Product Specification (PS)

for

RTX1040 DECT/CAT-IQ MODULE

1 Document Info

1.1 Contents

Table of Contents

1.2 Scope

This document provides the description of the RTX1040 DECT/CAT-IQ Hardware Module from RTX Telecom A/S.

The document includes a description of the technical solution and is intended as the technical description that accompanies the associated quotation of delivery of RTX1040 modules as stand-alone deliverables or associated with either a standard- or customized module firmware.

The document is targeted at customer system engineers.

1.3 History

Revision	Author	Issue Date	Comments
0.1	KHR	14-Jul-2011	Initial Revision
1.0	JNO	09-Sep-2011	Reviewed and released
2.0	JNO	8-Feb-2012	Fixed broken references
2.2	KHR	12-Apr-2012	General update
2.3	KHR	21-May-2012	Update of limits
2.4	KHR	20-June-2012	Update of "Scope" section and software feature list.
2.5	KHR	13-Dec-2012	Updated Max supply voltage to 3,45V to align with RF chip spec datasheet Ver.1.8

1.4 References

[1] ETSI TS 102 527-3 V1.3.1 (2011-02)

1.5 Terms & Abbreviations

Abbreviations	Description
FP	DECT Fixed Part
PP	DECT portable part
RTX1040	Project name within RTX
BB	Baseband
CVM	Cordless Voice Module – A DECT Modem controlled via an API from an external Host CPU
HW	Hardware
MMI	Man Machine Interface
PCB	Printed Circuit Board without components
PCBA	Printed Circuit Board with components
RF	Radio Frequency
RTX	RTX Telecom A/S
SW	Software
ULE	Ultra Low Energy

2 Introduction

2.1 Module Description

This document is the Product Specification (PS) for the RTX1040 module being developed and manufactured by RTX, hereafter referred to as RTX1040. The module development is done in iterations, where each improves performance and brings the module to mass manufacturing stage quality and performance.

The content of this document is subject to change as the iterations of development are carried out.

2.2 Scope

The purpose of this section is to provide an overall description in terms of functionality and features of the products related to the RTX1040.

The products specified by this document are the following:

- Hardware:
  - The RTX1040 Hardware Module
- Software:
  - The RTX1040Pp Portable Part Software Configuration
  - The RTX1040Fp Fixed Part Software Configuration
  - The RTX1040PpULE Portable Part software for ULE systems.

The RTX1040 is a general purpose DECT hardware module to be controlled by an external host processor. The host processor controls the RTX1040 through UART or SPI. Audio is transferred as PCM to/from the RTX1040, and data can be transferred using SPI.

Besides the external host processor, a regulated power supply and antennas need to be connected to the RTX1040.

The RTX1040 Hardware Module can be used with either a standard DECT/CAT-iq firmware from RTX, or with a custom firmware developed to provide specific features for a given project.

The software section of this document only applies to standard firmware. For projects using custom firmware, refer to the project description documentation.

Available standard softwares from RTX includes but is not limited to:

- RTX1040Pp – a software configuration to be used in handset applications
- RTX1040PpULE – a software configuration to be used in ULE applications
- RTX1040Fp – a software configuration used for base station applications.

3 Mechanical Specification

The module is a rectangular PCB which is to be soldered onto a motherboard using contact points on the module PCB edge. The module measures 42 x 27 mm, as shown in Figure 1, and has a maximum height of 4.0 mm including a 1 mm thick PCB.
The module has 56 connections, each of which is made as a single solder point on the module edge. The module does not have any buttons, led, connectors or display.

All measurements are in millimeters.

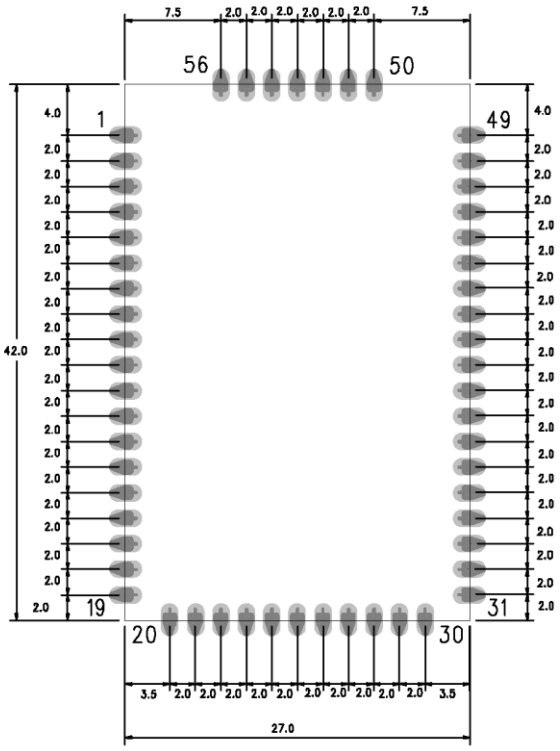


Figure 1: Module size.

