Novel Wi-Fi Antenna Design and Measurement
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Abstract: - A high performance monopole antenna fabricated using a folded wire line and metal patch as radiator is presented. A prototype of the proposed monopole antenna with a compact area size is implemented, and the multi-band WLAN antenna shows a wide operating bandwidth of about 530MHz and 3400MHz for low band and high band, bandwidth, making it easy to cover the IEEE 802.11a, IEEE 802.11b, IEEE 802.11g and IEEE 802.11n (MIMO) bands for wireless communication and future 4G wireless operation of a mobile VoIP/VoWLAN handset phone.

Key-Words: - monopole antenna, multi-band, MIMO, 4G, VoIP, VoWLAN

1 Introduction
The Institute of Electrical and Electronics Engineers (IEEE) has defined the most important characteristics of wireless LAN in the 802.11a, 802.11b, 802.11g and 802.11n group of standards of wireless network communication. Data is transmitted predominantly in the radio frequency range 2.4 GHz and 5 GHz. In this implement, the study mainly focuses on the current trends in development of compact and low profile multi-media PDA and smart mobile phone and provides a wideband monopole antenna design suitable for application in wireless LAN communicating system in the near future. In this design, the innovative monopole antenna for single fed to excite dual radiator path is presented. These proposed antennas can find applications in wireless LAN IEEE 802.11a/b/g/n and VoIP/WiFi wireless systems application. The design of a dual wideband monopole antenna with dual path of folded wire and metal patch radiator with applications for wireless VoIP and VoWLAN uses is investigated. With the broadside radiations, the proposed dual wideband monopole antenna carries a stable gain variation in the 2.4-2.5 GHz and 5-6 GHz bands, respectively.

2 Antenna Design
An internal small antenna usually suffers from degradation in performance of narrow bandwidth and radiation efficiency. In this experiment, we design and fabricate a dual broadband interior type wire monopole with a high performance radiation pattern over a design operation band using dual path, as shown in Fig. 1. It has a
measured return loss bandwidth (referenced -6dB) about 530MHz with center frequency at 2.35GHz (2.04-2.57GHz) and 3400MHz with center frequency at 5.42GHz (4.7-8.1GHz), as shown in Fig. 2. With the rapid growth of mobile Wi-Fi technique, wireless communication devices are more mini-size and had multi-band wireless functions. In this paper, the dual wideband monopole antenna has several advantages over conventional monopole-like antenna and planar antenna for mobile handsets. The small compact and low profile antenna radiator structure such as the wire monopole antenna that can be mounted on the portable equipment are becoming very attractive for the VoIP and VoWLAN communications application. In this design, we designed a novel compact internal wire monopole antenna for multi-band operation covering the IEEE 802.11a/b/g/n and Bluetooth co-existed bands and applications. In this design, multi-band monopole antenna for Wireless LAN antenna device applications is proposed. This kind of folded wire monopole antenna co-design can overcome the narrow bandwidth problem that happens to the conventional patch antenna; in practical application, when electronic components are placed very close to the conventional antenna, large degradation of the antenna performance will occur. In the proposed wire antennas, by adding a low-Q resonator factor as a wideband radiator design, antenna coupling between the low band and high band radiator can be improved and enhanced antenna bandwidth. We present an innovative wire monopole antenna suitable for application as an internal antenna co-integration on mobile PDA handheld. The proposed dual monopole antenna is designed on a practical PCB size (100mm x 60mm), which serves as a support for the monopole, and has a radiator compact size. The proposed wire monopole is formed by two wire line.

Fig. 1: (a),(b) Dual wideband monopole antenna Dimension = 4mm*4mm, Wire length = 23mm)
This long folder wire line radiator has a total length of about 23mm, which excites low band antenna bandwidth of the wire monopole antenna. The short metal patch radiator has a total length of about 4mm * 4mm, which excited high band antenna bandwidth of monopole antenna. With the finite dimensions of the folded wire monopole antenna in this design, the total length of the effective radiator wire path of the antenna is close to one quarter wavelength at free space of the center frequency of low band and high band, the low band resonant frequency of the long wire radiator occurs at about 2380MHz center frequency and high band resonant frequency of the short wire radiator occurs at about 5420MHz center frequency. In addition, by fine-tuning the length of the wire length of the long and short radiator, the antenna resonant frequency of the bandwidth can be effectively controlled, but antenna multi-coupling effect for multi-interference by long folded wire so the antenna resonant frequency has affected with each other.

3 Results
A 50\Omega semi-rigid RF cable is used to feed the monopole folded wire antenna, and is co-design and co-testing on the same PCB board. The feeding network is a wideband 50\Omega low loss RF cable as probe. The PCB material is metal conductor and dielectric substrate with the thickness 1mm and relative permittivity 4.6. The dual wideband impedance bandwidth is easily to apply practical PDA handset for VoIP/Wi-Fi application and wireless system integration and easily to fine tuning the antenna and RF circuit matching interface. The operating bandwidths of the proposed antennas can cover the 2.4/5.2/5.8 GHz WLAN bands, and the antenna gain is about larger than 2-3dBi in the 2.4 GHz and 5 GHz full bands; respectively. Besides, they can also generate the good radiation patterns in the azimuth plane and good antenna performance has been obtained. Based on the measurement coordinates (show in Fig. 3.) for H-plane, E1-plane and E2-plane. The measured data as shown in Table 1

![Fig. 2: Measured data of return loss](image)

![Fig. 3: Antenna chamber for pattern measurement](image)

<table>
<thead>
<tr>
<th>Frequency(MHz)</th>
<th>2400</th>
<th>2440</th>
<th>2480</th>
<th>2500</th>
<th>5000</th>
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<tbody>
<tr>
<td>Gain (dBi)</td>
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<td>2.7</td>
<td>2.6</td>
<td>2.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Frequency(MHz)</td>
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<td>5400</td>
<td>5600</td>
<td>5800</td>
<td>6000</td>
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<tr>
<td>Gain (dBi)</td>
<td>3.7</td>
<td>3.6</td>
<td>3.7</td>
<td>3.8</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Table 1: Measured gain data
4 Conclusion
In this paper, a compact and low profile internal folded wire monopole antenna for multi-bands has been proposed. This antenna was designed and measured. A good agreement between measurement and analysis has been obtained. The proposed antenna shows a wider operating bandwidth and it easy to cover the IEEE 802.11a, IEEE 802.11b, IEEE 802.11g and IEEE 802.11n bands for wireless communication and 4G wireless multimedia operations of a mobile handset phone, co-design, co-integration and application.

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References: