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TRANSMISSION TALK TUESDAY

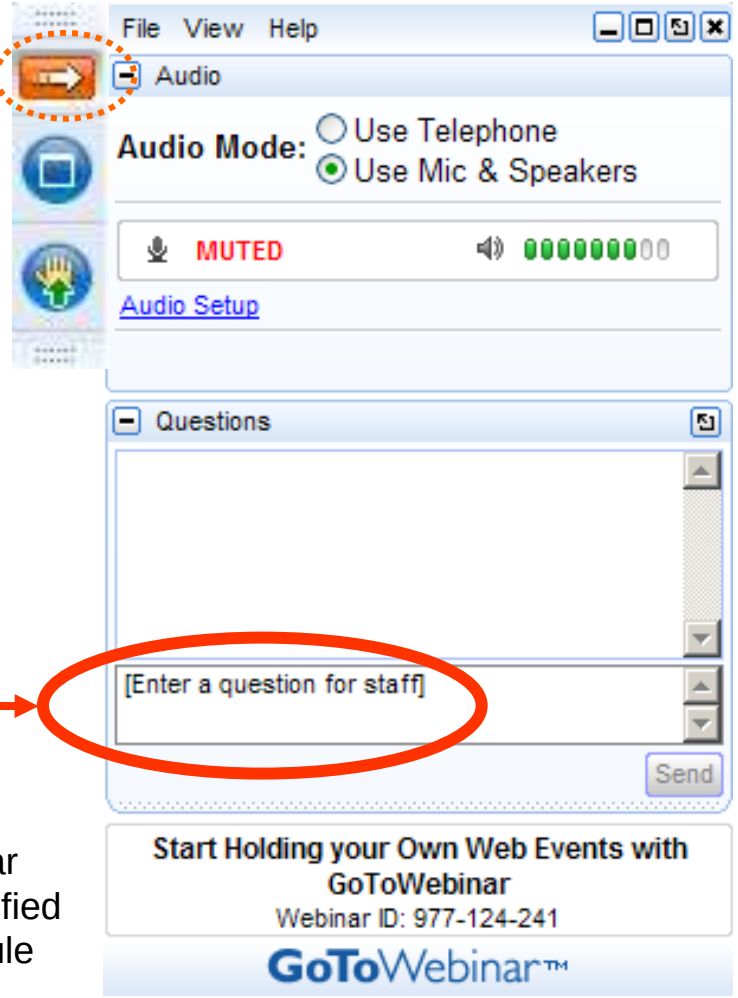
Single Frequency Networking

nautel
AM/FM Radio Transmitters

Your questions please?

(if you don't see the control panel, click on the orange arrow icon to expand it)

Please enter your questions in the text box of the webinar control panel (remember to press send)



SBE.

Remember: The completion of a Nautel webinar qualifies for ½ SBE re-certification credit, identified under Category I of the Re-certification Schedule for SBE Certifications.

