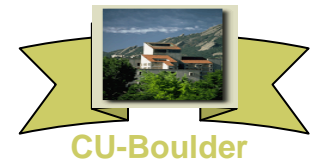


Modeling and Analysis of the Interference Potential of Cognitive Radio Devices to Wireless Microphones Operating in TV bands



Ramandeep S Dhillon
Prof Timothy X Brown
University of Colorado at Boulder

2008 International Symposium on Advanced Radio Technologies
Boulder, Colorado
June 04, 2008



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!



CU-Boulder

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

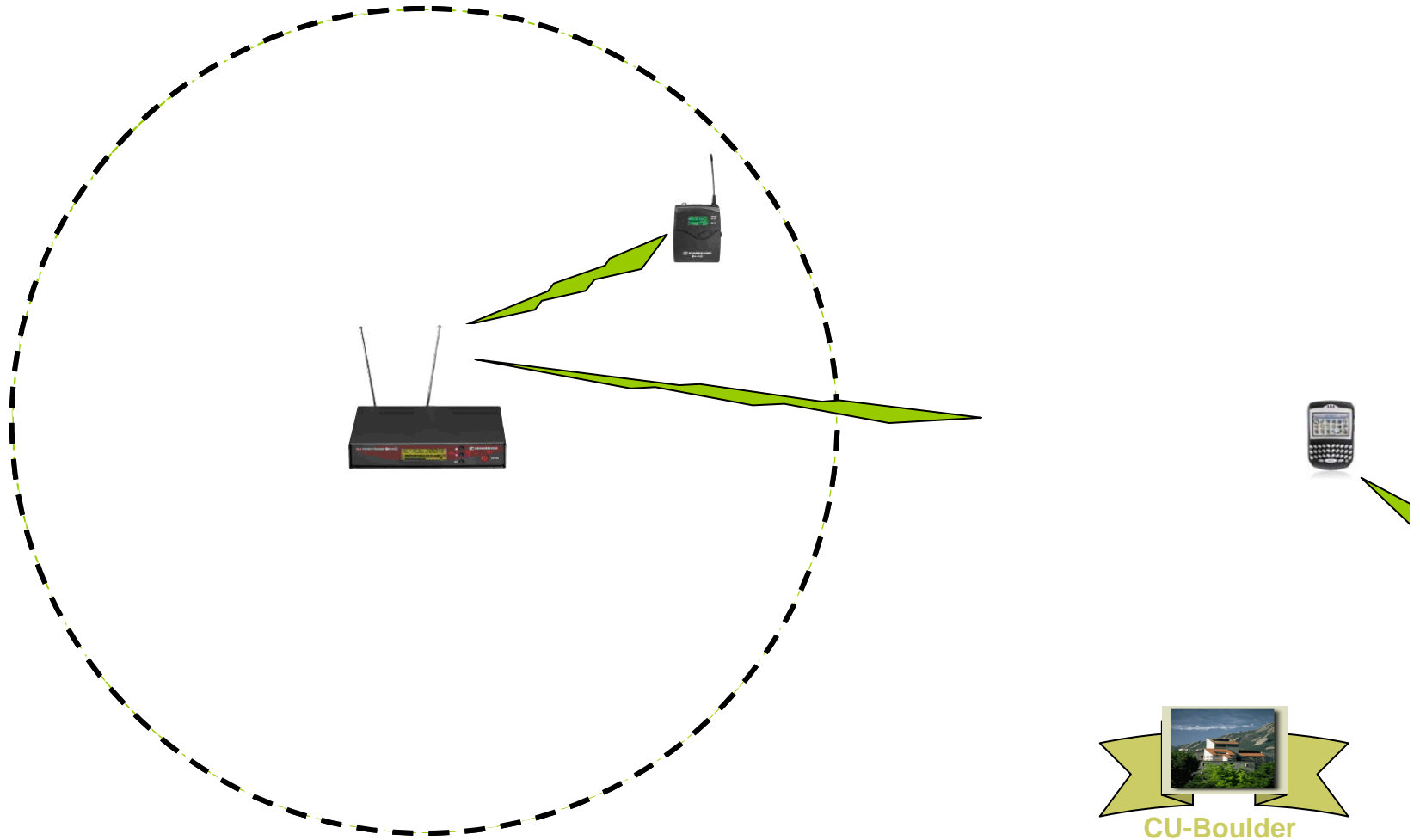


Research Goal

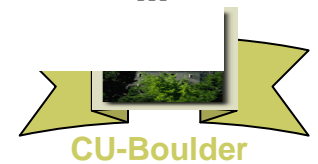
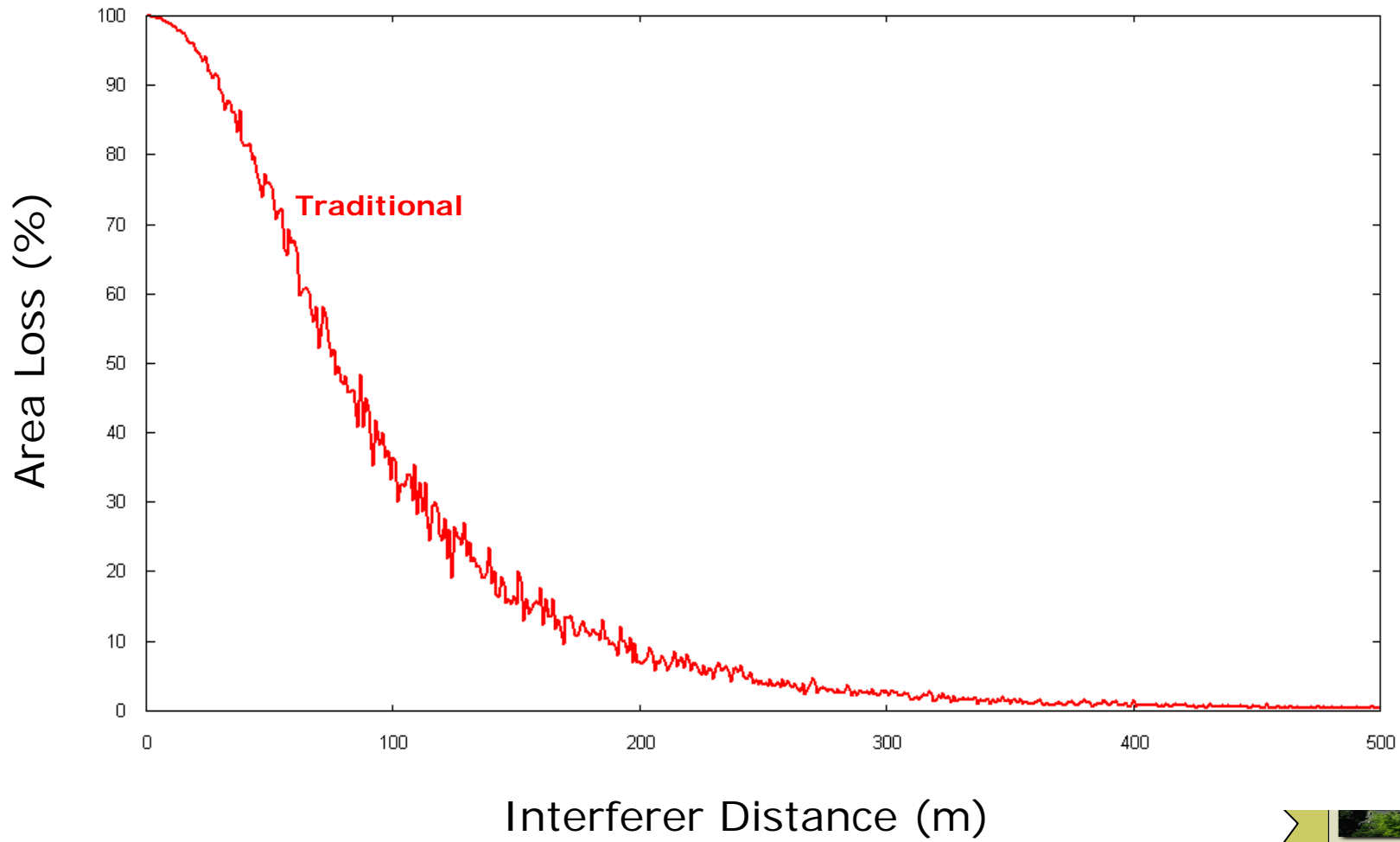
To analyze the interference that cognitive radios can cause to wireless microphones.



