Threshold of Free Window Duplex

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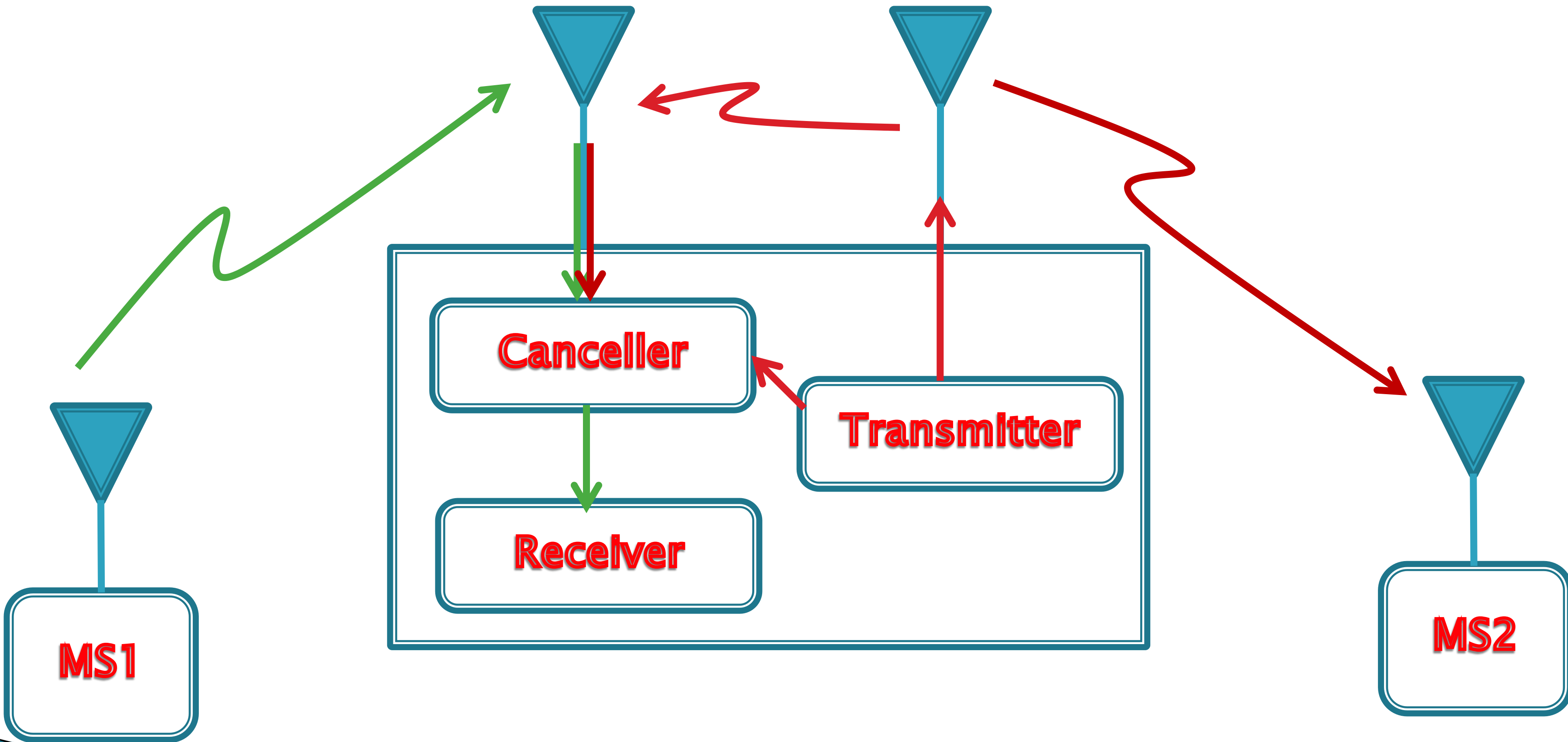
1. system model

As has been known, one of the topic desires in wireless communication is to achieve high spectrum efficiency, because the spectrum of today is so scarce.

