TI Designs

SimpleLink™ Wi-Fi™ Enabled NFC Card Reader

TI Designs

TI Designs provide the foundation that you need including methodology, testing and design files to quickly evaluate and customize the system. TI Designs help *you* accelerate your time to market.

Design Resources

TIDC-CC3200-NFC-CARD-READER	Tool Folder Containing Design Files
CC3200	Product Folder
TRF7970A NFC/RFID BP	Product Folder

TI E2E™ Community

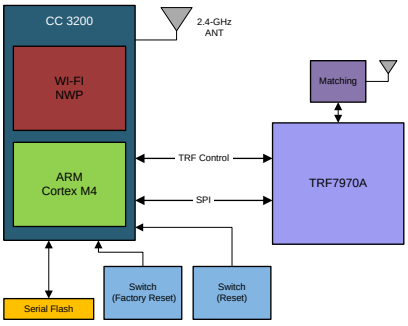
ASK Our E2E Experts
WEBENCH® Calculator Tools

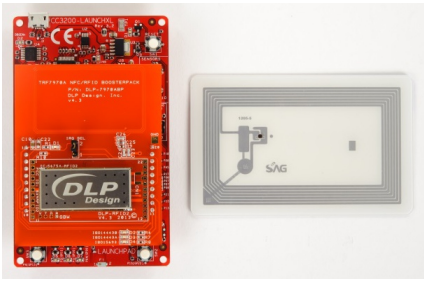
Design Features

- Offers Integrated CC3200 SimpleLink™ Wi-Fi™ and Embedded Wireless MCU
- Offers Wi-Fi Connectivity Over IEEE-802.11 b/g/n Networks
- Offers Near Field Communication (NFC) Standards NFCIP-1 (ISO/IEC 18092) and NFCIP-2 (ISO/IEC 21481)
- Offers an 13.56-MHz, HF RFID Reader and Writer
- Offers Completely Integrated Protocol Handling for ISO15693, ISO14443A/B, and FeliCa
- Offers an Integrated SMTP to Securely Transfer Data
- Offers an Integrated HTTP Server for Easy Provisioning
- Offers a Complete System Design With a Demonstration and Board Design Guide and Software

Featured Applications

- Enterprise Systems Accessories
  - Business Intelligence and Retail
  - Resources Planning Systems
- Electronic Point of Sale
- Industrial – Merchandise Management
- Industrial Asset Tracking
- Factory Control





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1 System Description

This TI design™ demonstrates the integration of the SimpleLink CC3200 Wireless MCU and the TI NFC device (DLP-7970A). The main use case sends an email to a preconfigured email server using an SMTP email application when the NFC reader detects a TAG. The MCU in the system is the CC3200 that controls the NFC device over an SPI interface

The system starts at configuration mode that lets you provision the SimpleLink-based system to the access point.

The current application supports the following two ISO types:

