



Research & Vehicle Technology
“Infotainment Systems Product Development”

Feature – Plug and Charge

**Infotainment Subsystem Part Specific
Specification (SPSS)**

Version 1.4

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Version Date: December 18, 2019

FORD CONFIDENTIAL



Revision History

| Date | Version | Notes | |
|-------------------|---------|--|--|
| August 31, 2018 | 0.1 | Draft | |
| October 5, 2018 | 1.0 | Initial Release | |
| February 12, 2019 | 1.1 | | |
| | | PNC-STR-575726/B-Overview | rpaquet2 - Updated diagram |
| | | PNC-STR-575727/B-Logical Signal Mapping | rpaquet2 - Update CAN Signal names ChrgrPncEnble_D_Rq and _st |
| | | PNC-IIR-REQ-324736/B-PNC Onboard Server_Tx | rpaquet2 - Added 337333, 343026, 343489 removed 326483 |
| | | MD-REQ-326487/B-setPlugAndChargeStatus | rpaquet2 - Update PnCStatus and EVSE Fault to state is uses the VIM process removed IndicatePNCInfo and put it in setStationInfo API |
| | | MD-REQ-326578/B-setVehicleChargeInfo | rpaquet2 - Updated to Total Time Plugged In |
| | | MD-REQ-326685/B-setStationInfo | rpaquet2 - Updated encoding added IndicateONCInfo to this API |
| | | MD-REQ-337333/A-ChargerPnC Sustain_Rq | rpaquet2 - new |
| | | MD-REQ-343026/A-ChargeStationID_Rq | rpaquet2 - new |
| | | PNC-IIR-REQ-324737/B-PNC Onboard Server_Rx | rpaquet2 - Added 343488, 337016 |
| | | MD-REQ-326486/B-PnCStat_St | rpaquet2 - Update the encodings |
| | | MD-REQ-326502/B-ChargeStationID_St | rpaquet2 - added new paramete TLS status |
| | | MD-REQ-326689/B-DigitalCommFault_St | rpaquet2 - Updated the encoding table |
| | | MD-REQ-337016/B-ChargeStationSchedule_St | rpaquet2 - Update the Time interval size and restructured the vector |
| | | PNC-IIR-REQ-326492/B-PNC Onboard HMI Client_Tx | rpaquet2 - Added Reset_Rq, 343488 |
| | | PNC-IIR-REQ-326494/B-PNC Onboard Client 2_Tx | rpaquet2 - 337016 |
| | | PNC-IIR-REQ-326495/B-PNC Onboard Client 2_Rx | rpaquet2 - Added 343489 |
| | | PNC-STR-575730/B-Functional Definition | rpaquet2 - Added 334896 |
| | | PNC-REQ-326839/B-Customer Connectivity Settings Impact | rpaquet2 - Updated table |
| | | PNC-REQ-330363/B-Installing Certificate Payload in Vehicle | rpaquet2 - Updated requirement text per feature owner |
| | | PNC-REQ-326844/B-Plug And Charge On Confirmation | rpaquet2 - Updated requirement content per feature owner |
| | | PNCv1-UC-REQ-320370/B-Onboarding Success - Contract Certificate Installation is Completed and PnC is Enabled | rpaquet2 - removed signal names |
| | | PNCv1-UC-REQ-320371/B-Onboarding Success – Vehicle HMI not Active | rpaquet2 - removed signal names |
| | | PNCv1-UC-REQ-320375/B-Onboarding failure, No Cloud to Vehicle Connectivity | rpaquet2 - Chagned TMC to VSDN |
| | | PNCv1-UC-REQ-324759/B-Onboarding failure, Downstream Module Error | rpaquet2 - updated text and removed signal name references |
| | | PNC-ACT-REQ-326382/B-Enabling PnC | rpaquet2 - Updated command /alert names |
| | | PNC-ACT-REQ-326383/B-Enabling Disabling Or Certification In Vehicle failure | rpaquet2 - Updated diagram |
| | | PNC-SD-REQ-326490/B-Onboarding and Enabling Plug and Charge | rpaquet2 - Updating command/alert names |
| | | PNC-SD-REQ-326533/B-Onboarding or Enabling-Disabling Failures | rpaquet2 - Updated the alert/command names |
| | | PNC-STR-575738/B-Requirements | rpaquet2 - Added 337332 |
| | | PNC-REQ-331117/B-Plug and Charge Authorization In Progress | rpaquet2 - Updated requirement content per feature owner |
| | | PNC-REQ-326845/B-Charge Begin Unsuccessful | rpaquet2 - Added note to Reason for Error |
| | | PNC-REQ-330368/B-Disabling or Re-Enabling PnC due to failure | rpaquet2 - Updated requirement content per feature owner |
| | | PNC-REQ-330365/B-Notifications at Public Stations | rpaquet2 - Updated text per feature owner |
| | | PNC-REQ-330366/B-PnC Off | rpaquet2 - Updated requirement content per feature owner |



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| PNC-REQ-330367/B-EVSE ID and Station Charge Schedule Information | rpaquet2 - Updated alert name and added note. |
| PNC-REQ-337332/A-Sending whether Vehicle is Charging using TLS or No TLS | rpaquet2 - New |
| PNC-REQ-330369/B-ISO/In network HMI error | rpaquet2 - Updated alert names and text |
| PNC-REQ-330370/B-PnC or non PnC Charging | rpaquet2 - Updated alert names and text per feature owner |
| PNC-REQ-330371/B-Payment or Backend issues | rpaquet2 - Updated the command name per feature owner |
| PNC-REQ-330373/B-EVSE or vehicle failure in charging setup process (e.g. certificate rejected by EVSE) | rpaquet2 - Updated alert names and text per feature owner |
| PNC-REQ-330374/B-Clearing charging related errors | rpaquet2 - Updated text per feature owner |
| PNC-STR-575739/B-Use Cases | rpaquet2 - Added 335765, 335766, 335767, 335768 removed 324844, 325361, 325366, 325365, 324846, 325362 |
| PNCv1-UC-REQ-324838/B-User is Authorized to Charge - Charge Begin is Successful | rpaquet2 - Stated Vehicle configured for NA or EU region |
| PNCv1-UC-REQ-324839/B-User Plugs into Network ISO station and Plug and Charge is Disabled (EU) | rpaquet2 - added Vehicle Configured for EU region |
| PNCv1-UC-REQ-325319/B-User Plugs into Network ISO station and Plug and Charge is Disabled (NA) | rpaquet2 - added vehicle configured for NA region |
| PNCv1-UC-REQ-324843/B-User Plugs into Network ISO station and EVSE Failure in Charging Authentication and Authorization Process (EU) | rpaquet2 - added vehicle configured for EU region and changed requirement name |
| PNCv1-UC-REQ-325360/B-User Plugs into Network ISO station and EVSE Failure in Charging Authentication and Authorization Process (NA) | rpaquet2 - added vehicle configured for NA region and changed requirement name |
| PNCv1-UC-REQ-324847/B-User Plugs into ISO, Out of Network Station | rpaquet2 - Added not about No display at known Charge location |
| PNCv1-UC-REQ-325364/B-User Plugs into Non ISO, Out-of-Network Station | rpaquet2 - Added note about no display at known charge location |
| PNCv1-UC-REQ-324848/B-User Plugs into an In-Network, Non ISO Station (EU) | rpaquet2 - added vehicle configured for EU region |
| PNCv1-UC-REQ-325363/B-User Plugs into an In-Network, Non ISO Station (NA) | rpaquet2 - added vehicle configured for NA region |
| PNCv1-UC-REQ-335765/A-User Plugs into an Out of Network, ISO Station when PnC is disabled | rpaquet2 - new |
| PNCv1-UC-REQ-335766/A-User Plugs into an Non-ISO, Out of network when PnC is disabled | rpaquet2 - new |
| PNCv1-UC-REQ-335767/A-User Plugs into an Non-ISO, In Network (NA) when PnC is disabled | rpaquet2 - new |
| PNCv1-UC-REQ-335768/A-User Plugs into an Non-ISO, In Network (EU) when PnC is disabled | rpaquet2 - new |
| PNCv1-UC-REQ-320378/B-Failure Corrected, Then Charging Begins Successfully While Centerstack is off | rpaquet2 - Updated post condition |
| PNC-ACT-REQ-326583/B-Plug In and Plug and Charge is Disabled | rpaquet2 - Updated diagram |
| PNC-ACT-REQ-330591/B-Charge Station Network and ISO Errors | rpaquet2 - Updated diagram |
| PNC-ACT-REQ-330592/B-Enable PnC Once Vehicle is Shifted Out of Park | rpaquet2 - Updated diagram |
| PNC-ACT-REQ-330593/B-Plug In and EVSE Failure | rpaquet2 - Updated diagram |
| PNC-ACT-REQ-330594/B-Plugged In and Charging Has Not Begun Transmit EVSEid | rpaquet2 - Updated diagram |
| PNC-SD-REQ-330599/B-Plugged In and Charging Has Not Started Transmit EVSEid | rpaquet2 - Updated Alert name |
| PNC-SD-REQ-326579/B-Plugged in and Charging | rpaquet2 - Updated alert name |
| PNC-SD-REQ-326580/B-Plug in and Charge Failed to Begin | rpaquet2 - Updated alert name |
| PNC-SD-REQ-326584/B-Plug In and Plug and Charge is Disabled | rpaquet2 - Updated Alert name |
| PNC-SD-REQ-329239/B-Plug In and Plug Authorization Failures | rpaquet2 - Update command/alert name |
| PNC-SD-REQ-330597/B-Charge Station ISO and Network Errors | rpaquet2 - Update Command/alert name |
| PNC-SD-REQ-330598/B-Enable PnC Once Vehicle is Shifted Out of Park | rpaquet2 - Updated diagram new logic |
| PNC-REQ-326850/B-Charge Complete - In Vehicle | rpaquet2 - Update the command or alert name per feature owner |
| PNC-REQ-326852/B-Trip and Charge Log Updated | rpaquet2 - Updated To Total time PPlugged In |