According to Shannon theory, reducing interference can be a effective way for increasing cannel capacity.

$$C=H \log[1+S/(I+N)]$$

Single channel full duplex was realized by cancelling the duplex interference[Stanford, 2011]. The concept was created in Modified TDD system (PKU, 2009) .
The scenarios is found below



We have achieved 35 -40dB interference cancellation

Modified TDD system

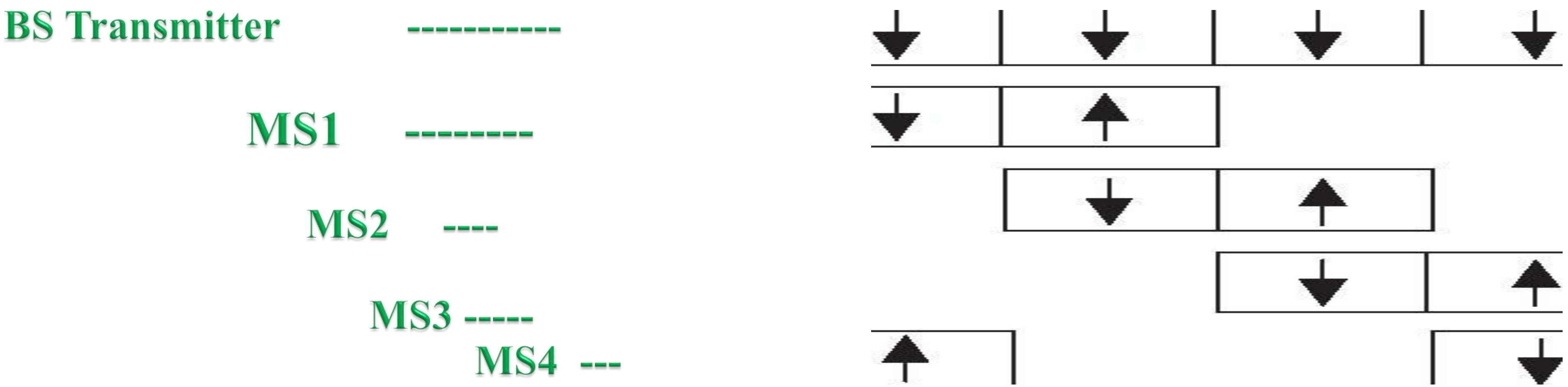
The proposed TDD BS can work in the two models;

1. The conventional TDD
   DL time slot (TS)
   UL TS

2. Single Channel Full Duplex (SCFD) Time Slot

   DL & UL TS (as shown in scenarios of Multi user)

Modified TDD system in SCFD model



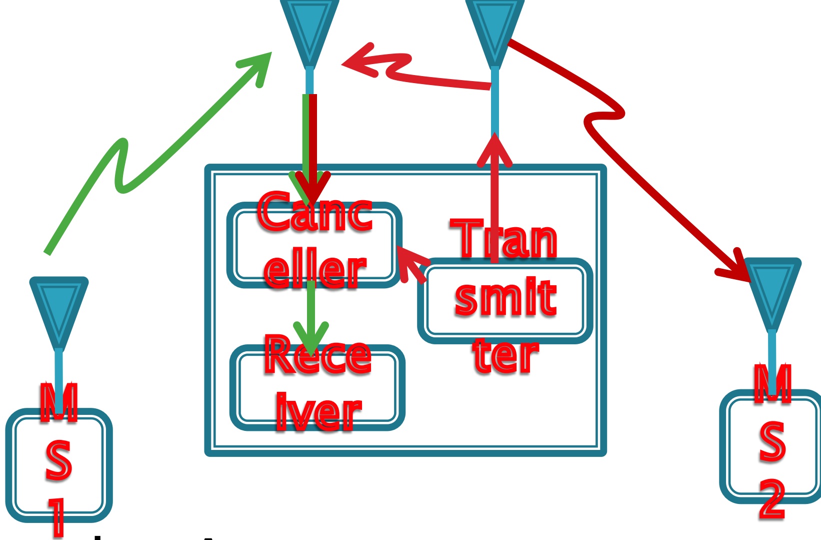
a SCFD TS can have two additional interferences

(1) MS to MS interference

(2) BS to BS interference, i.e. Duplex interference

X. Jin, M. Ma, B. Jiao, and W.C.Y. Lee, ``Studies on Spectral Efficiency of the CDD System,'' in *Proceedings of Vehicular Technology Conference*, Fall 2009.