- ISO15693
- ISO14443A

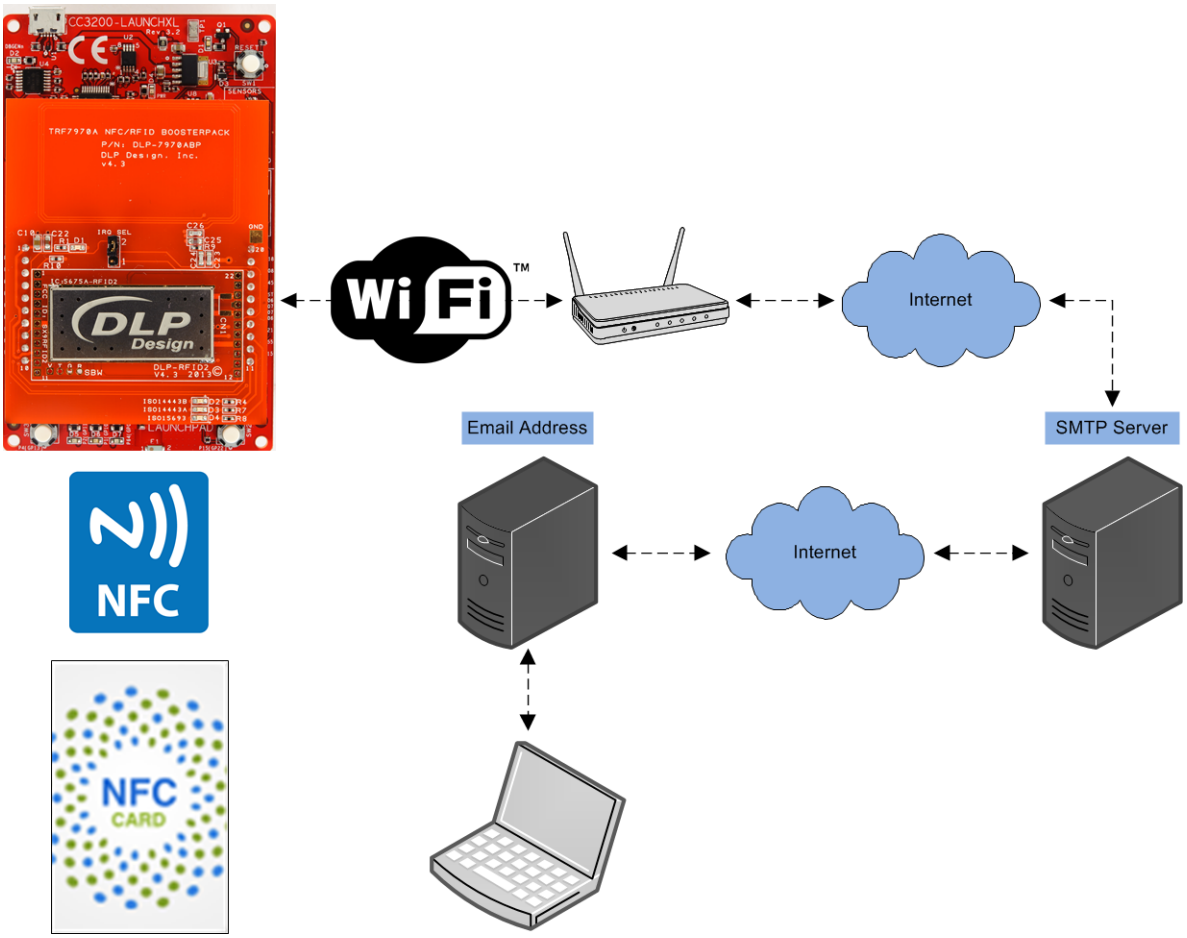

Figure 1. System Description

2 Block Diagram

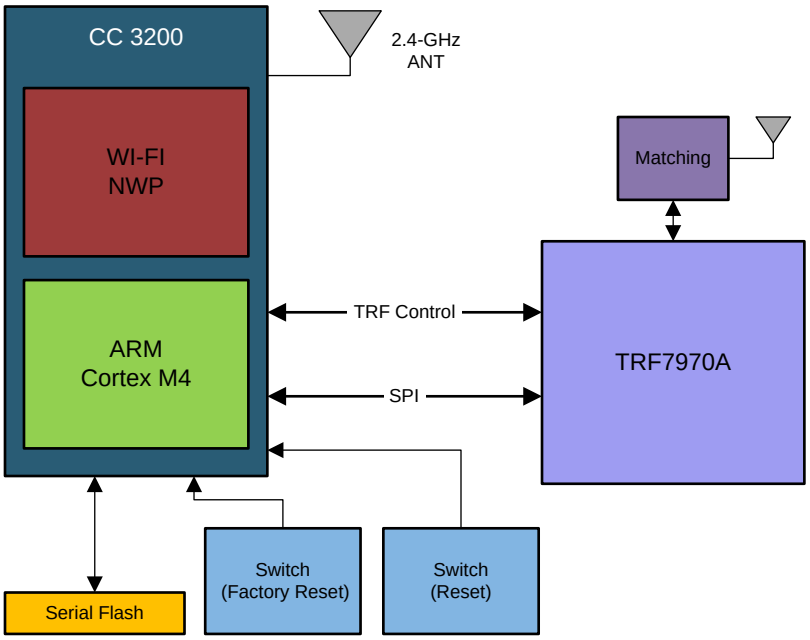

Figure 2. Block Diagram

3 Highlighted Products

The reference design features the following devices:

- CC3200
- DLP 7970

3.1 CC3200

The SimpleLink Wi-Fi CC3200- wireless MCU integrates a high-performance Cortex-M4 MCU and peripherals. This design utilizes the CC3200-LAUNCHXL EVM that contains the CC3200 reference design along with emulation and a BoosterPack™ connector. The CC3200 MCU controls the NFC/RFID using an SPI interface.

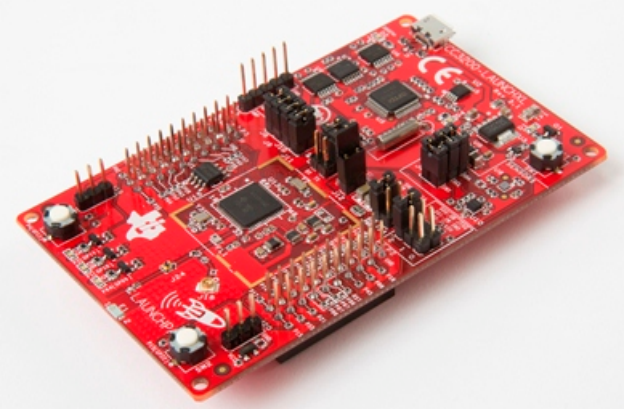

Figure 3. CC3200-LAUNCHXL

3.2 DLP 7970

NFC/RFID BoosterPack (DLP-7970ABP) is an add-on board designed to fit TI's MCUs. TRF7970A is a multi-protocol, fully integrated 13.56-MHz NFC/ HF RFID chip.

Figure 4. TRF7970 BP

For more information on each of these devices, see the respective product folders at www.TI.com.

4 System Design Theory

TI has predefined the ports on the TRF7970 BP. You must configure the pins and GPIOs of the CC3200 MCU in a certain way. Table 1 shows port mapping on both pieces of hardware.

Table 1. BP and LP Port Mapping

Function	Ports on TRF7970 BP	Port on CC3200 LP	Pin on CC3200	GPIO on CC3200
NFC TRF EN	10	P1.10	2	GPIO 11
NFC TRF IRQ	8	P1.8	62	GPIO 07
SPI CS	9	P1.9	1	GPIO 10
SPI MOSI	15	P2.6	7	GPIO 16
SPI MISO	14	P2.7	6	GPIO 15
SPI CLK	7	P1.7	5	GPIO 14

4.1 Software

MCU runs an initial configuration including the following:

- Clock configuration
- Pin muxing
- GPIO init
- SPI init
- UART init
- COUNTERs
- TRF7970 init

After the initial configuration, the MCU runs the FSM in the software states in Table 2.

