NTT Press Releases

(Press Release)

January 17, 2012

Nippon Telegraph and Telephone Corporation

World's Smallest Wireless Transceivers that have full coverage of the 60-GHz band

-- High-speed download of gigabyte-class content to mobile or tablet terminals --

Nippon Telegraph and Telephone Corporation (NTT, CEO: Satoshi Miura, Tokyo) has successfully developed the world's smallest wireless transceivers that cover all four of the channels[*1] allocated in the 60-GHz band[*2] (See Figure 1). They have a maximum transmission rate of 3.8 Gbit/s per channel. Simultaneous four channel transmissions makes the transmission rate about 15 Gbit/s. The wireless transceiver technologies will be used to download gigabyte-class content from kiosk terminals in stations, convenience stores, and so on.

1. Background

With the popularization of broad band networks, high-speed and large-capacity broadband wireless system have been researched and developed worldwide.
In order to achieve a noncontact high-speed download system which enables download of gigabyte-class content (e.g., a DVD of 4.7 GB) in about 10 seconds, NTT has worked in research and development of 60-GHz wireless transceivers.
In Japan, as per the revisions to the Radio Act in September 2011, four channels without licenses can be used (Figure 2).If these channels are used simultaneously, it will be possible to download gigabyte content within 10 seconds.

2. Research achievements

NTT has developed the world's smallest wireless transceivers which can use all four channels in the 60GHz-band.
We have realized the miniaturized transceivers by using our wireless module (Figure 3) in which a broadband antenna and MMICs[*3] are integrated in the multi-layer LTCC[*4] substrate. It can cover all four channels.
It is necessary to take into consideration not only the wireless access speed but also the speeds of storage and memory. Using PCs equipped with a high speed bus and storage, the read / write performances of the gigabyte-class HD video were tested. The result confirmed that a high-speed file transfer was possible in real time.
In the future, this wireless transceiver is expected to become a key technology for the non-contact high-speed transmission which can transmit gigabyte class content.

3. Technical point

(1) Wireless module

Wireless modules are realized by integration of broadband antenna and MMICs (Figure 3).
The antenna is a microstrip antenna with stacked rings formed on a multi-layer LTCC substrate. By using the metal ring as the metal wall and the parasitic element[*5], the antenna obtains a high-gain and compact size. It has the antenna gain[*6] of 10 dBi in the 60-GHz band.
A Frequency converter MMIC is one of the key devices for full coverage of the 60-GHz band. To make frequency bandwidth broad, we use 4-stage directional couplers. The lumped capacitor lies at the center point of the coupled line. This capacitor effectively increases the coupling, resulting in tight coupling. By properly choosing the physical shape, the bandwidth and the phase characteristics of the coupler are effectively improved. The converter has a relative bandwidth[*7] of 15% at 60GHz band.

(2) Wireless Transceiver

Since signal frequencies in the substrates in 60-GHz band wireless transceivers become high, coupling between elements or/and lines also becomes high, resulting in degraded signals. By using the stacked substrates and optimization of element arrangements, the coupling between elements and/or lines was suppressed, and high integration was realized.

4. Verification test results

Transmission rate verification tests of several gigabytes are demonstrated (Figure 4).
In this test, one channel of the 60-GHz band was used and read/write speeds in real time using the HD video were measured.

5. Future Developments

Aiming for smart phone implementation in the future, NTT will continue to miniaturize the transceiver further.
Moreover, NTT will advance the technology further towards implementations of non-contact high-speed transmission of gigabyte class content in kiosk terminals, recorders, home gateways, etc (Figure 5).

*1 Channel:
Channel is a segment for every specific frequency band used, and it is assigned by standards etc.

*2 60-GHz band:
The 60-GHz band is the millimeter wave band which has a wavelength of 1 mm - 10 mm, and is the frequency band currently assigned all over the world. In Japan, a 57-66 GHz frequency band can be used as an unlicensed band. In the standards of a 60-GHz band, four channels, 57.24-59.40 GHz, 59.40-61.56 GHz, 61.56-63.72 GHz, and 63.72-65.88 GHz, are assigned.

*3 MMIC（Monolithic Microwave Integrated Circuit）:
An MMIC is the integrated circuit for microwaves, and it integrates active and passive components on a semiconductor substrate.

*4 LTCC (Low-Temperature Co-fired Ceramics):
LTCC is a dielectric substrate which uses ceramics with a low loss tangent, and it can be used in high frequency components including an antenna. It is suitable for integration and miniaturization for a high frequency module.

*5 Parasitic element:
A parasitic element is a conductive element which is not electrically connected to anything else. The purpose of the parasitic elements is to modify the radiation pattern of the radio waves emitted by the radiator, directing them in a beam in one direction, increasing the antenna's directivity. Multi-element antennas such as the Yagi-Uda antenna typically consist of a radiator connected to the receiver or transmitter through a feed line, and parasitic directive and reflective elements, which are not.

*6 Antenna gain:
In electromagnetics, gain is the ratio of input to output power. An antenna's power gain or simply gain is a performance figure which combines the antenna's directivity and electrical efficiency. When no direction is specified, "gain" is understood to refer to the peak value of the gain.

*7 Relative bandwidth:
Relative bandwidth is a ratio of the bandwidth to the center frequency.

Attachment·Reference

- Figure 1: 60-GHz band wireless transceiver W: 119mm, H: 59mm, D: 33mm
- Figure 2: Channels for 60-GHz band and comparison of wireless systems
- Figure 3: 60-GHz band wireless module
- Figure 4: Verification tests of several gigabytes of transmission rate
- Figure 5: Future image of non-contact high-speed transmission of gigabyte class content

Inquiries

Nippon Telegraph and Telephone Corporation
NTT Science and Core Technology Laboratory Group, PR Section
a-info@lab.ntt.co.jp
046-240-5157

NTT Press Releases Index