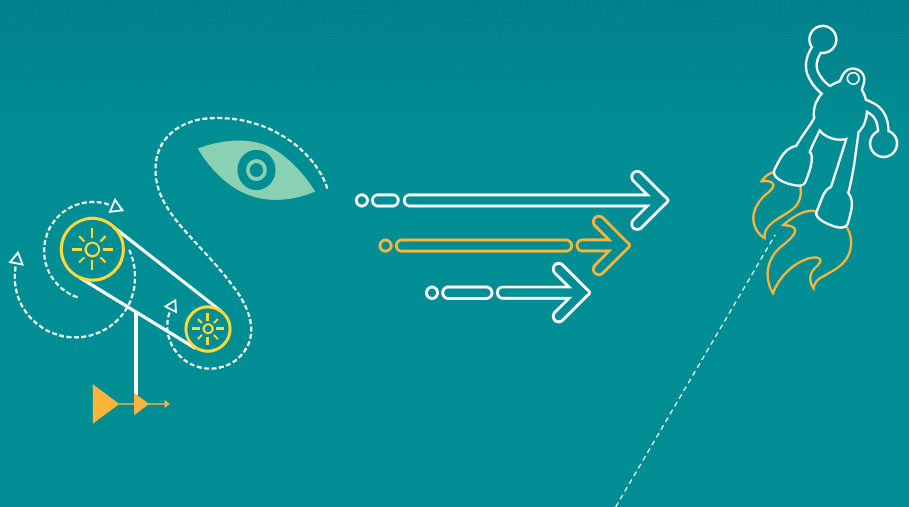
MPSS.JO.1.0 RF Frontend Software Overview

Qualcomm Technologies, Inc.



80-NT093-16 A

Qualcomm Technologies, Inc.
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Revision History

Revision	Date	Description
A	Feb 2015	Initial release

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- MSM8909 Overview
- MPSS.JO.1.0 (JO.1.0) RF Cards and RFFE Design Overview
- JO.1.0 RFC Overview
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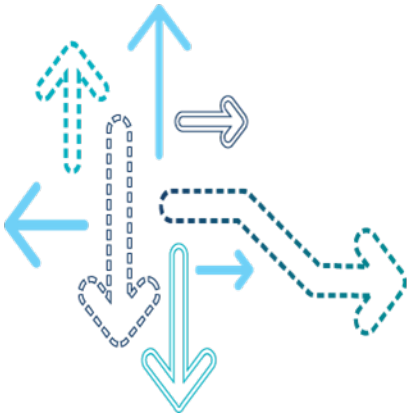
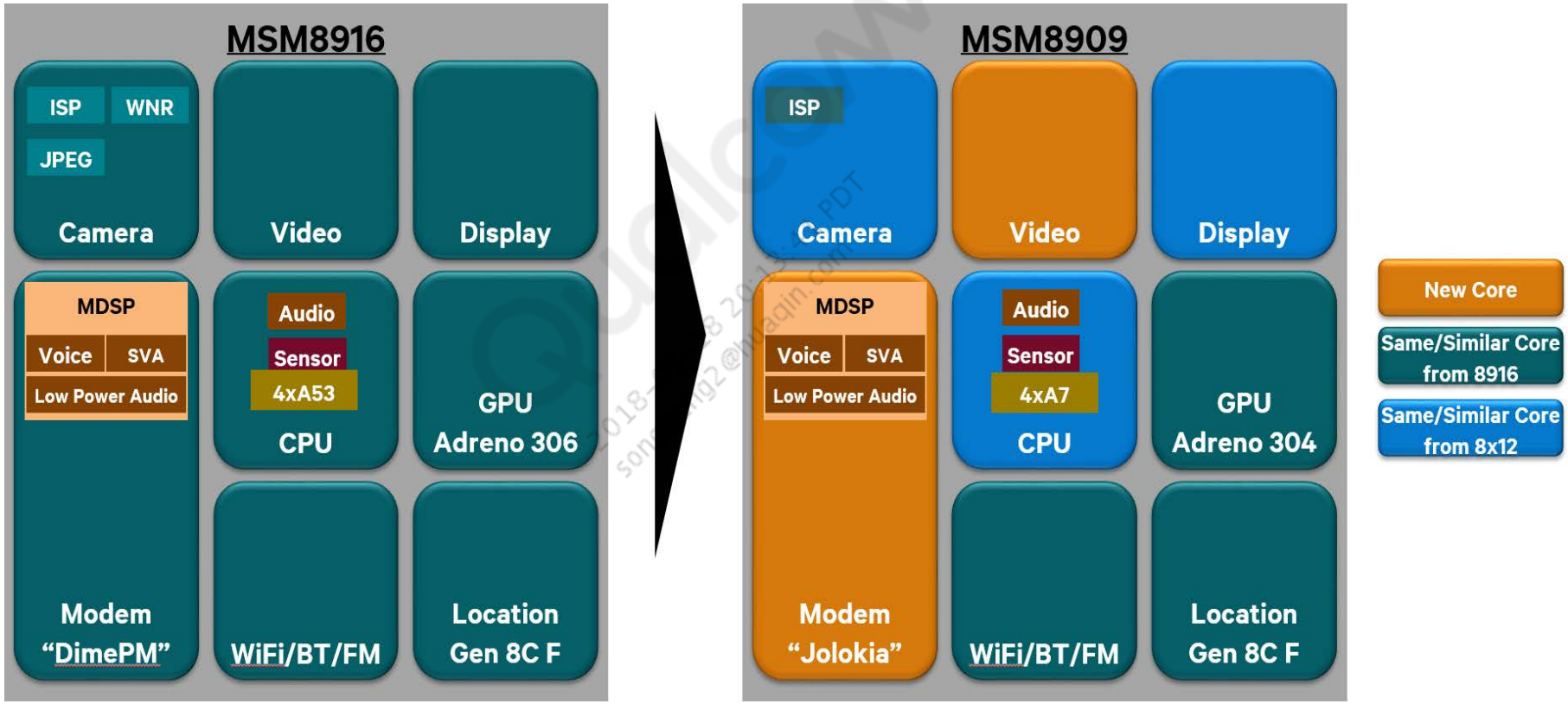
- References
- Questions?

MSM8909 Overview



MSM8916/MSM8909



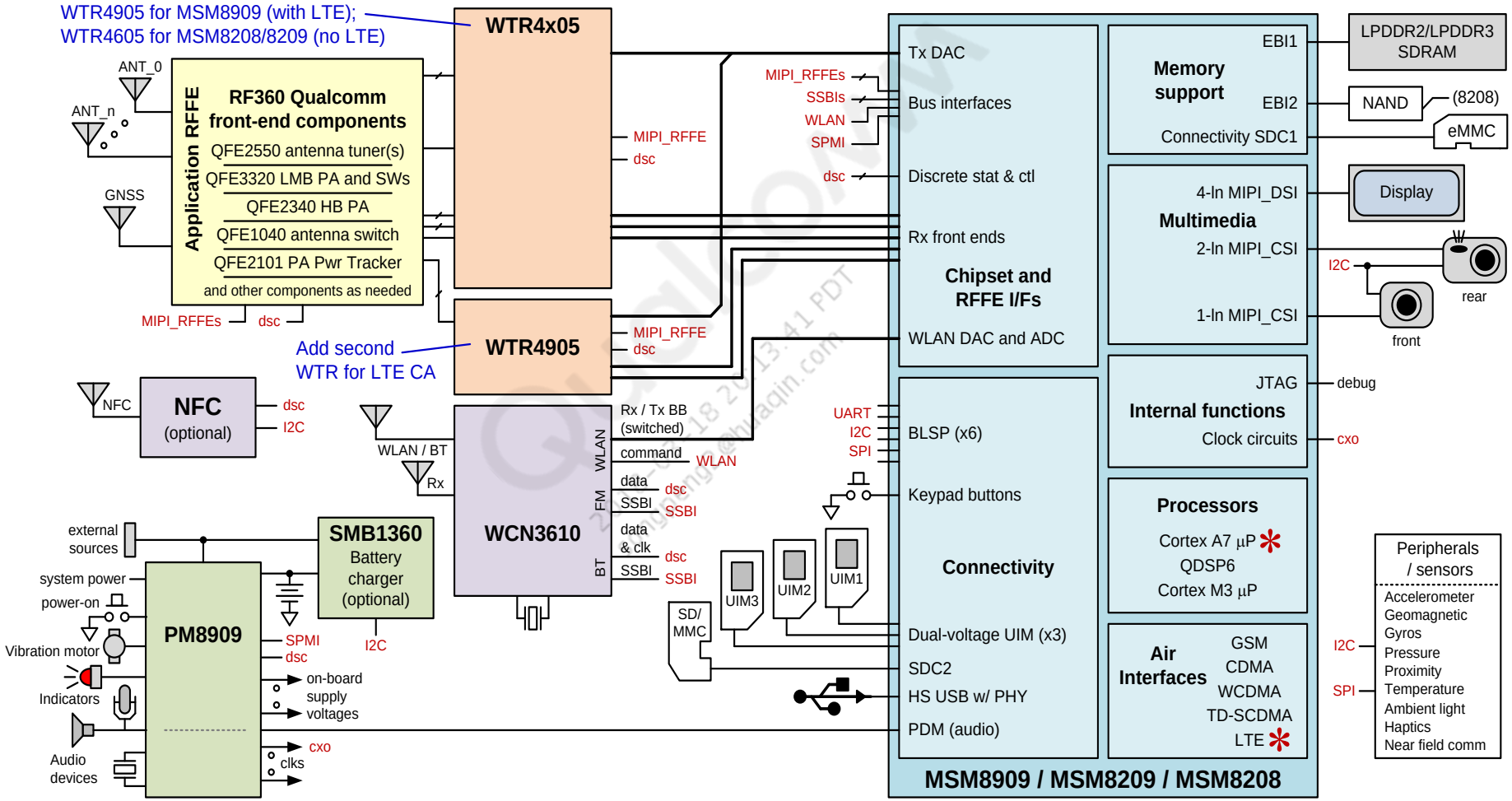
MSM8909 Feature Set

	MSM8909
Process technology	28 nm
Package	12 mm x 11.1 mm non-PoP
CPU	Quad Core ARM A7 upto 1.1 GHz
Memory	1x533 MHz LPDDR2/3 eMCP and nMCP memory packages
Modem	"Jolokia" modem LTE Cat 4, 2x10 MHz CA, HSPA+ 42/11, 1xAdv, DOrA, TD-SCDMA, DSDS
RF	WTR4905/WTR4605
PMIC	PM8909
Application DSP	Shared with Modem QDSP6
Bluetooth/WLAN/FM	WCN3610
USB/Miscellaneous	1xUSB2.0

MSM8909 Feature Set (cont.)

