On Limits of Constructive Interference in Backscatter Systems

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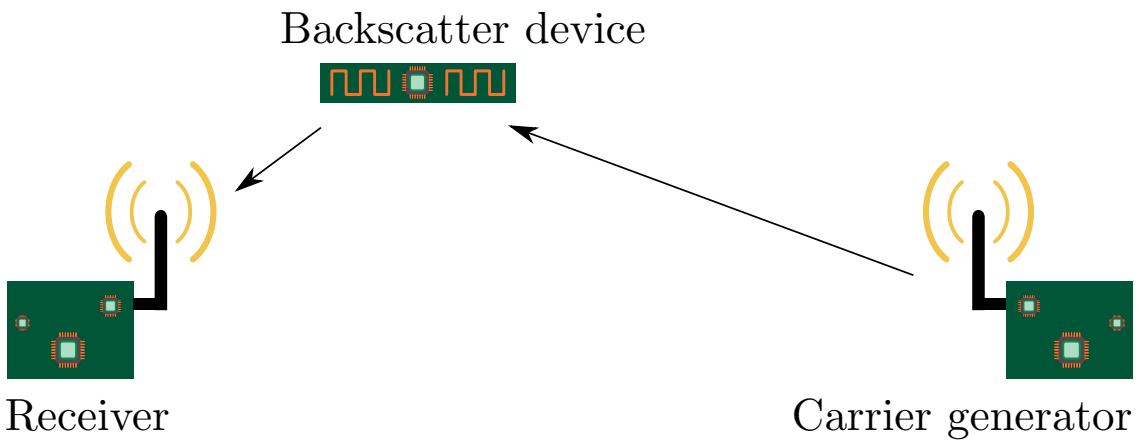
Internet of Energy Neutral Things

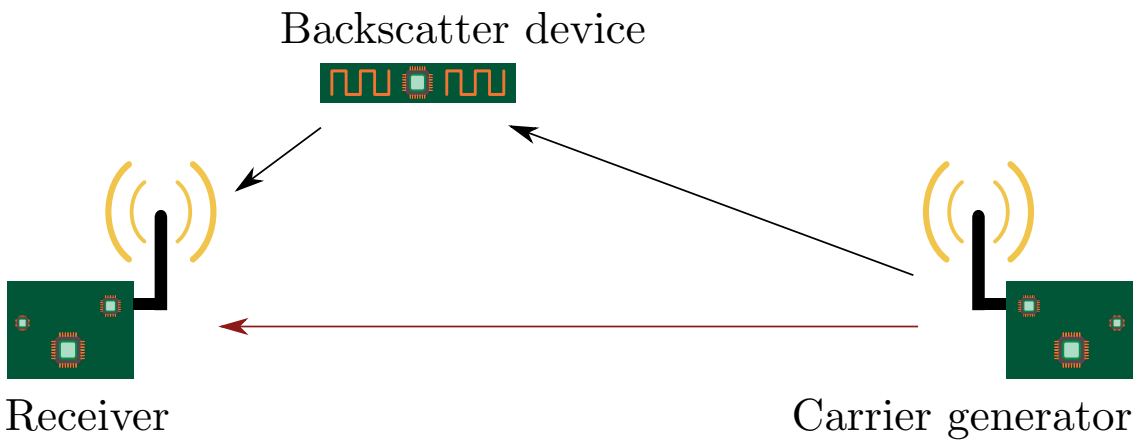
Backscatter Communication

Communicate by reflecting existing RF



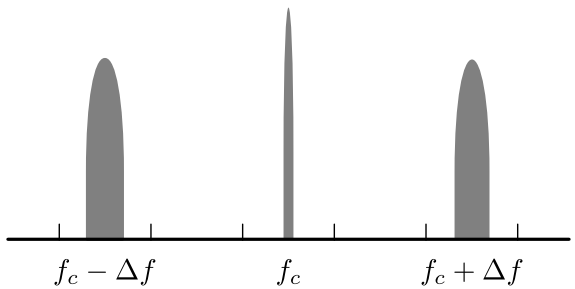
Backscatter Communication

Communicate by reflecting existing RF



Frequency-shifted Backscatter

Separate the carrier from the signal



$$2\sin(f_c t)\sin(\Delta f t) = \cos((f_c + \Delta f)t) - \cos((f_c - \Delta f)t)$$