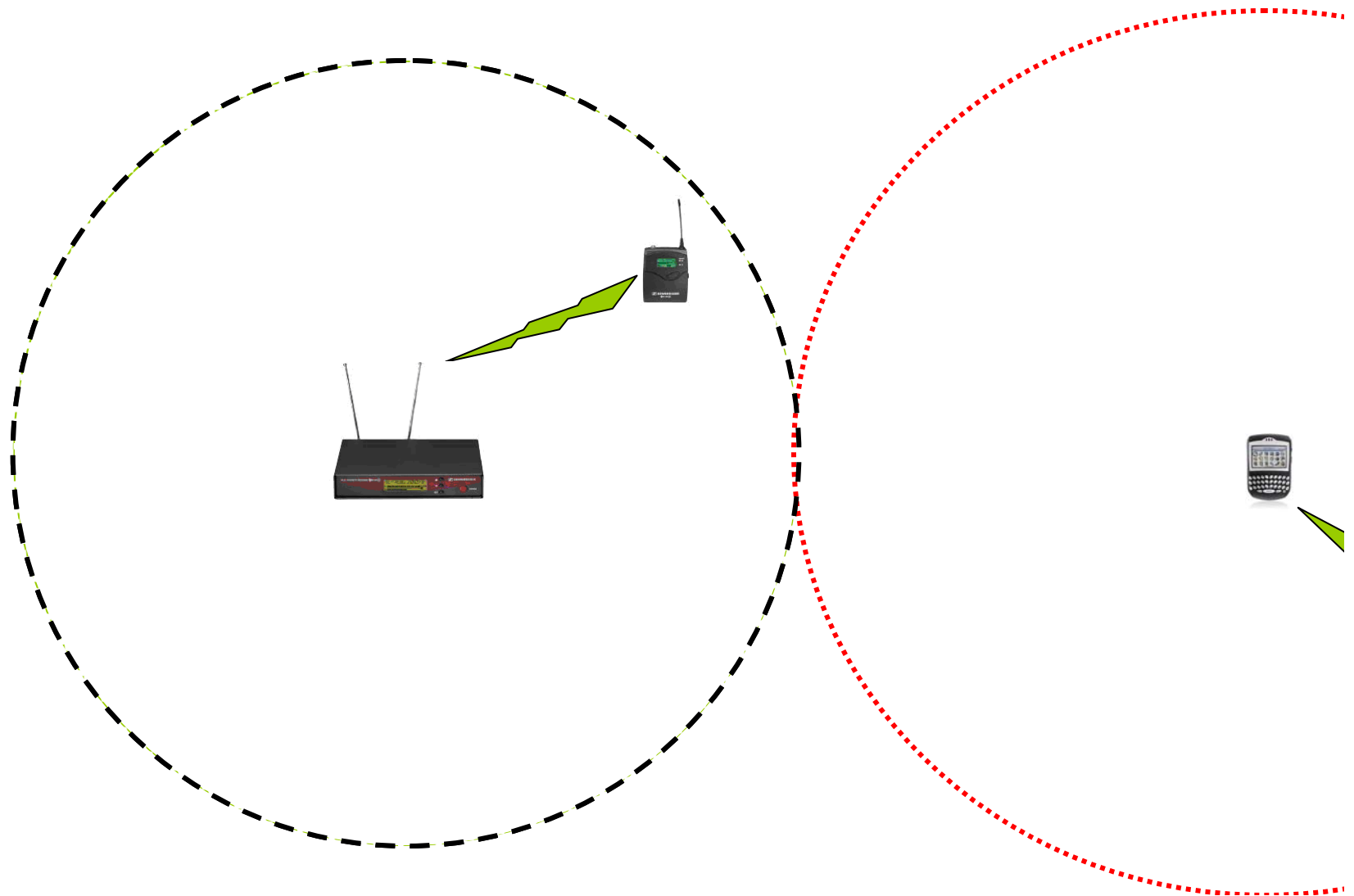
Traditional Interference Model



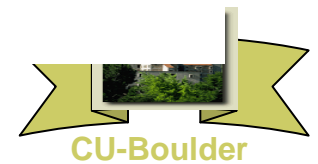
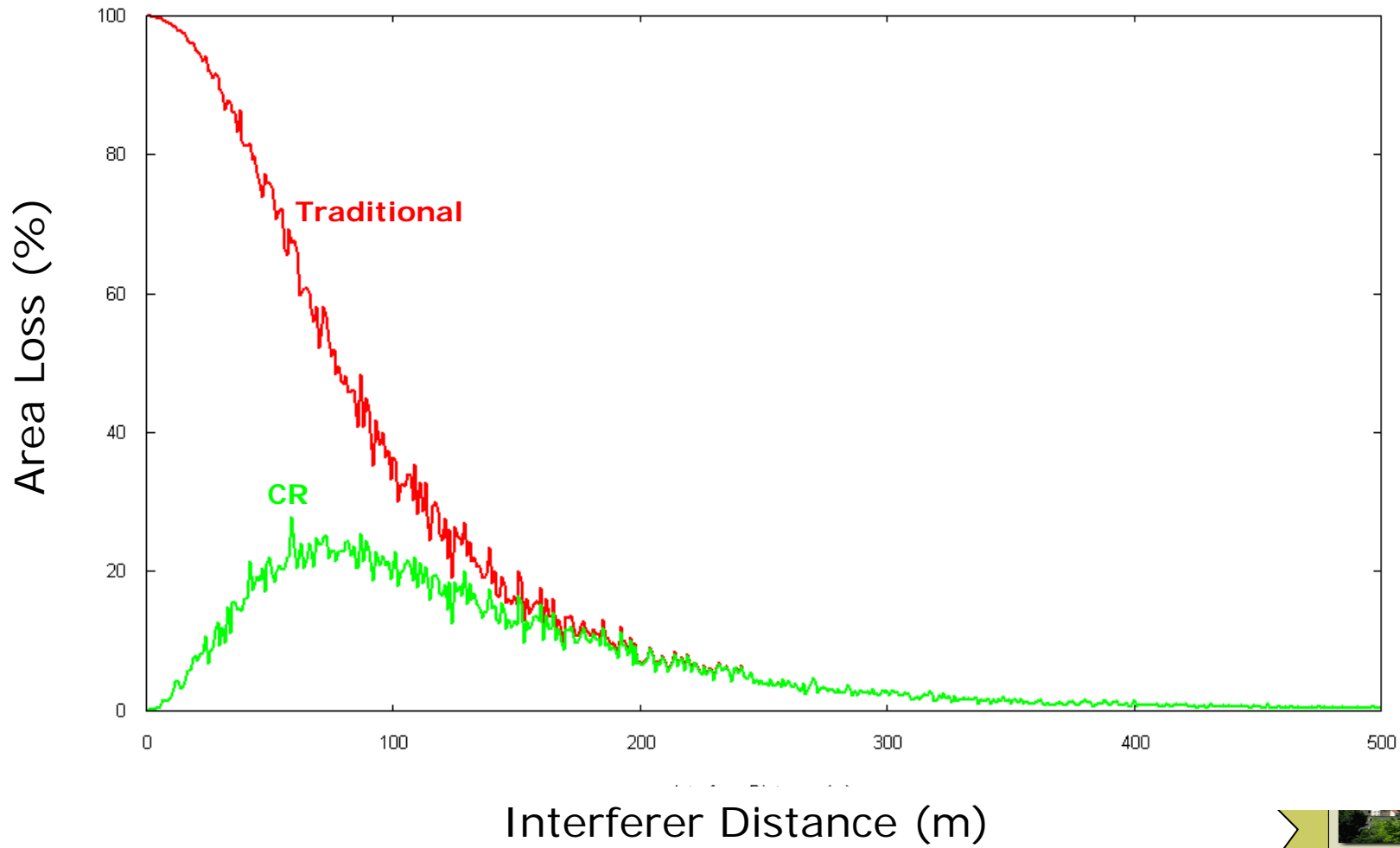
Area Loss Analysis: Traditional



