

[Training Preamble Modifier for SDMA]

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Source:

Naftali Chayat, Tal Kaitz (Alvarion)

Voice: +972-3-6456273

Fax: +972-3-6456222

John Liebetreu (Intel)

E-mail: tal.kaitz@alvarion.com

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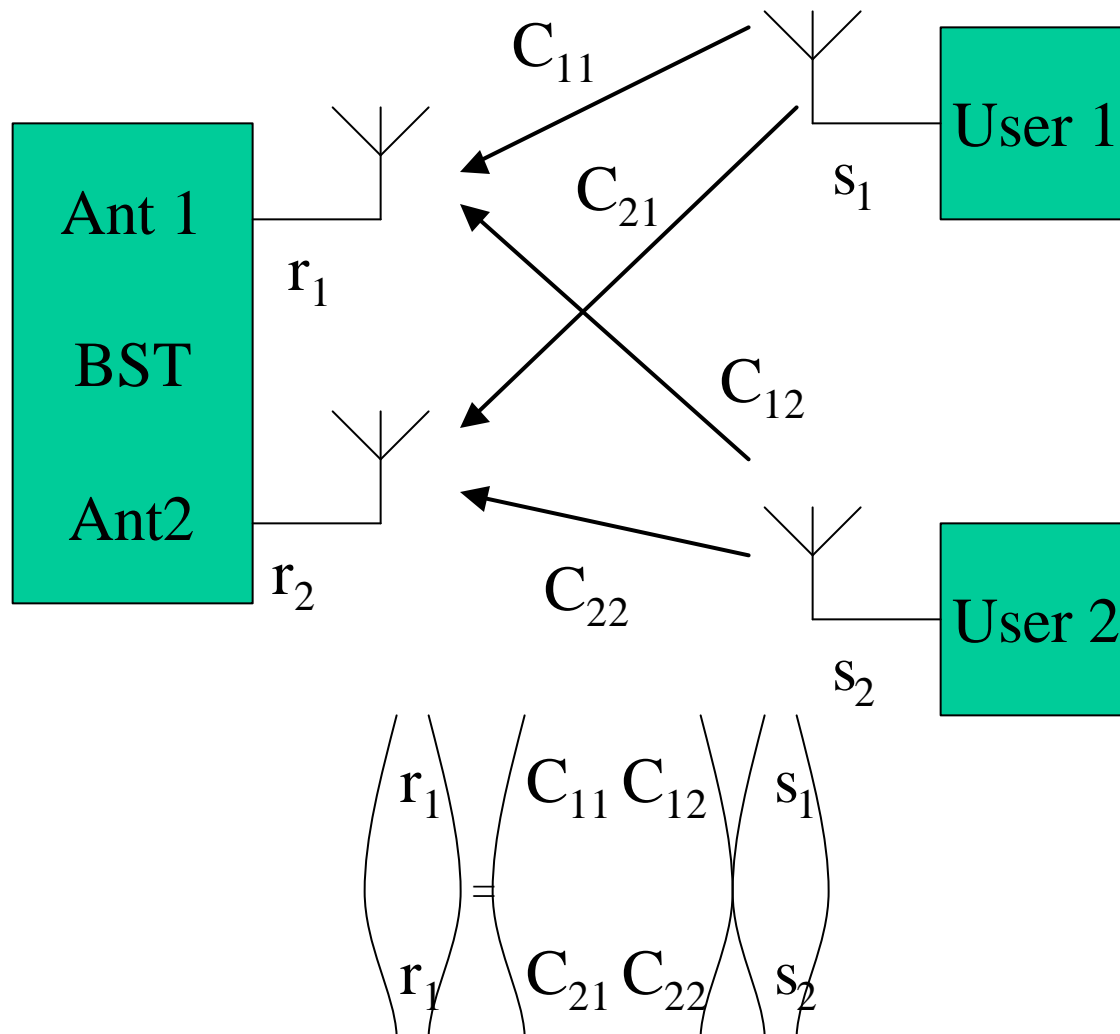
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Training preamble modifier for SDMA