TRANSMISSION TALK TUESDAY

Ideas for things to discuss

- **Why SFNs?**
  - Pros and cons
- **Quality issues**
  - Synchronization
  - Interference
- **Synchronization**
  - Best bang for the buck?
  - Options?
- **Other thoughts**
  - How to cut costs and maintain quality

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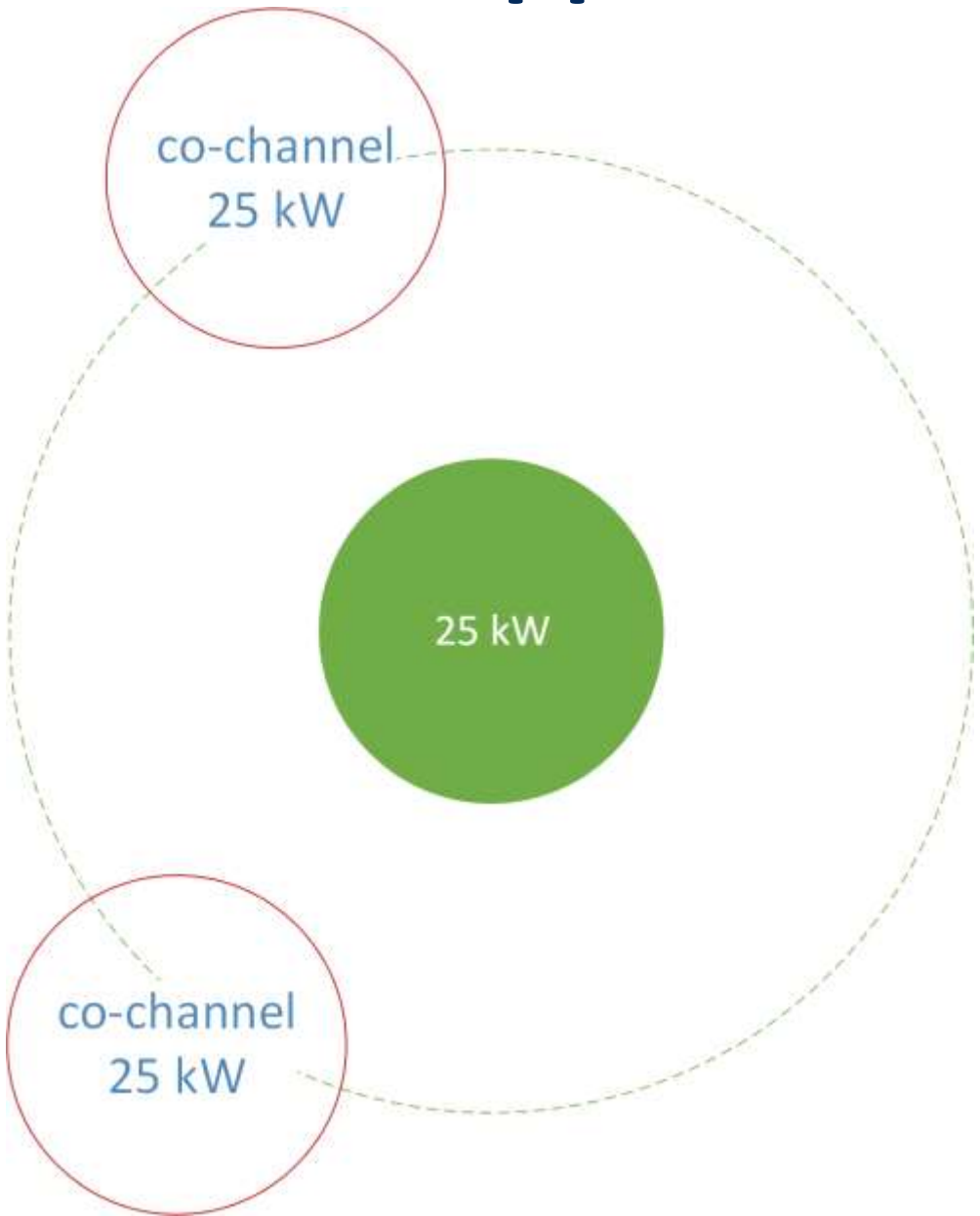
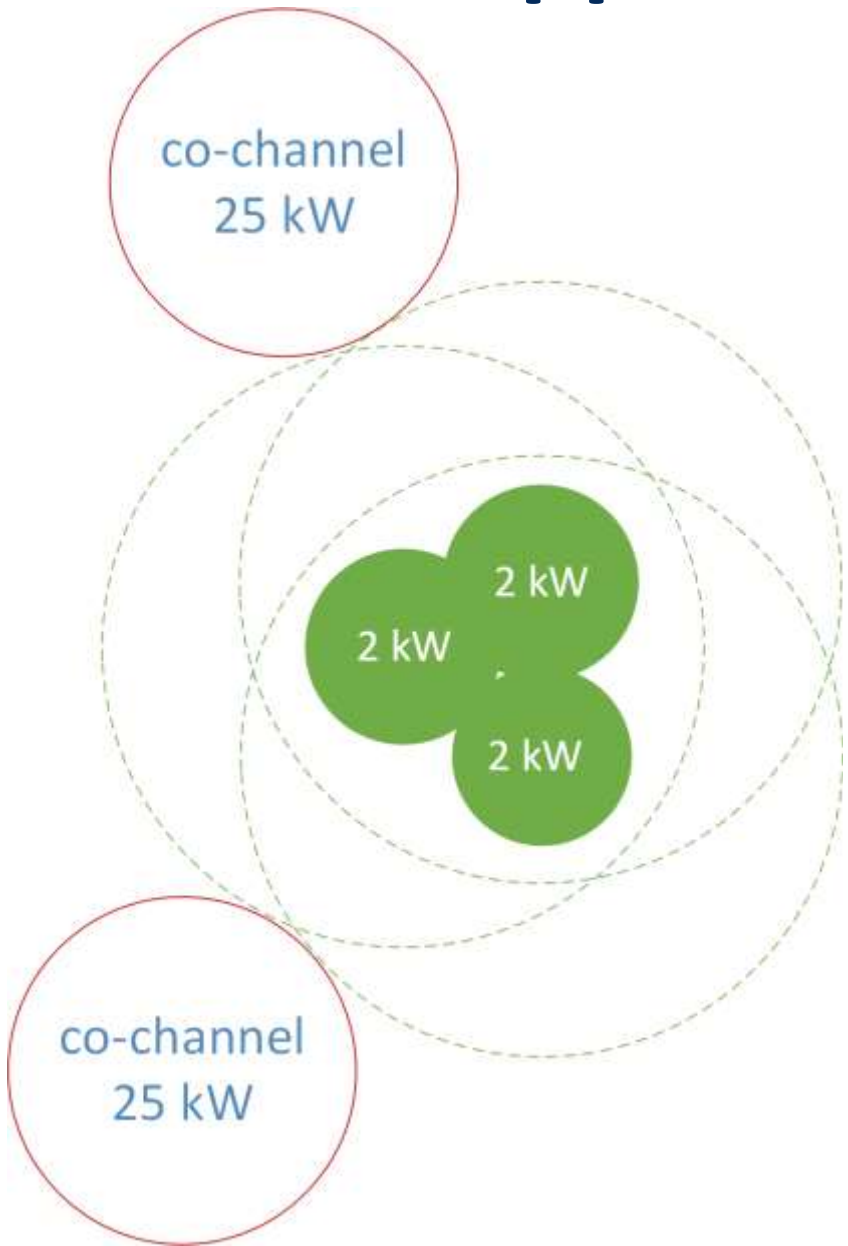
Application: The FM Band is Full

