Common Sense, Fairness and Information Theory

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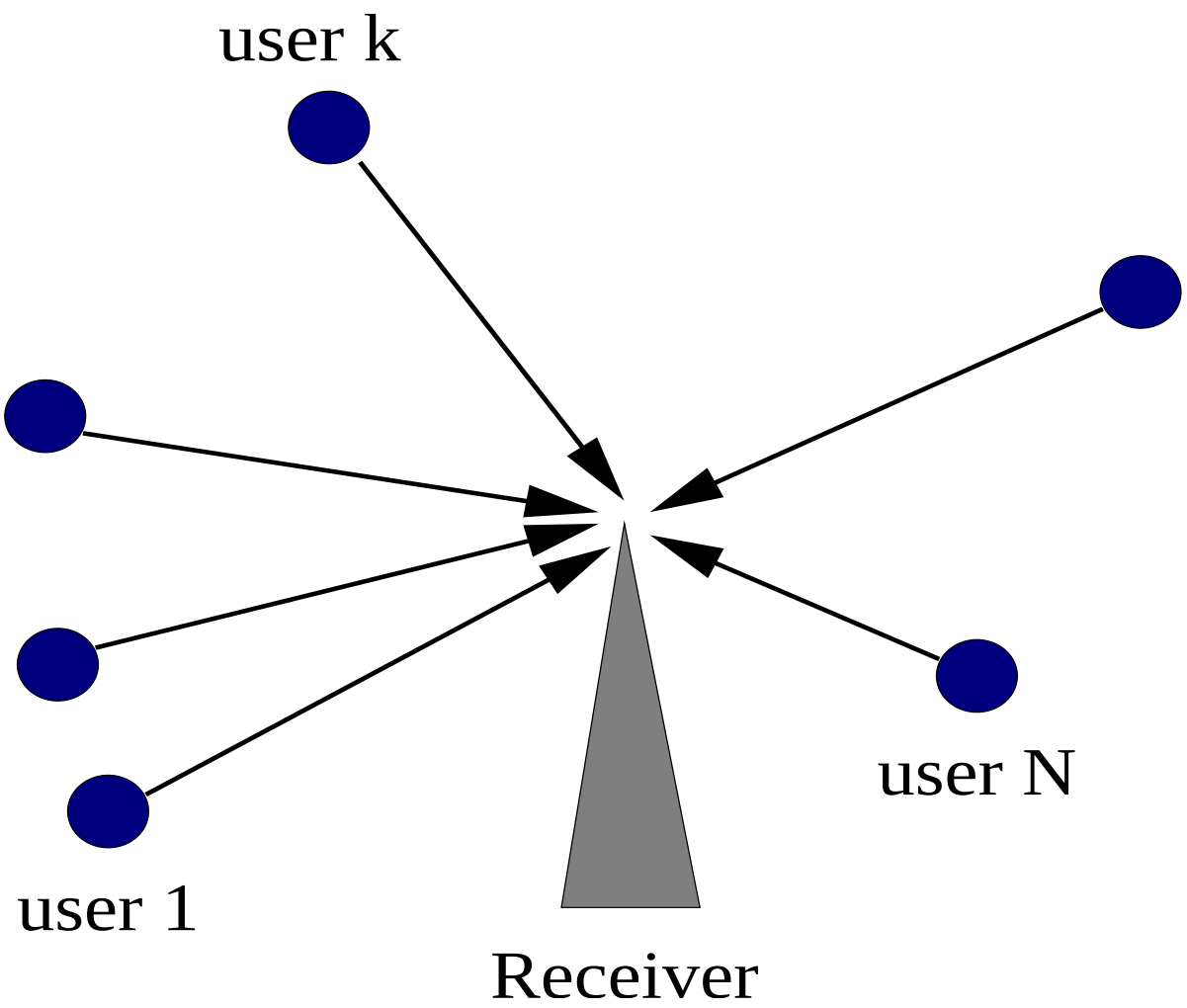
MAIN POINTS

