MIMO Pilot Allocation

IEEE 802.16 Presentation Submission Template (Rev. 9)

Document Number:

IEEE S802.16m-07/210, MIMO Pilot Allocation

Date Submitted:

2007-11-07

Source:

Isamu YOSHII, Katsuhiko HIRAMATSU   Voice: +81-50-3687-6548

Matsushita Electric (Panasonic)   E-mail: yoshii.isamu@jp.panasonic.com

Venue:

  IEEE 802.16 Session #52, Atlanta, USA

Base Contribution:

   C802.16m-07/210

Purpose:

 For discussion of MIMO Pilot Allocation in case of more than 5 antennas

Notice:

This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups. It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein.

Introduction

- Increasing the transmission antenna, the pilot density would be increased. The expansion of Legacy MIMO pilot allocation for larger number of antenna may waste the time-frequency resource, then reduce the system throughput.

- In this contribution, MIMO pilot allocation using the cyclic-shift(CS) is presented. It would be worth introducing the CS pilot concept in SDD as a new main function for reducing the overhead and improving the channel estimation accuracy.

MIMO pilot using cyclic-shift (CS)

- Transmitter sends impulse signal as pilot signal, the receiver can observe the multipath channel.

- When the interval of each antenna transmission (K samples) is longer than the multipath channel delay, the receiver can extract the multipath channel from each antenna using time-window based on the interval.

- The transmission interval can generate from the cyclic shift of OFDM symbol.

- When K samples is same as the CP length, 8 antennas pilots can be allocated in one OFDM symbol in case of Reference system.
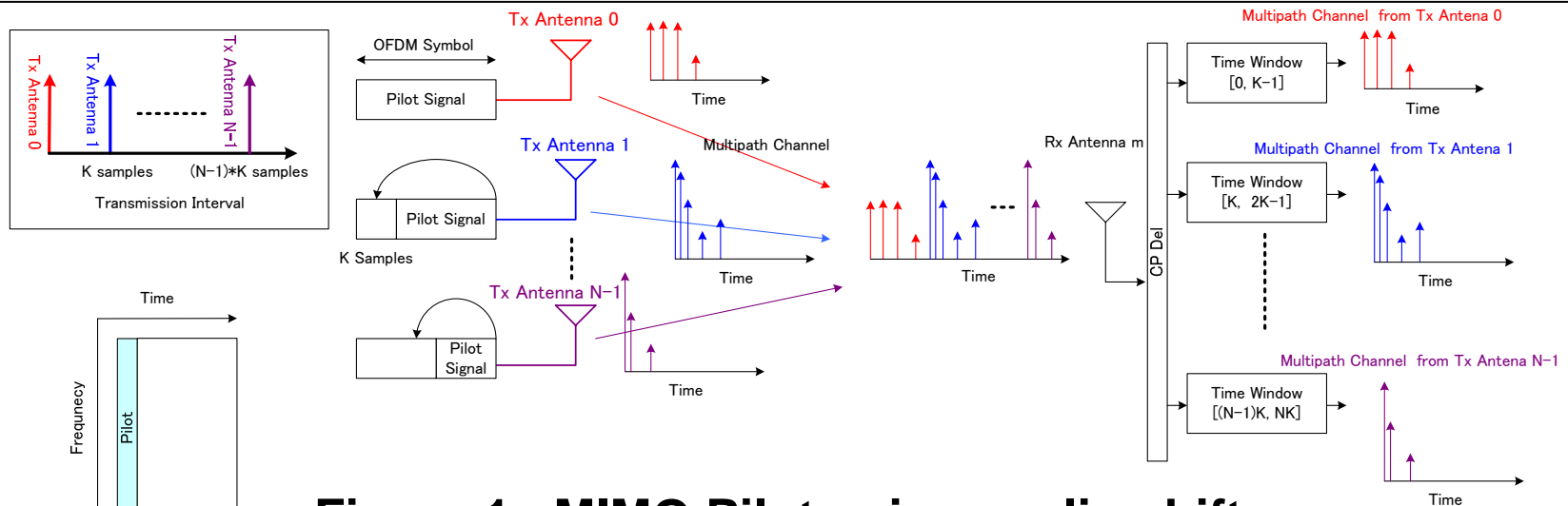
Figure 1   MIMO Pilot using cyclic-shift

Noise Elimination

- In the CS pilot allocation, firstly, the receiver extracts the target samples from the total samples using the time-window. Then by the zero-padding, the noise except the target samples is eliminated.
- Secondly, the receiver finds the peak over a certain threshold and detects the multipath for target antenna. This zero-padding also can eliminate the noise except the multipath samples.

Figure 2   Noise Elimination

Pilot Density Comparison

- Table 1 shows that in case of more than 3 antennas, the CS pilot reduces the "total pilot density" comparing the Legacy system.