		MSM8909
Graphics	GPU	Adreno 304 @ 400 MHz
	APIs	OpenGL ES 1.1/2.0/3.0, OpenCL1.1e, DX9.3
Display	Resolution	HD 720p @ 60 fps performance
	Interface	1xDSI 4-lane
Camera	Performance	Single ISP, 8 MP
	Interface	1X CSI: 2+1 lane, 1.5 Gbps/lane
Video	Decode	1080p30: HEVC/H.264/MP4/DivX/VP8 WVGA30: H.263
	Encode	720p30:H.264 WVGA30: VP8/MP4
Audio	Analog	Integrated Codec; I2S
	Audio	HD Audio; 16 bit/48 kHz; SVA; Snapdragon Audio+
	Voice	Fluence™; Snapdragon Voice+
Location		Gen 8C feather (GPS, Galileo, Glonass and BeiDou)

MSM8909 Block Diagram



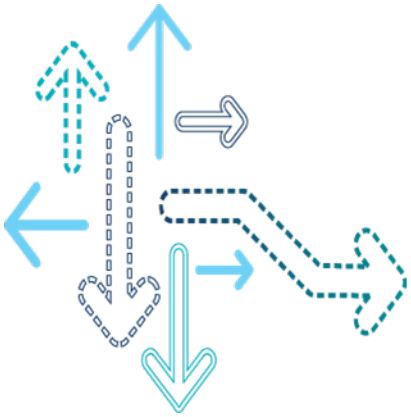
*	Cortex A7 µP	LTE
MSM8208	dual	—
MSM8209	quad	—
MSM8909	quad	X

RF Features

- Rx SAW-less for GSM and TDSCDMA
- ASDiv
- No Tx SAW required for majority of bands
- Support for intra and inter-band CA
- Support for APT, APT+DPD (No ET support)
- MSM8909 LA 1.0 supports WTR4905 RFIC
- MSM8909 LA 1.1 supports WTR4905 and WTR4605 RFIC
- Supports Qualcomm RF360 Front-End
  - QFE2340/QFE2320/QFE3320/QFE1040 Power Amplifiers/ASM (PA/ASM)
  - QFE2520/QFE2550 antenna tuners
  - QFE2101 Power Amplifier Power Management (PAPM)
- Mobile Industry Processor Interface (MIPI) RF Front-End (RFFE) interface support
  - 5 MIPI RFFE buses

Note: No support for SVLTE, SGLTE, SGTDS and DSDA

MPSS.JO.1.0 (JO.1.0) RF Cards and RFFE Design Overview



WTR4905 RF Card List

- MSM8909 LA 1.0

RF Card – MTP	Hardware ID	Available time	Reference schematic
RFC_WTR4905_CHILE_SRLTE_V2	32	Available in current software	80-NL713-48

Note: For the designs which need to use other RF cards, refer MSM8909 LA 1.1 baseline

WTR4905 RF Card List (cont.)

- MSM8909 LA 1.1

RF Card – MTP	Hardware ID	Available time	Reference schematic
RFC_WTR4905_CHILE_SRLTE_V2	32	Available in current software	80-NL713-48
RFC_WTR4905_NON_CA	31	MPSS FC Jan end	80-NL713-43
RFC_WTR4905_JAPAN_V2	37	MPSS FC Jan end	80-NL713-46
RFC_WTR4905_NA_DLCA	190	MPSS FC Jan end	80-NL713-49
RFC_WTR4905_CHILE_3G	43	MPSS FC Jan end	TBD

- For GSM/TD-SCDMA Sawless Rx design, refer to CHINA_CMCC_3M QRD card

RF Card – QRD	Hardware ID
RFC_WTR4905_CHINA_CMCC_3M	56
RFC_WTR4905_CHINA_CU_4M	57
RFC_WTR4905_CHINA_CT_4M	58
RFC_WTR4905_AMX	59
RFC_WTR4905_OM	60

RFC_WTR4905_CHILE_SRLTE_V2

- Supported band
  - GSM – G850, G900, G1800, G1900, GSM
  - CDMA – BC0, BC1, BC6
  - WCDMA – B1, B2, B3, B4, B5, B8
  - LTE – B1, B2, B3, B4, B5, B7, B8, B17, B20, B26, B28, B38, B39, B40, B41
  - TDSCDMA – B34, B39
- QFE devices
  - QFE2101, QFE2340, QFE2320, QFE2520
- Features
  - GSM diversity

RFC_WTR4905_NON_CA

- Supported band
  - GSM – G850, G900, G1800, G1900
  - CDMA – BC0
  - WCDMA – B1, B2, B5, B8
  - LTE – B1, B3, B4, B7, B17, B20, B26, B28, B38, B39, B40, B41
  - TDSCDMA – B34, B39
- QFE devices
  - QFE2101, QFE2340, QFE3320, QFE2550

RFC_WTR4905_JAPAN_V2

- Supported band
  - GSM – G850, G900, G1800, G1900
  - CDMA – BC0, BC1, BC6, BC10
  - WCDMA – B1, B2, B3, B5, B6, B8, B9, B11, B19
  - LTE – B1, B2, B3, B5, B8, B9, B11, B18, B19, B21, B25, B26, B28, B41
- QFE devices
  - QFE2101, QFE3320, QFE2520
- Features
  - GSM diversity

RFC_WTR4905_NA_DLCA

- **2DLCA RF card using 2*WTR4905**
- Supported band
  - GSM – G850, G900, G1800, G1900
  - CDMA – BC0, BC1, BC6, BC10, BC15
  - WCDMA – B1, B2, B4, B5, B8
  - LTE – B1, B2, B4, B5, B7, B8, B10, B12, B13, B17, B23, B25, B26, B29, B30, B41
- Supported CA
  - 12+30, 17+30, 2+13, 2+17, 2+29, 2+30, 2+4, 4+12, 4+13, 4+17, 4+29, 4+30, 4+5, 5+30
- QFE devices
  - QFE2101, QFE3320, QFE2340, QFE2550, QFE1040
- Features
  - 2DLCA

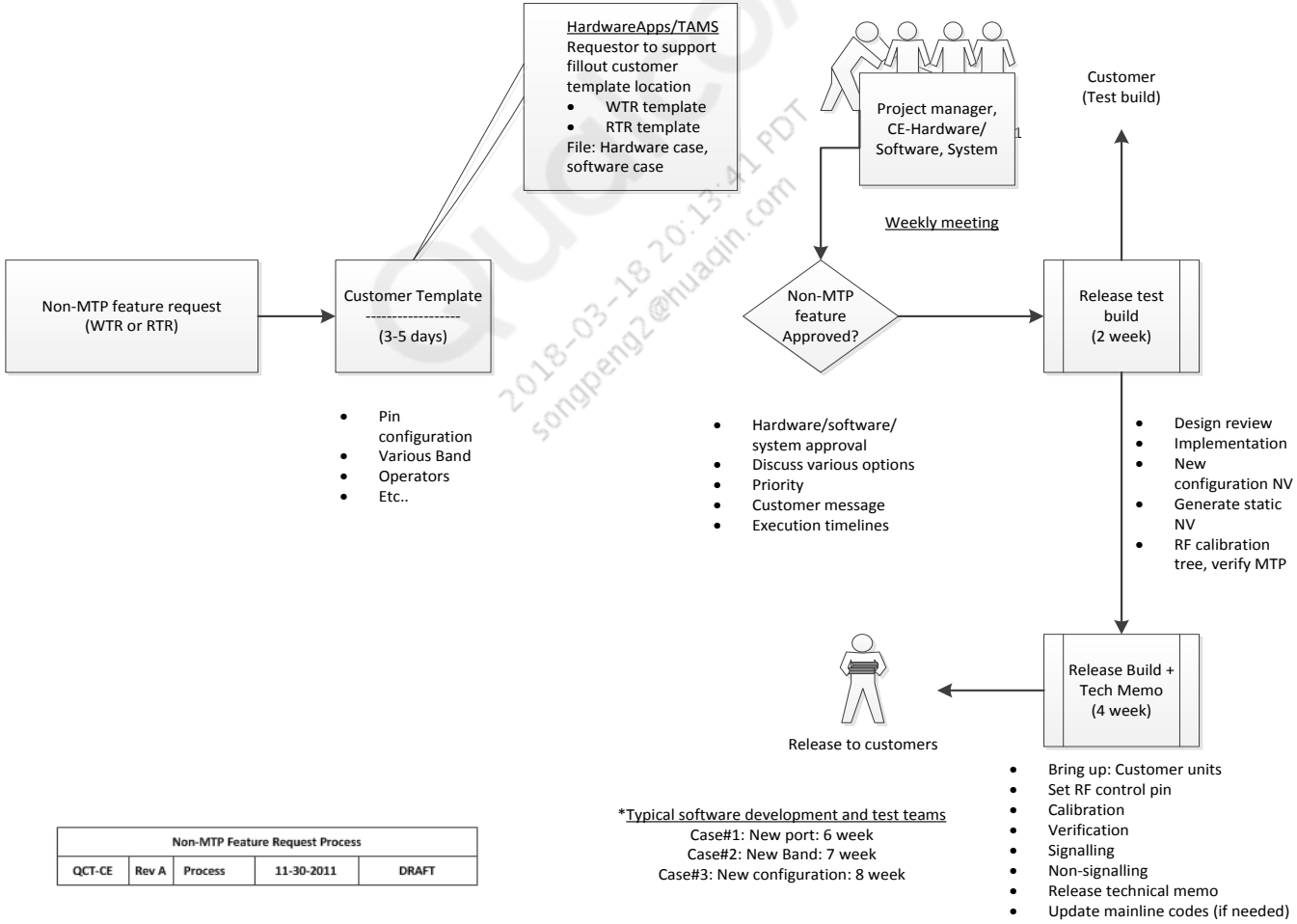
RFC_WTR4605_CHILE_3G

- **WTR4605 RF card**
- Supported band
  - GSM – G850, G900, G1800, G1900, GSM
  - CDMA – BC0, BC1, BC6
  - WCDMA – B1, B2, B3, B4, B5, B8
  - TDSCDMA – B34, B39
- QFE devices
  - QFE2101, QFE2320, QFE2520
- Features
  - WTR4905 for 3G-only
  - GSM diversity

Note: WTR4905 is enabled for 3G only, and is not enabled for LTE.