- Assume common signal space
- Assume signal-space agile radios (“zero cost” hardware)
- Greed unequivocally GOOD (no tragedy) at Shared Receiver
- Greed is (often) BAD at Multiple Independent Receivers
  - Strong Interference: system happy (but non-egalitarian)
  - Weak Interference: everyone unhappy (need etiquette)

Single Base Setup



Single Base Results

- Figure of Merit: sum capacity (using norm notation)

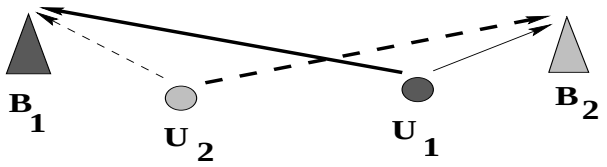
$$C = |\mathbf{r}|_1 = W \log\left(1 + \frac{|\mathbf{p}|_1}{N_0}\right)$$

- Greedy codeword update $\rightarrow$ sum capacity via emergent waterfilling
  - Works for all the usual channels, very robust.
- Caveat: higher power users get better performance
  - Can augment with greedy power control

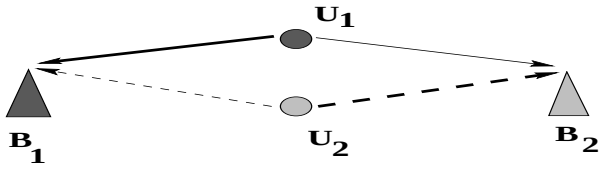
PUNCHLINE: Greed is GOOD (at a single base)

Multibase Interference Setup

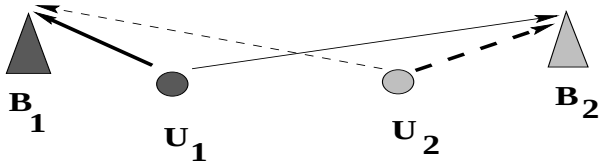
Strong ($g > 1$)



Equal ($g = 1$)

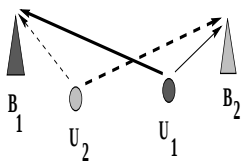
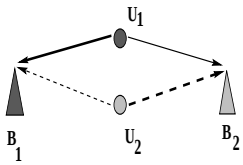
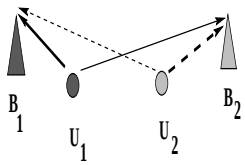


Weak ($g < 1$)