Naftali Chayat, Tal Kaitz – Alvarion

John Liebetreu – Intel

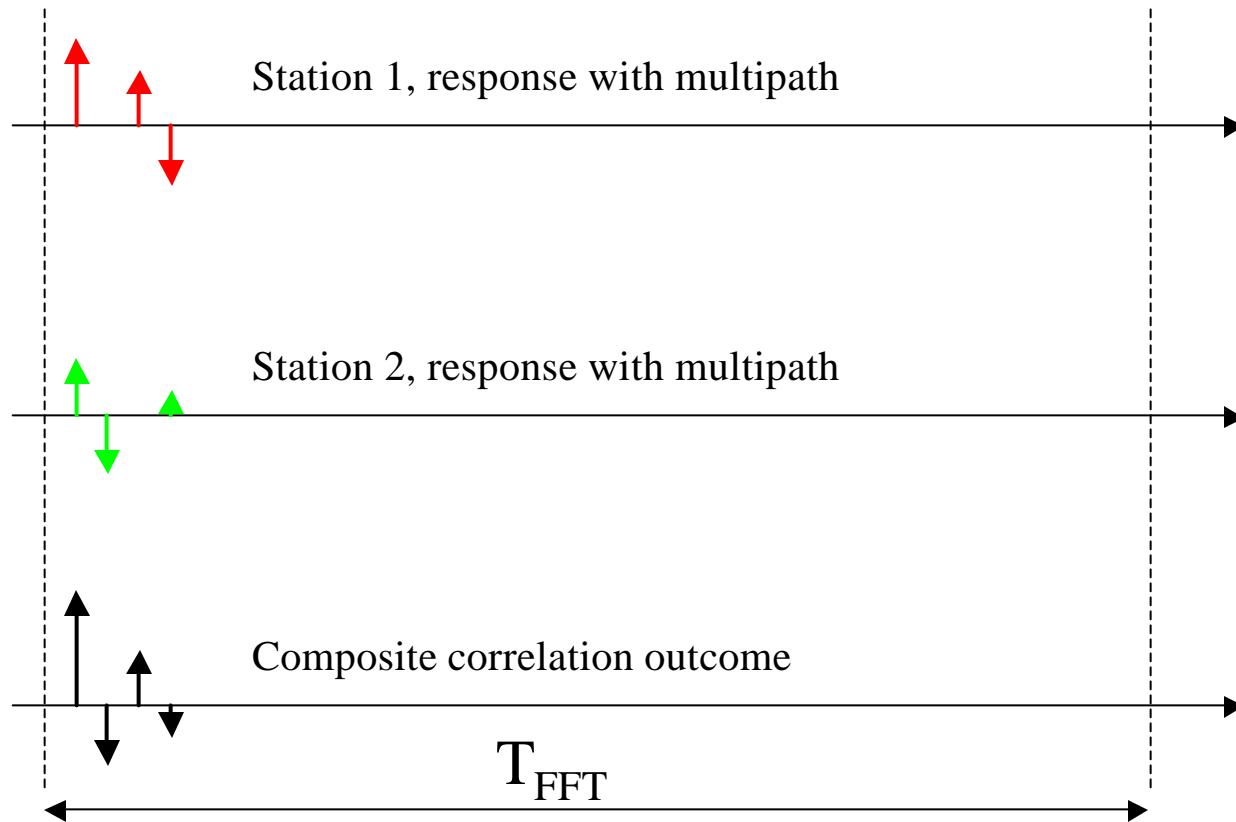
The SDMA concept on the UL



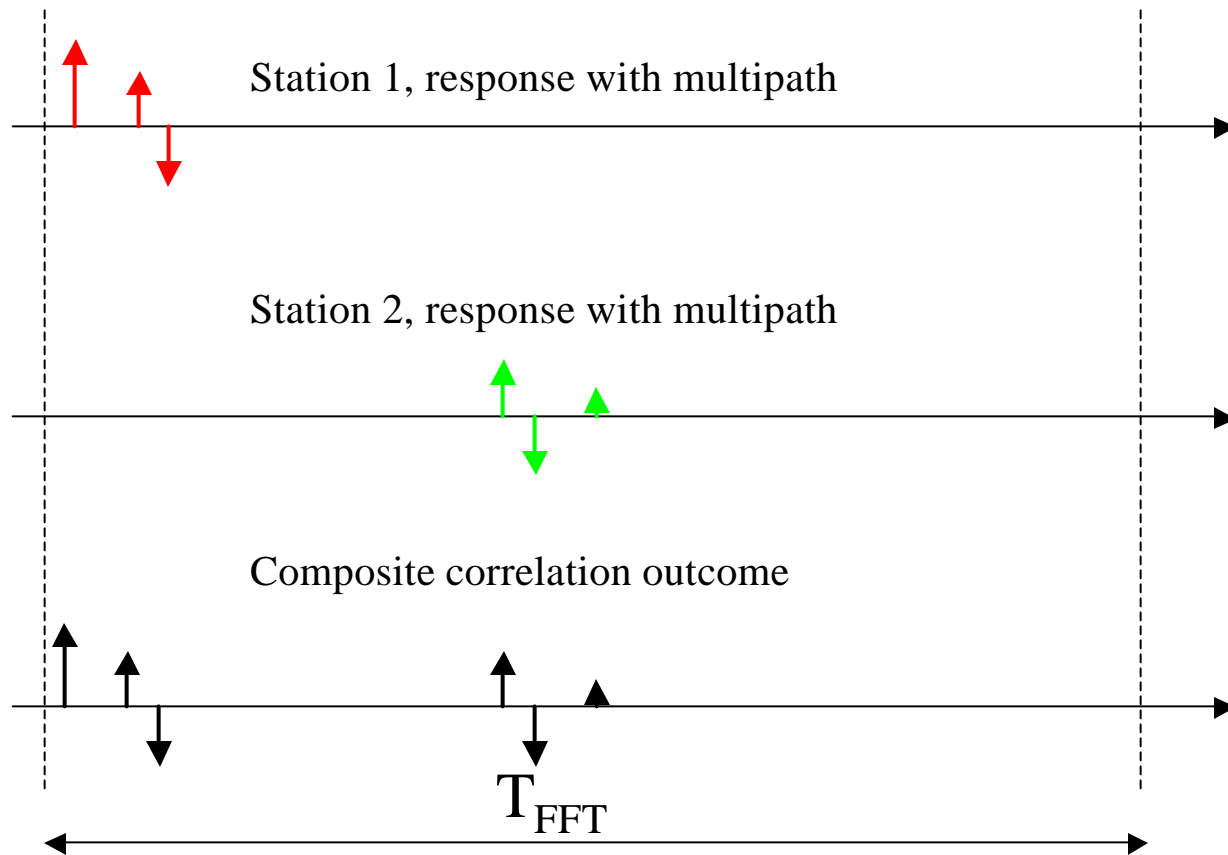
Channel matrix estimation

- Separation involves “equation solving” – knowledge of channel matrix is essential
- Each antenna receives a combination of signals from two users, including during the training preamble phase.
- How can the two channel responses be learnt from a mixture?

