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Tohoku University
NEC Corporation

Spintronics technology extends battery life for wireless sensors by up to 10 times

Tokyo, February 12, 2014 - Tohoku University and NEC Corporation (NEC; TSE: 6701) have developed a Micro Control Unit (MCU; *1) for wireless sensors using spintronics-based logic integrated circuit technology (*2). Early testing has demonstrated that power consumption of the new MCU has been reduced to as little as 1/80 of conventional systems (*3). As a result, the battery life of sensors equipped with this new MCU can be extended by as much as 10 times.

Currently, expectations are growing for technology that analyzes a large volume of data (big data) collected from various sensing systems to identify current conditions, such as system errors and equipment failures, and to make use of the data for predicting future conditions.

The maintenance of social infrastructure, such as bridges and tunnels, requires a high-performance wireless sensor capable of stable, prolonged operation in order to constantly collect and transmit data related to the infrastructure's status. Although it is essential to improve the performance of the MCU, which is the processing center, increased power consumption becomes a challenge when the performance of a wireless sensor is improved.

Tohoku University and NEC have jointly developed a new MCU technology to significantly reduce the power consumption of a high-performance MCU. A high-performance MCU normally consumes a large amount of power, but this technology reduces the standby power of the entire MCU by making the logic circuits and memory in the MCU non-volatile, and achieving both high performance

and power savings at the same time. Applying this MCU to a wireless sensor enables the advanced processing of data while substantially reducing power consumption.

Key features of this new technology are as follows:

1. Use of spintronics elements achieves high-speed power control while reducing standby power

The spintronics elements utilized in the power control circuits and multiple function blocks (*4) within the logic circuit enable high-speed power control while minimizing standby power. As the power of a necessary function block can be turned on as quickly as within approximately 120 nanoseconds, the power can be turned on and off as many times as necessary to reduce unnecessary power consumption.

2. Reduces the write power of a non-volatile register

The new CPU provides efficient control by canceling the overwriting process when writing the same data in order to minimize the power consumed by unnecessary writing.

A prototype micro control unit equipped with this technology has been constructed and used in an experiment with a wireless sensor. The experiment successfully demonstrated a reduction in the power consumption to 1/80 when compared to conventional systems.

These results will contribute to the creation of a wireless sensor that is able to achieve both high performance and low power consumption, while considerably reducing maintenance frequency, and promoting the utilization of big data using advanced sensors.

The development of this technology is part of NEC's focus on "Solutions for Society" that provide advanced social infrastructure using ICT.

Tohoku University and NEC have developed a variety of integrated circuits applying spintronics logic integrated circuits technology. Through the development and demonstration of this technology, Tohoku University and NEC have achieved their target of reducing the power efficiency index of various kinds of LSI to 1/64 or less.

Tohoku University and NEC announced the above results during the International Solid-State Circuits Conference (ISSCC) 2014, an international academic meeting on semiconductor circuit technologies held from February 9 to 13 in San Francisco, California.

Part of these findings were obtained through the Cabinet Office's Funding Program for World-Leading Innovative R&D on Science and Technology (Subject Title: "Research and Development into Energy Efficient Spintronics Logic Integrated Circuits," directed by Professor Hideo Ohno of Tohoku University).

*1 An integrated circuit where a computer system is embedded in a single chip; used for controlling electronic devices, etc.

*2 Spintronics-based logic integrated circuit technology uses intrinsic characteristics of electrons - negative charge and minute spin magnetics - to reverse the magnet's N/S poles according to the direction of electric current in order to memorize calculation results. The technology allows all circuits on the logic integrated circuit to be nonvolatile. Nonvolatile circuits are effective in achieving less power consumption in ICT equipment and systems.

*3 Compared with NEC's volatile micro control unit technology.

*4 Equipped with a timer, multiplier, communication controller and analog-digital converter, etc.