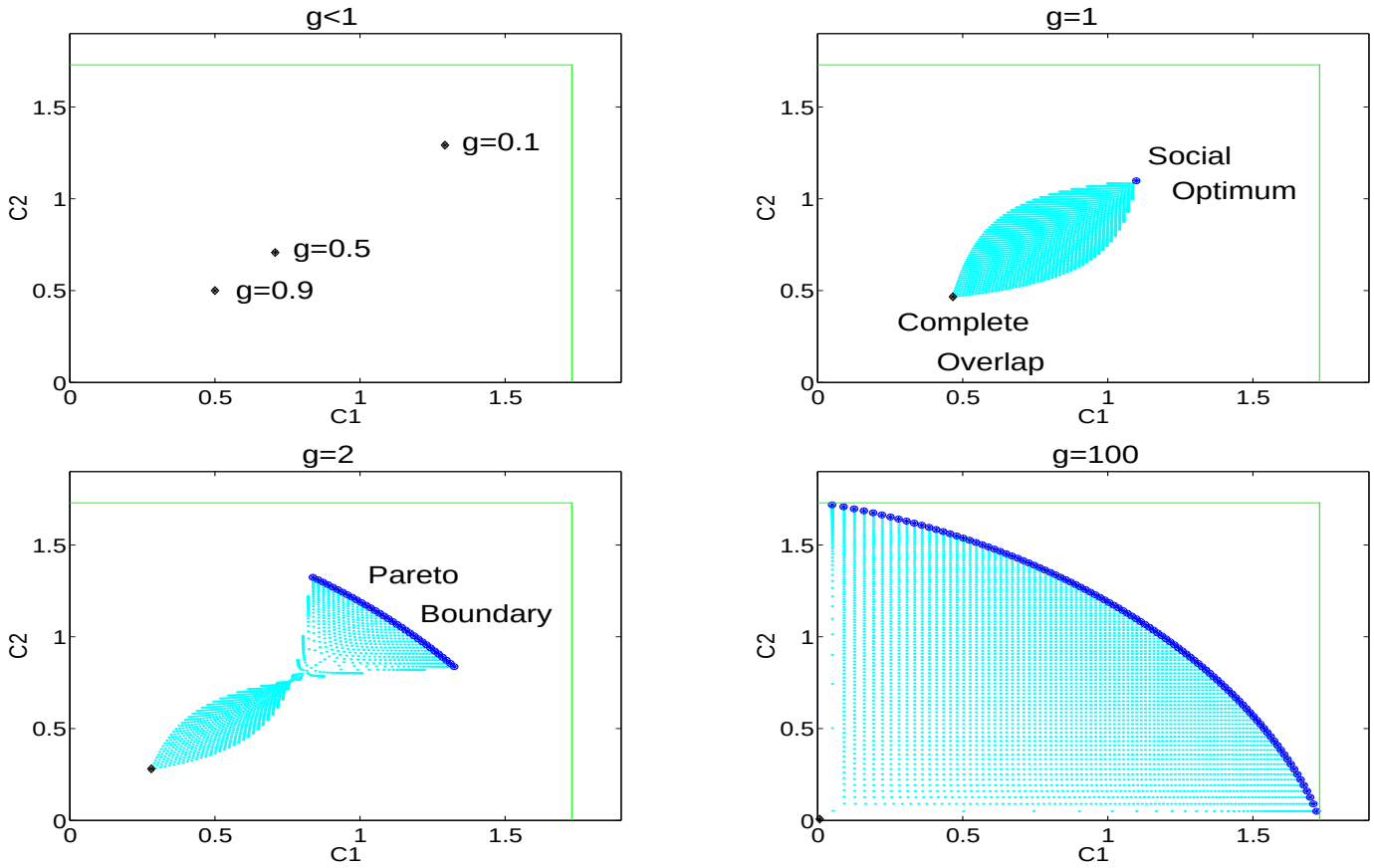


Ignore formal interference channel (treat interferers as noise)

