CCBE 2009

Revisiting Field Strength Requirements for DTV

CBC Radio-Canada

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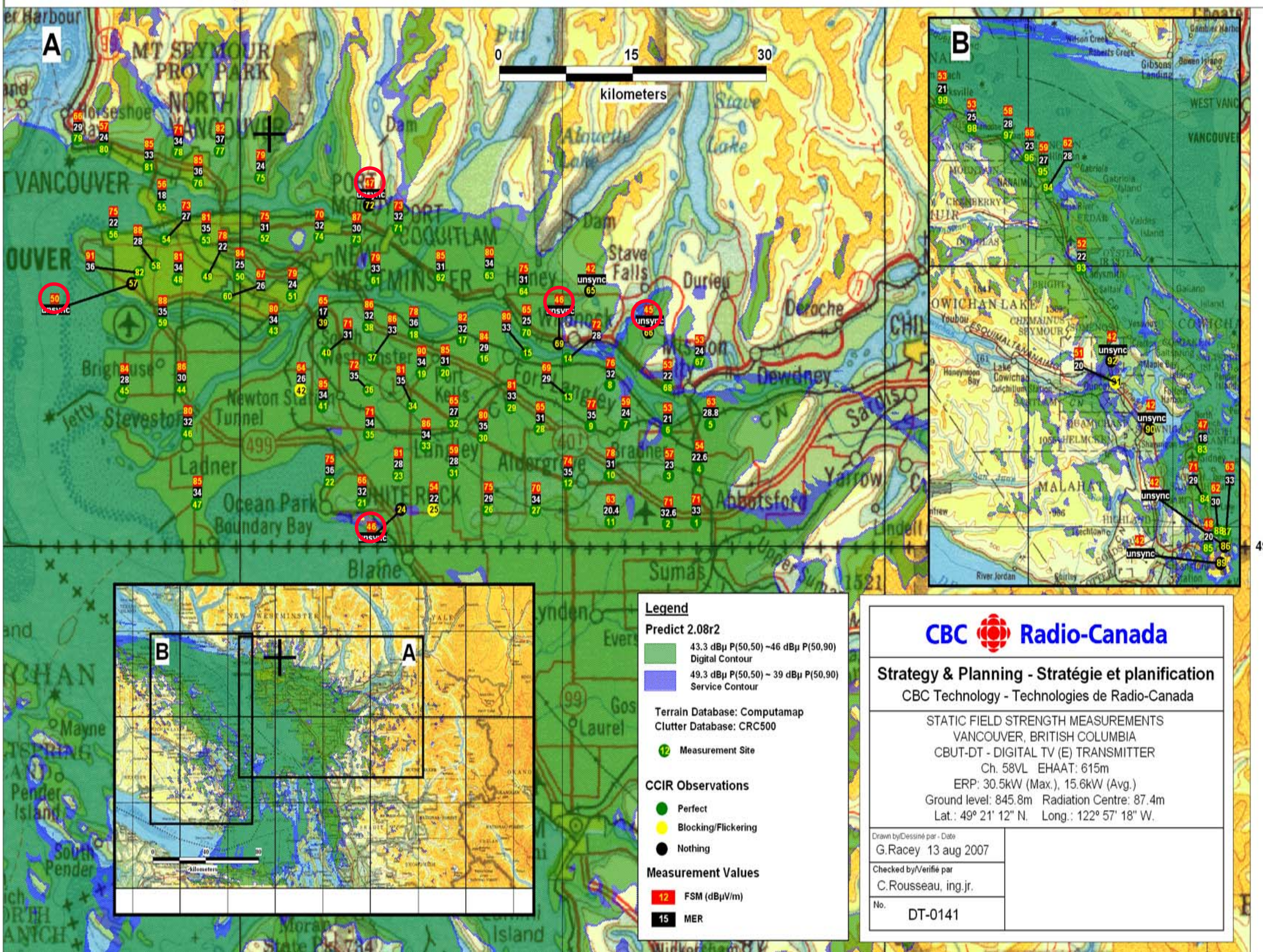
THE SCOOP!

