



Research & Vehicle Technology
“Infotainment Systems Product Development”

Feature – NFC Entry & Start InterfaceClient
Infotainment Subsystem Part Specific
Specification (SPSS)

Version 1.4
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FORD CONFIDENTIAL



Revision History

Date	Ver	Notes	
January 29, 2021	1.0	Initial Release	
July 9, 2021	1.1		
	STR-681966/B-Terminology and Abbreviations	MBORREL4: Added BUN, removed PaaK	
	STR-830044/B-Architectural Design	MBORREL4: Added REQ-421702, REQ-421704. Added boundary diagram and REQ-423121	
	STR-915628/A-Boundary Diagram	MBORREL4: New STR	
	NFCES-BD-REQ-423121/A-NFCES Boundary Diagram	MBORREL4: New req.	
	NFCES-CLD-REQ-421702/A-NFCES Server2	MBORREL4: New class for BUN	
	NFCES-CLD-REQ-421704/A-NFCES OnBoardClient2	MBORREL4: New class for BCM	
	STR-681969/B-Physical Mapping of Classes	MBORREL4: Added NFCServer2, NFCEsOnBoardClient2	
	STR-814874/B-Logical Signal Mapping	MBORREL4: Updated table	
	NFCES-IIR-REQ-403768/B-NFCESInterfaceClient_Rx	MBORREL4: Added REQ-421705-707	
	MD-REQ-421705/A-VehicleStartKeySource_St	MBORREL4: New req.	
	MD-REQ-421706/A-VehicleStartKeyType_St	MBORREL4: New req.	
	MD-REQ-421707/A-VehicleStartKeyIndex_St	MBORREL4: New req.	
	MD-REQ-404939/B-DigitalKeyList_Rsp	MBORREL4: Added CAK to DeviceType, PairingID to Vector. Changed signal name	
	MD-REQ-404941/B-DigitalKey_Rsp	MBORREL4: Updated Request Status. Changed signal name	
	MD-REQ-404938/B-DigitalKeyList_Rq	MBORREL4: Changed signal name	
	MD-REQ-404940/B-DigitalKey_Rq	MBORREL4: Replaced FESN with PairingID. Changed signal name	
	STR-830046/B-General Requirements	MBORREL4: Added REQ-421701	
	NFCES-REQ-362366/B-Feature Configuration - InterfaceClient	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.	
	NFCES-REQ-403966/B-CCS & NFC Fleet Restrictions	MBORREL4: Added 'Acceptance Criteria', added CCS entity values	
	NFCES-REQ-403965/B-NFC Fleet Restriction Behavior	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.	
	NFCES-REQ-403964/B-NFC Powermode Conditions	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.	
	NFCES-REQ-403967/B-Pairing NFC Key to Enhanced Memory Profile	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.	
	NFCES-REQ-421701/A-NFCESServer2 Configuration	MBORREL4: New req.	
	NFCES-UC-REQ-404010/B-User Enters NFC Key Screen	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.	
	NFCES-UC-REQ-404011/B-NFC Key List Updated while NFC Screen Open	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.	
	NFCES-REQ-403969/B-Requesting the NFC Key List	MBORREL4: Added 'Acceptance Criteria', added PairingID, added clarification on screen entry. Changed signal name	
	NFCES-REQ-403970/B-Sorting and Displaying the NFC Key List	MBORREL4: Added 'Acceptance Criteria', corrected KeyStatus. Changed signal name	
	NFCES-REQ-406217/B-Waiting for NFCESServer Response	MBORREL4: Added 'Acceptance Criteria', changed signal name	



NFCES-REQ-406218/B-Failed NFCES Server Response	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-405551/B-Displaying NFC Key Statuses	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-REQ-405552/B-NFC Key List Character Limit	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-REQ-403971/B-Updating the NFC Key List While Being Viewed	MBORREL4: Added 'Acceptance Criteria', changed signal name
STR-831459/B-Activity Diagrams	MBORREL4: Removed placeholder REQ-403919. Added REQ-362250
NFCES-ACT-REQ-362250/A-Requesting NFC Key List	MBORREL4: New req.
NFCES-SD-REQ-403920/B-Requesting NFC Key List	MBORREL4: Updated title, added diagram
STR-831447/B-Use Cases	MBORREL4: Added REQ-421722
NFCES-UC-REQ-404000/B-Add NFC Key – User Approves Request	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404001/B-Add NFC Key – User Denies Request	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404002/B-Add NFC Key – Connectivity Lost before Add Request Sent	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404003/B-Add NFC Key – Connectivity Lost after Add Request Sent	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404004/B-Add NFC Key – MyKey Active	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404005/B-Delete NFC Key – User Approves Request	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404006/B-Delete NFC Key – User Denies Request	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404007/B-Delete NFC Key – Connectivity Lost before Delete Request Sent	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404008/B-Delete NFC Key – Connectivity Lost after Delete Request Sent	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-404009/B-Delete NFC Key – MyKey Active	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-405389/B-Add/Delete NFC Key – Connectivity Lost before Selecting Button	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-405390/B-Master Reset Performed - Retail Vehicle	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-405391/B-Master Reset Performed - Fleet Vehicle	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-UC-REQ-421722/A-Master Reset Disabled - NFC Key used to start vehicle	MBORREL4: New req.
STR-831446/B-Requirements	MBORREL4: Added REQ-421723, REQ-421724, REQ-421725
NFCES-REQ-406219/B-NFC Key Failed Response	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403982/B-Add NFC Key – User Input	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-REQ-403983/B-Add NFC Key – User Input Enable/Disable	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403989/B-Add NFC Key – FriendlyName	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.



NFCES-REQ-403984/B-Add NFC Key – NFCESInterfaceClient Request	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403990/B-Add NFC Key – Progress Screen Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403991/B-Add NFC Key – Add Request Sent Approval Required Notification	MBORREL4: Updated to require approval, added 'Acceptance Criteria', changed signal name
NFCES-REQ-421723/A-Add NFC Key – Add Request Sent Approval Not Required Notification	MBORREL4: New req.
NFCES-REQ-405015/B-Add NFC Key – Waiting for Tap Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-405016/B-Add NFC Key – Tap Timeout Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-404985/B-Add NFC Key – Already Pending Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403985/B-Add NFC Key – Key Already Paired Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403987/B-Add NFC Key – Storage Full Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-405017/B-Add NFC Key – Key Not Programmed Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-405018/B-Add NFC Key – No Connectivity Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-405019/B-Add NFC Key – System Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403973/B-Add NFC Key – Final Success Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403974/B-Add NFC Key – Final System Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403975/B-Add NFC Key – Final Denied Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403976/B-Add NFC Key – Final Expired Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403988/B-Add/Delete NFC Key – No Connectivity Notification	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-REQ-403986/B-Add/Delete NFC Key – MyKey Active Notification	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-REQ-403992/B-Delete NFC Key – User Input	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.
NFCES-REQ-403993/B-Delete NFC Key – User Input Enable/Disable	MBORREL4: Updated 4th bullet. Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403997/B-Delete NFC Key – Deleting Starting NFC Key	MBORREL4: Updated per newly added signals. Added 'Acceptance Criteria'
NFCES-REQ-421724/A-Disable Master Reset per Starting NFC Key	MBORREL4: New req.
NFCES-REQ-403994/B-Delete NFC Key – User Input Confirmation	MBORREL4: Added 'Acceptance Criteria' only, no requirement changes made. Same content as previous Rev.



NFCES-REQ-403995/B-Delete NFC Key – NFCESInterfaceClient Request	MBORREL4: Updated for PairingID, added 'Acceptance Criteria', changed signal name
NFCES-REQ-403996/B-Delete NFC Key – Delete Request Sent Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403981/B-Delete NFC Key – Already Pending Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-405020/B-Delete NFC Key – No Connectivity Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-405021/B-Delete NFC Key – System Failure Notification	MBORREL4: Added 'Acceptance Criteria', changes signal name
NFCES-REQ-403977/B-Delete NFC Key – Final Success Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403978/B-Delete NFC Key – Final System Failure Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403979/B-Delete NFC Key – Final Denied Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403980/B-Delete NFC Key – Final Expired Notification	MBORREL4: Added 'Acceptance Criteria', changed signal name
NFCES-REQ-403972/B-Persisting NFC Notifications	MBORREL4: Added 7 day max and 'Acceptance Criteria', changed signal name
NFCES-REQ-421725/A-Request Key List upon Final Notifications	MBORREL4: New req.
STR-831449/B-Activity Diagrams	MBORREL4: Removed placeholder REQ-403913. Added REQ-424659, REQ-424759
NFCES-ACT-REQ-424659/A-Add Digital Key	MBORREL4: New req.
NFCES-ACT-REQ-424759/A-Delete Digital Key	MBORREL4: New req.
STR-831450/B-Sequence Diagrams	MBORREL4: Added REQ-362251
NFCES-SD-REQ-362251/A-Add Digital Key	MBORREL4: New req.
NFCES-SD-REQ-403914/B-Delete Digital Key	MBORREL4: Updated title, added diagram

October 20, 2021

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MD-REQ-404939/C-DigitalKeyList_Rsp	MBORREL4: Added LocalID
MD-REQ-404941/C-DigitalKey_Rsp	MBORREL4: Added CancelRequest
MD-REQ-404940/C-DigitalKey_Rq	MBORREL4: Added LocalID and Cancel Request
STR-831457/B-Requirements	MBORREL4: Added REQ-458377, REQ-458338
NFCES-REQ-403969/C-Requesting the NFC Key List	MBORREL4: Added LocalID
NFCES-REQ-403970/C-Sorting and Displaying the NFC Key List	MBORREL4: Updated to include/clarify items to display per key. Updated Acceptance Criteria
NFCES-REQ-458337/A-InfoBook content	MBORREL4: New req.
NFCES-REQ-406218/C-Failed NFCESServer Response	MBORREL4: Added second paragraph for retry strategy. Updated Acceptance Criteria
NFCES-REQ-458338/A-Pending Add/Delete - Cancel Button	MBORREL4: New req.
STR-831446/C-Requirements	MBORREL4: Added REQ-441758, REQ-458377, REQ-458397



NFCES-REQ-403983/C-Add NFC Key – User Input Enable/Disable	MBORREL4: Updated the My Key condition to include KeyRearInProgress
NFCES-REQ-403989/C-Add NFC Key – FriendlyName	MBORREL4: Added rules around the Friendly Name. Updated Acceptance Criteria
NFCES-REQ-458377/A-Add NFC Key - Default FriendlyName	MBORREL4: New req.
NFCES-REQ-405015/C-Add NFC Key – Waiting for Tap Notification	MBORREL4: Removed the need for FESN
NFCES-REQ-403993/C-Delete NFC Key – User Input Enable/Disable	MBORREL4: Updated the My Key condition to include KeyRearInProgress, added last bullet point. Updated Acceptance Criteria
NFCES-REQ-403997/C-Delete NFC Key – Deleting Starting NFC Key	MBORREL4: Added last line regarding missing signals. Updated Acceptance Criteria
NFCES-REQ-403996/C-Delete NFC Key – Delete Request Sent Approval Required Notification	MBORREL4: Corrected hex value to 0x5 (typo caught by dev team), updated title for clarity
NFCES-REQ-441758/A-Delete NFC Key – Delete Request Sent No Approval Required Notification	MBORREL4: New req.
NFCES-REQ-458397/A-Cancel Pending Add/Delete Request	MBORREL4: New req.

November 16, 2021

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STR-681966/C-Terminology and Abbreviations	MBORREL4: Added Terms
MD-REQ-404939/D-DigitalKeyList_Rsp	MBORREL4: Updated KeyType
MD-REQ-404941/D-DigitalKey_Rsp	MBORREL4: Updated OpCode, RequestStatus, added RequestProgress
STR-830046/C-General Requirements	MBORREL4: Added REQ-465877
NFCES-REQ-362366/C-Feature Configuration - InterfaceClient	MBORREL4: Updated req.
NFCES-REQ-465877/A-Digital Key Tech Configuration - InterfaceClient	MBORREL4: New req.
NFCES-REQ-403965/C-NFC Fleet Restriction Behavior	MBORREL4: Added Pairing/Changing Owner Device, updated Acceptance Criteria
NFCES-REQ-421701/B-NFCEServer2 Configuration	MBORREL4: Updated to include Digital Key Tech DID, updated Acceptance Criteria
NFCES-REQ-403969/D-Requesting the NFC Key List	MBORREL4: Updated KeyType, added FESN sub-bullet
NFCES-REQ-403970/D-Sorting and Displaying the NFC Key List	MBORREL4: Updated req. for Digital/Mobile Keys
NFCES-REQ-403971/C-Updating the NFC Key List While Being Viewed	MBORREL4: Added new Request Status values to requirement
STR-831447/C-Use Cases	MBORREL4: Added REQ-465882-889
NFCES-UC-REQ-465882/A-Pair Owner Device via Mobile App	MBORREL4: New req.
NFCES-UC-REQ-465883/A-Pair Owner Device via NFCESInterfaceClient	MBORREL4: New req.
NFCES-UC-REQ-465884/A-Change Owner Device via Mobile App	MBORREL4: New req.
NFCES-UC-REQ-465885/A-Change Owner Device via NFCESInterfaceClient	MBORREL4: New req.