The module solder points for the motherboard are specified in Figure 2.

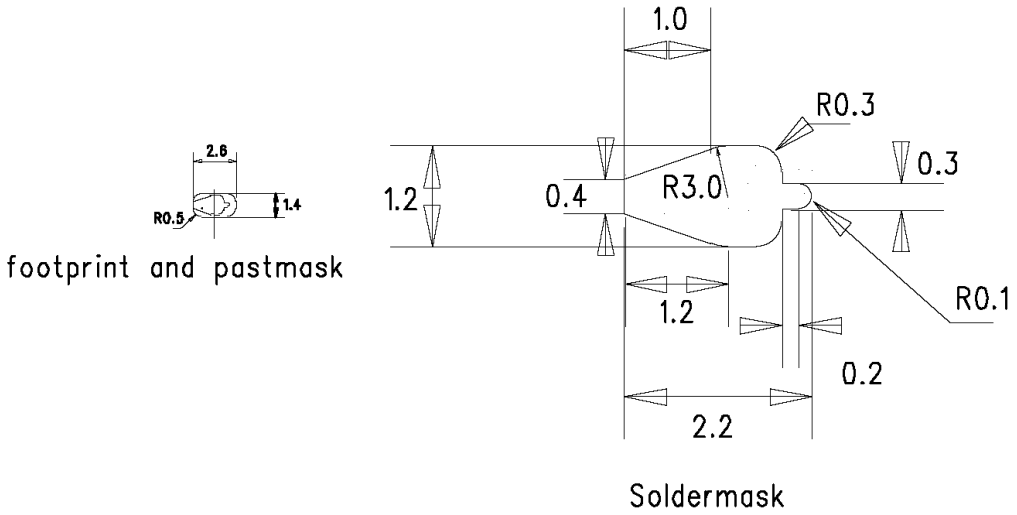


Figure 2: Module solder point specification.

Item	Specification	Note
Weight	8 g	PCBA = 5 g, RF shield = 3 g

4 Hardware Specification

The design is based on the following main components:

	Module
Transceiver (RF & baseband)	SC14441 (Dialog Semiconductor)
Flash	Quad SPI flash

Table 1: Main components.

The Quad SPI Flash memory is used to store the units' firmware, and a Nonvolatile storage area for storage of tuning and other parameters on the module.

4.1 Electrical Specification

The electrical specification can be found in Table 2.

Description	Conditions	Min.	Typ.	Max.	Units
Supply voltage		2,1	2,5	3,45	V
Input/Output voltage	(same as VDD_IO)		1,8		V
Power Consumption	See section 4.4				mA

Table 2: Electrical Specification.

4.2 Module Layout

The module layout is illustrated in Figure 3.

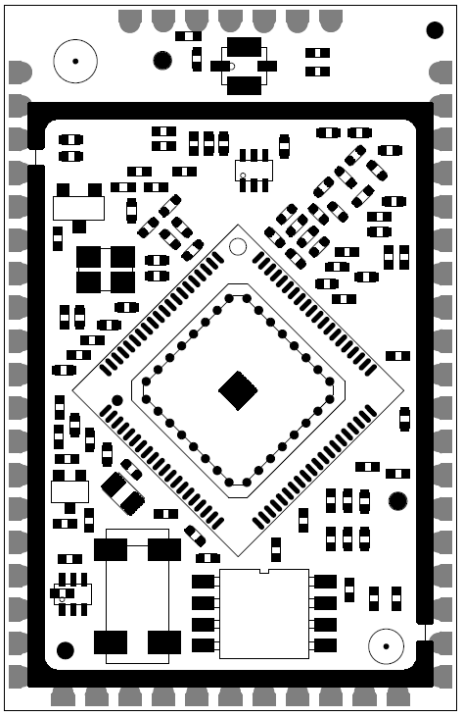


Figure 3. Module layout

4.3 Module pin specification

The preliminary pin-out specification is listed in the following table.