Non-POR Overview

- The RF cards listed in previous slides are Plan of Record (POR). For customer who does not use those cards needs non-POR support.
- Non-POR feature request process as shown below:



Non-POR Customer Information Template

- Project information
  - Base RF card
  - Supported carrier and bands
- Port-mapping
- GPIO table
- RFFE device list

Non-POR Customer Information Template (cont.)

General Information	
Based RF Card	
Supported bands	
Design review case #	
SW baseline	
Project plan	

Signal Name	Function	GPIO#	GRFC#
PA_ON0			
PA_ON1			
PA_ON2			
PA_ON3			
PA_ON4			
PA_ON5			
RF_ON0			
RF_ON1			
RX_ON0			
RX_ON1			
PA0_RANGE0			
PA0_RANGE1			
PA1_RANGE0			
PA1_RANGE1			
ANT_SW_SEL4			
BC1_SW_SEL1			
DRX_SWITCH_SEL0			
DRX_SWITCH_SEL1			
PRX_SWITCH_SEL0			
PRX_SWITCH_SEL1			
1X_MRD_BC0_BC1			
1X_MRD_IQ_SWSEL			
TX_GTR_THRES			
PA_INDICATOR			
GSM_TX_PHASE_D[0]			
GSM_TX_PHASE_D[1]			
GSM_TX_PHASE_D[2]			
LTE_ACTIVE			
LTE_SYNC			
WCN_PRIORITY			
SSBI1_RTR0			
SSBI2_RTR0			
SSBI1_RTR1			
SSBI2_RTR1			
RFFE1_CLK			
RFFE1_DATA			
RFFE2_CLK			
RFFE2_DATA			
HSIC_STROBE			
HSIC_DATA			
GPS_EXT_LNA_EN			
GPS_TX_AGGRESSOR			

RF port	Non-POR						<- Supported bands
	G	C	W	L	TDS	TD-LTE	
TX_DA1							
TX_DA2							
TX_DA3							
TX_DA4							
TX_DA5							
PRX_LB1							
PRX_LB2							
PRX_LB3							
PRX_MB1							
PRX_MB2							
PRX_MB3							
PRX_HB1							
PRX_HB2							
DRX_LB1							
DRX_LB2							
DRX_LB3							
DRX_MB1							
DRX_MB2							
DRX_HB1							
DRX_HB2							

RX0	MIPI/GRFC	Manufacturer	Part Number	CHANNEL	PID	MID	USID
ASM							
TUNER							

RX1	MIPI/GRFC	Manufacturer	Part Number	CHANNEL	PID	MID	USID
ASM							
TUNER							

TX0	MIPI/GRFC	Manufacturer	Part Number	CHANNEL	PID	MID	USID
HCPA							
PAPM							
ASM							
HDET							
THERM							

TX0	MIPI/GRFC	Manufacturer	Part Number	CHANNEL	PID	MID	USID
HCPA							
PAPM							
ASM							
HDET							
THERM							

Non-POR Application Note

- Port-mapping changes
- Static NV file changes
- Calibration sequence changes

Non-POR Application Note (cont.)

Qualcomm
TECHNOLOGIES, INC

8CH_BC1_0019 MSM8909+WTR4905 Add CDMA BC1 to CHINA

Application Note

80-NR417-1 A

November 12, 2014

Submit technical questions at:
https://support.cdmatech.com/

2.3 Code changes

If you are viewing this document using a color monitor, or if you print this document to a color printer, **red boldface** indicates code that is to be **added**, and ~~blue strikethrough~~ indicates code that is to be replaced or removed.

2.3.1 Add CDMA BC1 port configurations

File: rfc_wtr4905_china_cdma_config_data_ag.c

Add the following code in the file to map the ports:

```
rfc_device_info_type rf_card_wtr4905_china_rx0_cdma_bc1_device_info =
{
  0x04100225,   /* Revision: v4.16.549 */
  RFC_RX_MODEM_CHAIN_0,   /* Modem Chain */
  0 /* Warning: Not Specified */,   /* ET Modem Chain */
  0,   /* NV Container */
  RFC_INVALID_PARAM /* Warning: Not Specified */,   /* Antenna */
  /*NUM*/,  /* NUM_DEVICES_TO_CONFIGURE */
```

2.1 Port mapping

The new design (non-POR) is based on the CHINA configuration (shown on the left side of Table 2-1).

Table 2-1 Port mapping comparison

RF port	WTR4905_CHINA						Non-POR				
	QB	0	1,2,4,5,8	1,2,3,4,5,7,8,17,20,26,27,28	34,39	38,39,40,41	QB	0, 1	1,2,4,5,8	1,2,3,4,5,7,8,17,20,28	38,40,41
	G	C	W	L	TDS	TD-LTE	G	C	W	L	TD-LTE
TX_DA1	1800,1900		1,2,4	1,2,3,4	34,39	39	1800,1900	1	1,2,4	1,2,3,4	
TX_DA2	850,900	0	5,8	5,8,20,26,27			850,900	0	5,8	5,8,20	
TX_DA3				7		38,40,41				7	38,40,41
TX_DA4				17,28						17,28	
TX_DA5											
PRX_LB1				17,20,28						17,20,28	
PRX_LB2	900		8	8			900		8	8	
PRX_LB3	850	0	5	5,26,27			850	0	5	5	
PRX_MB1					34,39	39					
PRX_MB2			1,4	1,4					1,4	1,4	
PRX_MB3	1800,1900		2	2,3			1800,1900	1	2	2,3	
PRX_HB1						40					40
PRX_HB2				7		38,41				7	38,41
DRX_LB1				17d,20d,28d						17d,20d,28d	
DRX_LB2		0d	5d	5d,26d,27d				0d	5d	5d	
DRX_LB3			8d	8d					8d	8d	
DRX_MB1			1d,4d	1d,4d					1d,4d	1d,4d	
DRX_MB2			2d	2d,3d	34d,39d	39d		1d	2d	2d,3d	
DRX_HB1						40d					40d
DRX_HB2				7d		38d,41d				7d	38d,41d

2.4 Static NV items

The following NV items/files must be modified to include CDMA BC1.

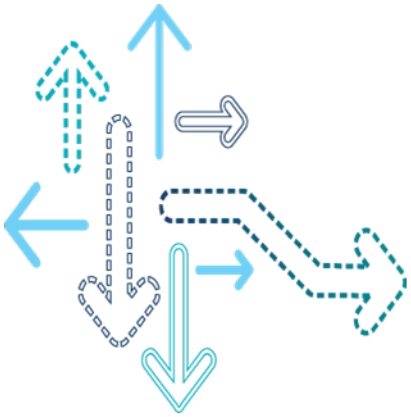
2.4.1 Make changes in masterfile to add CDMA BC1 support

2.5 Modify test tree (.xtt) for calibration using QSPR

Use QSPR to add CDMA BC1 into the test tree. To copy files using QSPR, right-click the selected nodes and select **Copy**. To paste files using QSPR, right-click the node in the CDMA section and select **Paste**.

1. To add CDMA BC1 into the CH calibration tree, copy the selected nodes from the calibration tree of the JAP configuration:

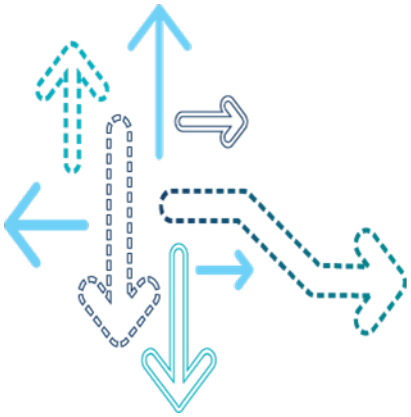
JO.1.0 RFC Overview



RFC Overview

- RFC contains hardware information which the RF driver uses to configure.
- RFC queries different RF devices configured
  - MIPI RFFE components, such as WTR, Antenna Switch (ASM), Power Amplifier (PA), are detected during RF initialization.
  - The RF driver reprograms USIDs of all MIPI devices based on RFC setting.
  - WTR and RFFE devices are then assigned to the respective Tx/Rx (primary and diversity) paths.
- RFC must accurately represent the design, which includes:
  - Bands supported
  - WTR port mapping
  - MIPI devices present
  - Supported GRFC signals

JO.1.0 RFC Structure



RFC Folder Structure

Source	Folder location	Note
Target-specific GPIO/GRFC table and chain definitions	\modem_proc\rfc_jolokia\target	List of all RF GPIOs
RF card files	\modem_proc\rfc_jolokia\rf_card	Design-specific RFFE settings
Static XML files/RF calibration XTTs	\modem_proc\rftarget_jolokia	Static QCN and calibration trees
Transceiver devices	\modem_proc\rfdevice_WTR4905	WTR settings
QFE devices	\modem_proc\rfdevice_QFE2101	PAPM
	\modem_proc\rfdevice_QFE2520	Antenna tuner
	\modem_proc\rfdevice_QFE2550	Antenna tuner
	\modem_proc\rfdevice_QFE2340	High-band PA
	\modem_proc\rfdevice_QFE3320 \modem_proc\rfdevice_QFE2320	Mid/low-band PA module
	\modem_proc\rfdevice_QFE1040	Diversity ASM

RFC Folder Structure (cont.)

