

Subcarrier Based Polling for OFDM

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This presentation illustrates IEEE 802.16.3abc-001/30,

Purpose:

To present a Subcarrier Based Polling for OFDM

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Subcarrier Based Polling for OFDM

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Background

- Bandwidth requests use a slotted ALOHA random access mechanism.
- The slotted ALOHA provides a robust multiple access mechanism, however it's efficiency is not high
- Here we propose an alternative approach based subcarrier polling.

Outline

- Basic concept
- Reduction in overhead
- Analysis Results
- Simulations Results

Basic Concept

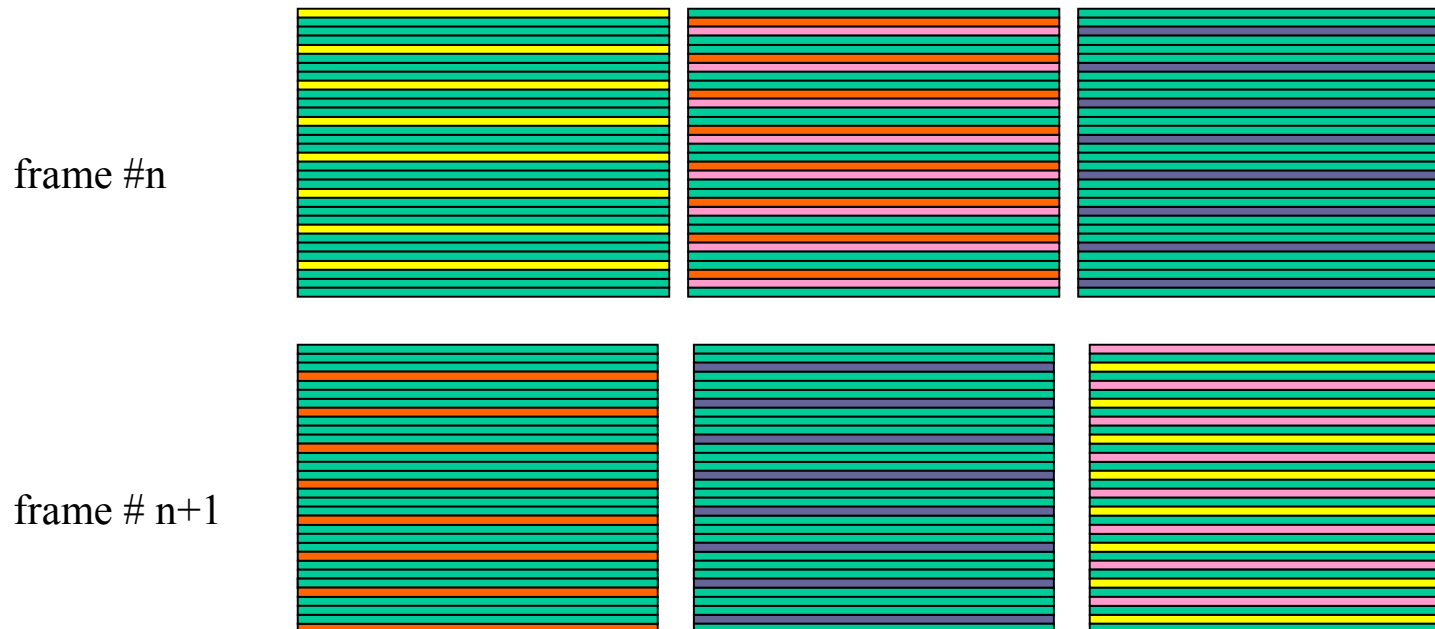
- Within the frame an allocation is provided for Subcarrier Based Polling (SBP)
- Each SS is assigned a set of OFDM symbols and subcarriers within the SBP allocation.
- Bandwidth Requests are performed by energizing the subcarrier set.
- The BS detects the energy of the SS, and grants bandwidth.

Basic Concept, cntd.



Basic Principles, cntd.

