Modeling and Analysis of the Interference Potential of Cognitive Radio Devices to Wireless Microphones Operating in TV bands

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Cognitive Radios in TV Bands

- CR = Dynamic Spectrum Access
- TV bands = TVs & wireless microphones

Major roadblock:
Incumbents believe new unlicensed devices would interfere with their devices!

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Why wireless microphones?

- Used by
  - Recording studios in TV Broadcast Stations
  - Organizers, performers in concerts, theaters
  - Commentators in sports events
  - Film production crews
- Deployed only for a short time
- Operate in arbitrary unused TV bands
- Thousands out there!
- Interference: audio quality is paramount

Research Goal

To analyze the interference that cognitive radios can cause to wireless microphones.

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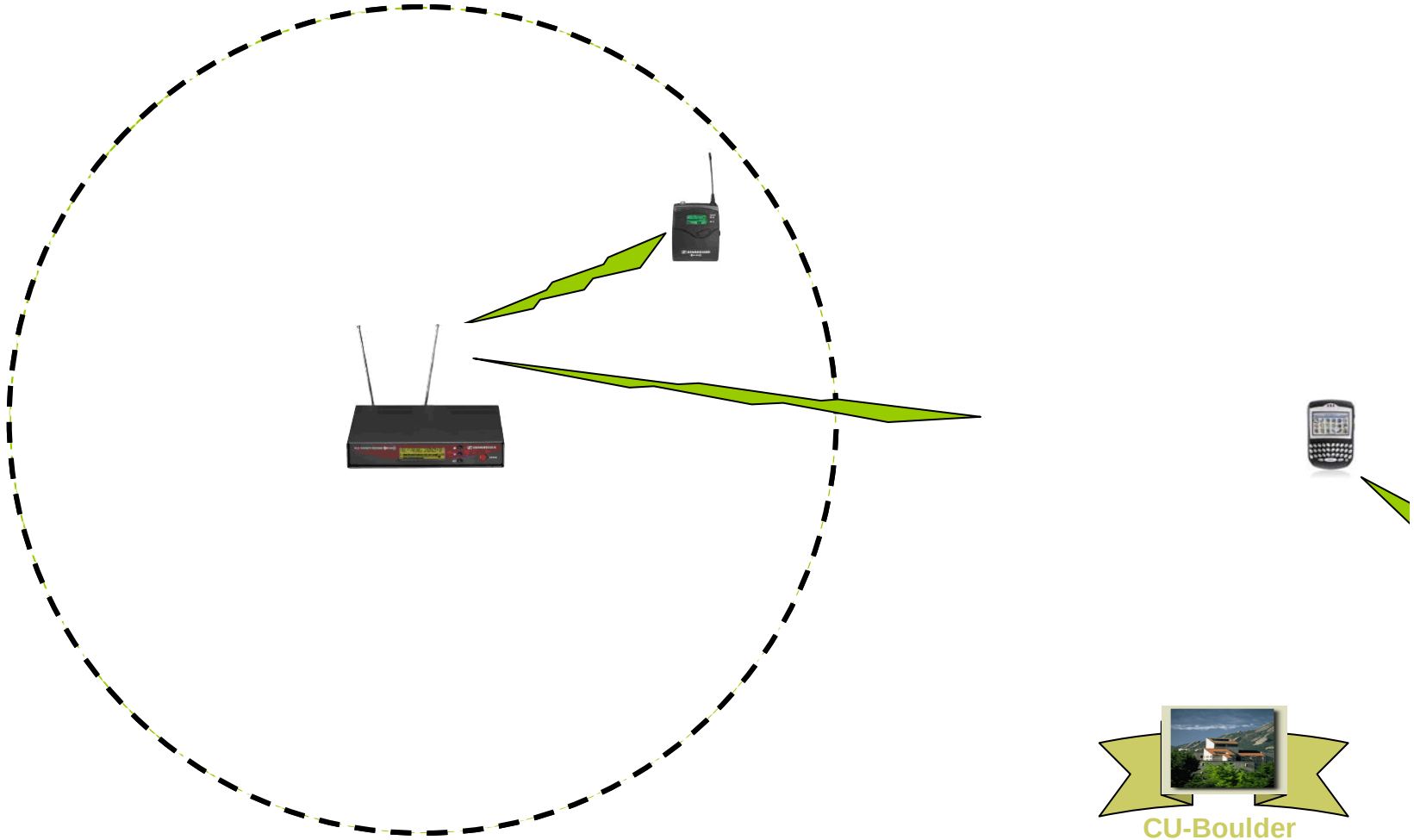
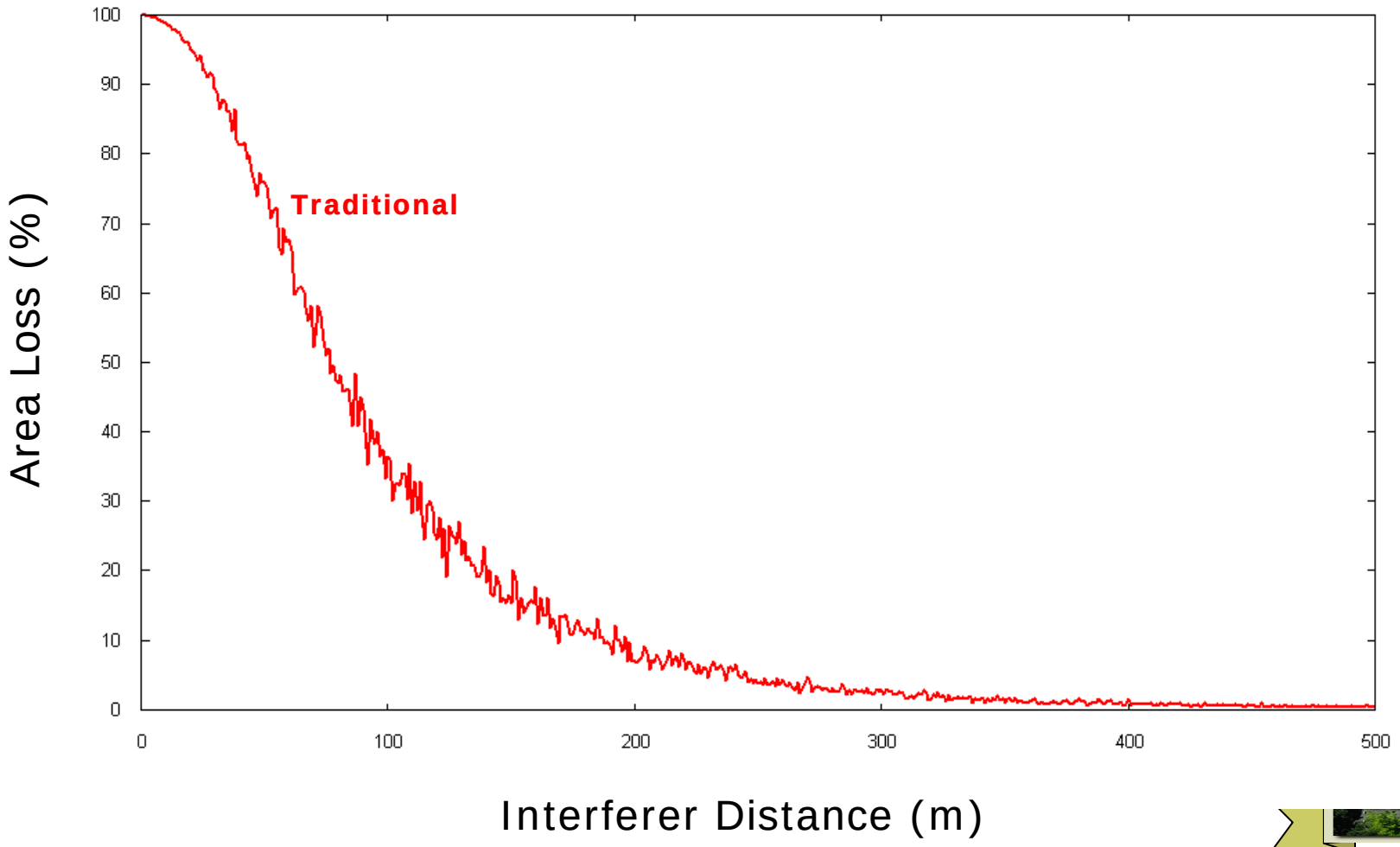
Traditional Interference Model