B. Kellogg, *et al.* Passive Wi-Fi: Bringing Low Power to Wi-Fi Transmissions. In *NSDI'16*, 151–164. 2016

Motivation


Low energy consumption


Short communication range


Susceptible to cross-technology interference

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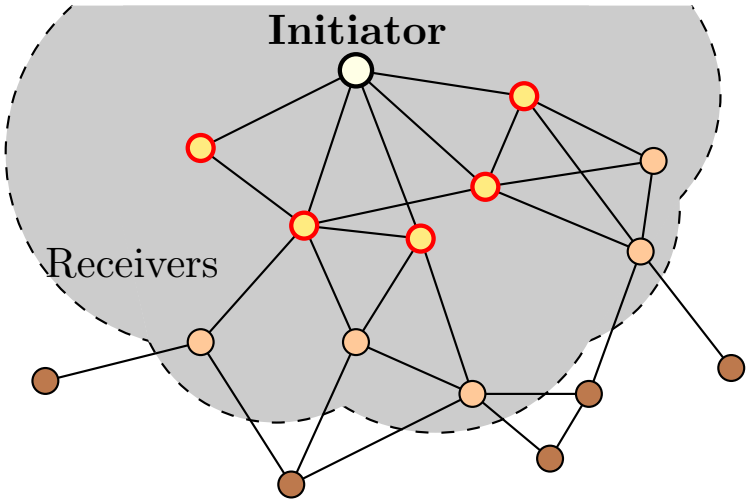
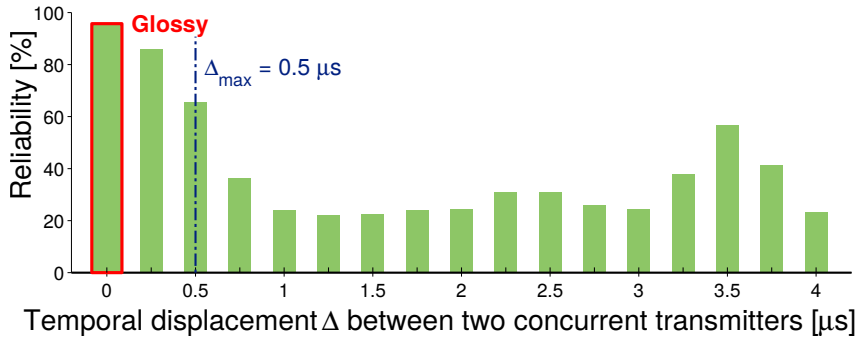
Constructive Baseband Interference

