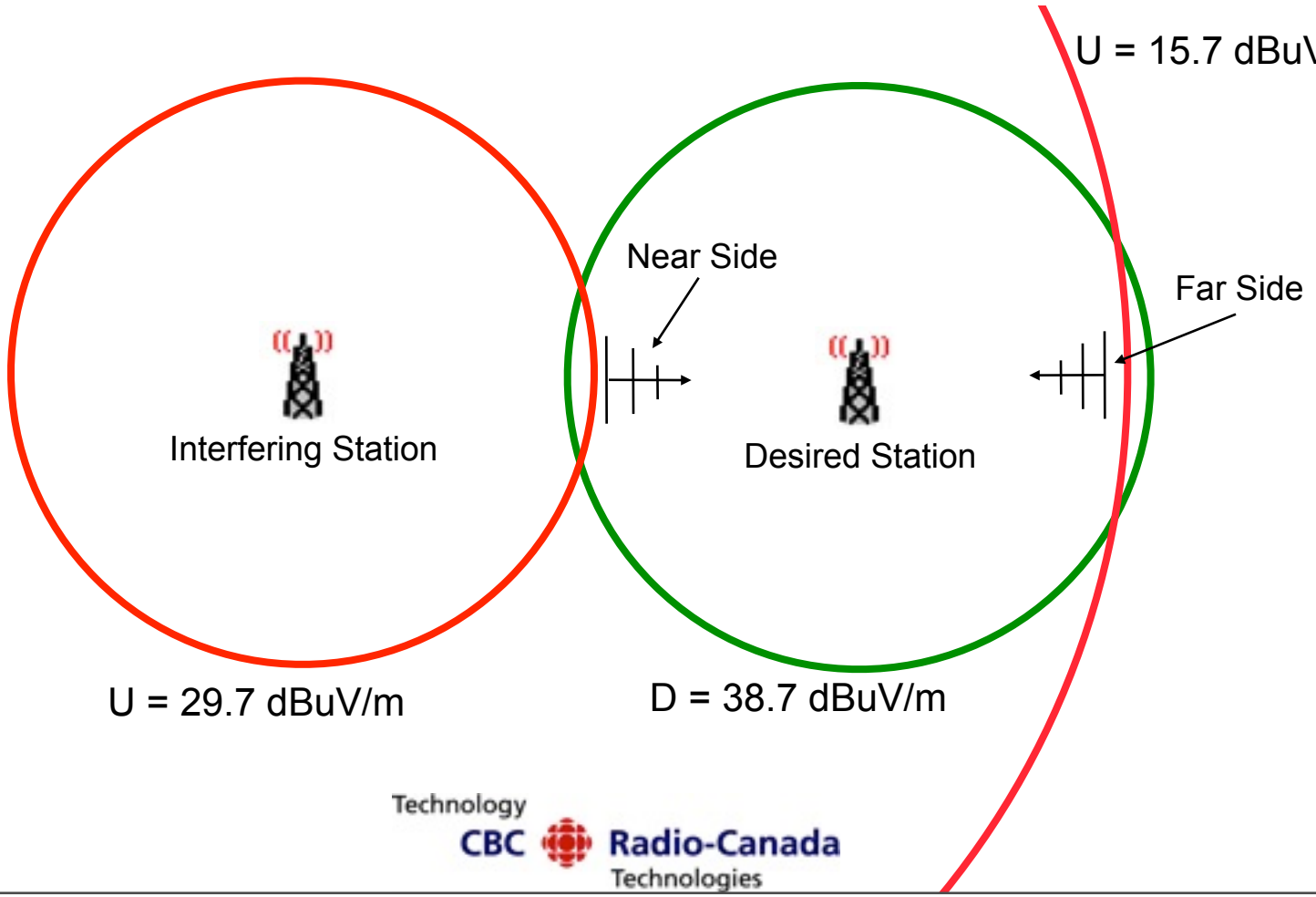
Directional Receiving Antenna

"Near Side" and "Far Side" cases for co-channel interference on channel 14



Directional Receiving Antenna

“Near Side” and “Far Side” cases for co-channel interference on channel 14



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Terrain-sensitive Methods

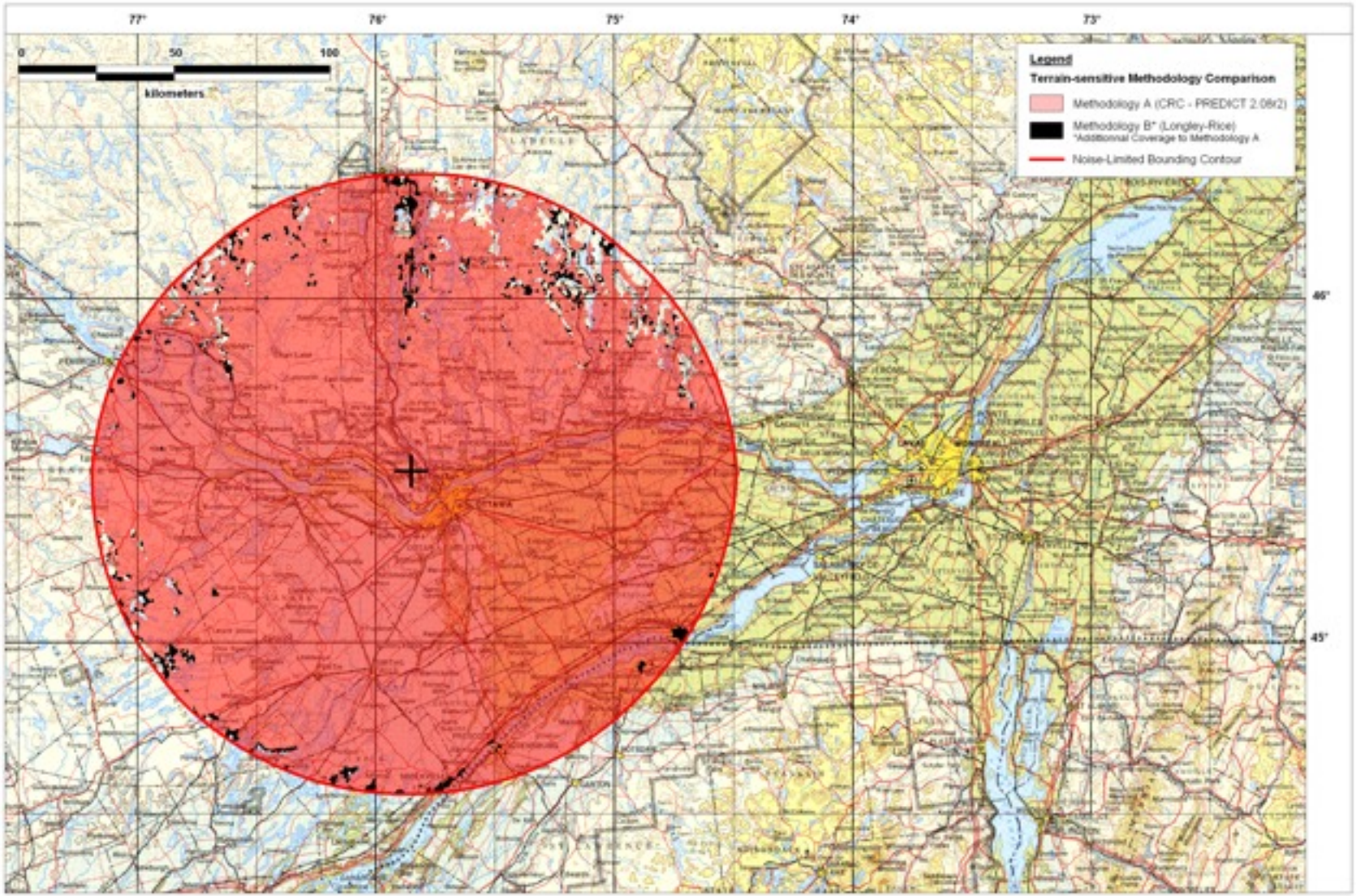
- Most influential factor on TV signal propagation is terrain elevation
- Two main propagation models used in Canada:
  - CRC-PREDICT® & LONGLEY-RICE
- Terrain clutter also has an impact on propagation
  - Propagation models using a clutter database should produce more accurate predictions
  - Not supported by LONGLEY-RICE

Terrain-sensitive Methods

- Other factors that can affect the prediction's precision
  - Cell's size used in the prediction software
  - Resolution and accuracy of the topographic data[1]
  - Resolution and accuracy of the clutter data
  - Resolution and accuracy of the antenna data
- Two predictions done according to the rules and procedures can yield significantly different results

1: Canadian Digital Elevation Data (CDED) is now available in a 0.75 arc seconds to 3 arc seconds resolution (around 20-25m) see: http://www.geobase.ca/geobase/en/data/cded/description.html

Terrain-sensitive Methods



Terrain-sensitive Methods

	Method A	Method B
Propagation Model	CRC-PREDICT® 2.08r2	LONGLEY-RICE 1.2.2
Cell Size	500m x 500m	1km x 1km
Topography Data	Computamaps ®	CRC (500m)
Clutter Data	Computamaps ®	None
Population Count	1 466 124	1 510 805
Difference	**44 681 (3%)**	

Conclusions

- New elements included in the rules and procedures give more precision to the predictions
  - More precision for antenna patterns and topographic data
  - Terrain-sensitive propagation models
- The noise-limited bounding contour and the protected area are NOT service contours
  - Represent the coverage in an “ideal world”
  - Serve for interference management

Conclusions

- The rules and procedures have a certain degree of flexibility in the protected area computation
  - Can affect the population count
  - Creates a “grey zone” in the interference ceiling computations
- Service contour still under development
  - Should reflect “real world” coverage

Questions ?