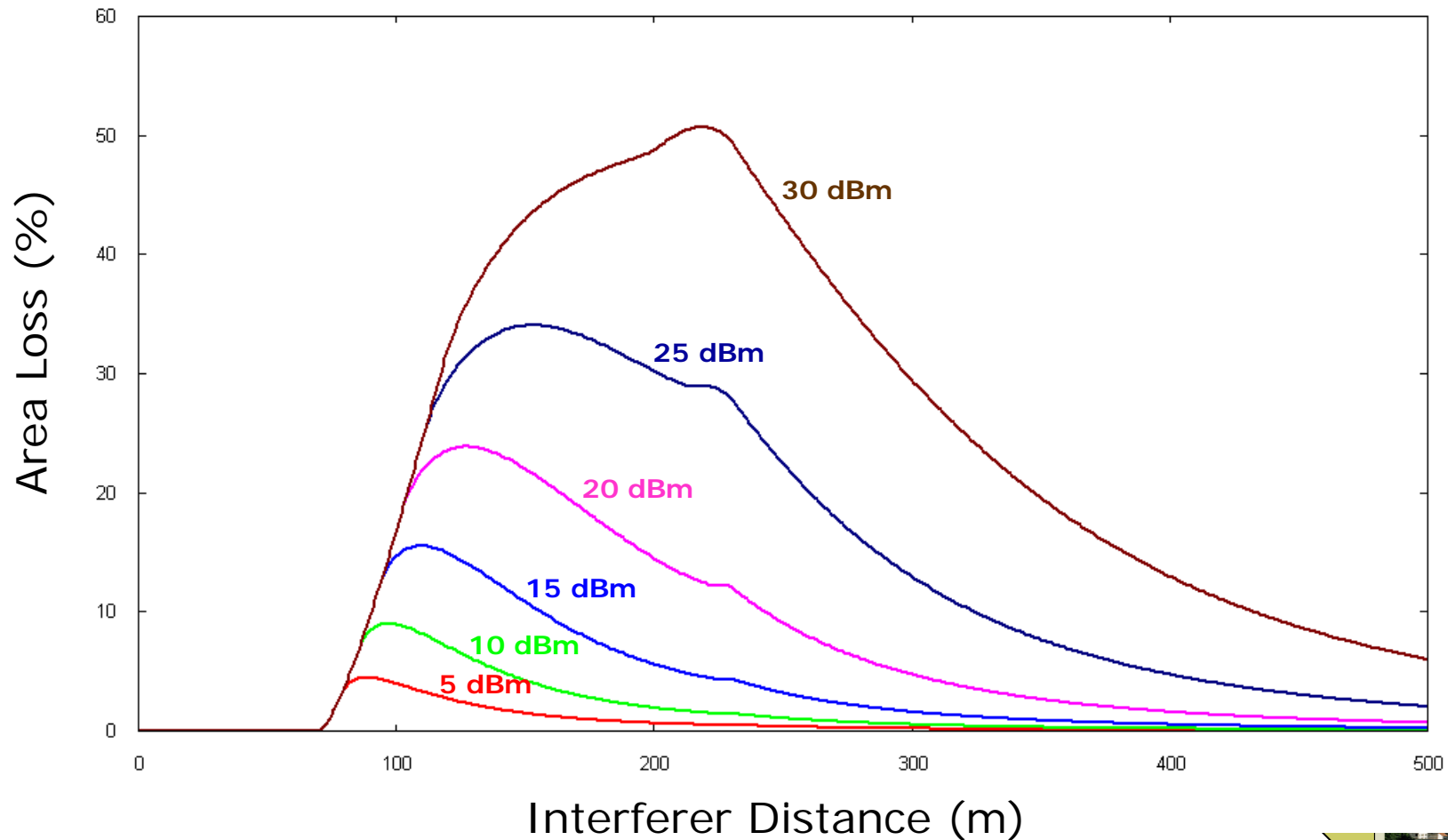
Cognitive Radio Interference Model



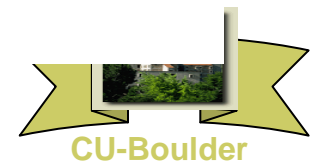
Area Loss Analysis: CR versus Trad.



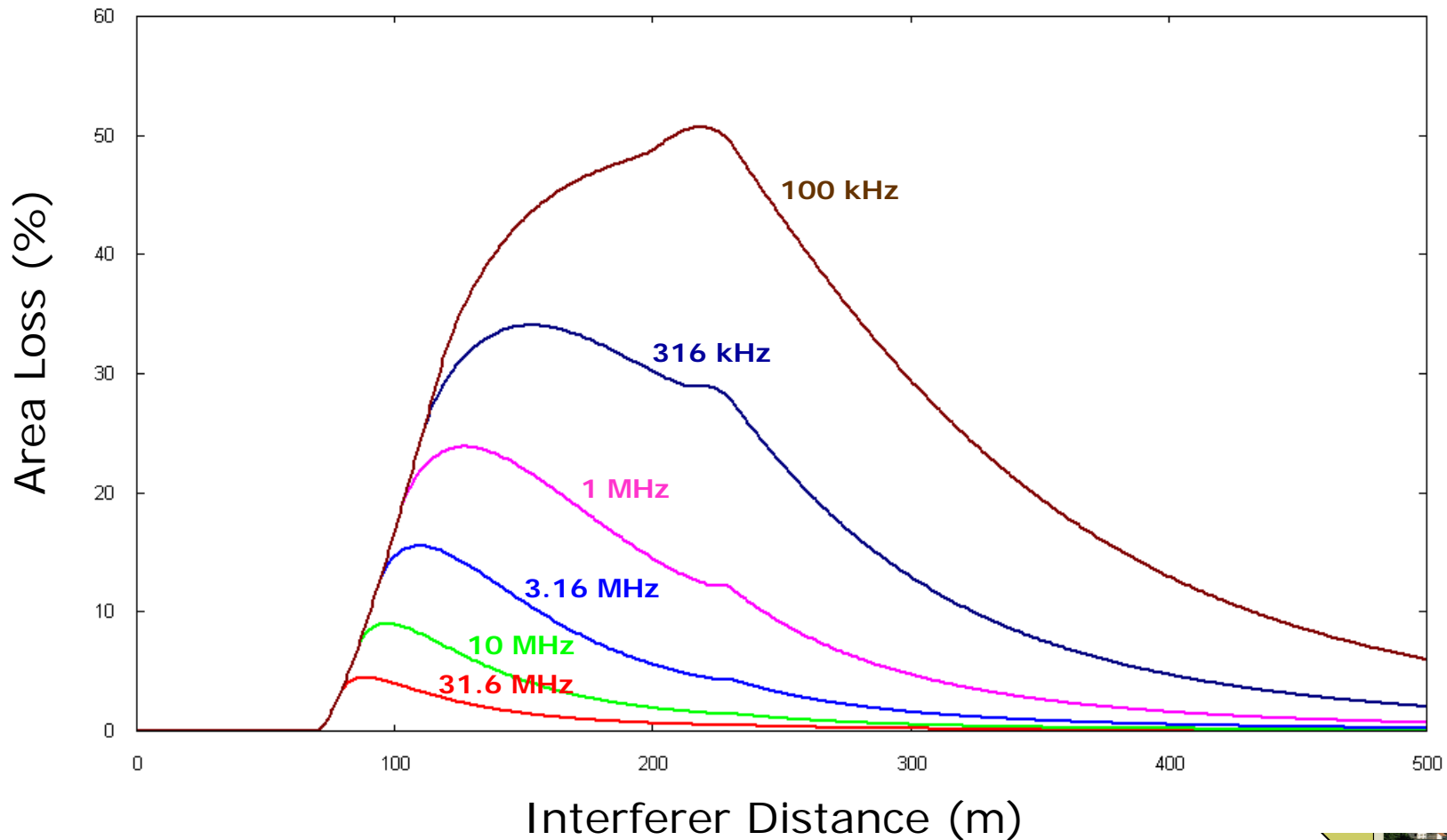
Results: Varying Interferer Power Levels



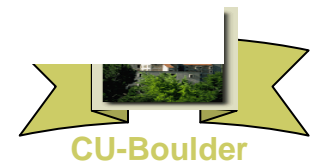
5 dB decrease in interferer power: 5-15% decrease in intf.