Correlating received signal with the preamble – same preamble case



Correlating received signal with the preamble – shifted preamble case



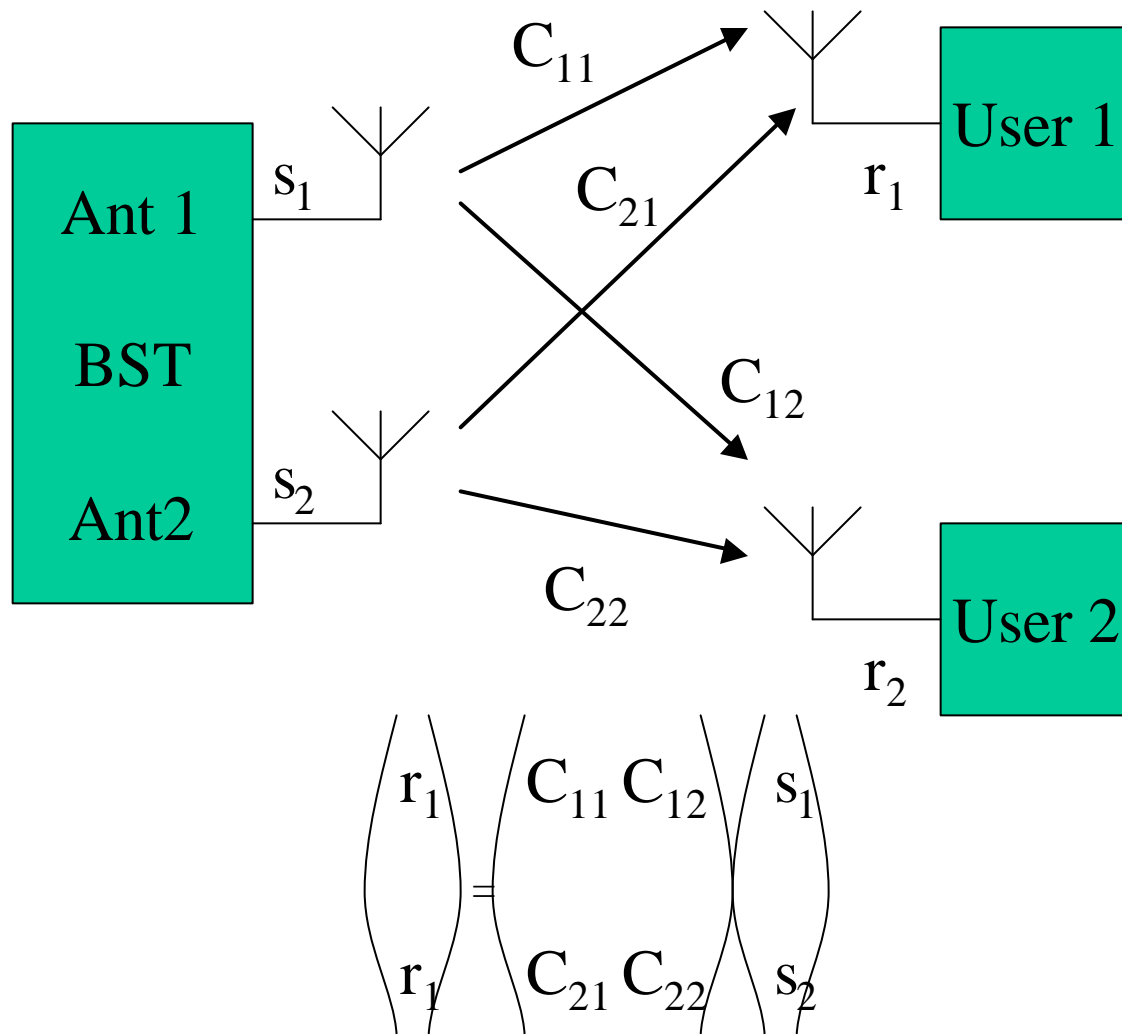
Pros and Cons

- Pros:
 - For short-moderate multipath, little mutual interference
 - The PAPR properties of the preamble are maintained
 - Very easy implementation in the transmitter
- Cons:
 - For long multipath, echoes from one station can leak into the channel estimate of other stations

Multipath limitations

- For long multipath, echoes from one station can leak into the channel estimate of other stations
- For full bandwidth preamble utilizing even subcarriers the autocorrelation consists of two peaks spaced $T_{\text{FFT}}/2$ apart
- A shift of $T_{\text{FFT}}/4$ is reasonable for separating two users
- Multipath becomes a problem when it approaches spread of $T_{\text{FFT}}/4$

The SDMA concept on the DL



Why different preambles on DL?

- Each user is illuminated by residual signal directed to another user
- Sum of two signals induces channel estimation error, which degrades the decoding performance
- Staggering the preambles (by cyclic shift) allows improved channel estimation
 - Channel smoothing removes faraway time components

Text changes - UL

- Mathematical description of cyclic shift of the preamble by M samples:

$$s(t) = \text{Re} \left\{ e^{2j\pi f_c t} \sum_{\substack{k=-N_{\text{used}}/2 \\ k \neq 0}}^{k=N_{\text{used}}/2} c_k \times e^{2j\pi k \Delta f (t - T_g - M / F_s)} \right\}$$

Text changes - UL

- Extended UIUC element for describing the shift:

The PHYMOD_IE can appear anywhere in the UL map, and it shall remain in effect until another PHYMOD_IE is encountered, or until the end of the UL map.

Table XX: PHYMOD UL IE format

Syntax	Size	Notes
PHYMOD_Information_element() {		
extended_UIUC_code	4 bits	PHYMOD = 0x04
Length	4 bits	Length=0x1
Preamble_Time_Shift	8 bits	Preamble time shift
}		

Preamble Time Shift

The parameter indicating how many samples of cyclic shift are introduced into the training symbols of the following allocations (M in equation above).

Text change – DL

- We propose same modification on the DL

The PHYMOD_IE can appear anywhere in the DL map, and it shall remain in effect until another PHYMOD_IE is encountered, or until the end of the DL map. Only stations supporting AAS functionality shall be assumed capable of receiving the consequently allocated bursts.

Table XX: PHYMOD DL IE format

Syntax	Size	Notes
PHYMOD_Information_element() {		
extended DIUC code	4 bits	PHYMOD = 0x04
Length	4 bits	Length=0x1
Preamble Time Shift	8 bits	Preamble time shift
}		

Preamble Time Shift

The parameter indicating how many samples of cyclic shift are introduced into the training symbols of the following allocations (M in equation above).

Mandatory/optional - rationale

- We propose the UL capability to be mandatory
 - The implementation is very simple
- On DL we propose the capability to receive such signals to be tied to the AAS functionality
 - Taking advantage of the proposed signals involves modification to the receiver – we do not want to impose this as mandatory