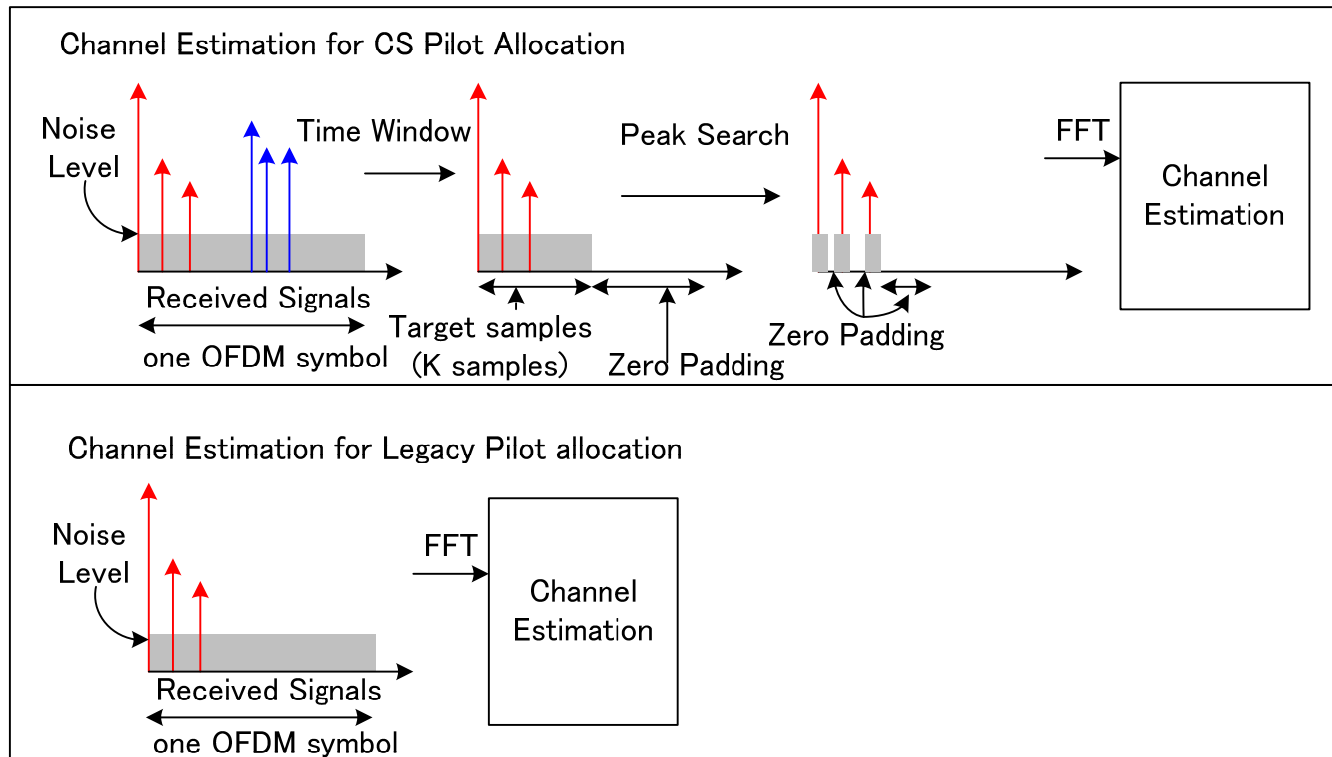- Moreover, "pilot density per antenna" of CS pilot is higher than Legacy system in any cases. <u>So the channel estimation accuracy of CS pilot would be better than Legacy thanks to the high "pilot density per antenna".</u>

Figure 3 Legacy & CS Pilot Allocation

Table 1 : Pilot Density Comparison

Legacy System （over 5 antenna case : C802.16e-04_563r1）

No of Antenna	1	2	3	4	5	6	7	8
Pilot Density (total)	0.0149	0.0298	0.0595	0.0595	0.1250	0.1500	0.1750	0.2000
Pilot Density per antenna	0.0149	0.0149	0.0198	0.0149	0.0250	0.0250	0.0250	0.0250

Cyclic Shift Pilot

	1	2	3	4	5	6	7	8
Total Overhead	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Pilot Density per antenna	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426

NMSE (Normalized Mean Square Error) of Channel Estimation

- NMSEs of the channel estimation for the CS pilot allocation and Legacy are evaluated in order to confirm the two characteristics of CS pilot.
- The simulation assumes 4x4 MIMO Pedestrian B model (3km/h).
- Channel estimation for Legacy is Zero-Forcing method with liner-interpolation. Figure 4 shows that the CS pilot is about 20dB in NMSE better than Legacy and the effect is almost same as the noise elimination effect.
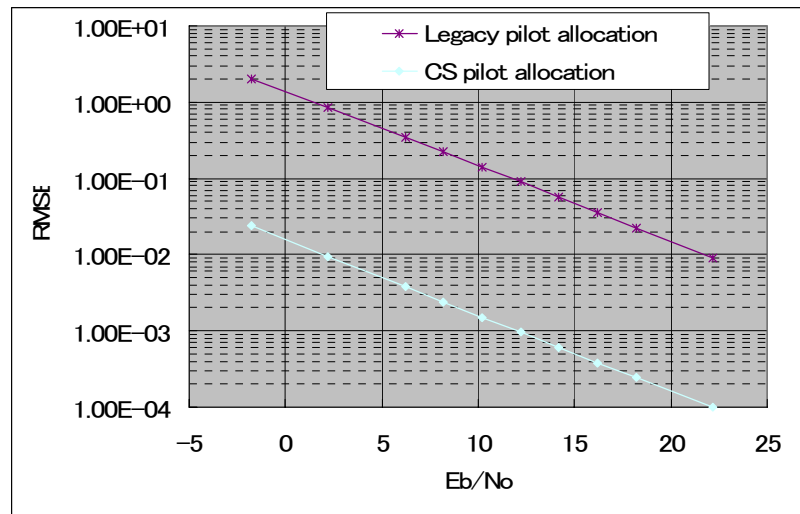

Figure 4 NMSE (4x4 MIMO) PB 3km/h

Conclusion

- Increasing pilot density could be one issue in case more than 5 antennas transmissions.

- The CS pilot can reduce the pilot density in time-frequency resource comparing Legacy system without the channel estimation degradation.

- In SDD, the pilot structure for more antennas than that of Legacy system should be discussed.

- It would be worth introducing the CS pilot concept in SDD as a new main function.