Pin	Port Name	Function	SC14441 pin no.	Configuration
1	P1_4 / INT / TDOD	Hook switch CRTL (line interface)	49	Output
2	P1_6 / PON	Power on (pull up to >1V)	45	Input
3	RESET	HW RESET input	62	Input
4	P2_6 / TF_IN	GPIO	53	
5	VIN	Vbat supply, typical 2,5VDC (max 3,45V)	12,76, 85	Voltage supply input
6	GND5	GND		Ground
7	LRSN	Speaker n signal	18	Output
8	LRSP	speaker p signal	23	Output
9	MICH	RX audio for the PSTN line interface	21	Input
10	GND4	GND		Ground
11	CIDINN / MICP	CID negative input	19	Input
12	CIDOUT / MICN	Ring out	20	Output
13	VREF – (GND)	Analog GND		Ground
14	CINDINP / VREFP	CID positive input	18	Input
15	P3_7 / RINGP	Ring detection	16	Input
16	P3_6 / RINGN	Ring detection	15	Input

Pin	Port Name	Function	SC14441 pin no.	Configuration
17	VBAT-	Battery GND		Battery GND
18	P3_4 / PARADET	Line sense	13	Input
19	P3_3 / ADC0	Line current detection	27	Input
20	P1_0 / INT0 / ADC1	Line current sense	28	Input
21	ADC2	Line pol detection	29	Input
22	GND8	GND		Ground
23	CHARGE_CTRL	Not used	32	Output
24	P1_7 / CHARGE	Not used	33	Input
25	P3_5 / RINGING	Ring input to capture timer	14	Input
26	P3_1 / PAOUTP	PA OUTPUT +	34	
27	P3_0 / PAOUTN	PA OUTPUT -	36	
28	CP_VOUT1 / LED1	LED Output 1	43	Output
29	CP_VOUT2 / LED2	LED Output 2	44	Output
30	GND9	GND		Ground
31	P2_7 / BXTAL	Crystal signal	47	Output
32	P1_3 / INT3 / SIO	Dutch CID impedance / Microwire CLK	50	Output
33	P1_2 / INT2 / SK	Microwire data	51	
34	P1_1 / INT1 / LE	SPI interrupt	52	output
35	+1V8	Core voltage output	73	Output
36	JTAG	JTAG single wire interface	63	Output
37	P0_0 / UTX	UART TX	61	Output
38	P0_1 / URX	UART RX	60	Input
39	GND2	GND		Ground
40	P2_4 / SCL1 / PCMD0	PCM Data out	65	Output
41	P2_5 / PCM_FSC / SF	PCM frame sync	64	Master = output, Slave = Input
42	P2_0 / PMW0 / LED3	Open drain for LED’s	72	Input
43	P2_1 / PMW1 / LED4	Open drain for LED’s	71	Input
44	P2_2 / PCM_CLK	PCM clock	67	Master = output, Slave = Input
45	P2_3 / SDA1 / PCMD1	PCM data input	66	Input
46	P0_4 / SPI_EN	SPI enable	57	Input
47	P0_5 / SPI_CLK	SPI clock	56	Master = output, Slave = Input
48	P0_6 / SPI_DO	SPI Data out	55	Output
49	P0_7 / SPI_DI	SPI Data input	54	Input
50	GND6	GND		Ground
51	VIN1	PA power supply (2.5 V DC)	-	Input
52	RFP0n	Antenna select	74	Output

Pin	Port Name	Function	SC14441 pin no.	Configuration
53	GND	GND		Ground
54	ANT	Antenna 50 Ohm, single ended	-	Output
55	GND3	GND		Ground
56	RFP0	Antenna select	6	Output

Table 3. Module pin specification

Description	Conditions	Min.	Typ.	Max.	Units
Logic low digital input	VDD=1.6 .. 1.98V			0.3*VDD	V
Logic high digital input	VDD=1.6 .. 1.98V	0.7*VDD			V
Logic low digital output	Iout=100uA VDD=1.6 .. 1.98V			0.1	V
Logic high digital output	Iout=100uA	VDD-0.1			V

Table 4. Digital threshold levels

Description	Conditions	Min.	Typ.	Max.	Units
Differential RMS input voltage between MICp and MICn	MIC_GAIN[3:0] = 0 @ 1020 Hz	114	131	149	mV
Reference level at Vmic=0dB	MIC_GAIN[3:0] = 0000		0		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 0001		1.8		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 0010		4.1		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 0011		6.0		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 0100		7.8		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 0101		10.1		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 0110		12		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 0111		14.5		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 1000		16.1		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 1001		18.1		dB
Microphone gain	MIC_GAIN[3:0] = 1010		20.6		dB