Area Loss Analysis: Traditional



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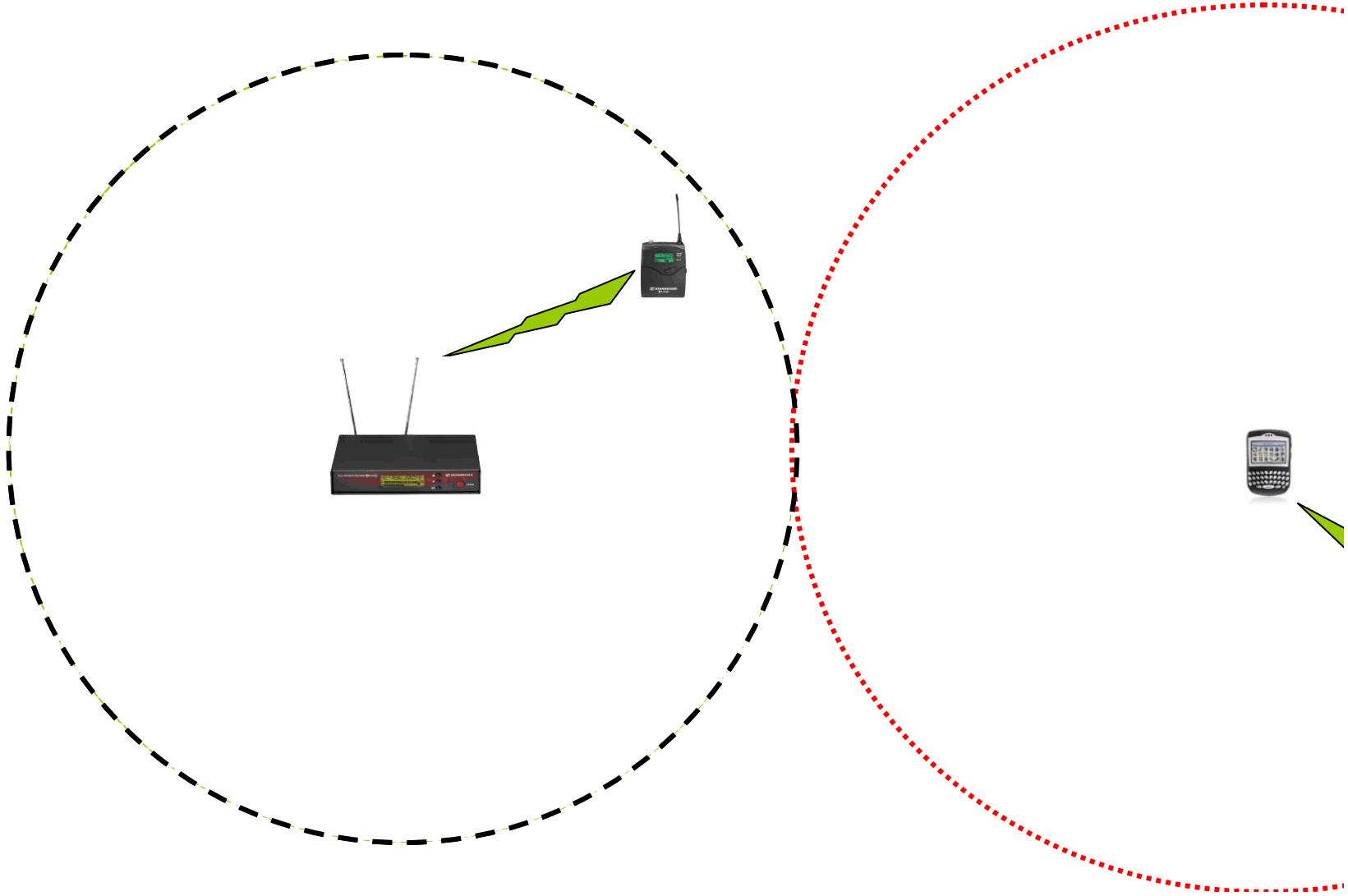