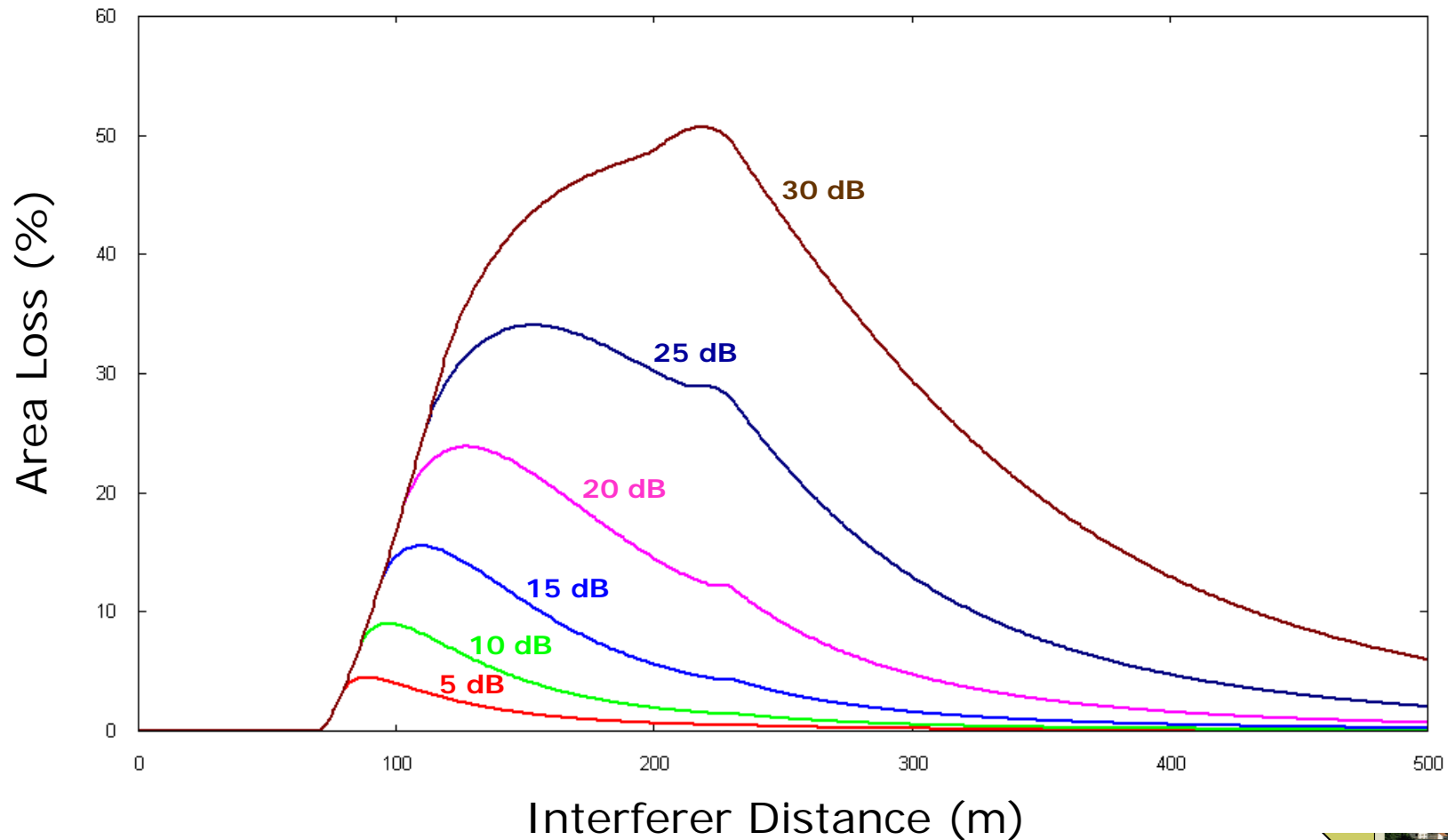
Results: Different Interferer Bandwidths



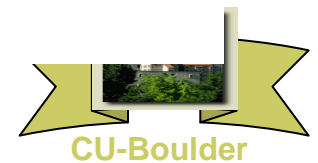
5 dB increase in CR bandwidth: 5-15% decrease in intf.



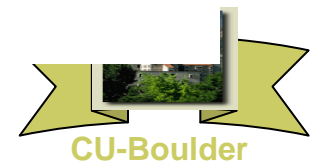
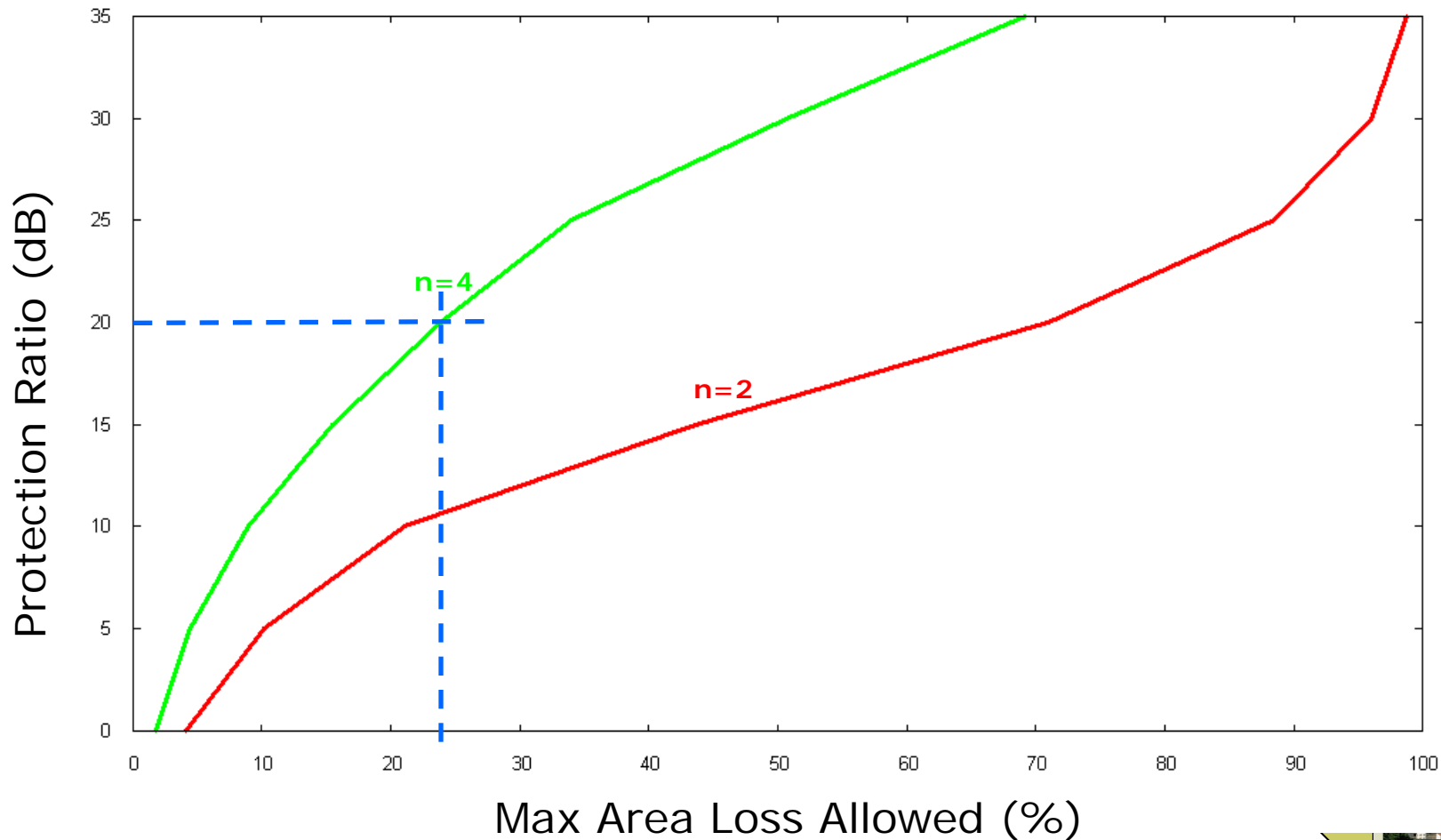
Results: Different Protection Ratios