- UHF DTV “Grade B”: 41 => **48** dBuV/m
- UHF DTV “Grade A”: 61 => **65** dBuV/m
- H-VHF DTV “Grade B”: 36 => **42** dBuV/m
- H-VHF DTV “Grade A”: 60 => **68** dBuV/m

HOW TO GET THERE!

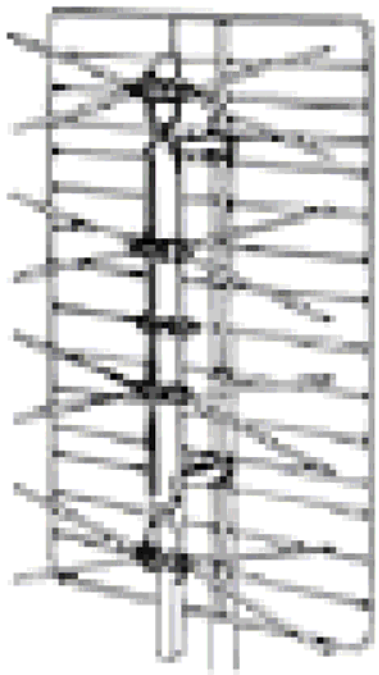
- TRIGGER
- INVESTIGATION & RESULTS
- IMPACT
- CONCLUSION & NEXT STEPS


A
B
0
15
30
kilometers
Legend
Predict 2.08r2
43.3 dBµ P(50,50) ~46 dBµ P(50,90) Digital Contour
49.3 dBµ P(50,50) ~ 39 dBµ P(50,90) Service Contour
Terrain Database: Computamap
Clutter Database: CRC500
Measurement Site
CCIR Observations
Perfect
Blocking/Flickering
Nothing
Measurement Values
FSM (dBµV/m)
MER
CBC Radio-Canada
Strategy & Planning - Stratégie et planification
CBC Technology - Technologies de Radio-Canada
STATIC FIELD STRENGTH MEASUREMENTS
VANCOUVER, BRITISH COLUMBIA
CBUT-DT - DIGITAL TV (E) TRANSMITTER
Ch. 58VL EHAAT: 615m
ERP: 30.5kW (Max.), 15.6kW (Avg.)
Ground level: 845.8m Radiation Centre: 87.4m
Lat.: 49° 21' 12" N. Long.: 122° 57' 18" W.
Drawn by/Dessiné par - Date
G.Racey 13 aug 2007
Checked by/Verifié par
C.Rousseau, ing.jr.
No.
DT-0141

THE ORIGIN of 41 dBuV/m

Planning Factor	Symbol	Low VHF	High VHF	UHF
Geometric Mean Frequency (MHz)	F	69	194	615
Dipole Factor (dBm-dBµV/m)	K_d	-111.8	-120.8	-130.8
Dipole Factor Adjustment	K_a	None	None	See Text
Thermal Noise (dBm)	N_t	-106.2	-106.2	-106.2
Antenna Gain (dBd)	G	4	6	10
Downlead Line Loss (dB)	L	1	2	4
System Noise Figure (dB)	N_s	10	10	7
Required Carrier to Noise Ratio (dB)	C/N	15	15	15

