

RW Packet Traffic Arbiter

API and FS

RW-PTA-API-FS

Version 1.1

2019-10-21



Revision History

Version	Date	Revision Description	Author
0.01	2014-12-01	Initial release	LV
1.0	2017-04-27	Stripped down version for API and Functional Spec only	DP
1.1	2019-10-21	Updated arbitration table (WLAN abort condition during BT event).	LV

Changes between a version and the previous one is reflected by the addition of **change bars**, like for the line below:

...This line has been modified from previous version...

Remove the following part if this document has reached v1.0.

As this document is not yet a 1.0 version, the items summarized in the table below remain to be clarified or to be determined in later releases.

TBD	Date entered	Description	Status
TBD-1			
TBD-2			
TBD-3			
TBD-4			
TBD-5			
TBD-6			
TBD-7			
TBD-8			
TBD-9			
TBD-10			

Items to be determined in the Future Versions of this Document.



Table of Contents

Revision History	2
Table of Contents	3
List of Figures	4
List of Tables	5
1 Overview	6
1.1 Document Overview.....	6
1.2 Product Overview.....	6
2 PTA block design	7
2.1 Block level architecture	7
3 Sub-block design	8
3.1 Priority.....	8
3.2 Arbiter	8
3.3 Channel Overlap.....	9
3.4 Registers	11
3.4.1 Revision register	11
3.4.2 Configuration register	11
3.4.3 BT Transmit statistic	12
3.4.4 BT Transmit abort statistic	12
3.4.5 BT Receive statistic	12
3.4.6 BT Receive abort statistic.....	12
3.4.7 WLAN Transmit statistic.....	12
3.4.8 WLAN Transmit abort statistic.....	12
3.4.9 WLAN Receive statistic.....	12
3.4.10 WLAN Receive abort statistic	13



List of Figures

Figure 2-1 – Block diagram	7
Figure 3-1 – Channel Margin	10
Figure 3-2 – Channel Overlap Block Diagram	10
Figure 3-3 – WLAN 40MHz bandwidth.....	11



List of Tables

Table 3-1 – Priority Table	8
Table 3-2 – Arbitration Table.....	9
Table 3-5 – PTA Registers	11
Table 3-6 – REVISION register.....	11
Table 3-7 – CONFIG register	12
Table 3-8 – STAT_BT_TX register	12
Table 3-8 – STAT_BT_TX_ABORT register.....	12
Table 3-8 – STAT_BT_RX register	12
Table 3-8 – STAT_BT_RX_ABORT register	12
Table 3-8 – STAT_WLAN_TX register	12
Table 3-8 – STAT_WLAN_TX_ABORT register	12
Table 3-8 – STAT_WLAN_RX register	12
Table 3-8 – STAT_WLAN_RX_ABORT register.....	13

1 Overview

1.1 Document Overview

This document describes the coexistence arbitration between WLAN and BT IP from a functional and SW API point of view.

1.2 Product Overview

This block has the following features:

- ✓ Basic Arbitration
- ✓ PTI Arbitration
- ✓ Channel overlap detection
- ✓ Configurable channel margin

2 PTA block design

2.1 Block level architecture

PTA block is dedicated to abort the transfer with the lowest priority, which can interfere with the transfer with the highest priority. Figure 2-1 shows PTA block architecture. The arbitration scheme can be static, programmed through a register, or based on the transfer PTI.

