

# Class #3

Case 1 : Uplink Multiple Access ; LOS Link, no multipath

	TDMA	DS-SSMA	OFDMA
(a) Orthogonality (CToF difference) →	Yes	No	Yes
(b) Ability to narrow band and release the BW to another user	No	Yes	Yes
(c) Power Control Requirement	No	Yes	No/Maybe*
(d) PAPR	Low	Low	High**
(e) Ability to exploit diversity (time, freq) → multi-user diversity	Low	Low	High

\*\* → Unitary matrix pre coding  $\begin{bmatrix} \leftarrow \\ \leftarrow \\ \leftarrow \\ \leftarrow \end{bmatrix} \begin{bmatrix} \leftarrow \\ \leftarrow \\ \leftarrow \\ \leftarrow \end{bmatrix}$   
 FBMC, UMC, SC-FDMA

Case 2: Downlink  $P \rightarrow P$  **Multiplex Delay spread**

(\*) Delay spread & orthogonality  $\rightarrow$  DS-SSMA has an issue  $X$

(\*) Delay spread & optimum Rx  $\rightarrow$  TDMA has an issue  $X$

**\* OFDMA**

~~Delay spread does not affect orthogonality~~  
 Delay spread  $\rightarrow$  exponential in  $L$   
 optimum Rx complexity scales only linearly with BW

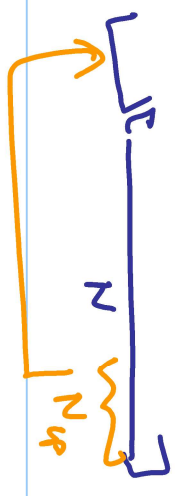
MLSE  $\rightarrow$  VA  $L-1$   
 $L$ , many  $M$   $e^{2L}$   
 $y_i = H_i X_i + N_i$   
 $i=1 \dots N \leftarrow 2N$

### Case 3 : Modern Related Issues

- (a) Freq. Sync. ?  $\leftarrow$   $\rightarrow$  N out of  $N+N_p$
- ✓(b) Time Sync.  $\leftarrow$   $\rightarrow$
- (c) Channel Estimation ✓ CIR  $\leftrightarrow$  CFR  $\leftarrow$
- ✓(d) Bit detection (coded systems)  $\leftarrow$

Intro to OFDM Notation

# 1. OFDM Block



- (a)  $k \rightarrow$  Block index
- (b)  $t$  or  $m \rightarrow$  time index (sample)
- (c)  $n \rightarrow$  sub-carrier index

