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CLRC663 Software Design Guide for NXPRDLib

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Document information

Info	Content
Keywords	NxpRdLib, CLRC663, MIFARE examples, MIFARE Plus, MIFARE Ultralight, MIFARE Ultralight C, SamAV2, Software design guide
Abstract	This document provides illustrative information on setting up the software stack for NXP's NxpRdLib

Revision history

Rev	Date	Description
0.2	20110601	Fig 1 and Section 4.3 Licenses updated
0.1	20110315	Initial Draft

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1. Introduction

1.1 Scope

The main target of this document is focused on explaining the steps to build up the software stack of NxpRdLib for CLRC663. For correct reader and chip configuration, different layer dependent objects must be generated and linked.

Protocol related communication to MIFARE cards is not scope of this document. For more information on card commands and how they are used, refer to the Example Project source code, the “NXP Reader library” document and the MIFARE application notes.

1.2 Audience

This document is intended for use by manufacturers wanting to develop applications based on the software stack NxpRdLib.

1.3 Applicable Documents or References

[1] [ISO/IEC 14443]

[2] NXP Reader Library (in .chm format)

[3] ISO/IEC 15693

[4] Felica

[5]

1.4 Acronyms and Abbreviations

BAL	Bus Abstraction Layer
HAL	Hardware Abstraction Layer
PAL	Protocol Abstraction Layer
AL	Application Layer

1.5 Requirements

Opening the Example Project Solution requires Microsoft Visual Studio 2005 or later.

Furthermore, a Pegoda2 reader is necessary to execute the examples.

2. Overview

The Example Projects provide developers with plenty of card communication examples based on MIFARE card products to start rapid development of applications. Examples included are:

- MIFARE Classic
- MIFARE Ultralight, MIFARE Ultralight C
- MIFARE Plus

- ISO14443B
- Felica
- ICODE

Programming applications with the NxpRdLib requires a basic knowledge of the different reader modes and the BFL structure.

Note, the complete command set is described in the NXP Reader library [2]. In order to use the command set within a new application project, the NxpRdLib.dll has to be included in the project file. The inclusion of DLL-build is not mandatory, alternatively the c-files could be included directly in the project.

Building the software stack for a specific reader mode requires different software models to be generated.

2.1 NXP Reader Library Overview

The NXP reader library is encapsulated into Layers and Components written in ANSI C. The library structure provides a modular way of programming and setting up the reader interface.

The reader library consists of 4 layers

- BAL (Bus Abstraction Layer)
- HAL (Hardware Abstraction Layer)
- PAL (Protocol Abstraction Layer)
- AL (Application Layer)