Description	Conditions	Min.	Typ.	Max.	Units
relative to 0dB					
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 1011		22.0		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 1100		24.0		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 1101		26.4		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 1110		27.9		dB
Microphone gain relative to 0dB	MIC_GAIN[3:0] = 1111		29.8		dB
Resistance of Analog input to GND		75	150		kOhm
Speaker output LSRp to GND	0dBm0 on CIN	310	357	403	mVrms

Table 5. Analog levels

4.4 External Parts

Outside the RTX1040 a power supply and antenna circuit shall be designed. This design is the responsibility of the customer. RTX can participate in review of the antenna part and provide the customer with suggestions and best practice advice to optimize the performance.

The power supply shall provide a regulated DC voltage of between 2.2 and 3.5 Volt.

Description	Conditions	Min.	Typ.	Max.	Units
PP Talk mode	Vin = 2.5V @ 25°C			tbd	mA_{rms}
PP Idle mode (lowest power level)	Vin = 2.5V @ 25°C		0,7	tbd	mA_{rms}
PP off mode	Vin = 2.5V @ 25°C		80	tbd	μA_{rms}
PP ULE mode	Vin = 2.5V @ 25°C			tbd	μA_{rms}
FP Talk mode (1 voice link)	Vin = 2.5V @ 25°C			tbd	mA_{rms}
FP Idle mode	Vin = 2.5V @ 25°C		85	tbd	mA_{rms}

4.5 Radio Performance

The radio uses RTX's DECT/CAT-iq protocol, with the key parameters as defined in Table 6. The parameters are verified as conducted measurements on the module antenna terminal.

RTX1040 DECT				
No	**Item**	**Radio Part**	**Specification**	**Comment**
1	Receiver Sensitivity	DECT	Minimum: -89 dBm Typically: -92 dBm Maximum: -93 dBm	@ BER = 0.001
2	Receive IIP3	DECT	-26dBm	
3	Transmit Power (NTP)	DECT	Minimum: 21dBm Typically: 23 dBm Maximum: 24 dBm	@ 2,5V supply
4	Operating Frequency Band	J-DECT	1895.616MHz～ 1902.528MHz	
5	Carrier Frequencies	J-DECT	F1 1895.616MHz F2 1897.344MHz F3 1899.072MHz F4 1900.8MHz F5 1902.528MHz	
6	Transmit Power	J-DECT	10 mW or lower mean power pr channel (ARIB STD-T101)	

Table 6. Key RF parameters

4.6 Test Interface

The FP and PP has a UART & JTAG test interface. The UART supports the RTX UART interface specification, as this interface will be used during the RTX development and production. The JTAG interface will be used during development at RTX.

The following connections will be available:

Function	Remarks
Ground (GND)	
UART RX	$V_{DDIO} = 1.8V$ $V_{high} > 0.7 * V_{DDIO}$ $V_{low} < 0.3 * V_{DDIO}$
UART TX	$V_{DDIO} = 1.8V$ $V_{high} > 0.7 * V_{DDIO}$ $V_{low} < 0.3 * V_{DDIO}$
Supply	$3 \pm 0.2V$
JTAG	$V_{DDIO} = 1.8V$ $V_{high} > 0.7 * V_{DDIO}$ $V_{low} < 0.3 * V_{DDIO}$

Table 7. Test & debugging interface

4.7 PCB

The PCB must meet the following specification:

- PCB shall be produced by UL recognized manufacturer
- PCB shall be manufactured in accordance with IPC6012 – class 2
- Flammability Rating must be UL94-V0 or Better
- PCB thickness = 1.0mm ± 10%
- Single sided SMD mounting.
- Standard FR4 4-layers PCB with no micro vias and no silkscreen.
- Surface Treatment : gold or gold flash

Layer	Spec
Solder Mask - Top Layer	
Layer 01 – Top Layer	17 µm Basic CU
Prepreg	2 x 2116
Layer 02 - Inner Layer	35 µm Basic CU
Core substrate	0.016"
Layer 03 - Inner Layer	35 µm Basic CU
Prepreg	2 x 2116
Layer 04 - Bottom Layer	17 µm Basic CU
Solder Mask - Bottom Layer	

Table 8. PCB layer structure

Marking on PCB Board	Marking placed in
PCB Manufacturer recognized symbol/logo	Solder mask
Flammability Rating of PCB ex. "UL94-V0"	Solder mask
Copper layer numbering	Not used

Table 9. PCB marking

5 Soldering Profile

The RTX1040 should be soldered using a standard reflow soldering profile and standard solder paste as shown below. Adjustments to the profile may be necessary depending on process requirements.