Table 2. Software State Description

State	State Description
Init	Initialize the parameters.
Create config	New configuration record created and saved into serial flash.
Save config	The current configuration record is saved into the serial flash.
Read config	Parameters are updated based on information saved in the serial flash.
Delete config	Erase the configuration stored in serial flash.
Set AP	NWP gets into AP mode with predefined SSID name.
Set STA	NWP gets into STA mode. Connect to the AP with SSID name saved in the connection profile.
Connect to gmail	Get a Gmail IP. Ping the IP by.
NFC Reader OFF (AP)	NWP is in AP mode. NFC reader is disabled. You can connect and configure the device.
NFC Reader ON (STA)	NWP is in STA mode connected to AP. NFC reader is scanning for Iso15693 and Iso14443a tags. If tag is detected, it reads the tag ID and 4 lines from the tag buffer.
Send an email	Create an email subject and message based on the tag information. Open the secured socket with the Gmail server. Run the SMTP state machine. Send an email to the administrator address using a predefined Gmail ™account.

Figure 5 shows the software flow.

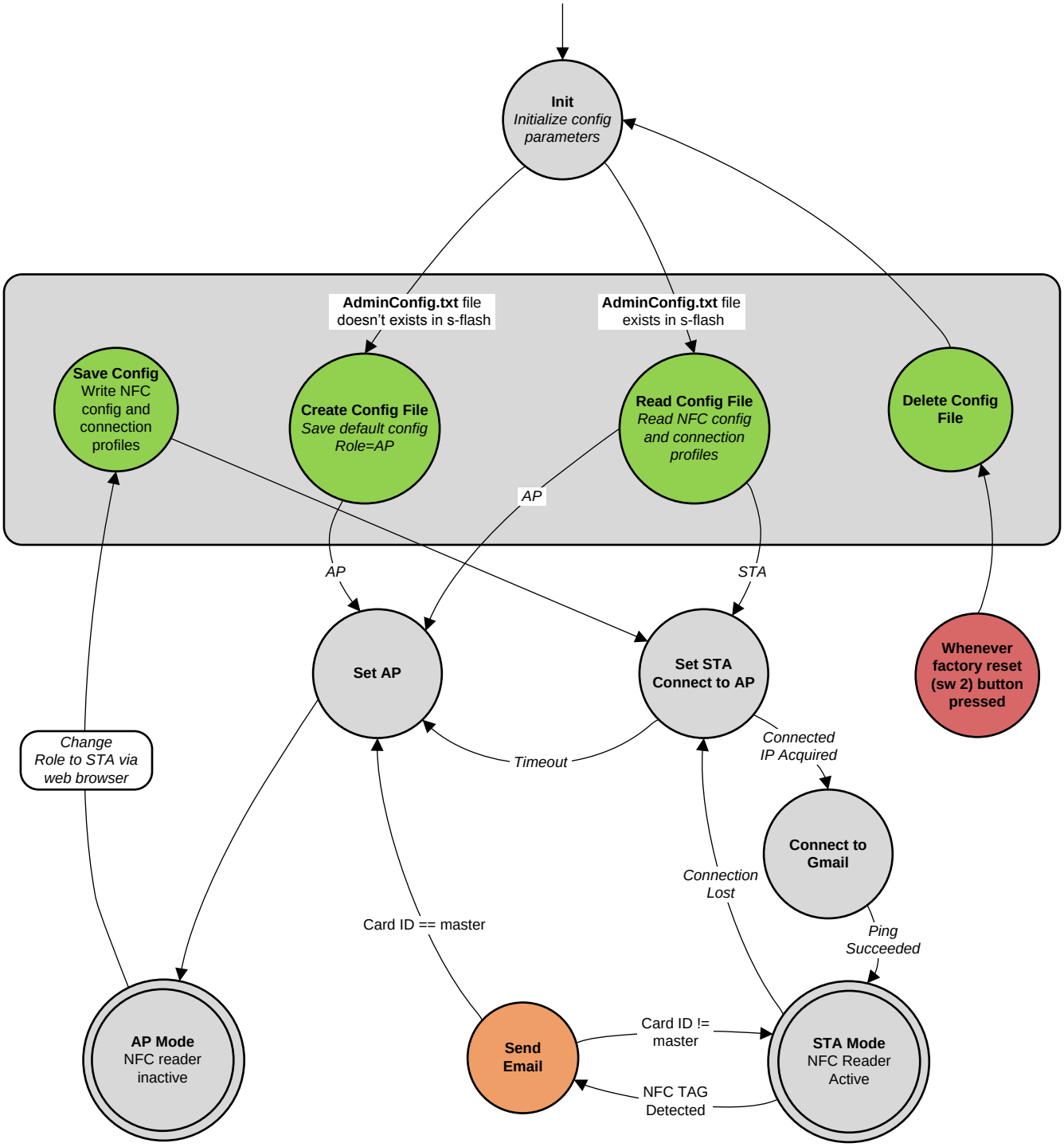

Figure 5. Software FSM

5 Getting Started

This section explains how to bring up and run this system.

5.1 Hardware

The following pieces of hardware are required:

- CC3200-LAUNCHXL, V4.1
- TRF7970A NFC/RFID BP
- Any NFC card that supports ISO15693 and ISO14443A

You can read the cards but cannot program them.