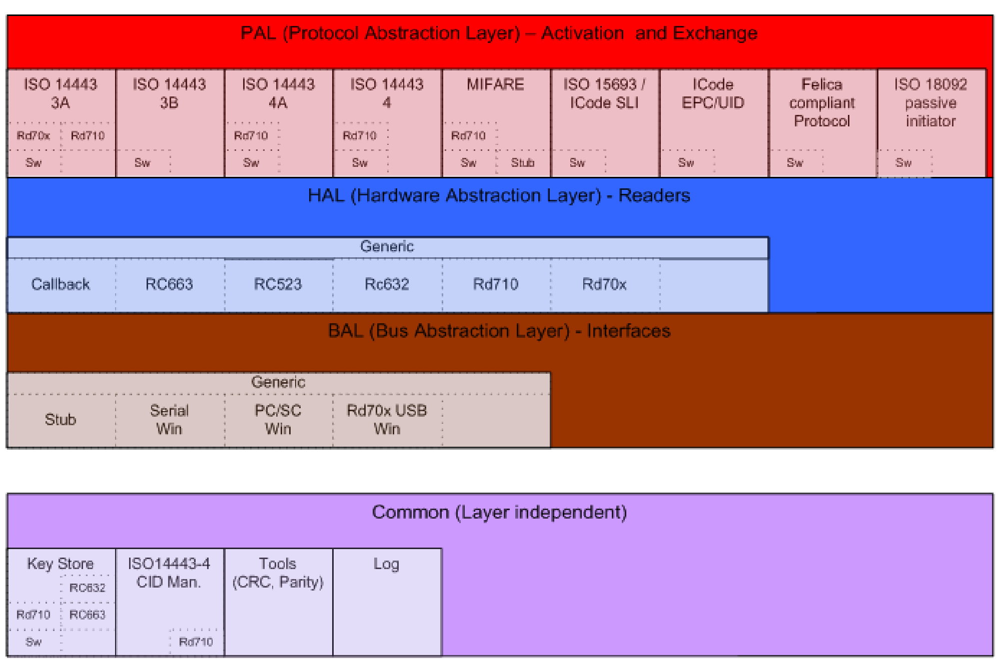

Fig 1. **Reader Library Model**

Each Layer consists of different components having a generic interface and a specific implementation.

2.2 Building the stack

In order to use the software library a stack of components has to be build up from bottom (BAL) to top (AL) layer. Fig 2 shows the various elements to build up a full software stack on the PC site for contactless card communication.

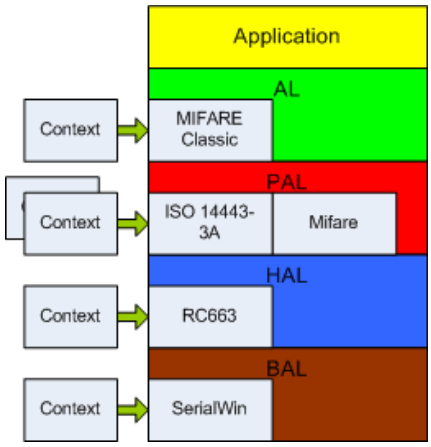

Fig 2. Building up the stack

Every component has to be initialized before usage. E.g. Initialization of the BAL layer requires specific context or data parameter to be fed into the component.

BAL Init

Therefore, Rd710 USB (Windows) BAL parameter structure has to be initialized

```
hbalReg_PcscWin_DataParams_t balPcsc;
```

and passed to the init function of the component

```
status = phbalReg_PcscWin_Init(&balPcsc, sizeof(phbalReg_PcscWin_DataParams_t));
```

Every component has an Init function for context data and component initialization. The init function checks the context data length to ensure no buffer overflow.

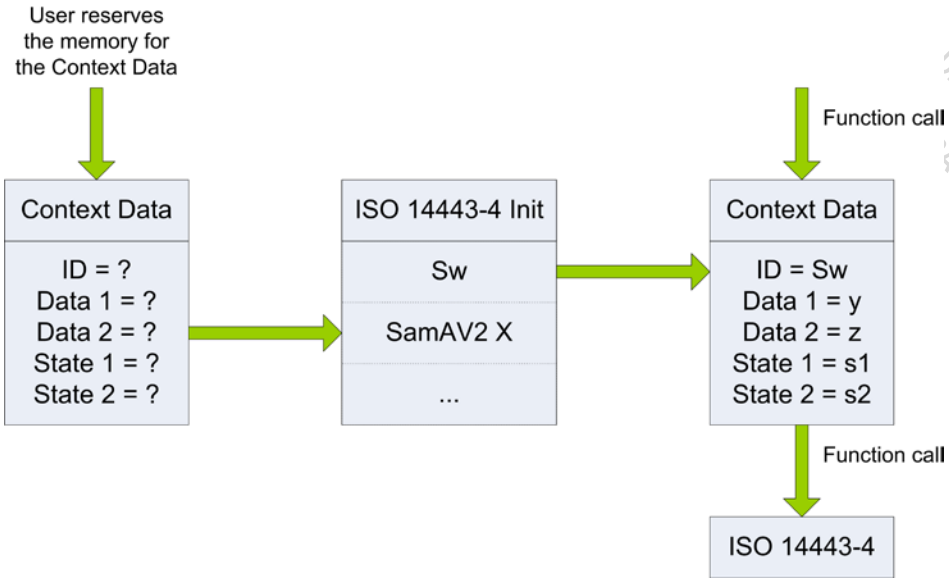

Fig 3. Context handling

The correct reader port parameter must be set with the setPort-function. Depending on the reader mode, different parameters are possible.

```
status = phbalReg_SetPort(&balPcsc, pComPort);
status = phbalReg_OpenPort(&balPcsc);
```

The next layer can now be built up using the same procedure.