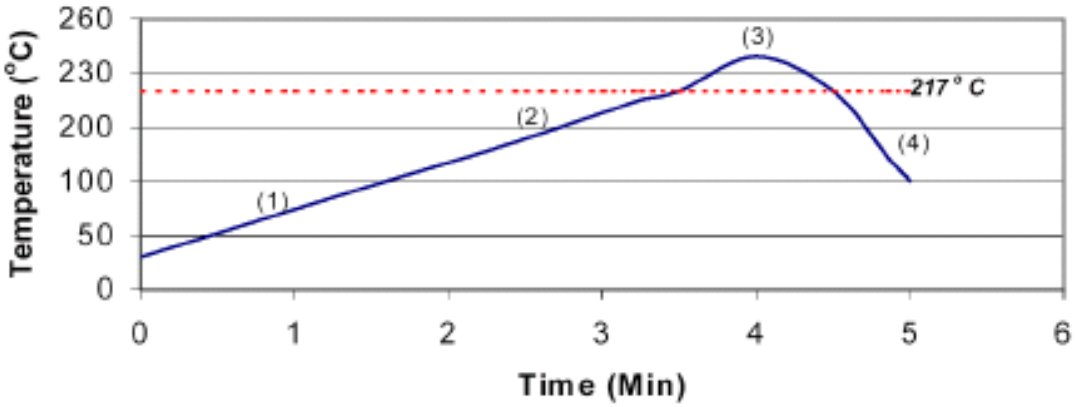


Figure 4: Solder Paste Composition: Sn96.5 / Ag3 / Cu0.5 alloy. Solder Paste supplier: Indium Corporation.

1: Preheat
The temperature rise from room temperature to 150 degrees shall be made for 30 seconds or longer. Typically 90 – 120 seconds. A linear ramp rate of 0.5 – 2.0 degrees/second allows gradual evaporation of volatiles.

2: Soak or Dryout
When 150 degrees is reached, the temperature raised to 190 degrees with a continued linear ramp of 0.5 – 2.0 degrees/second. Typically 90 – 120 seconds. This stage serves to activate the flux and stabilize the temperature across the board. The uniform heating allows a more linear ramp rate right up to liquid temperature.

3: Reflow
The linear ramp rate of 0.5 – 2.0 degrees/second is continued up to the point of liquidus. When liquidus is reached the temperature should rise with about 1-2 degrees/second to a spike 15-43 degrees above liquidus to form a quality solder joint. Time above liquidus should be 30-90 seconds to reduce excessive inter-metallic compound. Thermal damage and charring of the post-reflow residue can also result from excessive time above liquid and/or too high a peak temperature.

4: Cooling
A rapid cooldown of < 4 degrees/second is desired to form a fine grain structure. Slow cooling will form a large grain structure, which typically exhibits poor fatigue resistance. If excessive cooling > 4 degrees/second is used, both the component and the solder joint can be stressed due to a high TCE mismatch.

Stencil thickness of 0.127 mm is recommended.

6 Standards & Approvals

If the RTX1040 module is put into production, it will be certifiable against the following standards:

6.1 Radio, EMC and safety

Japan	
Type Approvals	**Standard**
Radio and EMC	ARIB STD T-101 TELEC-T254
SAR	TBD

Continental EU	
Type Approvals	**Standard**
Radio	ETSI EN 300 406 ETSI EN 300 175
EMC	EN 301 489-6, EN 301 489-1
Safety (R&TTE)	IEC/EN 60950-1: 2010
RoHS	2002/95/EC
SAR	EN 50385 (Confirmation Certificate or SAR Impact assessment may be enough)
Environmental	comply with European RoHS requirements

US	
Type Approvals	**Standard**
Radio and EMC	FCC Part 15, subpart D. (1920 – 1930 MHz)
SAR	FCC guideline (OET bulletin 65 Suppl. C: 2001)

6.2 Environmental

Parameter	Requirement
Temperature	Non-operational : -20°C to 60°C Operational: 0°C to 50°C
Humidity	Non-operational : 30 - 95%, non-condensing Operational: 30 - 95%, non-condensing

Parameter	Requirement
Mechanical shock	TBD
Vibration	TBD

Indicative humidity tests are carried out in RTX facilities. Full humidity testing and documentation of test results shall be conducted as part of an ODM supply of modules.

