# Base Station and User Equipment Antennas for 60-GHz-Band Near-Field Wireless Communication System: GATE

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## Abstract

This paper presents base station and user equipment antennas for a 60-GHz-band near-field wireless communication system: gigabit access transponder equipment (GATE). The GATE uses electrically large antennas for base stations to provide a uniform field distribution and low interference between adjacent links.

## 1. Introduction

Demands for high-speed wireless communication have increased because of widespread mobile terminals such as smart phones and tablets. The 60-GHz band, 57 – 66 GHz, is allocated worldwide for wireless communication and can be used without a license [1].
The gigabit access transponder equipment (GATE) system [3] uses electrically large aperture or array antennas as antennas for base stations. Electrically large antennas realize long near-field areas where radio wave intensity does not attenuate by the square of the propagation distance. The GATE system uses the near-field region to provide stable field intensity and low interference between adjacent links. For user equipment such as mobile terminals or tablets, small linear polarized antennas [4], [5] are used. In this paper, base station and user equipment antennas for the 60-GHz-band GATE system are presented.

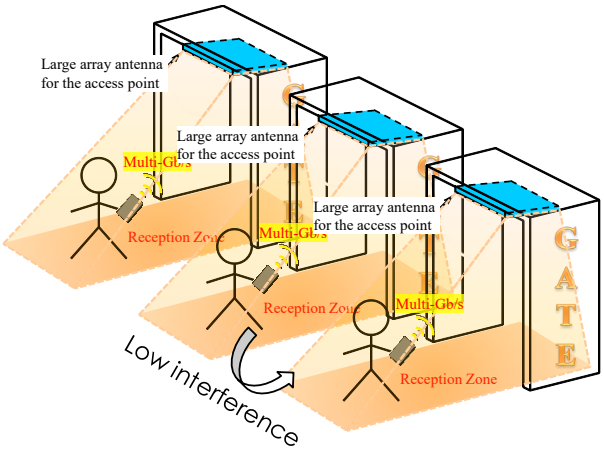


Figure 1: 60-GHz-Band Near-Field Wireless Communication System: GATE.

## 2. Base Station Antennas for GATE

A circularly-polarized slot array antenna [6], [7] for base stations of GATE is shown in Fig. 2. It consists of a corporate feed waveguide in the lower layer and a radiating part in the upper layer. The antenna is fed through an aperture (WR-15) from its backside, and the power divided equally by the corporate feed waveguide circuit. At the end of the feeding circuit, 2×2-element circular-polarized subarray is fed. The antenna was designed using a hybrid method of moments (MoM)/finite element method (FEM) [8].
The 128×64-element array was fabricated by diffusion bonding of 0.2-mm thickness aluminum (A6063) plates as shown in Fig. 2 (a). The aperture dimension of the arrays is 544 × 272 mm$^2$. The measured amplitude distribution of 128×64-element array shows uniform whereas the phase distribution shows non-uniformity. The reason for the non-uniformity may result from the incompleteness of the fabrication of the feeding circuit.

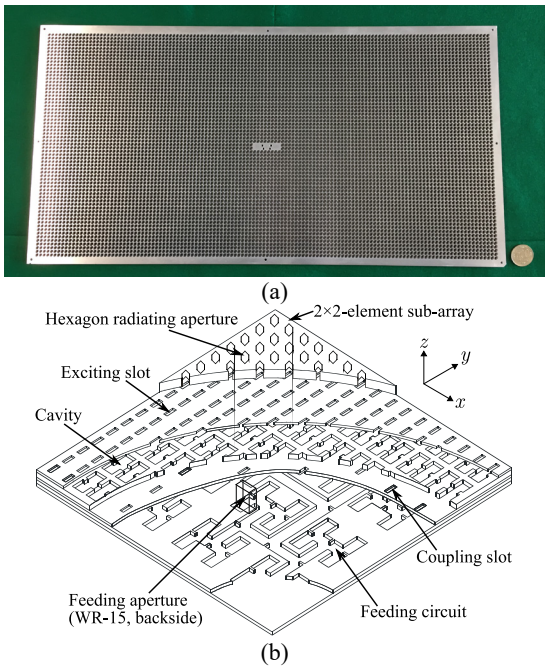


Figure 2: (a) 60-GHz-band 128×64-element slot array antenna by aluminum, (b) its structure.

## 3. User Equipment Antennas for GATE

A metal cap antenna for user equipment of GATE is shown in Fig. 3 [5]. The antenna is composed of a substrate and a metal cap antenna. The metal cap antenna is composed of a T-junction and two slots and fed by a post wall waveguide on the substrate. Two slots are employed to increase directivity and realize the same beamwidth in both E- and H-planes. The substrate is inserted into the metal cap until it touches the metal cap antenna. This structure realizes robustness against fabrication tolerance. Measured frequency characteristics of gain was more than 7.8 dBi from 57 to 66 GHz.

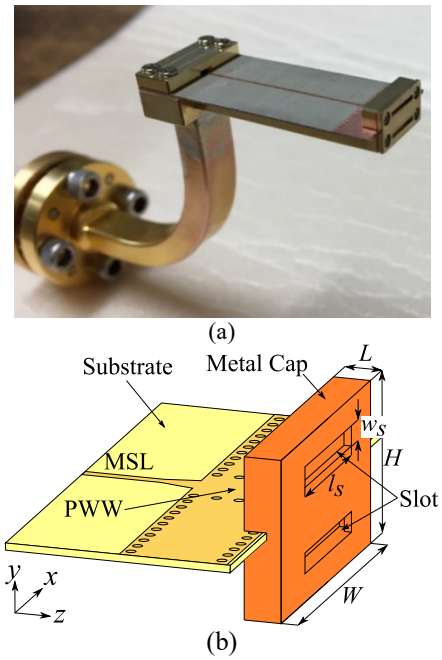


Figure 3: (a) Fabricated metal cap antenna with a waveguide feed, (b) its structure.

## 4. Conclusions

This paper has presented base station and user equipment antennas for the 60-GHz-band near-field wireless communication system: GATE. As a base station antenna, a 128x64-element circular-polarized waveguide slot array antenna was introduced and shows uniform amplitude distribution. As a user equipment, a metal cap antenna was described and shows wideband gain characteristics.

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