Application Report
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WL18xx 5GHZ Antenna Diversity

WL18xx System Group

ABSTRACT

Realistic wireless channel models consider the impact of multipath propagation. Since a transmitted signal is subject to reflections and refraction on walls, surfaces, and so forth, the receiving node will see signals differing in phase and amplitude. Using more than one antenna allows the evaluation of different multipath scenarios to avoid or reduce the effects of fading and interferences. Diversity is used to describe a strategy for choosing the best of two paths of transmitting or receiving an RF signal in order to maximize the possibility that a packet will be correctly received.

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1 Introduction

The WL18XX 5GHz path consists of separated TX/RX RF lines that can be connected to a single antenna using SPDT or two antennas using the DPDT RF switch. For the two antennas solution, the antennas can be placed at such angles on the board that will hedge against polarization effects for a given position or they can be physically separated so that if one antenna is experiencing destructive interference, the other is likely to be experiencing constructive interference.

New 5GHz firmware-based diversity algorithm is introducing smart selection of the antenna to be used for reception or transmission of a packet based on the signal strength indication (RSSI) value observed during the preamble portion of a packet.

The mechanism is divided into two main stages:

- Antenna diversity during scan
  - Diversity operates to enlarge the access points (APs) list and provide a full observation even if there are hidden APs to one of the antennas.
- Antenna diversity during connection
  - The diversity algorithm analyzes the RSSI samples received from the PHY layer and choose the better performance antenna automatically.

The solution is available starting with the WL8 R8.6 SW release (June 2015).

1.1 Acronyms

Table 1. Acronyms

AP	Access Point
DPDT	Double-Pole, Double-Throw
MAC	Medium Access Control
PHY	Physical Layer
RSSI	Received Signal Strength Indication
Rx	Receive
STA	Station
TP	Throughput
Tx	Transmit
WL8	TI Wilink 8
WLAN	Wireless Lan

2 Use Cases

The use cases include real-life situations for which this feature can improve the performance of the WL8 by evaluating and selecting one of the antennas for both reception and transmission. This process improves link robustness.

The following use cases can be mentioned:

- Destructive multiple paths

  In urban and indoor environments, there is no clear line of sight between transmitter and receiver. Instead, the signal is reflected along multiple paths before finally being received. Each of these bounces can introduce phase shifts, time delays, attenuations, and distortions that can destructively interfere with one another at the aperture of the receiving antenna. Antenna diversity is especially effective at mitigating these multipath effects.
- Radiation pattern Nulls

  A radiation pattern defines the variation of the power radiated by an antenna as a function of the direction away from the antenna. This power variation as a function of the arrival angle is observed at the antenna far field.

- Airplay certification compliance (audio costumers)

  Airplay certification (https://developer.apple.com/programs/mfi/) includes a test where the device is being rotated 360° while receiving traffic from an Apple AP. A certain level of throughput (TP) and retry percentages should be kept for all angles.