Glossy





F. Ferrari, *et al.* Efficient network flooding and time synchronization with Glossy. In *IPSN'11*, 73–84. 2011

Challenges in Achieving Constructive Interference


Same frequency


Synchronized baseband


Adequate phase offset

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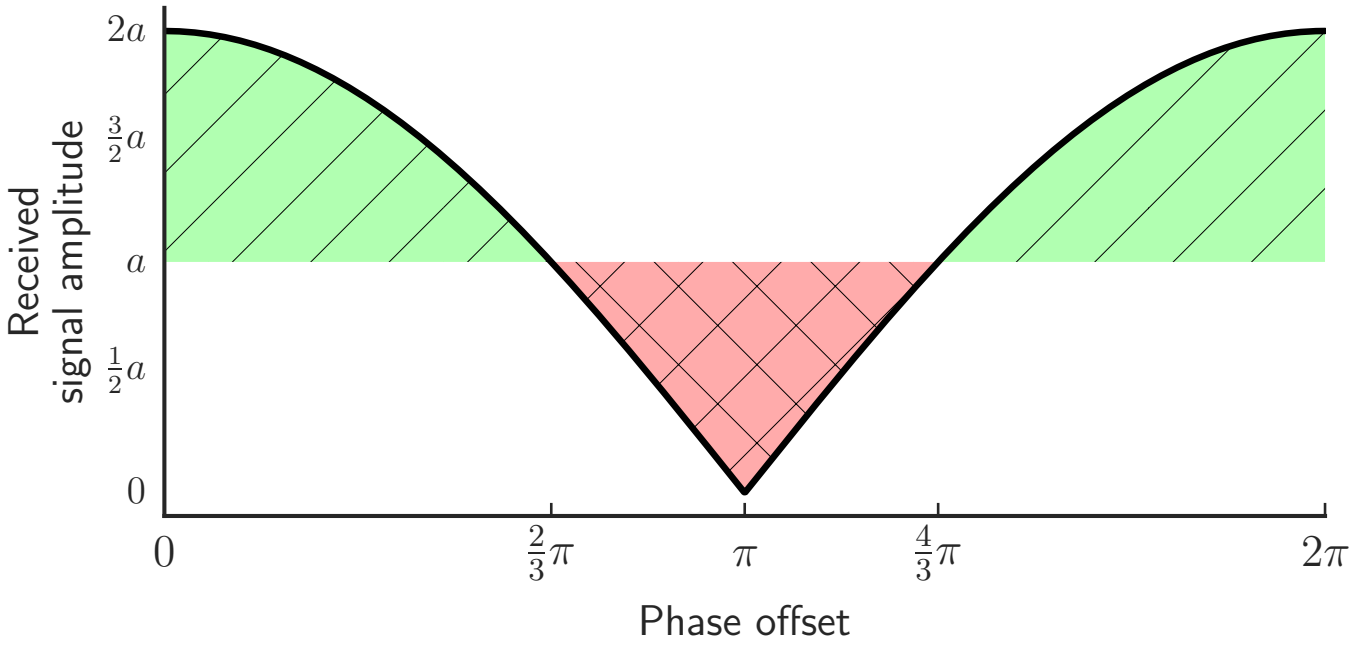
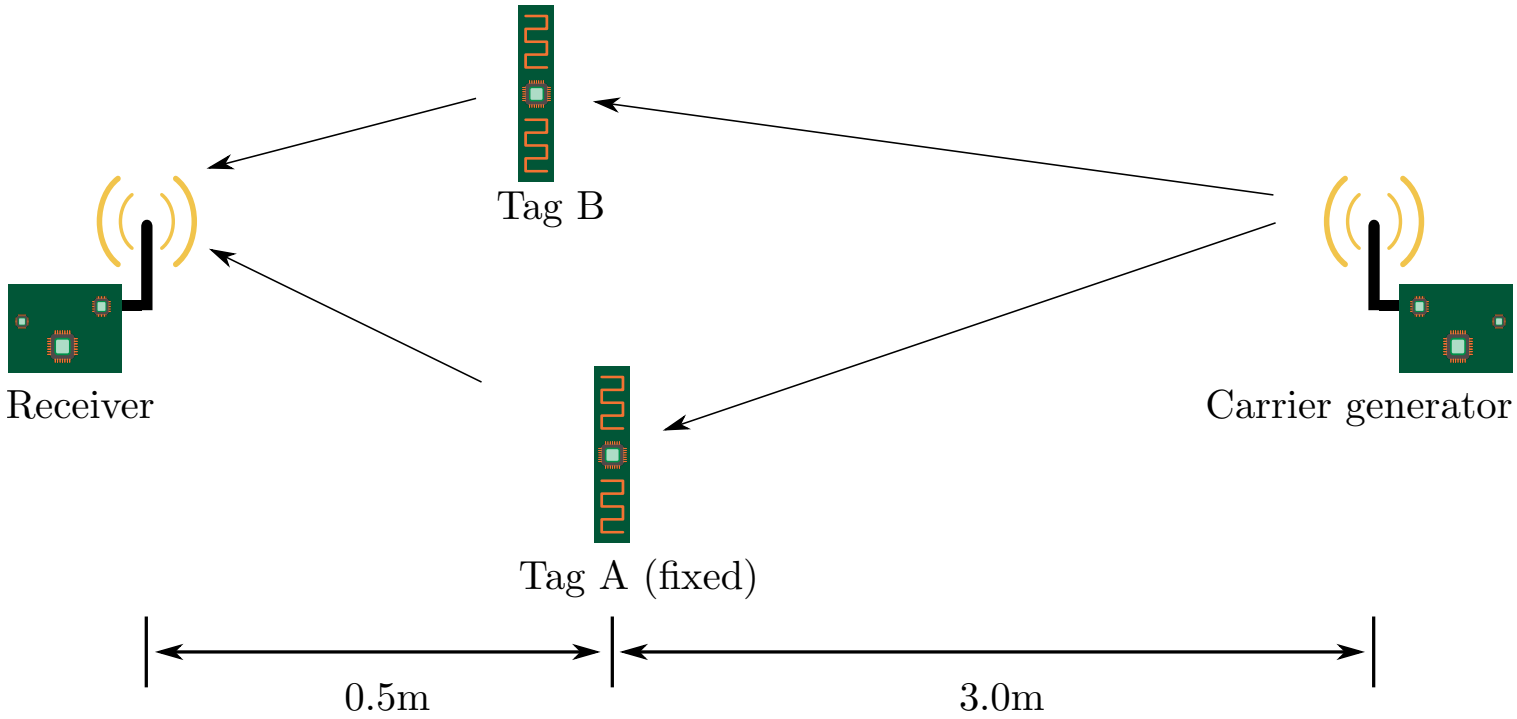
Constructive Interference with Two Transmitters