2. Study on the potentials



BS transmit Antenna ➔ BS receive Antenna

White Gaussian Channel

MS Transmit antenna ➔ BS receive antenna

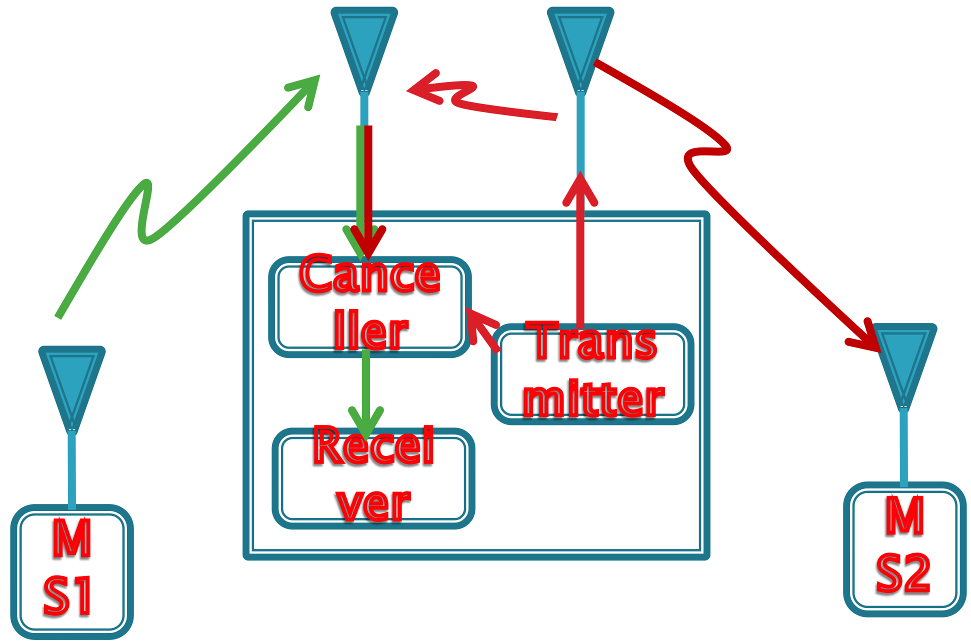
Frequency Selective Channel

In addition, it is assumed that we are working with very broad bandwidth system so that the bandwidth is much greater than that of coherency bandwidth.

Water-filling

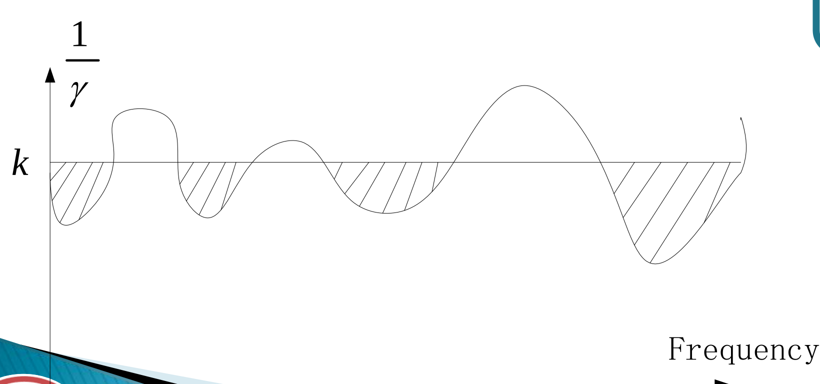
For the normalized receive power, the signal to the interference plus noise ratio (SINR) can be expressed as