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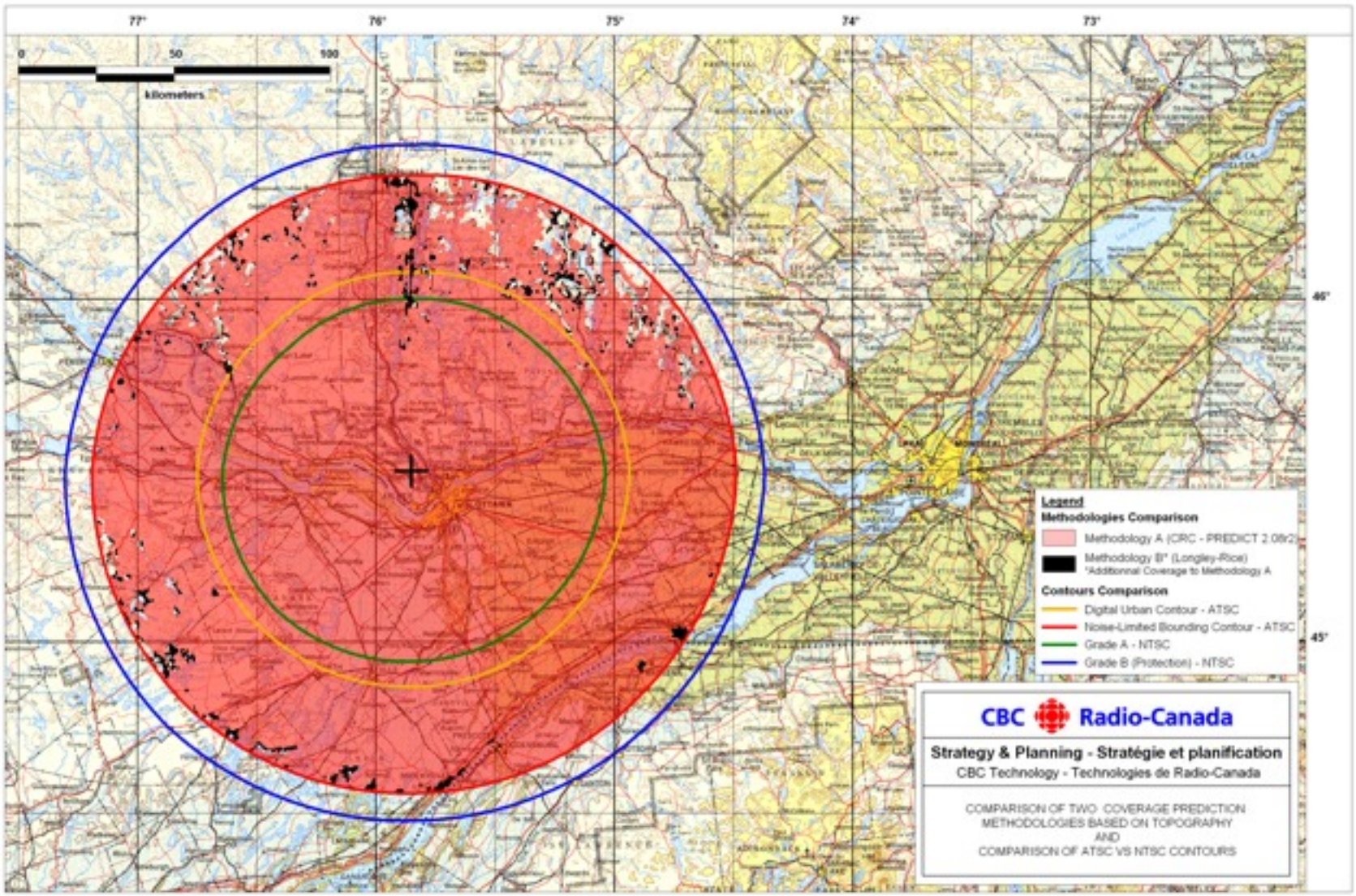
Questions ?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Methodologies Comparison
Methodology A (CRC - PREDICT 2.08r2)
Methodology B* (Longley-Rice)
*Additionnal Coverage to Methodology A
Contours Comparison
Digital Urban Contour - ATSC
Noise-Limited Bounding Contour - ATSC
Grade A - NTSC
Grade B (Protection) - NTSC
CBC Radio-Canada
Strategy & Planning - Stratégie et planification
CBC Technology - Technologies de Radio-Canada
COMPARISON OF TWO COVERAGE PREDICTION METHODOLOGIES BASED ON TOPOGRAPHY AND COMPARISON OF ATSC VS NTSC CONTOURS