NFCES-UC-REQ-465886/A-Delete Shared Device via Mobile App	MBORREL4: New req.
NFCES-UC-REQ-465887/A-Delete Shared Device via NFCESInterfaceClient	MBORREL4: New req.
NFCES-UC-REQ-465888/A-Delete Owner Device via Mobile App	MBORREL4: New req.
NFCES-UC-REQ-465889/A-Delete Owner Device via NFCESInterfaceClient	MBORREL4: New req.
STR-831446/D-Requirements	MBORREL4: Added REQ-465891-903
NFCES-REQ-465891/A-Setup/Change Owner Device – User Input	MBORREL4: New req.
NFCES-REQ-403983/D-Add NFC Key – User Input Enable/Disable	MBORREL4: Removed Vehicle Connectivity precondition.
NFCES-REQ-465892/A-Setup/Change Owner Device – User Input Enable/Disable	MBORREL4: New req.
NFCES-REQ-465893/A-Setup/Change Owner Device – Button Pressed	MBORREL4: New req.
NFCES-REQ-465894/A-Setup/Change Owner Device – Progress Screen Notification	MBORREL4: New req.
NFCES-REQ-465895/A-Setup/Change Owner Device – Vehicle Not In Pairing Mode Failure Notification	MBORREL4: New req.
NFCES-REQ-465896/A-Setup/Change Owner Device – Vehicle Preconditions Failure Notification	MBORREL4: New req.
NFCES-REQ-465897/A-Setup/Change Owner Device – Vehicle Safety Failure Notification	MBORREL4: New req.
NFCES-REQ-465898/A-Setup/Change Owner Device – Successfully Paired Notification	MBORREL4: New req.
NFCES-REQ-465899/A-Setup/Change Owner Device – Awaiting KTS Notification	MBORREL4: New req.
NFCES-REQ-465900/A-Setup/Change Owner Device – Failed Pairing Notification	MBORREL4: New req.
NFCES-REQ-465901/A-Shared Device Added – Final Success Notification	MBORREL4: New req.
NFCES-REQ-403992/C-Delete NFC Key – User Input	MBORREL4: Updated req.
NFCES-REQ-403993/D-Delete NFC Key – User Input Enable/Disable	MBORREL4: Added Digital/Mobile Key half of req. Removed Vehicle Connectivity precondition.
NFCES-REQ-465902/A-Delete Owner/Friend Key When Button Disabled	MBORREL4: New req.
NFCES-REQ-465903/A-Delete NFC Key – Starting Key Delete Final Success Notification	MBORREL4: New req.
NFCES-REQ-421725/B-Request Key List upon Final Notifications	MBORREL4: Added last two bullets

January 21, 2022

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NFCES-REQ-403969/E-Requesting the NFC Key List	MBORREL4: Updated for dynamic key list requests
NFCES-REQ-403970/E-Sorting and Displaying the NFC Key List	MBORREL4: Updated to clarify after the whole NFC list is received (now that it is requested dynamically)
NFCES-REQ-406217/C-Waiting for NFCESServer Response	MBORREL4: Updated to include multiple requests as a means to wait
STR-831446/E-Requirements	MBORREL4: Removed REQ-421723, REQ-405017 (no HMI popups for these values, none planned)
NFCES-REQ-403991/C-Add NFC Key – Add Request Sent Approval Required Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-405015/D-Add NFC Key – Waiting for Tap Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-405016/C-Add NFC Key –Tap Timeout Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-404985/C-Add NFC Key – Already Pending Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-403985/C-Add NFC Key – Key Already Paired Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-403987/C-Add NFC Key – Storage Full Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-405018/C-Add NFC Key – No Connectivity Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-405019/C-Add NFC Key – System Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-403996/D-Delete NFC Key – Delete Request Sent Approval Required Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-441758/B-Delete NFC Key – Delete Request Sent No Approval Required Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-403981/C-Delete NFC Key – Already Pending Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-405020/C-Delete NFC Key – No Connectivity Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-405021/C-Delete NFC Key – System Failure Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-465903/B-Delete NFC Key – Starting Key Delete Final Success Notification	MBORREL4: Removed need for FESN/FriendlyName in notification (correcting to match HMI)
NFCES-REQ-458397/B-Cancel Pending Add/Delete Request	MBORREL4: Clarified that request is sent after confirmation notification is accepted



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1 Overview

NFC Entry and Start feature enables customers to unlock, start their vehicle, etc. using an NFC-enabled device (e.g. key card or smartphone) as a vehicle key. To unlock the vehicle, the customer holds their NFC-enabled device near an exterior NFC reader of the vehicle. To authorize start and drive-away, the customer holds their NFC-enabled device near, or places it on, an interior NFC reader of the vehicle.

1.1 Terminology and Abbreviations

The following table lists terminologies that are used in this document along with a brief description.

Acronym	Description
BCM	Body Control Module
BUN	Bluetooth Low Energy, Ultra Wide Band, Near field Communication Module
CAN	Controller Area Network
CCC	Car Connectivity Consortium
DID	Data Identifier
ECG	Enhanced Communication Gateway
FTCP	Ford Telematics Communication Protocol
GPS	Global Positioning System
HMI	Human Machine Interface
IVIC	In Vehicle Infotainment Connectivity
NFAM	Near Field Auxiliary Module
NFC	Near Field Communication
PEPS	Passive Entry, Passive Start
SoA	Service Oriented Architecture
TCU	Telematics Control Unit

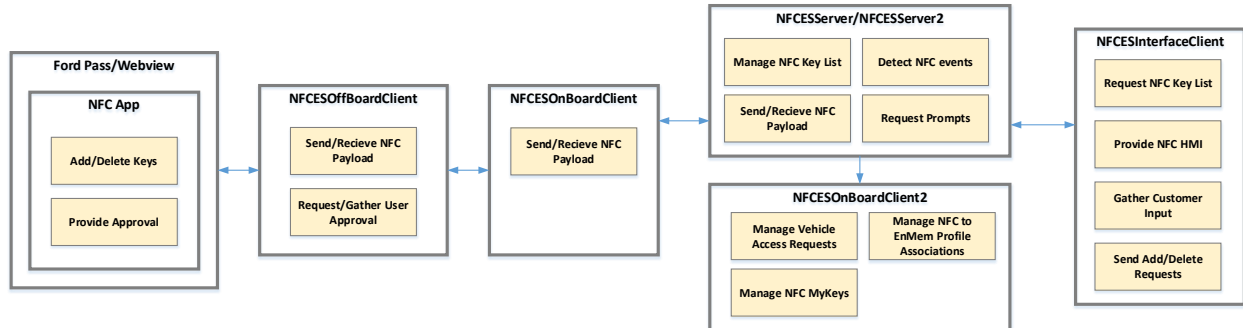
Term	Definition
Trusted Device	Refers to any Factory devices (Key fob, Factory NFC Card, etc.) and the Owner Device as defined by the CCC Digital Key Specification.
Owner Device	Defined by the CCC, the Owner device is the first device paired to the vehicle that has the ability to share keys to other users (Friends), manage shared keys, etc. There can be a max of one Owner Device per vehicle.
Shared/Friend Device	Defined by the CCC, a Friend device is any mobile device that contains a Digital Key shared by the Owner.



2 Architectural Design

2.1 Boundary Diagram

2.1.1 NFCES-BD-REQ-423121/A-NFCES Boundary Diagram



2.2 NFCES-CLD-REQ-362235/A-NFCES Server

The NFC Entry and Start Server (NFCESServer) is responsible for the tasks listed below:

- Transmitting NFC Key List to NFCESInterfaceClient
- Receiving NFC Key List request from NFCESInterfaceClient
- Receiving add/delete key requests from NFCESInterfaceClient & NFCESOnBoardClient
- Transmitting NFC Event information to the NFCESOnBoardClient
- Managing authorized NFC Key List
- Detecting NFC Key taps and events

Please review the implementation guide/ block diagram to locate the NFCESServer class.

2.3 NFCES-CLD-REQ-421702/A-NFCES Server2

The NFC Entry and Start Server2 (NFCESServer2) is responsible for the tasks listed below:

- Transmitting NFC Key List to NFCESInterfaceClient
- Receiving NFC Key List request from NFCESInterfaceClient
- Receiving add/delete key requests from NFCESInterfaceClient & NFCESOnBoardClient
- Transmitting NFC Event information to the NFCESOnBoardClient
- Managing authorized NFC Key List
- Detecting NFC Key taps and events

Note: NFCESServer2 & NFCESServer are mutually exclusive.

Please review the implementation guide/ block diagram to locate the NFCESServer2 class.

2.4 NFCES-CLD-REQ-362234/A-NFCES InterfaceClient

The NFC Entry and Start InterfaceClient (NFCESInterfaceClient) is responsible for the tasks listed below:

- Receiving NFC Key List from NFCESServer
- Transmitting NFC Key List request to NFCESServer
- Transmitting add/delete key requests to NFCESServer
- Providing an NFC Key List Management HMI to user
- Displaying feature relevant notifications

Please review the implementation guide/ block diagram to locate the NFCESInterfaceClient class.



2.5 NFCES-CLD-REQ-362238/A-NFCES OnBoardClient

The NFC Entry and Start OnBoardClient (NFCESOnBoardClient) is responsible for the tasks listed below:

- Receiving commands from NFCESOffBoardClient
- Translating and transmitting NFCESOffBoardClient commands to the NFCESServer
- Receiving request/status information from NFCESServer
- Translating NFC request/status information and transmitting alerts to the NFCESOffBoardClient

Please review the implementation guide/ block diagram to locate the NFCESOnBoardClient class.

2.6 NFCES-CLD-REQ-421704/A-NFCES OnBoardClient2

The NFC Entry and Start OnBoardClient2 (NFCESOnBoardClient2) is responsible for the tasks listed below:

- Transmitting NFC key source, type, and index status information to the NFCESInterfaceClient

Please review the implementation guide/ block diagram to locate the NFCESOnBoardClient2 class.

2.7 NFCES-CLD-REQ-362237/A-NFCES OffBoardClient

The NFC Entry and Start OffBoardClient (NFCESOffBoardClient) is responsible for the tasks listed below:

- Transmitting commands to the NFCESServer
- Receiving alerts from NFCESOnBoardClient
- Request user authorization for add/delete key requests

Please review the implementation guide/ block diagram to locate the NFCESOffBoardClient class.

2.8 NFCES-CLD-REQ-362236/A-NFCES OffBoardGateway

The NFC Entry and Start OffBoardGateway (NFCESOffBoardGateway) is responsible for the tasks listed below:

- Transmitting data/messages between the NFCESOnBoardClient and the NFCESOffBoardClient

Please review the implementation guide/ block diagram to locate the NFCESOffBoardGateway class.

2.9 Physical Mapping of Classes

The table below shows an example of how the logical classes that make up the NFC Enter & Start feature may be mapped into physical modules. This mapping example is specific to the FNV3 architecture and does not necessarily carryover to other carlines or vehicle architectures.

Logical Class	Physical Module (ECU)
NFCESServer	NFAM
NFCESServer2	BUN
NFCESInterfaceClient	APIM
NFCESOnBoardClient	ECG
NFCESOnBoardClient2	BCM
NFCESOffBoardClient	NGSDN/Ford Cloud
NFCESOffBoardGateway	TCU

2.10 Logical Signal Mapping

The CAN signals mentioned throughout this document shall refer to the CAN signal's logical name. The logical names shall be mapped to their actual CAN signal names. Please use the table below to perform the mapping. The InfoCAN database file is the master file for the actual CAN signal names. Note: There may be cases where the actual CAN signal name is used in this documentation.

Logical Name	CAN Signal Name
--------------	-----------------



IgnitionStatus_St	Ignition_Status
GearLeverPosition_St	GearLvrPos_D_Actl
VehicleSpeed_St	Veh_V_ActlEng
IgnKeyType_D_Actl	IgnKeyType_D_Actl
CarMode_St	LifeCycMde_D_Actl
DigitalKeyList_Rq	See TP SPSS
DigitalKeyList_Rsp	See TP SPSS
DigitalKey_Rq	See TP SPSS
DigitalKey_Rsp	See TP SPSS
VehicleStartKeySource_St	VehStrtKeySrc_D_Stat
VehicleStartKeyType_St	VehStrtKeyType_D_Stat
VehicleStartKeyIndex_St	VehStrtKeyIndx_No_Actl

2.11 NFCESInterfaceClient Interface

2.11.1 NFCES-IIR-REQ-403768/B-NFCESInterfaceClient_Rx

2.11.1.1 MD-REQ-027149/A-IgnitionStatus_St (TcSE ROIN-225464-1)

Message Type: Status

Signal used to indicate ignition state.

Name	Literals	Value	Description
Type	-	-	Indicates ignition state
	Unknown	0x0	
	Off	0x1	
	Accessory	0x2	
	Run	0x4	
	Start	0x8	
	Invalid	0xF	

2.11.1.2 MD-REQ-028253/A-GearLeverPosition_St (TcSE ROIN-282103-1)

Message Type: Status

Status used to indicate the current gear selected.

Name	Literals	Value	Description
Type	-	-	Used to indicate current gear selected.
	Park	0x0	
	Reverse	0x1	
	Neutral	0x2	
	Drive	0x3	
	Sport_DriveSport	0x4	
	Low	0x5	
	First	0x6	
	Second	0x7	
	Third	0x8	
	Fourth	0x9	
	Fifth	0xA	



	Sixth	0xB	
	Undefined_Treat_as_Fault	0xC	
	Undefined_Treat_as_Fault1	0xD	
	Unknown_Position	0xE	
	Fault	0xF	

2.11.1.3 MD-REQ-014025/A-VehicleSpeed_St (TcSE ROIN-223023-1)

Message Type: Status

Status used to indicate vehicle speed.

Name	Literals	Value	Description
Type	-	-	Indicates vehicle speed. Unit: kph Resolution:0.01 Offset:0
	kph	0x0 to 0xFFFF	

2.11.1.4 MD-REQ-238455/A-IgnKeyType_D_Actl

Message Type: Status

This signal represents the MyKey system status and is provided to all affected system components to configure their local modes.

Name	Literals	Value	Description
IgnKeyType_D_Actl	-	-	Type of key that is in the ignition
	KeyReadInProgress	0x0	Key(s) will be read now
	KeyInIgnStandardKey	0x1	Admin (full) mode
	KeyInIgnMyKey	0x2	MyKey restricted mode
	Key_Not_Prgm_Read_Failure	0x3	Key not programmed
	Unknown	0xE	Disable MyKey System mode
	Invalid	0xF	Initial value

2.11.1.5 MD-REQ-086348/A-CarMode_St

Message Type: Status

Name	Literals	Value	Description
Type	-	-	Defines what car mode state is active.
	Normal	0x0	
	Factory	0x1	
	NotUsed	0x2	
	Transportation	0x3	

2.11.1.6 MD-REQ-421705/A-VehicleStartKeySource_St

Message Type: Status

Signal used to indicate the key source used to start the vehicle.

Name	Literals	Value	Description
Type	-	-	Key source used to start vehicle.



	Null	0x0	
	Digital_Key	0x1	
	Peps_and_Ikt	0x2	
	Legacy_Paak	0x3	

2.11.1.7 MD-REQ-421706/A-VehicleStartKeyType_St

Message Type: Status

Signal used to indicate the key type used to start the vehicle.

Name	Literals	Value	Description
Type	-	-	Key type used to start vehicle.
	Null	0x0	
	User	0x1	
	Factory	0x2	
	Not_Used	0x3	

2.11.1.8 MD-REQ-421707/A-VehicleStartKeyIndex_St

Message Type: Status

Signal used to indicate the key index used to start the vehicle.

Name	Literals	Value	Description
Type	-	-	Key index used to start vehicle.
	unitless	0x00-0xFF	0-255

2.11.1.9 MD-REQ-404939/D-DigitalKeyList_Rsp

Message Type: Response

This signal is used to provide the Digital Key List to the requestor.

Name	Literals	Value	Description
List Size	-	-	The provided list size
	Inactive	0x00	
	List Size 1	0x01	
	List Size 2	0x02	
	...		
	List Size 254	0xFE	
	No Entry	0xFF	
Total Number Of Keys Available	-	-	The total number of keys available in the list (paired keys)
	Invalid	0x00	
	1 Key Available	0x01	
	2 Keys Available	0x02	
	...		
	254 Keys Available	0xFE	
	No Entry	0xFF	



Additional Key Storage Available	-	-	Indicator for whether there is additional storage available for new keys
	No	0x00	
	Yes	0x01	
	Reserved	0x02-0xFF	
Vector			Array (1...N) of record (IndexNumber, DeviceType, KeyType, KeyStatus, LocalID, FriendlyName, FESN, PairingID) with TotalNumberOfKeysAvailable defined in ListSize
IndexNumber	-	-	
	Inactive	0x00	
	Index 1	0x01	
	Index 2	0x02	
	
	Index 255	0xFF	
DeviceType	-	-	Describes Device type
	NFC Card	0x00	
	Digital Key	0x01	
	CAK	0x02	
	Reserved	0x03 - 0xFF	
KeyType	-	-	Describes Key type
	Factory	0x00	
	Retail User	0x01	
	Fleet User	0x02	
	Owner Device	0x03	
	Shared Device	0x04	
	Reserved	0x05 – 0xFF	
KeyStatus	-	-	Describes Key status
	Pending Add	0x00	
	Pending Delete	0x01	
	Added/Confirmed	0x02	
	Reserved	0x03 – 0xFF	
LocalID	-	-	Describes the Local ID
	Inactive	0x00	
	ID 1	0x01	
	ID 2	0x02	
	
	ID 255	0xFF	



FESN	-	-	Data array that consists of textual information up to 8 characters in length, plus end of string
FriendlyName	-	-	Data array that consists of textual information up to 64 characters in length, plus end of string
PairingID	-	-	Data array that consists of textual information up to 8 characters in length, plus end of string

2.11.1.10 MD-REQ-404941/D-DigitalKey_Rsp

Message Type: Response

This signal is used to provide add/delete status to the NFCESInterfaceClient.