- RFC target folder
  - MSM8909 specific GRFC/GPIO definitions can be found in \modem_proc\rfc_jolokia\target\msm8909\src\rfc_msm_signal_info_ag.c file.
  - General RF Controls (GRFC) – These are digital control signals that be controlled with precise timing.
  - More information on how to configure GRFCs' for RF purposes can be found in App Note 80-NE606-4
- RF card folder
  - The RF card folder houses the RF card configuration settings for different RF cards.
  - Each RF card has multiple sub-folders' which are used to configure the different physical/logical devices used and also the different RATs' for both Tx and Rx path.

RFC Folder Structure (cont.)

- RF card common file
  - The RF card common file contains the device's RF configuration. This includes the physical device list, logical device list, the GRFC signals that are used for this RF card etc.
  - This file must accurately capture only the RF devices used in the design. All unused device settings must be removed from this file.
  - This file also captures each RF device's physical path on the MIPI RFFE bus.
    - RFFE is a serial bus to interface RF components following the MIPI standard.
    - The MSM8909 modem supports five RFFE channels.
    - Multiple peripherals may be connected to each bus
    - Devices should meet requirements in RFFE Vendor Specification (80-N7876-1).

RFC Folder Structure - RF Card Common File

- RF card common file
  - Following is a snippet of code from the RF card common file of RFC_WTR4905_NON_CA RF card

```
rfc_phy_device_info_type rfc_wtr4905_non_ca_phy_devices_list[] =
{
//Snip

  { /*Device: WTR4905 */
    WTR4905, /* PHY_DEVICE_NAME */
    0, /* PHY_DEVICE_INSTANCE */
    RFC_NO_ALTERNATE_PART, /* PHY_DEVICE_ALT_PART_NUM_OF_INSTANCE */
    RFDEVICE_COMM_PROTO_RFFE, /* PHY_DEVICE_COMM_PROTOCOL */
    {    4,0 /* 0 not specified */,}, /* PHY_DEVICE_COMM_BUS */
    0x217, /* PHY_DEVICE_MANUFACTURER_ID */
    0xC8, /* PHY_DEVICE_PRODUCT_ID */
    0, /* PHY_DEVICE_PRODUCT_REV */
    0x1, /* DEFAULT USID RANGE START */
    0x1, /* DEFAULT USID RANGE END */
    0x1, /* PHY_DEVICE_ASSIGNED_USID */
    0 /*Warning: Not specified*/, /* RFFE_GROUP_ID */
    FALSE, /* INIT */
    RFC_TX_MODEM_CHAIN_0, /* ASSOCIATED_DAC */
  }, /* END - Device: WTR4905 */

  //Snip
```

The RFFE channel corresponding to each device is defined when defining the physical devices in RF card common file.

Note: Parameter PHY_DEVICE_COMM_BUS defines the serial BUS on which the physical device is present.

For example, from the above code snippet WTR is seen on BUS 4, with the associated RFFE5_CLK and RFFE5_DATA lines.

Note: For more details on how to define other physical and logical MIPI devices, refer to App Notes *Third-Party MIPI PA Customization (80-NE606-3) (PA)* and Third-Party MIPI ASM Customization (80-NE606-2) (ASM) respectively.

RFC Folder Structure - RF Card Common File (cont.)

- Physical device list and Logical device list MSM8909/MSM8209/MSM8208 Digital Baseband (80-NP408-5B)
  - Multiple logical components within a single chip are used in the hardware design. These devices usually use a single MIPI digital communication core but have multiple functions, for example, QFE2340 contains PA and ASM.
  - Prior to this change, multiple device type instances were created in cmn_devices_list to support a single physical MIPI device, for example, QFE2340 needs the following devices in rfc_<rf_card>_cmn_devices_list:
    - PA instance 0 to support PA module inside of QFE2340
    - ASM instance 0 to support ASM module inside of QFE2340

```
{ /*Device: QFE2340 */
  RFDEVICE_PA, /* DEVICE_TYPE */
  QFE2340, /* DEVICE_NAME */
  0, /* DEVICE_TYPE_INSTANCE */
  RFDEVICE_COMM_PROTO_RFFE, /* DI
  {     0,0 /* 0 not specified */,}, .
  0x0217, /* MANUFACTURER_ID */
  0x21, /* PRODUCT_ID */
  0, /* PRODUCT_REV */
  0x0F, /* DEFAULT USID RANGE STA
  0x0F, /* DEFAULT USID RANGE ENI
  0x0F, /* ASSIGNED_USID */
  0x0F, /* RFFE_GROUP_ID */
  FALSE, /* INIT */
  RFC_INVALID_PARAM, /* ASSOCIAT
  RFDEVICE_TYPE_INVALID, /* ASSO
  0 /*Warning: Not specified*/, /* A
}, /* END - Device: QFE2340 */
```

```
{ /*Device: QFE2340 */
  RFDEVICE_ASM, /* DEVICE_TYPE */
  QFE2340, /* DEVICE_NAME */
  0, /* DEVICE_TYPE_INSTANCE */
  RFDEVICE_COMM_PROTO_RFFE, /* DEV
  {     0,0 /* 0 not specified */,}, /*
  0x0217, /* MANUFACTURER_ID */
  0x21, /* PRODUCT_ID */
  0, /* PRODUCT_REV */
  0x0F, /* DEFAULT USID RANGE STAR
  0x0F, /* DEFAULT USID RANGE END
  0x0F, /* ASSIGNED_USID */
  0x0F, /* RFFE_GROUP_ID */
  FALSE, /* INIT */
  RFC_INVALID_PARAM, /* ASSOCIATE
  RFDEVICE_PA, /* ASSOCIATED_DEVI
  0, /* ASSOCIATED_DEVICE_TYPE_IN
}, /* END - Device: QFE2340 */
```

RFC Folder Structure - RF Card Common File (cont.)

- MIPI device configuration must be listed in both PA and ASM instances. This requires additional effort to maintain the RFC code. Additionally, in the old method, self-calibration and functions related to the physical device have to be executed for each logical device, which is redundant.
- To optimize the efficiency of RFC code, physical and logical device lists are added into the RFC code structure to separate the concept of physical devices and logical devices.

Physical Device

```
{ /*Device: QFE2340 */
  QFE2340, /* PHY_DEVICE_NAME */
  2, /* PHY_DEVICE_INSTANCE */
  RFC_NO_ALTERNATE_PART, /* PHY_DEVICE_ALT_PART_NUM_OF_INSTANCE */
  RFDEVICE_COMM_PROTO_RFFE, /* PHY_DEVICE_COMM_PROTOCOL */
  {     0,0 /* 0 not specified */,}, /* PHY_DEVICE_COMM_BUS */
  0x0217, /* PHY_DEVICE_MANUFACTURER_ID */
  0x21, /* PHY_DEVICE_PRODUCT_ID */
  0, /* PHY_DEVICE_PRODUCT_REV */
  0x0F, /* DEFAULT USID RANGE START */
  0x0F, /* DEFAULT USID RANGE END */
  0x0F, /* PHY_DEVICE_ASSIGNED_USID */
  0 /*Warning: Not specified*/, /* RFFE_GROUP_ID */
  FALSE, /* INIT */
  RFC_INVALID_PARAM, /* ASSOCIATED_DAC */
}, /* END - Device: QFE2340 */
```

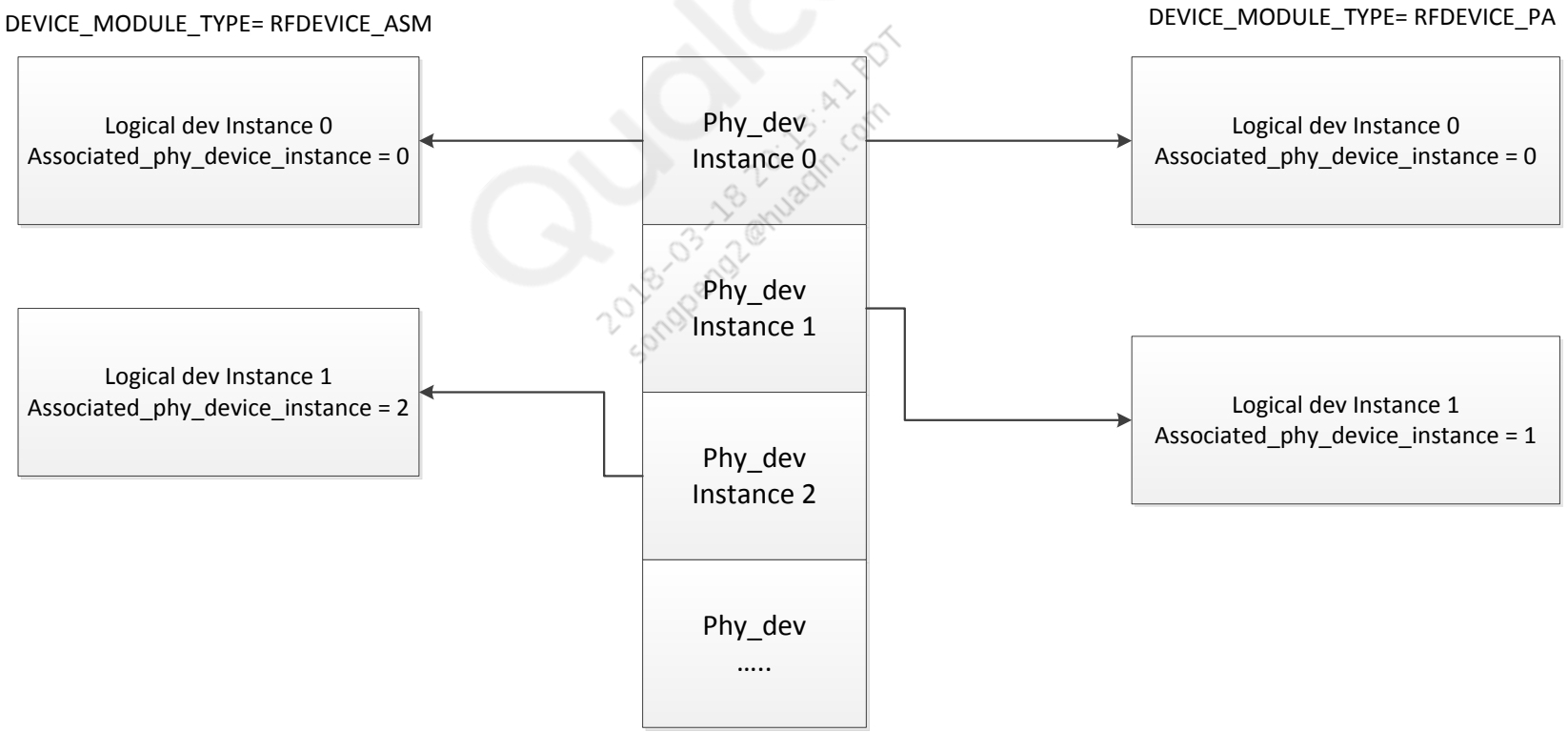
Logical Devices

```
{ /*Device: QFE2340 */
  RFDEVICE_PA, /* DEVICE_MODULE_TYPE */
  QFE2340, /* DEVICE_MODULE_NAME */
  0, /* DEVICE_MODULE_TYPE_INSTANCE */
  2, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE2340 */
```

```
{ /*Device: QFE2340 */
  RFDEVICE_ASM, /* DEVICE_MODULE_TYPE */
  QFE2340, /* DEVICE_MODULE_NAME */
  3, /* DEVICE_MODULE_TYPE_INSTANCE */
  2, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE2340 */
```