- The allocations are rotated in a pseudo random manner
 - If request failed due to fade, it will likely succeed in the next frame



Parameters

FFT size	Number of subcarriers in a set	Number of sets in an OFDM symbol
64	4	13
256	8	25
512	8	49

Parameters (cntd)

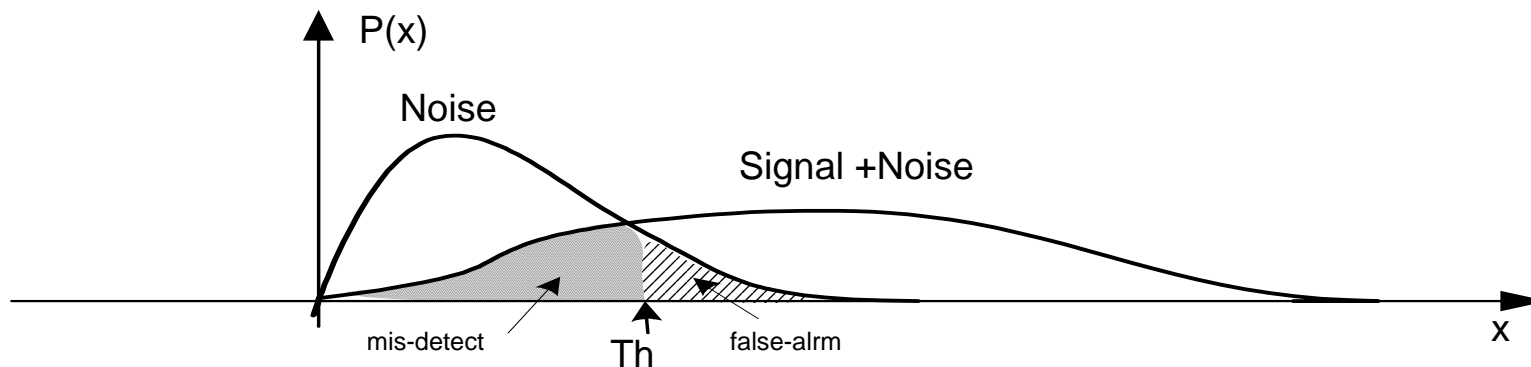
- Allocations are one regular grids
 - Maximize diversity.
- Subcarrier loading to give very low PAPR
 - Increase immunity to stations whose TPC has gone berserk.
- Busting:
 - each SS transmits only a fraction of the subcarrier, hence, only a fraction of power
 - Power density can be increased relative to data transmission.

Protocol efficiency

- Assumptions
 - 100 SS's.
 - 5 requesting BW
- Slotted ALOHA approach:
 - 15 slots (gives 94% percent of success)
 - Each slot 2 OFDM symbol
 - Overall $15*2= 30$ OFDM symbols
- SBP approach
 - 4 OFDM symbols for SBP
 - Polling requires $5*2$ OFDM symbols
 - Overall $4+5*2= 14$ OFDM
- 50% efficiency improvements

Performance Analysis

- Performance of SBP can be easily analyzed using False Alarm (FA) and Miss-detection probability.
- $\text{Prob}\{\text{FA}\}$: detection occurred | no trans.
- $\text{Prob}\{\text{MD}\}$: no detection | trans.



Performance Analysis

- Detection is performed by collecting energy and comparing to threshold

$$Y = \sum_{n=1}^{N_{sc}} |r_n|^2$$

$$Y \lessgtr th$$

Performance Analysis:AWGN

- For AWGN

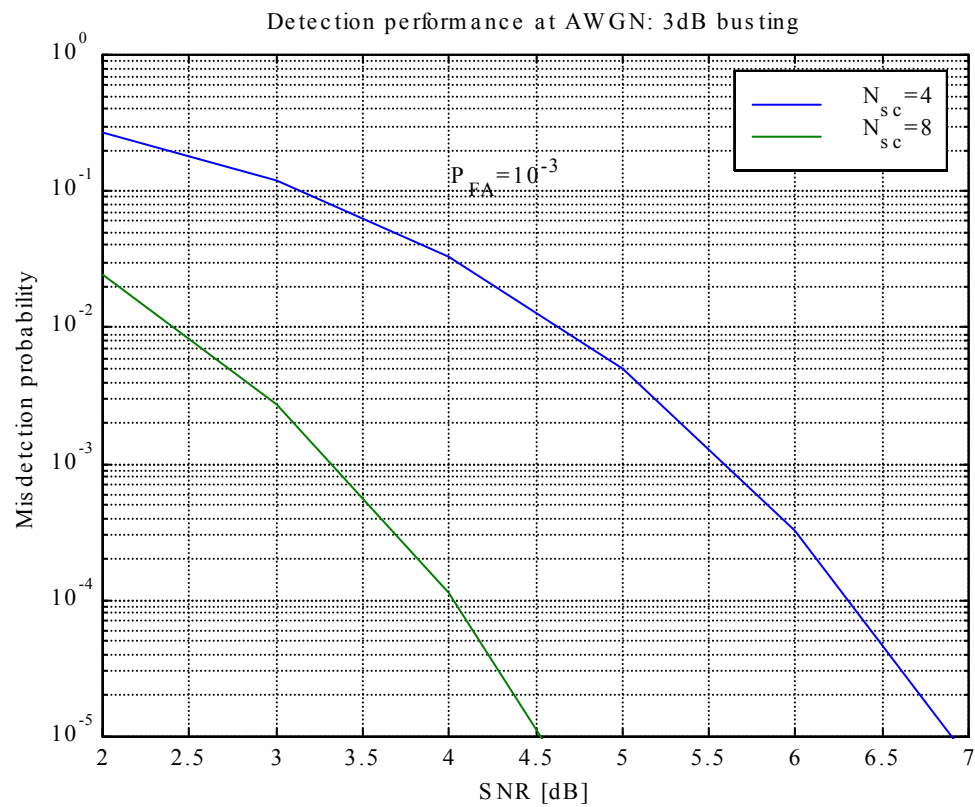
- ‘Off’ transmission:

$Y \sim$ chi square with N degrees of freedom

- ‘On’ transmission

$Y \sim$ non –central chi square

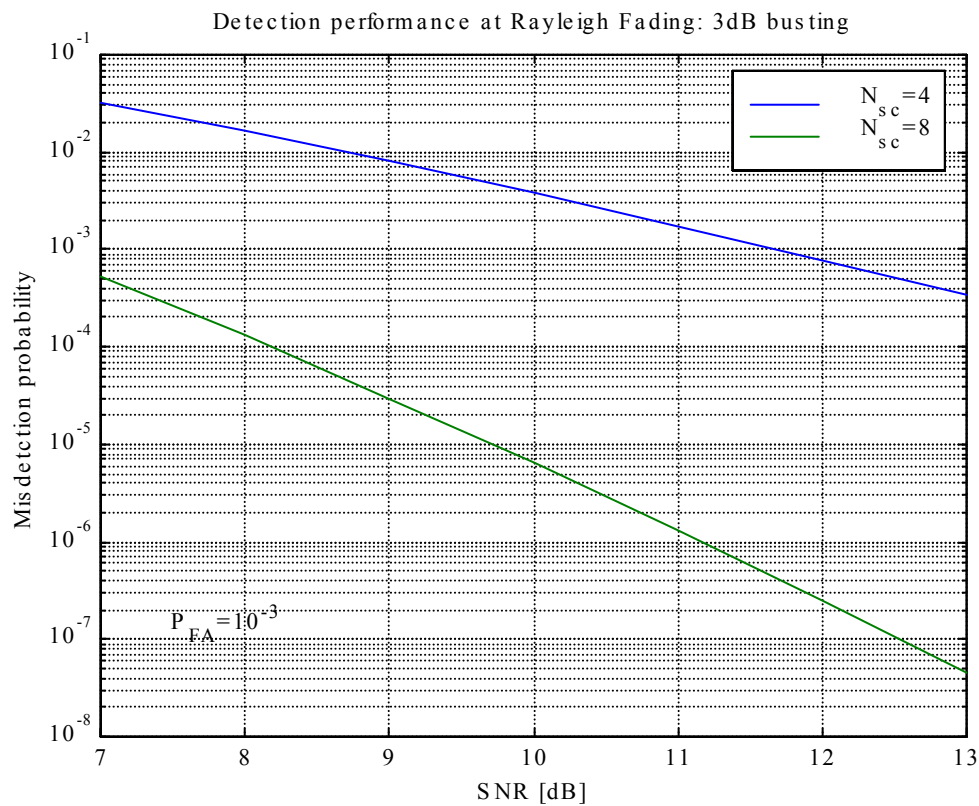
AWGN performance



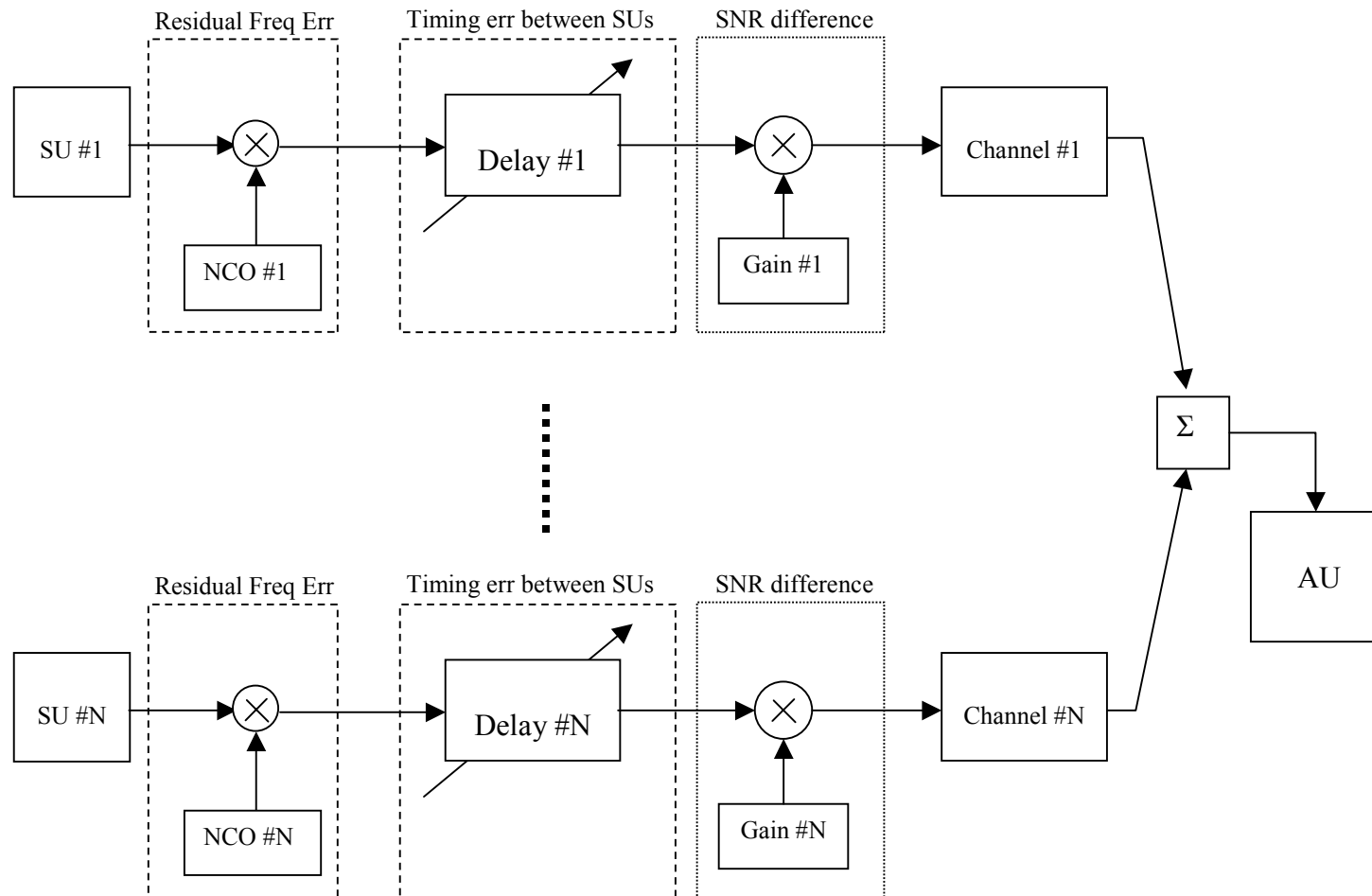
Multipath Performance

- Assumption:
 - the channel response at every subcarrier has independent Rayleigh statistics.
 - Worst case assumption
- $Y \sim$ chi square with N degrees.