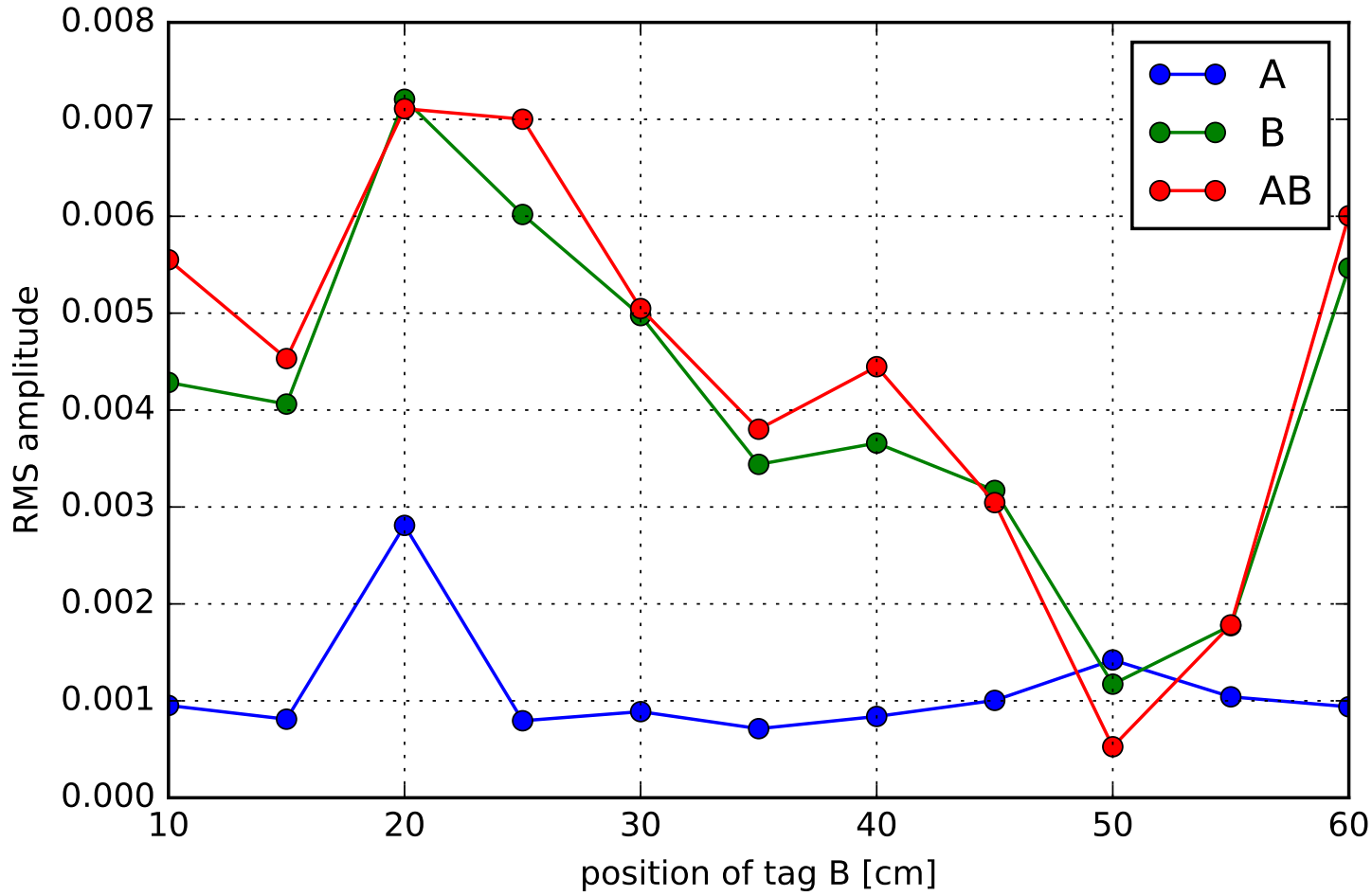
Constructive Interference is More Likely