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| PNCv1-UC-REQ-324852/B-Charging Completed Successfully | rpaquet2 - Updated Post condition |
| PNCv1-UC-REQ-324853/B-Cloud Fails to Send Cost Information Once Charging is Complete | rpaquet2 - Added Total time plugged in |
| PNCv1-UC-REQ-330860/B-PnC Charge Summary Delay | rpaquet2 - Updated Total ime Plugged In |
| PNC-ACT-REQ-326582/B-Charging Complete | rpaquet2 - Updated diagram |
| PNC-SD-REQ-326575/B-Charge Complete | rpaquet2 - Updated alert name Payment logic |
| PNC-REQ-330377/B-Disabling PnC | rpaquet2 - Update command/alert name and updated signal name |
| PNC-REQ-330378/B-Re-Enabling PnC | rpaquet2 - Update command/alert name and updated signal nam |
| PNCv1-UC-REQ-324854/B-Plug and Charge Re-Enabling | rpaquet2 - update command /alert names |
| PNCv1-UC-REQ-324857/B-Plug and Charge Re-Enabled - Downstream Module Error | rpaquet2 - Updated post condition |
| PNCv1-UC-REQ-325313/B-Plug and Charge is Disable (EU) | rpaquet2 - update command name |
| PNCv1-UC-REQ-325314/B-Plug and Charge is Disable (NA) | rpaquet2 - updated command name |
| PNCv1-UC-REQ-325318/B-Plug and Charge is Disable - Downstream Module Error | rpaquet2 - Updated post condition |
| PNC-ACT-REQ-326554/B-Disabling Plug and Charge | rpaquet2 - Updated diagram |
| PNC-ACT-REQ-326555/B-Re-Enabling Plug and Charge | rpaquet2 - Updated diagram |
| PNC-SD-REQ-326553/B-Disabling Plug and Charge | rpaquet2 - Updated comamnd/alert name |
| PNC-SD-REQ-326556/B-Re-Enabling Plug and Charge | rpaquet2 - Updated diagram logic |
| PNC-REQ-330379/B-Managing Expired Contract Certificates | rpaquet2 - Updated text and command/alert name per feature owner |
| PNCv1-UC-REQ-320374/B-Deletion of Expired Contract Cert's and Install New Contract Cert's | rpaquet2 - updated command/alert names |
| PNC-ACT-REQ-326781/B-Delete Expiring Contract Certifications And Reinstall | rpaquet2 - Updated diagram |
| PNC-SD-REQ-326782/B-Delete Expiring Certs and Installing New Cert | rpaquet2 - Updated logic and alert name |
| PNC-REQ-330380/B-Master Reset | rpaquet2 - updated command/alert name and text per feature owner |
| PNCv1-UC-REQ-325271/B-Master Reset Initiated from APIM | rpaquet2 - updated command names and removed signal reference |
| PNCv1-UC-REQ-325272/B-Last User Removes Vehicle from Mobile App | rpaquet2 - removed signal reference and updated command name |
| PNC-ACT-REQ-326783/B-Master Reset from PnC Onboard HMI Client | rpaquet2 - Update diagram |
| PNC-ACT-REQ-330600/B-Last User has Removed Vehicle from App | rpaquet2 - Updated Diagram |
| PNC-SD-REQ-326837/B-Master Reset | rpaquet2 - Update logic in diagram |
| PNC-SD-REQ-330601/B-Last User has Removed Vehicle from App | rpaquet2 - Update logic in diagram |
| PNC-STR-582143/B-Requirements | rpaquet2 - New |
| PNC-REQ-335761/A-OBCC Swap Detection | rpaquet2 - new |
| PNC-REQ-335762/A-Deleting Certificates in New OBCC Module | rpaquet2 - new |
| PNC-REQ-335763/A-Installing New Certificates in New OBCC Module | rpaquet2 - new |
| PNCv1-UC-REQ-326621/B-Installing New Certification after OBCC Swap | rpaquet2 - updated command name and removed signal reference |
| PNC-ACT-REQ-326765/B-Install New Certification After Module Swap | rpaquet2 - Updated diagram |
| PNC-SD-REQ-326779/B-Installing New Cert After Module Swap | rpaquet2 - Update logic |
| PNC-FUN-REQ-334896/A-Wake Up Strategy | new |
| PNC-STR-602039/A-Requirements | rpaquet2 - New |
| PNC-REQ-334897/A-OBCC-BCCM Wakeup Strategy | rpaquet2 - New |
| SCG-REQ-343878/A-Static List Locations | rpaquet2 - New |
| PNC-REQ-334898/A-Time Limit for Wakeup Strategy | rpaquet2 - New |



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| | PNC-STR-602040/A-Use Cases | rpaquet2 - New |
| | PNCv1-UC-REQ-334895/A-Wake Up for PnC Enable-Disable and Cert installs | rpaquet2 - New |
| | | |
| June 14, 2019 | 1.2 | |
| | PNC-STR-575727/C-Logical Signal Mapping | rpaquet2 - Updated two signal names to match database |
| | PNC-IIR-REQ-324736/C-PNC Onboard Server_Tx | rpaquet2 - removed 326578 and 326685 as the content was moved to 326684 |
| | MD-REQ-326487/C-setPlugAndChargeStatus | rpaquet2 - no change |
| | MD-REQ-326684/B-SoaHmiPncMessage | rpaquet2 - Changed name of MD and combined setPaymentInfo, setStationInfo and setVehiclechargeInfo into this SOA API deleted the display disable at plugin |
| | MD-REQ-343489/B-DgtlCommPnc_Rq | rpaquet2 - Updated md name and the encodings |
| | MD-REQ-326486/C-PnCStat_St | rpaquet2 - Updated the last encoding |
| | PNC-IIR-REQ-326493/B-PNC Onboard HMI Client_Rx | rpaquet2 - removed 326578 and 326685 as the content was moved to 326684 |
| | MD-REQ-326487/C-setPlugAndChargeStatus | rpaquet2 - no change |
| | MD-REQ-326684/B-SoaHmiPncMessage | rpaquet2 - Changed name of MD and combined setPaymentInfo, setStationInfo and setVehiclechargeInfo into this SOA API deleted the display disable at plugin |
| | MD-REQ-343489/B-DgtlCommPnc_Rq | rpaquet2 - Updated md name and the encodings |
| | PNC-REQ-326839/C-Customer Connectivity Settings Impact | Rpaquet2 - Added content for Disabling |
| | PNC-REQ-326844/C-Plug And Charge On Confirmation | rpaquet2 - Updated In Vehicle Notification part |
| | PNCv1-UC-REQ-320370/C-Onboarding Success - Contract Certificate Installation is Completed and PnC is Enabled | rpaquet2 - Updated to add PAAK FI |
| | PNC-STR-575738/C-Requirements | rpaquet2 - removed 331117, 330366 per feature owner |
| | PNC-REQ-326845/C-Charge Begin Unsuccessful | Rpaquet2 - Updated table |
| | PNC-REQ-330369/C-ISO/In network HMI error | rpaquet2- Updated per feature owner |
| | PNC-REQ-330373/C-EVSE or vehicle failure in charging setup process (e.g. certificate rejected by EVSE) | rpaquet2 - Updated APIM part |
| | PNC-STR-575739/C-Use Cases | rpaquet2- removed 324839, 325319, 326620 per feature owner |
| | PNCv1-UC-REQ-325364/C-User Plugs into Non ISO, Out-of-Network Station | rpaquet2 - Updated per feature owner |
| | PNCv1-UC-REQ-324848/C-User Plugs into an In-Network, Non ISO Station (EU) | rpaquet2 - Update per feature owner |
| | PNCv1-UC-REQ-325363/C-User Plugs into an In-Network, Non ISO Station (NA) | rpaquet2 - Updated per feature owner |
| | PNCv1-UC-REQ-335765/B-User Plugs into an Out of Network, ISO Station when PnC is disabled | rpaquet2- Updated per feature owner |
| | PNCv1-UC-REQ-335766/B-User Plugs into an Non-ISO, Out of network when PnC is disabled | rpaquet2 - Updated per feature owner |
| | PNCv1-UC-REQ-335767/B-User Plugs into an Non-ISO, In Network (NA) when PnC is disabled | rpaquet2 - Updated per feature owner |
| | PNCv1-UC-REQ-335768/B-User Plugs into an Non-ISO, In Network (EU) when PnC is disabled | rpaquet2 - Updated per feature owner |
| | PNC-STR-575741/B-Activity Diagrams | rpaquet2- removed 326583 per feature owner |
| | PNC-STR-575742/B-Sequence Diagrams | rpaquet2 - removed 326584 per feature owner |
| | PNC-SD-REQ-330597/C-Charge Station ISO and Network Errors | rpaquet2 - Removed Non PNC Supported In/Out of network scenarios |
| | PNC-REQ-326850/C-Charge Complete - In Vehicle | rpaquet2- Updated PlgActv signal name |
| | PNC-STR-575749/B-Use Cases | rpaquet2 - removed 324853 per feature owner |
| | PNCv1-UC-REQ-330860/C-PnC Charge Summary Delay/Failed | rpaquet2 - Updated Scenario and Post Condition and requirement name |
| | PNC-REQ-330759/B-Notifications for Plug and Charge Status Change | rpaquet2 - Updae per feature owner |
| | PNC-REQ-330377/C-Disabling PnC | rpaquet2 - Updated APIM part |
| | PNC-REQ-330378/C-Re-Enabling PnC | rpaquet2 - Updated APIM part |
| | PNC-STR-582019/B-Requirements | rpaquet2 - removed 330379 and put content into 326853 |



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| | PNC-REQ-326853/B-Managing Expired Contract Certifications - Success | rpaquet2 - added requirement info from 330379 as that requirement goes away |
| | PNCv1-UC-REQ-320376/B-Failed to Delete Expired Contract Cert's and Install New Contract Cert's | rpaquet2 - took vehicle HMI out of post condition |
| | PNC-REQ-330380/C-Master Reset | rpaquet2 - Updated per feature owner |
| | PNC-SD-REQ-326837/C-Master Reset | rpaquet2 - Updated alerts in the diagram per feature owner |
| | PNC-SD-REQ-330601/C-Last User has Removed Vehicle from App | rpaquet2 - Updated alerts in the diagram per feature owner |
| | PNC-REQ-335761/B-OBCC Swap Detection | rpaquet2 - Updated per feature owner |
| | PNC-REQ-335762/B-Deleting Certificates in New OBCC Module | rpaquet2 - Updated per feature owner |
| | PNCv1-UC-REQ-326621/C-Installing New Certification after OBCC Swap | rpaquet2 - Update per feature owner |
| | PNC-SD-REQ-326779/C-Installing New Cert After Module Swap | rpaquet2 - Updated alerts in the diagram per feature owner |
| | PNC-REQ-334897/B-OBCC-BCCM Wakeup Strategy | rpaquet2 - removed 343878 per feature owner |
| | PNC-REQ-334898/B-Time Limit for Wakeup Strategy | rpaquet2 - Updated Rule |
| | PNCv1-UC-REQ-334895/B-Wake Up for PnC Enable-Disable and Cert installs | rpaquet2 - Updated per feature owner |
| | PNC-STR-575737/B-Appendix B: Reference Documents | rpaquet2 - Added Peripheral Provisioning SPSS |
| | | |
| August 5, 2019 | 1.3 | |
| | MD-REQ-343489/C-DgtlCommPnc_Rq | rpaquet2 - Update 0x3 value |
| | PNC-REQ-330380/D-Master Reset | rpaquet2 - Updated content |
| | PNCv1-UC-REQ-325271/C-Master Reset Initiated from APIM | rpaquet2 - Update post condition |
| | PNCv1-UC-REQ-325272/C-Last User Removes Vehicle from Mobile App | rpaquet2 - Updated post condition |
| | PNC-SD-REQ-330601/D-Last User has Removed Vehicle from App | rpaquet2 - Updated DgtlCommPnc to state delete all |
| | | |
| December 18, 2019 | 1.4 | |
| | PNC-STR-575730/C-Functional Definition | rpaquet2 - added 369804 |
| | PNC-REQ-326839/D-Customer Connectivity Settings Impact | rpaquet2 - Updated Content per feature owner |
| | PNCv1-UC-REQ-320370/D-Onboarding Success - Contract Certificate Installation is Completed and PnC is Enabled | rpaquet2 - updated pre condition |
| | PNC-STR-575738/D-Requirements | rpaquet2 - removed 330370 added 372234 |
| | PNC-REQ-326845/D-Charge Begin Unsuccessful | rpaquet2 - Updated table per feature owner |
| | PNC-REQ-330367/C-EVSE ID and Station Charge Schedule Information | rpaquet2 - update signal states |
| | PNC-REQ-337332/B-Sending whether Vehicle is Charging using TLS or No TLS | rpaquet2 - updated signal states |
| | PNC-REQ-372234/A-Send GPS Signal in PnCChargingStationInfoAlert | rpaquet2 - New |
| | PNC-REQ-330369/D-ISO/In network HMI error | rpaquet2 - updated signal states |
| | PNC-STR-575742/C-Sequence Diagrams | rpaquet2 - removed 326579 |
| | PNC-STR-575748/B-Requirements | rpaquet2 - removed 326851 and 326852 per feature owner |
| | PNC-REQ-326850/D-Charge Complete - In Vehicle | rpaquet2 - Updated per feature owner |
| | PNC-REQ-330378/D-Re-Enabling PnC | rpaquet2 - corrected spelling error |
| | PNC-FUN-REQ-369804/A-V2G Certificate Delivery upon OBCC Being Provisioned | new |
| | PNC-STR-704666/A-Requirements | rpaquet2 - New |
| | PNC-REQ-369816/A-V2G Certificate Process | rpaquet2 - New |
| | PNC-STR-704667/A-Use Cases | rpaquet2 - New |
| | PNCv1-UC-REQ-369805/A-Install V2G Certificates | new |
| | PNC-STR-704668/A-White Box Views | rpaquet2 - New |
| | PNC-STR-704670/A-Sequence Diagrams | rpaquet2 - New |
| | PNC-SD-REQ-369778/A-V2G Certificate Delivery once OBCC Provisioned | rpaquet2 - New |
| | | |