Name	Literals	Value	Description
OpCode	-	-	Describes which opcode is being requested
	Reserved	0x00	
	AddKey	0x01	
	DeleteKey	0x02	
	DeleteAllKeys	0x03	
	CancelRequest	0x04	
	OwnerPairing	0x05	
	SharedKey	0x06	
	Reserved	0x07 - 0xFF	
Request Status	-	-	Describes the status of the request
	Reserved	0x00	
	Final Success	0x01	
	Final Rejected	0x02	
	Final Timeout	0x03	
	Final System Error	0x04	
	Success - Request Sent - Approval Required	0x05	
	Rejected - No space available	0x06	
	Rejected - Already pending	0x07	
	Rejected - Already programmed	0x08	
	Rejected - Tap timeout	0x09	
	Rejected - Not programmed to vehicle	0x0A	
	Rejected - System Error	0x0B	
	Waiting for Card Tap	0x0C	
	Rejected - No Connectivity	0x0D	
	Success - Request Sent - No Approval Required	0x0E	



	Final Success – Deleted Key Used to Start	0x0F	
	Pairing NFC	0x10	
	Pairing BLE	0x11	
	Success - Paired	0x12	
	Success - Awaiting KTS	0x13	
	Failed - Vehicle Not In Pairing Mode	0x14	
	Failed - Vehicle Safety	0x15	
	Failed - Pre-Conditions Not Met	0x16	
	Reserved	0x17 - 0xFF	
Request Progress	-	-	Pairing progress for Digital Key owner pairing.
	0 Percent	0x00	
	1 Percent	0x01	
	2 Percent	0x02	
	3 Percent	0x03	
	...		
	99 Percent	0x63	
	100 Percent	0x64	
	Reserved	0x65 - 0xFF	
FESN	-	-	Data array that consists of textual information up to 8 characters in length, plus end of string.
FriendlyName	-	-	Data array that consists of textual information up to 64 characters in length, plus end of string

2.11.1.11 MD-REQ-406216/A-SdnConnectionStatusBroadcast

This API is used to receive the SDN Connection Status from FCI. The FCI publishes this status via this API.

Method Type		OnChange			
QoS Level		Default			
Retained		No			
R/O	Name	Type	Literals	Value	Description
Request					
-	-	-	-	-	N/A
Response					
O	InterfaceType	Enum	-	-	
			Connection_Interface_Unknown	0x0	
			Connection_TCU_Cell	0x1	
			Connection_TCU_Wifi	0x2	
			Connection_SYNC_Wifi	0x3	



			Connection_SYNC_SDL	0x4	
O	SdnConnStatus	Enum	-	-	
			SDN_Connected	0x0	
			SDN_Disconnected	0x1	

2.11.2 NFCES-IIR-REQ-403769/A-NFCESInterfaceClient_Tx

2.11.2.1 MD-REQ-404938/B-DigitalKeyList_Rq

Message Type: Request

This signal is used to request the Digital Key List from the NFCESServer.

Name	Literals	Value	Description
OpCode	-	-	Describes which opcode is being requested
	Reserved	0x00	
	Read	0x01	
	Reserved	0x02 - 0xFF	
NumberOfItems	-	-	The number of items being requested
	Invalid	0x00	
	1	0x01	
	2	0x02	
	...		
	254	0xFE	
	No Entry	0xFF	
StartIndex	-	-	The position in the list from which the request shall start
	Invalid	0x00	
	1	0x01	
	2	0x02	
	...		
	254	0xFE	
	No Entry	0xFF	

2.11.2.2 MD-REQ-404940/C-DigitalKey_Rq

Message Type: Request

This signal is used to request an add/delete of a Digital Key from the NFCESServer.

Name	Literals	Value	Description
OpCode	-	-	Describes which opcode is being requested
	Reserved	0x00	
	AddKey	0x01	
	DeleteKey	0x02	
	DeleteAllKeys	0x03	



	CancelRequest	0x04	
	Reserved	0x05 - 0xFF	
LocalID	-	-	Describes the Local ID
	Inactive	0x00	
	ID 1	0x01	
	ID 2	0x02	
	
	ID 255	0xFF	
FriendlyName	-	-	Data array that consists of textual information up to 64 characters in length, plus end of string
PairingID	-	-	Data array that consists of textual information up to 8 characters in length, plus end of string



3 General Requirements

3.1 NFCES-REQ-362366/C-Feature Configuration - InterfaceClient

The NFCESInterfaceClient shall have a configurable parameter/DID to allow the NFC Key feature to be enabled/disabled.

- When the parameter indicates that NFC Key is enabled, all the functionality and signals defined in this SPSS in relation to NFC Cards shall be supported.
 - The further support of Digital/Mobile Keys shall be determined by REQ-465877
- When the parameter indicates that NFC Key is disabled, none of the functionality defined in this SPSS shall be supported.
 - The default value for this parameter shall be Disabled.

Acceptance Criteria

The configurable parameter being set to 'enabled' will result in the relevant HMI screens/menu/popups being shown or presented upon their respective triggers. The relevant interfaces and functions will also become active/initiated. The configurable parameter being set to 'disabled' will result in none of the above.

3.2 NFCES-REQ-465877/A-Digital Key Tech Configuration - InterfaceClient

The NFCESInterfaceClient shall have a configurable parameter/DID to determine the availability of Digital/Mobile Keys and which Digital Key Technology is to be supported.

- When the parameter indicates that NFC technology is supported, all the functionality and signals in relation to Digital/Mobile NFC Keys shall be supported.
- When the parameter indicates that NFC+BLE+UWB technology is supported, all the functionality and signals in relation to Digital/Mobile NFC+BLE+UWB Keys shall be supported.
- When the parameter indicates that No Digital Key technology (None) is supported, none of the functionality in relation to Digital/Mobile Keys shall be supported.
 - The default value for this parameter shall be None.

Note: The requirements relative to Digital/Mobile Keys will be identified in this SPSS by the notation "When configured for Digital/Mobile Keys..." (NFC vs NFC+BLE+UWB will be mentioned specifically if the requirement only applies to one).

Acceptance Criteria

The configurable parameter being set to 'NFC' or 'NFC+BLE+UWB' will result in the relevant HMI screens/menu/popups being shown or presented upon their respective triggers. The relevant interfaces and functions will also become active/initiated. The configurable parameter being set to 'None' will result in none of the above.

3.3 NFCES-REQ-403966/B-CCS & NFC Fleet Restrictions

The NFCESInterfaceClient shall monitor the CCS entity 'NFC_Fleet (FEATURE106)' to determine whether to perform the NFC Fleet Restrictions:

- When the bSAllow of CCS entity NFC_Fleet (ID 106, type 1) is Disabled, the NFC Fleet Restrictions shall be disabled.
- When the bSAllow of CCS entity NFC_Fleet (ID 106, type 1) is Enabled, the NFC Fleet Restrictions shall be enabled.

Acceptance Criteria

The CCS entity being set to 'enabled' will result in NFC Fleet behaviors becoming active. The CCS entity being set to 'disabled' will result in NFC Fleet behaviors becoming inactive.

3.4 NFCES-REQ-403965/C-NFC Fleet Restriction Behavior

If the NFC Fleet Restrictions are enabled per REQ-403966, the NFCESInterfaceClient shall:

- Disable all notifications related to successfully adding or deleting devices from the vehicle
- Disable "Add Key" functionality
- Disable "Delete Key" functionality
- Disable Pairing/Changing Owner Device functionality, when configured for Digital/Mobile Keys

Acceptance Criteria



NFC Fleet behavior being active will result in the removal of the Add Key button, Delete Key button, Setup/Change Owner Phone button on the HMI, and the removal of all popups related to successfully adding, deleting or sharing NFC devices from the vehicle.

3.5 NFCES-REQ-403964/B-NFC Powermode Conditions

The NFCESInterfaceClient shall only allow the NFC feature functionality when the following preconditions are met:

- IgnitionStatus_St = "(0x4) Run" AND GearLeverPosition_St = "(0x0) Park"
OR
- VehicleSpeed_St <= Driver Restrictions Threshold

Acceptance Criteria

When the listed preconditions are not met, the NFC Key menu will not be available, and/or the functionality provided by this feature will not be made available.

3.6 NFCES-REQ-403967/B-Pairing NFC Key to Enhanced Memory Profile

The NFCESInterfaceClient shall allow a customer to pair one NFC key to one Enhanced Memory Profile. Refer to the Enhanced Memory SPSS for full details.

Acceptance Criteria

When Enhanced Memory and NFC Key are supported/configured ON at the same time, the Enhanced Memory menu shall allow the pairing of an NFC device to a Personal Profile.

3.7 NFCES-REQ-421701/B-NFCESServer2 Configuration

The NFCESInterfaceClient shall use the Digital Key Tech Configuration as per REQ-465877 to determine whether NFCESServer2 is present on the vehicle.

- When the parameter indicates that NFC+BLE+UWB technology is supported, the TP interfaces (listed below) sent to/received by the NFCESServer2 shall be used.
- When the parameter indicates that NFC+BLE+UWB technology is not supported (i.e. None or NFC), the TP interfaces (listed below) sent to/received by the NFCESServer shall be used.

TP Interfaces:

- REQ-404939-DigitalKeyList_Rsp
- REQ-404941-DigitalKey_Rsp
- REQ-404938-DigitalKeyList_Rq
- REQ-404940-DigitalKey_Rq

Acceptance Criteria

When NFCESServer2 is present (determined by the digital technology used), the TP interfaces shall be sent to it instead of the NFCESServer. The two Servers are mutually exclusive, and this req. dictates which message to send/receive TP signals on.



4 Functional Definition

4.1 NFCES-FUN-REQ-403918/A-NFC Key List

4.1.1 Use Cases

4.1.1.1 NFCES-UC-REQ-404010/B-User Enters NFC Key Screen

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met
Scenario Description	User starts vehicle with any key Using NFCESInterfaceClient, user navigates to NFC Key List NFCESInterfaceClient requests NFC Key List from NFCESServer
Post-conditions	NFCESInterfaceClient displays NFC Key List
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

Upon the customer entering the NFC Key List screen, the NFC Key List is shown.

4.1.1.2 NFCES-UC-REQ-404011/B-NFC Key List Updated while NFC Screen Open

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity
Scenario Description	User currently viewing NFC Key List Vehicle receives addition/deletion approval from NFCESOffBoardClient NFCESServer sends update to NFCESInterfaceClient NFCESInterfaceClient requests NFC Key List from NFCESServer
Post-conditions	NFCESInterfaceClient displays updated NFC Key List
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

While the NFC Key List is being viewed, if an incoming request from NFCESServer is received, the relative notification is shown and the NFC Key List is refreshed/updated.

4.1.2 Requirements

4.1.2.1 NFCES-REQ-403969/E-Requesting the NFC Key List

When the user enters the NFC Key List screen (either from a different domain/menu, or from any of the Add/Delete Key screens), the NFCESInterfaceClient shall request the NFC Key List using DigitalKeyList_Rq. The NFCESInterfaceClient shall request the list by specifying NumberOfItems = 23 (max allowed per request), and StartIndex = 1.

The NFCESServer will respond with the List Size and Total Number Of Keys Available from which the NFCESInterfaceClient shall request the remaining keys until all have been received. List Size indicates the number of keys being sent in the response, where Total Number Of Keys Available indicates the total number of keys created/available.

**Example**

- 10 NFC keys are currently created and the NFCESInterfaceClient requests for 23 keys (max allowed per request).
- NFCESInterfaceClient uses DigitalKeyList_Rq and sets the following:
 - OpCode = Read
 - NumberOfItems = 23
 - StartIndex = 1
- NFCESServer responds with DigitalKeyList_Rsp and includes the following:
 - List Size = List Size 10
 - Total Number Of Keys Available = 10 Keys Available
 - Additional Key Storage Available = Yes
 - IndexNumber = Index 1
 - DeviceType = NFC Card/Digital Key/CAK
 - KeyType = Factory/Retail/Fleet/OwnerDevice/SharedDevice
 - KeyStatus = PendingAdd/PendingDelete/AddedConfirmed
 - LocalID = {Local ID of key 1}
 - FESN = {FESN of key 1}
 - If DeviceType = NFC Card, otherwise FESN is null
 - FriendlyName = {Name of key 1}
 - PairingID = {Pairing ID of key 1}
 -
 - IndexNumber = Index 2
 - DeviceType = NFC Card/Digital Key/CAK
 - KeyType = Factory/Retail/Fleet/OwnerDevice/SharedDevice
 - KeyStatus = PendingAdd/PendingDelete/AddedConfirmed
 - LocalID = {Local ID of key 2}
 - FESN = {FESN of key 2}
 - If DeviceType = NFC Card, otherwise FESN is null
 - FriendlyName = {Name of key 2}
 - PairingID = {Pairing ID of key 2}
 -
 - ...
 -
 - IndexNumber = Index 10
 - DeviceType = NFC Card/Digital Key/CAK
 - KeyType = Factory/Retail/Fleet/OwnerDevice/SharedDevice
 - KeyStatus = PendingAdd/PendingDelete/AddedConfirmed
 - LocalID = {Local ID of key 10}
 - FESN = {FESN of key 10}
 - If DeviceType = NFC Card, otherwise FESN is null
 - FriendlyName = {Name of key 10}
 - PairingID = {Pairing ID of key 10}

Acceptance Criteria

Entering the NFC Key screen will result in a request for the NFC Key list (resulting in the NFC Key list being shown to the user).