RFC Folder Structure - RF Card Common File (cont.)

- Association between Physical and Logical Device Lists *MSM8909/MSM8209/MSM8208 Digital Baseband* (80-NP408-5B)
  - One physical device can be associated with one or more logical devices based on functionality.



RFC Folder Structure

- RF card files
  - Each RAT has its own sub-folder where the corresponding configuration for that particular RAT is defined.
  - These files are used to configure the Tx/Rx path for each technology/bands.
  - The configuration settings involve defining the different MIPI devices that are used for the particular technology/band and also configuring the device port settings.
  - For example, consider LTE B1 Tx/Rx settings.
    - Since the technology is LTE, the settings corresponding to LTE RAT can be found in the file <rfcard>_lte_config_data_ag.c under \modem_proc\rfc_jolokia\rf_card\<rfcard>\lte\src folder.
    - The MIPI RFFE device settings corresponding to LTE B1 for PRx are configured in rf_card_<rfcard>_rx0_lte_b1_device_info
    - The GRFC settings corresponding to LTE B1 in PRx are configured in rf_card_<rfcard>_rx0_lte_b1_sig_cfg
    - Similarly, MIPI RFFE device settings corresponding to LTE B1 DRx are configured in rf_card_<rfcard>_rx1_lte_b1_device_info
    - The GRFC settings corresponding to LTE B1 in DRx are configured in rf_card_<rfcard>_rx1_lte_b1_sig_cfg
    - The Tx path is similarly configured based on rf_card_<rfcard>_tx0_lte_b1_device_info and rf_card_<rfcard>_tx0_lte_b1_sig_cfg respectively.

RFC Folder Structure - RF Card Files

- Example code snippet for LTE B1 Tx0 settings for RF card RFC_WTR4905_NON_CA

```
rfc_device_info_type rf_card_wtr4905_non_ca_tx0_lte_b1_device_info =
{
  RFC_ENCODED_REVISION,
  RFC_TX_MODEM_CHAIN_0,   /* Modem Chain */
  0 /* Warning: Not Specified */,   /* FBRx ADC for Tx States */
  0,   /* NV Container */
  RFC_INVALID_PARAM /* Warning: Not Specified */,   /* Antenna */
  7,  /* NUM_DEVICES_TO_CONFIGURE */
  {
    {
      RFDEVICE_TRANSCEIVER,
      WTR4905,  /* NAME */
      0,  /* DEVICE_MODULE_TYPE_INSTANCE */
      0,  /* PHY_PATH_NUM */
      {
        0 /*Warning: Not specified*/,  /* INTF_REV */
        (int)WTR4905_LTEFDD_TX_BAND1_THMLB1,  /* PORT */
        ( RFDEVICE_PA_LUT_MAPPING_VALID | WTR4905_LP_LUT_TYPE << RFDEVICE_PA_STATE_0_BSHFT | WTR4905_HP_LUT_T
        FALSE,  /* TXAGC_LUT */
        WTR4905_FBRX_LOW_ATTN_MODE,  /* FBRX_ATTN_STATE */
        0,  /* Array Filler */
      },
    },
    {
      RFDEVICE_PA,
      QFE3320_EPT,  /* NAME */
      1,  /* DEVICE_MODULE_TYPE_INSTANCE */
      0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
      {
        0  /* Orig setting: */,  /* INTF_REV */
        (0x0217 << 22)/*mfg_id*/ | (0x26 << 14)/*prd_id*/ | (28)/*port_num*/,  /* PORT_NUM */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
      },
    },
    {
      RFDEVICE_PAPM,
      QFE2101,  /* NAME */
      0,  /* DEVICE_MODULE_TYPE_INSTANCE */
      0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
      {
        0  /* Orig setting: */,  /* INTF_REV */
        (0x217 << 22)/*mfg_id*/ | (0x31 << 14)/*prd_id*/ | (9)/*port_num*/,  /* PORT_NUM */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
      },
    },
    {
      RFDEVICE_ASM,
      QFE3320_TX,  /* NAME */
      0,  /* DEVICE_MODULE_TYPE_INSTANCE */
      0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
      {
        0  /* Orig setting: */,  /* INTF_REV */
        (0x0217 << 22)/*mfg_id*/ | (0x26 << 14)/*prd_id*/ | (17)/*port_num*/,  /* PORT_NUM */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
      },
    {
      RFDEVICE_ASM,
      QFE3320_MB,  /* NAME */
      2,  /* DEVICE_MODULE_TYPE_INSTANCE */
      0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
      {
        0  /* Orig setting: */,  /* INTF_REV */
        (0x0217 << 22)/*mfg_id*/ | (0x26 << 14)/*prd_id*/ | (5)/*port_num*/,  /* PORT_NUM */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
      },
    },
    {
      RFDEVICE_HDET,
      TRX_HDET,  /* NAME */
      0,  /* DEVICE_MODULE_TYPE_INSTANCE */
      0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
      {
        0  /* Orig setting: */,  /* INTF_REV */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
      },
    },
    {
      RFDEVICE_TUNER,
      QFE2550,  /* NAME */
      0,  /* DEVICE_MODULE_TYPE_INSTANCE */
      0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
      {
        0  /* Orig setting: */,  /* INTF_REV */
        0  /* Orig setting: */,  /* DISTORION_CONFIG */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
        0,  /* Array Filler */
      },
    },
  },
};

rfc_sig_info_type rf_card_wtr4905_non_ca_tx0_lte_b1_sig_cfg =
{
  RFC_ENCODED_REVISION,
  {
    { (int)RFC_WTR4905_NON_CA_TX_GTR_TH,   { RFC_CONFIG_ONLY, 0 }, {RFC_LOW, 0 }  },
    { (int)RFC_SIG_LIST_END,   { RFC_LOW, 0 }, {RFC_LOW, 0 } }
  },
};
```


RFC Folder Structure - RF Card Files (cont.)

- As shown in the previous code snippet, define all the devices used and their corresponding port settings for LTE B1 Tx path in rf_card_wtr4905_non_ca_tx0_lte_b1_device_info.
- The Tx path in reference design uses WTR4905. The different devices along its Tx path are QFE3320 LB/MB PA+ASM, QFE2101 PAPM and the QFE2550 Tuner component.
- Each MIPI device used in this path must be defined previously in the RF Card Common file, i.e. rfc_wtr4905_non_ca_cmn_ag.cpp as mentioned earlier.
- All GRFCs' used (if any) are shown in the rf_card_wtr4905_non_ca_tx0_lte_b1_sig_cfg code block.
- Similar settings can be found for other LTE bands in this file.
- Other technology settings are stored in the corresponding folders under \modem_proc\rfc_jolokia\rf_card\<rfcard> folder.

RFC Folder Structure - Static XML Files/RF Calibration XTTs

- RF static NV files corresponding to each RF card can be found in \modem_proc\rftarget_jolokia\qcn\<rfcard> folder.
- These NV files consists of reference static NV items for all the supported bands of the particular RF card.
- NV items are required to be configured for each tech/band.
- Some of the most common NV items are as follows:
  - NV_RF_HW_CONFIG_I – This NV item must be set based on the hardware ID corresponding to the RF card used.
  - NV_RF_BC_CONFIG_I – This NV item is used to enable/disable GSM/WCDMA/CDMA bands on the primary chain.
  - NV_RF_BC_CONFIG_DIV_I – This NV item is used to enable/disable GSM/WCDMA/CDMA bands on the diversity chain.
  - NV_LTE_BC_CONFIG_I – This NV item is used to enable/disable LTE bands.
  - RFNV_TDSCDMA_BC_CONFIG_I – This NV item is used to enable/disable TDSCDMA bands on primary chain.
  - RFNV_TDSCDMA_BC_CONFIG_DIV_I – This NV item is used to enable/disable TDSCDMA bands on diversity chain.
  - More description and details on NV settings for each tech can be found from App Note 80-NH377-170.

RFC Folder Structure - Static XML Files/RF Calibration XTTs (cont.)

- RF calibration XTT files can be found in \modem_proc\rftarget_jolokia\xtt folder.
- These files are used to calibrate different technology/band corresponding to the RF card.
- The XTT chosen is based on the RF card choice. There are different XTT files for each RF card.
- Each XTT has its own parameter file settings.
- The parameter file consists of calibration settings corresponding to each XTT. This file can be found in \modem_proc\rftarget_jolokia\xtt\<rfcard>\RFCalInput folder.

RFC Folder Structure – QFE Devices - QFE2101

- QFE2101
  - QFE2101 is a PA power management IC that implements power tracking technology as part of an overall RF frontend solution
  - The device supports multiple operating modes to improve PA efficiency over its entire operating range
    - Average Power Tracking (APT) for 3G/4G mode
    - APT for 2G mode – In APT modes, the software programs the QFE output voltage (which powers the PA) to track the transmitter's RF waveform average power, as it changes incrementally over time. The QFE provides a fast step response so it quickly changes its output voltage when RF power is increased or decreased.
    - Bypass mode – This mode connects the battery directly to the PA supply pins, and can be entered either through an RFFE command or automatically in APT mode once the PA supply voltage is too low to sustain the required output power.
    - Sleep/standby – The PA is inactive and most QFE2101 circuits are disabled.

RFC Folder Structure – QFE Devices - QFE2101 (cont.)

- QFE2101 RFC settings

  - Physical device list

```
{ /*Device: QFE2101 */
  QFE2101, /* PHY_DEVICE_NAME */
  1, /* PHY_DEVICE_INSTANCE */
  RFC_NO_ALTERNATE_PART, /* PHY_DEVICE_ALT_PART_NUM_OF_INSTANCE */
  RFDEVICE_COMM_PROTO_RFFE, /* PHY_DEVICE_COMM_PROTOCOL */
  {     0,0 /* 0 not specified */,}, /* PHY_DEVICE_COMM_BUS */
  0x217, /* PHY_DEVICE_MANUFACTURER_ID */
  0x31, /* PHY_DEVICE_PRODUCT_ID */
  0, /* PHY_DEVICE_PRODUCT_REV */
  0x4, /* DEFAULT USID RANGE START */
  0x4, /* DEFAULT USID RANGE END */
  0x4, /* PHY_DEVICE_ASSIGNED_USID */
  0 /*Warning: Not specified*/, /* RFFE_GROUP_ID */
  TRUE, /* INIT */
  RFC_INVALID_PARAM, /* ASSOCIATED_DAC */
}, /* END - Device: QFE2101 */
```

Device	QFE2101
MID	0x217
PID	0x31
Default USID	0x4

  - Logical device list

```
{ /*Device: QFE2101 */
  RFDEVICE_PAPM, /* DEVICE_MODULE_TYPE */
  QFE2101, /* DEVICE_MODULE_NAME */
  0, /* DEVICE_MODULE_TYPE_INSTANCE */
  1, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE2101 */
```


RFC Folder Structure – QFE Devices – QFE2340

- QFE2340
  - QFE2340 is a High band PA module. It consists of:
    - Two PA input switches
    - Two gain paths
      - High-power PA path
      - Low-power bypass path
    - Four PA output switches for band selection
      - B7, B38, B40, and B41
    - Two Rx path switches for TDD operation
      - B40 and B38/B41 (including XGP) TDD reception
    - Digital circuits for modem IC interfaces and device status and control
      - MIPI standard for RFFE components

RFC Folder Structure – QFE Devices – QFE2340 (cont.)

QFE2340 is a single physical component which consists of both PA component and an ASM component internally.

Hence, it is necessary to define both RFDEVICE_PA and RFDEVICE_ASM component when defining QFE2340 in RFC.

- Physical device list

```
{ /*Device: QFE2340 */
  QFE2340, /* PHY_DEVICE_NAME */
  2, /* PHY_DEVICE_INSTANCE */
  RFC_NO_ALTERNATE_PART, /* PHY_DEVICE_ALT_PART_NUM_OF_INSTANCE */
  RFDEVICE_COMM_PROTO_RFFE, /* PHY_DEVICE_COMM_PROTOCOL */
  {    0,0 /* 0 not specified */,}, /* PHY_DEVICE_COMM_BUS */
  0x0217, /* PHY_DEVICE_MANUFACTURER_ID */
  0x21, /* PHY_DEVICE_PRODUCT_ID */
  0, /* PHY_DEVICE_PRODUCT_REV */
  0x0F, /* DEFAULT USID RANGE START */
  0x0F, /* DEFAULT USID RANGE END */
  0x0F, /* PHY_DEVICE_ASSIGNED_USID */
  0 /*Warning: Not specified*/, /* RFFE_GROUP_ID */
  FALSE, /* INIT */
  RFC_INVALID_PARAM, /* ASSOCIATED_DAC */
}, /* END - Device: QFE2340 */
```

Device	QFE2340
MID	0x217
PID	0x21
Default USID	0xF

- Logical device list

```
 { /*Device: QFE2340 */
   RFDEVICE_PA, /* DEVICE_MODULE_TYPE */
   QFE2340, /* DEVICE_MODULE_NAME */
   0, /* DEVICE_MODULE_TYPE_INSTANCE */
   2, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
 }, /* END - Device: QFE2340 */
```

```
{ /*Device: QFE2340 */
  RFDEVICE_ASM, /* DEVICE_MODULE_TYPE */
  QFE2340, /* DEVICE_MODULE_NAME */
  3, /* DEVICE_MODULE_TYPE_INSTANCE */
  2, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE2340 */
```


RFC Folder Structure – QFE Devices – QFE2340 (cont.)

- B7 TX RFC

```
rfc_device_info_type rf_card_wtr3925_ssku_qfes_et_tx0_lte_b7_device_info =
{

 //Snip
 {
   RFDEVICE_PA,
   QFE2340,  /* NAME */
   0,  /* DEVICE_MODULE_TYPE_INSTANCE */
   0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
   {
     0  /* Orig setting:  */,  /* INTF_REV */
     (0x217 << 22)/*mfg_id*/ | (0x21 << 14)/*prd_id*/ | (1)/*port_num*/,  /* PORT_NUM */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
   },
 },
//Snip

 {
   RFDEVICE_ASM,
   QFE2340,  /* NAME */
   0,  /* DEVICE_MODULE_TYPE_INSTANCE */
   0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
   {
     0  /* Orig setting:  */,  /* INTF_REV */
     (0x217 << 22)/*mfg_id*/ | (0x21 << 14)/*prd_id*/ | (3)/*port_num*/,  /* PORT_NUM */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
   },
 },
```


Note: In this example above, the PA settings define the input port for the PA in case of band 7, which is HB1_IN. The QFE2340 ASM settings is used to configure the ASM switch inside the component to HB1_TX for B7.

RFC Folder Structure – QFE Devices – QFE3320

- QFE3320
  - QFE3320 is a Mid/Low band PA module. It consists of:
    - Mid-band switched PA paths
    - Low-band switched PA paths
    - Multiband antenna switch – Nine ports for mid bands and seven ports for low bands
    - Bias circuits that extend the device's linearity performance
    - Digital circuits for modem IC interfaces and device status and control
      - MIPI standard for RFFE components

RFC Folder Structure – QFE Devices – QFE3320 (cont.)

- QFE3320 is a single physical component which consists of PA component and an ASM component internally.
- The PA component is logically separated for GSM and Non-GSM operations.
- The ASM component is logically divided into LB ASM and MB ASM.

Hence, it is necessary to define all supported logical components when defining QFE3320 in RFC.

- Physical device list

```
{ /*Device: QFE3320_EPT */
  QFE3320, /* PHY_DEVICE_NAME */
  3, /* PHY_DEVICE_INSTANCE */
  RFC_NO_ALTERNATE_PART, /* PHY_DEVICE_ALT_PART_NUM_OF_INSTANCE */
  RFDEVICE_COMM_PROTO_RFFE, /* PHY_DEVICE_COMM_PROTOCOL */
  {     0,0 /* 0 not specified */,}, /* PHY_DEVICE_COMM_BUS */
  0x0217, /* PHY_DEVICE_MANUFACTURER_ID */
  0x26, /* PHY_DEVICE_PRODUCT_ID */
  0, /* PHY_DEVICE_PRODUCT_REV */
  0xC, /* DEFAULT USID RANGE START */
  0xC, /* DEFAULT USID RANGE END */
  0x02, /* PHY_DEVICE_ASSIGNED_USID */
  0 /*Warning: Not specified*/, /* RFFE_GROUP_ID */
  TRUE, /* INIT */
  RFC_INVALID_PARAM, /* ASSOCIATED_DAC */
}, /* END - Device: QFE3320_EPT */
```

Device	QFE2101
MID	0x217
PID	0x26
Default USID	0xC

RFC Folder Structure – QFE Devices – QFE3320 (cont.)

- Logical device list

```
{ /*Device: QFE3320_EPT */
  RFDEVICE_PA, /* DEVICE_MODULE_TYPE */
  QFE3320_EPT, /* DEVICE_MODULE_NAME */
  1, /* DEVICE_MODULE_TYPE_INSTANCE */
  3, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE3320_EPT */

{ /*Device: QFE3320_GSM */
  RFDEVICE_PA, /* DEVICE_MODULE_TYPE */
  QFE3320_GSM, /* DEVICE_MODULE_NAME */
  2, /* DEVICE_MODULE_TYPE_INSTANCE */
  3, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE3320_GSM */

{ /*Device: QFE3320_TDD */
  RFDEVICE_PA, /* DEVICE_MODULE_TYPE */
  QFE3320_TDD, /* DEVICE_MODULE_NAME */
  3, /* DEVICE_MODULE_TYPE_INSTANCE */
  3, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE3320_TDD */

{ /*Device: QFE3320_TX */
  RFDEVICE_ASM, /* DEVICE_MODULE_TYPE */
  QFE3320_TX, /* DEVICE_MODULE_NAME */
  0, /* DEVICE_MODULE_TYPE_INSTANCE */
  3, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE3320_TX */

{ /*Device: QFE3320_LB */
  RFDEVICE_ASM, /* DEVICE_MODULE_TYPE */
  QFE3320_LB, /* DEVICE_MODULE_NAME */
  1, /* DEVICE_MODULE_TYPE_INSTANCE */
  3, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE3320_LB */

{ /*Device: QFE3320_MB */
  RFDEVICE_ASM, /* DEVICE_MODULE_TYPE */
  QFE3320_MB, /* DEVICE_MODULE_NAME */
  2, /* DEVICE_MODULE_TYPE_INSTANCE */
  3, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE3320_MB */
```


RFC Folder Structure – QFE Devices – QFE3320 (cont.)