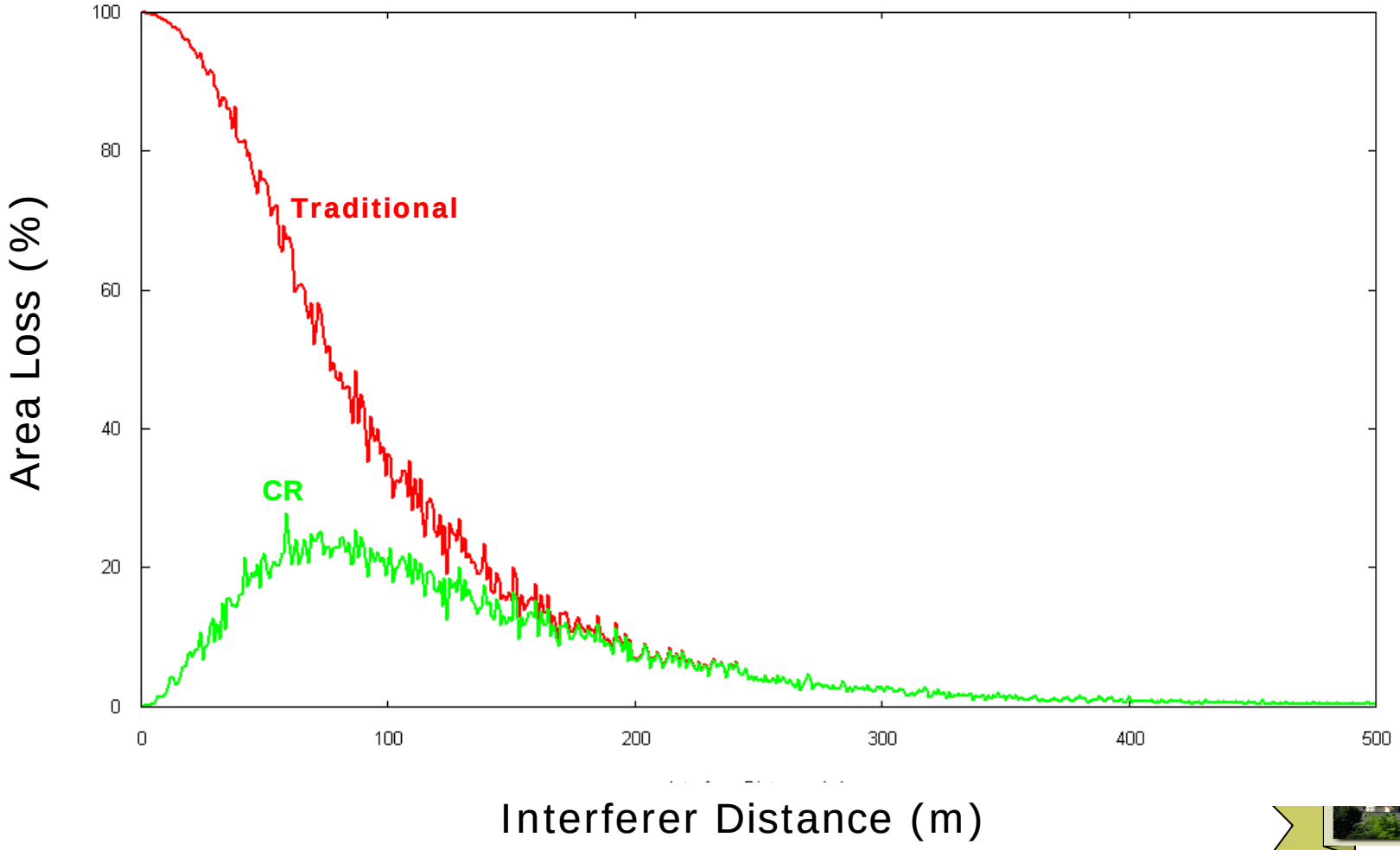
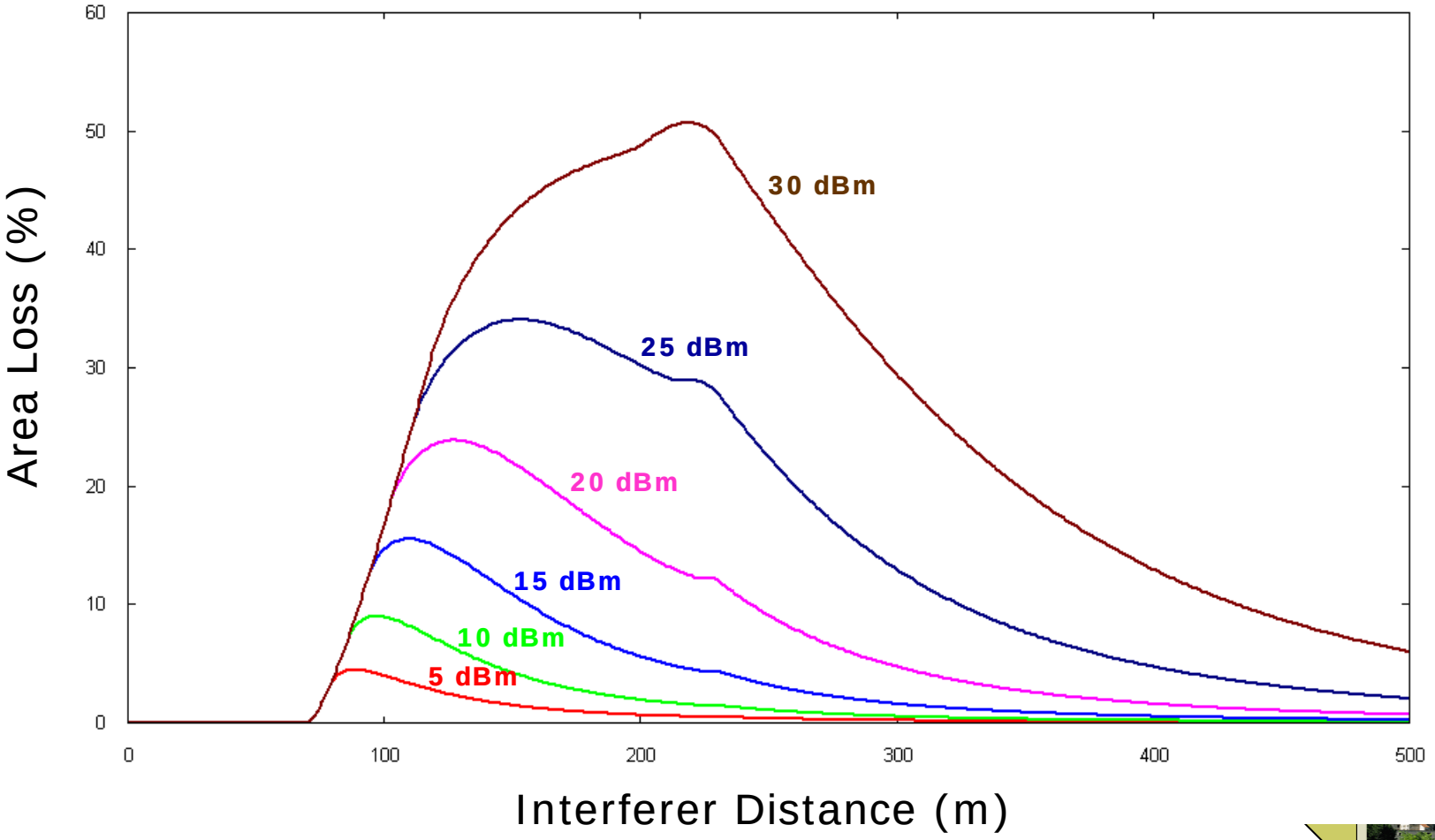
Cognitive Radio Interference Model