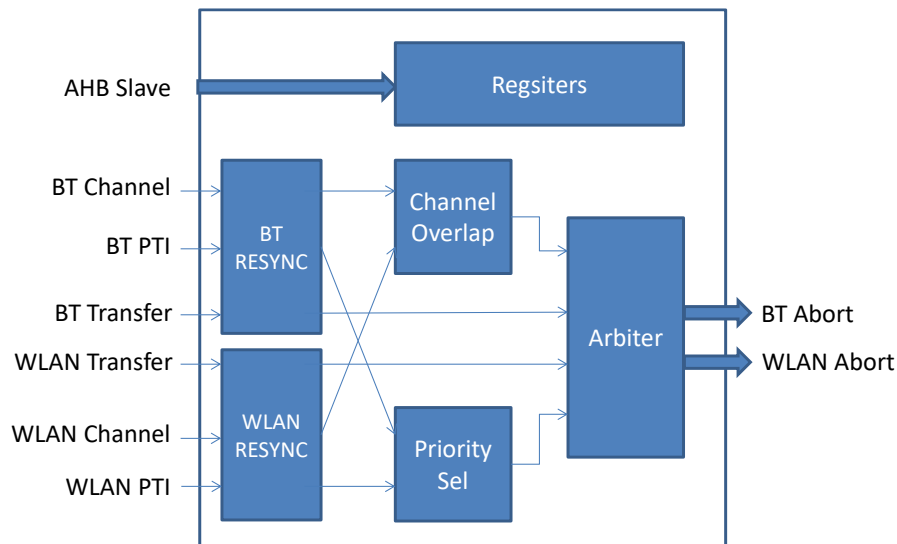


Figure 2-1 – Block diagram

3 Sub-block design

3.1 Priority

This functional part is used to detect the most priority interface. Two priority modes are supported, basic priority and PTI priority. In basic mode, the priority is defined by the “basic_priority” register field. In PTI mode, the priority is determined from the transfers PTI. The transfer with the highest PTI has the priority; basic_priority is used if PTI are the same. PTI is expected to be set to the lowest priority when no transfer is on-going.

basic_priority	pti_mode	Packet Traffic Info	Priority
BT	Enable	BT PTI > WLAN PTI	BT
		BT PTI < WLAN PTI	WLAN
		BT PTI = WLAN PTI	BT
	Disable	-	BT
WLAN	Enable	BT PTI < WLAN PTI	WLAN
		BT PTI > WLAN PTI	BT
		BT PTI = WLAN PTI	WLAN
	Disable	-	WLAN

Table 3-1 – Priority Table

3.2 Arbiter

The arbiter is used to generate the abort controls, based on the priority, channels information & transfers type.

Priority	BT transfer type	WLAN transfer type	Abort Type & Rules
BT	TX	Idle	WLAN TX Abort if Channel overlap & (!pti_enable wlan_pti_mode) & no_sim_tx WLAN RX Abort if Channel overlap & (!pti_enable wlan_pti_mode) <i>- PTI can't be used, don't know the next WLAN PTI, except when wlan_pti_mode is set</i>
	RX	Idle	WLAN TX Abort if Channel Overlap & (!pti_enable wlan_pti_mode) WLAN RX Abort if Channel Overlap & (!pti_enable wlan_pti_mode) & no_sim_rx <i>- PTI can't be used, don't know the next WLAN PTI, except when wlan_pti_mode is set</i>
	Event	Idle	WLAN TX Abort if Channel Overlap & (!pti_enable wlan_pti_mode) <i>- no_sim_tx can't be used, don't know the next BT transfer direction.</i> <i>- no_sim_rx can't be used, don't know the next BT transfer direction.</i>
	TX	TX	WLAN TX Abort if Channel overlap & no_sim_tx.
	TX	RX	WLAN RX Abort if channel overlap
	RX	TX	WLAN TX Abort if Channel overlap.

	RX	RX	WLAN RX Abort if Channel overlap & no_sim_rx.
	Event	TX	WLAN TX Abort if Channel Overlap & (!pti_enable wlan_pti_mode) <i>- no_sim_tx can't be used, don't know the next BT transfer direction.</i>
	Event	RX	WLAN TX Abort if Channel Overlap & (!pti_enable wlan_pti_mode) <i>- no_sim_rx can't be used, don't know the next BT transfer direction.</i>
WLAN	Idle	TX	BT TX Abort if !chan_enable & !pti_enable & no_sim_tx BT RX Abort if !chan_enable & !pti_enable <i>- Channel can't be used, don't know the next BT Channel.</i> <i>- PTI Can't be used, don't know the next BT PTI.</i>
	Idle	RX	BT TX Abort if !chan_enable & !pti_enable BT RX Abort if !chan_enable & !pti_enable & no_sim_rx <i>- Channel can't be used, don't know the next BT Channel.</i> <i>- PTI Can't be used, don't know the next BT PTI.</i>
	Event	TX	BT TX Abort if !chan_enable & !pti_enable & no_sim_tx BT RX Abort if !chan_enable & !pti_enable <i>- Channel can't be used, don't know the next BT Channel.</i> <i>- PTI Can't be used, don't know the next BT PTI.</i>
	Event	RX	BT TX Abort if !chan_enable & !pti_enable BT RX Abort if !chan_enable & !pti_enable & no_sim_rx <i>- Channel can't be used, don't know the next BT Channel.</i> <i>- PTI Can't be used, don't know the next BT PTI.</i>
	TX	TX	BT TX Abort if Channel overlap & no_sim_tx
	TX	RX	BT TX Abort if Channel overlap
	RX	TX	BT RX Abort if Channel overlap
	RX	RX	BT RX Abort if Channel overlap & no_sim_rx

Table 3-2 – Arbitration Table

3.3 Channel Overlap

The channel overlap is used to detected transfers in the same frequency range. The chan_margin register allows to configure the minimum distance between the border of the channels, as defined in the Figure 3-1.