Signal Space Structure vs. g

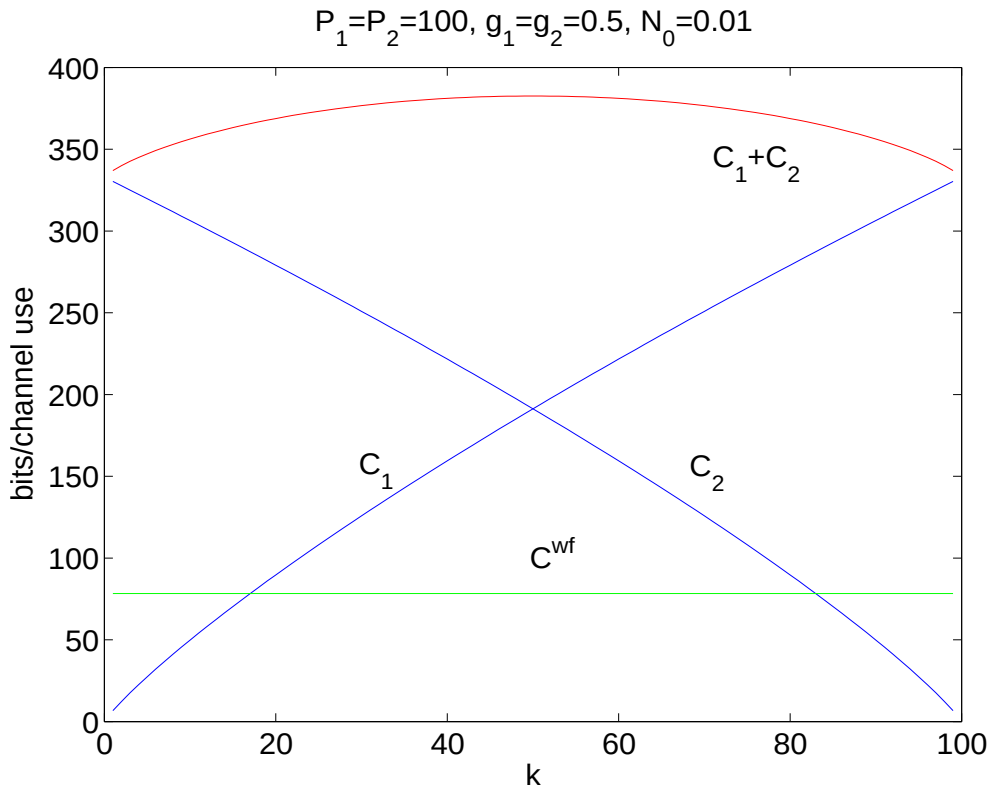
Overlap	**Scenarios**		
	$g_1 g_2 > 1$ 	$g_1 g_2 = 1$ 	$g_1 g_2 < 1$ 
Complete	*unique*	*unique*	*unique*
Incomplete	*many*	*many*	-
None	*many*	*unique*	-

Waterfilling vs. g (SNR=10dB)



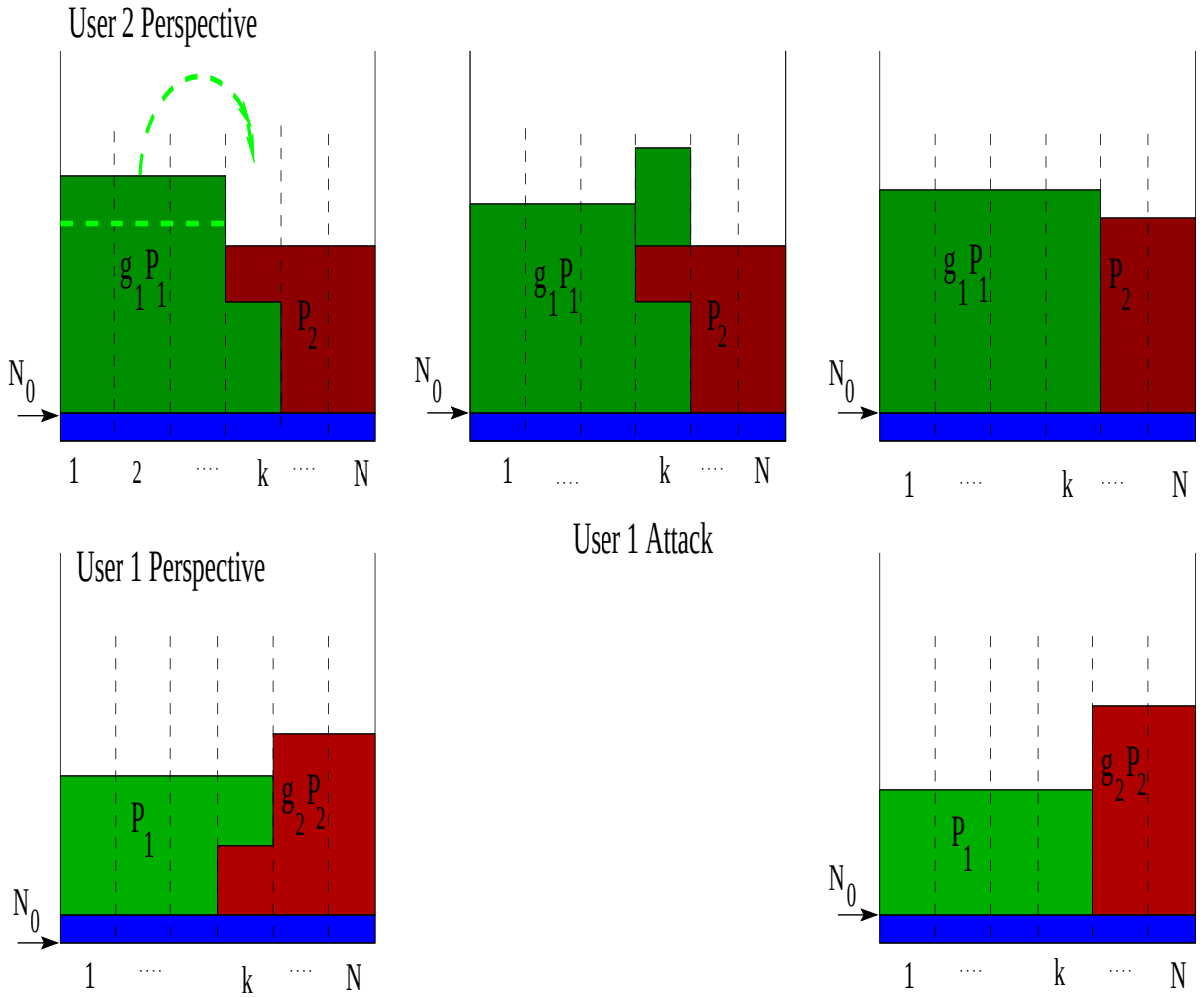
PUNCHLINE: Greed can be terrible (at multiple bases)