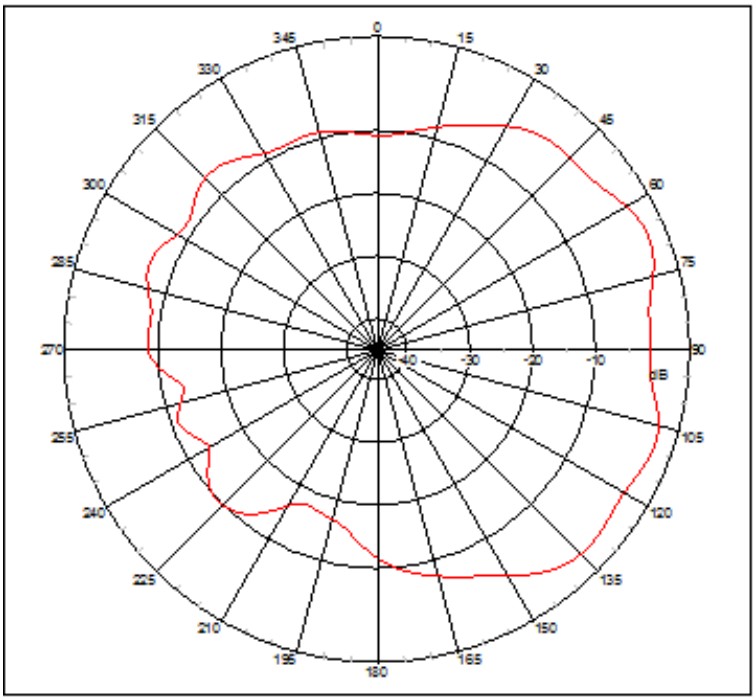

Figure 1. Polar Radiation Pattern of Typical Antenna at 5GHz Band

3 Feature Description

The diversity algorithm is divided into two stages:

- Before WLAN connection (includes scan for APs)
- After WLAN connection - Improving the link by finding and favoring the optimal antenna

3.1 Scan and Connection

For each scan command (over selected A band channels) coming from the host, a different antenna is used. The above is true for all kind of scan types: scheduled scan, one shot, background scan, and so forth. By doing this, the APs that are hidden from one of the antennas can be found, and the expanded APs list can be driven to the host.

3.2 During Connection

Algorithm goal: study and analyze the best signal path. The algorithm “learns” the link by the RSSI received per packet, and tries to reach the ‘strong’ range of RSSI > -70dBm.

Once it has converged to this ‘strong’ region, it does not try to change the antenna unless:

- Loss of expected packets is detected
- RSSI drop below -70dBm

4 Feature Requirements

4.1 Hardware Requirements

- DPDT RF switch – the switch is integrated on TI modules WL1837MODGI and WL1807MODGI
- Two 5GHz antennas connected

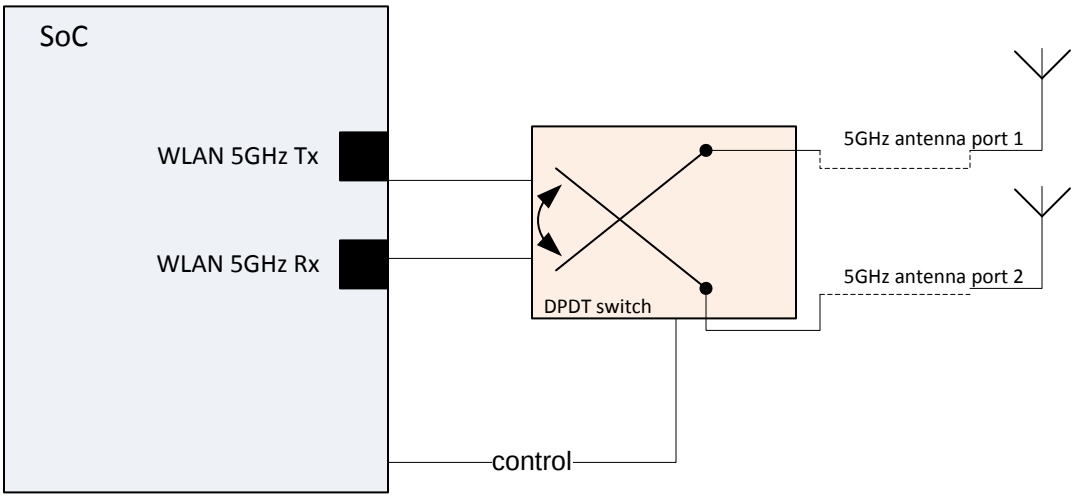

Figure 2. 5GHz Antenna Diversity Hardware Functionality

4.2 Software Requirements

- The solution is available starting with the WL8 R8.6 SW release

5 Features Limitations

- 5GHz antenna diversity operates in STA/P2P-client modes only

6 Feature Activation

Update the wl18xx-conf.bin file parameters as follows to activate the feature:

1. Set the “number_of_assembled_ant5” parameter to 0x02. This indicates that there are two 5GHz antennas assembled.
2. Verify that the “high_band_component_type” parameter is set to 0xA. This indicates that a DPDT switch is assembled.

The script ‘configure-device.sh’ can be used in order to configure the wlconf file correctly.

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