Table of Contents

| | |
|--|-----------|
| REVISION HISTORY | 2 |
| 1 ARCHITECTURAL DESIGN..... | 9 |
| 1.1 Overview..... | 9 |
| 1.2 Physical Mapping of Classes | 9 |
| 1.3 PNC-CLD-REQ-324730/A-PNC On Board Server..... | 10 |
| 1.4 PNC-CLD-REQ-324731/A-PNC On Board HMI Client | 10 |
| 1.5 PNC-CLD-REQ-324732/A-PNC On Board Client 3 | 10 |
| 1.6 PNC-CLD-REQ-324734/A-PNC On Board Client 2 | 10 |
| 1.7 PNC-CLD-REQ-324735/A-PNC Off Board HMI Client | 10 |
| 1.8 PNC-CLD-REQ-326384/A-PNC Off Board Server..... | 10 |
| 1.9 PNC-CLD-REQ-326385/A-PNC Off Board Gateway | 10 |
| 1.10 Logical Signal Mapping | 10 |
| 1.11 PNC OnboardServer Interface | 11 |
| 1.11.1 PNC-IIR-REQ-324736/C-PNC Onboard Server_Tx..... | 11 |
| 1.11.2 PNC-IIR-REQ-324737/B-PNC Onboard Server_Rx | 13 |
| 1.12 PNC Onboard HMI Client Interface..... | 19 |
| 1.12.1 PNC-IIR-REQ-326492/B-PNC Onboard HMI Client_Tx..... | 19 |
| 1.12.2 PNC-IIR-REQ-326493/B-PNC Onboard HMI Client_Rx | 20 |
| 1.13 PNC Onboard Client 2 Interface | 22 |
| 1.13.1 PNC-IIR-REQ-326494/B-PNC Onboard Client 2_Tx | 22 |
| 1.13.2 PNC-IIR-REQ-326495/B-PNC Onboard Client 2_Rx..... | 26 |
| 2 FUNCTIONAL DEFINITION | 28 |
| 2.1 PNC-FUN-REQ-324756/A-Onboarding and Enabling Plug and Charge | 28 |
| 2.1.1 Requirements | 28 |
| 2.1.2 Use Cases | 31 |
| 2.1.3 White Box Views..... | 36 |
| 2.2 PNC-FUN-REQ-324739/A-Warm Welcome..... | 38 |
| 2.2.1 Requirements | 38 |
| 2.2.2 Use Cases | 40 |
| 2.3 PNC-FUN-REQ-324745/A-Plug In and Charge Begin | 41 |
| 2.3.1 Requirements | 41 |
| 2.3.2 Use Cases | 45 |
| 2.3.3 White Box Views..... | 58 |
| 2.4 PNC-FUN-REQ-324747/A-Charge Complete | 65 |
| 2.4.1 Requirements | 65 |
| 2.4.2 Use Cases | 66 |
| 2.4.3 White Box Views..... | 68 |
| 2.5 PNC-FUN-REQ-324755/A-Disabling and Re-Enabling Plug and Charge | 69 |
| 2.5.1 Requirements | 69 |
| 2.5.2 Use Cases | 71 |
| 2.5.3 White Box Views..... | 76 |
| 2.6 PNC-FUN-REQ-326626/A-Managing Expired Contract Certificates | 78 |
| 2.6.1 Requirements | 78 |
| 2.6.2 Use Cases | 79 |



| | | |
|--------|---|-----------|
| 2.6.3 | White Box Views..... | 81 |
| 2.7 | <i>PNC-FUN-REQ-326625/A-Master Reset.....</i> | <i>83</i> |
| 2.7.1 | Requirements | 83 |
| 2.7.2 | Use Cases | 83 |
| 2.7.3 | White Box Views..... | 85 |
| 2.8 | <i>PNC-FUN-REQ-326780/A-PnC Onboard Client2 Module Swap.....</i> | <i>87</i> |
| 2.8.1 | Requirements | 87 |
| 2.8.2 | Use Cases | 88 |
| 2.8.3 | White Box Views..... | 89 |
| 2.9 | <i>PNC-FUN-REQ-334896/A-Wake Up Strategy.....</i> | <i>89</i> |
| 2.9.1 | Requirements | 89 |
| 2.9.2 | Use Cases | 90 |
| 2.10 | <i>PNC-FUN-REQ-369804/A-V2G Certificate Delivery upon OBCC Being Provisioned.....</i> | <i>90</i> |
| 2.10.1 | Requirements | 90 |
| 2.10.2 | Use Cases | 91 |
| 2.10.3 | White Box Views..... | 92 |
| 3 | APPENDIX A: DEFINITIONS / ACRONYMS..... | 93 |
| 4 | APPENDIX B: REFERENCE DOCUMENTS | 94 |



1 Architectural Design

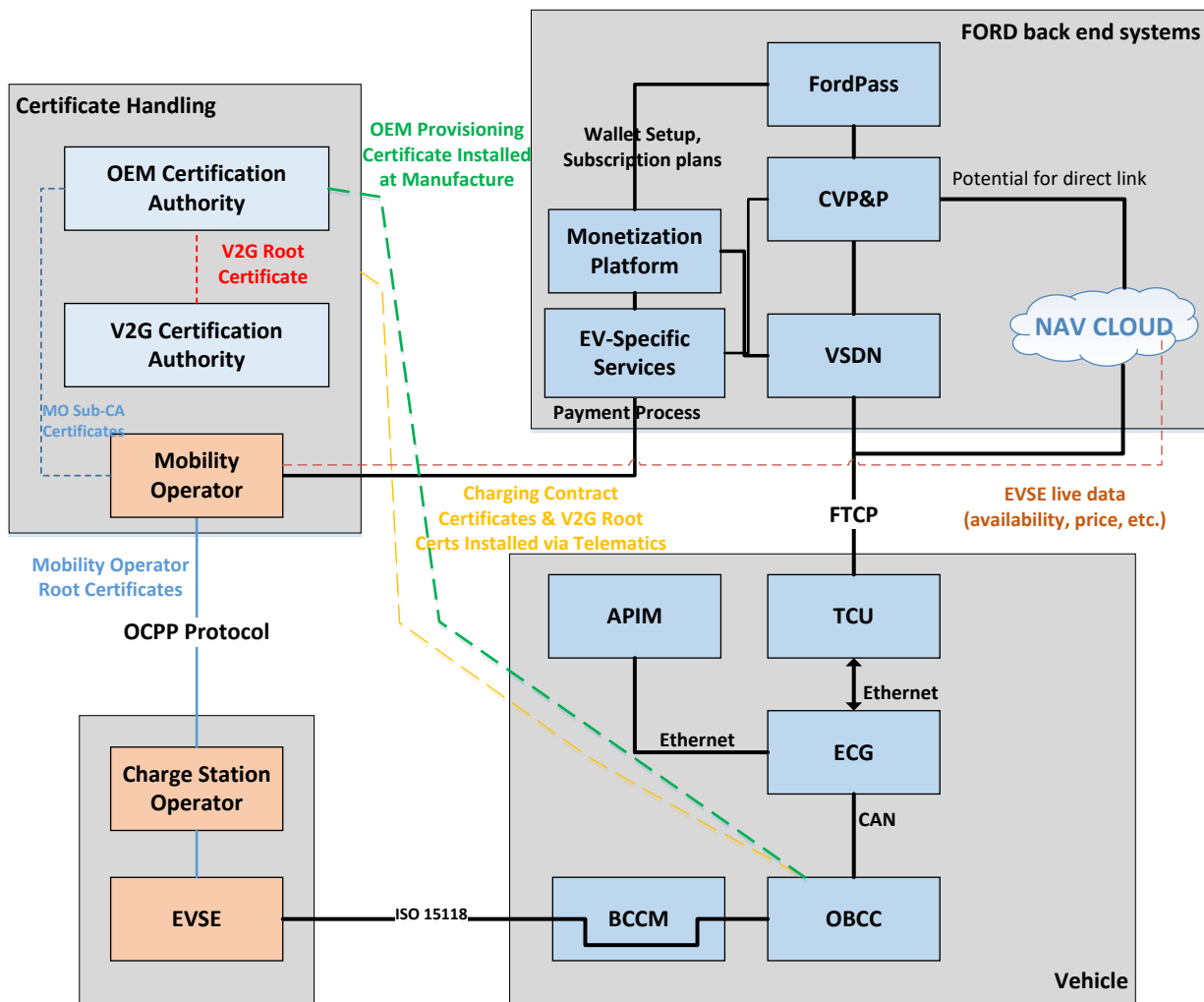
1.1 Overview

Plug and Charge provides an effortless charging experience for the owner of Ford BEV when a user plugs their vehicle at charging station that support PnC Functionality i.e. ISO 15118.2 and charge station in Ford network (cf. Ford Network Charging Stations below).

When the user plugs in:

- A secure handshake takes place between the vehicle and the charge station after which Certificates transfer begins. This allows for seamless vehicle identification and billing to take place behind the scenes
- Charging will begin automatically and the user will be able to see this on the app and in-vehicle

Below is a detailed view of the Plug & Charge architecture; the main pieces are the Cloud, the Vehicle, the Charging station and the Certificate handling authorities.