4.1.2.2 *NFCES-REQ-403970/E-Sorting and Displaying the NFC Key List*

Upon receiving the complete NFC key list and DigitalKeyList_Rsp with CES = Final Result – Success (after all requests), the NFCESInterfaceClient shall:

- Store the list temporarily, in order to sort/display
 - The stored list shall be discarded upon exiting the NFC Key screen
- Sort the list in alphanumerical order based on the FriendlyName
 - Factory Keys shall be shown/grouped first, followed by added/non-factory keys
 - When configured for Digital/Mobile Keys, the Digital/Mobile Keys shall be shown after the NFC Cards, with the Owner Key listed first, followed by Shared Keys
 - If the FriendlyName was not populated in the response, the FESN shall be used in its place
- Display the sorted list



- If the NFCESInterfaceClient screen size limits the number of Digital Keys that can be displayed, a scroll bar shall be provided, and the remainder of the list shall be shown upon scrolling (the NFCESInterfaceClient shall not request for new list data upon scrolling)

For each key, the NFCESInterfaceClient shall display:

- Type of device per DigitalKeyList_Rsp(DeviceType) (may be represented as an icon)
- FriendlyName per DigitalKeyList_Rsp(FriendlyName), or the FESN if the FriendlyName field is not populated
 - If configured for Digital/Mobile Keys, and if the NFC FriendlyName field is not populated, the NFCESInterfaceClient shall display "Digital Key #" in its place, where # shall be set to the respective PairingID.
- FESN per DigitalKeyList_Rsp(FESN), if the DeviceType is NFC Card
- NFC Key Status per DigitalKeyList_Rsp(KeyStatus) (when "Pending")
- An indication that it is a 'factory card', if DeviceType = NFC Card and KeyType = Factory
- When configured for Digital/Mobile Keys, an indication if it is an Owner or Shared device per DigitalKeyList_Rsp(KeyType)

Acceptance Criteria

The NFC Key list will be shown to the user in alphanumerical order based on the FriendlyName (and grouped based on type), with a scroll bar if needed. Device type, Friendly Name, FESN, and key status are displayed for each key as defined in the requirement

4.1.2.3 NFCES-REQ-458337/A-InfoBook content

The NFCESInterfaceClient shall provide an Infobook button. When selected, the NFCESInterfaceClient shall display

- Purpose of the NfcKeyList screen
- Definition of Digital Key terminology
- Information on what the user can use the NfcKeyList screen to do
- Information about the functionality and restrictions on factory keys
- Information about the icons and/or coloring used in the NfcKeyList screen as applicable
- Location of the FESN on NFC key cards

Acceptance Criteria

An infobook button shall be made available to the user, and when pressed, shall display the content detailed in the requirement (location of infobook button dependent on HMI spec)

4.1.2.4 NFCES-REQ-406217/C-Waiting for NFCESServer Response

While waiting for the NFCESServer to transmit its response, while making multiple requests to obtain the entire NFC Key List, or while the NFCESServer transmits DigitalKeyList_Rsp with CES = Intermediate Result – Wait, the NFCESInterfaceClient shall display a popup indicating that it is 'updating.' The user shall not be able to click on the list of NFC keys until the screen has finished updating, at which point the updating popup shall close.

Acceptance Criteria

Receiving a wait response will result in an 'updating' popup to be shown to the user, preventing the user from interacting with the NFC Key list.

4.1.2.5 NFCES-REQ-406218/C-Failed NFCESServer Response

If the NFCESServer responds with DigitalKeyList_Rsp with a CES = Final Result – Fail, the NFCESInterfaceClient shall again request the NFC key list via DigitalKeyList_Rq (per REQ-403969). If the second attempt also fails, no list shall be populated, and an error notification shall be displayed.

If the NFCESServer does not respond with DigitalKeyList_Rsp within 1s from the initial request, the NFCESInterfaceClient shall perform a retry and send the request again. The NFCESInterfaceClient shall perform a total of 3 retries. If the last attempt also results in no response, no list shall be populated, and an error notification shall be displayed.

Acceptance Criteria



Receiving a failed response will result in a retry request. Receiving another failed response will result in an empty NFC Key list and an 'error' popup. Receiving no response within the defined time will result in the retry strategy defined in the requirement.

4.1.2.6 NFCES-REQ-405551/B-Displaying NFC Key Statuses

The NFCESInterfaceClient shall:

- Enable/not grey-out any NFC Key whose KeyStatus = "(0x02) Added/Confirmed"
- Disable/grey-out any NFC Key whose KeyStatus = "(0x00) Pending Add" or "(0x01) Pending Delete"

Acceptance Criteria

Receiving a keystatus of 'added/confirmed' will result in that NFC Key list item being enabled/not greyed-out. Receiving a keystatus of 'pending add' or 'pending delete' will result in that NFC Key list item being disabled/greyed-out.

4.1.2.7 NFCES-REQ-458338/A-Pending Add/Delete - Cancel Button

If an NFC key has a KeyStatus = "(0x00) Pending Add" or "(0x01) Pending Delete", the NFCESInterfaceClient shall show/provide a Cancel button for that NFC key.

Acceptance Criteria

A Cancel button shall be shown/offered for keys in a 'Pending' state

4.1.2.8 NFCES-REQ-405552/B-NFC Key List Character Limit

The NFCESInterfaceClient shall limit the number of NFC FriendlyName characters that shall be displayed. The maximum NFC key name characters shall be equal to the maximum number of allowable characters to be displayed that is listed in the following requirements (refer to the Bluetooth Connectivity SPSS and Media Player SPSS documents):

1. BTC-FUR-REQ-194148-Device Friendly Name
2. MP-FUR-REQ-205797-USB Device Name
3. MP-FUR-REQ-205793-Unnamed USB Device

Acceptance Criteria

The NFC Key FriendlyName received will be shown/limited to the number of allowable characters in the referenced requirements.

4.1.2.9 NFCES-REQ-403971/C-Updating the NFC Key List While Being Viewed

If the user is viewing the NFC Key List screen when the NFCESServer transmits DigitalKey_Rsp with any of the below Request Statuses, the NFCESInterfaceClient shall request the NFC key list via DigitalKeyList_Rq (per REQ-403969). Once the NFCESInterfaceClient receives the updated list, it shall update the display to show the new information. If the NFCESInterfaceClient is in the process of updating the NFC Key list, the NFCESInterfaceClient shall display a popup indicating that it is 'updating.' The user shall not be able to click on the NFC key list until the list has finished updating, at which point the popup shall close. The NFCESInterfaceClient shall disregard any updates from the NFCESServer regarding the NFC key list if the user has left the NFC Key List screen.

If the user is NOT in the NFC Key List screen when the NFCESServer transmits DigitalKey_Rsp with any of the below Request Statuses, the NFCESInterfaceClient shall not request the list as described above (the latest list is always requested when the user enters the NFC Key List screen).

DigitalKey_Rsp

- Request Status = "0x01: Final Success", "0x02: Final Rejected"
"0x03: Final Timeout", "0x04: Final System Error"
"0x0F: Final Success – Deleted Key Used to Start"
"0x12: Success - Paired"
"0x13: Success - Awaiting KTS"

Acceptance Criteria

Receiving the indicated responses (when viewing the NFC Key list) will result in the list being updated/refreshed.

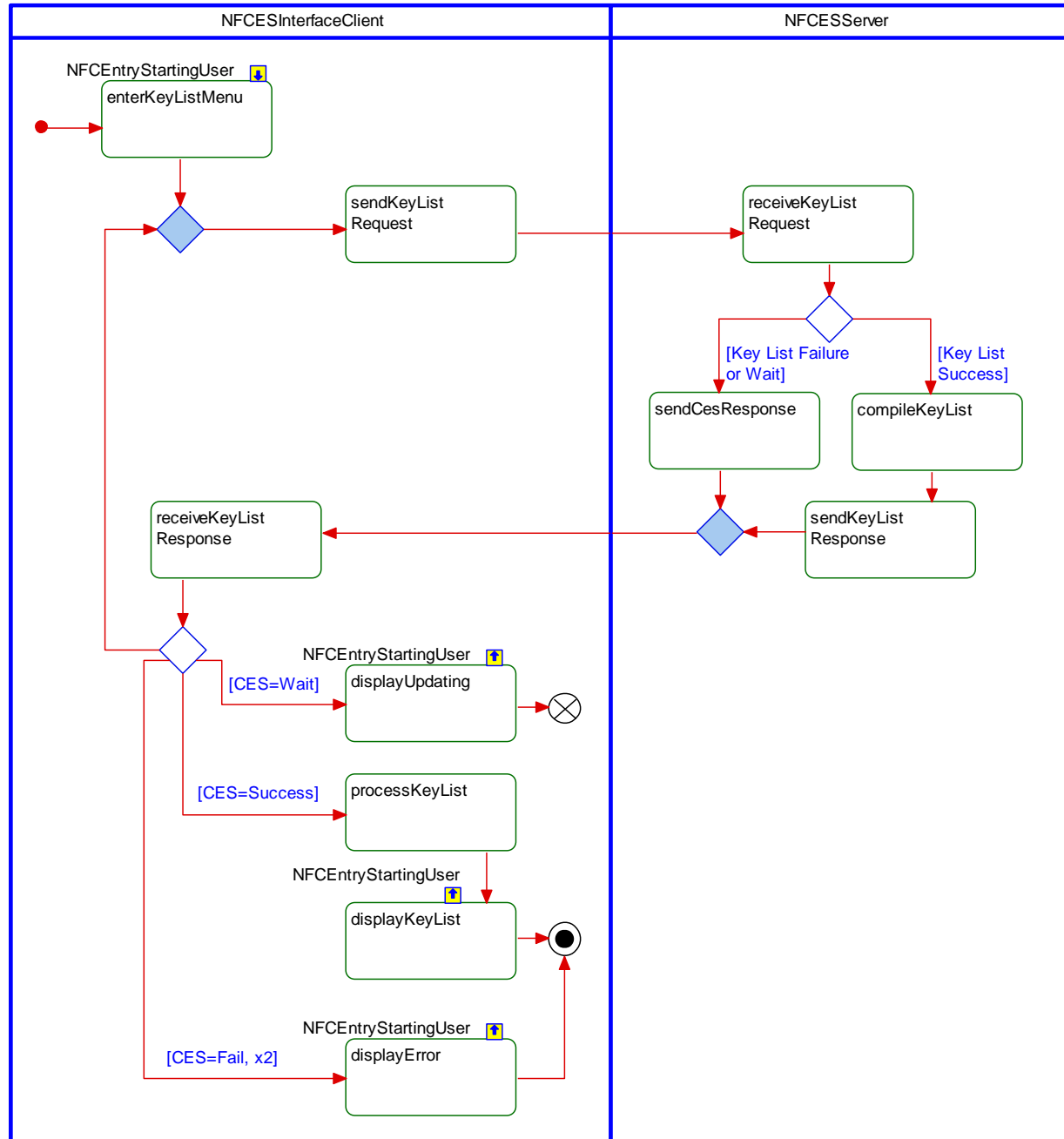


4.1.3 White Box View

4.1.3.1 Activity Diagrams

4.1.3.1.1 NFCES-ACT-REQ-362250/A-Requesting NFC Key List

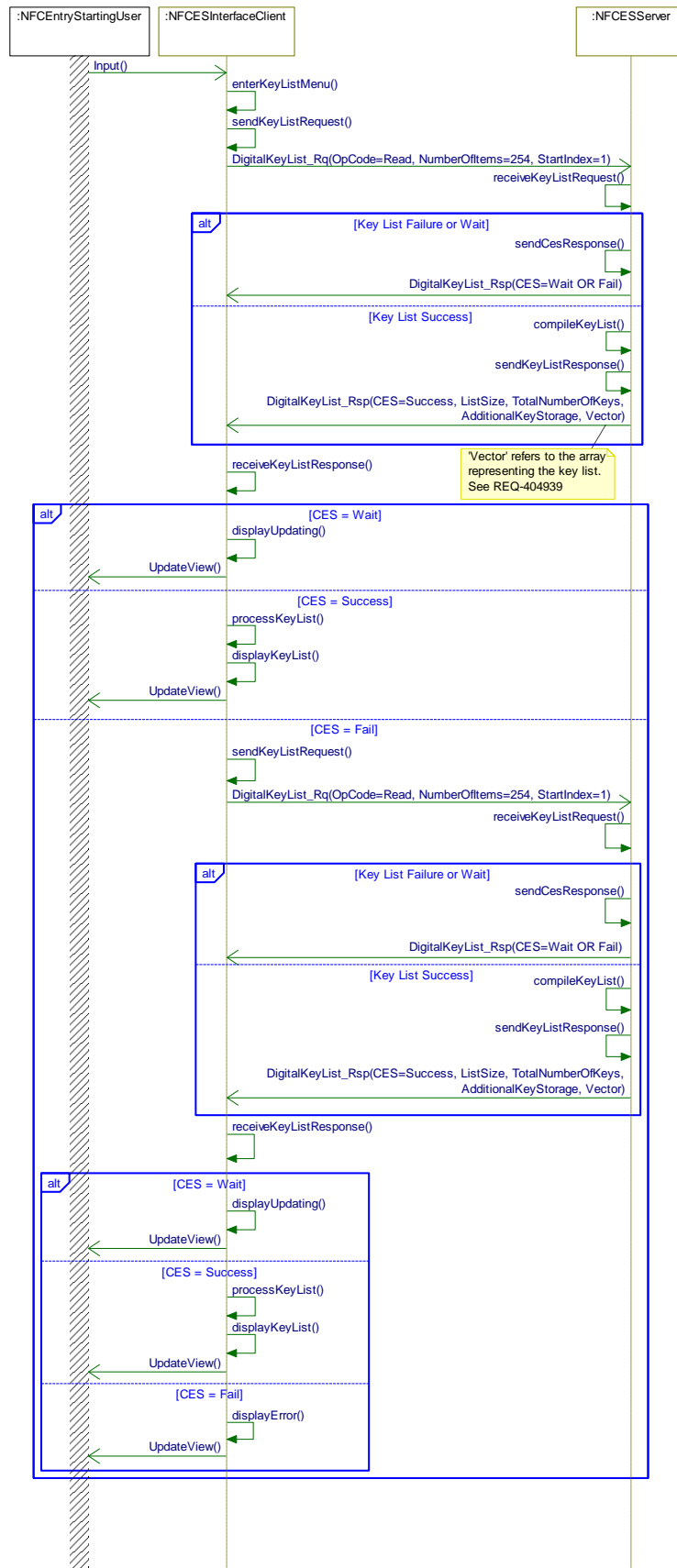
Activity Diagram





4.1.3.2 Sequence Diagrams

4.1.3.2.1 NFCES-SD-REQ-403920/B-Requesting NFC Key List Sequence Diagram





4.2 NFCES-FUN-REQ-403912/A-Add/Delete NFC Key

4.2.1 Use Cases

4.2.1.1 NFCES-UC-REQ-404000/B-Add NFC Key – User Approves Request

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key to the vehicle that is not a MyKey User has a physical NFC key that has not been programmed to the vehicle
Scenario Description	User starts vehicle with any key User selects Add NFC key on NFCESInterfaceClient NFCESInterfaceClient prompts user to enter name for new key User enters key name using NFCESInterfaceClient NFCESInterfaceClient prompts user to scan new NFC key User places new NFC key near interior NFC reader NFCESInterfaceClient displays message indicating that key add request has been sent to vehicle owner for approval User receives request to add NFC key in Ford/Lincoln mobile app User approves request NFCESOffBoardClient transmits command to vehicle
Post-conditions	NFCESInterfaceClient displays approval confirmation NFC Key is now paired to vehicle and may be used for entry
List of Exception Use Cases	Add NFC Key – User Denies Request Add NFC Key – Connectivity Lost before Add Request Sent Add NFC Key – Connectivity Lost after Add Request Sent
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is successfully added, shown in the NFC Key List, and can be used for entry, starting, etc.

4.2.1.2 NFCES-UC-REQ-404001/B-Add NFC Key – User Denies Request

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key to the vehicle that is not a MyKey User has a physical NFC key that has not been programmed to the vehicle
Scenario Description	User starts vehicle with any key User selects Add NFC key on NFCESInterfaceClient NFCESInterfaceClient prompts user to enter name for new key User enters key name using NFCESInterfaceClient NFCESInterfaceClient prompts user to scan new NFC key User places new NFC key near interior NFC reader



	NFCESInterfaceClient displays message indicating that key add request has been sent to vehicle owner for approval User receives request to add NFC key in Ford/Lincoln mobile app User denies request NFCESOffBoardClient transmits command to vehicle
Post-conditions	NFCESInterfaceClient displays request denied confirmation NFC Key is not paired to vehicle
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is not added, cannot be seen in the NFC Key List, and cannot be used for entry, starting, etc.

