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Frequency Synchronization Techniques for Multi-Carrier Systems

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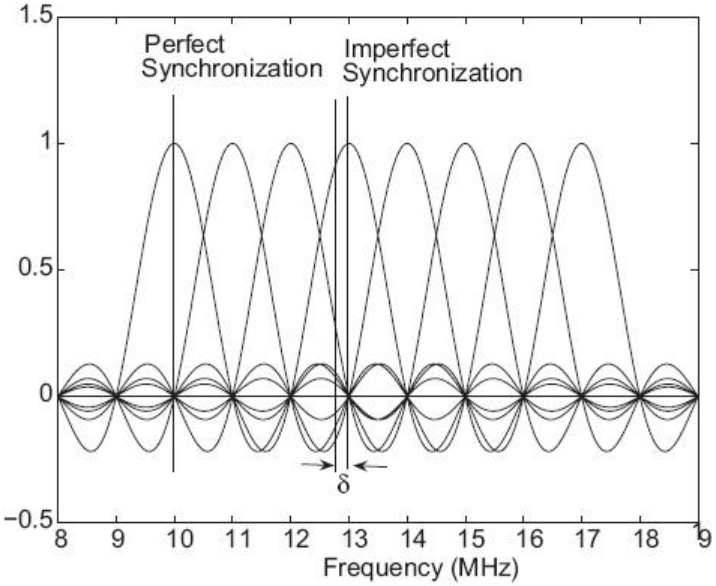
Outline:

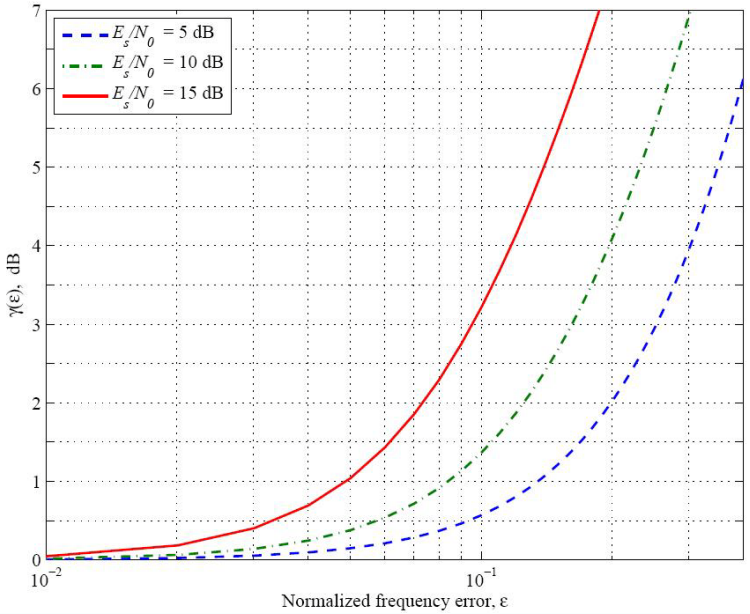
- Effect of frequency offset.
- Synchronization for OFDMA downlink.
- Synchronization for OFDMA uplink.

Effect of frequency offset

The integer part of the CFO produces a shift in the subcarriers.

The fractional part destroy the orthogonality among subcarriers



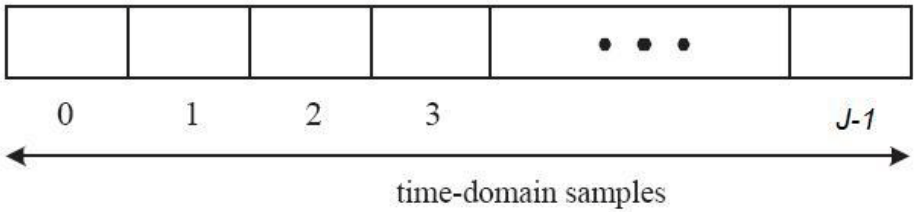


CFO must be kept as low as 4-5% of the subcarrier space.

Doppler shifts and low cost oscillators prevent to fulfil above requirement.