1.2 Physical Mapping of Classes

The table below shows an example of how the logical classes may be mapped into physical modules. This mapping example is specific to CX727 FNV2.

| Logical Class | | Physical Module (ECU) | |
|--|--|---|--|
| PNC Offboard HMI Client | | Ford Pass | |
| FILE: PLUG AND CHARGE SPSS v1.4 DEC 18, 2019 | | FORD MOTOR COMPANY CONFIDENTIAL The information contained in this document is Proprietary to Ford Motor Company. | |
| | | Page 9 of 94 | |



| | |
|------------------------|------------|
| PNC Offboard Server | SDN |
| PNC Offboard Gateway | TCU |
| PNC Onboard Server | ECG |
| PNC Onboard HMI Client | APIM |
| PNC Onboard Client 2 | OBCC(DCGM) |
| PNC Onboard Client 3 | BCCM/HPCM |

1.3 PNC-CLD-REQ-324730/A-PNC On Board Server

Responsible for determining when alerts will be sent to the vehicle HMI and backend.

1.4 PNC-CLD-REQ-324731/A-PNC On Board HMI Client

Responsible for displaying Plug and Charge status information to the user in the Vehicle HMI.

1.5 PNC-CLD-REQ-324732/A-PNC On Board Client 3

Responsible for providing plug status Charger information.

1.6 PNC-CLD-REQ-324734/A-PNC On Board Client 2

Responsible for starting payment process and sending vehicle charging status.

1.7 PNC-CLD-REQ-324735/A-PNC Off Board HMI Client

Responsible for providing a user interface to Plug and Charge from outside the vehicle.

1.8 PNC-CLD-REQ-326384/A-PNC Off Board Server

Responsible for verifying certification approval.

1.9 PNC-CLD-REQ-326385/A-PNC Off Board Gateway

Responsible for providing a modem to transmit data into and out of the vehicle.

1.10 Logical Signal Mapping

Each logical name used in this document is mapped to its corresponding CAN signal. Please refer to the following mapping:

| Logical name | CAN signal name |
|-------------------------|------------------------|
| PnCStat_St | DgtlCommPnc_D_Stat |
| DigitalCommGtwyMode_Rq | DgtlCommGtwyMde_D_Rq |
| DigitalCommGtwyMode_St | DgtlCommGtwyMde_D_Stat |
| DCCharge_St | DcChrgRdy_D_Stat |
| ChargeInPowerMode_St | ChrgInPwMde_D_Actl |
| BatterySystemReady_St | BattChrgRdyStat_D_Actl |
| ChargerReady_St | ChrgRdyStat_D_Actl |
| ChargingSystem_St | ChrgStat_D2_Dsply |
| DCChargeService_Rq | DcChrgSrvRqd_B_Rq |
| DigitalCommFault_St | DgtlCommGtwy_D_Falt |
| EVSEDCChargeISO_St | EvseDcChrgIso_D_Stat |
| PlugStatus_St | PlgActvArb_B_Actl |
| BatteryStateOfCharge_St | BattTracSoc_Pc_Dsply |



| | |
|--------------------------|------------------------------|
| VehicleRange_St | VehElRnge_L2_Dsply |
| ChargerPnC_Sustain_Rq | ChrgrPnC_Sustn_B_Rq |
| Reset_Rq | FactoryReset_Rq |
| ModemReset_Rq | ModemReset_D_Rq |
| DgtlCommPnc_Rq | DgtlCommPnc_D_Rq |
| ChargeStationID_Rq | See TP SPSS |
| ChargeStationID_St | See TP SPSS |
| ChargeStationSchedule_St | See TP SPSS |
| setPaymentInfo | SoaHmiPncMessage - API |
| setStationInfo | SoaHmiPncMessage - API |
| setVehicleChargeInfo | SoaHmiPncMessage - API |
| setPlugAndChargeStatus | setPlugAndChargeStatus - API |

1.11 PNC OnboardServer Interface

1.11.1 PNC-IIR-REQ-324736/C-PNC Onboard Server_Tx

1.11.1.1 MD-REQ-326487/C-setPlugAndChargeStatus

| Method Type | | | | | |
|---------------|------------|-----------|----------------------|-------|--|
| Method Type | | On Change | | | |
| QoS Level | | Default | | | |
| Retained | | Yes | | | |
| R/O | Name | Type | Literals | Value | Description |
| Request (_St) | | | | | |
| O | PNCstatus | ENUM | - | - | To indicate the state of Plug and Charge. This parameter uses the VIM process and will be pulled into it's own SOA-API |
| | | | Null | 0x0 | |
| | | | NoContractsInstalled | 0x1 | |
| | | | Disable | 0x2 | |
| | | | Enable | 0x3 | |
| | | | NotUsed | 0x4 | |
| | | | NotUsed | 0x5 | |
| | | | NotUsed | 0x6 | |
| | | | Faulty | 0x7 | |
| O | EVSE Fault | ENUM | - | - | Indicates EVSE is Faulted. This parameter uses the VIM process and will be pulled into it's own SOA-API |
| | | | No Fault | 0x0 | |



| | | | | | |
|--|--|--|-------|---------------|--|
| | | | Fault | 0x1.. 0x40 | Any value will result in same fault indication. Reference DgtlCommGtwy_D_Fa lt for literal values |
|--|--|--|-------|---------------|--|

1.11.1.2 MD-REQ-326684/B-SoaHmiPncMessage

| Method Type | | On Change | | | |
|----------------------|-----------------------------|-----------------|---|-------|-------------|
| QoS Level | | Default | | | |
| Retained | | Yes | | | |
| R/O | Name | PncRequest Type | Literals | Value | Description |
| Request (_St) | | | | | |
| O | DISPLAY_STATION_TYPE | 0 | PnC Supported, Out of Network | 0x0 | |
| O | DISPLAY_AUTHORIZATION_ERROR | 1 | Payment subscription balance is low | 0x0 | |
| | | | Payment balance has run out | 0x1 | |
| | | | Charging account is overdue, but charging is still allowed (post-pay account) | 0x2 | |
| | | | Charging account is overdue and charging is suspended (post-pay account) | 0x3 | |
| | | | Payment method issue for variable fees or monthly subscription fees | 0x4 | |
| | | | Backend System Error | 0x5 | |
| O | DISPLAY_PAYMENT_INFO | 2 | State of Charge (SOC) | 0x1 | Float |
| | | | Total Time Plugged-in | 0x2 | Int32 |
| | | | Total Distance Added | 0x3 | Float |
| | | | Total Cost | 0x4 | Float |
| | | | Balance In Subscription | 0x5 | Float |
| | | | Payment status - PaymentInfo_Available = 0 - PaymentInfo_NotAvailable = 1 | 0x6 | |

1.11.1.3 MD-REQ-337333/A-ChargerPnC Sustain_Rq

Message Type: Request

This signal is used to request that wake up stay active or not.



| Name | Literals | Value | Description |
|------|----------|-------|-------------|
| Type | - | - | |
| | Inactive | 0x0 | |
| | Active | 0x1 | |

1.11.1.4 MD-REQ-343026/A-ChargeStationID_Rq

Message Type: request

This signal is used to request the Charge Station information.

| Name | Literals | Value | Description |
|-------------|---------------------------|-------|-------------|
| RequestData | - | - | |
| | No Request | 0x00 | |
| | Request Charge Station ID | 0x01 | |

1.11.1.5 MD-REQ-343489/C-DgtlCommPnc_Rq

Message Type: Request

Command from ECG to OBCC to reset PnC Feature and Disable the feature when CCS settings are disabled

| Literals | Value | Description |
|------------|-------|-------------|
| No Request | 0x0 | |
| Reset | 0x1 | |
| Disable | 0x2 | |
| DeleteAll | 0x3 | |
| NotUsed | 0x4 | |
| NotUsed | 0x5 | |
| NotUsed | 0x6 | |
| NotUsed | 0x7 | |

1.11.2 PNC-IIR-REQ-324737/B-PNC Onboard Server_Rx**1.11.2.1 MD-REQ-326486/C-PnCStat_St**

Message Type: status

This signal is used to indicate the state of Plug and Charge.

| Name | Literals | Value | Description |
|------|----------------------|-------|-------------|
| Type | - | - | |
| | Null | 0x0 | |
| | NoContractsInstalled | 0x1 | |
| | Disable | 0x2 | |
| | Enable | 0x3 | |
| | NotUsed | 0x4 | |
| | NotUsed | 0x5 | |
| | NotUsed | 0x6 | |
| | Faulty | 0x7 | |

**1.11.2.2 MD-REQ-326502/B-ChargeStationID_St**

Message Type: status

This signal is used to provide the Charge Station information.

| Name | Literals | Value | Description |
|-------------------|----------|-------|---------------------------------|
| TLS Status | - | - | |
| | No TLS | 0x00 | |
| | TLS | 0x01 | |
| | | | |
| Charge Station ID | - | - | Max. 37 bytes Variable Raw Data |

1.11.2.3 MD-REQ-326679/A-ChargeInPowerMode_St

Message Type: status

This signal is used to indicate the operational mode of EVSE(Electrical Vehicle Supply Equipment).

| Name | Literals | Value | Description |
|------|---------------------|-------|-------------|
| Type | - | - | |
| | EvseNotDetected | 0x0 | |
| | EvsePaused | 0x1 | |
| | DigitalCommDetected | 0x2 | |
| | AcBasic | 0x3 | |
| | AcDigital | 0x4 | |
| | DcCharging | 0x5 | |
| | IcCharging | 0x6 | |
| | EvseNotCompatible | 0x7 | |
| | EvseFault | 0x8 | |

1.11.2.4 MD-REQ-326682/A-ChargingSystem_St

Message Type: status

Indicates the high voltage charging system status..

| Name | Literals | Value | Description |
|------|------------------------|-------|-------------|
| Type | - | - | |
| | NotReady | 0x0 | |
| | FaultInsideCar | 0x1 | |
| | FaultOutsideCar | 0x2 | |
| | EvseNotCompatible | 0x3 | |
| | EvseNotDetected | 0x4 | |
| | EvsePaused | 0x5 | |
| | ChargeScheduled | 0x6 | |
| | ChargingAC | 0x7 | |
| | ChargingDCFastCharge | 0x8 | |
| | ChargingInductive | 0x9 | |
| | ChargingSystemMaintain | 0xA | |
| | CabinPreconditioning | 0xB | |



| | | | |
|--|---------------------|-----|--|
| | DriveConditioning | 0xC | |
| | ChargeTargetReached | 0xD | |

1.11.2.5 MD-REQ-326683/A-DCChargeService_Rq

Message Type: request

DCGM Service Request, Warning Light.

| Name | Literals | Value | Description |
|------|----------|-------|-------------|
| Type | - | - | |
| | Off | 0x0 | |
| | On | 0x1 | |

1.11.2.6 MD-REQ-326689/B-DigitalCommFault_St

Message Type: status

Indicates EVSE error.