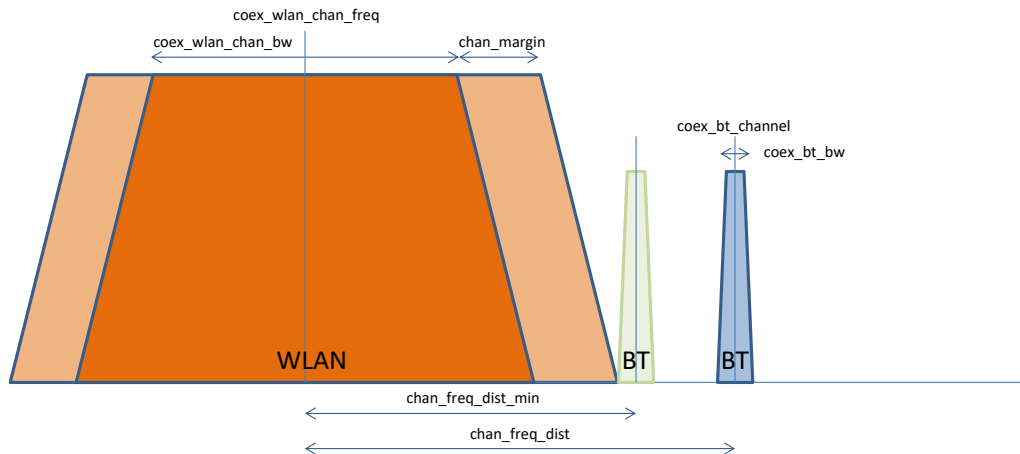


Figure 3-1 – Channel Margin

The Figure 3-2 shows the implementation of the channel overlap detection. The “+2” block is used to convert the BT channel to the BT channel center frequency. These 2 channels frequency are subtracted to determine the channel distance. The “Channel Margin Table” contains the 4 possibilities of channel bandwidth configuration (2 BT bandwidth x 2 WLAN Bandwidth).

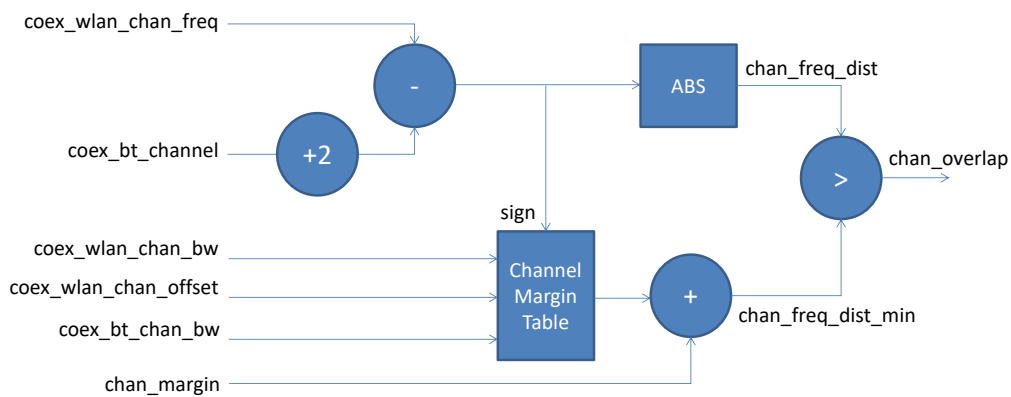


Figure 3-2 – Channel Overlap Block Diagram

As shown in Figure 3-3, the second channel can be placed before or after the WLAN primary channel, defined by the `coex_wlan_chan_offset` signal. Sign is used to determinate the position of the BT channel, and then the margin need between channels in WLAN 40MHz bandwidth.

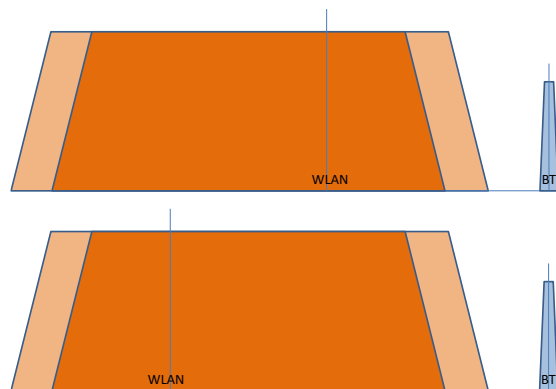


Figure 3-3 – WLAN 40MHz bandwidth

3.4 Registers

The following table summarizes the PTA registers.