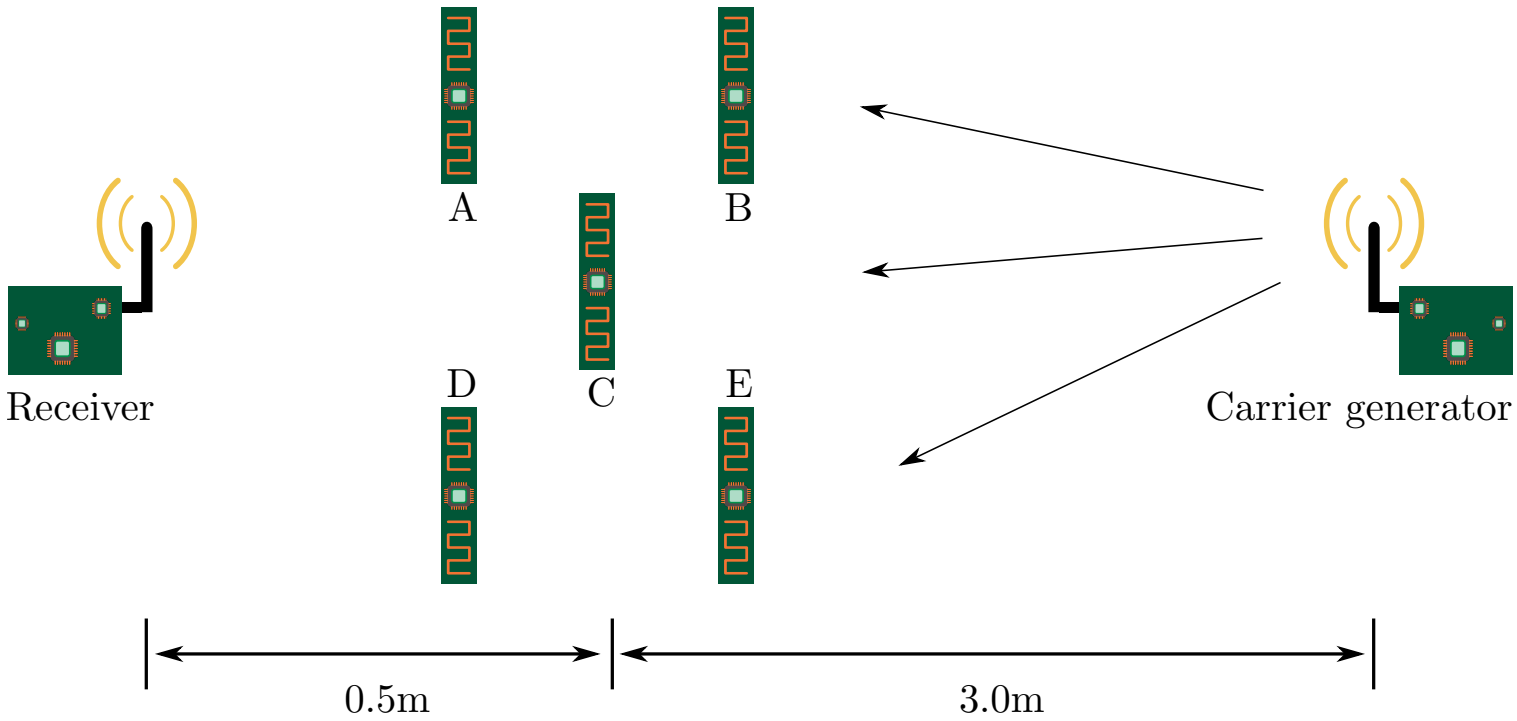
Experiment with Two Transmitters



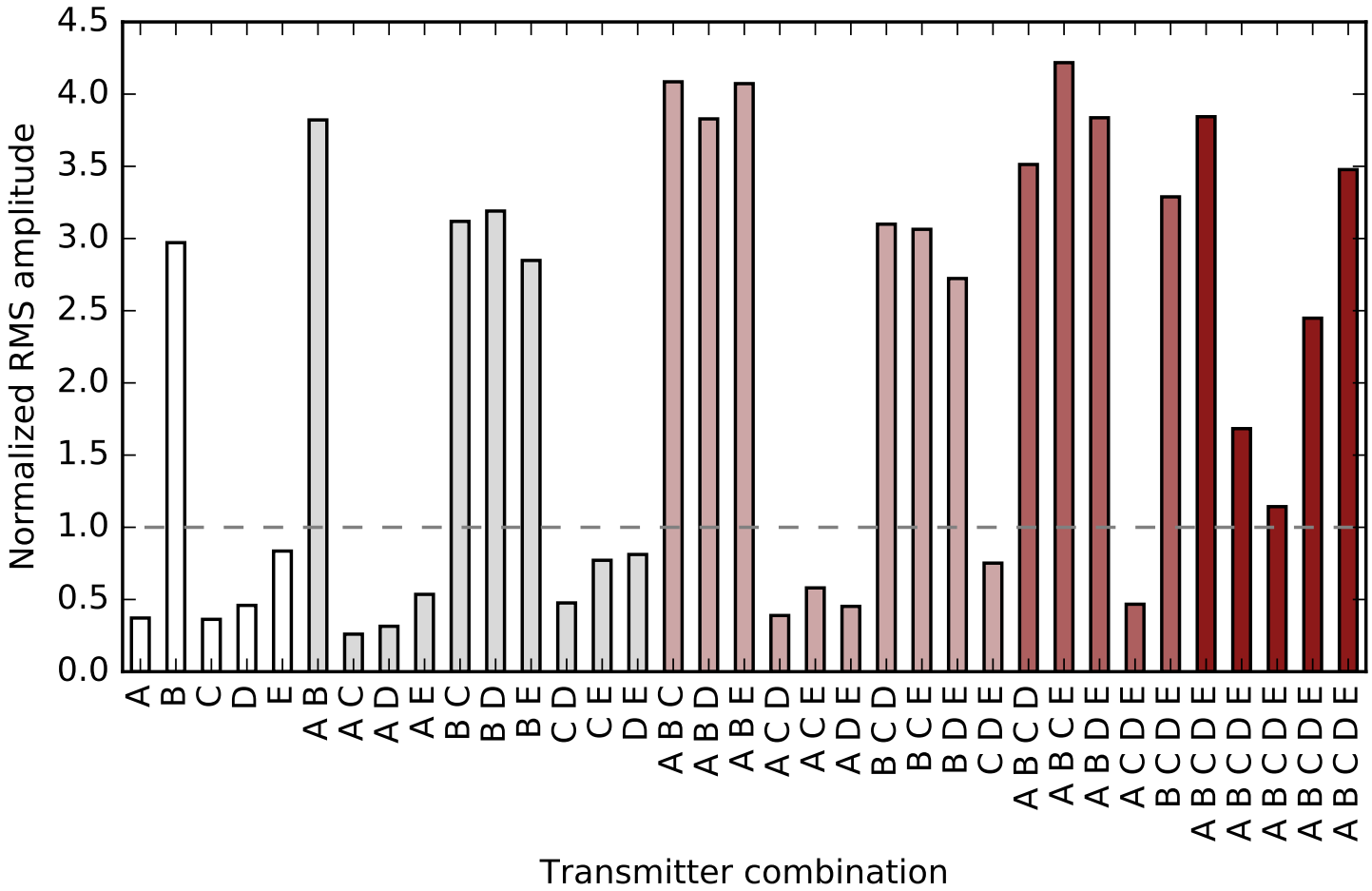
