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학술발표 F2D 광계측

13:00-14:30 좌장 : 민성욱(경희대)

학술발표 F3A 광원소자(II)

14:50-16:20 좌장 : 김두근(중앙대)

학술발표 F3B 마이크로-포토닉스

14:50-16:20 좌장 : 윤호성(KT)

CMOS APD를 이용한 WLAN 용 Radio-over-Fiber 시스템

Radio-over-Fiber systems for WLAN using CMOS APD

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Abstract

We present radio-over-fiber (RoF) systems for IEEE 802.11a wireless local area network (WLAN) using a Si avalanche photodetector (APD) fabricated in 0.18 ㎛ standard complementary metal-oxide-semiconductor (CMOS) process. The bias voltage of the APD is optimized and downlink data transmission of 20 Mb/s, 16 quadrature amplitude modulation data at 5.805 GHz with a wireless link is successfully performed.

As increasing demand for wireless communications including cellular services and wireless local area network (WLAN), radio-over-fiber (RoF) technology has been regarded as a promising candidate for extension of radio coverage using low loss and huge bandwidth of optical fiber [1]. For wide deployment of these systems, low-cost realization is indispensible especially due to reduced cell size such as pico-cell. There have been several approaches to reduce the cost of RoF systems using VCSELs and multimode fibers [2-3]. However, all the previous works concentrated only on the central stations (CS) and transmission medium despite the fact that low-cost implementation of remote antenna units (RAUs) is also very important.

CMOS compatible APDs (CMOS-APDs) can be an attractive solution for low-cost realization of RAU. Mature CMOS technologies make it possible to reduce fabrication cost of APDs which can detect 850 nm optical signals and integrate the RAU including the APD and necessary electronic circuits.

In this paper, we present RoF systems for 5 GHz band IEEE 802.11a WLAN based on the CMOS-APD. Bias voltage optimization and downlink data transmission of 20 Mb/s 16 quadrature amplitude modulation (QAM) data at 5.805 GHz with a 0.5 m wireless link is performed.

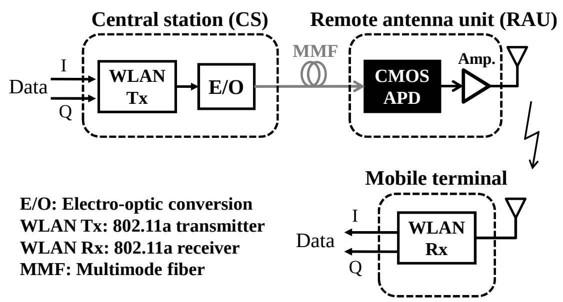

Fig. 1 Schematic diagram of RoF downlink systems for WLAN based on the CMOS-APD.

Fig. 1 shows schematic diagram of downlink RoF systems for WLAN based on the CMOS-APD. The CMOS-APD was fabricated using 0.18 ㎛ standard CMOS technology and detailed device structure is shown in elsewhere [4]. Fig. 2 shows photodetection frequency response of the CMOS-APD at different bias voltages. It is seen that about 10-dB loss at 5 GHz band is inevitable due to roll-off of frequency response in order to utilize the CMOS-APD in RoF systems for IEEE 802.11a WLAN.

In the experiment of downlink data transmission system, baseband data of 20 Mb/s, 16 QAM are frequency up-converted using a WLAN transmitter and modulated to optical signal using an 850 nm LD and electro-optic modulator in the CS. At the RAU, transmitted WLAN signal embedded in optical signal is photodetected by the CMOS-APD, amplified, and then radiated via an antenna. After transmission through 0.5 m wireless link, which has about 40-dB loss, received signal at mobile terminal is frequency down-converted using a WLAN receiver and demodulated by a vector signal analyzer (VSA) for the evaluation of system performance.

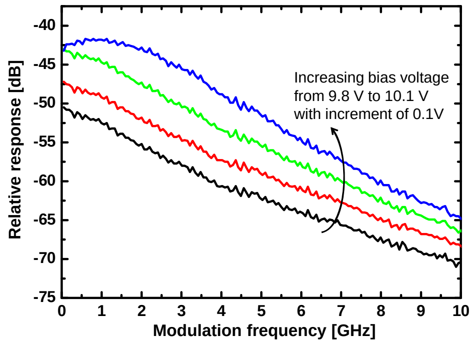

Fig. 2 Photodetection frequency response of the CMOS-APD at different bias voltages

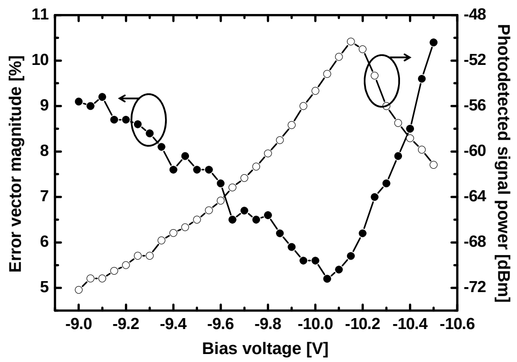

Fig. 3 EVM of data and photodetected signal power of 5.8 GHz CW signals as a function of bias voltages.

For the optimization of the CMOS-APD performance, error vector magnitude (EVM) of received data and photodetected signal power of 5.8 GHz CW signal dependent on the bias voltages are investigated as shown in Fig. 3. The bias voltage for maximum photodetected signal power is 10.15 V while EVM is minimized at 10.05 V. This slight difference of bias voltage is caused by increased noise in the avalanche regime. When the CMOS-APD operates in avalanche region, the photodetected signal power is enhanced due to avalanche gain, however, noise also increases owing to multiplied dark currents. Therefore, the bias voltage of the CMOS-APD should be determined to optimize EVM performance. Fig. 4 shows the constellation and eye diagram of received data at 10.05 V. The EVM of about 5.5% corresponding 22.5 dB SNR is obtained in the RoF system.

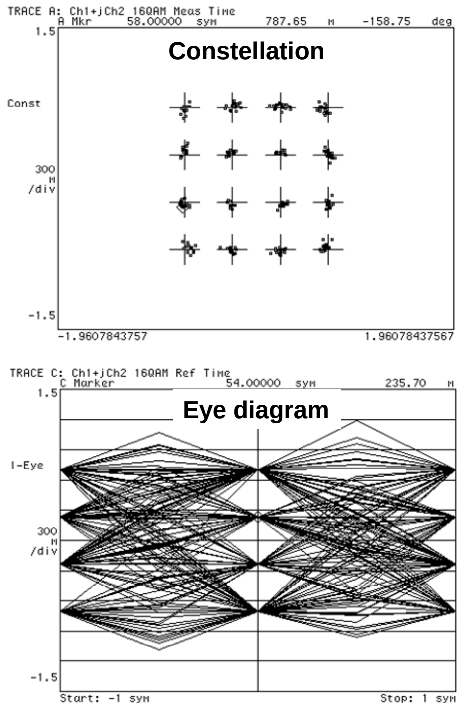

Fig. 4. Constellation and eye diagram of demodulated 20Mb/s 16 QAM data at VSA

RoF systems for IEEE 802.11a WLAN based on the CMOS-APD are presented. To optimize the CMOS-APD performance, bias voltage dependences of EVM are investigated and downlink data transmission of 20 Mb/s, 16 QAM data at 5.805 GHz is successfully demonstrated with a 0.5 m wireless link. In the experiments, 5.5 % EVM is obtained.

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