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Hitachi Developed Prototype of Low Power Transceiver to Achieve High Speed Data Transmission in Low Signal Integrity

Achieving 25Gb/s data transmission at 50dB transmission loss, and to enable the connection of information equipment with 10m copper cable

Tokyo, February 3, 2016 --- Hitachi, Ltd. (TSE: 6501) has developed the prototype of low power transceiver that achieves communications at the data transmission speed of 25Gb/s with the copper cable up to 10m. IEEE 802.3bj[*1] for the copper cable that connects information equipment such as storages or servers in data center is 5m. This prototype eventually demonstrated a high speed data transmission in a communication environment where its signal level has been reduced to 1/300 (50bB transmission loss[*2]). IEEE 802.3bj has already determined a shift to 25Gb/s from the current 10Gb/s over a single lane in data transmission. This adaptation requires a 25Gb/s data communication technology that is low power consumption without changing its connecting structure modification which would be deployed for installing expensive optical fiber. Furthermore, the developed technology has achieved low power yet high speed data transmission that its power efficiency is world's top class of 0.269pJ/bit/dB[*3].

In recent years, with the increase of the service expansion with the massive data communication such as video streaming and cloud service, the amount of data is expected to be increased exponentially due to the spread of IoT which is aiming at connecting various things to the Internet. Consequently, the enhancement of the communication speed of information equipment is required. IEEE 802.3bj determines that the data transmission over a single lane is 25Gb/s instead of the conventional 10Gb/s. This standard will be rapidly adapted worldwide.

In a high speed transmission of 25Gb/s, its transmission loss of copper cable will be doubled compared to the conventional transmission speed of 10Gb/s. Under this situation, expensive optical fiber is expected to be used for the longer distance transmission of more than 5m for IEEE 802.3bj. The concern here is that the structure modification will rise consequently along with the newly implemented optical fiber. It is required to extend the communication distance of copper cable to achieve a high speed transmission of 25Gb/s with a conventional connecting structure.
Therefore, Hitachi has developed the prototype of low power transceiver that can

transmit data at 25Gb/s through copper cable up to 10m. The prototype of this transceiver was tested by using 10m copper cable that would reduce its signal level to 1/300. It has successfully transmitted data with a bit error rate that is less than 10^{-12} *4 as defined in IEEE 802.3bj.

The features of the newly developed transceiver are as the following.

1. The technology of low power decision circuit with 1mV class*5 sensitivity.

In data transmission, it has achieved to determine the digital value as 0 or 1 for the received signals in decision circuit. In general, a decision circuit amplifies attenuated input signal, and then determines digital value after adding the compensation to cancel intersymbol interference*6 to the amplified signal. Conventionally, the challenge of decision circuit is that the decision accuracy of high speed signal will be low from the delay time prior the measurement begins. Hitachi has improved the decision accuracy without increasing operating power by eliminating the delay time prior the measurement and combining amplification and compensation. This has made it possible to achieve the detection of 1mV class signal and the low power data transmission with 10m copper cable where its signal level is reduced to 1/300 at 25Gb/s. Furthermore, the developed technology has achieved low power that its power efficiency is 0.269pJ/bit/dB.

2. The technology of dynamic offset*7 cancel with high accuracy.

As to achieve high quality data transmission, transceiver is required to maintain data decision accuracy for a long period of time when there is condition change of temperature or voltage, and differences on transceivers as products. The conventional challenge is that transmission quality will be decreased because its lowered decision accuracy is caused by offset, which is triggered by condition change and product differences. Thus, the dynamic offset cancel that can continuously compensate the amount of offset under condition change during a long term operation was developed using a detector, which is capable of detecting the amount of offset with high accuracy. This has made it possible to achieve a high quality data transmission without decreasing a bit error rate but maintaining decision accuracy for a long time.

As to verify the performance of this developed prototype of transceiver, the communication validation was conducted in a communication through 50dB transmission loss channel at 25Gb/s using 10m OMNIBIT®* cable, manufactured by

Hitachi metals, Ltd.. As a result, it is confirmed that a high quality communication is achieved[*8] with a bit error rate that is less than 10^{-12} as defined in IEEE 802.3bj while its power efficiency is world's top class of 0.269pJ/bit/dB.