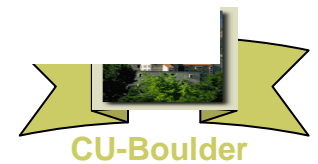
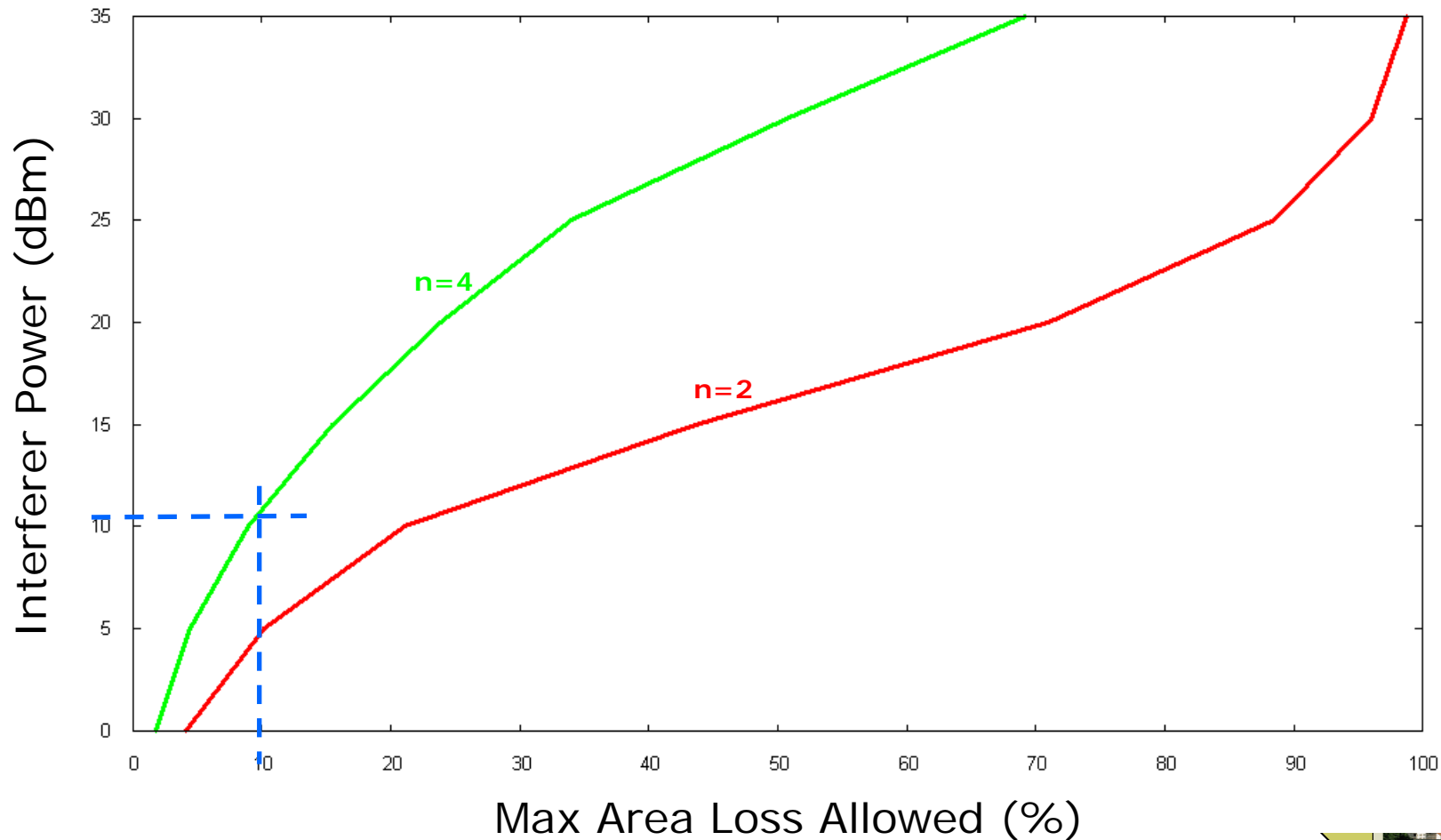
5 dB decrease in protection ratio: 5-15% decrease in intf.