- GSM 850 Tx RFC

```
rfc_device_info_type rf_card_wtr4905_non_ca_tx0_gsm_g850_device_info =
{
 //Snip
 {
   RFDEVICE_PA,
   QFE3320_GSM,  /* NAME */
   2,  /* DEVICE_MODULE_TYPE_INSTANCE */
   0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
   {
     0  /* Orig setting:  */,  /* INTF_REV */
     (0x0217 << 22)/*mfg_id*/ | (0x26 << 14)/*prd_id*/ | (0)/*port_num*/,  /* PORT_NUM */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
   },
 },
//Snip
 {
   RFDEVICE_ASM,
   QFE3320_LB,  /* NAME */
   1,  /* DEVICE_MODULE_TYPE_INSTANCE */
   0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
   {
     0  /* Orig setting:  */,  /* INTF_REV */
     (0x0217 << 22)/*mfg_id*/ | (0x26 << 14)/*prd_id*/ | (6)/*port_num*/,  /* PORT_NUM */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
   },
 },
```


Note: In this example above, the PA settings define the input port for the PA in case of GSM 850, which is LB3_IN. The QFE3320 ASM settings is used to configure the ASM switch inside the component to TRX_LB5 for GSM850.

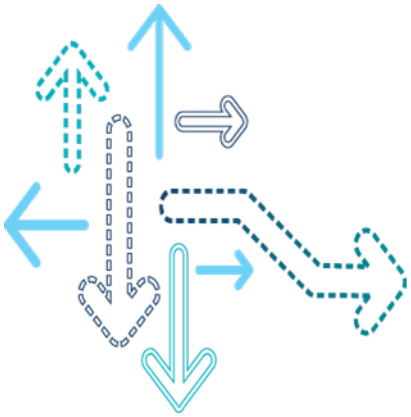
RFC Folder Structure – QFE Devices – QFE3320 (cont.)

- LTE B17 TX RFC

```
rfc_device_info_type rf_card_wtr4905_non_ca_tx0_lte_b17_device_info =
{
 //Snip
 {
   RFDEVICE_PA,
   QFE3320_EPT,  /* NAME */
   1,  /* DEVICE_MODULE_TYPE_INSTANCE */
   0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
   {
     0  /* Orig setting:  */,  /* INTF_REV */
     (0x0217 << 22)/*mfg_id*/ | (0x26 << 14)/*prd_id*/ | (9)/*port_num*/,  /* PORT_NUM */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
   },
 },
//Snip
 {
   RFDEVICE_ASM,
   QFE3320_LB,  /* NAME */
   1,  /* DEVICE_MODULE_TYPE_INSTANCE */
   0 /*Warning: Not specified*/,  /* PHY_PATH_NUM */
   {
     0  /* Orig setting:  */,  /* INTF_REV */
     (0x0217 << 22)/*mfg_id*/ | (0x26 << 14)/*prd_id*/ | (3)/*port_num*/,  /* PORT_NUM */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
     0,  /* Array Filler */
   },
 },
```


Note: In this example above, the QFE3320_EPT LB/MB PA settings define the input port for the PA for LTE B17 (LB). The QFE3320_LB ASM settings is used to configure the ASM switch inside the component to LTE B17.

JO.1.0 RFFE Structures



RF Physical Device Structure Definition

```
/*Physical Device Structure to store physical device info from RFC*/
typedef struct
{
  rfdevice_id_enum_type rf_device_id; /*PHY_DEVICE_NAME*/
  uint8 phy_dev_instance; /* PHY_DEVICE_INSTANCE*/
  uint32 alternate_part_idx; /* Alternate Part Index Num */
  rfdevice_comm_proto_enum_type rf_device_comm_protocol; /*PHY_DEVICE_COMM_PROTOCOL*/
  uint32 bus[RFC_MAX_SLAVES_PER_DEVICE]; /*PHY_DEVICE_COMM_BUS*/
  uint32 manufacturer_id;
  uint32 product_id;
  uint32 product_rev;
  uint32 default_usid_range_start;
  uint32 default_usid_range_end;
  uint32 assigned_usid;
  uint32 group_id;
  boolean init_required;
  uint32 associated_dac;
} rfc_phy_device_info_type;
```

```
{ /*Device: QFE2340 */
  QFE2340, /* PHY_DEVICE_NAME */
  2, /* PHY_DEVICE_INSTANCE */
  RFC_NO_ALTERNATE_PART, /* PHY_DEVICE_ALT_PART_NUM_OF_INSTANCE */
  RFDEVICE_COMM_PROTO_RFFE, /* PHY_DEVICE_COMM_PROTOCOL */
  {    0,0 /* 0 not specified */,}, /* PHY_DEVICE_COMM_BUS */
  0x0217, /* PHY_DEVICE_MANUFACTURER_ID */
  0x21, /* PHY_DEVICE_PRODUCT_ID */
  0, /* PHY_DEVICE_PRODUCT_REV */
  0x0F, /* DEFAULT USID RANGE START */
  0x0F, /* DEFAULT USID RANGE END */
  0x0F, /* PHY_DEVICE_ASSIGNED_USID */
  0 /*Warning: Not specified*/, /* RFFE_GROUP_ID */
  FALSE, /* INIT */
  RFC_INVALID_PARAM, /* ASSOCIATED_DAC */
}, /* END - Device: QFE2340 */
```


RF Logical Device Structure Definition

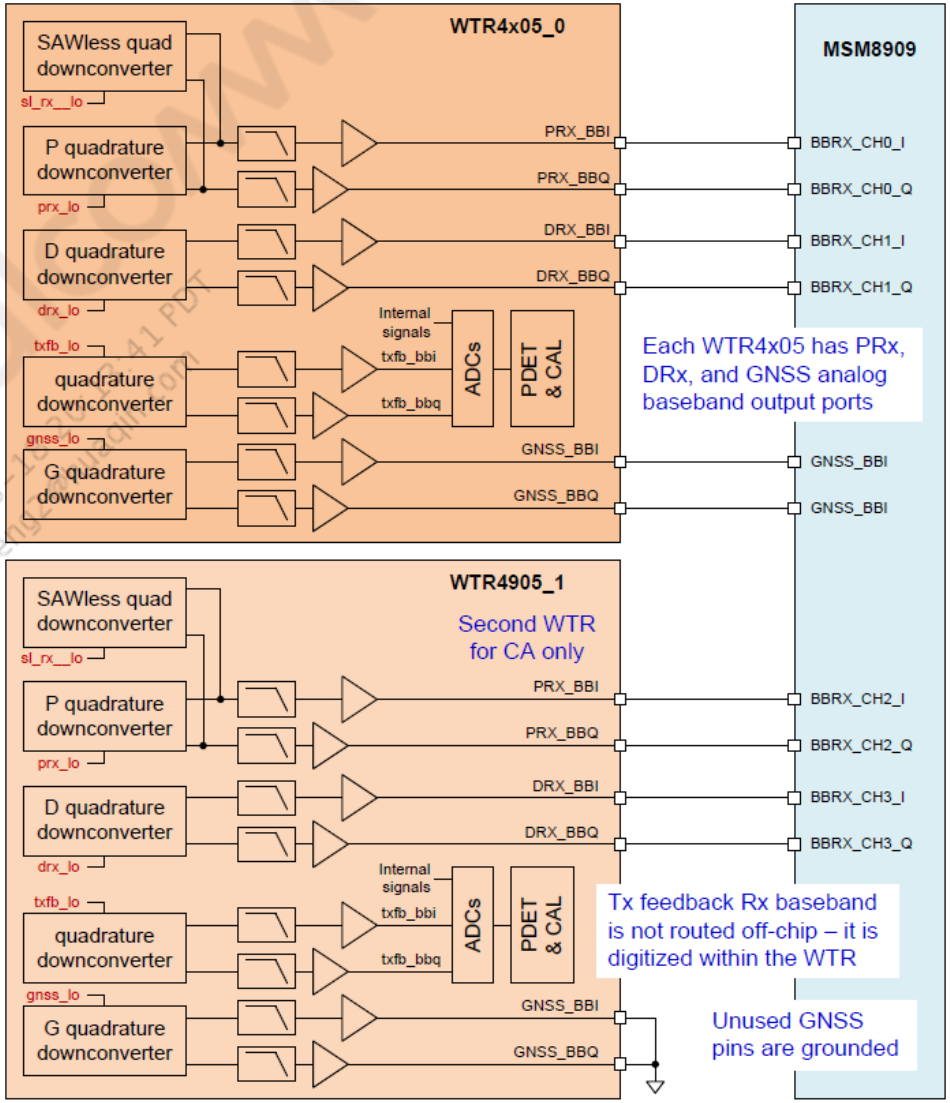
```
/*Logical Device Structure to store logical device info from RFC*/

typedef struct
{
  rfdevice_type_enum_type rf_device_type; /*DEVICE_MODULE_TYPE*/
  rfdevice_id_enum_type rf_device_id; /*LOGICAL_DEVICE_NAME*/
  uint32 rf_asic_id; /*DEVICE_MODULE_TYPE_INSTANCE*/
  uint8 associated_phy_dev_instance; /* ASSOCIATED PHY_DEVICE_INSTANCE*/
} rfc_logical_device_info_type;
```

```
{ /*Device: QFE2340 */
  RFDEVICE_PA, /* DEVICE_MODULE_TYPE */
  QFE2340, /* DEVICE_MODULE_NAME */
  0, /* DEVICE_MODULE_TYPE_INSTANCE */
  2, /* ASSOCIATED_PHY_DEVICE_INSTANCE */
}, /* END - Device: QFE2340 */
```


Modem Chain to Baseband Connection

- Modem Chain
  - Modem chain is the physical connection between RF (WTR) and the Baseband (MSM8909).
  - This represents the connection between WTR IQ lines to the baseband IQ channel as seen below.



