Wireless Communications and Optimization Notebook

Junchi Wang

January 2026

Category	**Narrowband**	**Wideband**
Key comparison	$B \ll B_c$	$B \gtrsim B_c$
Channel behavior	Frequency-flat	Frequency-selective
Multipath effect	Single effective tap	Multiple resolvable taps
ISI	No ISI	ISI present
Typical model	$y = hx + n$	$y(t) = \sum_\ell h_\ell x(t - \tau_\ell) + n(t)$
Typical systems	Single-carrier	OFDM, UWB

Table 1: Comparison between narrowband and wideband transmission

Category	**Slow Fading**	**Fast Fading**
Key comparison	$T_c \gg T_s$	$T_c \ll T_s$
Channel variation	Slow in time	Rapid in time
Cause	Low mobility	High mobility
Doppler spread	Small	Large
Channel model	Quasi-static	Time-varying
Performance metric	Outage probability	Ergodic capacity

Table 2: Comparison between slow fading and fast fading