4.2.1.3 NFCES-UC-REQ-404002/B-Add NFC Key – Connectivity Lost before Add Request Sent

Actors	NFC User, NFCESInterfaceClient, NCFESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key to the vehicle that is not a MyKey User has a physical NFC key that has not been programmed to the vehicle
Scenario Description	User starts vehicle with any key User selects Add NFC key on NFCESInterfaceClient NFCESInterfaceClient prompts user to enter name for new key User enters key name using NFCESInterfaceClient Vehicle loses Network Connectivity
Post-conditions	NFC Key Add process is aborted NFCESInterfaceClient displays message indicating that network connectivity is required to add a key. NFC Key is not paired to vehicle
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is not added, cannot be seen in the NFC Key List, and cannot be used for entry, starting, etc.

4.2.1.4 NFCES-UC-REQ-404003/B-Add NFC Key – Connectivity Lost after Add Request Sent

Actors	NFC User, NFCESInterfaceClient, NCFESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key to the vehicle that is not a MyKey User has a physical NFC key that has not been programmed to the vehicle
Scenario Description	User starts vehicle with any key User selects Add NFC key on NFCESInterfaceClient NFCESInterfaceClient prompts user to enter name for new key



	User enters key name using NFCESInterfaceClient NFCESInterfaceClient prompts user to scan new NFC key User places new NFC key near interior NFC reader NFCESInterfaceClient displays message indicating that key add request has been sent to vehicle owner for approval User receives request to add NFC key in Ford/Lincoln mobile app Vehicle loses Network Connectivity OR Users smart device loses Network Connectivity
Post-conditions	NFC Key Add process times out and is aborted Notification is sent to users smart device indicating that key add command was not delivered successfully (if users device has Network Connectivity) NFCESInterfaceClient displays message indicating that key add request has timed out NFC Key is not paired to vehicle
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is not added, cannot be seen in the NFC Key List, and cannot be used for entry, starting, etc.

4.2.1.5 NFCES-UC-REQ-404004/B-Add NFC Key – MyKey Active

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User starts the vehicle with a MyKey
Scenario Description	User selects Add NFC key on NFCESInterfaceClient
Post-conditions	NFCESInterfaceClient displays message indicating that the requested action is not permitted with a MyKey active
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User is prevented from adding a key.

4.2.1.6 NFCES-UC-REQ-404005/B-Delete NFC Key – User Approves Request

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key that can start the vehicle and it is not a MyKey or the key the user wants to delete
Scenario Description	User starts vehicle with a key other than the one they want to delete Using NFCESInterfaceClient, user navigates to NFC Key List and selects the "delete" option for the key they want to delete NFCESInterfaceClient confirms user intent ("are you sure?")



	NFCESInterfaceClient send key delete request to NFCESServer User receives notification of deletion approval request on their smart device User approves deletion request NFCESOffBoardClient transmits command to vehicle
Post-conditions	Vehicle deletes pairing with specified key NFCESInterfaceClient displays success message
List of Exception Use Cases	Delete NFC Key – User Denies Request Delete NFC Key – Connectivity Lost before Delete Request Sent Delete NFC Key – Connectivity Lost after Delete Request Sent
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is successfully deleted, removed from the NFC Key List, and can no longer be used for entry, starting, etc.

4.2.1.7 NFCES-UC-REQ-404006/B-Delete NFC Key – User Denies Request

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key that can start the vehicle and it is not a MyKey or the key the user wants to delete
Scenario Description	User starts vehicle with a key other than the one they want to delete Using NFCESInterfaceClient, user navigates to NFC Key List and selects the "delete" option for the key they want to delete NFCESInterfaceClient confirms user intent ("are you sure?") NFCESInterfaceClient send key delete request to NFCESServer User receives notification of deletion approval request on their smart device User denies deletion request NFCESOffBoardClient transmits command to vehicle
Post-conditions	Vehicle does not delete pairing with specified key NFCESInterfaceClient displays request denied confirmation
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is not deleted, shown in the NFC Key List, and can still be used for entry, starting, etc.

4.2.1.8 NFCES-UC-REQ-404007/B-Delete NFC Key – Connectivity Lost before Delete Request Sent

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key that can start the vehicle and it is not a MyKey or the key the user wants to delete



Scenario Description	User starts vehicle with a key other than the one they want to delete Using NFCESInterfaceClient, user navigates to NFC Key List and selects the "delete" option for the key they want to delete NFCESInterfaceClient confirms user intent ("are you sure?") Vehicle loses Network Connectivity
Post-conditions	NFC Key Delete process is aborted NFCESInterfaceClient displays message indicating that network connectivity is required to delete a key. NFC Key remains paired to vehicle
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is not deleted, shown in the NFC Key List, and can still be used for entry, starting, etc.

4.2.1.9 NFCES-UC-REQ-404008/B-Delete NFC Key – Connectivity Lost after Delete Request Sent

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key that can start the vehicle and it is not a MyKey or the key the user wants to delete
Scenario Description	User starts vehicle with a key other than the one they want to delete Using NFCESInterfaceClient, user navigates to NFC Key List and selects the "delete" option for the key they want to delete NFCESInterfaceClient confirms user intent ("are you sure?") NFCESInterfaceClient send key delete request to NFCESServer User receives notification of deletion approval request on their smart device User approves deletion request Vehicle loses Network Connectivity OR Users smart device loses Network Connectivity
Post-conditions	NFC Key Delete process times out and is aborted Notification is sent to users smart device indicating that key delete command was not delivered successfully (if users device has Network Connectivity) NFCESInterfaceClient displays message indicating that key delete request has timed out NFC Key remains paired to vehicle
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User's key is not deleted, shown in the NFC Key List, and can still be used for entry, starting, etc.

4.2.1.10 NFCES-UC-REQ-404009/B-Delete NFC Key – MyKey Active

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized



	Vehicle has network connectivity User starts the vehicle with a MyKey
Scenario Description	Using NFCESInterfaceClient, user navigates to NFC Key List and selects the "delete" button for the key they want to delete
Post-conditions	NFCESInterfaceClient displays message indicating that the requested action is not permitted with a MyKey active
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User is prevented from deleting key.

4.2.1.11 NFCES-UC-REQ-405389/B-Add/Delete NFC Key – Connectivity Lost before Selecting Button

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity User has Ford/Lincoln mobile app installed on their smart device Users smart device has network connectivity User has a key to the vehicle that is not a MyKey
Scenario Description	User starts vehicle with any key Vehicle loses or has no Network Connectivity User attempts to select Add NFC key or Delete NFC Key on NFCESInterfaceClient
Post-conditions	NFC Key Add/Delete process is not started NFCESInterfaceClient displays message indicating that network connectivity is required to add or delete a key.
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

User is prevented from adding/deleting a key.

4.2.1.12 NFCES-UC-REQ-405390/B-Master Reset Performed - Retail Vehicle

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle is not subscribed to Fleet Services Vehicle has previously added NFC Keys
Scenario Description	User starts vehicle Using NFCESInterfaceClient, user navigates to Reset menu and selects the "Master Reset" button
Post-conditions	NFCESInterfaceClient performs a Master Reset



	NFCESServer deletes all NFC Keys
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

All NFC Keys, except Factory Cards are deleted, removed from the NFC Key List, and can no longer be used for entry, starting, etc.

4.2.1.13 NFCES-UC-REQ-405391/B-Master Reset Performed - Fleet Vehicle

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle is subscribed to Fleet Services Vehicle has previously added NFC Keys
Scenario Description	User starts vehicle Using NFCESInterfaceClient, user navigates to Reset menu and selects the "Master Reset" button
Post-conditions	NFCESInterfaceClient performs a Master Reset NFCESServer does not delete NFC Keys
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

Acceptance Criteria

All NFC Keys remain added, shown in the NFC Key List, and can still be used for entry, starting, etc.

4.2.1.14 NFCES-UC-REQ-421722/A-Master Reset Disabled - NFC Key used to start vehicle

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle is not subscribed to Fleet Services Vehicle has previously added NFC Keys
Scenario Description	User starts vehicle with NFC User Key Using NFCESInterfaceClient, user navigates to Reset menu
Post-conditions	Master Reset button is disabled
List of Exception Use Cases	
Interfaces	CAN, HMI, FTCP

**Acceptance Criteria**

User is prevented from initiating a Master Reset

4.2.1.15 NFCES-UC-REQ-465882/A-Pair Owner Device via Mobile App

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle does not have Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has not been programmed to the vehicle
Scenario Description	In Ford/Lincoln mobile app, user selects to pair an NFC connected device key Ford/Lincoln mobile app prompts user to name the connected device key User names digital key in Ford/Lincoln mobile app Ford/Lincoln mobile app tells user to start vehicle with factory key if not already started, tap Start Pairing/Next (on device), and follow instructions on device User starts vehicle with a factory key User selects Next in Ford/Lincoln mobile app Smart Device UI changes from Ford mobile app to native app (device OS specific) For NFC, Native app instructs user to place device on/near reader <ul style="list-style-type: none">User places devices on/near reader For NFC+BLE+UWB, Native app instructs user to hold device <ul style="list-style-type: none">User holds devices NFCESInterfaceClient displays pairing progress. NFCESInterfaceClient displays a success message if pairing process completes within 5 seconds. Native app display success message if pairing process completes within 30 seconds, else it displays message saying "Retry" or "Cancel" If native app displays successful message, user can select continue and be taken back to Ford/Lincoln mobile app for final messaging.
Post-conditions	User can use their smart device to access and start this vehicle via NFC, BLE, or UWB (if capable). User's smart device has a digital key to this vehicle, which can be seen in the native app and the Ford/Lincoln app on their device User's phone is now the Owner device for this vehicle, according to CCC DK definition. Smart device is now paired to the vehicle with a digital key.
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's digital/mobile key is successfully added, shown in the NFC Key List, and can be used for entry, starting, etc. It is also shown as the Owner device.

4.2.1.16 NFCES-UC-REQ-465883/A-Pair Owner Device via NFCESInterfaceClient



Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle does not have Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has not been programmed to the vehicle
Scenario Description	User selects to Setup Owners Device on NFCESInterfaceClient NFCESInterfaceClient prompts user to scan QR code on screen User scans QR code with Smart device and it opens Ford/Lincoln mobile app If user is logged into Primary account in Ford/Lincoln mobile app, mobile app prompts user to name digital key (prepopulated with device name). User names digital key in Ford/Lincoln mobile app Ford/Lincoln mobile app tells user to tap Start Pairing/Next (on device), and follow instructions on device User selects Next in Ford/Lincoln mobile app Smart Device UI changes from Ford mobile app to native app (device OS specific) For NFC, Native app instructs user to place device on/near reader <ul style="list-style-type: none">User places devices on/near reader For NFC+BLE+UWB, Native app instructs user to hold device <ul style="list-style-type: none">User holds devices NFCESInterfaceClient displays pairing progress. NFCESInterfaceClient displays a success message if pairing process completes within 5 seconds. Native app display success message if pairing process completes within 30 seconds, else it displays message saying "Retry" or "Cancel" If native app displays successful message, user can select continue and be taken back to Ford/Lincoln mobile app for final messaging.
Post-conditions	User can use their smart device to access and start this vehicle via NFC, BLE, or UWB (if capable). User's smart device has a digital key to this vehicle, which can be seen in the native app and the Ford/Lincoln app on their device User's phone is now the Owner device for this vehicle, according to CCC DK definition. Smart device is now paired to the vehicle with a digital key.
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's digital/mobile key is successfully added, shown in the NFC Key List, and can be used for entry, starting, etc. It is also shown as the Owner device.

4.2.1.17 NFCES-UC-REQ-465884/A-Change Owner Device via Mobile App

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity



	Vehicle has Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has been programmed to the vehicle
Scenario Description	In Ford/Lincoln mobile app, user selects to change owner/primary device Ford/Lincoln mobile app informs user that this action will delete current owner key once completed, but shared/friend keys will remain active, and prompts them to continue User selects to continue Ford/Lincoln mobile app prompts user to name the connected device key User names digital key in Ford/Lincoln mobile app Ford/Lincoln mobile app tells user to start vehicle with factory key if not already started, tap Start Pairing/Next (on device), and follow instructions on device User starts vehicle with a factory key Previous Owner Key is terminated User selects Next in Ford/Lincoln mobile app Smart Device UI changes from Ford mobile app to native app (device OS specific) For NFC, Native app instructs user to place device on/near reader <ul style="list-style-type: none">User places devices on/near reader For NFC+BLE+UWB, Native app instructs user to hold device <ul style="list-style-type: none">User holds devices NFCESInterfaceClient displays pairing progress. NFCESInterfaceClient displays a success message if pairing process completes within 5 seconds. Native app display success message if pairing process completes within 30 seconds, else it displays message saying "Retry" or "Cancel" If native app displays successful message, user can select continue and be taken back to Ford/Lincoln mobile app for final messaging.
Post-conditions	User can use their new smart device to access and start this vehicle via NFC, BLE, or UWB (if capable). User's new smart device has a digital key to this vehicle, which can be seen in the native app and the Ford/Lincoln app on their device. User's new smart device is now the owner/primary device for this vehicle, according to CCC DK definition. User's old smart device no longer has a digital key to this vehicle and can no longer be used to access and start the vehicle.
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's new digital/mobile key is successfully added, shown in the NFC Key List, and can be used for entry, starting, etc. It is also shown as the Owner device. User's old digital/mobile key is deleted.

4.2.1.18 NFCES-UC-REQ-465885/A-Change Owner Device via NFCESInterfaceClient

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity



	Vehicle has Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has been programmed to the vehicle
Scenario Description	User selects to Setup Owners Device on NFCESInterfaceClient NFCESInterfaceClient prompts user to scan QR code on screen User scans QR code with smart device If user is logged into Primary account in Ford mobile app, mobile app prompts user to name digital key (prepopulated with device name) In Ford/Lincoln mobile app, user selects to change owner/primary device Ford/Lincoln mobile app informs user that this action will delete current owner key once completed, but shared/friend keys will remain active, and prompts them to continue User selects to continue Ford/Lincoln mobile app prompts user to name the connected device key User names digital key in Ford/Lincoln mobile app Ford/Lincoln mobile app tells user to start vehicle with factory key if not already started, tap Start Pairing/Next (on device), and follow instructions on device User starts vehicle with a factory key Previous Owner Key is terminated User selects Next in Ford/Lincoln mobile app Smart Device UI changes from Ford mobile app to native app (device OS specific) For NFC, Native app instructs user to place device on/near reader <ul style="list-style-type: none">• User places devices on/near reader For NFC+BLE+UWB, Native app instructs user to hold device <ul style="list-style-type: none">• User holds devices NFCESInterfaceClient displays pairing progress. NFCESInterfaceClient displays a success message if pairing process completes within 5 seconds. Native app display success message if pairing process completes within 5 seconds, else it displays message saying "Retry" or "Cancel" If native app displays successful message, user can select continue and be taken back to Ford/Lincoln mobile app for final messaging.
Post-conditions	User can use their new smart device to access and start this vehicle via NFC, BLE, or UWB (if capable). User's new smart device has a digital key to this vehicle, which can be seen in the native app and the Ford/Lincoln app on their device. User's new smart device is now the owner/primary device for this vehicle, according to CCC DK definition. User's old smart device no longer has a digital key to this vehicle and can no longer be used to access and start the vehicle.
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's new digital/mobile key is successfully added, shown in the NFC Key List, and can be used for entry, starting, etc. It is also shown as the Owner device. User's old digital/mobile key is deleted.