5.2 Firmware and Tools

The following firmware and tools are required:

- Uniflash – A CC3200 flashing tool
- Tera Term
- CC3200 SDK 1.1.0 and the latest service

5.3 Application Code

Flash the board using Uniflash. Include Table 3 the flashing process.

You can find the files in the following installation directory:

C:\ti\CC3200SDK_1.1.0\cc3200-sdk

Table 3. Code Files

Examples	Descriptions
nfc_reader/	
demo_config.h	global settings: default SSID, security, email, master ID, and so forth
*.c, *.h	application specific files
nfc/	NFC driver
html/	Html files that must write to serial flash (sFlash)

5.4 Configuring the Source Email

TI verified this demonstration with Gmail.

When using Gmail, you must change the security definitions.

To configure the source email, do the following.

1. Navigate to My Account.
2. Navigate to Sign-in and security.
3. Navigate to connected applications and sites (you may need to scroll to the end of the page).

4. Turn on Allow less secure applications. (See Figure 6.)

NOTE: This procedure ensures the demonstration connects to the source email without login errors and without considering sent massages as spam.

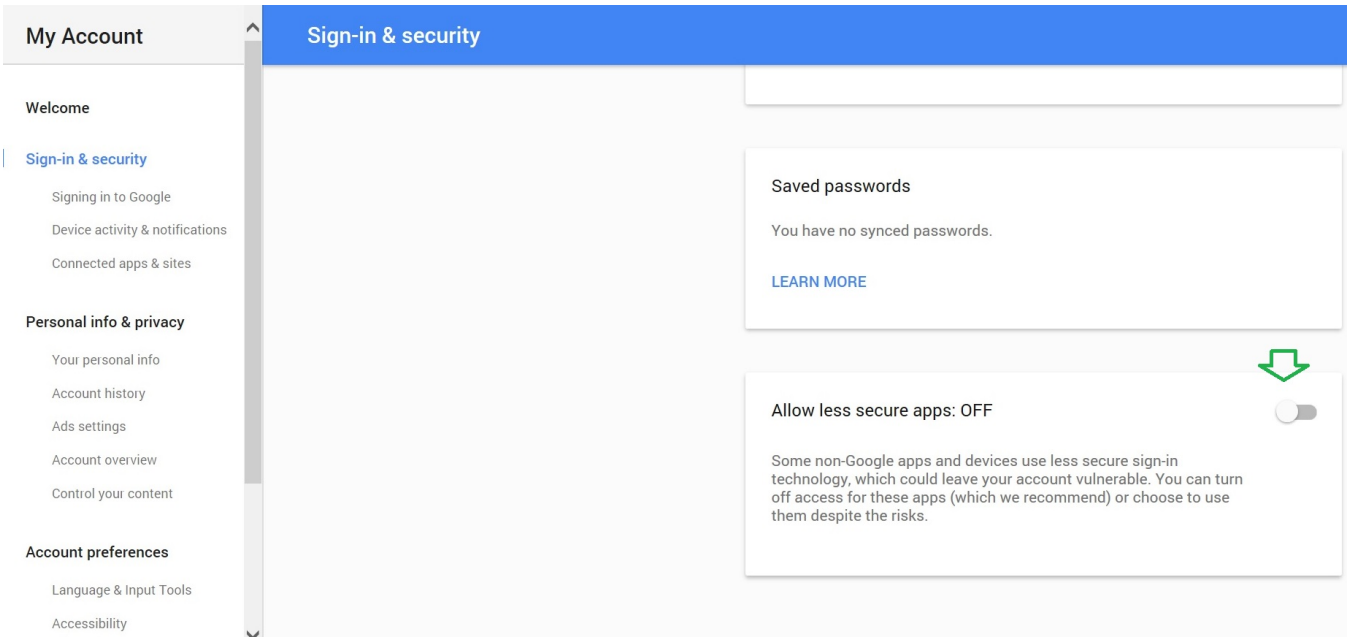

Figure 6. Security Setting Page in Gmail

6 Setting Up the Demonstration

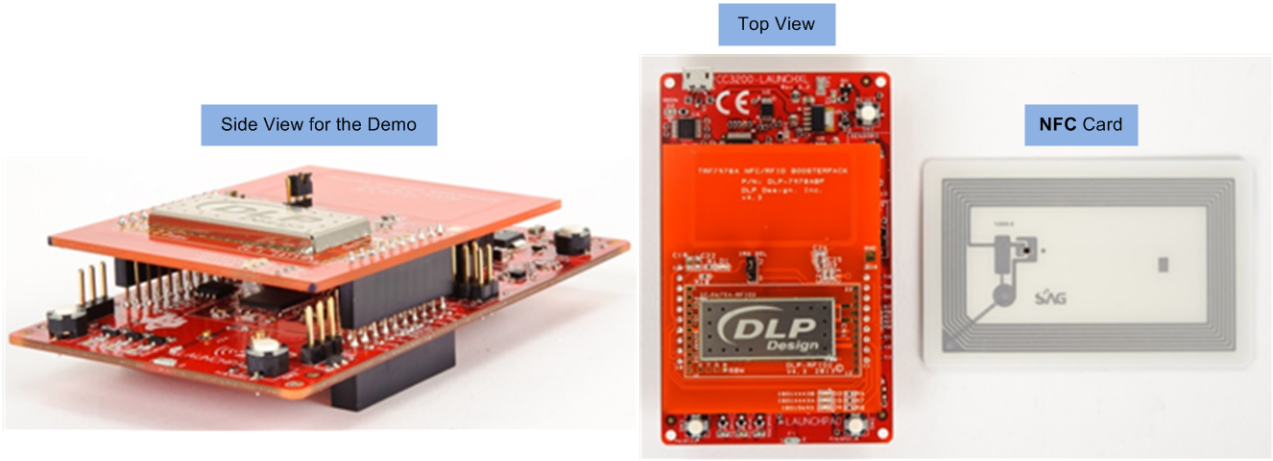

Figure 7. Configuring the Demonstration

6.1 Introducing the Demonstration

You must connect over the STMP service to send information from the NFC reader to the admin email.