6.3 Flammability

All flammable parts used shall be made of material which does not exceed the flammable grades specified in the table below.

Part	Grade of flammability	Documentation
Printed circuit board (PCB)	UL94 V-0	Certificate or UL number

7 Software Specification

This section contains a description of the standard software for the RTX1040 Module.

Projects based on a custom firmware should refer to specification & documentation delivered as part of that development project.

7.1 Overall feature list

The table below describes the product high level features.

High-level Features	
Protocols Supported	DECT, DECT 6.0, (in future also J-DECT ARIB STD-T101 & Mandatory CAT-iq 2.0 features)
GAP Compliant	Yes
Number of handset pr base	6
Codecs	Full codec negotiation in accordance with CAT-iq spec. G722 (64 kbit/s voice service) ADPCM G726 (32kbit/s voice service)
Call features	All mandatory CAT-iq features (call transfer, call waiting, parallel calls, CLIP, CNIP etc.)
List Access Features	All mandatory CAT-iq features (Missed calls list, outgoing calls list, incoming accepted calls list, all calls list, contact list, internal names list, DECT settings list, line settings list)
ULE	The software supports ULE on both FP & PP.

7.2 General Description

The software implements all mandatory CAT-iq V2.0 features according to ETSI TS 102 527-3 V1.3.1 (2011-02) [1].

The software supports DECT, DECT 6.0 and J-DECT operation. J-DECT specifications are in very early adoption and the specifications may evolve further over time. The software is in compliance with specifications as of today.

The software is based on the standard RTX OS and framework, and supports the RTX production test interface, used for testing the hardware in production.

7.2.1 Test interface

The RTX defined production test interface is used to support development, production PCBA test and final test. The test interface uses batch files for communicating with the PCBA, and each command is described in the help file supplied with the batch files.

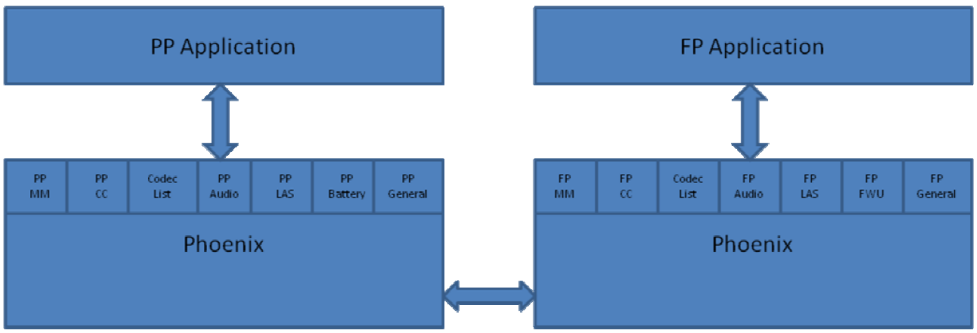
7.3 Software API

The RTX software platforms are controlled via an API called Phoenix. For each platform configuration (in this case PP and FP configurations) a subset of this API is used.

The Phoenix API is a generic API framework that provides API's for standard call features as well as advanced and product segment specific features, like battery management, and firmware update. Below is a list of all Phoenix sub API's.

- **CC** – PP (and FP speakerphone) UT call control interface between UI and
- NwkSwitch.
- **Codec** – Codec negotiation interface
- **Codec List** – UI codec negotiations support functions
- **FP CC** – Fp LT call control interface between UI and external host
- **FP FWU** – Fp firmware update
- **FP General** – Fp general handling (Linkdate, SW version, etc.)
- **FP MM** – FP Mobility Management (Protocol, registration etc.)
- **PP Audio** – PP audio handling (Tone handling, MIDI, mute etc.)
- **PP Battery** – PP battery handling (Charge, capacity calculation, etc)
- **PP General** – PP general handling (Linkdate, SW version, etc.)
- **List Access Service** – CAT-iq v2.0 list access
- **PP MM** – PP Mobility Management (Protocol, registration etc.)
- **Types** – Common type definitions shared between different API's

The API's available in a typical FP and PP system configuration is exemplified below:



7.3.1 Fixed Part Software API

Details of the Fixed Part Software and relating API's can be released after signing an NDA with RTX Telecom A/S.

7.3.2 Portable Part Software API

Details of the Fixed Part Software and relating API's can be released after signing an NDA with RTX Telecom A/S.