Address	Name
0x0000	REVISION
0x0004	CONFIG
0x0008	STAT_BT_TX
0x000C	STAT_BT_TX_ABORT
0x0010	STAT_BT_RX
0x0014	STAT_BT_RX_ABORT
0x0018	STAT_WLAN_TX
0x001C	STAT_WLAN_TX_ABORT
0x0020	STAT_WLAN_RX
0x0024	STAT_WLAN_RX_ABORT

Table 3-3 – PTA Registers

3.4.1 Revision register

Field Name	rw	Bit	Reset	Description
revision	R	31-0	-	RW PTA Revision number

Table 3-4 – REVISION register

3.4.2 Configuration register

Field Name	rw	Bit	Reset	Description
sw_wlan_rx_abort	R/W	19	1'b0	WLAN RX Abort controlled by the software, only when PTA is disabled.
sw_wlan_tx_abort	R/W	18	1'b0	WLAN TX Abort controlled by the software, only when PTA is disabled.
sw_bt_rx_abort	R/W	17	1'b0	BT RX Abort controlled by the software, only when PTA is disabled.
sw_bt_tx_abort	R/W	16	1'b0	BT TX Abort controlled by the software, only when PTA is disabled.
chan_margin	R/W	13-8	6'h0	Channel Margin (0-63MHz) Define the minimum distance between the channels boundary. Used when chan_enable is set.
wlan_pti_mode	R/W	7	1'b0	WLAN PTI Mode 0: WLAN PTI can't be used in IDLE 1: WLAN PTI can be used in IDLE
bt_event_mask	R/W	6	1'b0	BT event mask 0: coex_bt_event is used 1: coex_bt_event is masked
chan_enable	R/W	5	1'b0	Channel Overlap Detection Mode 0: Disable 1: Enable
pti_enable	R/W	4	1'b0	PTI Priority Mode 0: Default Priority is used 1: Packet Traffic Information is used to determinate the priority
no_sim_rx	R/W	3	1'b0	0: Simultaneous Reception are allowed 1: Simultaneous Reception are not allowed
no_sim_tx	R/W	2	1'b0	0: Simultaneous Transmission are allowed 1: Simultaneous Transmission are not allowed
basic_priority	R/W	1	1'b0	Default Priority, used when pti_enable is low or when priority is equal. 0: BT 1: WLAN
pta_enable	R/W	0	1'b0	Enable the Packet Traffic Arbiter

Table 3-5 – CONFIG register

3.4.3 BT Transmit statistic

Field Name	rw	Bit	Reset	Description
stat_bt_tx	R/W	31-0	32'h0	Number of Bluetooth TX Write '0' to clear.

Table 3-6 – STAT_BT_TX register

3.4.4 BT Transmit abort statistic

Field Name	Rw	Bit	Reset	Description
stat_bt_tx_abort	R/W	31-0	32'h0	Number of Bluetooth TX aborted Write '0' to clear.

Table 3-7 – STAT_BT_TX_ABORT register

3.4.5 BT Receive statistic

Field Name	rw	Bit	Reset	Description
stat_bt_rx	R/W	31-0	32'h0	Number of Bluetooth RX Write '0' to clear.

Table 3-8 – STAT_BT_RX register

3.4.6 BT Receive abort statistic

Field Name	Rw	Bit	Reset	Description
stat_bt_rx_abort	R/W	31-0	32'h0	Number of Bluetooth RX aborted Write '0' to clear.

Table 3-9 – STAT_BT_RX_ABORT register

3.4.7 WLAN Transmit statistic

Field Name	rw	Bit	Reset	Description
stat_wlan_tx	R/W	31-0	32'h0	Number of WLAN TX Write '0' to clear.

Table 3-10 – STAT_WLAN_TX register

3.4.8 WLAN Transmit abort statistic

Field Name	Rw	Bit	Reset	Description
stat_wlan_tx_abort	R/W	31-0	32'h0	Number of WLAN TX aborted Write '0' to clear.

Table 3-11 – STAT_WLAN_TX_ABORT register

3.4.9 WLAN Receive statistic

Field Name	rw	Bit	Reset	Description
stat_wlan_rx	R/W	31-0	32'h0	Number of WLAN RX Write '0' to clear.

Table 3-12 – STAT_WLAN_RX register



3.4.10 WLAN Receive abort statistic

Field Name	Rw	Bit	Reset	Description
stat_wlan_rx_abort	R/W	31-0	32'h0	Number of WLAN RX aborted Write '0' to clear.

Table 3-13 – STAT_WLAN_RX_ABORT register