| Name | Literals | Value | Description |
|------|-------------------------|-------|-------------|
| Type | - | - | |
| | No fault | 0x0 | |
| | EvseStatShutdown | 0x1 | |
| | EvseStatUtilityIntrpt | 0x2 | |
| | EvseEmergencyShutdown | 0x3 | |
| | EvseMalfunction | 0x4 | |
| | EvseStopNotification | 0x5 | |
| | EvseSlaacErr | 0x6 | |
| | EvseUdpErr | 0x7 | |
| | EvseTcpCnnctFail | 0x8 | |
| | EvseTlsFail | 0x9 | |
| | EvseTlsUnexpectedMsg | 0xA | |
| | EvseTlsBadRecordMac | 0xB | |
| | EvseTlsDecryptFail | 0xC | |
| | EvseTlsHandshakeFail | 0xD | |
| | EvseTlsBadCert | 0xE | |
| | EvseTlsCertExpired | 0xF | |
| | EvseTlsUnknownCa | 0x10 | |
| | EvseMsgTimeout | 0x11 | |
| | EvseCommSetupTimeout | 0x12 | |
| | EvseCableCheckTimeout | 0x13 | |
| | EvsePreChargeTimeout | 0x14 | |
| | EvseResFailed | 0x15 | |
| | EvseResSeqErr | 0x16 | |
| | EvseResSignErr | 0x17 | |
| | EvseResUnknownSession | 0x18 | |
| | EvseResServiceIDInvlid | 0x19 | |
| | EvseResPymt Seleclnvlid | 0x1A | |
| | EvseResCertExp | 0x1B | |
| | EvseResCertRvk | 0x1C | |



| | | | |
|--|------------------------------------|------|--|
| | EvseResCertNoCertAvail | 0x1D | |
| | EvseResCertChainErr | 0x1E | |
| | EvseResContrCancel | 0x1F | |
| | EvseResChlgInvlid | 0x20 | |
| | EvseResWrongEnTransMde | 0x21 | |
| | EvseResWrongChrgParam | 0x22 | |
| | EvseResChargPfInvlid | 0x23 | |
| | EvseResTrfSelecnvlid | 0x24 | |
| | EvseResPwrDelNotApplied | 0x25 | |
| | EvseResMetSignNotVld | 0x26 | |
| | EvseResNoChrgSvcSelec | 0x27 | |
| | EvseResContrErr | 0x28 | |
| | EvseResCertNotAllowed | 0x29 | |
| | EvseResNoSuppAppProt | 0x2A | |
| | EvseResContrNotAccept | 0x2B | |
| | EvseResMoUnknown | 0x2C | |
| | EvseResOemProvCertRev | 0x2D | |
| | EvseResOemSubCa1CertRev | 0x2E | |
| | EvseResOemSubCa2CertRev | 0x2F | |
| | EvseResMoProvCertRev | 0x30 | |
| | EvseResMoSubCa1CertRev | 0x31 | |
| | EvseResMoSubCa2CertRev | 0x32 | |
| | EvseResRootCaCertRev | 0x33 | |
| | EvseResCpsProvCertRev | 0x34 | |
| | EvseResSubCA1CertRev | 0x35 | |
| | EvseResSubCA2CertRev | 0x36 | |
| | EvseResCpsRootCaCertRev | 0x37 | |
| | EvseGbtCstEvseOverTemp | 0x38 | |
| | EvseGbtCstEVSEConnectorFalt | 0x39 | |
| | EvseGbtCstEInternalOverTemperature | 0x3A | |
| | EvseGbtCstEnergyTransrFalt | 0x3B | |
| | EvseGbtCstEEmergShutdown | 0x3C | |
| | EvseGbtCstOtherFalt | 0x3D | |
| | EvseGbtCstChrgCurrntMismtch | 0x3E | |
| | EvseGbtCstChrgVoltMismtch | 0x3F | |
| | EvseGbtCommTimeOut | 0x40 | |

1.11.2.7 MD-REQ-028126/A-PlugStatus_St (TcSE ROIN-221127-1)

Message Type: Status

Represents the Plug Status.

Indicates if vehicle is plugged in or not.

| Name | Literals | Value | Description |
|------|----------|-------|--|
| Type | - | - | Indicates if vehicle is plugged in or not. |
| | OffPlug | 0x0 | |
| | OnPlug | 0x1 | |

**1.11.2.8 MD-REQ-326835/A-BatteryStateOfCharge_St**

Message Type: Status

Represents the current level of charge.

Status used to indicate the current level of vehicle charge.

| Name | Literals | Value | Description |
|------|----------|-------|---|
| Type | - | - | This signal indicates the current level of charge. Units:Percent Resolution:0.5 Offset:0 |
| | Minimum | 0x0 | |
| | Maximum | 0xFF | |

1.11.2.9 MD-REQ-326836/A-VehicleRange_St

Message Type: Status

Represents the distance to empty.

| Name | Literals | Value | Description |
|------|----------|-------|--|
| Type | - | - | This signal indicates the distance to empty. |
| | Unknown | 0xFFE | |
| | Faulted | 0xFFF | |

1.11.2.10 MD-REQ-326838/A-Reset_Rq

Message Type: Request

Signal sent by the Master Reset Client to initiate a Master Reset

| Literals | Value | Description |
|----------------------|-------|-------------|
| Inactive | 0x0 | |
| ResetFactoryDefaults | 0x1 | |

1.11.2.11 MD-REQ-326678/A-DCCharge_St

Message Type: status

PNC Onboard Client 2 status to support digital communication based charging.

| Name | Literals | Value | Description |
|------|-------------------------|-------|-------------|
| Type | - | - | |
| | Not Ready | 0x0 | |
| | Initialization | 0x1 | |
| | ChargeReady | 0x2 | |
| | WeldCheck (Cable Check) | 0x3 | |
| | PreCharge | 0x4 | |
| | Charging | 0x5 | |
| | ChargeComplete | 0x6 | |
| | GBT PreCharge | 0x7 | |
| | EVSE Paused | 0x8 | |
| | EVSE Not Compatible | 0x9 | |



EVSE Fault

0xA

1.11.2.12 MD-REQ-326677/A-DigitalCommGtwyMode_St

Message Type: status

The status of the digital communications regarding discovered charging services reported.

| Name | Literals | Value | Description |
|------|-----------------|-------|-------------|
| Type | - | - | |
| | Not Detected | 0x0 | |
| | DC EIM | 0x1 | |
| | DC PnC | 0x2 | |
| | DC EIM/PnC | 0x3 | |
| | AC EIM | 0x4 | |
| | AC PnC | 0x5 | |
| | AC EIM/PnC | 0x6 | |
| | Restart Request | 0x7 | |
| | Inactive | 0x8 | |

1.11.2.13 MD-REQ-326674/A-DigitalCommGtwyMode_Rq

Message Type: request

This signal is used to request the mode to use.

| Name | Literals | Value | Description |
|------|----------------------------|-------|-------------|
| Type | - | - | |
| | No Dgtl Communication | 0x0 | |
| | Attempt Dgtl Communication | 0x1 | |
| | DC EIM | 0x2 | |
| | DC PnC | 0x3 | |
| | AC EIM | 0x4 | |
| | AC PnC | 0x5 | |

1.11.2.14 MD-REQ-343488/A-ModemReset_Rq

Message Type: Request

Signal used to initiate a Brand Reset

| Literals | Value | Description |
|--------------------|-------|-------------|
| Null | 0x0 | |
| WifiHotspotReset | 0x1 | |
| PaaKReset | 0x2 | |
| OnlineTrafficReset | 0x3 | |
| CCSReset | 0x4 | |
| BrandConnectReset1 | 0x5 | |
| BrandConnectReset2 | 0x6 | |
| NotUsed_1 | 0x7 | |
| NotUsed_2 | 0x8 | |
| NotUsed_3 | 0x9 | |



| | | |
|-----------|-----|--|
| NotUsed_4 | 0xA | |
| NotUsed_5 | 0xB | |
| NotUsed_6 | 0xC | |
| NotUsed_7 | 0xD | |
| NotUsed_8 | 0xE | |
| NotUsed_9 | 0xF | |

1.11.2.15 MD-REQ-337016/B-ChargeStationSchedule_St

Message Type: status

This signal is used to provide the schedule for the connected Charge Station

| Name | Literals | Value | Description |
|-----------------------------|----------|---------------|---|
| Schedule ID | - | - | |
| | ID 1 | 0x1 | |
| | ID 254 | 0xFF | |
| | | | |
| Schedule Index | - | - | This parameter shall increment for every message payload sent until all data is transferred. When sending data for new Schedule ID the index shall start at 1 again |
| | ID 1 | 0x1 | |
| | ID 254 | 0xFF | |
| | | | |
| Number Of Items Transmitted | - | - | Indicates the number of schedule inputs sent in current payload. Max number of items to be sent in a given Schedule Index is 800 |
| | 1 | 0x0001 | |
| | ... | | |
| | 800 | 0x0320 | |
| | Reserved | 0x0321-0xFFFF | |
| | | | |
| | | | |
| Power Value | - | - | 15 bits Fixed Units: Watts Resolution: 50 Watts |
| Time Interval | - | - | 25 bits Fixed Units: Time Resolution: Seconds |

1.12 PNC Onboard HMI Client Interface

1.12.1 PNC-IIR-REQ-326492/B-PNC Onboard HMI Client_Tx

1.12.1.1 MD-REQ-326838/A-Reset_Rq

Message Type: Request



Signal sent by the Master Reset Client to initiate a Master Reset

| Literals | Value | Description |
|----------------------|-------|-------------|
| Inactive | 0x0 | |
| ResetFactoryDefaults | 0x1 | |

1.12.1.2 MD-REQ-343488/A-ModemReset_Rq

Message Type: Request

Signal used to initiate a Brand Reset

| Literals | Value | Description |
|--------------------|-------|-------------|
| Null | 0x0 | |
| WifiHotspotReset | 0x1 | |
| PaakReset | 0x2 | |
| OnlineTrafficReset | 0x3 | |
| CCSReset | 0x4 | |
| BrandConnectReset1 | 0x5 | |
| BrandConnectReset2 | 0x6 | |
| NotUsed_1 | 0x7 | |
| NotUsed_2 | 0x8 | |
| NotUsed_3 | 0x9 | |
| NotUsed_4 | 0xA | |
| NotUsed_5 | 0xB | |
| NotUsed_6 | 0xC | |
| NotUsed_7 | 0xD | |
| NotUsed_8 | 0xE | |
| NotUsed_9 | 0xF | |

1.12.2 PNC-IIR-REQ-326493/B-PNC Onboard HMI Client_Rx

1.12.2.1 MD-REQ-326487/C-setPlugAndChargeStatus

| Method Type | | | | | |
|---------------|-----------|------|----------------------|-------|--|
| On Change | | | | | |
| QoS Level | | | | | |
| Default | | | | | |
| Retained | | | | | |
| Yes | | | | | |
| R/O | Name | Type | Literals | Value | Description |
| Request (_St) | | | | | |
| O | PNCstatus | ENUM | - | - | To indicate the state of Plug and Charge. This parameter uses the VIM process and will be pulled into it's own SOA-API |
| | | | Null | 0x0 | |
| | | | NoContractsInstalled | 0x1 | |
| | | | Disable | 0x2 | |



| | | | | | |
|---|------------|------|----------|---------------|---|
| | | | Enable | 0x3 | |
| | | | NotUsed | 0x4 | |
| | | | NotUsed | 0x5 | |
| | | | NotUsed | 0x6 | |
| | | | Faulty | 0x7 | |
| | | | | | |
| O | EVSE Fault | ENUM | - | - | Indicates EVSE is Faulted. This parameter uses the VIM process and will be pulled into it's own SOA-API |
| | | | No Fault | 0x0 | |
| | | | Fault | 0x1.. 0x40 | Any value will result in same fault indication. Reference DgtlCommGtwy_D_Fa It for literal values |