Area Loss Analysis: CR versus Trad.



Results: Varying Interferer Power Levels



5 dB decrease in interferer power: 5-15% decrease in intf.

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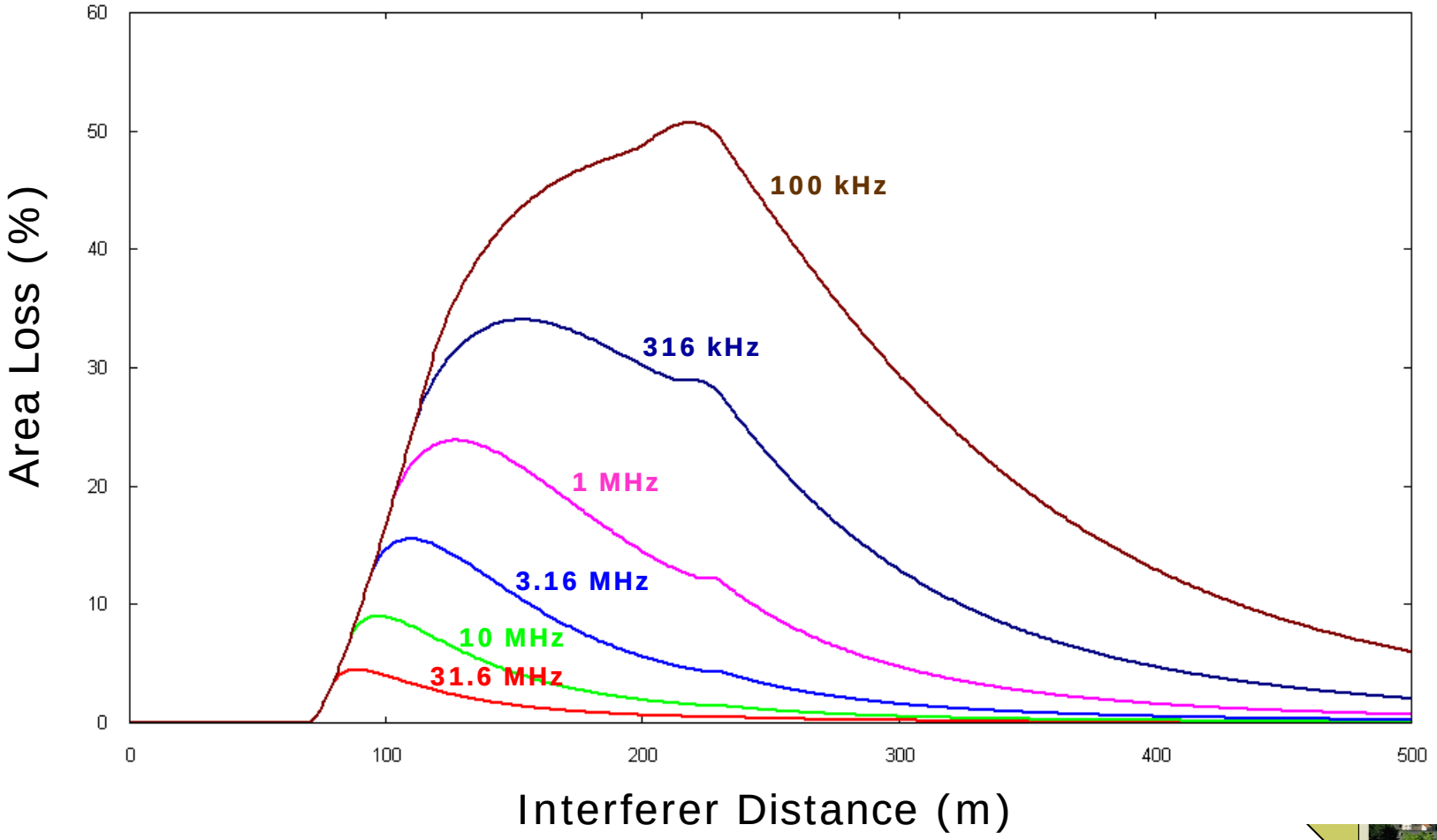
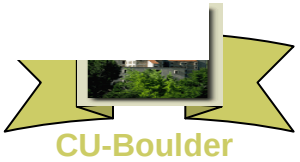
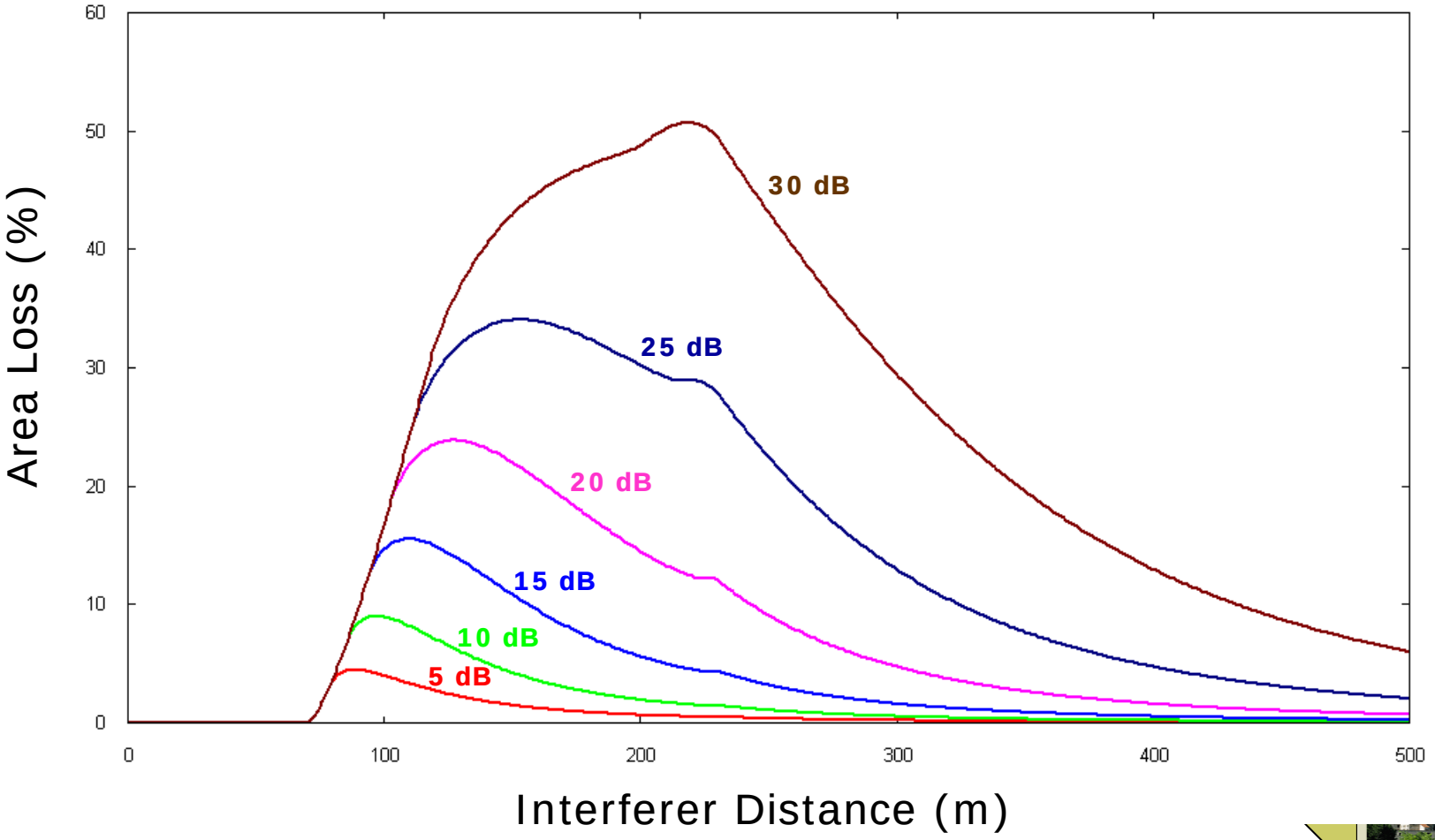
Results: Different Interferer Bandwidths