Before starting the demonstration, consider the following terms:

- **SSID name and Security type:** the information of the specific access point that for use by the system
- **Admin Email Address:**the destination email address where you receive the information for scanned NFC cards
- **Admin Card ID:** the card number you assign as master
- **Source Email Address:** the source email address that the SMTP service sends information through
- **Email Password:**the password for the source email

6.2 Configuring the Demonstration (Configuration Mode)

After power up, the system starts in access point (AP) mode with the SSID name, NFCReader, and without security.

1. Verify that the AP is active by opening Tera Term and viewing the output in Figure 8 on the HyperTerminal.

NOTE: The yellow LED blinking indicates that the AP is active.

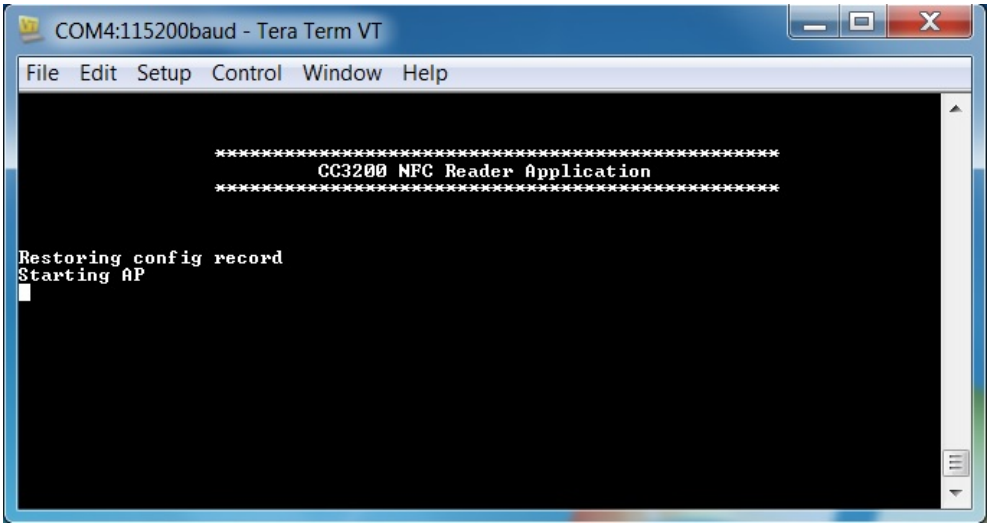

Figure 8. Teraterm Terminal When Starting the Device

2. Use a mobile device to connect to the NFC reader AP.

NOTE: Access the NFC reader AP using following IP number: 192.168.1.1 or type http://mysimplelink.net.

When connected to the NFC reader, the yellow LED start blinks at higher frequency.

3. Navigate to the NFC Demo Config tab.
4. Enter the SSID name.
5. Enter the Security type.
6. Enter the Security key.
7. Enter the Profile priority.

NOTE: If network parameters are blank, the NFC reader uses *demo* as a default, unsecure AP name.

8. Click Add. (See Figure 9.)
9. Enter the Admin Email Address.
10. Enter the Admin Card ID.
11. Enter the Source Email Address.
12. Enter the Email Password. (See Figure 9.)

NOTE: The administrator card holds a unique master NFC tag ID. If you leave the Admin Card ID empty, the program works but requires a master card to transfer from NFC active station (STA) to AP mode.

13. Change the device role from AP to STA. (See Figure 9.)
14. Click DONE.
15. Click Apply to enable the settings.

NOTE: When the email server connects, the NFC reader runs.

