IEEE P802.22 Wireless RANs

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| Comment Resolution: Text for Section 13.2.1 (Transmit Diversity using 2 Antennas) |
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Abstract

This document addresses CID#19, CID#171, CID#196 referent the MIMO section of 802.22b standard. More specifically, it provides text to section 13.2.1 on transmit diversity using 2 antennas (Alamouti O-STBC) considered in 802.22b standard.

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CID#19

Section 13.2.1 ia left as TBD.

CID#171

There is no description in "13.2.1Transmit diversity using 2 antennas (Alamouti O-STBC)".

CID#196

This subclause (13.2.1) is TBD. It should be completed.

13.2 Space Time Coding (STC)

13.2.1 Transmit diversity using 2 antennas (Alamouti O-STBC)

Improvement in wireless link robustness against the deleterious effects of fading is achieved by the use of Orthogonal Space-Time Block Codes (O-STBCs) through exploitation of the extra degrees of freedom provided by the multi-input-multi-output (MIMO) channel.

Let us consider a wireless communications system with two antennas at the transmitter side and a single antenna at the receiver side. Additionally, let both transmit antennas, namely antenna one and two, be spaced at least half-wave length from each other and from which two symbols *s1* and *s2* are respectively transmitted (simultaneously) at a given symbol period *T*. If during the following symbol period *-s2\** and *s1\**, where \* represents complex conjugation operation, are now transmitted respectively from antenna one and two, we can represent the encoding scheme in the following manner,

G2 = ,

where the columns of the above encoding matrix represent the transmit antennas, the rows correspond to the symbol periods and *sn* is the symbol taken from a complex constellation *C* with *n* ∈ {1,2}.

Considering that the channel remains constant across two consecutive symbol periods, i.e., a block fading channel, we can write

h1(t) = h1(t+T) = h1,

h2(t) = h2(t+T) = h2,

where *T* is the symbol period, *h1* and *h2* are the channels paths between the transmit antenna and the receive antenna. Thus, received signals are expressed by

r1 = h1s1 + h2s2 + w1,

r2 = -h1s2\* + h2s1\* + w2.

Here, w1 and w2 are zero-mean white complex Gaussian distributed noise values with variance σ2w/2 per dimension.

After performing the following signal combination at the receiver,


,

the estimated symbols are given by

 = s1 (|h1|2+|h2|2) + h1\*w1 + h2w2\*,

= s2 (|h1|2+|h2|2) - h1w2\* + h2\*w1.

The diversity order provided by the Alamouti scheme is the same as the one provided by the maximum ratio combining (MRC) receiver with a single transmit antenna and two receive antennas. However, Alamouti scheme benefits from having the complexity transferred to the transmitter premises where device size is not a major constraint.