The Assessment and Analysis of using a Temperature Sensor to Regulate the Automatic Gain Control of the Amplifier in a FLASH-OFDM System

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***Abstract*—This study emphasizes the simulation and analysis of the compensatory effect of temperature on automatic gain control (AGC). From the analytical results, a temperature regulation mechanism was proposed. The technology most appropriate for and adaptive to mobile terminal stations under various temperatures was considered to ensure excellent transfer quality of the mobile terminal station. Finally, the effectiveness of the proposed temperature-regulating AGC mechanism in regulating the output power and gain of low noise amplifiers (LNAs) was verified. This mitigated the effects of interference and improved the service quality during the transfer process. The temperature sensor for regulating AGC was then applied to mobile wireless transfer devices and integrated into fast low-latency access with seamless handoff-orthogonal frequency division multiplexing (FLASH-OFDM) wireless mobile network cards to assess and verify the expected effects. In the future, this mechanism can provide a reference for mobile device technologies such as worldwide interoperability for microwave access (WIMAX) and long-term evolution (LTE).**

***Index Terms*—Automatic Gain Control (AGC), Low Noise Amplifiers (LNAs), Temperature Sensor, Frequency Division Multiplexing (FLASH-OFDM), Long-Term Evolution (LTE).**

I. Introduction

WITH modern advancements and competitiveness, wireless networking has been actively developed into moveable, mobile communication services. Relevant research trends toward the development of high-speed mobile stations. The specifications for 3G to 4G wireless communications system standards are compatible with the interface standards of IEEE 802.16e and IEEE 802.16. They possess the advantages of a fast transfer speed, high bandwidth, and large coverage area. Mobile terminals face constant competition every day. In addition to considering production costs, small and lean mobile terminal stations and multiple functions must also be developed. This results in the emergence of several problems related to various aspects, such as power-saving mechanisms, the number of antennae, memory capacity, and overall size. When functionality increases but size decreases, temperature processing becomes a factor that must be considered during circuit design. When a mobile terminal station encounters temperature differences between the interior and exterior environment, it requires a control mechanism to ensure good quality of service (QoS) of the mobile station. This study proposed the use of temperature sensors to complement regulatory action for automatic gain. Suitable modulating values were altered at appropriate times to maintain QoS for mobile station transfer. This ensured that data were transferred correctly.

This study comprises five sections: Section 2 provides an introduction to the fast low-latency access with seamless handoff-orthogonal frequency division multiplexing (FLASH-OFDM system); Section 3 describes the assessment procedure using FLASH-OFDM; Section 4 details the assessment and analysis of a FLASH-ODFM system under various temperatures; and Section 5 presents the conclusion and future implications.

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II. . The FLASH-OFDM Mobile Station System

The FLASH-OFDM system, as shown in Fig. 1, is a cellular network based on IP that provides a genuine manifestation of an all-IP solution. Therefore, all network control and data traffic were connected to the router structure via all-IP data packets. Access to the network was primarily based on the distribution of radio router base stations that generally adopted the IETF standard for basic network communication and FLASH-OFDM mobile terminal equipment obtained from the IP host.

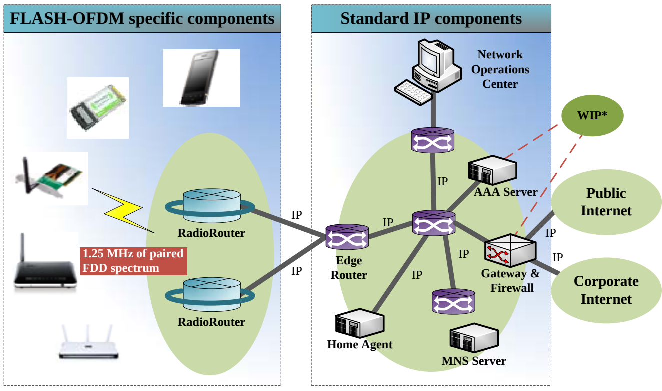

Fig. 1. MFLASH-OFDM system

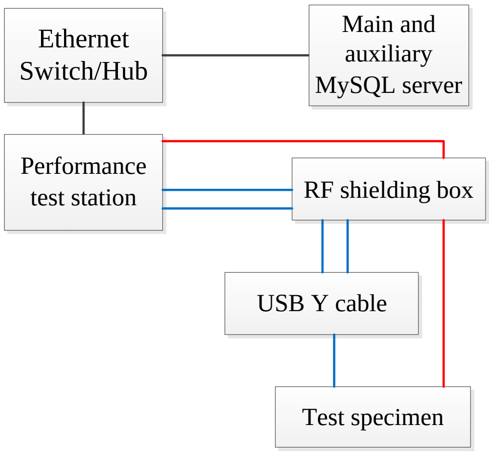

Fig. 2. Hardware structure connection diagram

III. Assessment Procedures Using A FLASH-OFDM System

The purpose of assessing mobile terminal stations was to confirm whether the monomer was normal. The performance of the hardware was primarily assessed for normal operations. During temperature compensations, the program runs a computing process, such as that shown in Fig. 2, for AGC compensation.