HAL init

The HAL layer requires the structure

```
phhalHw_Rd710_DataParams_t halRd710;;
```

to be initialized first.

The init routine is called by the HAL-structure parameter and referenced to the bottom BAL layer:

```
status = phhalHw_Rd710_Init(
        &halReader,
        sizeof(phhalHw_Rd710_DataParams_t),
        &balPcsc,
        NULL,
        bHalBufferReader,
        sizeof(bHalBufferReader),
        bHalBufferReader,
        sizeof(bHalBufferReader));
```

Depending on the connected reader type (SAM, no SAM, …) it might be necessary to initialize additional structures. Refer to the examples in the code for more information.

PAL Init

The protocol abstraction layer inherits implementation of card activation and card protocol. Dependent on the card to be operated in the field, specific objects have to be initialized. For communication with a MIFARE Ultralight card on a Pegoda in non-SAM mode for example, we have to call the following structures:

```
  status = phpalI14443p3a_Sw_Init(&palI14443p3a, sizeof(palI14443p3a), &halReader);
  /* initialise the 'protocol abstraction layer' PAL: */
  /* use the the ISO14443-4 TypeA protocol, glue it togeter with the underlaying PAL
component. */
  status = phpalI14443p4a_Sw_Init(&palI14443p4a, sizeof(palI14443p4a),&halReader);
  /* initialise the 'protocol abstraction layer' PAL: */
  /* use the the ISO14443-4 protocol, glue it togeter with the underlaying PAL
component. */
  status = phpalI14443p4_Sw_Init(&palI14443p4, sizeof(palI14443p4), &halReader);
  /* initialise the 'protocol abstraction layer' PAL: */
  /* use the the Mifare protocol, glue it togeter with the underlaying PAL component.
*/
 status = phpalMifare_Sw_Init(&palMifare, sizeof(palMifare),&halReader, &palI14443p4);
  /* initialise the Key Store: */
 status = phKeyStore_Sw_Init(&KeyStore, sizeof(KeyStore), pKeyEntries,
wNoOfKeyEntries, pKeyVersionPairs, wNoOfKeyVersionPairs, pKUCEntries,
wNoOfKUCEntries);
```

On some machines the RS232 physical interface jitters when the port is opened. For that case, send a dummy command in order to resynchronize the interface. */

```
    phhalHw_WriteRegister(&halReader, 0x37, 0xFF);
```

Then, the HAL has to be configured for type-A cards with command

```
     status = phhalHw_ApplyProtocolSettings(&halReader, PHHAL_HW_CARDTYPE_ISO14443A);
```

Different card settings are defined in the header file ***phhalHw.h.***

AL operations

The application layer is the top layer of the software stack, providing specific implementations of various contactless protocols. The activation of the card must be done upfront in the lower protocol abstraction layer.

Typical examples could be activating and authenticating the card.

```
status = phpalI14443p3a_ActivateCard(&palI14443p3a, pUidIn, bLenUidIn,
pUidOut, &bLenUidOut, &bSak, &bMoreCardsAvaliable);


status = phalMfc_Authenticate(&alMifareC, bBlockNo, bKeyType, wKeyNumber,
wKeyVersion, pUidOut, bLenUidOut);
```

For detailed examples refer to the source code in the Example project.

Layer independent components

The software keystore and cryptographic functions in the library are not part of the layered approach. Before using any crypto operations within the provided functions, the dedicated crypto implementation has to be initialized:

```
phStatus_t phCryptoSym_Sw_Init  ( phCryptoSym_Sw_DataParams_t *  pDataParams,
  uint16_t  wSizeOfDataParams,
  void *  pKeyStoreDataParams
 )
```

3. How to set up different reader modes

The following subchapters should provide an entry point for understanding the basic handling of different reader modes and setting up the software stack, respectively.