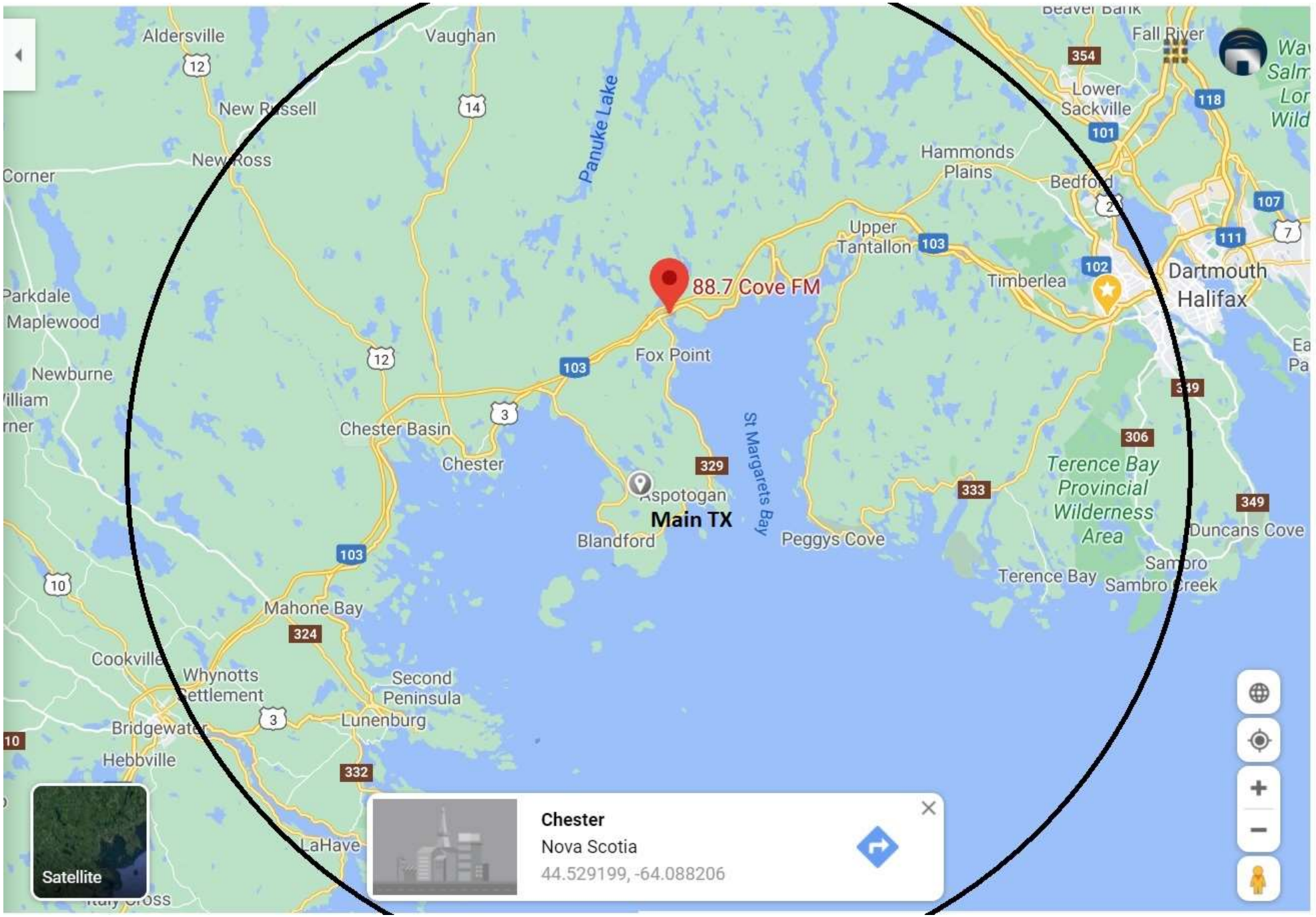


- Difficult to find white space for high power stations due to large F(50,10) interfering contour
- Also consider 1st and 2nd adjacent channel protection
- Directional Antenna patterns can only help so much
- Difficult to find translator frequencies

Application: The FM Band is Full



- Lower power transmitters reduce interfering contour
- Transmission power savings
- We can now create new “equivalent” full power stations for the community of license.
  - fringe listening will be reduced
- Future station expansion possibilities
- We must minimize SFN interference through synchronization and planning.