Modem Chain to Baseband Connection (cont.)

- RFC files use the same modem chain macro for all basebands, which may have different physical connections.

Modem chain macro in RFC <rfc_msm_signal_info_ag.h>	Physical mapping (MSM8909)
RFC_RX_MODEM_CHAIN_0	0
RFC_RX_MODEM_CHAIN_1	1
RFC_RX_MODEM_CHAIN_2	2
RFC_RX_MODEM_CHAIN_3	3
RFC_TX_MODEM_CHAIN_0	0
RFC_TX_MODEM_CHAIN_1	1

- Chain 0 in RFC maps to BBRX_IP_CH0/BBRX_QP_CH0
- Chain 1 in RFC maps to BBRX_IP_CH1/BBRX_QP_CH1.

Modem Chain to Baseband Connection (cont.)

- Software configuration for Modem Chain

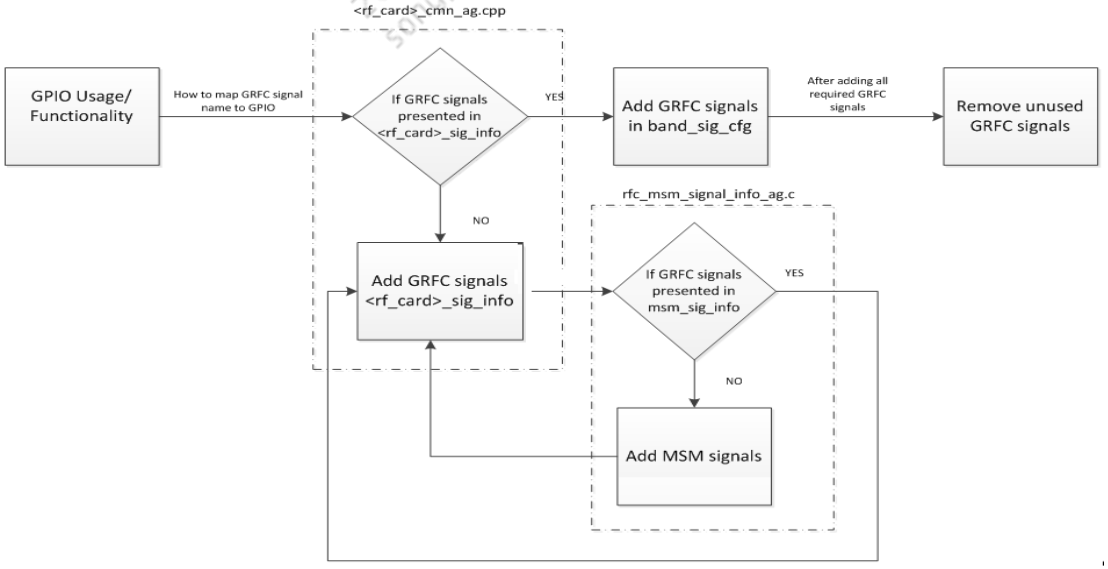
```
rfc_device_info_type rf_card_wtr4905_chile_srlte_v2_rx0_lte_b1_device_info =
{
  RFC_ENCODED_REVISION,
  RFC_RX_MODEM_CHAIN_0,    /* Modem Chain */
  0 /* Warning: Not Specified */,    /* FBRx ADC for Tx States */
  0,    /* NV Container */
  RFC_INVALID_PARAM /* Warning: Not Specified */,    /* Antenna */
  3,   /* NUM_DEVICES_TO_CONFIGURE */
  {
```

```
rfc_device_info_type rf_card_wtr4905_chile_srlte_v2_rx1_lte_b1_device_info =
{
  RFC_ENCODED_REVISION,
  RFC_RX_MODEM_CHAIN_1,    /* Modem Chain */
  0 /* Warning: Not Specified */,    /* FBRx ADC for Tx States */
  1,    /* NV Container */
  RFC_INVALID_PARAM /* Warning: Not Specified */,    /* Antenna */
  3,   /* NUM_DEVICES_TO_CONFIGURE */
  {
```

```
rfc_device_info_type rf_card_wtr4905_chile_srlte_v2_tx0_lte_b1_device_info =
{
  RFC_ENCODED_REVISION,
  RFC_TX_MODEM_CHAIN_0,    /* Modem Chain */
  0 /* Warning: Not Specified */,    /* FBRx ADC for Tx States */
  0,    /* NV Container */
  RFC_INVALID_PARAM /* Warning: Not Specified */,    /* Antenna */
  6,   /* NUM_DEVICES_TO_CONFIGURE */
  {
```

Generic RF Controls (GRFC) Frontend Devices

- Qualcomm Technologies Inc. (QTI) recommends all customers to undergo a hardware review for every RF project.
- All GPIO assignments are reviewed during this process to ensure that the assigned GPIO is used for the intended functionality.
- A GRFC control logic table is required to make the necessary code changes for GRFC.
- For additional information on GRFC device customization, see *Chile Non-CA with Qualcomm RF360™ for MSM8909 + WTR4905 Reference Schematic* (80-NL713-48)



Software Design Review (SDR)

- It is highly recommended that customer have Software Design Review (SDR) with QTI before
  bringup to minimize the bringup issues
- Required item when submitting SDR
  1. Customized RFC code. (defined macro)
  2. Customized PA/ASM driver if any 3rd party devices are used.
  3. PA/ASM datasheet.
  4. Schematic
  5. Supported band list
  6. Special feature i.e., CA combo, SxLTE/DSDx
- Include all above items when submitting SDR case.
- Include hardware review case number.

Software Design Review (SDR) (cont.)

- Following Items will be checked through SDR.
  1. Supported band
  2. MIPI device setting in Cmn file (MID/PID/USID/Assigned USID)
  3. WTR port mapping (each band)
  4. MIPI PA/ASM driver implementation
  5. MIPI device port setting in RFC (each band)
  6. GRFC signals setting in RFC (each band)
  7. Removing all un-used MIPI devices/ GRFC signals.
  8. Other features (LTE CA/ DSDx/ etc)

- A general report will be provided, which covers above items.
- Code change will be provided if needed.

SDR Report Sample

- Below is a snapshot of SDR report

9.1 LTE B1

RF path	Device Type	Name	Instance Type	Phy path	ManufacturerID	Product ID	Port	Note
rx0	RFDEVICE_TRANSCEIVER	WTR4905	0	0			(int)WTR4905_LTEFDD_PRXLGY1_BAND1_PMB2	
	RFDEVICE_ASM	GEN_ASM	1	0	0x0107	0x02	0	
tx0	RFDEVICE_TRANSCEIVER	WTR4905	0	0			(int)WTR4905_LTEFDD_TX_BAND1_THMLB1	
	RFDEVICE_PA	GEN_PA	1	0	0x107	0x2	0	
	RFDEVICE_PAPM	QFE1100	0	0	0x217	0x30	9	
	RFDEVICE_ASM	GEN_ASM	1	0	0x0107	0x02	0	
rx1	RFDEVICE_TRANSCEIVER	WTR4905	0	1			(int)WTR4905_LTEFDD_DRXLGY1_BAND1_DMB2	
	RFDEVICE_ASM	GEN_ASM	9	0	0x11A	0xD0	3	

Comment:

1. Rx1 port is 3, maps to HB4 on DRx ASM, which is NC
2. WTR_DMB2 is NC

Problem Area Code for RFFE Software Cases

Field	Category	Comment
Initial problem type	Software	
Problem Area 1	RF	
Problem Area 2	RF driver design	
Problem Area 3	RF band support	Questions related to band support
	RF bringup	Questions during RF bringup
	RF card/RF chipset (WTR/WFR)	Questions related to RF card and WTR/WFR chipset
	RF design review	Software design review request in RF
	RFFE – GRFC/GPIO (PA/ASM)	Questions related to GRFC-controlled RFFE devices, i.e., PA/ASM All questions/issues related to GRFC settings
	RFFE – MIPI (PA/ASM)	Questions related to MIPI-controlled RFFE devices, i.e., PA/ASM

References

Documents	
Qualcomm Technologies, Inc.	
Title	DCN
Application Note: Software Glossary for Customers	CL93-V3077-1
MSM8909 RF Software Overview	80-NR964-12
MSM8909/MSM8209/MSM8208 Digital Baseband	80-NP408-5B
WTR4905 with Qualcomm RF360 5-Mode CMCC China Optimized Preliminary Reference Schematic	80-NL713-43
Chile Non-CA with Qualcomm RF360™ for MSM8909 + WTR4905 Reference Schematic	80-NL713-48
WTR4905 with Qualcomm RF360™ (Japan) Preliminary Reference Schematic	80-NL713-46
NA CA with Qualcomm RF360 for MSM8909 + WTR4905 Preliminary Reference Schematic	80-NL713-49
Third-Party MIPI ASM Customization	80-NE606-2
Third-Party MIPI PA Customization	80-NE606-3
Application Note: Generic RF Controls (GRFC) Customization	80-NE606-4
RFFE Vendor Specification	80-N7876-1
QFE2101 PA Power Management IC Device Specification	80-NL893-1
QFE2330/QFE2340 High-Band Multimode Power Amplifier Device Specification	80-NF232-1
QFE3320 Low/Mid Band Tx Front-End Device Specification (Advance Information)	80-NJ121-1
RF Controls (RFC) Software Implementation	80-NT180-102
Standards	
MIPI Alliance Specification for RF Front-End Control Interface	Draft Ver 1.01 Rev 0.04 (Jul 2011)

References (cont.)

Acronyms	
Term	**Definition**
ASDiv	Antenna Switch Diversity
GRFC	Generic RF Controls
RFC	RF Controls
ASM	Antenna Switch Module
PA	Power Amplifier
RFFE	RF Front End
APT	Average Power Tracking
QFE	Qualcomm Front End
SDR	Software Design Review

Questions?

https://support.cdmatech.com