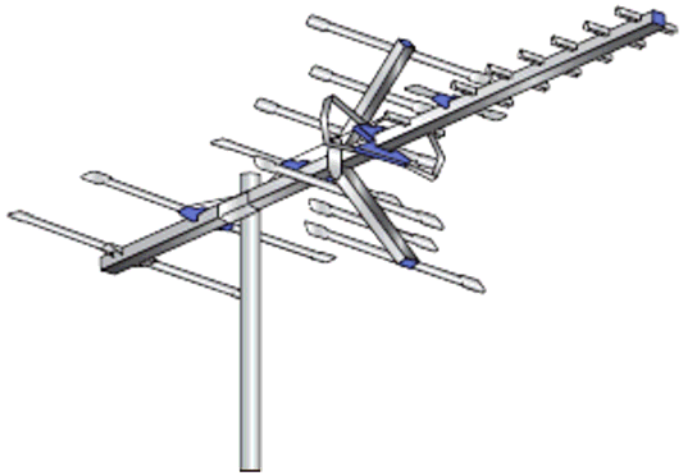
UHF 4 Bow-Tie



UHF

- Gain (specs): 10 dBd
- Measured gain: 7.5 dBd
- Return loss: 15.5 dB

High-VHF & UHF Yagi



High-VHF

- Gain (specs): 4.1 dBd
- Measured gain: 1.9 dBd
- Return loss: 5.1 dB

UHF

- Gain (specs): 7.2 dBd
- Measured gain: 3.5 dBd
- Return loss: 13.7 dB

Indoor Log-Periodic & Rabbit ears

Low-VHF

- Measured gain: -5.3 dBd
- Return loss: 4.5 dB

High-VHF

- Measured gain: -8.8 dBd
- Return loss: 7.9 dB

UHF

- Measured gain: 1.5 dBd
- Return loss: 18.3 dB

Indoor square panel

Low-VHF

- Measured gain: -32.3 dBd
- Return loss: 4.3 dB

High-VHF

- Measured gain: -20.2 dBd
- Return loss: 9.3 dB

UHF

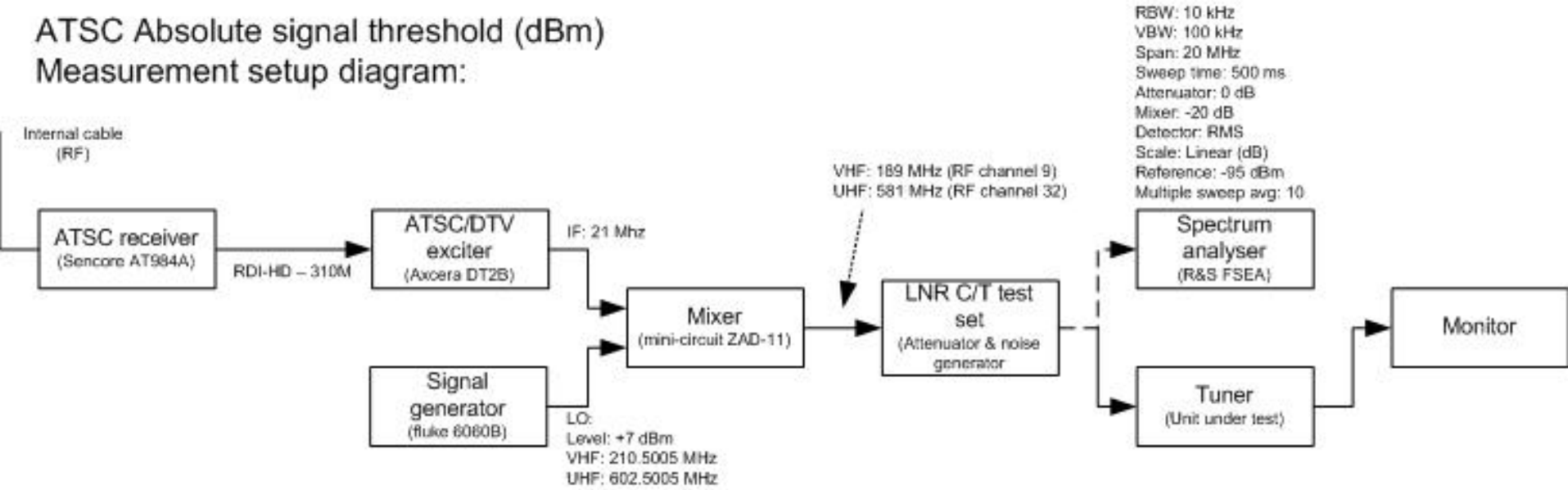
- Measured gain: -6.8 dBd
- Return loss: 12.0 dB

Consumer antenna summary

- Gain 2.9 dB below specs on average
  - Mismatch loss: 0.5 to 1.8 dB
  - 300 ohms => 75 ohms balun loss : 1 to 2 dB
- Return loss:
  - High-VHF : 9.3 dB on average
  - UHF: 12.9 dB on average
- Compares with other studies

ATSC RX NOISE FIGURE & C/N TEST SETUP

ATSC Absolute signal threshold (dBm)
Measurement setup diagram:



