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| Project | **IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16> | |
| Title | Superimposed High Rate Space-Time Block Coding | |
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| Re: | IEEE 802.16m-07/040 Call for Contributions on Project 802.16m SDD | |
| Abstract | We propose the architecture for superimposed high-rate space-time block coding, which features high rate, high spectral efficiency and power imbalance for easy decoding, etc. | |
| Purpose | To be discussed and adopted by TGm for use in the 802.16m SDD. | |
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**Suggested ToC Topic for IEEE 802.16m SDD:** Support of Advanced Antenna Techniques

**Title:** Superimposed High Rate Space-Time Block Coding

**Description:** We propose the architecture for superimposed high-rate space-time block coding. Space-time block coding, e.g. Alamouti space-time block coding, has the advantage of little feedback and high diversity gain. However, many existing schemes have the transmit rate limitation. For example, the well-known Alamouti space-time block coding has only rate 1 even with two transmit antennas and two receive antennas. This limitation mostly is due to its orthogonality design criteria, instead of the diversity and rate tradeoff. Here a high-rate space-time block coding scheme is proposed by superimposing two Alamouti STBC's together with Unitary matrix rotation and signal rotation. The mathematic description can be expressed by

$$\begin{aligned}
&\mathbf{C}\left(s_1, s_2, s_3, s_4; A_1, A_2, \theta_1, \theta_2\right) \\
&= A_1 \mathbf{C}_{\text{Alamouti}}\left(s_1, s_2\right) + A_2 \mathbf{U}\left(\theta_1\right) \cdot \mathbf{C}_{\text{Alamouti}}\left(s_3 e^{j\theta_2}, s_4 e^{j\theta_2}\right) \\
&= A_1 \begin{bmatrix} s_1 & s_2 \\ -s_2^* & s_1^* \end{bmatrix} + A_2 \mathbf{U}\left(\theta_1\right) \begin{bmatrix} s_3 e^{j\theta_2} & s_4 e^{j\theta_2} \\ -s_4^* e^{-j\theta_2} & s_3^* e^{-j\theta_2} \end{bmatrix}
\end{aligned}$$

where $A_1$ and $A_2$ are the signal amplitudes of the two layers with , $\mathbf{U}\left(\theta_1\right)$ is a 2x2 unitary matrix with $\mathbf{U}\mathbf{U}^{\mathrm{H}} = \mathbf{I}$, which is a function of $\theta_1$ , $\theta_1$ , and $\theta_2$ are the rotation angle of the second layer and one possible example of **U is** $\mathbf{U} = \mathbf{U}_0 e^{j\theta}$**.**

The proposed scheme is engineered for high-rate applications with no enough feedback, e.g. broadcast multicast services. The salient features of this design include

1) strong backward compatibility,
2) high spectral efficiency with signal constellation optimization and nonorthogonal design.
3) simple transmitter design with peak-to-average power ratio control,
4) transmit power imbalance for help receiver do interference cancellation.
5) simple system design, where feedback is optional.

**Related Area(s) in SRD:** Section 5.7: Support advanced antenna techiques, Section 7.1: User throughput, Section 7.2: Sector throughput and VoIP capacity, Section 7.4: Cell coverage