4.2.1.19 NFCES-UC-REQ-465886/A-Delete Shared Device via Mobile App



Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle has Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has been programmed to the vehicle Owner's smart device is the owner device for this vehicle (per CCC Digital Key definition) User's smart device is a friend device for this vehicle (per CCC Digital Key definition).
Scenario Description	In Ford/Lincoln mobile app, user selects vehicle User selects to view the list of keys Ford/Lincoln mobile app displays list of keys User selects to delete a shared/friend key Ford/Lincoln mobile app prompts user to confirm deletion of shared/friend key User selects to confirm deletion of shared/friend key Ford/Lincoln mobile app displays message that key deletion request has been sent With a native app/Ford mobile app message, Friend is notified of pending key deletion. The vehicle deletes the selected key and notifies the user in the vehicle that a key has been terminated With a native app/Ford mobile app message, Friend is notified of key deletion. With a native app/Ford mobile app message, Owner is notified of key deletion from friend device.
Post-conditions	User's phone can no longer be used to access and start the vehicle
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's shared digital/mobile key is successfully deleted, and no longer shown in the NFC Key List.

4.2.1.20 NFCES-UC-REQ-465887/A-Delete Shared Device via NFCESInterfaceClient

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle has Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has been programmed to the vehicle Owner's smart device is the owner device for this vehicle (per CCC Digital Key definition) User's smart device is a friend device for this vehicle (per CCC Digital Key definition).



Scenario Description	User starts vehicle with Trusted device User selects to view the list of keys on NFCESInterfaceClient NFCESInterfaceClient displays the list of keys User selects to delete a shared/friend key NFCESInterfaceClient prompts user to confirm deletion of shared/friend key User selects to confirm deletion of shared/friend key NFCESInterfaceClient displays message saying shared/friend key has been deleted Primary account holder is notified of key deletion via email With a native app/Ford mobile app message, Friend is notified of key deletion With a native app/Ford mobile app message, Owner is notified of key deletion from friend device
Post-conditions	User's smart device can no longer be used to access and start the vehicle.
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's shared digital/mobile key is successfully deleted, and no longer shown in the NFC Key List.

4.2.1.21 NFCES-UC-REQ-465888/A-Delete Owner Device via Mobile App

Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle has Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has been programmed to the vehicle User's smart device is the owner device for this vehicle (per CCC Digital Key definition)
Scenario Description	In native app, user selects vehicle Native app displays the list of keys User selects to delete their Owner key Native app prompts user to confirm deletion of their Owner key User selects to confirm deletion of their Owner key With a native app/Ford mobile app message, Owner is notified of key deletion The NFCESInterfaceClient displays that a key was terminated.
Post-conditions	User's phone can no longer be used to access and start the vehicle
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's owner digital/mobile key is successfully deleted, and no longer shown in the NFC Key List.

4.2.1.22 NFCES-UC-REQ-465889/A-Delete Owner Device via NFCESInterfaceClient



Actors	NFC User, NFCESInterfaceClient, NFCESServer
Pre-conditions	Powermode conditions are met Vehicle is authorized Vehicle has network connectivity Vehicle has Digital Key paired User has Ford/Lincoln mobile app installed on their smart device User's smart device has network connectivity User has a Factory key to the vehicle User's smart device is Digital Key capable (CCC compliant) and has been programmed to the vehicle User's smart device is the owner device for this vehicle (per CCC Digital Key definition)
Scenario Description	User starts vehicle with Factory device User selects to view the list of keys on NFCESInterfaceClient NFCESInterfaceClient displays the list of keys User selects to delete the Owner key NFCESInterfaceClient prompts user to confirm deletion of Owner key User selects to confirm deletion of Owner key NFCESInterfaceClient displays message saying Owner key has been terminated Primary account holder is notified of key deletion via email With a native app/Ford mobile app message, Owner is notified of key deletion
Post-conditions	User's smart device can no longer be used to access and start the vehicle.
List of Exception Use Cases	
Interfaces	CAN, HMI

Acceptance Criteria

User's owner digital/mobile key is successfully deleted, and no longer shown in the NFC Key List.

4.2.2 Requirements**4.2.2.1 *NFCES-REQ-406219/B-NFC Key Failed Response***

The NFCESInterfaceClient shall display a notification indicating that a system error has occurred when DigitalKey_Rsp is received from the NFCESServer with CES = Final Result – Fail. When this occurs, no other values are received beyond the CES.

Acceptance Criteria

Receiving the indicated response will result in a 'System Error' popup being displayed.

4.2.2.2 *NFCES-REQ-403982/B-Add NFC Key – User Input*

The NFCESInterfaceClient shall provide a user interface (button/graphic) to allow the addition/creation of an NFC Key. This user interface shall not be show or made available when the NFCESInterfaceClient is configured for Fleet.

Acceptance Criteria

An Add Key button will be present for a user to add an NFC Key (when not a fleet vehicle).

4.2.2.3 *NFCES-REQ-465891/A-Setup/Change Owner Device – User Input*

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall provide a user interface (button/graphic) to allow the pairing/changing of an Owner Device. This user interface shall not be show or made available when the NFCESInterfaceClient is configured for Fleet.

Acceptance Criteria



A Setup/Change Owner Device button(s) will be present for a user to pair/change an Owner Device (when not a fleet vehicle).

4.2.2.4 NFCES-REQ-403983/D-Add NFC Key – User Input Enable/Disable

The NFCESInterfaceClient shall enable (show, unhide, etc.) the Add NFC Key user interface (button/graphic) when the following are true:

- Ignition_Status = Run
- IgnKeyType_D_Actl != (0x2) KeyInIgnMyKey OR (0x0) KeyReadInProgress
- DigitalKeyList_Rsp last indicated that Additional Key Storage Available = "(0x01) Yes"

Acceptance Criteria

The Add Key button will only be made available to the user when the listed preconditions are met.

4.2.2.5 NFCES-REQ-465892/A-Setup/Change Owner Device – User Input Enable/Disable

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall enable (show, unhide, etc.) the Setup/Change Owner Device user interface (button/graphic) when the following are true:

- Ignition_Status = Run
- IgnKeyType_D_Actl != (0x2) KeyInIgnMyKey
- VehicleStartKeyType_St = "(0x2) Factory"

The user interface shall read "Setup Owner Device" if the above conditions are met AND the sorted list obtained from DigitalKeyList_Rsp does not contain a key with KeyType = OwnerDevice.

The user interface shall read "Change Owner Device" if the above conditions are met AND the sorted list obtained from DigitalKeyList_Rsp does contain a key with KeyType = OwnerDevice.

Acceptance Criteria

The Setup/Change Owner Device button will only be made available to the user when the listed preconditions are met. Displaying "setup" vs "change" text in the button shall differ based on whether an Owner Device already exists.

4.2.2.6 NFCES-REQ-403989/C-Add NFC Key – FriendlyName

The NFCESInterfaceClient shall prompt and provide the user a means to enter an NFC Key FriendlyName. The entered FriendlyName shall:

- Not be zero length
- Not consist only of whitespace characters
- Not consist of any more than 64 characters after any leading and trailing whitespace have been removed from the input
- Not be identical to any of the other friendly names in the most recently received list of keys (including pending/requested keys), after any leading and trailing whitespace have been removed from the input

The NFCESInterfaceClient shall not allow the user to proceed beyond the FriendlyName input screen if the above has not been met.

The NFCESInterfaceClient shall remove leading and trailing whitespace characters from the user inputted FriendlyName before transmitting or storing it.

Acceptance Criteria

The user will be presented with a popup and means (ex. keyboard) to enter a FriendlyName for their NFC Key. The entered FriendlyName must follow the defined rules.

4.2.2.7 NFCES-REQ-458377/A-Add NFC Key - Default FriendlyName

When the NFCESInterfaceClient prompts the user per REQ-403989, the text field shall be pre-populated with a default name as follows:

- If the most recent list of keys received from the NFCESServer has no pairing records or pending pairing records whose FriendlyName is exactly "Key Card #", where "#" is any integer, the default name shown shall be "Key Card 1".



- Otherwise, the default name shown shall be "Key Card n", where n is the largest "Key Card #" number present in the list of pairing records and pending pairing records, plus one.

Example:

If the most recently received key list contains the following entries:

Entry Type	Friendly Name
Pairing	Factory Card 1
Pairing	Factory Card 2
Pairing	Aaron's Favorite Key
Pairing	Key Card 1
Pairing	Key Card 2
Pending deletion	Key Card 2
Pending addition	Key Card 3

then the pre-populated name on the Prompt for Friendly Name screen shall be "Key Card 4".

Acceptance Criteria

The FriendlyName field (in the keyboard) will be prepopulated with a default name as defined in the requirement.

4.2.2.8 NFCES-REQ-403984/B-Add NFC Key – NFCESInterfaceClient Request

When permitted per REQ-403983, the NFCESInterfaceClient shall send DigitalKey_Rq to the NFCESServer when the user requests to add an NFC Key. The request shall include the below parameters:

DigitalKey_Rq

- Opcode = 0x01: AddKey
- FriendlyName = {Name of key}

Acceptance Criteria

A press of the Add Key button (when permitted) will result in the indicated request being sent.

4.2.2.9 NFCES-REQ-465893/A-Setup/Change Owner Device – Button Pressed

When configured for Digital/Mobile Keys and permitted per REQ-465892, the NFCESInterfaceClient shall perform the below when the user selects the Setup/Change Owner Device button:

- Generate a QR code with a deeplink to the mobile app "key management page"
- The QR code shall be displayed on a screen
- The QR code screen shall have a cancel button

Acceptance Criteria

A press of the Setup/Change Owner Device button (when permitted) will result in the indicated HMI behaviors

4.2.2.10 NFCES-REQ-403990/B-Add NFC Key – Progress Screen Notification

When the DigitalKey_Rq is sent requesting an AddKey operation, the NFCESInterfaceClient shall display a progress notification indicating that the request is being sent (progress screen).

Acceptance Criteria

Sending the indicated request will result in a 'progress' popup being displayed.

4.2.2.11 NFCES-REQ-465894/A-Setup/Change Owner Device – Progress Screen Notification

When configured for Digital/Mobile Keys and the NFCESInterfaceClient receives DigitalKey_Rsp(OpCode = OwnerPairing, ResponseStatus = Pairing NFC or Pairing BLE), the NFCESInterfaceClient shall:

- Display a screen to the user indicating that Owner Pairing has begun with a progress bar
- The progress bar fill percentage shall be populated based on the Request Progress received via DigitalKey_Rsp
 - Request Progress values of 0x00-0x64 shall be used to indicate 0-100% progress. Any value beyond 0x64 shall be shown as 100% as well

**Acceptance Criteria**

Receiving the indicated response will result in an 'Owner Pairing Stared" popup with a progress bar being displayed. Progress bar will update based on the indicated interface.

4.2.2.12 NFCES-REQ-465895/A-Setup/Change Owner Device – Vehicle Not In Pairing Mode Failure Notification

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall display a notification indicating that the Vehicle Not in Pairing Mode when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x05: OwnerPairing
- Request Status = 0x14: Failed - Vehicle Not In Pairing Mode

Acceptance Criteria

Receiving the indicated response will result in a 'Vehicle Not in Pairing Mode' popup being displayed.

4.2.2.13 NFCES-REQ-465896/A-Setup/Change Owner Device – Vehicle Preconditions Failure Notification

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall display a notification indicating that the Vehicle Preconditions Not Met when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x05: OwnerPairing
- Request Status = 0x16: Failed - Pre-Conditions Not Met

Acceptance Criteria

Receiving the indicated response will result in a 'Vehicle Preconditions Not Met' popup being displayed.

4.2.2.14 NFCES-REQ-465897/A-Setup/Change Owner Device – Vehicle Safety Failure Notification

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall display a notification indicating that the Vehicle must be in Park when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x05: OwnerPairing
- Request Status = 0x15: Failed - Vehicle Safety

Acceptance Criteria

Receiving the indicated response will result in a 'Vehicle Must be in Park' popup being displayed.

4.2.2.15 NFCES-REQ-465898/A-Setup/Change Owner Device – Successfully Paired Notification

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall display a notification indicating that the Owner Pairing was successful when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x05: OwnerPairing
- Request Status = 0x12: Success - Paired

Acceptance Criteria

Receiving the indicated response will result in an 'Owner Pairing Successful' popup being displayed.

4.2.2.16 NFCES-REQ-465899/A-Setup/Change Owner Device – Awaiting KTS Notification

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall display a notification indicating that the Owner Pairing was successful but awaiting KTS when DigitalKey_Rsp is received from the NFCESServer with the below values.



DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x05: OwnerPairing
- Request Status = 0x13: Success - Awaiting KTS

Acceptance Criteria

Receiving the indicated response will result in an 'Owner Pairing Successful, Awaiting KTS' popup being displayed.

4.2.2.17 NFCES-REQ-465900/A-Setup/Change Owner Device – Failed Pairing Notification

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall display a notification indicating that the Owner Pairing has failed when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x05: OwnerPairing
- Request Status = 0x04: Final System Error

Acceptance Criteria

Receiving the indicated response will result in an 'Owner Pairing Failure' popup being displayed.

4.2.2.18 NFCES-REQ-403991/C-Add NFC Key – Add Request Sent Approval Required Notification

The NFCESInterfaceClient shall display a notification indicating that the Add Key Request Requiring Approval has been successfully sent when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x05: Success - Request Sent - Approval Required

Acceptance Criteria

Receiving the indicated response will result in an 'Add Request Sent - Approval Required' popup being displayed.

4.2.2.19 NFCES-REQ-405015/D-Add NFC Key – Waiting for Tap Notification

The NFCESInterfaceClient shall display a notification instructing the user to tap their NFC Key when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x0C: Waiting for Card Tap

Acceptance Criteria

Receiving the indicated response will result in a 'Tap your NFC device' popup being displayed.

4.2.2.20 NFCES-REQ-405016/C-Add NFC Key – Tap Timeout Failure Notification

The NFCESInterfaceClient shall display a notification indicating that the tap time has elapsed when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x09: Rejected - Tap timeout

Acceptance Criteria

Receiving the indicated response will result in a 'Tap Timed Out' popup being displayed.



4.2.2.21 NFCES-REQ-404985/C-Add NFC Key – Already Pending Failure Notification

The NFCESInterfaceClient shall display a notification indicating a pending NFC Key Add operation when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x07: Rejected - Already pending

Acceptance Criteria

Receiving the indicated response will result in a 'Add Key Pending' popup being displayed.

4.2.2.22 NFCES-REQ-403985/C-Add NFC Key – Key Already Paired Failure Notification

The NFCESInterfaceClient shall display a notification indicating that the tapped NFC Key is already paired to the vehicle when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x08: Rejected - Already programmed

Acceptance Criteria

Receiving the indicated response will result in a 'Key Already Paired' popup being displayed.