ATSC RX NOISE FIGURE & C/N

Manufacturer	Model	Mode	Effective noise figure (dB)	Large signal C/N treshold
LG	LST-4200A	UHF (chanel 32)	7.7 dB	15.0 dB
		VHF (channel 9)	6.9 dB	
Zenith	DTT901	UHF (chanel 32)	8.4 dB	14.0 dB
		VHF (channel 9)	6.1 dB	
Samsung	LN-T1953H	UHF (chanel 32)	6.0 dB	17.0 dB
		VHF (channel 9)	6.1 dB	
Samsung	SIR-T451	UHF (chanel 32)	10.3 dB	15.0 dB
		VHF (channel 9)	9.5 dB	
OnAir USB	NA	UHF (chanel 32)	14.6 dB	15.4 dB
		VHF (channel 9)	11.7 dB	
Panasonic	TH-50PZ800U	UHF (chanel 32)	7.2 dB	15.1 dB
		VHF (channel 9)	7.2 dB	
Samsung	DTB-H260f	UHF (chanel 32)	6.9 dB	15.1 dB
		VHF (channel 9)	13.2 dB	
		UHF average:	7.2 dB	15.2 dB
		High-VHF average:	7.9 dB	

ATSC RX RETURN LOSS

Channel	Panasonic TV	Samsung TV	Samsung STB	Avg all RX
10	10.1 dB	11.1 dB	9.8 dB	10.3 dB
14	10.7 dB	6.3 dB	11.6 dB	
19	1.7 dB	5.6 dB	13.2 dB	
25	9.8 dB	6.1 dB	14.8 dB	
51	15.8 dB	13.1 dB	4.8 dB	
Avg UHF:	9.5 dB	7.7 dB	11.1 dB	9.4 dB

CABLES & “LNAs”

- RG-6 : 75 ft cable
  - ✓4 dB loss @ UHF (615 MHz)
  - ✓2 dB loss @ H-VHF (194 MHz)
  - ✓Planning criteria are OK

- 11 “LNAs” tested
  - Specs from 2.2 dB to 7.5 dB Noise figure (NF)
  - Real performance from 2.8 dB to **28 dB** NF
  - 2 out of 11 working as per specifications
  - Can’t rely on Consumer LNAs to help