$$\gamma = \frac{|h|^2}{\alpha p + N}$$



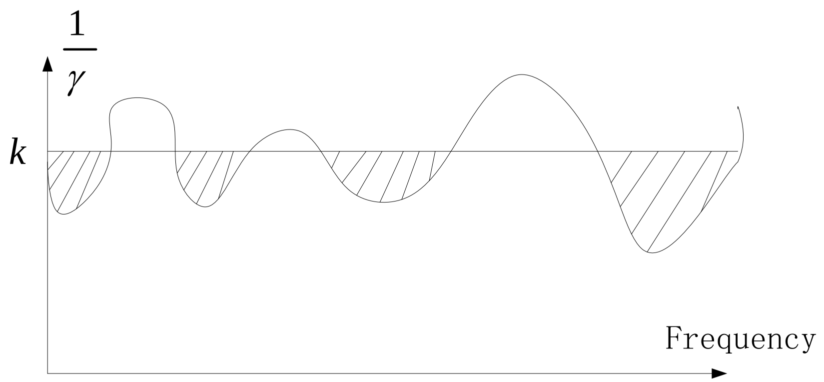
with the PDF,

$$f_\gamma(x) = \frac{1}{\Gamma}\exp\left(-\frac{x}{\Gamma}\right)$$



Threshold

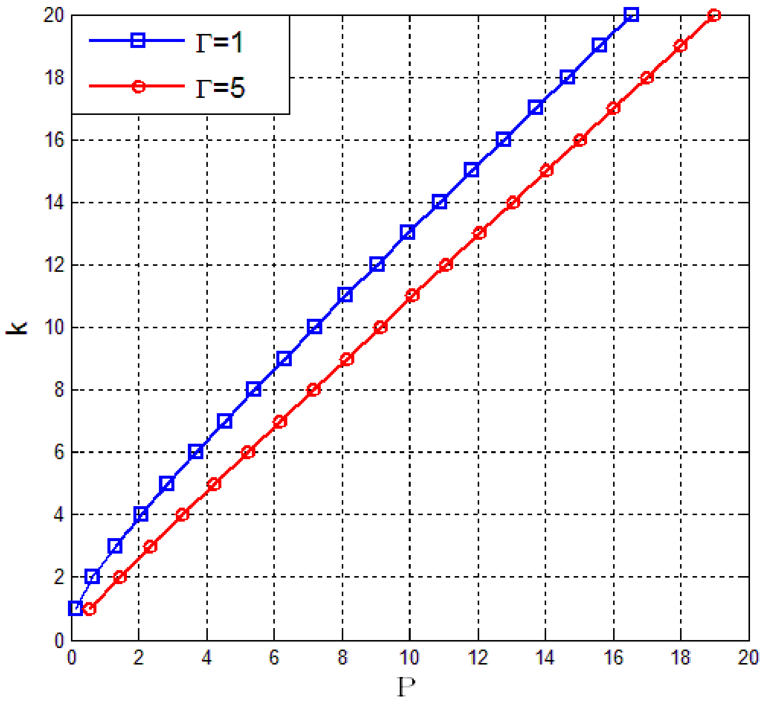
Set a threshold by $k = 1/\gamma$



By solving

$$\bar{P} = \int_{\frac{1}{k}}^{\infty} \left(k - \frac{1}{x}\right) f_r(x)dx = k exp\left(-\frac{1}{k\Gamma}\right) - \frac{1}{\Gamma} E_1(\frac{1}{k\Gamma})$$