5 dB increase in CR bandwidth: 5-15% decrease in intf.



Results: Different Protection Ratios



5 dB decrease in protection ratio: 5-15% decrease in intf.

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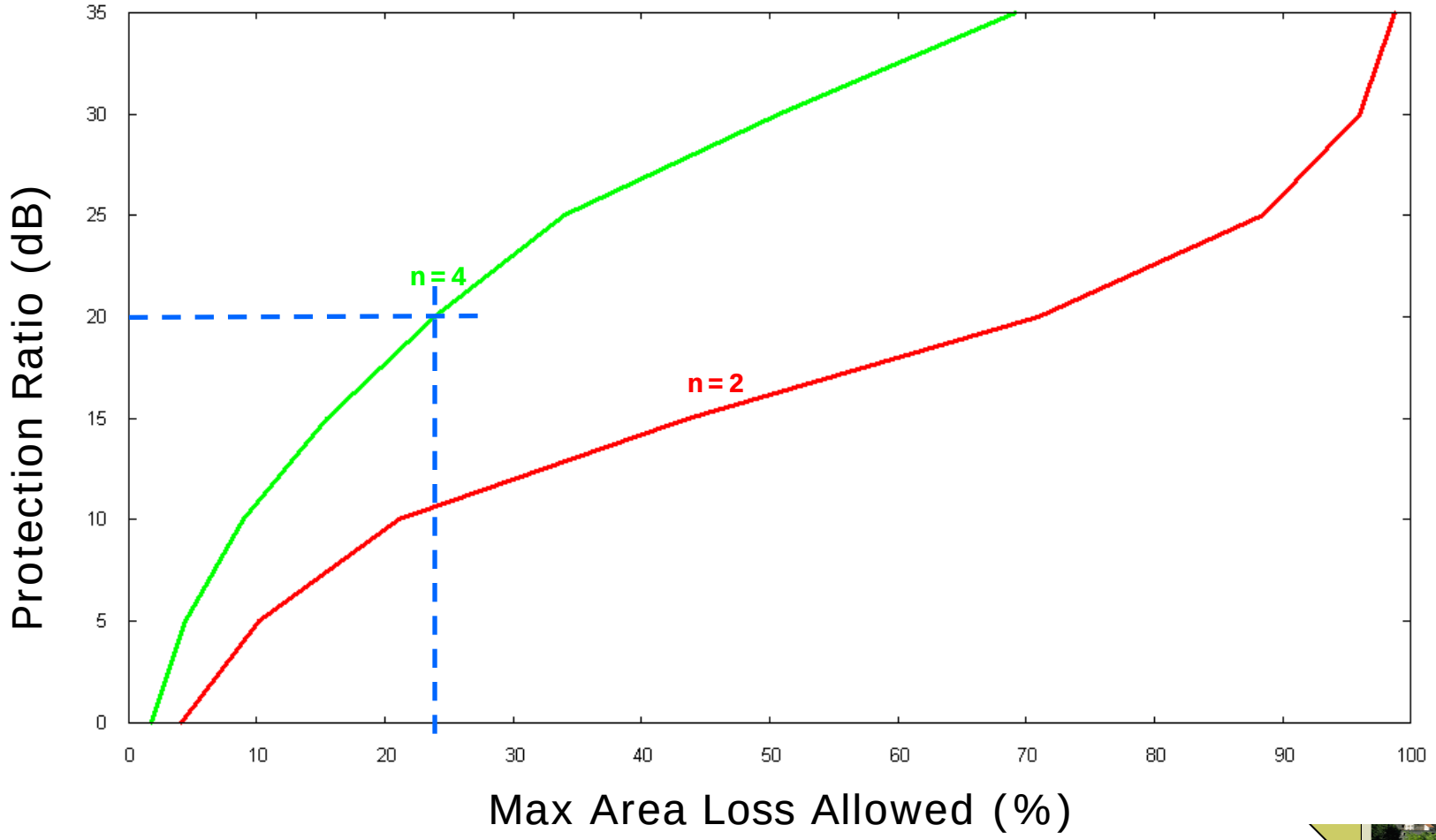
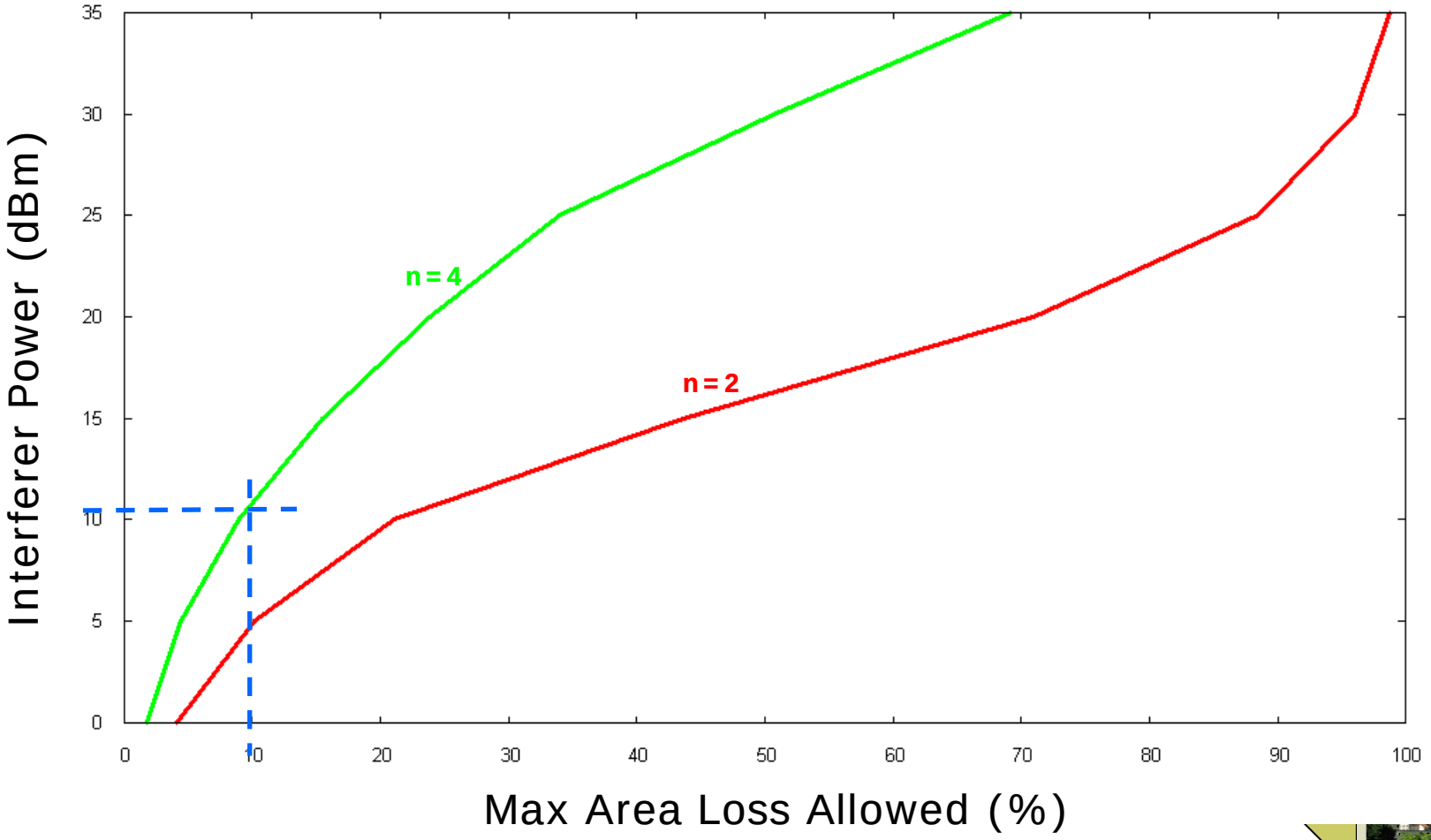
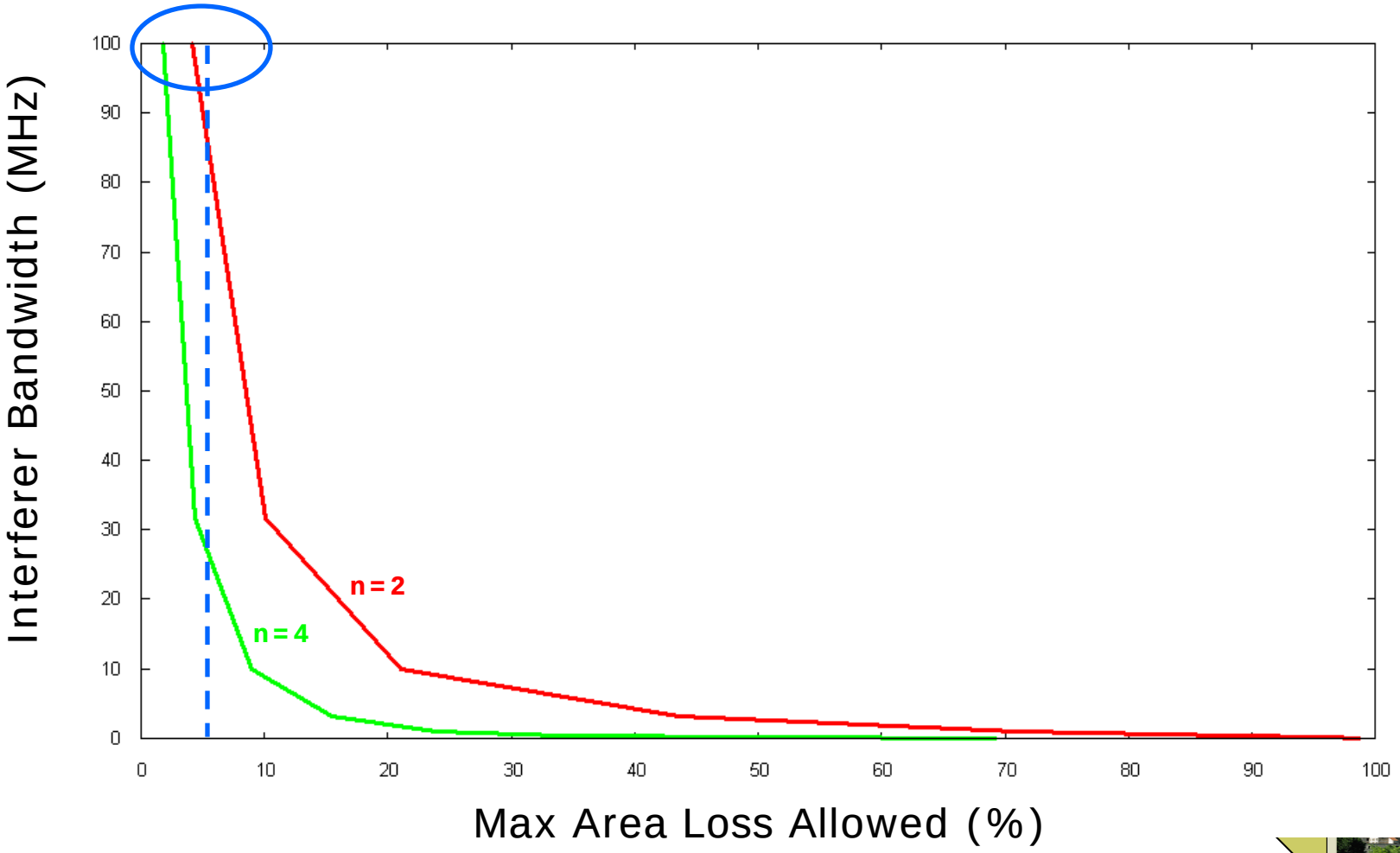
Protection Ratio – Maximum Area Loss Allowed