Capacity vs. Partitioning



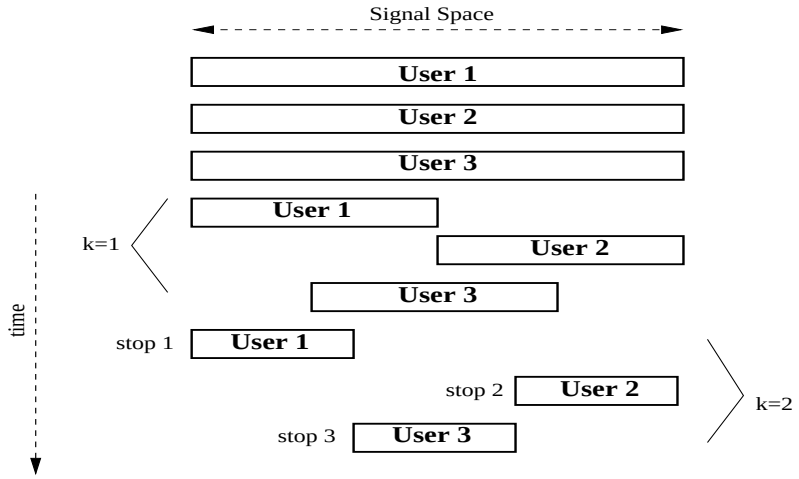
Separation Better if $g > \frac{1}{M-1}\left(\frac{1}{\sqrt[N]{1+M(\mathrm{SNR})}-1} - \frac{1}{(\mathrm{SNR})}\right)$

Appeasement or War: $g \geq 1$



Thoughtful Etiquettes for $g < 1$

- Cannot inflict much damage when $g < 1$
- Be polite & try to get your own subspace $\rightarrow$ tit-4-tat if warranted!



GREEDY CONCLUSIONS

- Assume common signal space
- Assume signal-space agile radios ("zero cost" hardware)
- Greed unequivocally GOOD (no tragedy) at Shared Receiver
- Greed (usually) BAD at Multiple Independent Receivers
  - Strong Interference $\rightarrow$ **Deference & Aggression**
  - Weak Interference $\rightarrow$ **Etiquette**

    Selective pressure via purchase decisions?

    Tit for Tat has evolutionary advantage