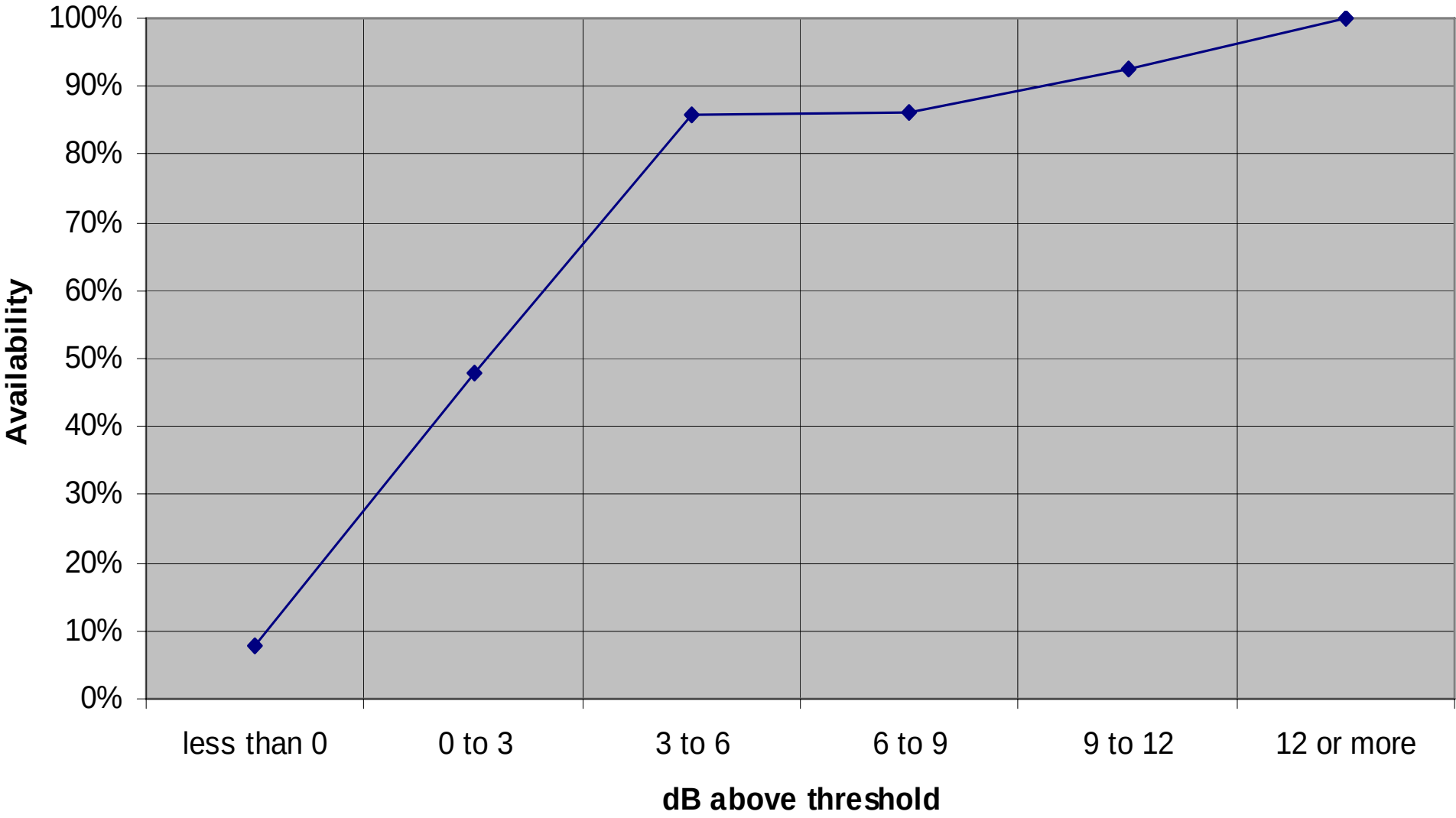
DIGITAL GRADE A ASSUMPTIONS

- Same receivers
- Indoor antenna
- Shorter cable (10 ft RG-59)
- Height Loss (from 9.1 m to 1.5 m) ~ 6 dB
- Building penetration loss ~ 8 dB (detached house)
  - Source: Plets, D. & al.h, “Extensive Penetration Loss Measurements and Models for Different Building Types for DVB-H in the UHF Band”, IEEE Transactions on Broadcasting, June 2009