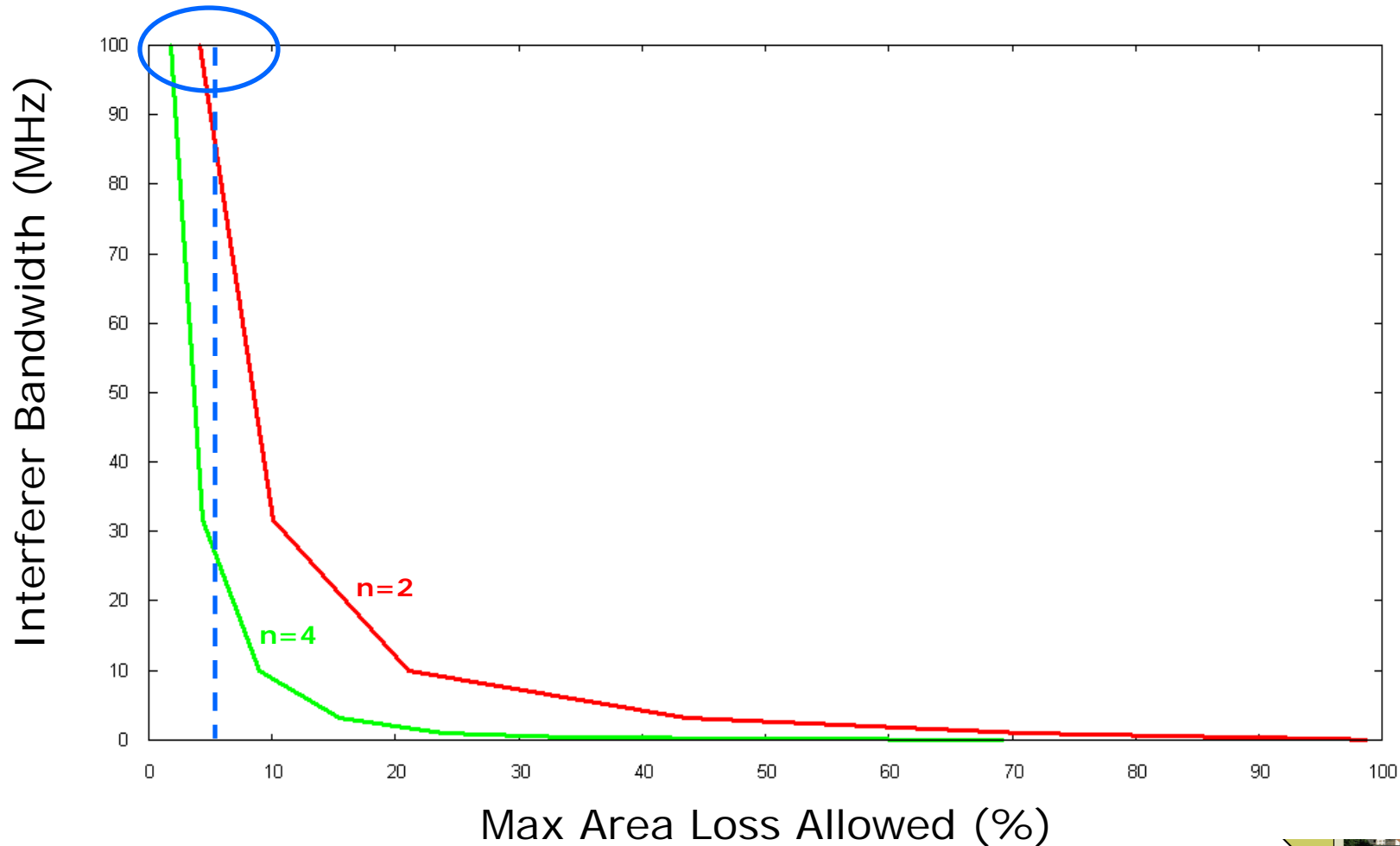
Protection Ratio – Maximum Area Loss Allowed



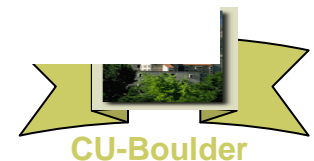
Interferer Power – Maximum Area Loss Allowed



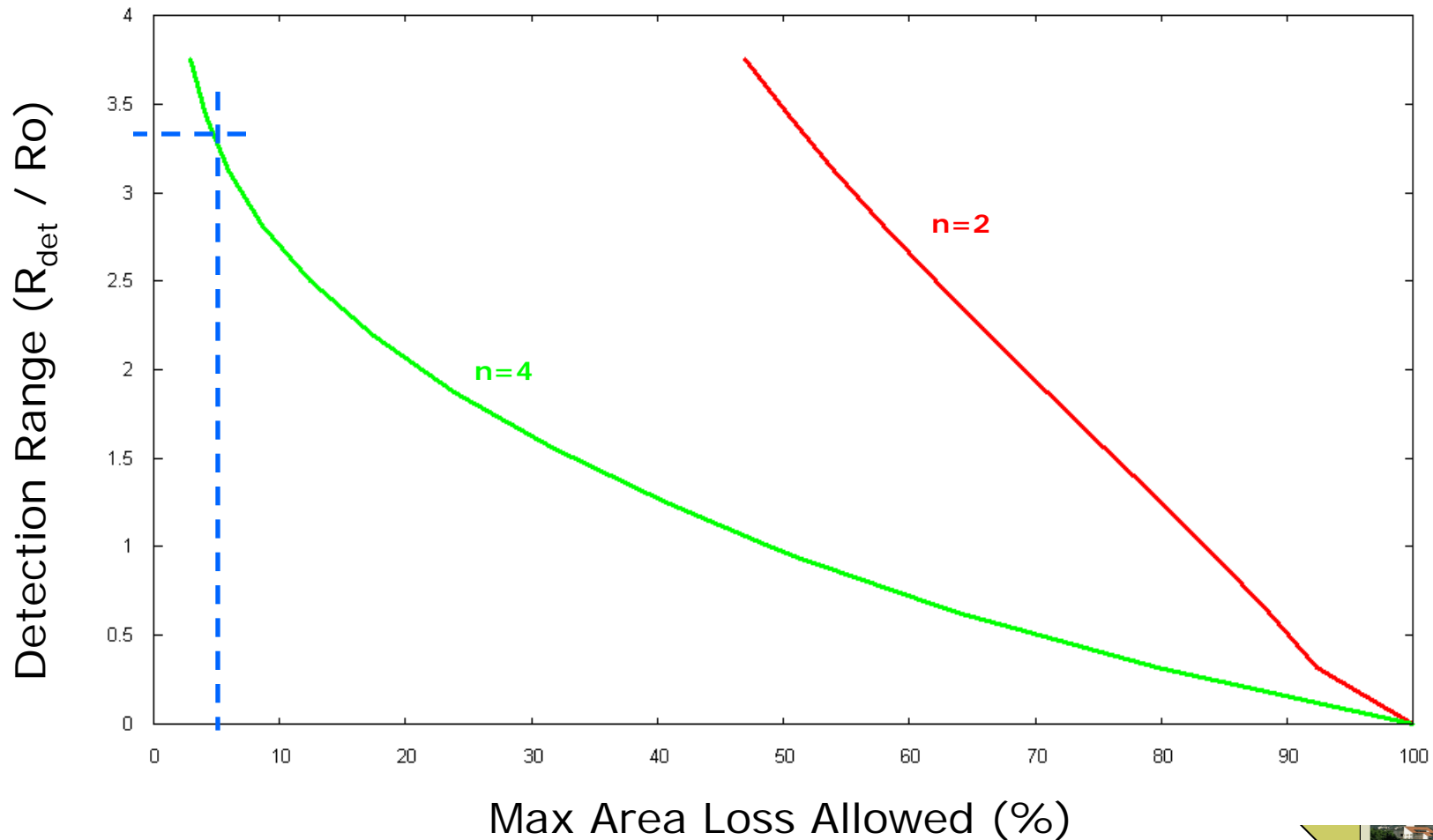
Interferer Bandwidth – Maximum Area Loss Allowed