88.7 Cove FM
Main TX
Aldersville
Vaughan
New Russell
New Ross
Corner
Panuke Lake
Hammonds Plains
Bedford
Fall River
Lower Sackville
Upper Tantallon
Timberlea
Dartmouth
Halifax
Parkdale
Maplewood
Newburne
Fox Point
Chester Basin
Chester
Aspotogan
Blandford
St Margarets Bay
Peggys Cove
Terence Bay Provincial Wilderness Area
Terence Bay
Sambro
Sambro Creek
Duncans Cove
Mahone Bay
Cookville
Whynotts Settlement
Second Peninsula
Lunenburg
Bridgewater
Hebbville
LaHave
Satellite
Chester
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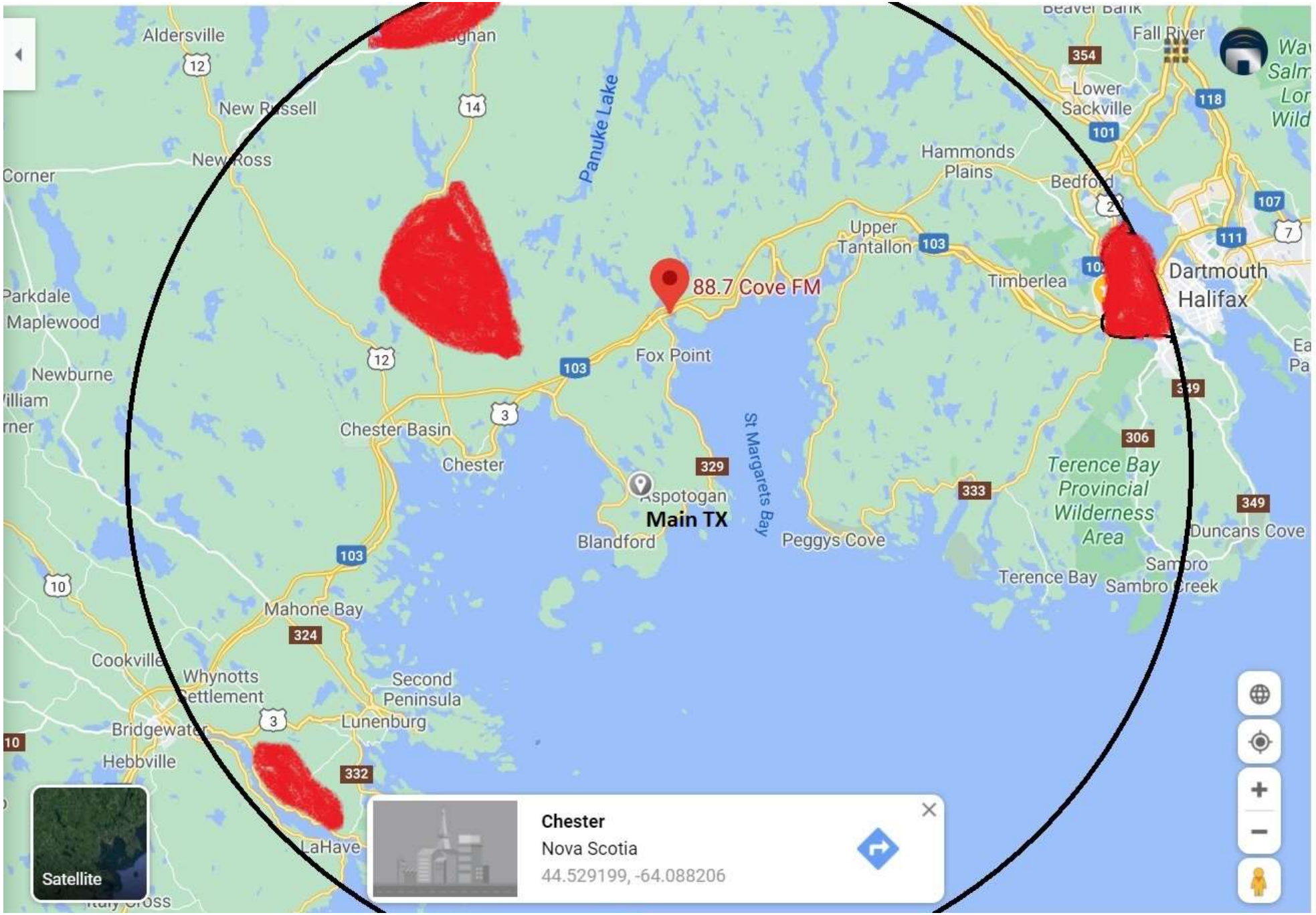