The simulated connection test for the FLASH-OFDM mobile terminal station and system base station was conducted to analyze the actual downlink and uplink data. Fig. 3 is a connection diagram of the hardware structures[1][2][3][4][5][6][7].

Fig. 4 is a photograph of the actual system.

IV. Assessment And Analysis Of The FLASH-OFDM System Under Various Temperatures

The results were also recorded in Table 1. The results in Table 6 indicate that with temperature compensation changes from -25 °C to 65 °C, uplink speeds greater than 1.5Mbps and downlink speeds greater than 4.5Mbps could be achieved. With no temperature compensation, at high temperatures of 35 °C and low temperatures of -25 °C, both downlinking and uplinking showed variation changes. Under no temperature compensation mechanism simulations, all parameter values of TX-VGC temperature correction and RX-VGC temperature correction were set as zero. The test was conducted from -25 °C to 65 °C, with every 10 °C increase considered one level. The steps that were performed for this process were similar to those of the temperature compensation method and are listed in Table 1.

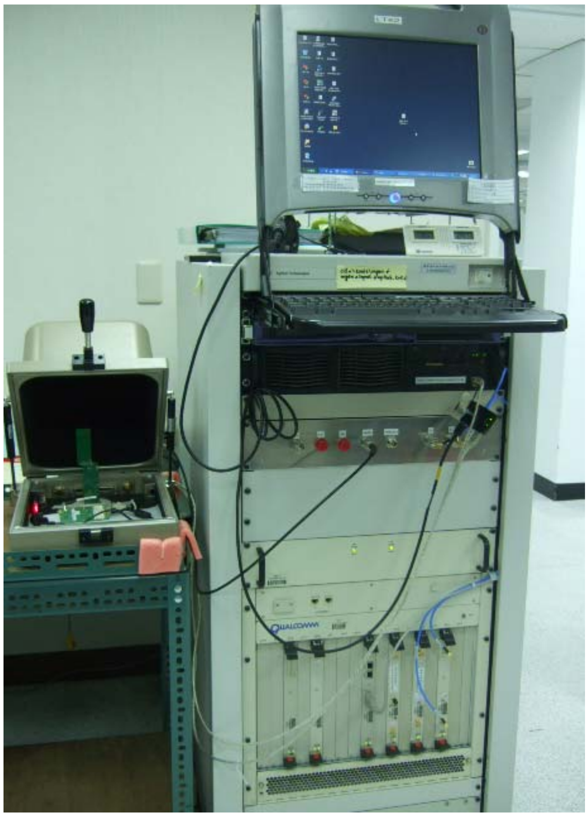

Fig. 3. Photograph of the actual system

TABLE I
ACTUAL ASSESSMENT ANALYSIS DATA (RELATIVE HUMIDITY 85%)

Test Item℃	Temperature compensation	Notemperature compensation
Downlink		
65	> 4.5Mbps	>3.8Mbps
55	> 4.5Mbps	> 3.5Mbps
45	> 4.5Mbps	> 4.0Mbps
35	> 4.5Mbps	> 4.4Mbps
25	> 4.5Mbps	> 4.5Mbps
15	> 4.5Mbps	> 4.5Mbps
5	> 4.5Mbps	> 4.5Mbps
-5	> 4.5Mbps	> 4.5Mbps
-15	> 4.5Mbps	> 4.5Mbps
-25	> 4.5Mbps	> 4.3Mbps
Uplink		
65	>1.5Mbps	>0.9Mbps
55	>1.5Mbps	>1.1Mbps
45	>1.5Mbps	>1.3Mbps
35	>1.5Mbps	>1.5Mbps
25	>1.5Mbps	>1.5Mbps
15	>1.5Mbps	>1.5Mbps
5	>1.5Mbps	>1.5Mbps
-5	>1.5Mbps	>1.5Mbps
-15	>1.5Mbps	>1.5Mbps
-25	>1.5Mbps	>1.2Mbps

V. Conclusion

The discussed temperature compensation mechanism is widely used for various technologies in microwave circuits. If costsare not considered, this mechanism canprovide steadier receiving SNR and output power values to identify the most appropriate regulatory correction code. Because the quality of the transfer process could be affected by differences in high and low temperatures when moving the mobileterminal station, the AGC regulatory mechanism is also affected by and shows differences because of variations in movement speed.

The plan proposed in this study is expected to be increasingly employed in future generations of mobile communication devices. Considering the cost, quality, size, and even application to other industrial controls, the proposed mechanism can effectively regulate differences caused by temperature changes and, thus, contribute to maintaining stable parameters.This mechanism was integrated into FLASH-OFDM product application. Simulation analyses were conducted with base stations, and actual client base stations were assessed. Regardless of whether a PCI interface or USB interface device was used, the analysis results showed that by integrating the temperature compensation regulation AGC mechanism in mobile terminal stations, the transmission output power performance could be successfully controlled at 20 ± 1 dB when the FLASH-OFDM system was used to simulate a connection. Simulated successful connections also effectively controlled the SNR performance at levels greater than 24 dB in receiving systems. This confirmed that the proposed mechanism could assist AGC in adjusting the appropriate parameters, which facilitated the completion and perfection of the mobile terminal device.

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ISBN: 978-988-19252-5-1
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)