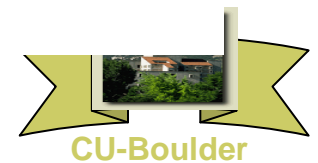
For < 5% interference, interferer bandwidth > 100 MHz



Detection Range Required – Maximum Area Loss Allowed



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



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)



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



Thanks for Listening.

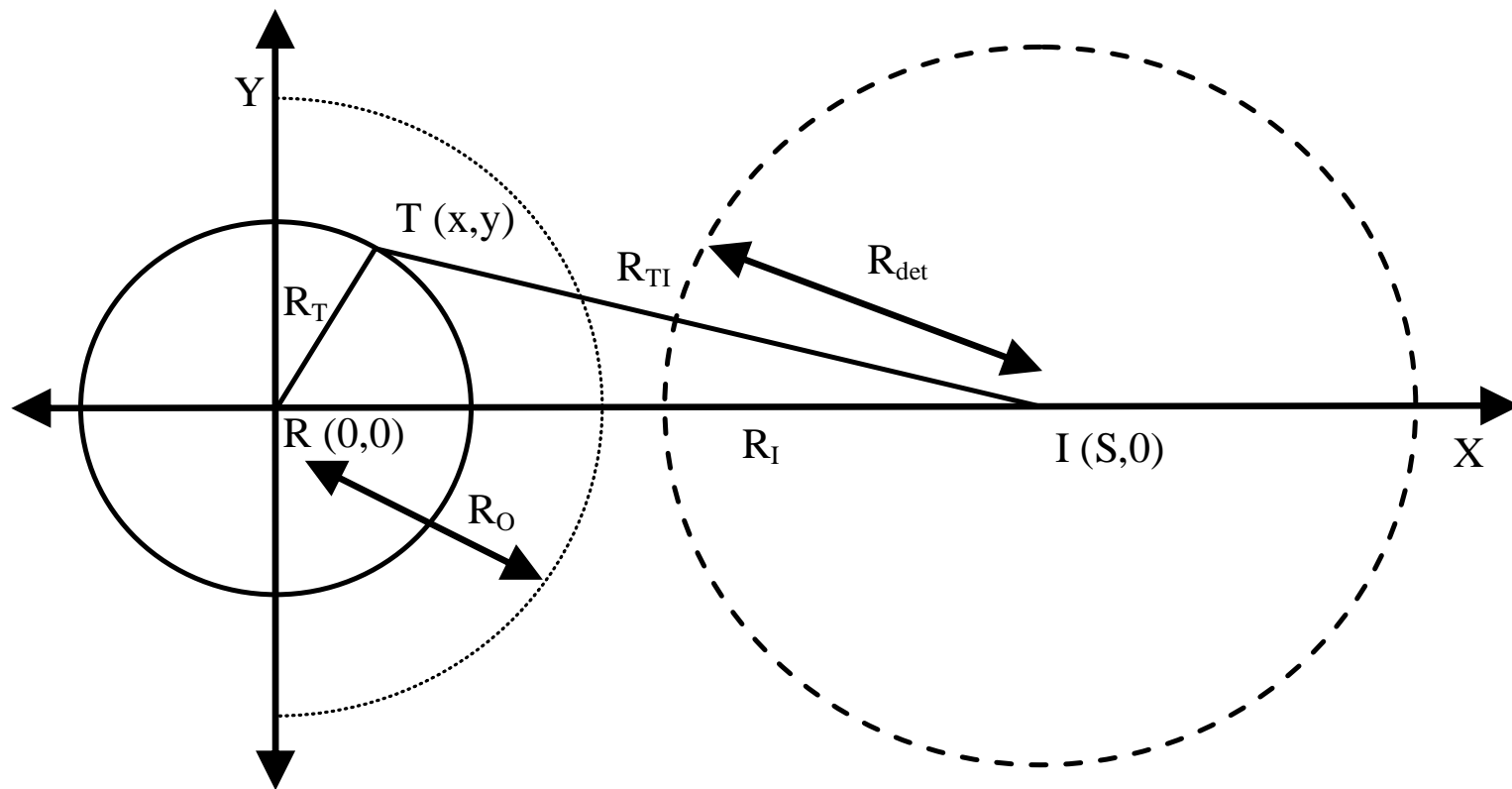
Questions ?



Backup Slides follow...



Interference Contour Model



Interference Contour Model

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

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



Different Protection Ratios: Trad. Radio