1.12.2.2 MD-REQ-326682/A-ChargingSystem_St

Message Type: status

Indicates the high voltage charging system status..

| Name | Literals | Value | Description |
|------|------------------------|-------|-------------|
| Type | - | - | |
| | NotReady | 0x0 | |
| | FaultInsideCar | 0x1 | |
| | FaultOutsideCar | 0x2 | |
| | EvseNotCompatible | 0x3 | |
| | EvseNotDetected | 0x4 | |
| | EvsePaused | 0x5 | |
| | ChargeScheduled | 0x6 | |
| | ChargingAC | 0x7 | |
| | ChargingDCFastCharge | 0x8 | |
| | ChargingInductive | 0x9 | |
| | ChargingSystemMaintain | 0xA | |
| | CabinPreconditioning | 0xB | |
| | DriveConditioning | 0xC | |
| | ChargeTargetReached | 0xD | |

1.12.2.3 MD-REQ-326684/B-SoaHmiPncMessage

| | |
|-------------|-----------|
| | |
| Method Type | On Change |
| QoS Level | Default |
| Retained | Yes |
| | |



| R/O | Name | PncRequest Type | Literals | Value | Description |
|----------------------|-----------------------------|-----------------|---|-------|-------------|
| Request (_St) | | | | | |
| O | DISPLAY_STATION_TYPE | 0 | PnC Supported, Out of Network | 0x0 | |
| | | | | | |
| O | DISPLAY_AUTHORIZATION_ERROR | 1 | Payment subscription balance is low | 0x0 | |
| | | | Payment balance has run out | 0x1 | |
| | | | Charging account is overdue, but charging is still allowed (post-pay account) | 0x2 | |
| | | | Charging account is overdue and charging is suspended (post-pay account) | 0x3 | |
| | | | Payment method issue for variable fees or monthly subscription fees | 0x4 | |
| | | | Backend System Error | 0x5 | |
| | | | | | |
| O | DISPLAY_PAYMENT_INFO | 2 | State of Charge (SOC) | 0x1 | Float |
| | | | Total Time Plugged-in | 0x2 | Int32 |
| | | | Total Distance Added | 0x3 | Float |
| | | | Total Cost | 0x4 | Float |
| | | | Balance In Subscription | 0x5 | Float |
| | | | Payment status - PaymentInfo_Available = 0 - PaymentInfo_NotAvailable = 1 | 0x6 | |

1.13 PNC Onboard Client 2 Interface

1.13.1 PNC-IIR-REQ-326494/B-PNC Onboard Client 2_Tx

1.13.1.1 MD-REQ-326502/B-ChargeStationID_St

Message Type: status

This signal is used to provide the Charge Station information.

| Name | Literals | Value | Description |
|-------------------|----------|-------|---------------------------------|
| TLS Status | - | - | |
| | No TLS | 0x00 | |
| | TLS | 0x01 | |
| | | | |
| Charge Station ID | - | - | Max. 37 bytes Variable Raw Data |

**1.13.1.2 MD-REQ-326677/A-DigitalCommGtwyMode_St**

Message Type: status

The status of the digital communications regarding discovered charging services reported.

| Name | Literals | Value | Description |
|------|-----------------|-------|-------------|
| Type | - | - | |
| | Not Detected | 0x0 | |
| | DC EIM | 0x1 | |
| | DC PnC | 0x2 | |
| | DC EIM/PnC | 0x3 | |
| | AC EIM | 0x4 | |
| | AC PnC | 0x5 | |
| | AC EIM/PnC | 0x6 | |
| | Restart Request | 0x7 | |
| | Inactive | 0x8 | |

1.13.1.3 MD-REQ-326678/A-DCCharge_St

Message Type: status

PNC Onboard Client 2 status to support digital communication based charging.

| Name | Literals | Value | Description |
|------|-------------------------|-------|-------------|
| Type | - | - | |
| | Not Ready | 0x0 | |
| | Initialization | 0x1 | |
| | ChargeReady | 0x2 | |
| | WeldCheck (Cable Check) | 0x3 | |
| | PreCharge | 0x4 | |
| | Charging | 0x5 | |
| | ChargeComplete | 0x6 | |
| | GBT PreCharge | 0x7 | |
| | EVSE Paused | 0x8 | |
| | EVSE Not Compatible | 0x9 | |
| | EVSE Fault | 0xA | |

1.13.1.4 MD-REQ-326690/A-EVSEDcChargeISO_St

Message Type: status

Isolation monitoring result of the EVSE reported by PNC Onboard Client 2.

| Name | Literals | Value | Description |
|------|----------|-------|-------------|
| Type | - | - | |
| | Invalid | 0x0 | |
| | Valid | 0x1 | |
| | Warning | 0x2 | |
| | Not Used | 0x3 | |
| | Not Used | 0x4 | |



| | | | |
|--|----------------|-----|--|
| | Not Used | 0x5 | |
| | No Data Exists | 0x6 | |
| | Faulty | 0x7 | |

1.13.1.5 MD-REQ-326683/A-DCChargeService_Rq

Message Type: request

DCGM Service Request, Warning Light.

| Name | Literals | Value | Description |
|------|----------|-------|-------------|
| Type | - | - | |
| | Off | 0x0 | |
| | On | 0x1 | |

1.13.1.6 MD-REQ-326689/B-DigitalCommFault_St

Message Type: status

Indicates EVSE error.

| Name | Literals | Value | Description |
|------|-------------------------|-------|-------------|
| Type | - | - | |
| | No fault | 0x0 | |
| | EvseStatShutdown | 0x1 | |
| | EvseStatUtilityIntrpt | 0x2 | |
| | EvseEmergencyShutdown | 0x3 | |
| | EvseMalfunction | 0x4 | |
| | EvseStopNotification | 0x5 | |
| | EvseSlaacErr | 0x6 | |
| | EvseUdpErr | 0x7 | |
| | EvseTcpCnnctFail | 0x8 | |
| | EvseTlsFail | 0x9 | |
| | EvseTlsUnexpectedMsg | 0xA | |
| | EvseTlsBadRecordMac | 0xB | |
| | EvseTlsDecryptFail | 0xC | |
| | EvseTlsHandshakeFail | 0xD | |
| | EvseTlsBadCert | 0xE | |
| | EvseTlsCertExpired | 0xF | |
| | EvseTlsUnknownCa | 0x10 | |
| | EvseMsgTimeout | 0x11 | |
| | EvseCommSetupTimeout | 0x12 | |
| | EvseCableCheckTimeout | 0x13 | |
| | EvsePreChargeTimeout | 0x14 | |
| | EvseResFailed | 0x15 | |
| | EvseResSeqErr | 0x16 | |
| | EvseResSignErr | 0x17 | |
| | EvseResUnknownSession | 0x18 | |
| | EvseResServiceIDInvlid | 0x19 | |
| | EvseResPymt Seleclnvlid | 0x1A | |
| | EvseResCertExp | 0x1B | |



| | | | |
|--|-----------------------------------|------|--|
| | EvseResCertRvk | 0x1C | |
| | EvseResCertNoCertAvail | 0x1D | |
| | EvseResCertChainErr | 0x1E | |
| | EvseResContrCancel | 0x1F | |
| | EvseResChlgInvlD | 0x20 | |
| | EvseResWrongEnTransMde | 0x21 | |
| | EvseResWrongChrgParam | 0x22 | |
| | EvseResChargPfInvlD | 0x23 | |
| | EvseResTrfSelecInvlD | 0x24 | |
| | EvseResPwrDelNotApplied | 0x25 | |
| | EvseResMetSignNotVld | 0x26 | |
| | EvseResNoChrgSvcSelec | 0x27 | |
| | EvseResContrErr | 0x28 | |
| | EvseResCertNotAllowed | 0x29 | |
| | EvseResNoSuppAppProt | 0x2A | |
| | EvseResContrNotAccept | 0x2B | |
| | EvseResMoUnknown | 0x2C | |
| | EvseResOemProvCertRev | 0x2D | |
| | EvseResOemSubCa1CertRev | 0x2E | |
| | EvseResOemSubCa2CertRev | 0x2F | |
| | EvseResMoProvCertRev | 0x30 | |
| | EvseResMoSubCa1CertRev | 0x31 | |
| | EvseResMoSubCa2CertRev | 0x32 | |
| | EvseResRootCaCertRev | 0x33 | |
| | EvseResCpsProvCertRev | 0x34 | |
| | EvseResSubCA1CertRev | 0x35 | |
| | EvseResSubCA2CertRev | 0x36 | |
| | EvseResCpsRootCaCertRev | 0x37 | |
| | EvseGbtCstEvseOverTemp | 0x38 | |
| | EvseGbtCstEVSEConnectorFalt | 0x39 | |
| | EvseGbtCstInternalOverTemperature | 0x3A | |
| | EvseGbtCstEnergyTransrFalt | 0x3B | |
| | EvseGbtCstEEmergShutdown | 0x3C | |
| | EvseGbtCstOtherFalt | 0x3D | |
| | EvseGbtCstChrgCurrntMismtch | 0x3E | |
| | EvseGbtCstChrgVoltMismtch | 0x3F | |
| | EvseGbtCommTimeOut | 0x40 | |

1.13.1.7 MD-REQ-337016/B-ChargeStationSchedule_St

Message Type: status

This signal is used to provide the schedule for the connected Charge Station

| Name | Literals | Value | Description |
|-------------|----------|-------|-------------|
| Schedule ID | - | - | |
| | ID 1 | 0x1 | |
| | ID 254 | 0xFF | |
| | | | |



| | | | |
|-----------------------------|----------|---------------|---|
| Schedule Index | - | - | This parameter shall increment for every message payload sent until all data is transferred. When sending data for new Schedule ID the index shall start at 1 again |
| | ID 1 | 0x1 | |
| | ID 254 | 0xFF | |
| | | | |
| Number Of Items Transmitted | - | - | Indicates the number of schedule inputs sent in current payload. Max number of items to be sent in a given Schedule Index is 800 |
| | 1 | 0x0001 | |
| | ... | | |
| | 800 | 0x0320 | |
| | Reserved | 0x0321-0xFFFF | |
| | | | |
| | | | |
| Power Value | - | - | 15 bits Fixed Units: Watts Resolution: 50 Watts |
| Time Interval | - | - | 25 bits Fixed Units: Time Resolution: Seconds |

1.13.2 PNC-IIR-REQ-326495/B-PNC Onboard Client 2_Rx

1.13.2.1 MD-REQ-326674/A-DigitalCommGtwyMode_Rq

Message Type: request

This signal is used to request the mode to use.

| Name | Literals | Value | Description |
|------|----------------------------|-------|-------------|
| Type | - | - | |
| | No Dgtl Communication | 0x0 | |
| | Attempt Dgtl Communication | 0x1 | |
| | DC EIM | 0x2 | |
| | DC PnC | 0x3 | |
| | AC EIM | 0x4 | |
| | AC PnC | 0x5 | |

1.13.2.2 MD-REQ-326679/A-ChargeInPowerMode_St

Message Type: status

This signal is used to indicate the operational mode of EVSE(Electrical Vehicle Supply Equipment).