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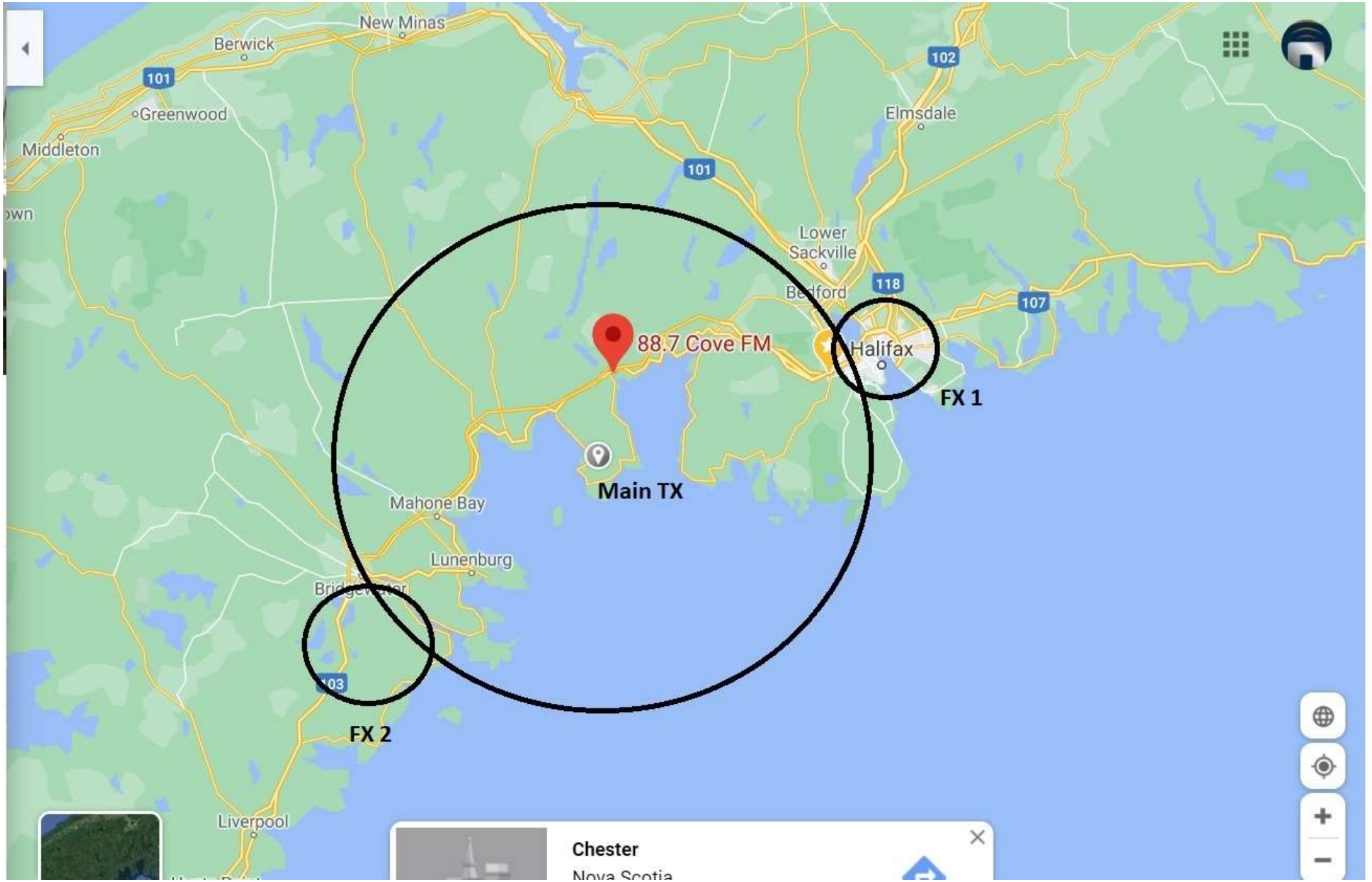
New Minas
Berwick
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Greenwood
Middleton
102
Elmsdale
101
Lower
Sackville
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107
88.7 Cove FM
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FX 1
Main TX
Mahone Bay
Lunenburg
103
FX 2
Liverpool
Chester
Nova Scotia
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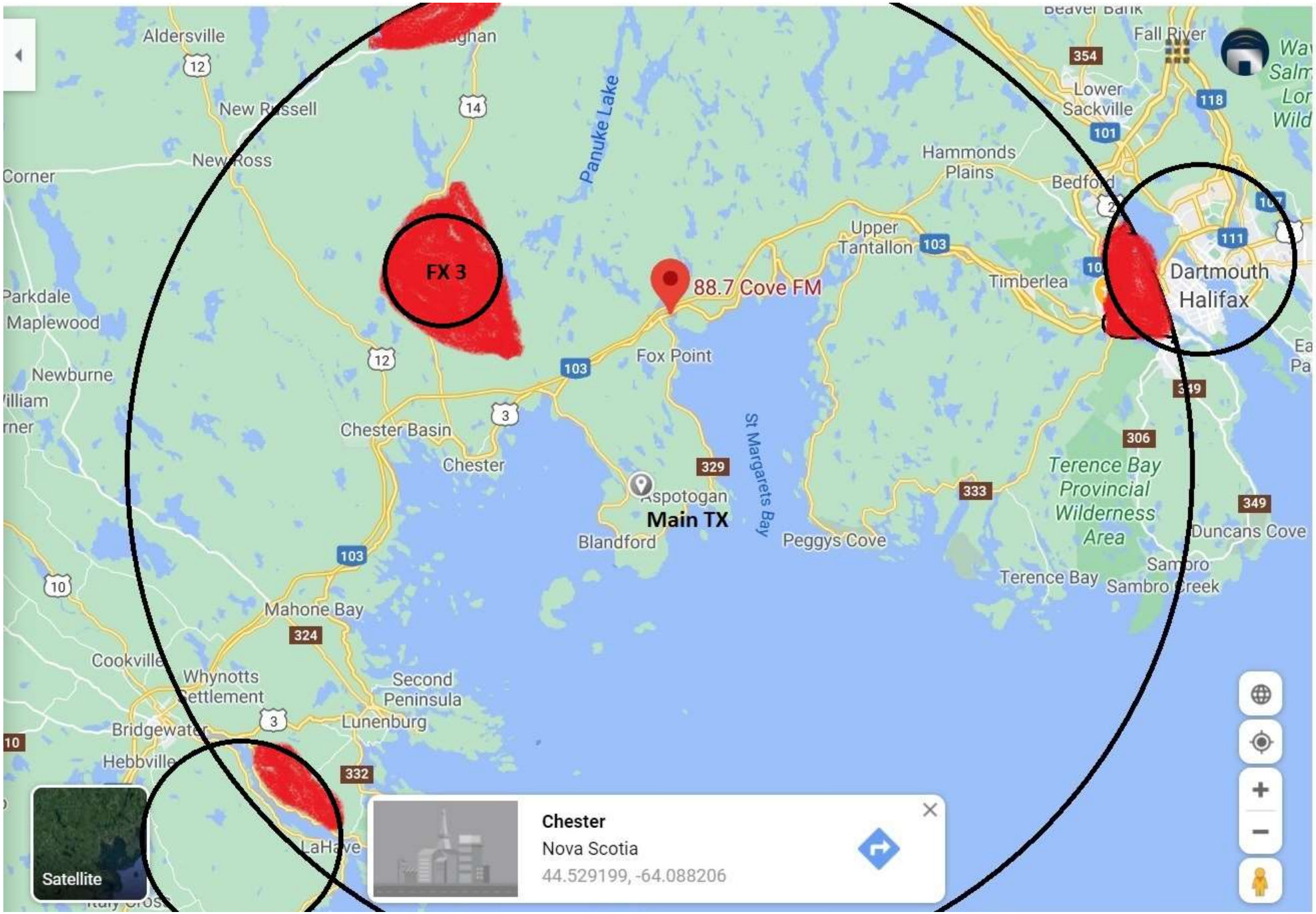
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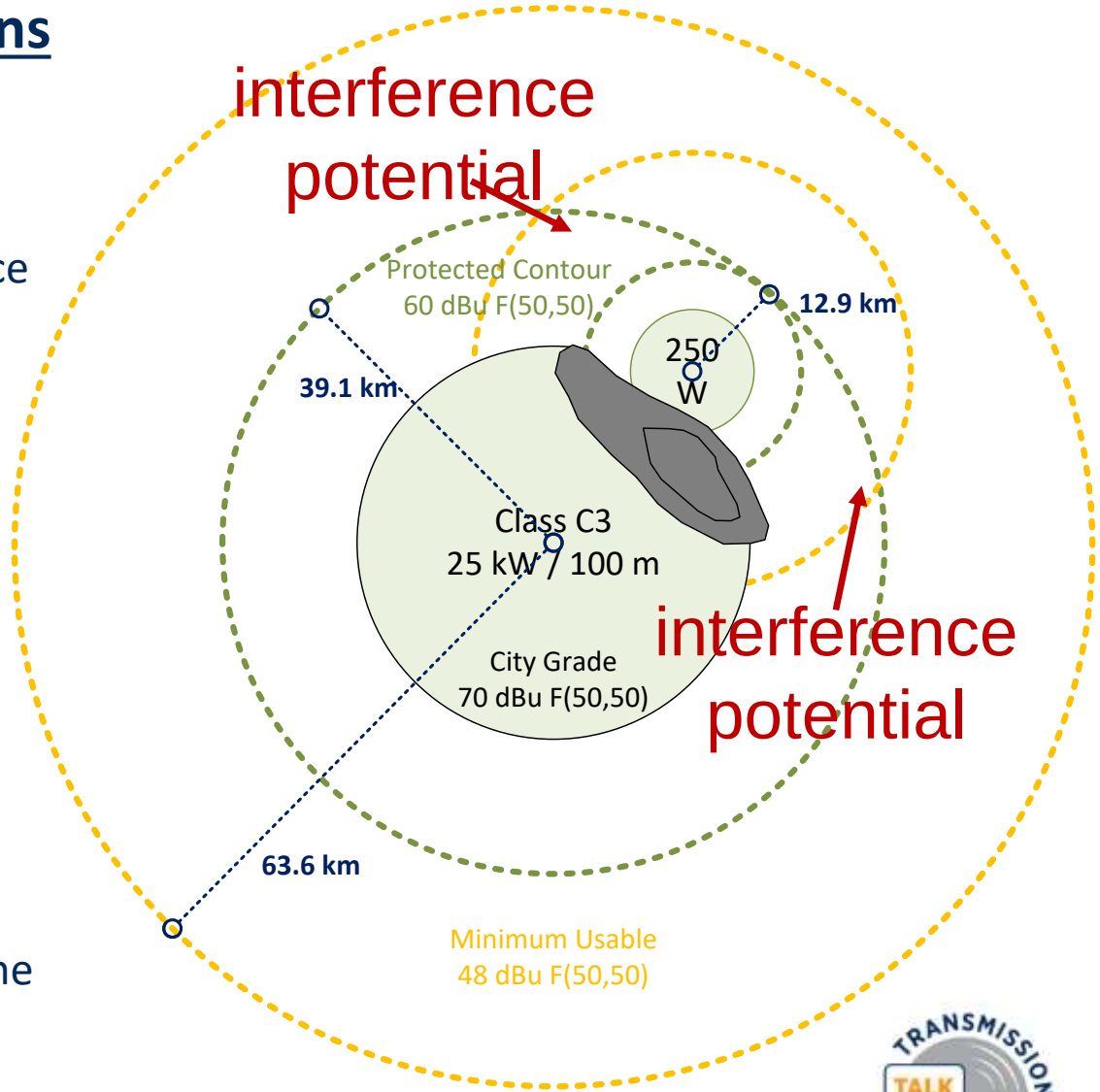
44.529199, -64.088206