Experiment with Two Transmitters



Experiments with Five Transmitters



Experiment with Five Transmitters



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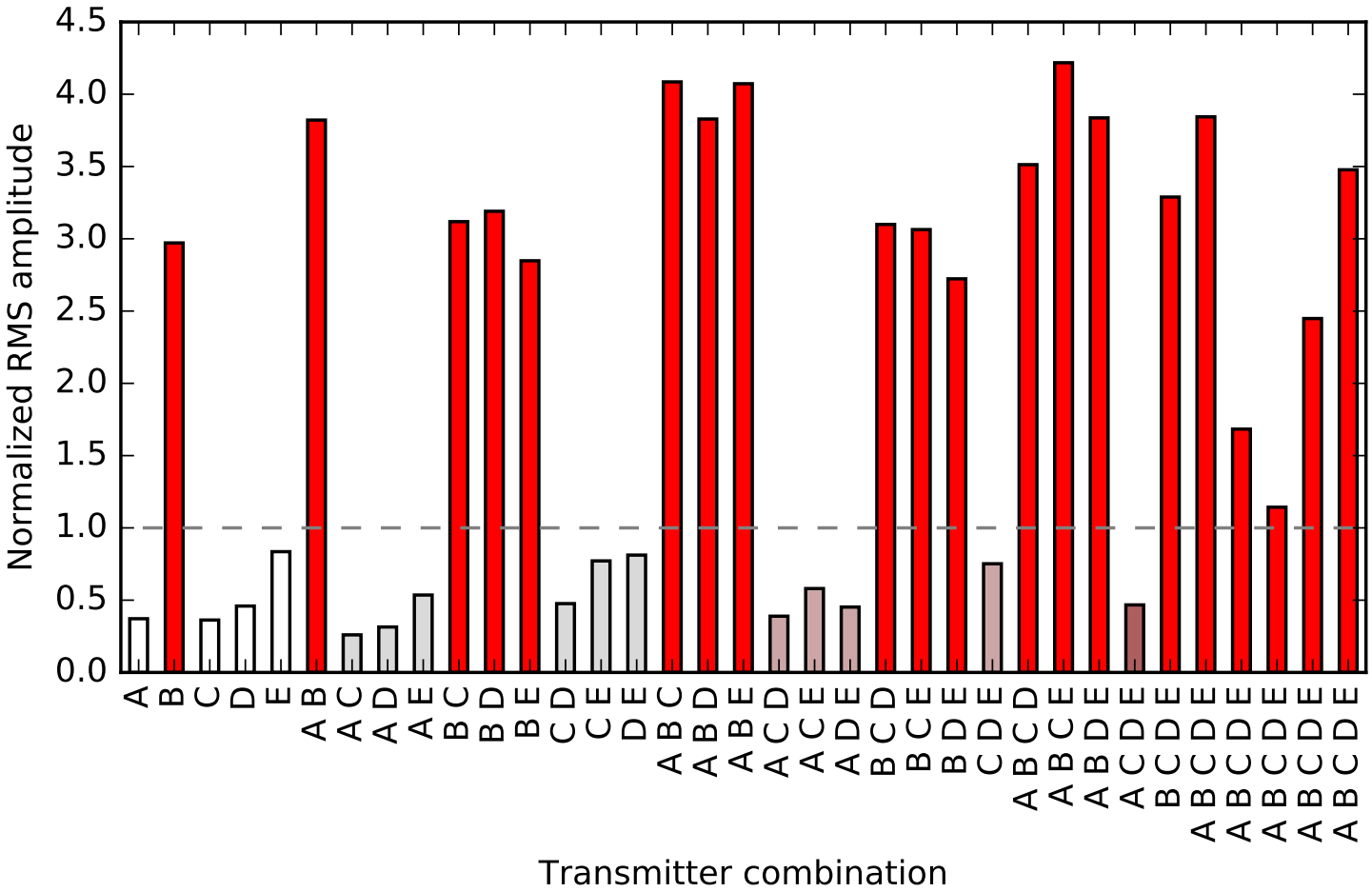