| Name | Literals | Value | Description |
|------|-----------------|-------|-------------|
| Type | - | - | |
| | EvseNotDetected | 0x0 | |
| | EvsePaused | 0x1 | |



| | | | |
|--|---------------------|-----|--|
| | DigitalCommDetected | 0x2 | |
| | AcBasic | 0x3 | |
| | AcDigital | 0x4 | |
| | DcCharging | 0x5 | |
| | IcCharging | 0x6 | |
| | EvseNotCompatible | 0x7 | |
| | EvseFault | 0x8 | |

1.13.2.3 MD-REQ-326680/A-BatterySystemReady_St

Message Type: status

Status of the Battery system for charge.

| Name | Literals | Value | Description |
|------|----------------------|-------|-------------|
| Type | - | - | |
| | Not Ready | 0x0 | |
| | Charge Wait | 0x1 | |
| | Battery Charge Ready | 0x2 | |
| | Charging | 0x3 | |
| | Charging Completed | 0x4 | |
| | Faulted | 0x5 | |
| | Not Used | 0x6 | |

1.13.2.4 MD-REQ-326681/A-ChargerReady_St

Message Type: status

Charger Ready status indicator.

| Name | Literals | Value | Description |
|------|--------------------|-------|-------------|
| Type | - | - | |
| | 0x0: Not Ready | 0x0 | |
| | 0x1: Charger Ready | 0x1 | |
| | 0x2: ChargeFault | 0x2 | |
| | 0x3: Charging | 0x3 | |

1.13.2.5 MD-REQ-343489/C-DgtlCommPnc_Rq

Message Type: Request

Command from ECG to OBCC to reset PnC Feature and Disable the feature when CCS settings are disabled

| Literals | Value | Description |
|------------|-------|-------------|
| No Request | 0x0 | |
| Reset | 0x1 | |
| Disable | 0x2 | |
| DeleteAll | 0x3 | |
| NotUsed | 0x4 | |
| NotUsed | 0x5 | |
| NotUsed | 0x6 | |
| NotUsed | 0x7 | |



2 Functional Definition

2.1 PNC-FUN-REQ-324756/A-Onboarding and Enabling Plug and Charge

2.1.1 Requirements

2.1.1.1 PNC-REQ-326839/D-Customer Connectivity Settings Impact

The CCS feature provides the ability for a user to opt-in/opt-out from connectivity settings within the vehicle. This will allow the user to enter a customized connectivity mode such as privacy mode or to prevent data sharing such as GPS location. Customer connectivity settings (CCS) is enabled or disabled from the vehicle HMI.

- When the customer turns off any of the following customer connectivity settings in the vehicle HMI, Plug and Charge feature will be disabled in both vehicle and cloud (PAAK FI).
 - Vehicle Connectivity
 - Vehicle Data
- Before the ECG app shutdown, ECG shall turn OFF PnC feature by broadcast DgtlCommPnc_D_Rq = Disable to OBCC
- When the user initiates Master Reset/Brand connect Reset in the SYNC after CCS settings are Disabled, ECG Platform application shall handle these requirements by sending DgtlCommPnc_D_Rq = **Reset** to OBCC to delete all contract certificates.
- When the user initiates "Last user removes VIN from FordPass app" that triggers clear user setting command from the cloud after Vehicle data CCS setting is disabled, ECG Platform application shall handle these requirements by sending DgtlCommPnc_D_Rq = **DeleteAll** to OBCC to delete all contract certificates.

OBCC:

OBCC shall disable the PnC feature and send DgtlCommPnc_D_Stat with 0x2: Disable to BCCM and ECG

The Plug & Charge experience will be impacted based on CCS settings as shown below.

| CCS Impact on Requirements | Vehicle Connectivity Disabled | Vehicle Data Disabled | Location Sharing Disabled | Driving Characteristics Disabled |
|--|---|---|-----------------------------------|---|
| PnC toggle on available | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Yes |
| PnC toggle off available | N/A (PnC is off already) | N/A (PnC is off already) | Yes | Yes |
| Charging begins when using PnC after plugged in (assuming no other errors) | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Yes |
| Charging in progress status shown in vehicle/app | Follows overall charging approach | Follows overall charging approach | Follows overall charging approach | Follows overall charging approach |
| Vehicle data available in Trip & Charge log | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Partial availability – total distance added will not be available |
| Ability for contract certs to be replaced after expiration | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Yes |
| Notifications | | | | |



| | | | | |
|---|---|---|-----|---|
| Plug & Charge setup, re-enable or disable notifications in app/vehicle | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Yes |
| Any payment related error shown in vehicle | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Yes |
| EVSE or vehicle failure in authorization process (e.g. certificate rejected by EVSE) shown in app/vehicle | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Yes |
| Charge event summary (cost + vehicle data) shown in vehicle | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Partial availability – total distance added will not be available |
| “Charging Receipt” notification shown in app | Yes – doesn’t come from vehicle | Yes – doesn’t come from vehicle | Yes | Yes |
| Issue with expired certificate removal and reinstall in app | No – PnC ECG app is turned off in vehicle | No – PnC ECG app is turned off in vehicle | Yes | Yes |

2.1.1.2 PNC-REQ-326840/A-Contract Certificate Installation

Using the vehicle VIN#, Ford can retrieve the OEM Provisioning Certificate and corresponding OEM Provisioning Public Key installed in the OBCC module of the customer vehicle. Using these files, along with additional files supplied by the Ford Mobility Operator partner, Ford will create a Charging Contract Certificate and associated data files.

Contract Certificates are unique for each mobility operator authorizing payment for charging station operators in various markets (e.g., EU and US).

A Contract Certificate Data Package is comprised of several data elements:

- Module FESN (of the target OBCC)
- Charging Contract Certificate
- Charging Contract Private Key
- Mobility Operator Sub-CA Certificate Chain
- eMobility Account ID (EMAID)

The eMAID, encoded as the Subject field of the Charging Contract Certificate, is sent to the charging station by the vehicle OBCC when starting a charging session. The eMAID is needed by the back-end billing and payment system of the Mobility Operator to identify and authorize payment on a valid Plug & Charge agreement.

2.1.1.3 PNC-REQ-326841/A-Contract Data Package Delivery

- The Contract Certificate Data Package will be encrypted using the OEM Provisioning Certificate Public Key installed in the vehicle OBCC module. Additionally, the Data Package will be signed using a separate Private Key provided by Ford IVSS.
- The Contract Data Package is sent to the vehicle via the Ford Telematics system. The Data Package is received by the vehicle Telematics Control Unit (TCU), routed to the OBCC module through the Enhanced Communication Gateway (ECG) via Ethernet and then authenticated by the OBCC module using a pre-installed IVSS Public Key.



- The OBCC then retrieves the OEM Provisioning Private Key stored in the Hardware Security Module (HSM), decrypts the Contract Data Package, and extracts various data elements. The OBCC module installs the Charging Contract Certificate in non-volatile RAM (NVR) and the Contract Private Key in the HSM.

2.1.1.4 PNC-REQ-326842/A-V2G Root Certificate Delivery

V2G Root Certificates are issued by a Certificate Authority designated for a given global region. They are used as the basis for checking other derived PnC certificates to ensure they are genuine and trustworthy.

In order to use the Plug and Charge feature, a complement of (2 – 10) V2G Root Certificates must be installed in the OBCC modules of vehicles operating in that a given global region.

The vehicle OBCC module uses V2G Root Certificates to authenticate charging stations using the ISO 15118-2 standard protocol and establish a secure, encrypted communication session. Which complement of V2G Root Certificates are needed will be determined by the Charging Contract Certificates created and sent to the vehicle upon user activation of the PnC feature.

Using a mechanism similar to that used to install Charging Contract Certificates via the Telematics system, the compliment of V2G Root Certificates needed by the vehicle to operate in that given region.

2.1.1.5 PNC-REQ-326843/A-Storing Setting in the Cloud

After the vehicle enables Plug & Charge, a confirmation is sent to the Cloud. The expiration date of the contract cert and the VIN to ESN mapping for the OBCC are also stored by the cloud. The PnC element stored in the cloud is now enabled.

2.1.1.6 PNC-REQ-330363/B-Installing Certificate Payload in Vehicle

Cloud:

If user enables PnC and correct certs are not already installed in the vehicle (cloud logic)
THEN send PnCManageCertificate Command with SyncP Payload to ECG

ECG:

Sends SyncP Payload to OBCC Module by using SyncPRequest Diagnostic Routine

Response from OBCC:

After completing the certificate Service request by SyncP Request, OBCC shall send a Positive Diagnostic Routine to the control Routine with a Payload of a SyncP packet.

ECG:

ECG receives SyncP response signed with OBCC SyncP key from OBCC module and sends SyncP response as an "PnCManageCertificatestatus Alert" to the Cloud

Retry Strategy:

ECG shall do Retry 3 times if SyncP Request Diagnostic Routine timeout or fail to Receive Command Response after 10 sec and 10s will be calibrated value.

Enabling PnC:

OBCC:

After Certificates are Successful Installed, OBCC Enable the PnC Feature and send status to BCCM and ECG

2.1.1.7 PNC-REQ-326844/C-Plug And Charge On Confirmation

Once Plug & Charge has successfully been enabled, a notification will be sent to the user via FordPass and in vehicle indicating that they are set to use PnC.

If for any reason there is a failure in enabling Plug & Charge, only a FordPass notification will be sent.

SUCCESS

ECG:



If state of signal changes from DgtlCommPnc_D_Stat = NoContractsInstalled to Enable, indicating PnC is now enabled In-Vehicle

THEN send PnCFeatureStatus alert to the cloud

(FordPass notification: Plug & Charge enabled)

Non-Correlated Alert:

ECG sends PnCFeatureStatus alert as non-correlated Alert if there is any state change in OBCC Module

In-Vehicle HMI Notification:

- If signal changes from DgtlCommPnc_D_Stat = NoContractsInstalled to Enable, indicating PnC is now enabled in-vehicle SYNC shall detect Signal Change and display PnC has been enabled successfully Message in Vehicle HMI by subscribing to the ECG's VIM CAN signals directly.

(Vehicle HMI notification: Plug & Charge enabled)

- SYNC shall Persist last received CAN Signal value and compare with new incoming CAN Signal value upon every vehicle Key-on events.