Things to Consider

- Synchronization
  - Carrier
  - Pilot (if stereo)
  - Audio
- Terrain shielding
- Radiation Pattern

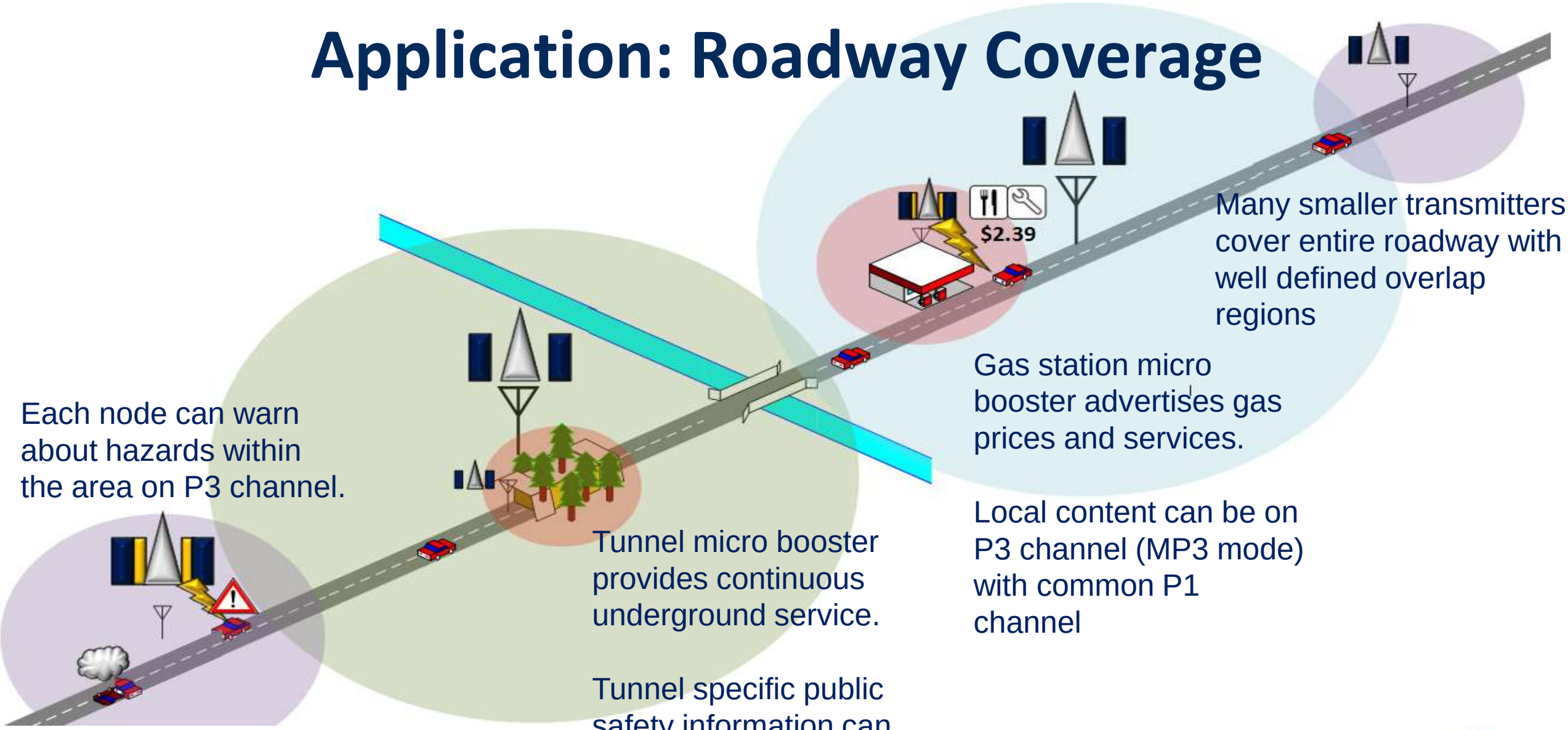
FM Single Frequency Networks Today

- **FM Booster stations** are **"fill-in" translator stations** on the **same** frequency as the main station.
  - Booster contour may not exceed the protected F(50,50) service contour of the primary station.
  - Boosters maximum ERP is 20% of primary station's class
  - FM booster call signs incorporate the call sign of the main station with the suffix -FM (booster number) added
    - A primary FM station may have more than one booster.
  - Increase city grade coverage with better building penetration
  - Booster stations may not cause interference to reception of the primary station's signal within the community of license



https://www.fcc.gov/media/radio/fm-translators-and-boosters

Application: Roadway Coverage



Many smaller transmitters cover entire roadway with well defined overlap regions

Gas station micro booster advertises gas prices and services.

Local content can be on P3 channel (MP3 mode) with common P1 channel

Each node can warn about hazards within the area on P3 channel.

Tunnel micro booster provides continuous underground service.

Tunnel specific public safety information can be carried on P3 partitions

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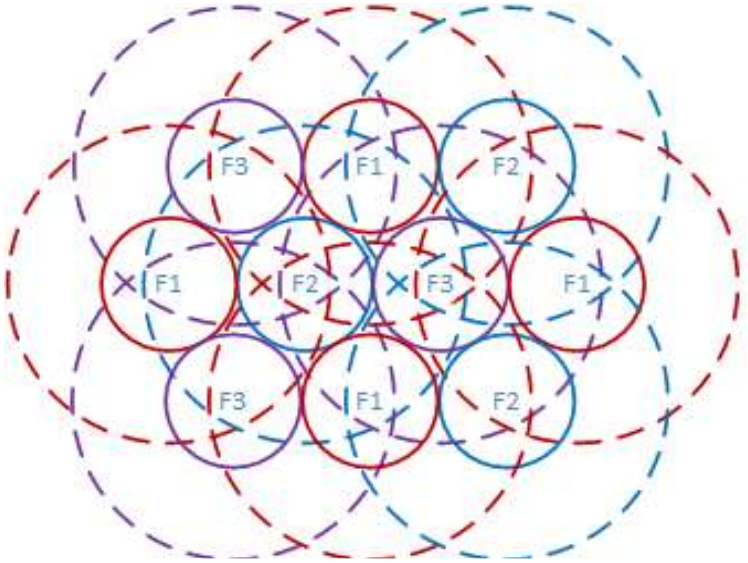
Application: Wide Area Coverage



- Public broadcasters with a mandate for national, state–wide, or wide area coverage
  - mandated to reach majority of population
- Translator network requires at least 3 channel allocations – more in difficult terrain
- Also consider adjacent channels
- SFN is spectrum efficient

Stereo FM Synchronization

25 kW Class C3 and 250W Booster

- Shown with **60 dBu and 70 dBu contour**

26.2 km or 87.3 µs separation

Large **interference** potential (**14 dB D/U**)

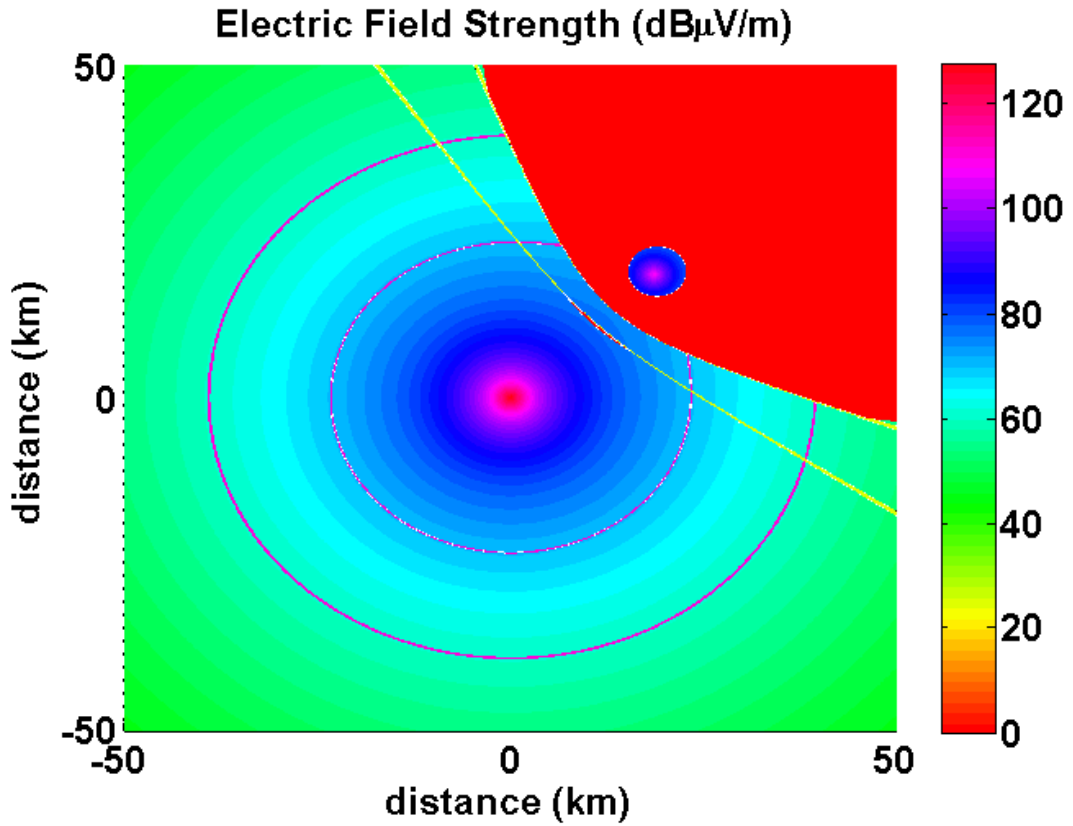
- Booster not reaching city grade contour
- **Terrain shielding is a must !!!**

60 µs booster time advance

- Booster delay 87.3 µs – 60 µs = 27.3 µs
- Meets primary wave 30 µs or 9 km out

10 µs timing margin provides small buffer

- 14 dB D/U change over 3 km is not possible
- No seamless coverage



Mono FM Synchronization

Smaller **interference** potential (**3 dB D/U**)