Interferer Power – Maximum Area Loss Allowed



Interferer Bandwidth – Maximum Area Loss Allowed



For < 5% interference, interferer bandwidth > 100 MHz

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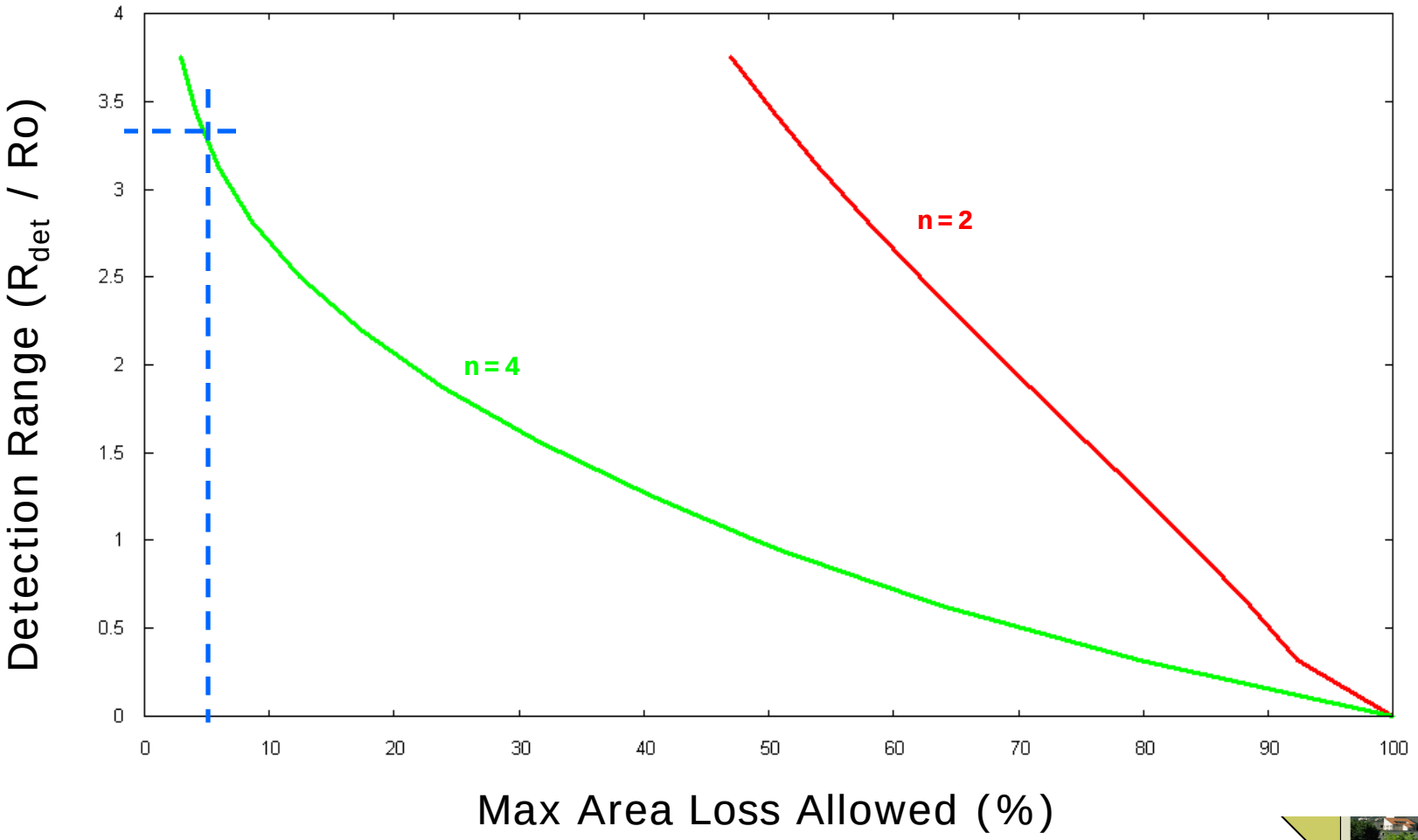
Detection Range Required – Maximum Area Loss Allowed



