

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.

Contents

1	Introduction	2
2	Use Cases	2
3	Feature Description.....	3
4	Feature Requirements	4
5	Features Limitations	4
6	Feature Activation	4

List of Figures

1	Polar Radiation Pattern of Typical Antenna at 5GHz Band	3
2	5GHz Antenna Diversity Hardware Functionality	4

List of Tables

1	Acronyms	2
---	----------------	---

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.

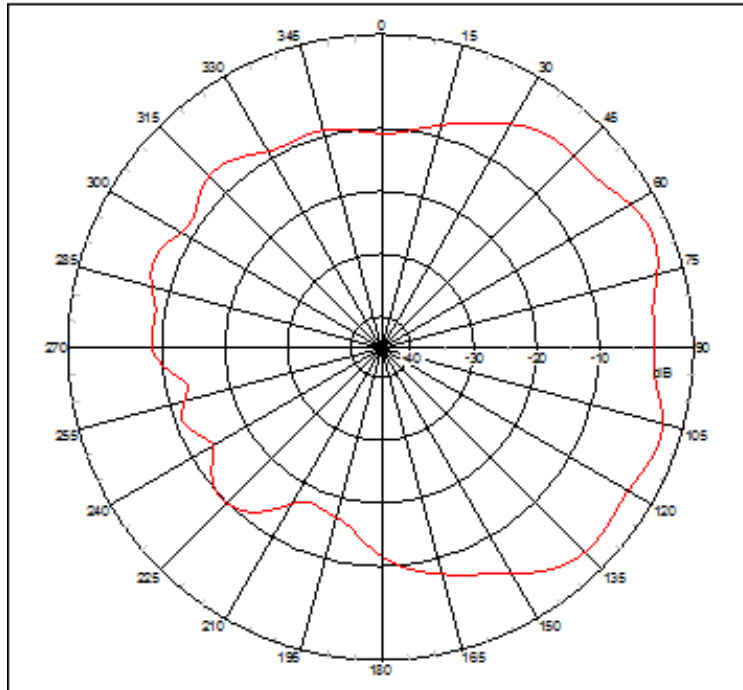


Figure 1. Polar Radiation Pattern of Typical Antenna at 5GHz Band

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

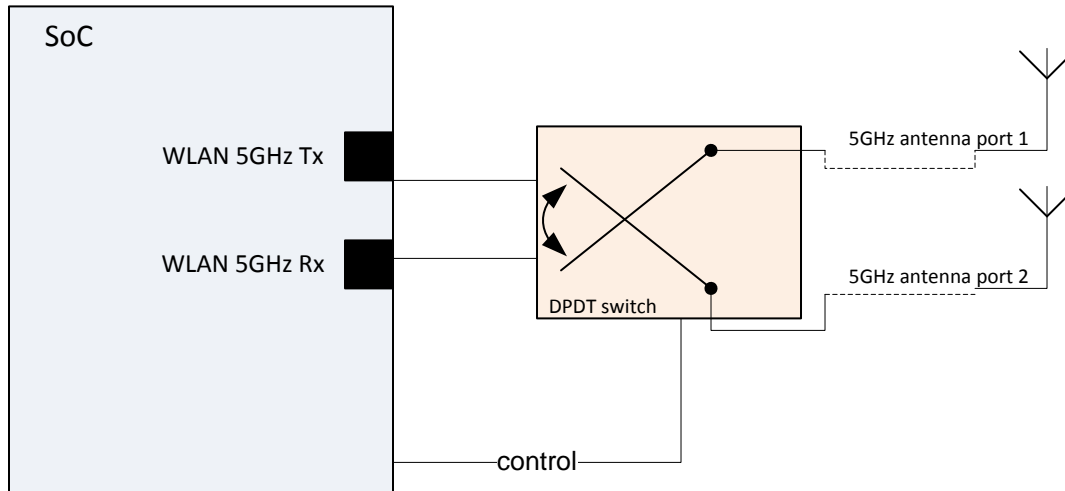


Figure 2. 5GHz Antenna Diversity Hardware Functionality

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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com