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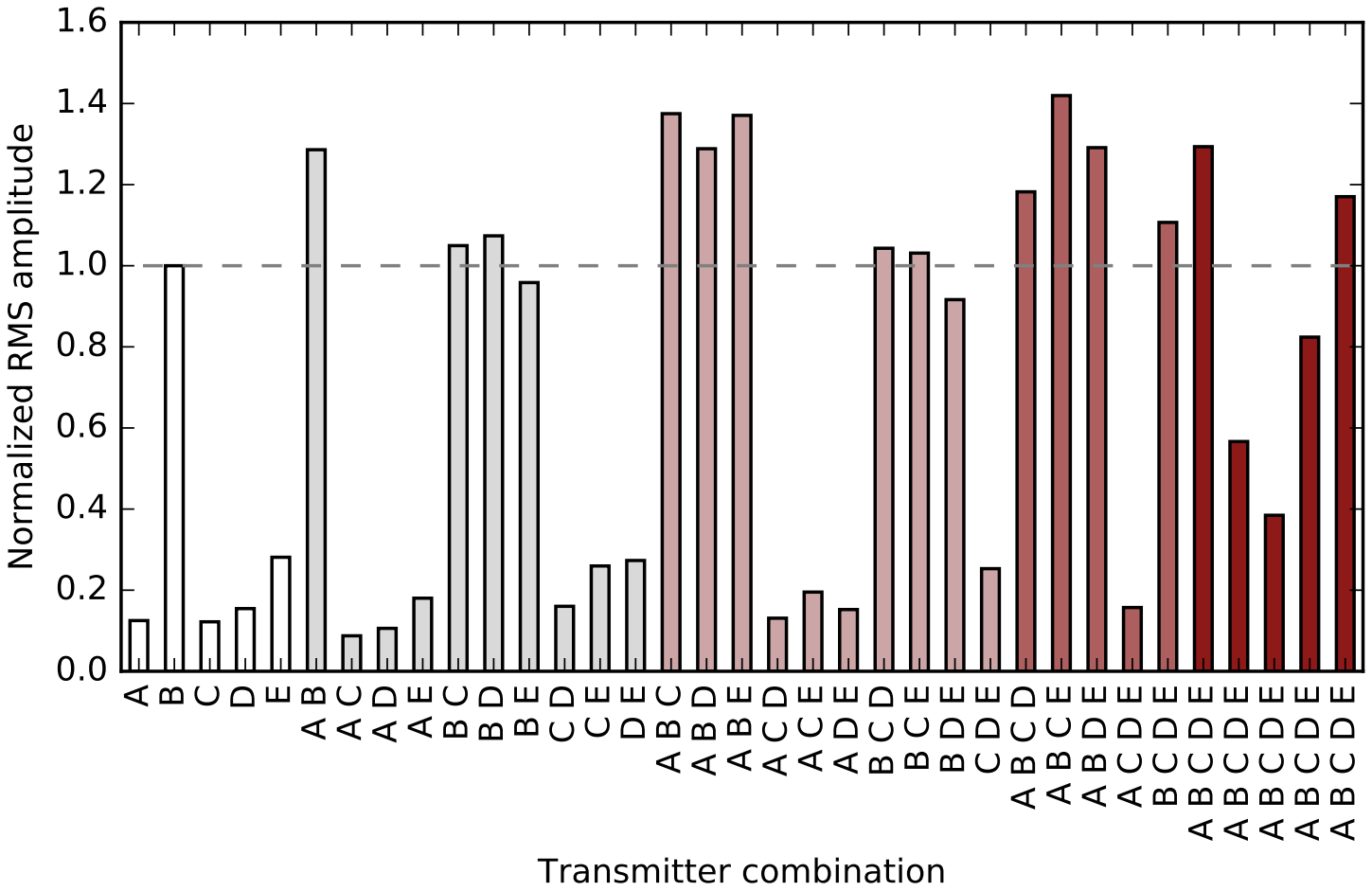

Summary

1. Experimental evaluation of constructive baseband interference in backscatter communications
2. Need for careful selection of concurrent tags
3. Only low gains are achieved ($\sim$ 3dB)