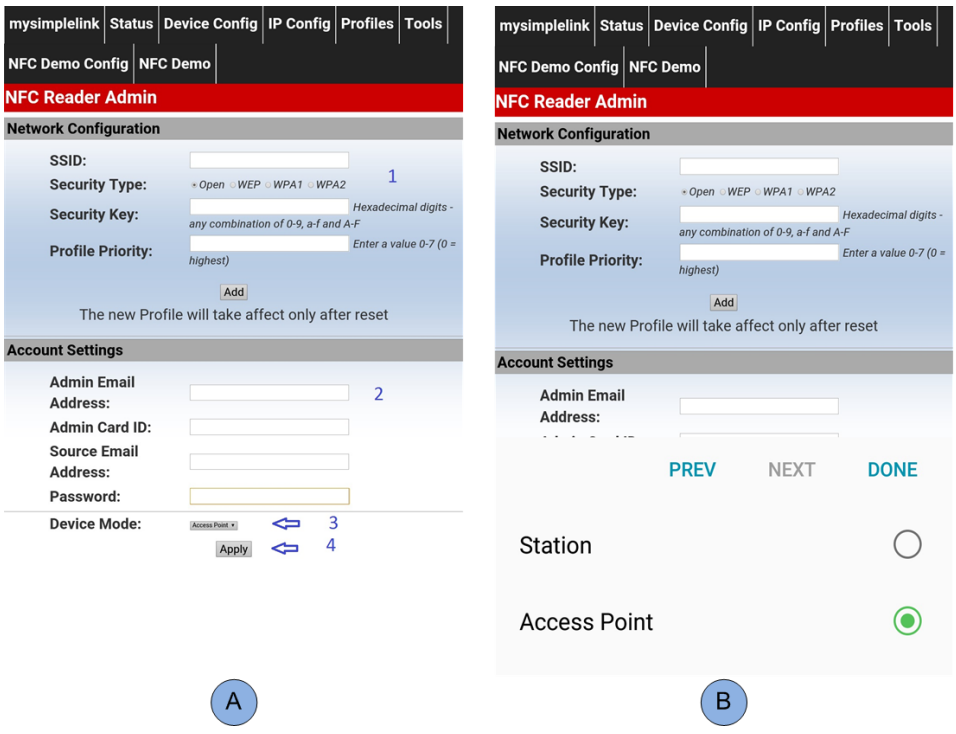

Figure 9. The NFC Demo Config Tab from the HTML Page

sFlash saves the network settings, admin or master data, and the source email and password. When powering up in the future, serial flash restores all admin parameters and the source email.

The NFCReader AP is unavailable and disconnects admin. The red LED blinking indicates that Simple Links has changed its role to STA and is trying to connect to the target AP. When connected, the red LED stops blinking. The red LED stays ON until the Gmail host IP is derived and pinged.

If unable to connect to the target AP in 10 seconds, the device switches back to AP mode to let you configure again.

6.3 Running the Demo (Active Mode)

The green LED blinking indicates that the NFC reader is connected to cloud and ready to scan NFC tags.

1. Open and view Tera Term to verify the connection and that the NFC reader is active. (See Figure 10.)

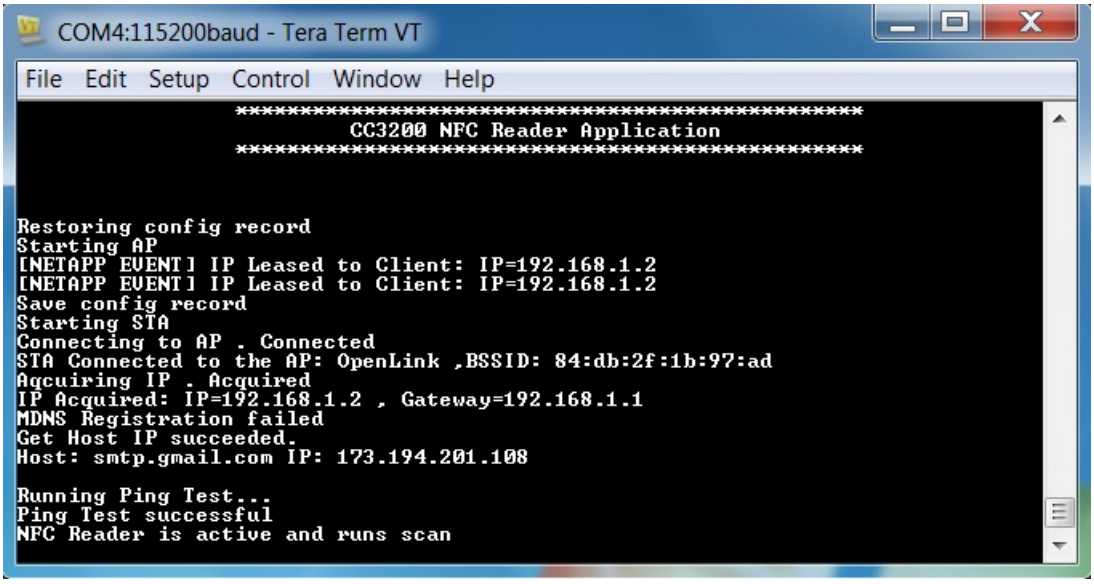

Figure 10. Tera Term Terminal Connected and the NFC Reader is Active

2. Bring any NFC tag close to the reader.

NOTE: The CC3200 sends an email to the admin email address. The email consists of the following:

- The NFC tag type
- The NFC tag ID number
- The content from the NFC tag
- The number of NFC tags scanned since the last reset
- A link to SimpleLink Wi-Fi

For an example of this email, see Figure 11.