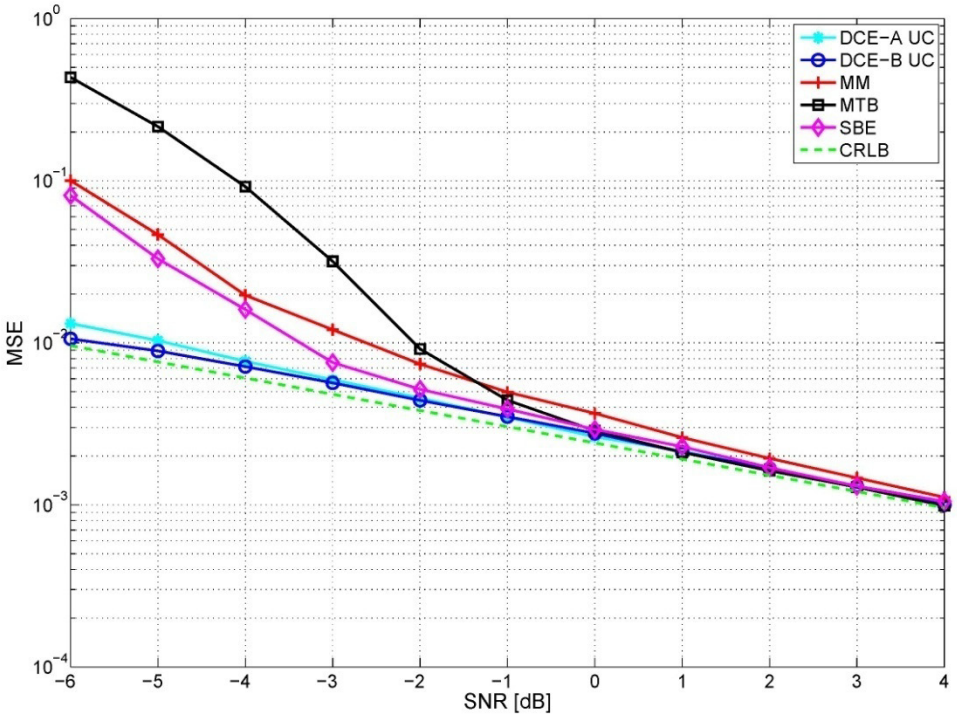
Synchronization for OFDMA downlink

Estimation methods are based on the AC of a repetitive preamble. The AC provides J-1 lags.



The classic methods are:

Schmidl and Cox (S&C)	•Full range. •Simple	•Two OFDM blocks •Poor performance
Morelli and Mengalli (M&M)	•One OFDM block •Performance > S&C	•Do not have full range •Uses only J/2 lags
Minn (MTB)	•Performance > M&M (SNR>0dB) •Uses J-1 lags	•Do not has full range •Complexity •Noise power (although not accurate)



Our estimators are based on a novel AC function (ACA).

The ACA provides:

- Another degree of freedom.
- Accurate statistic description.

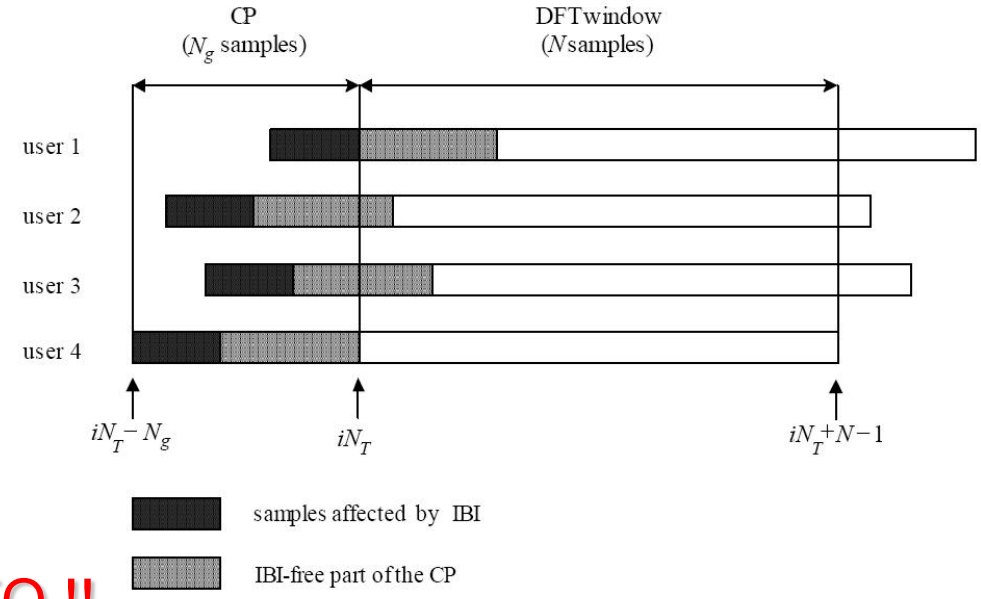
SBE	•Generalization of M&M. •Performance > M&M and MTB	•Does not have full range. •Noise Power (not accurate)
DCE	•Novel method (Based on ACA) •Performance > SBE (low CFO)	•Reduced range. •Noise Power (not accurate) •Complexity

Future works: Synchronization for OFDMA uplink

The BS receives the signals of all user with different CFO and TO.

The orthogonality between users is destroyed.

It is necessary to estimate each CFO !!



Methods for generalized carrier assignment are complex. Current proposal are approximations to the MLE (SAGE).