Hitachi will continue its research and development for high speed wired communication technology through developing validation module with this developed prototype of transceiver and conducting further validation tests for commercialization.

The achievement of this research will be presented on February 1 at ISSCC 2016 in San Francisco, USA.

*1 IEEE 802.3bj: One of data transmitting method that is the most commonly used technology standard for Ethernet ®. IEEE 802.3bj is a standard of 100 Gb/s data transmission by achieving 100Gb/s transmission over 4-lane with 25Gb/s transmission over 1-lane. IEEE stands for The Institute of Electrical and Electronics Engineers is a professional association with its headquarter in USA.

*2 Transmission loss: the amount of signal attenuation during data transmission.

*3 0.269pJ/bit/dB: Power efficiency 0.269pJ/bit/dB: Power efficiency is defined as power consumption over data rate by transmission loss. Lower power efficiency indicates to transmit data at higher speed to longer distance with lower power consumption In this case, power efficiency of only analog frontend is calculated.

*4 a bit error rate10^{-12}: Indication of an data error occurred when transmitting one trillion data.

*5 1mV class: Minimum input sensitivity for a decision circuit. If the input amplitude is less than this sensitivity, it will be indicated as wrong data.

*6 Intersymbol Interference: Interference of one symbol with subsequent symbols.

*7 Offset: The shift of center of signal from 0.

*8 The actual result of the validation test is the high quality communication was achieved less than 10^{-12} at 50dB transmission loss.

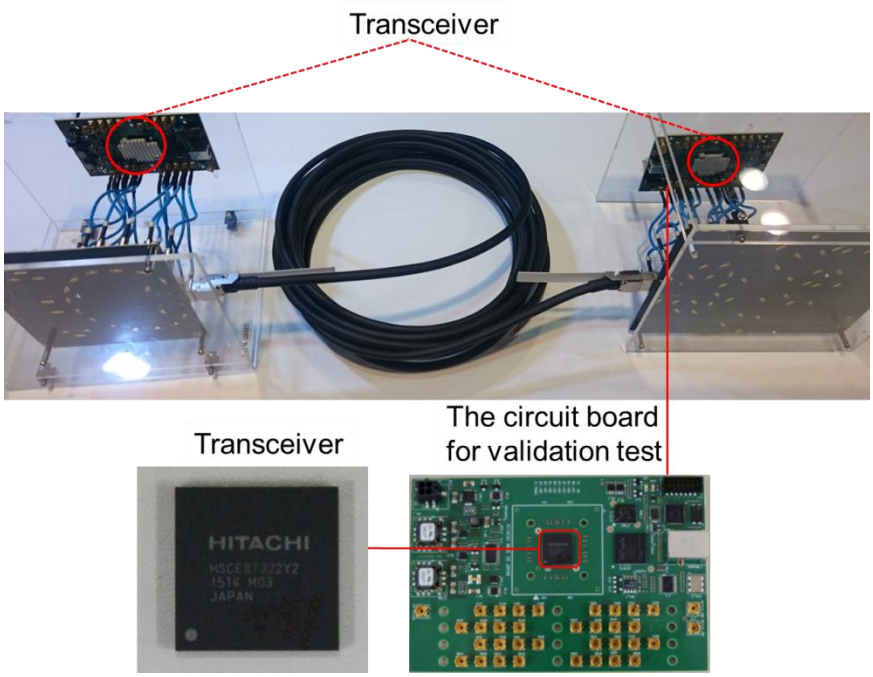

Fig. 1 The prototype of low power transceiver

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges with our talented team and proven experience in global markets. The company's consolidated revenues for fiscal 2014 (ended March 31, 2015) totaled 9,761 billion yen ($81.3 billion). Hitachi is focusing more than ever on the Social Innovation Business, which includes power & infrastructure systems, information & telecommunication systems, construction machinery, high functional materials & components, automotive systems, healthcare and others. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

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