4.2.2.23 NFCES-REQ-403987/C-Add NFC Key – Storage Full Failure Notification

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Add operation due to storage full when DigitalKey_Rsp is received with the values below:

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x06: Rejected - No space available

Acceptance Criteria

Receiving the indicated response will result in a 'Storage Full' popup being displayed.

4.2.2.24 NFCES-REQ-405018/C-Add NFC Key – No Connectivity Failure Notification

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Add operation due to no connectivity when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x0D: Rejected - No Connectivity

Acceptance Criteria

Receiving the indicated response will result in a 'No Connectivity' popup being displayed.

4.2.2.25 NFCES-REQ-405019/C-Add NFC Key – System Failure Notification

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Add operation due to system error (on NFCESServer) when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x0B: Rejected - System Error

**Acceptance Criteria**

Receiving the indicated response will result in a 'system error' popup being displayed.

4.2.2.26 *NFCES-REQ-403973/B-Add NFC Key – Final Success Notification*

The NFCESInterfaceClient shall display a notification indicating a successful NFC Key Add operation when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x01: Final Success
- FESN = {FESN of key}
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in a 'Successful Key Add' popup being displayed.

4.2.2.27 *NFCES-REQ-465901/A-Shared Device Added – Final Success Notification*

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall display a notification indicating that a Shared Key has been successfully added when DigitalKey_Rsp is received from the NFCESServer with the below values. This notification shall include the FriendlyName as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x06: SharedKey
- Request Status = 0x01: Final Success
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in a 'Shared Key Successfully Added' popup being displayed.

4.2.2.28 *NFCES-REQ-403974/B-Add NFC Key – Final System Failure Notification*

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Add operation due to system error (on NFCESOffBoardClient) when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x04: Final System Error
- FESN = {FESN of key}
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in a 'System Error' popup being displayed.

4.2.2.29 *NFCES-REQ-403975/B-Add NFC Key – Final Denied Notification*

The NFCESInterfaceClient shall display a notification indicating a denied NFC Key Add operation when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x02: Final Rejected
- FESN = {FESN of key}



- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in a 'Denied Key Add' popup being displayed.

4.2.2.30 NFCES-REQ-403976/B-Add NFC Key – Final Expired Notification

The NFCESInterfaceClient shall display a notification indicating an expired NFC Key Add operation when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x01: AddKey
- Request Status = 0x03: Final Timeout
- FESN = {FESN of key}
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in an 'Expired Key Add' popup being displayed.

4.2.2.31 NFCES-REQ-403988/B-Add/Delete NFC Key – No Connectivity Notification

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Add/Delete (whichever was requested) due to No Connectivity, when connectivity is lost and the Add/Delete button is pressed. Connectivity shall be obtained from FCI and shall be considered lost when:

SdnConnectionStatusBroadcast(

- InterfaceType = Connection_TCU_Cell
- SDNConnStatus= SDN_Disconnected)

Note: Loss of connectivity for this feature is in regards to the capability to send/receive FTCP, which is why only the 'Connection_TCU_Cell' interface type is considered.

Acceptance Criteria

Pressing the Add or Delete Key button when there is no connectivity (per listed interface) will result in a 'No Connectivity' popup being displayed.

4.2.2.32 NFCES-REQ-403986/B-Add/Delete NFC Key – MyKey Active Notification

The NFCESInterfaceClient shall display a notification indicating that a MyKey cannot be used to add/delete an NFC key, when IgnKeyType_D_Actl = (0x2) KeyInIgnMyKey and the user presses the Add or Delete NFC Key button.

Acceptance Criteria

Pressing the Add or Delete Key button when a MyKey is the active key (per listed interface) will result in a 'MyKey Cannot be Used' popup being displayed.

4.2.2.33 NFCES-REQ-403992/C-Delete NFC Key – User Input

The NFCESInterfaceClient shall provide a user interface (button/graphic) to allow the deletion/removal of an NFC Key (whether NFC Card, Digital Key, Owner or Shared). This user interface shall not be show or made available when the NFCESInterfaceClient is configured for Fleet.

Acceptance Criteria

A Delete Key button will be present for a user to delete an NFC Key (when not a fleet vehicle).

4.2.2.34 NFCES-REQ-403993/D-Delete NFC Key – User Input Enable/Disable

The NFCESInterfaceClient shall enable (show, unhide, etc.) the Delete NFC Key user interface (button/graphic) when the following are true:

- Ignition_Status = Run
- IgnKeyType_D_Actl != (0x2) KeyInIgnMyKey OR (0x0) KeyReadInProgress



- The NFC Key selected for deletion is not the one used to start the vehicle (see REQ-403997)
- DigitalKeyList_Rsp(KeyType != (0x00) Factory) for the selected NFC Key
 - The Delete NFC Key user interface shall not be shown for any NFC Key that is a Factory Key

When configured for Digital/Mobile Keys, the NFCESInterfaceClient shall only enable (show, unhide, etc.) this user interface for Digital/Mobile Keys where:

- If DigitalKeyList_Rsp(KeyType = OwnerDevice), the NFCESInterfaceClient shall only provide the deletion/removal button when VehicleStartKeyType_St = "(0x2) Factory"
- If DigitalKeyList_Rsp(KeyType = SharedDevice), the NFCESInterfaceClient shall only provide the deletion/removal button when:
 - VehicleStartKeyType_St = "(0x2) Factory" OR
 - The key used to start the vehicle is an Owners Key
 - To determine this, the NFCESInterfaceClient shall correlate the index received via VehicleStartKeyIndex_St to the IndexNumbers received via DigitalKeyList_Rsp. If the KeyType of the matching IndexNumber must be set to 'OwnerDevice'

Acceptance Criteria

The Delete Key button will only be made available to the user when the listed preconditions are met. A Factory Key cannot be deleted.

4.2.2.35 *NFCES-REQ-465902/A-Delete Owner/Friend Key When Button Disabled*

When configured for Digital/Mobile Keys, and the user selects a disabled delete button (per REQ-403993), the NFCESInterfaceClient shall display a notification to the user that details:

- For delete owner key: to delete an owner phone, restart the vehicle with a factory key. For more information, see your Owner's Manual.
- For delete friend key: to delete a friend phone, restart the vehicle with a factory or owner key. For more information, see your Owner's Manual.

Acceptance Criteria

Display popup when a disabled delete button is selected by the user.

4.2.2.36 *NFCES-REQ-403997/C-Delete NFC Key – Deleting Starting NFC Key*

The NFCESInterfaceClient shall disable the Delete button for the NFC Key used to start the vehicle. If the user selects the Starting NFC Key for deletion, the NFCESInterfaceClient shall not send the delete request and shall instead display a notification to the user indicating an error due to the selected key being in use.

The Starting NFC Key shall be communicated periodically to the NFCESInterfaceClient by the NFCESOnBoardClient2 using VehicleStartKeySource_St, VehicleStartKeyType_St, and VehicleStartKeyIndex_St.

After requesting and receiving the NFC Key List per REQ-403969, the NFCESInterfaceClient shall disable the Delete button for the NFC Key whose Index and Key Type match that of the values received in VehicleStartKeySource_St and VehicleStartKeyIndex_St.

If any of the above VehicleStartKey signals go missing from the bus for more than 5s, the NFCESInterfaceClient shall disable all Delete buttons for all NFC Keys.

Acceptance Criteria

Pressing the Delete Key button for the NFC Key that was used to start the vehicle will result in an "Error due to selected key in use" popup being displayed. If the required signals go missing for the defined time, the Delete buttons for all keys will be disabled.

4.2.2.37 *NFCES-REQ-421724/A-Disable Master Reset per Starting NFC Key*

The NFCESInterfaceClient shall disable the Master Reset button when the below conditions are true:

- VehicleStartKeyType_St = User, AND
- VehicleStartKeySource_St = Digital_Key

If the above signals become missing or their values cannot be determined, the Master Reset button shall be enabled.

**Acceptance Criteria**

The Master Reset button is disabled when the NFC Key that was used to start the vehicle was a user's digital key (not a Factory Card).

4.2.2.38 NFCES-REQ-403994/B-Delete NFC Key – User Input Confirmation

When the user requests to delete an NFC Key, the NFCESInterfaceClient shall require and provide an additional user interface (button/graphic) for the user to provide confirmation of the delete request.

Acceptance Criteria

Pressing the Delete Key button (when permitted) will result in a confirmation popup, asking the user to confirm their selection.

4.2.2.39 NFCES-REQ-403995/B-Delete NFC Key – NFCESInterfaceClient Request

If the user selects to delete an NFC key from the NFC Key list, the NFCESInterfaceClient shall send DigitalKey_Rq to remove the NFC key by specifying the PairingID of the NFC Card or Digital Key. The request shall include the below parameters:

DigitalKey_Rq

- Opcode = 0x02: DeleteKey
- PairingID = {PairingID of key}

Acceptance Criteria

A press of the Delete Key button (when permitted, and after confirmation) will result in the indicated request being sent.

4.2.2.40 NFCES-REQ-403996/D-Delete NFC Key – Delete Request Sent Approval Required Notification

The NFCESInterfaceClient shall display a notification indicating that the Delete Key Request Requiring Approval has been successfully sent when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x05: Success - Request Sent - Approval Required

Acceptance Criteria

Receiving the indicated response will result in a 'Delete Request Sent - Approval Required' popup being displayed.

4.2.2.41 NFCES-REQ-441758/B-Delete NFC Key – Delete Request Sent No Approval Required Notification

The NFCESInterfaceClient shall display a notification indicating that the Delete Key Request Not Requiring Approval has been successfully sent when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x0E: Success - Request Sent - No Approval Required

Acceptance Criteria

Receiving the indicated response will result in a 'Delete Request Sent - No Approval Required' popup being displayed.

4.2.2.42 NFCES-REQ-403981/C-Delete NFC Key – Already Pending Failure Notification

The NFCESInterfaceClient shall display a notification indicating a pending NFC Key Delete operation when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success



- Opcode = 0x02: DeleteKey
- Request Status = 0x07: Rejected - Already pending

Acceptance Criteria

Receiving the indicated response will result in a 'Delete Key Pending' popup being displayed.

4.2.2.43 *NFCES-REQ-405020/C-Delete NFC Key – No Connectivity Failure Notification*

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Delete operation due to no connectivity when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x0D: Rejected - No Connectivity

Acceptance Criteria

Receiving the indicated response will result in a 'No Connectivity' popup being displayed.

4.2.2.44 *NFCES-REQ-405021/C-Delete NFC Key – System Failure Notification*

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Delete operation due to system error (on NFCESServer) when DigitalKey_Rsp is received from the NFCESServer with the below values.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x0B: Rejected - System Error

Acceptance Criteria

Receiving the indicated response will result in a 'System Error' popup being displayed.

4.2.2.45 *NFCES-REQ-403977/B-Delete NFC Key – Final Success Notification*

The NFCESInterfaceClient shall display a notification indicating a successful NFC Key Delete operation when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x01: Final Success
- FESN = {FESN of key}
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in a 'Successful Key Delete' popup being displayed.

4.2.2.46 *NFCES-REQ-465903/B-Delete NFC Key – Starting Key Delete Final Success Notification*

The NFCESInterfaceClient shall display a notification indicating a successful delete of the starting NFC Key when DigitalKey_Rsp is received from the NFCESServer.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x0F: Final Success – Deleted Key Used to Start

Acceptance Criteria

Receiving the indicated response will result in a "Key used to start vehicle was deleted" popup being displayed.



4.2.2.47 NFCES-REQ-403978/B-Delete NFC Key – Final System Failure Notification

The NFCESInterfaceClient shall display a notification indicating a failed NFC Key Delete operation when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x04: Final System Error
- FESN = {FESN of key}
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in a 'Failed Key Delete' popup being displayed.

4.2.2.48 NFCES-REQ-403979/B-Delete NFC Key – Final Denied Notification

The NFCESInterfaceClient shall display a notification indicating a denied NFC Key Delete operation when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x02: Final Rejected
- FESN = {FESN of key}
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in a 'Denied Key Delete' popup being displayed.

4.2.2.49 NFCES-REQ-403980/B-Delete NFC Key – Final Expired Notification

The NFCESInterfaceClient shall display a notification indicating an expired NFC Key Delete operation when DigitalKey_Rsp is received from the NFCESServer. This notification shall include the FESN as provided via DigitalKey_Rsp.

DigitalKey_Rsp

- CES = Final Result - Success
- Opcode = 0x02: DeleteKey
- Request Status = 0x03: Final Timeout
- FESN = {FESN of key}
- FriendlyName = {Name of key}

Acceptance Criteria

Receiving the indicated response will result in an 'Expired Key Delete' popup being displayed.

4.2.2.50 NFCES-REQ-403972/B-Persisting NFC Notifications

If the NFCESInterfaceClient receives DigitalKey_Rsp with any of the below Request Statuses at a time when the NFCESInterfaceClient cannot display the correlated notifications, the NFCESInterfaceClient shall persist/queue the notification until a time when it can display it. The NFCESInterfaceClient shall persist/queue a notification for a max of 7 days. The notifications shall be persisted through ignition cycles, battery disconnects, loss of power, etc.

DigitalKey_Rsp

- RequestStatus = "0x01: Final Success", "0x02: Final Rejected",
"0x03: Final Timeout", "0x04: Final System Error"

Acceptance Criteria

Receiving the indicated response at a time when the HMI cannot display the associated popup will result popup being queued until a time when it can be displayed.



4.2.2.51 NFCES-REQ-421725/B-Request Key List upon Final Notifications

If the NFC Key List is being displayed when the NFCESInterfaceClient receives and displays any of the final notifications below, it shall also request for and update the NFC Key List via DigitalKeyList_Rq (see REQ-403969).

- Request Status = 0x01: Final Success, per REQ-403973, REQ-403977
- Request Status = 0x04: Final System Error, per REQ-403974, REQ-403978
- Request Status = 0x02: Final Rejected, per REQ-403975, REQ-403979
- Request Status = 0x03: Final Timeout, per REQ-403976, REQ-403980
- Request Status = 0x12: Success - Paired, per REQ-465898
- Request Status = 0x13: Success - Awaiting KTS, per REQ-465899

Acceptance Criteria

When a final notification is displayed, the NFC List shall be updated to show the current/latest key information.

4.2.2.52 NFCES-REQ-458397/B-Cancel Pending Add/Delete Request

If the user selects and confirms to Cancel an NFC key that is pending add or pending delete (per REQ-458338), the NFCESInterfaceClient shall send DigitalKey_Rq to cancel the pending operation. The request shall include the below parameters:

DigitalKey_Rq

- Opcode = 0x04: CancelRequest
- FriendlyName = Null
- PairingID = Null
- LocalID = the Local ID associated with the request that the user is cancelling

Note: The Local ID is only received and used by the NFCESInterfaceClient for this purpose (to cancel a pending operation).