For < 5% interference, detection range > 3 times Ro

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Inferences: Interference Reduction

- What the Cognitive Radio can do?
  - Improve system design (antenna, bandwidth)
  - Increase detection range
  - Implement power control
- Wireless Microphone System
  - More resilient systems
    (i.e. lower protection ratios)

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Future Work

- Multiple interferers
- Network detection: Cooperative CRs

Conclusion

- Cognitive Radio devices can be deployed with minimal harmful interference to wireless microphones
- Requires modest sensitivity for detecting incumbent signals
- Better wireless microphones can help

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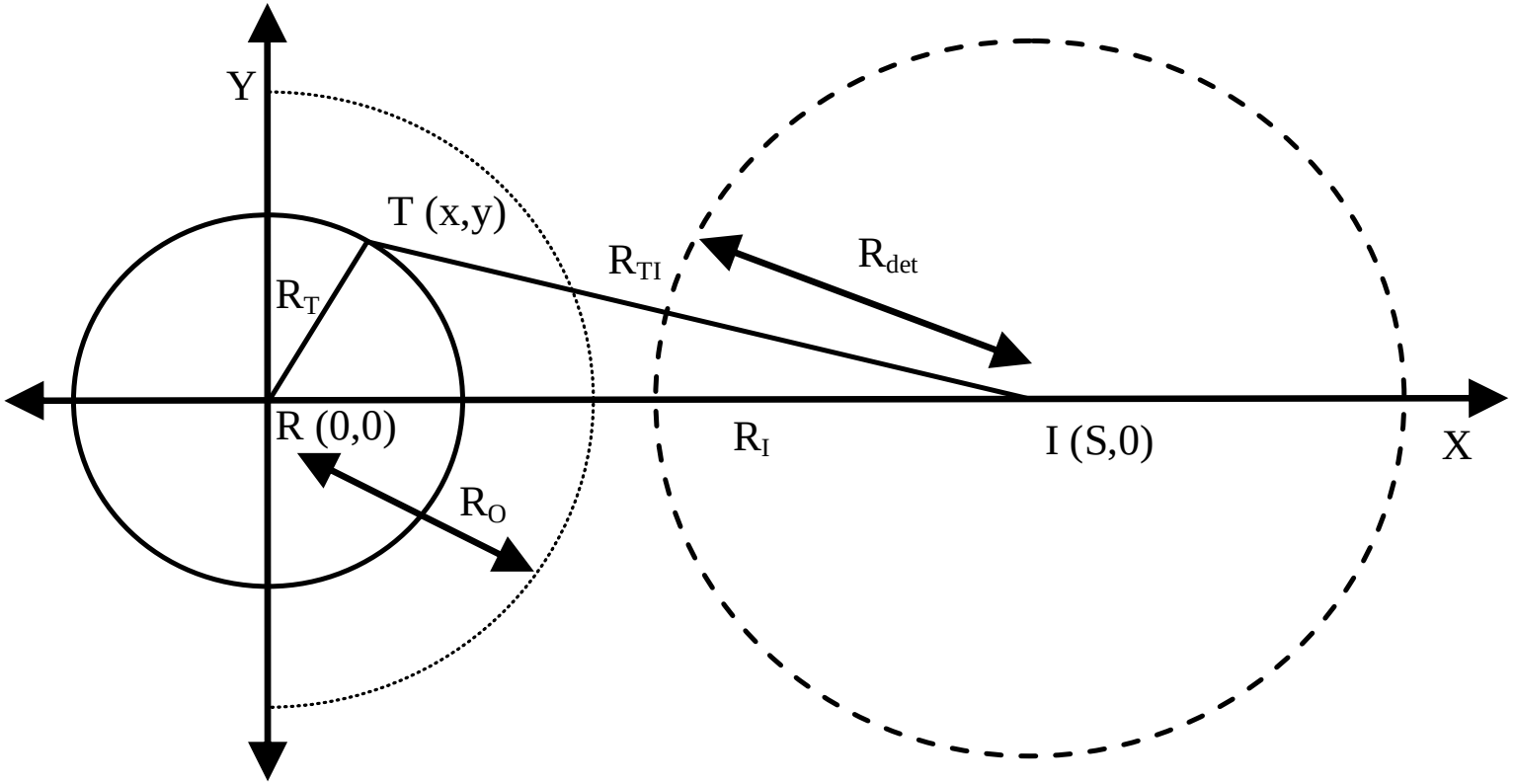
Thanks for Listening.

Questions ?

Backup Slides follow…

Interference Contour Model



Interference Contour Model

$$R_T = R_I \frac{K^{1/n}}{\left[K \left(\frac{R_I}{R_O} \right)^n + 1 \right]^{1/n}}$$

$$K = \frac{P_t G_{tr} W_i S_{\sigma i} L_s}{Z P_i G_{ir} W_t S_{\sigma t}}$$

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Different Protection Ratios: Trad. Radio