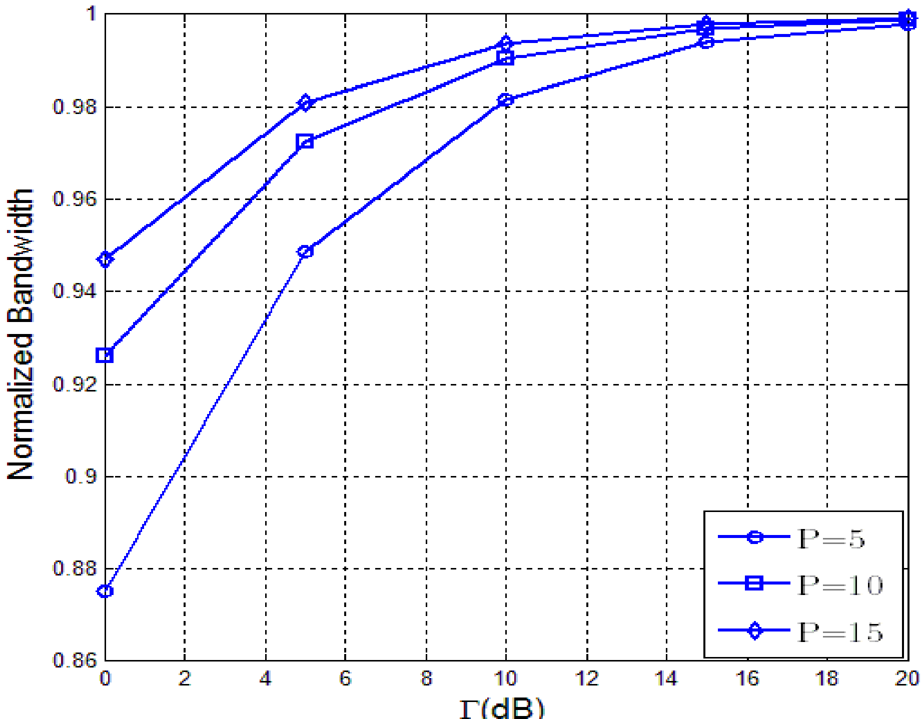
The numerical results



Normalized bandwidth

With ergodic assumption, the probability can be converted to the bandwidth as

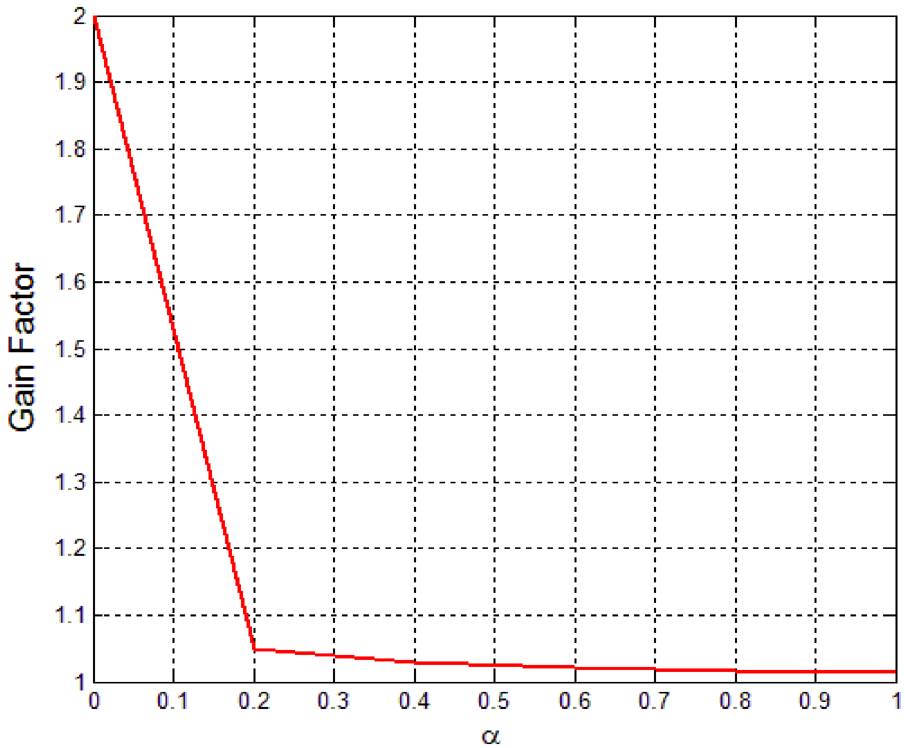
Normalized bandwidth = $\int_{1/k}^{\infty} \frac{1}{\Gamma} \exp\left(-\frac{x}{\Gamma}\right) dx = \exp\left(-\frac{1}{k\Gamma}\right)$



Relative gain of the capacity

$$C(1/k) = \int_{1/k}^{\infty} log_2\left(1 + \left(k - \frac{1}{x}\right)x\right) f_\gamma(x)dx = \frac{1}{ln2} E_1\left(\frac{1}{k\Gamma}\right)$$

Normalized bandwidth =*1+C(1/K)/C(0) for SINR=-20dB*



Thanks