Some points to remember from chapter 2:

- In order to use the library, the NxpRdLib software stack has to be built up from bottom to top layer
- Every component has dependencies to a component on the same layer or below
- For every card a complete stack has to be built to be able to communicate with the card
- The HAL layer provides the functionality to switch between multiple cards.

3.1 Single ISO14443 card activation

The basic example of activation a single card and initializing the components and layers are already described in chapter 2.2. The stack model is outlined again in Fig 4.

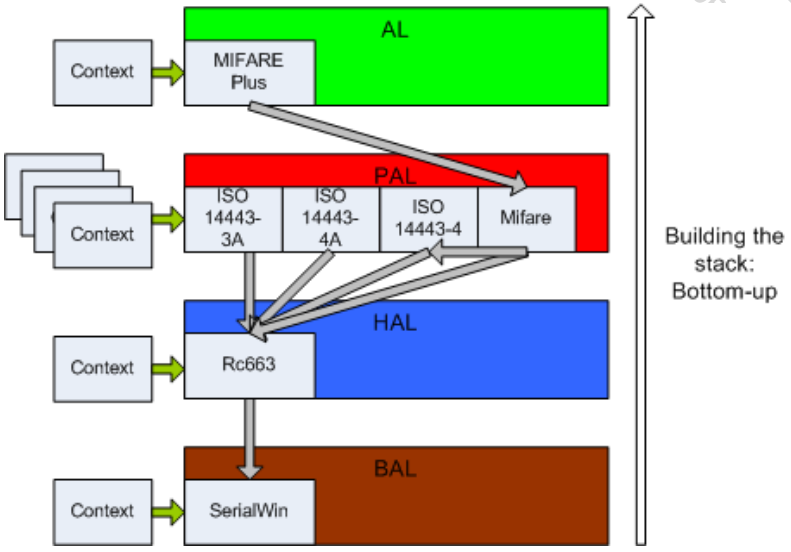

Fig 4. Single ISO14443 card activation

3.2 Multiple ISO14443 card activation

Communicating to more than one card requires initialization of additional HAL layers on a common BAL layer:

```
phhalHw_Rd710_DataParams_t halRd710[1];
phhalHw_Rd710_DataParams_t halRd710[2];
phhalHw_Rd710_DataParams_t halRd710[x];
```

The Init function has to be called for all HAL objects while specifying the same BAL object to all HAL objects.

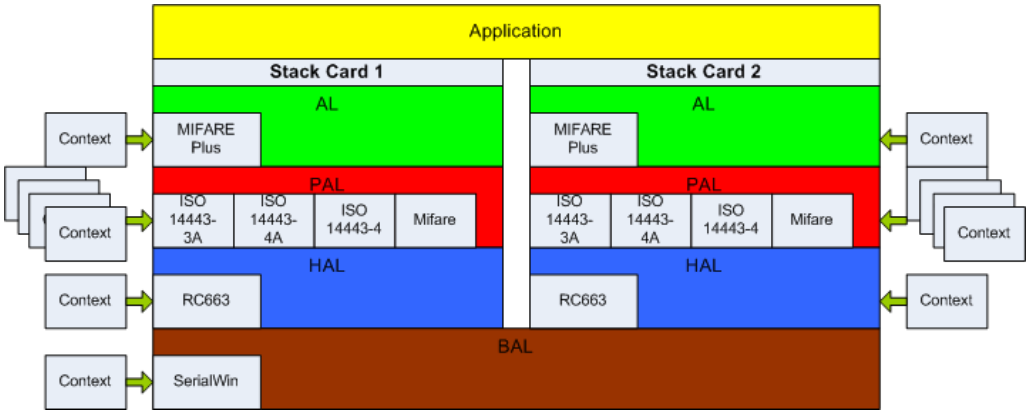

Fig 5. Multiple ISO14443 card activation

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