# Design of a reconfigurable vehicle antenna using a parallel-T matching network

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Recently, there has been much research about constructing a wireless internet environment in a moving vehicle using a built-in platform. For commercial internet service, WiFi, Mobile WiMAX, and HSDPA are potentially applicable for a moving vehicle, and the most appropriate service considering the throughput capacity may be varied instantaneously according to the vehicle's moving speed and location. Therefore, the built-in platform for mobile internet should be switchable among the services, and the external antenna connected to the platform should also operate at those frequency bands that are WiFi (2.4 GHz – 2.5 GHz), Mobile WiMAX (2.3 GHz – 2.7 GHz), and HSDPA (2.1 GHz – 2.2 GHz) including voice communications band (800 MHz ~ 900 MHz). Since the bandwidth of a single vehicle antenna is broad enough to cover the entire bands, multiple antennas may be installed to cover those frequency bands. However, this necessitates more space, plural feed cables, and a higher manufacturing cost.

In this paper, we propose a novel reconfigurable antenna that can cover those frequency bands using three different modes incorporating PIN diodes. The designed antenna covers three different frequency bands (800 MHz – 900 MHz, 2.1 GHz – 2.2 GHz, and 2.3 GHz – 2.7 GHz) by changing the electrical shape of the matching network using the PIN diodes. Since the PIN diodes operate as an RF switch on the feed network, the proposed antenna structure can be converted into three different forms; a folded monopole and monopoles with a single or a parallel T-matching network. The proposed antenna is printed on both sides of a polyacrylate substrate, and the top and bottom conductors are connected through via holes. The PIN diodes are mounted on the matching network at four different positions. In the first mode, the antenna works as a folded monopole for the voice band of 800 MHz – 900 MHz when all the PIN diodes are electrically opened. The second mode works in the HSDPA band (2.1 GHz – 2.2 GHz), and this mode is for a case when a vehicle is moving faster than 60 km/h. At this mode, the antenna works as a monopole with a single-T matching network by turning on PIN diodes that are at the upper layer. The third mode is for the Mobile WiMAX and WiFi service (2.3 GHz – 2.7 GHz) when the vehicle is moving slower than 60 km/h. In this mode, the antenna has the electrical form of a monopole with a parallel-T matching network by turning on all PIN diodes. The designed antenna is built and installed in a real vehicle, and the indoor and outdoor measurement results for each mode will be discussed.