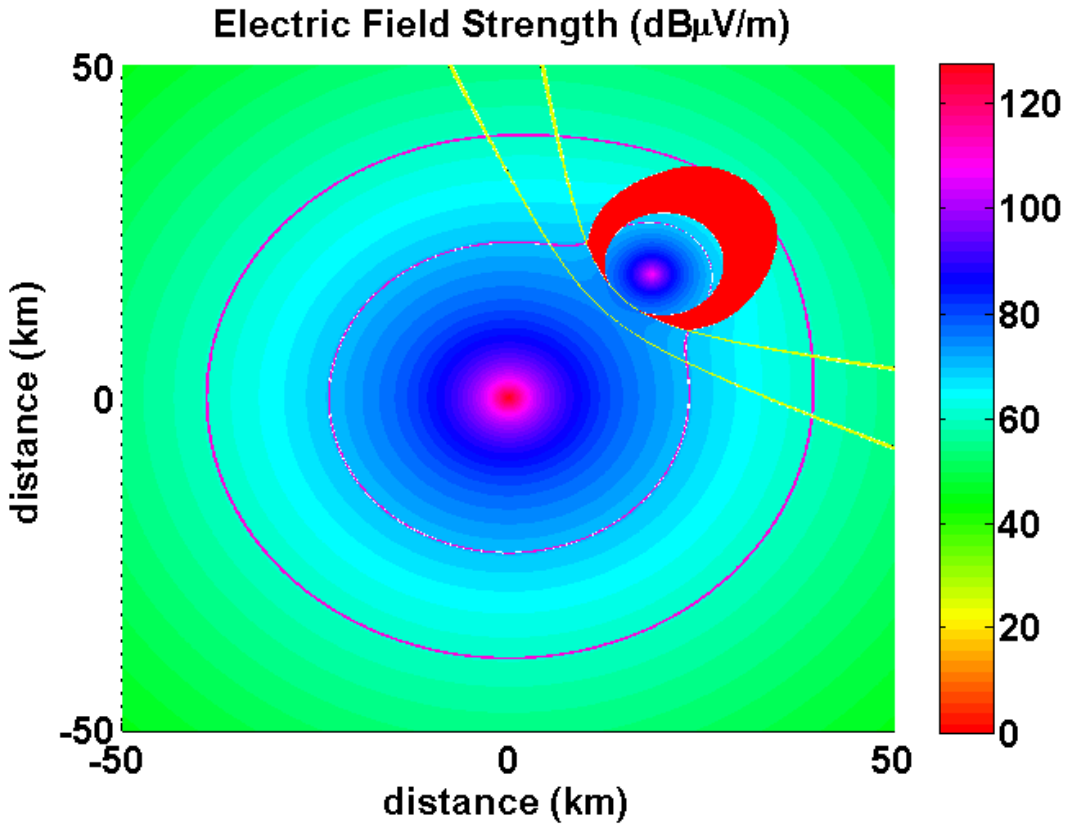
- Booster exceeds **city grade contour**

45 µs booster time advance

- Booster delay 87.3 µs – 45 µs = 42.3 µs
- Meets primary wave 22.5 µs or 6.7 km out

10 µs timing margin provides small buffer

- 3 dB D/U change over 3 km can be possible
- Limited seamless coverage is possible
- Time advance could be decreased to curve the timing margin for a better match



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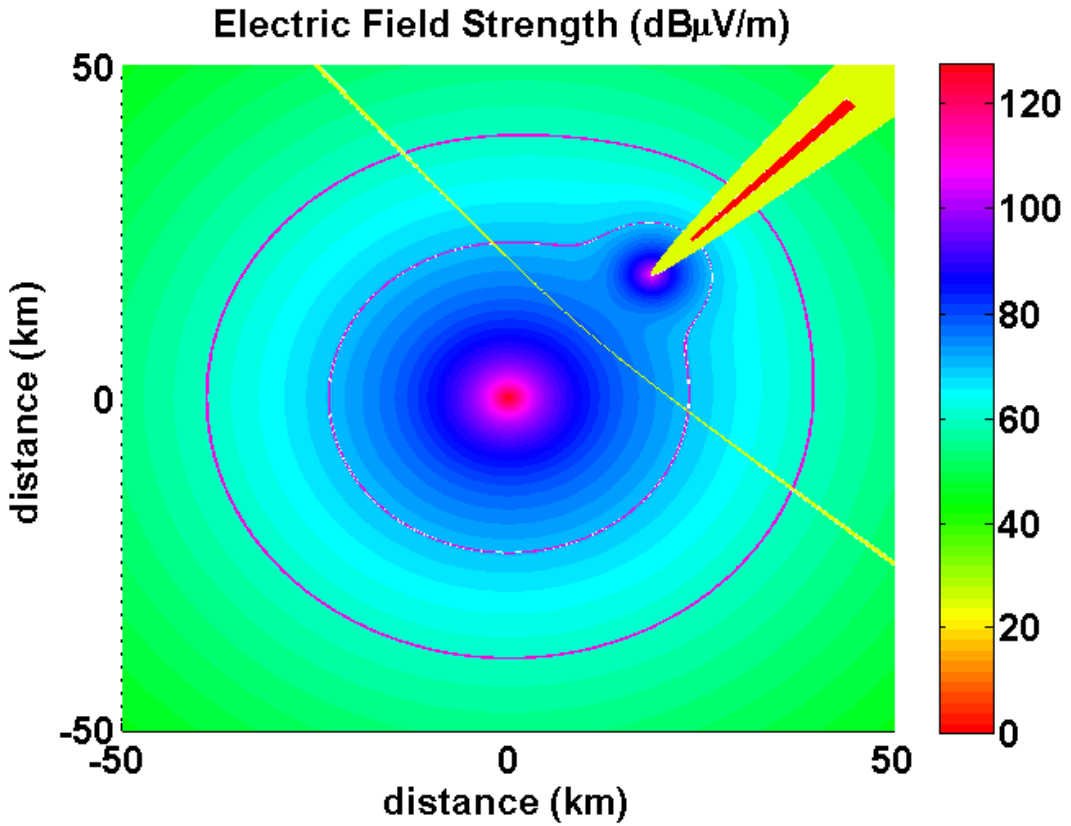
IBOC Synchronization

Hybrid FM+IBOC System
- Primary 2.5 kW IBOC at -10 dBc injection
- Booster 25 W IBOC at -10 dBc injection

Minimal **interference** potential (7 dB D/U)
- Booster increases **city grade contour**
- Little impact on combined **60 dBu contour**

40 µs booster time advance
- Booster delay 87.3 µs – 40 µs = 47.3 µs
- Meets primary wave 20 µs or 6 km out

40 µs timing margin provides large buffer
- Seamless coverage is possible



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Elevated IBOC Power Levels

Hybrid FM+IBOC System

- Primary 2.5 kW IBOC at -10 dBc injection
- Booster **250 W IBOC at 0 dBc** injection

No **interference** (7 dB D/U)