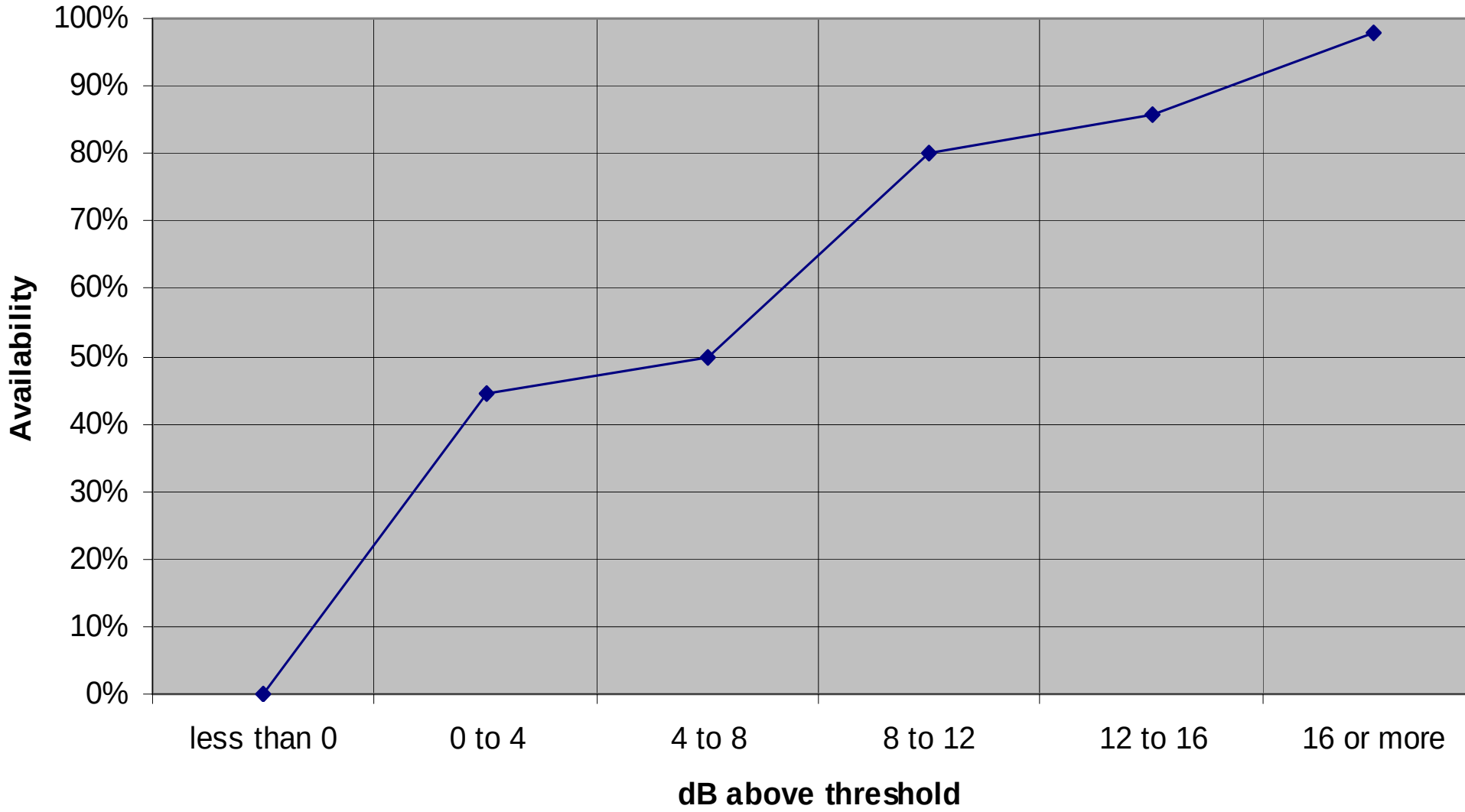
ADDING UP TO…

- UHF DTV “Grade B”: **45** dBuV/m
- UHF DTV “Grade A”: **62** dBuV/m
- H-VHF DTV “Grade B”: **39** dBuV/m
- H-VHF DTV “Grade A”: **65** dBuV/m
- Still a few dBs missing…

Required margin to decode ATSC signal (All CBC UHF measurements)



Required margin to decode ATSC signal (All CBC High VHF measurements)



POTENTIAL CAUSES FOR +3dB

- More man-made noise than expected
- Multipath not accounted for in threshold
  - Tap equalizer corrects this but adds noise
- Poor antenna & RX VSWR not only creates mismatch losses, but also degrades system noise figure (up to 4.8 dB)
  - Source: Bendov, O. & al., “Planning Factors for Fixed & Portable DTTV Reception”, IEEE Transactions on Broadcasting, Sept. 2004