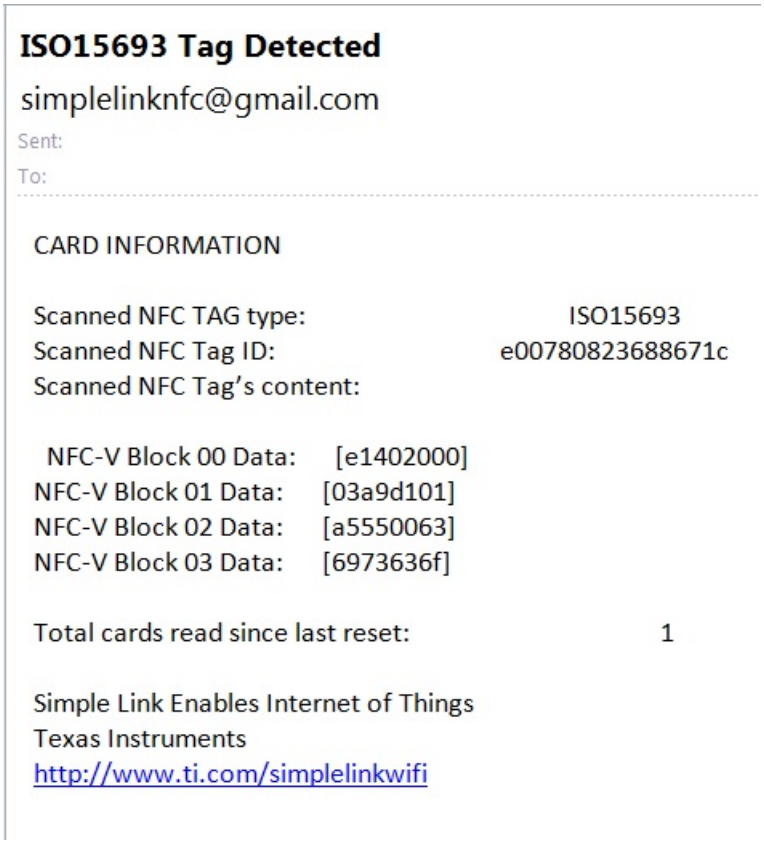

Figure 11. Email When a Non-master Card is Detected

3. Verify that the tag has been read by opening and viewing the Tera Term terminal. (See Figure 12.)

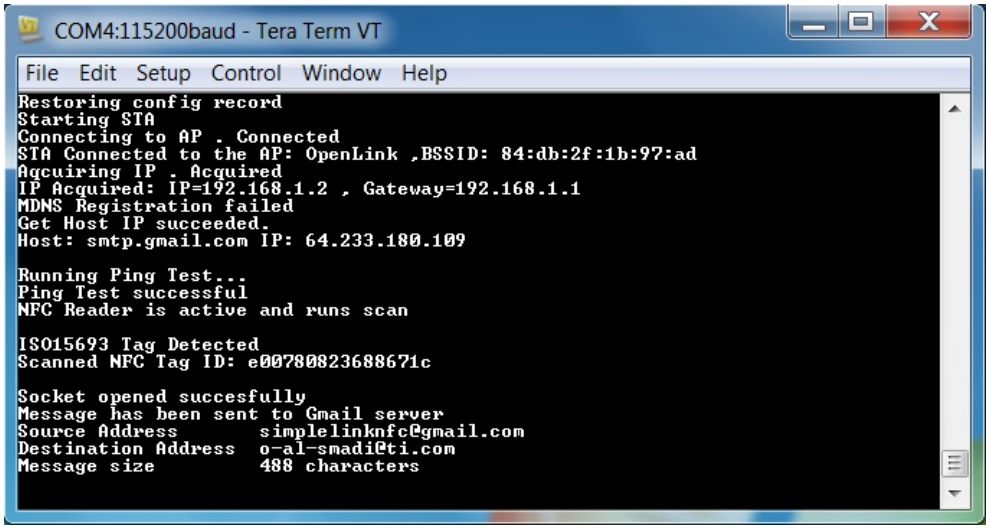

Figure 12. Tera Term Terminal When a Non-master Card is Detected

NOTE: If the reader detects the master tag, the reader sends the email and the device enters to AP mode ready for new configuration settings. NFC reader exits active mode and enters configuration mode (see Figure 13 and Figure 14). The configuration stored in sFlash remains. The master card ID in Figure 13 is e007000017f4e068.