Acceptance Criteria

Pressing the Cancel button will result in the indicated request being sent

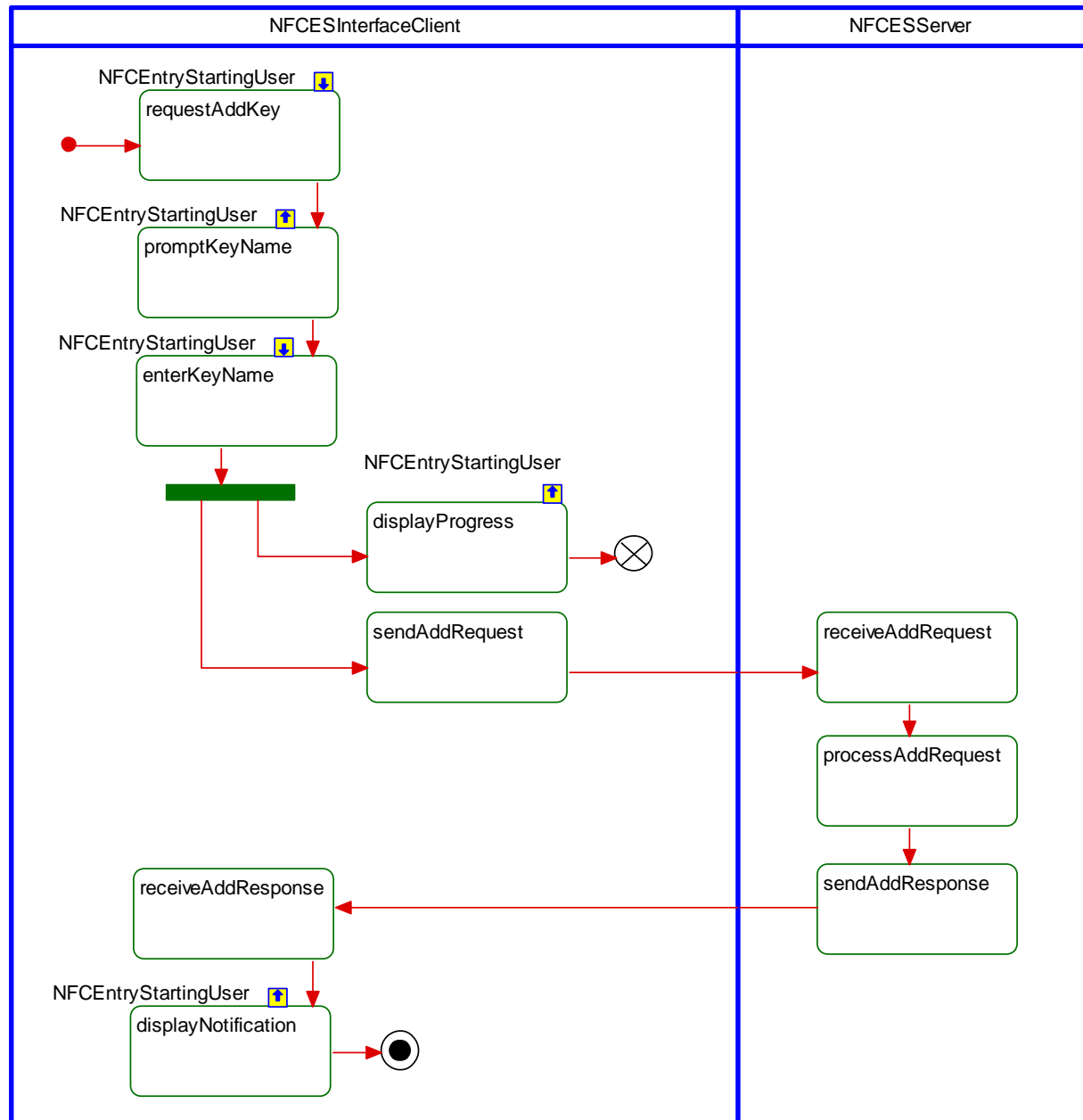


4.2.3 White Box View

4.2.3.1 Activity Diagrams

4.2.3.1.1 NFCES-ACT-REQ-424659/A-Add Digital Key

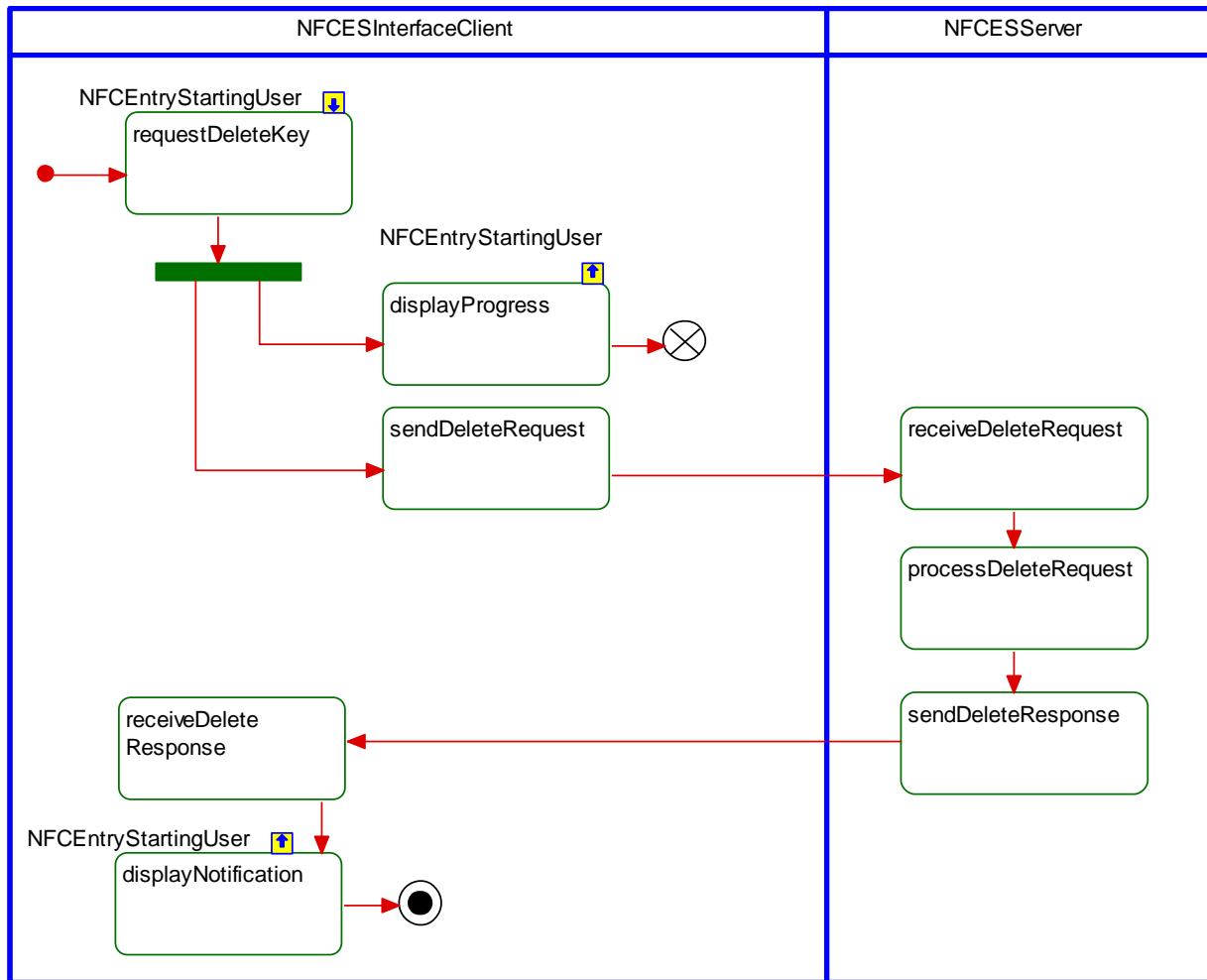
Activity Diagram





4.2.3.1.2 NFCES-ACT-REQ-424759/A-Delete Digital Key

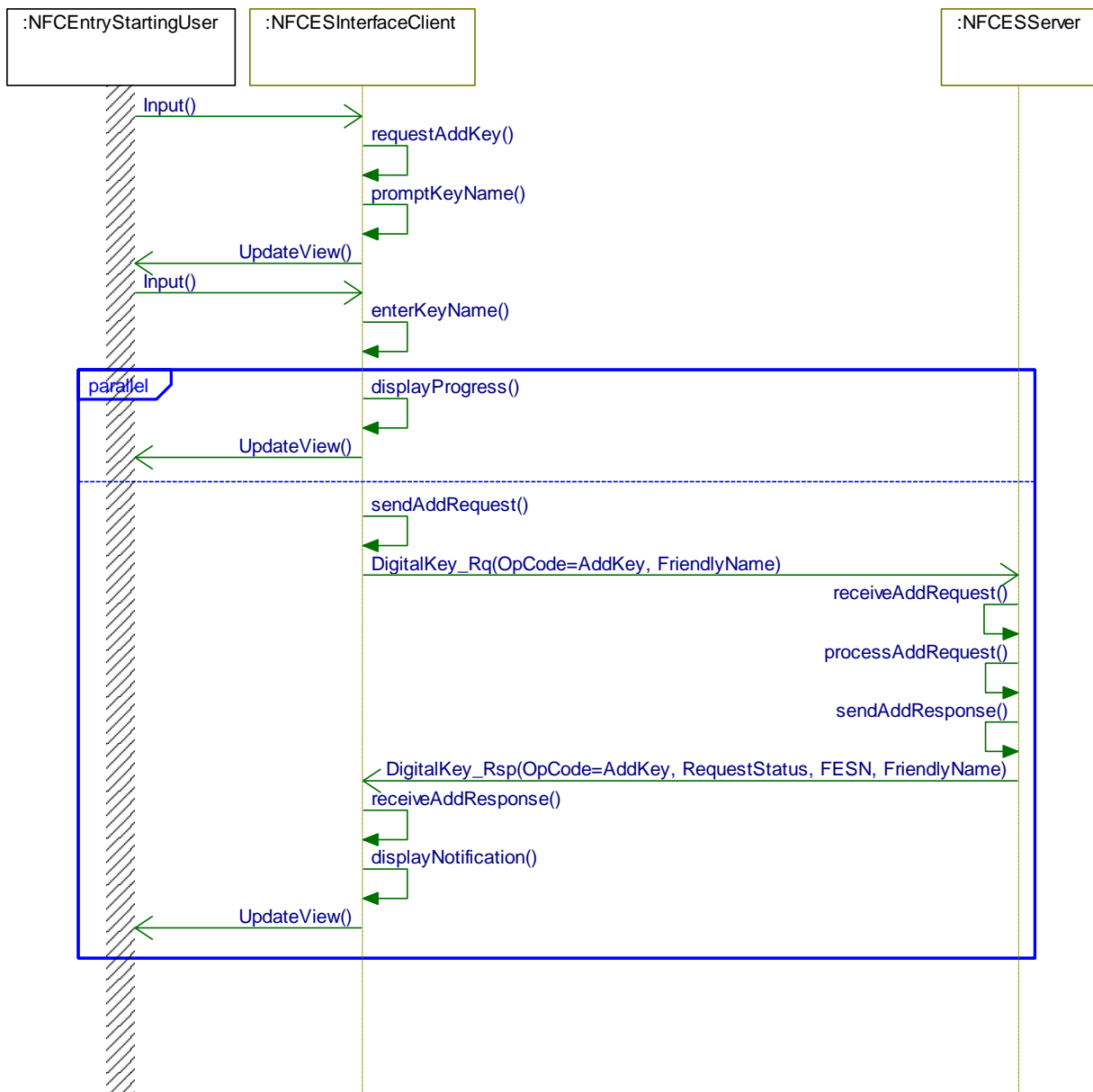
Activity Diagram





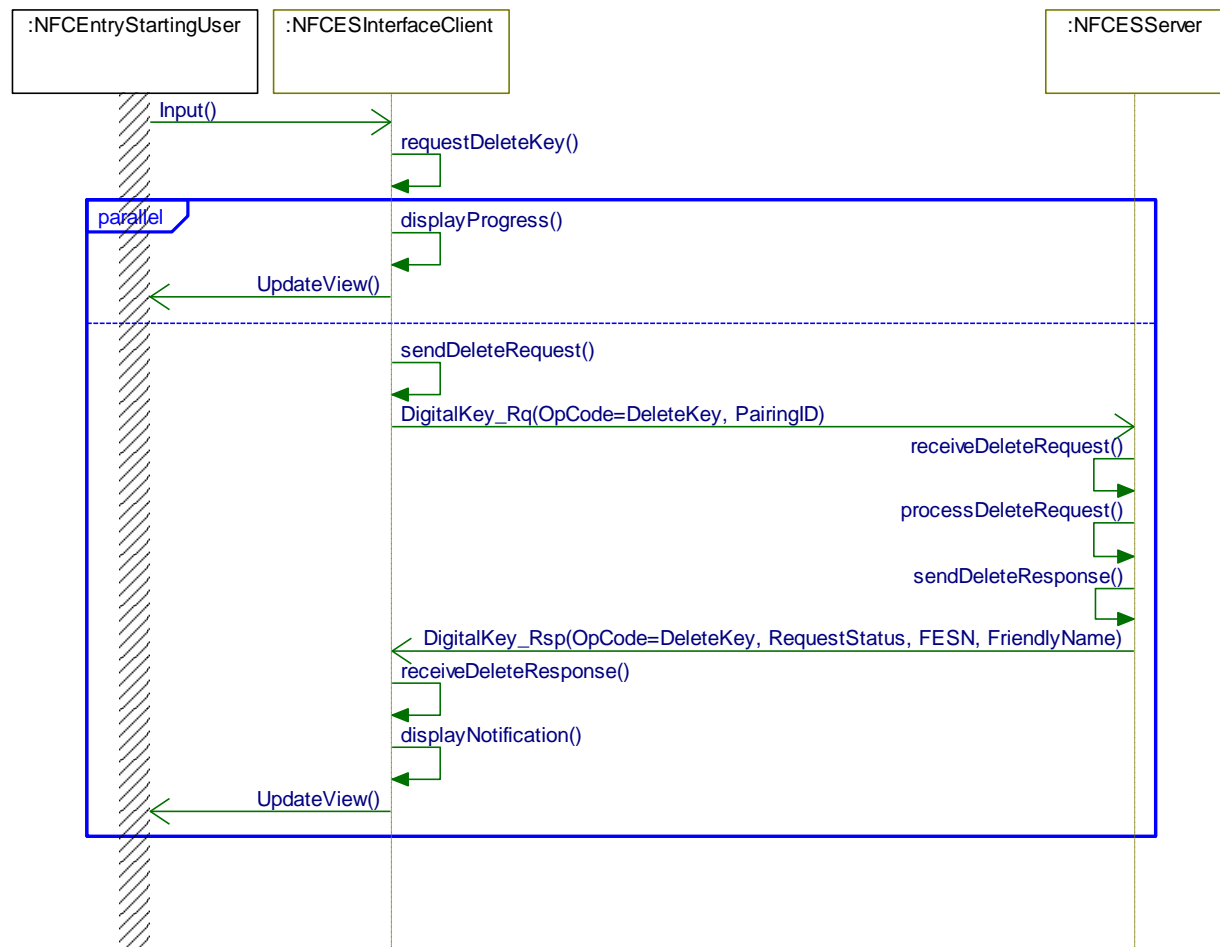
4.2.3.2 Sequence Diagrams

4.2.3.2.1 NFCES-SD-REQ-362251/A-Add Digital Key Sequence Diagram





4.2.3.2.2 NFCES-SD-REQ-403914/B-Delete Digital Key Sequence Diagram





5 Appendix: Reference Documents

Reference #	Document Title
1	
2	
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