Multipath performance



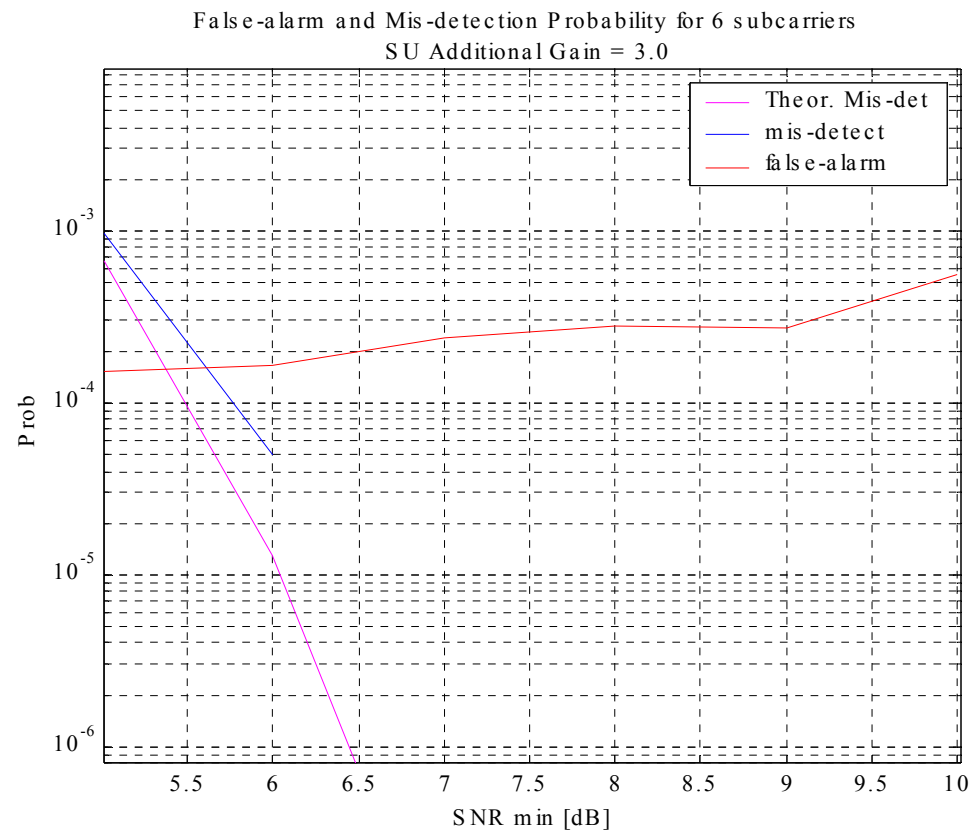
Simulation



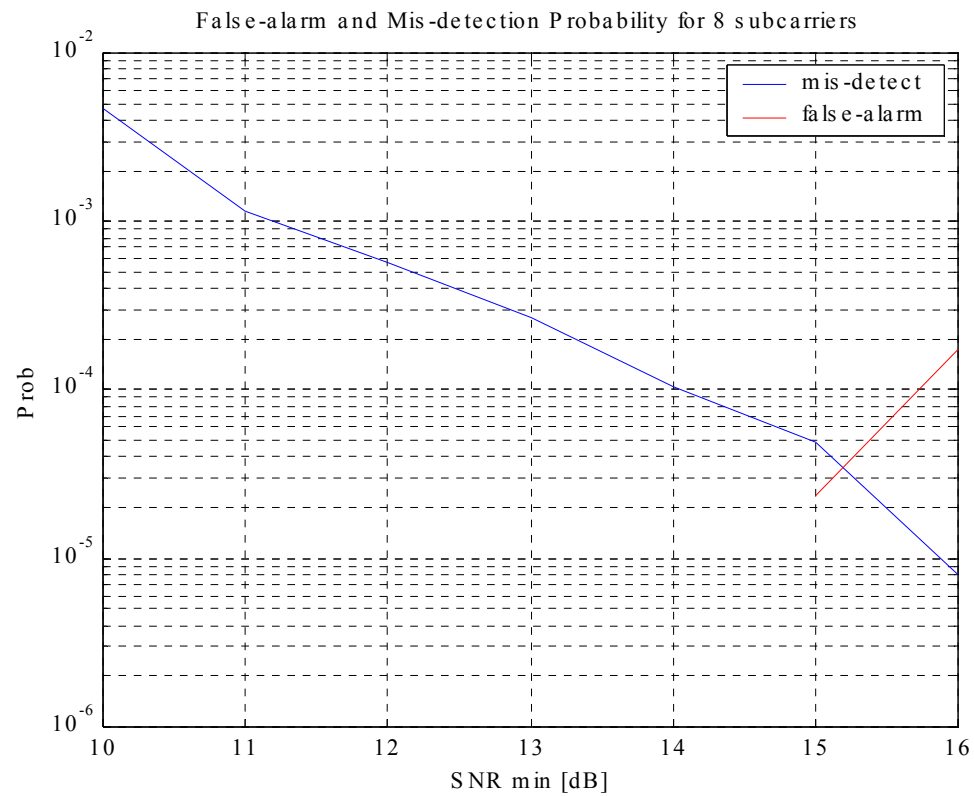
Simulations conditions

- AWGN or SUI#3 (FFT256 4MHz)
- Frequency offsets 10% of sub carrier spacing.
- Timing offsets +/- GI/2
- SU transmit Prob =50%

Simulations, AWGN



Simulations, Multipath



Conclusions

- A simple mechanism for bandwidth requests
- 50 % protocol overhead reduction (for BW section)
- Simply integrates into OFDM using existing elements.
- Good performance in AWGN and multipath.