同軸ケーブル網を用いたMIMO通信ネットワーク

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九州工業大学 大学院情報工学研究院
電子情報工学研究系（尾知研究室） 客員准教授
株式会社レイドリクス 長尾 勇平
**Network system is very big**

Need lower cost

Number of mobile terminals that are based on IEEE 802.11 standard will increase at a great rate.

**Solution**

Wireless system using the Coaxial cables because they was already wired.
Conventional system

One signal is transmitted by AP in Coaxial Cable Network

Transmission speed is 292.5[Mbps] at IEEE802.11ac
Two signals are transmitted by AP in Coaxial Cable Network

Transmission speed is 585[Mbps] at IEEE802.11ac
Conventional system model

- Antenna
- Coaxial cable
- booster
- Network configuration
- Room
- Internet
- Server Room
- WiFi signal
- Other Signals
- WiFi signal
- n is floor number in a building

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Proposed method

- It is possible to separate the system channel to two
  - TV cable ← I cannot change it because it is different by building.
  - TX channel ← My target is to change it.
- MIMO need to have different channel
- Quasi MIMO Channel affect TX channel quite directly
  - I change the length of cable in TX
  - $\Rightarrow$ Amplitude and phase difference changes

TX channel have different channels

Amplitude

TX Cable

TX Cable

time
Network configuration equipment have impedance

- It is impossible to fully match impedance.

⇒ Since the reflected wave is present, the standing wave is generated.

\[ V(x) = V_f e^{\gamma x} + V_r e^{-\gamma x} \]

Solving for amplitude

\[ V(x) = V_f \left| \frac{V_f}{V_x} \right| + V_r \left| \frac{V_x}{V_r} \right| \]

Constant

Change

- \( V_r \) is big, in other words length of cable is short.

Standing wave amplitude is big.

- VSWR values is big. Channel is bad condition.
I measured the channel on pseudo network using E5016B
- Signal flow : A→B
- Redline : Short(About 2.5[m]) or Long(About 5.0[m])
- Place : 1F, 2F, 5F
Insertion Loss on pseudo network environment

Frequency vs. Voltage ratio

Channel environment is change

Gain frequency for booster
## Simulation parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulator</td>
<td>802.11ac</td>
</tr>
<tr>
<td>Packet length[Byte]</td>
<td>1500</td>
</tr>
<tr>
<td>Frequency[MHz]</td>
<td>630-710</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>80[MHz]</td>
</tr>
<tr>
<td>Number of TX antennas</td>
<td>2</td>
</tr>
<tr>
<td>Modulation</td>
<td>BPSK, QPSK, 16QAM, 64QAM</td>
</tr>
<tr>
<td>Number of RX antennas</td>
<td>1</td>
</tr>
<tr>
<td>Coding rate</td>
<td>1/2 , 3/4, 3/4, 5/6</td>
</tr>
<tr>
<td>Number of spatial streams</td>
<td>2</td>
</tr>
<tr>
<td>Quasi MIMO channel</td>
<td></td>
</tr>
<tr>
<td>Measured Floor</td>
<td>1, 2, 5</td>
</tr>
<tr>
<td>Length of cable</td>
<td>About 2.5[m]</td>
</tr>
<tr>
<td></td>
<td>About 5.0[m]</td>
</tr>
</tbody>
</table>
Simulation Result (SISO vs. MIMO) on 5F

SNR [dB] vs. BER for 1×1 SISO and 2×1 MIMO systems:
- 1×1 SISO, BPSK
- 1×1 SISO, 16QAM
- 1×1 SISO, 64QAM
- 2×1 MIMO, BPSK
- 2×1 MIMO, QPSK
- 2×1 MIMO, 16QAM
- 2×1 MIMO, 64QAM

Same frequency utilization:
- 5[dB]
- 3[dB]
- 27[dB]
Simulation Result (All Rooms use MIMO)

Almost the same receiving characteristic on each floor

Transmission speed can be improved

SNR=50[dB]  BER=10^{-3}
Conclusion & Future Works

■ Conclusion

☑ The proposed MIMO communication system using Coaxial cable
  ■ Quasi MIMO Channel made the different channel
  ■ Performance evaluation
    ■ On the same frequency utilization, proposed system has worse BER performance
    ■ In the good channel condition, the proposed system can received the MIMO signals
      ⇒ Transmission speed can be improved

■ Future work

☑ Implementation of a real machine


最後に会社紹介など
Radrix Co. Ltd.

106 Incubation Facility
Kyushu Institute of Technology
680-4 Kawazu, Iizuka, Fukuoka
JAPAN820-8502

TEL : (+81) 948-29-7937
FAX : (+81) 948-29-7963
URL : www.radrix.com
E-MAIL : ochi@radrix.com

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National Engineering University
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College of Computer Science
5-Departments
- Artificial Intelligence
- Computer Science and Electronics
- Mechanical Information Science
- Bio-infomatics
- Information Innovation
Centennial in 2009
Research of Ochi Laboratory

Wireless communication
IEEE802.11
Digital Terrestrial Television

Image Processing
JPEG2000, H.264 Encryption

Collaborated with Kurosaki Lab.

RTL Design

Prof. Ochi

Associate Prof. Kurosaki

Assistant Prof. Leonard

6 Doctor students

8 Master students

7 Master students
国内会議講演論文(査読なし)


Insertion Loss on pseudo network environment_5F

Frequency vs. Voltage ratio

-31.5
-31.7
-31.9
-32.1
-32.3
-32.5
-32.7
-32.9
-33.1

Voltage ratio[dB]

70  80  90  100  110  120  130  140  150  160  170
Frequency[MHz]

Short Coaxial Cable_5F
Long Coaxial Cable_5F
お問い合わせ先

国立大学法人九州工業大学 イノベーション推進機構
産学連携・URA領域
知的財産部門
客員教授 安東 静

TEL 093-884-3499
FAX 093-884-3531
e-mail ando@ccr.kyutech.ac.jp