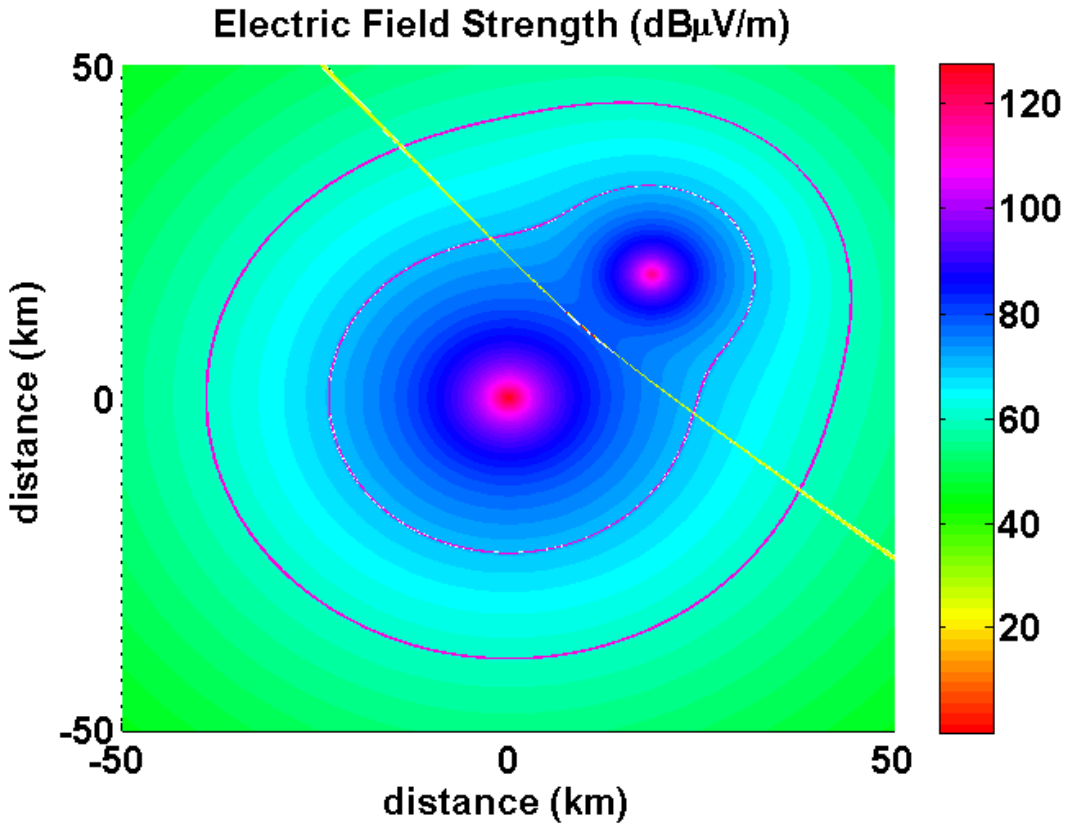
- Booster increases **city grade contour**
- Big increase in combined **60 dBu contour**

39 µs booster time advance

- Eliminates back end interference entirely
- Booster delay 87.3 µs – 40 µs = 47.3 µs
- Meets primary wave 20 µs or 6 km out

40 µs timing margin provides large buffer

- Extended seamless coverage is possible



Booster Elevated IBOC Power Levels

Increase IBOC to 0dBc injection? **Yes**

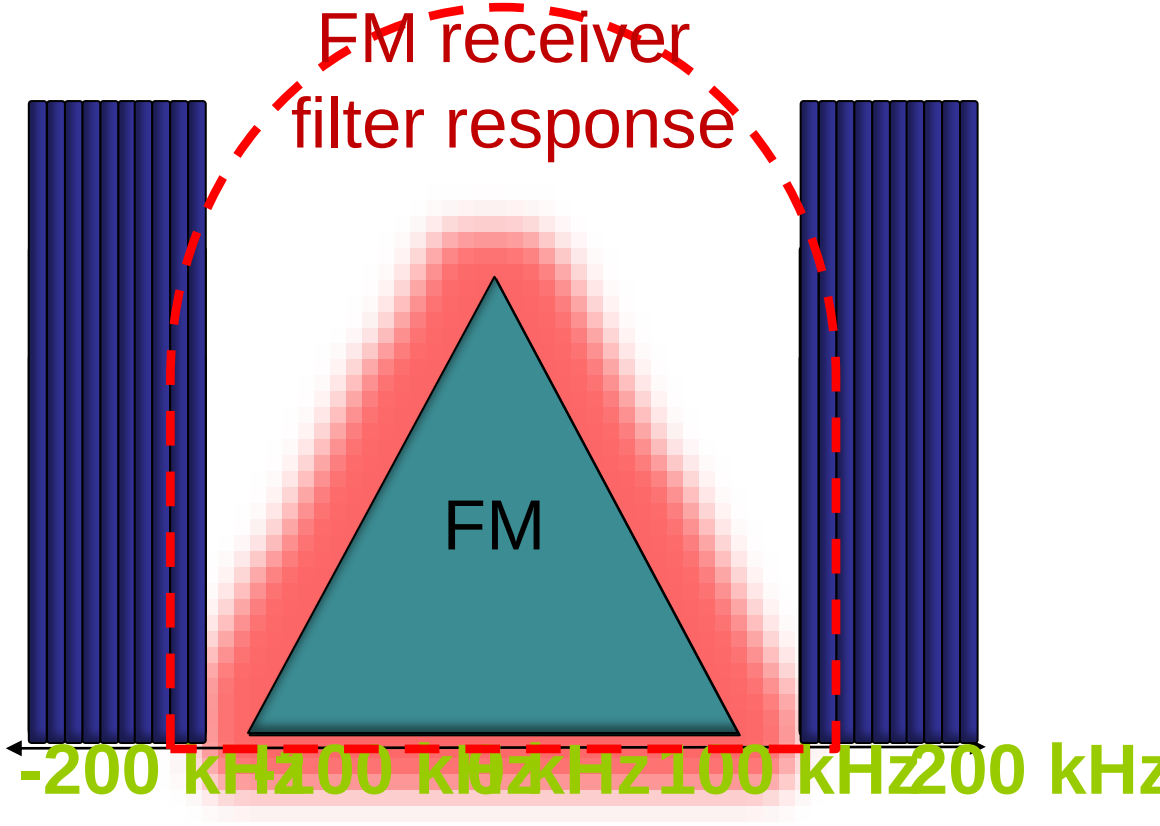
- Smaller FM interference region
- Large IBOC coverage
- Place booster closer to protected contour
- Tests conducted at WD2XAB Baltimore

Increase IBOC higher? **Caution**

- Risk to drown out FM receivers close by
- FM receiver selectivity captures IBOC
  - 20 dB bandwidth ~260-500 kHz

IBOC only boosters? **No for hybrid FM+HD**

- Future application in all-digital operation



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THANK YOU!

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