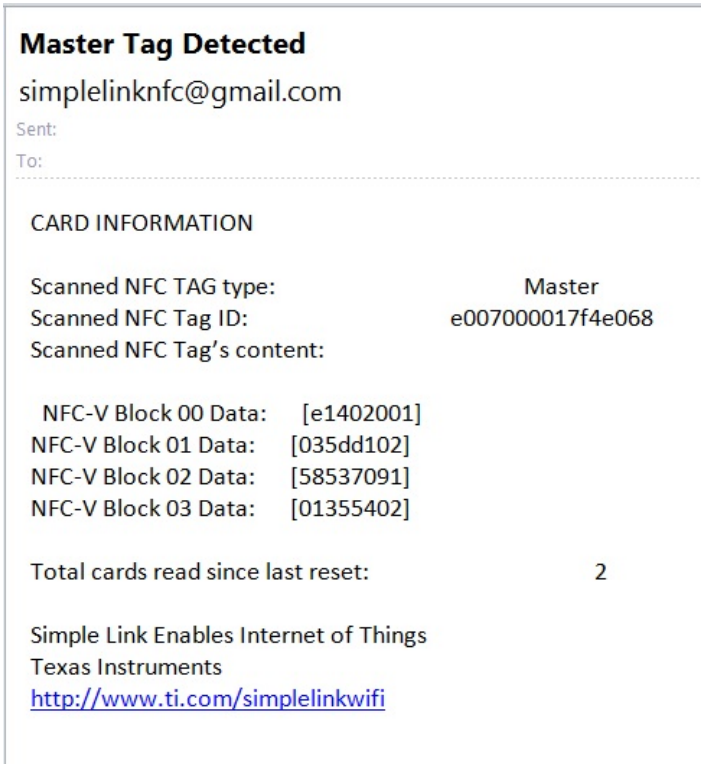

Figure 13. Email When the Master Card is Detected

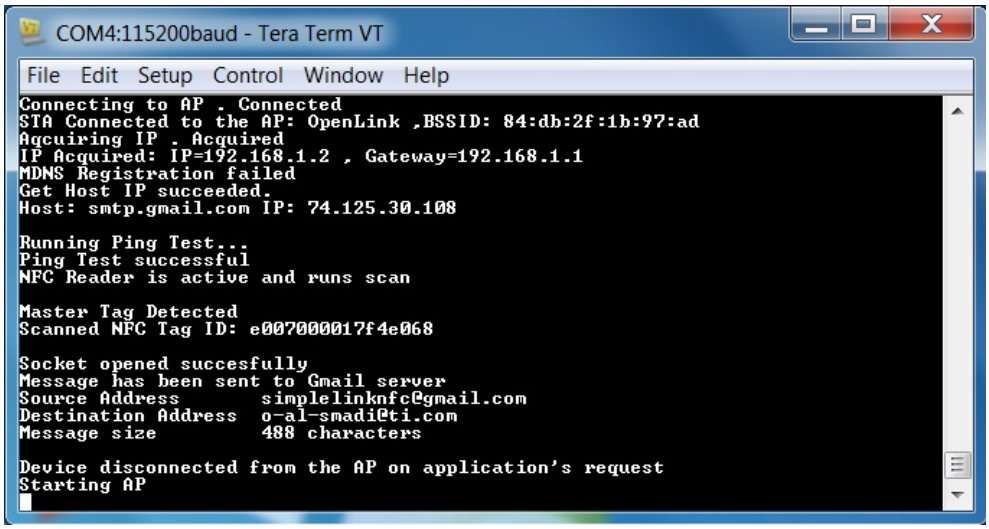

Figure 14. Tera Term Terminal When the Master Card is Detected

NOTE: From the NFC Demo tab, you can swipe the master card to read the last NFC card number and total NFC tags scanned since the last reset (see Figure 15).

When you change the role by swiping the master card, the system changes its role to AP mode and keeps its data.

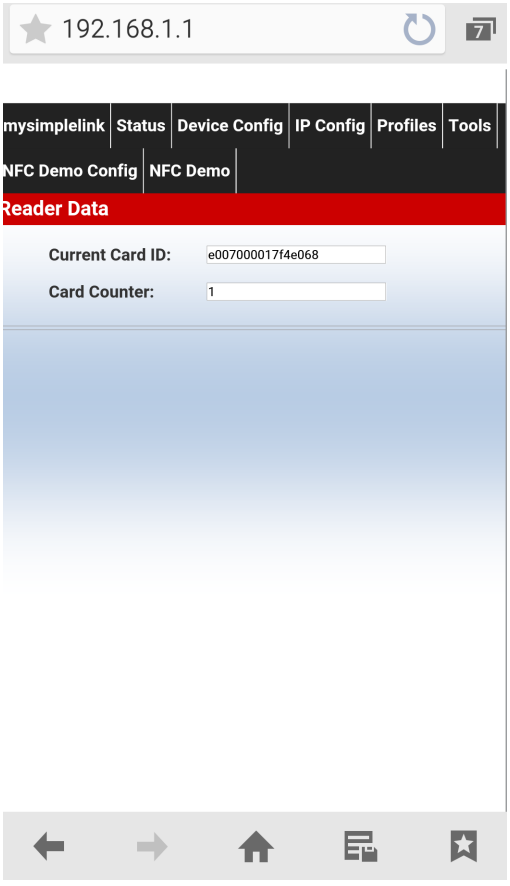

Figure 15. NFC Demo Tab from the HTML Page

6.4 Additional Configurations

To perform a factory reset, do the following:

1. Press Sw2.

NOTE: The reader restarts and removes all configurations from sFlash. The device starts in AP mode. The NFC reader stops. The device goes into configuration mode.

To change the configuration when in AP mode, do the following:

1. Add another SSID.
2. Add the security type.
3. Add the security key.
4. Change the source email address.
5. Change the source email password.
6. Change the mode from AP to STA.
7. Click Apply.

NOTE: This action saves a new configuration, connects, and activates the NFC reader.

mDNS broadcast is always enabled. The broadcast sends the following information in a packet:

- The NFC reader name
- The IP address of the device

7 Compile, Download, and Debug

The CC3200 SDK supports CCS 6.0.1, IAR 7.30, and GCC IDE/compiler.

To compile and debug CC3200, follow the steps in the *CC3200 SimpleLink Wi-Fi and IoT Solution With MCU LaunchPad™ Getting Started Guide* (SWRU376B).

The demo_config.h file contains the default settings and is located in the following directory:

C:\ti\CC3200SDK_1.0.0\cc3200-sdk

Table 4. demo_config.h Directory

Examples	Description
nfc_reader/	
demo_config.h	global settings: default ssid, security, email, master ID, and so forth

NOTE: You can change your default settings such as the default SSID, security, email, master ID, and so forth.

8 Design Files

The hardware in this design combines the CC3200 LaunchPad ™and the TRF7970 NFC BoosterPack.

To download the designs files (schematic, bill of materials, layout prints, gerber, assembly drawings, and the project files) for each board, see the following links:

- CC3200 LaunchPad
- TRF7970 NFC BoosterPack

9 Software Files

To download the software files, see the design files at TIDC-CC3200-NFC-CARD-READER.

10 References

- CC3200 SimpleLink Wi-Fi and Internet-of-Things solution, a Single-Chip Wireless MCU
- TRF7970A NFC BoosterPack

11 Terminology

- NFC: near field communication
- SMTP: Simple Mail Transfer Protocol

12 About the Author

SERGEY OSTROVSKY is a hardware engineer at TI where he implements CC3100/3200 Silicon hardware. Sergey brings to this role his 12 years of experience in hardware design.

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