Experimental Study of Polarization and Frequency Diversity Antenna in Indoor Environment

Yiwen Zhu† Hiroyasu Sato† Qiang Chen† Takashi Sudo†† Takafumi Ohishi†† Takuji Suzuki††
†Graduate School of Engineering, Tohoku University, ††Healthcare company, Toshiba Corporation

1. Foreword In recent years, Body-centric wireless communication devices, such as on-body sensor for healthcare applications are desired and studied by many researchers. The antenna diversity technique such as polarization diversity and frequency diversity are important for high communication quality. This paper focuses on the evaluation of polarization and frequency diversity antenna in indoor environment. Diversity gains of narrowband and broadband frequency range are measured.

2. Experimental Setup Fig.1 shows the experimental setup. In order to evaluate the transmitting diversity, vertically polarized (Tx.V) and horizontally polarized (Tx.H) transmitting patch antennas were placed on the surface of a human equivalent-phantom (SPARG) with height of 1.4m. A vertically polarized receiving patch antenna (Rx.V) was placed on a rotating table with distance of 5m from the transmitting diversity antennas. 4-Port Vector Network Analyzer (Agilent N5224A) was used to measure received power as S21: vertically polarized levels, S43: horizontally polarized levels, in a frequency range of 2.4 GHz to 2.5 GHz, including Bluetooth® [1] frequency range. A power splitter was used and whose output ports were connected to receivers Port 2 and Port 4. In order to simulate the multipath fading environment, vertically polarized patch antenna (Rx. V) was rotated in the horizontally and the vertically direction using a rotating table as shown in Fig. 1.

3. Result The result of cumulative probability are shown in Fig. 2. The diversity gain is evaluated at the cumulative probability of -20 dB (1%). In the narrow band case (2.45 GHz), polarization diversity (PD) gain of almost 10.3 dB is obtained. In the wideband case (using 100 MHz), PD gain of 3.8 dB is obtained. Frequency diversity (FD) gain is almost 20 dB is obtained and gain of 23.6 dB is obtained when FD + PD.

4. Conclusion The experimental evaluation of polarization diversity and frequency diversity in Indoor environment were performed. It is found that quite large diversity gain of 23.6 dB is realized in Bluetooth® frequency band when both the polarization diversity and the frequency diversity is applied.

Acknowledge
This work was partly supported by COI STREAM (Center of Innovation Science and Technology based Radical Innovation and Entrepreneurship Program) and by JSPS KAKENHI Grant Number 26289122.

[1] The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc.

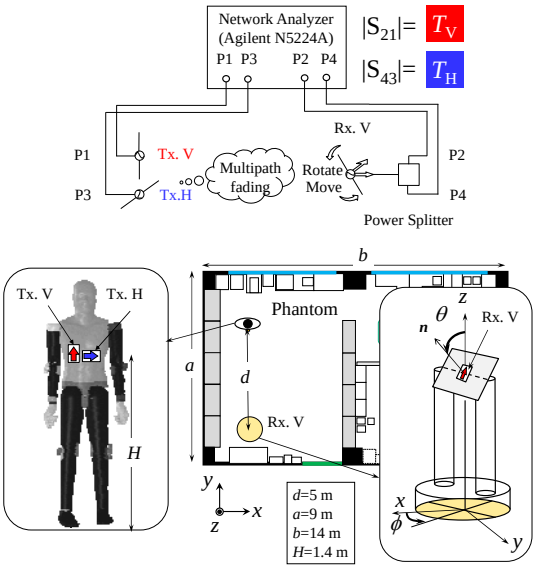

Fig. 1. Experimental setup.

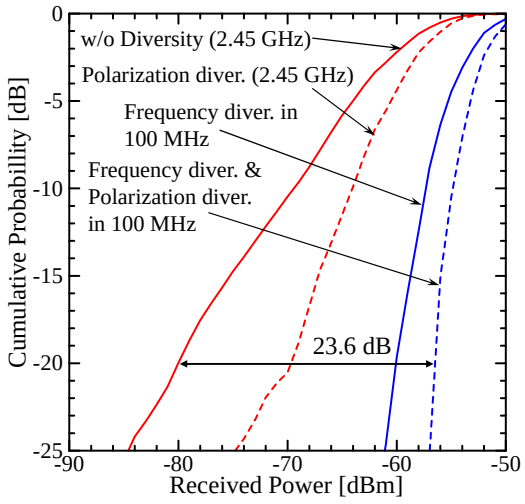

Fig. 2. Cumulative probability.