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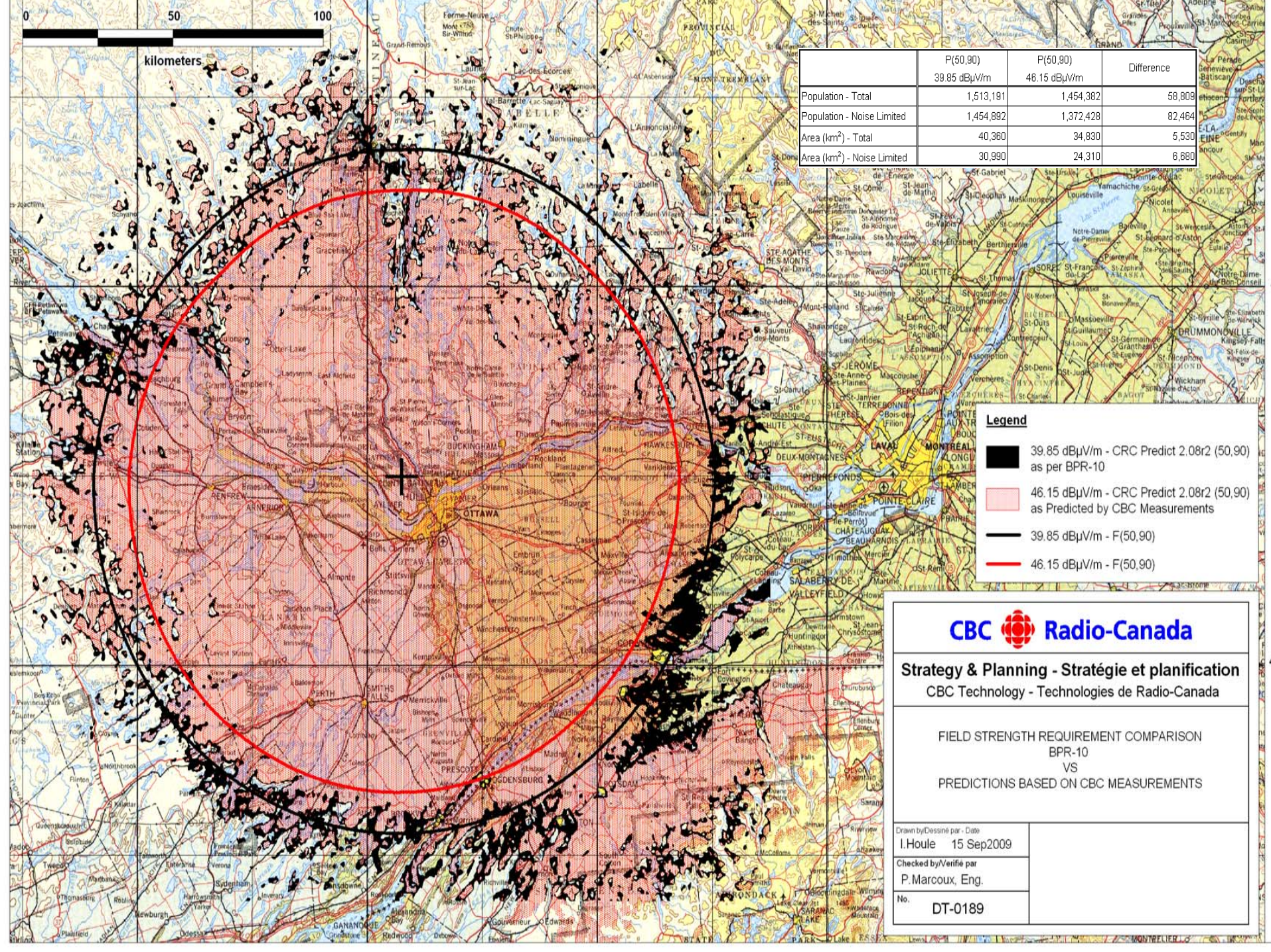
- Now good to go!



	P(50,90) 39.85 dBµV/m	P(50,90) 46.15 dBµV/m	Difference
Population - Total	1,513,191	1,454,382	58,809
Population - Noise Limited	1,454,892	1,372,428	82,464
Area (km^2) - Total	40,360	34,830	5,530
Area (km^2) - Noise Limited	30,990	24,310	6,680

CONCLUSIONS

- Significantly greater field strength is required for DTV service than Noise-Limited contour
- Broadcasters can use these figures to plan their DTV service area
- Parameters in Industry Canada's DTV post transition plan allow to reach 82 km with these Digital Grade B levels => Replication of H-VHF and UHF Analog is possible!

NEXT STEPS

- Discussions for inclusion of such levels in BPR-10
  - Pros:
    - more representative of real service area
    - not required to solve complaints outside Grade B
  - Cons:
    - potential binding to CRTC rules (must carry, etc.)
    - potential binding to Copyrights rules
- Measurements to confirm indoor predictions

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www.hdtvprimer.com

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Questions?

Thank you!

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