2.1.2 Use Cases

2.1.2.1 PNCv1-UC-REQ-320369/A-Enabling PnC while CCS is Turned Off

| | |
|------------------------------------|--|
| Actors | User |
| Pre-conditions | CCS is turned off |
| Scenario Description | User enables Plug and Charge |
| Post-conditions | User is prompted in Ford Pass to turn on CCS for best user experience. |
| List of Exception Use Cases | |
| Interfaces | Phone HMI |

2.1.2.2 PNCv1-UC-REQ-320370/D-Onboarding Success - Contract Certificate Installation is Completed and PnC is Enabled

| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. User registers for FordPass app2. User has Authorized Vehicle3. User sets up wallet4. User selects subscription in FordPass5. CCS settings are enabled6. Cloud Connectivity is Available7. Vehicle is key on and Center Stack is Activated |
| Scenario Description | The Customer Enable Plug and Charge in FordPass |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Cloud will Check Whether Contract Cert's are installed in the Vehicle3. If No, PAAK FI will Sends request to IVSS for Contract Certificate4. IVSS Creates Charging Contract Data associated with VIN#5. IVSS Sends eMAID to Mobility Operator to Create Customer Account6. IVSS Package Secure Payload for Telematics Delivery7. IVSS Sends Secure Payload data to PAAK FI8. PAAK FI Sends Payload Data to VSDN9. VSDN Sends Payload Data to Vehicle's ECG |



| | |
|------------------------------------|---|
| | <ol style="list-style-type: none">10. ECG Shall Sends Diagnostic Routine Command to OBCC with Payload Data11. OBCC Install the Certificates and Enable the PnC Feature12. OBCC Sends Diagnostic Command Response and PnC Feature status Signal to ECG13. ECG Sends PnCManageCertificateStatus Alert to Cloud14. ECG Sends PnCFeatureStatus alert to the cloud15. Message on Centerstack tells the user "Plug & Charge is now active on this vehicle. Charging will now start automatically when you plug in to a Plug & Charge-enabled station in the Ford network, and your account will be billed."16. User receives a Notification in FordPass that tells "Plug & Charge is now active on this vehicle. Charging will now start automatically when you plug in to a Plug & Charge-enabled station in the Ford network, and your account will be billed." |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface, Centerstack HMI, Offboard HMI, Offbaord interface |

2.1.2.3 PNCv1-UC-REQ-320371/B-Onboarding Success – Vehicle HMI not Active

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. User registers for FordPass app2. User has Authorized Vehicle3. User sets up wallet4. User selects subscription in FordPass5. CCS are Enabled6. Cloud Connectivity is Available7. Vehicle is key off and Center Stack is deactivated (User must clear notification, disappears if ignored during current key cycle) |
| Scenario Description | The Customer Enable Plug and Charge in FordPass |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Cloud will Check Whether Contract Cert's are installed in the Vehicle3. If No, SDN will Sends request to IVSS for Contract Certificate4. IVSS Creates Charging Contract Data associated with VIN#5. IVSS Sends eMAID to Mobility Operator to Create Customer Account6. IVSS Package Secure Payload for Telematics Delivery7. IVSS Sends Secure Payload data to SDN8. SDN Sends Payload Data to VSDN9. VSDN Sends Payload Data to Vehicle's ECG10. ECG Shall Sends Diagnostic Routine Command to OBCC with Payload Data11. OBCC Install the Certificates and Enable the PnC Feature12. OBCC Sends Diagnostic Command Response and PnC Feature status Signal to ECG13. ECG Sends PnCManageCertificateStatus Alert to Cloud14. ECG Sends PnCFeatureStatus alert to the cloud15. Message on Centerstack tells the user "Plug & Charge is now active on this vehicle. Charging will now start automatically when you plug in to a Plug & Charge-enabled station in the Ford network, and your account will be billed." |



| | |
|-----------------------------|--|
| | 16. User receives a Notification in FordPass that tells "Plug & Charge is now active on this vehicle. Charging will now start automatically when you plug in to a Plug & Charge-enabled station in the Ford network, and your account will be billed." |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface, Centerstack HMI, Offboard HMI, Offbaord interface |

2.1.2.4 PNCv1-UC-REQ-320372/A-Onboarding success – vehicle authorization message is displayed along with PnC enabled message

| | |
|-----------------------------|--|
| Actors | User |
| Pre-conditions | User has registered for FordPass User has authorized vehicle Wallet is set up CCS are enabled User has not turned on vehicle since authorization User has enabled Plug and Charge |
| Scenario Description | User keys on and dismisses vehicle authorization message |
| Post-conditions | PnC enabled message is displayed in center stack |
| List of Exception Use Cases | |
| Interfaces | Vehicle Interface, Offboard Interface, Centerstack HMI |

2.1.2.5 PNCv1-UC-REQ-320373/A-Onboarding failure, When the SDN fails to Send request to IVSS for Contract Certificates

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | 1. User registers for FordPass app 2. User has Authorized Vehicle 3. User sets up wallet 4. User selects subscription in FordPass 5. CCS are Enabled 6. Cloud Connectivity is Available |
| Scenario Description | Onboarding failure, When the SDN fails to Send request to IVSS for Contract Certificates |
| Post-conditions | 1. FordPass Sends a PnC Enable Command to the Cloud 2. Cloud will Check Whether Contract Cert's are installed in the Vehicle 3. If No, SDN will Sends request to IVSS for Contract Certificate 4. SDN fails to Sends Request to IVSS for Contact Certificates 5. User receives a PnC Failure Notification in FordPass |
| List of Exception Use Cases | |
| Interfaces | Offboard interface, Offboard HMI |

**2.1.2.6 PNCv1-UC-REQ-320375/B-Onboarding failure, No Cloud to Vehicle Connectivity**

| | |
|------------------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. User registers for FordPass app2. User has Authorized Vehicle3. User sets up wallet4. User selects subscription in FordPass5. CCS are Enabled |
| Scenario Description | Onboarding failure, No Cloud to Vehicle Connectivity |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Cloud will Check Whether Contract Cert's are installed in the Vehicle3. If No, SDN will Sends request to IVSS for Contract Certificate4. IVSS Creates Charging Contract Data associated with VIN#5. IVSS Sends eMAID to Mobility Operator to Create Customer Account6. IVSS Package Secure Payload for Telematics Delivery7. IVSS Sends Secure Payload data to SDN8. SDN Sends Payload Data to VSDN9. VSDN Shall fails to Send Contract Cert's Payload data and PnC Enable Command to ECG10. VSDN retries X time to Connect the Vehicle11. User receives a PnC Failure Notification in FordPass |
| List of Exception Use Cases | |
| Interfaces | Offboard interface, Offboard HMI |

2.1.2.7 PNCv1-UC-REQ-324759/B-Onboarding failure, Downstream Module Error

| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. User registers for FordPass app2. User has Authorized Vehicle3. User sets up wallet4. User selects subscription in FordPass5. CCS are Enabled6. Cloud Connectivity is Available |
| Scenario Description | Onboarding failure, Downstream Module Error |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Cloud will Check Whether Contract Cert's are installed in the Vehicle3. If No, SDN will Sends request to IVSS for Contract Certificate4. IVSS Creates Charging Contract Data associated with VIN#5. IVSS Sends eMAID to Mobility Operator to Create Customer Account6. IVSS Package Secure Payload for Telematics Delivery7. IVSS Sends Secure Payload data to SDN8. SDN Sends Payload Data to VSDN9. VSDN Sends Payload Data to Vehicle's ECG10. ECG Shall Sends Diagnostic Routine Command to OBCC with Payload Data11. ECG Fails to Send or OBCC fails to Process Diagnostic Routine Command12. ECG will do 3 Retry if command failed or timeout |



| | |
|-----------------------------|--|
| | 13. User receives a PnC Failure Notification in FordPass |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface, Offboard interface, Offboard HMI |

2.1.2.8 PNCv1-UC-REQ-324836/A-Onboarding failure, when No FordPass to Cloud Connectivity

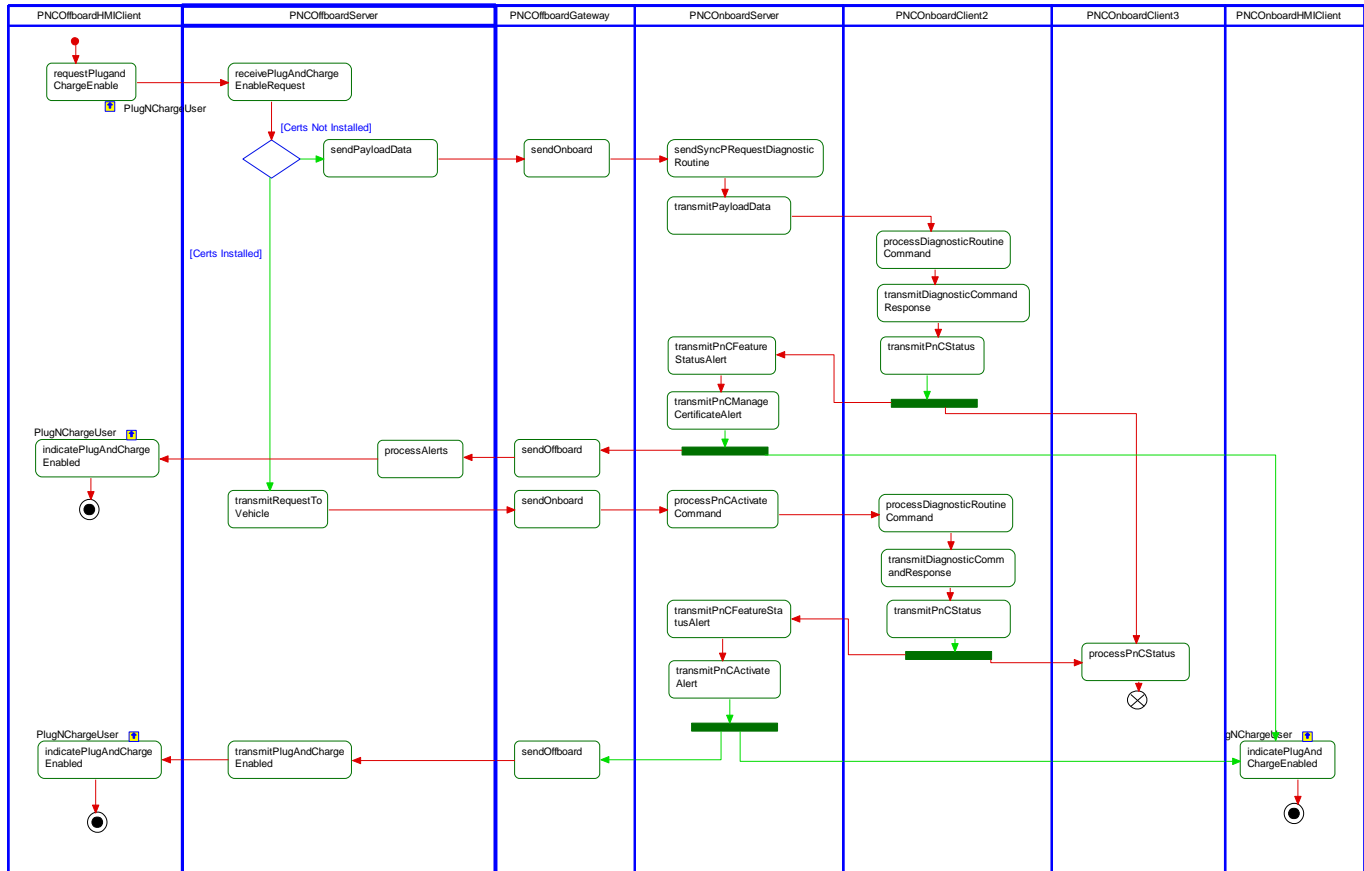
| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. User registers for FordPass app2. User has Authorized Vehicle3. User sets up wallet4. User selects subscription in FordPass5. CCS are Enabled |
| Scenario Description | Onboarding failure, when No FordPass to Cloud Connectivity |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Command in Progress for 120 sec in FordPass3. FordPass shows PnC enable failure Notification |
| List of Exception Use Cases | |
| Interfaces | Offboard interface, Offboard HMI |



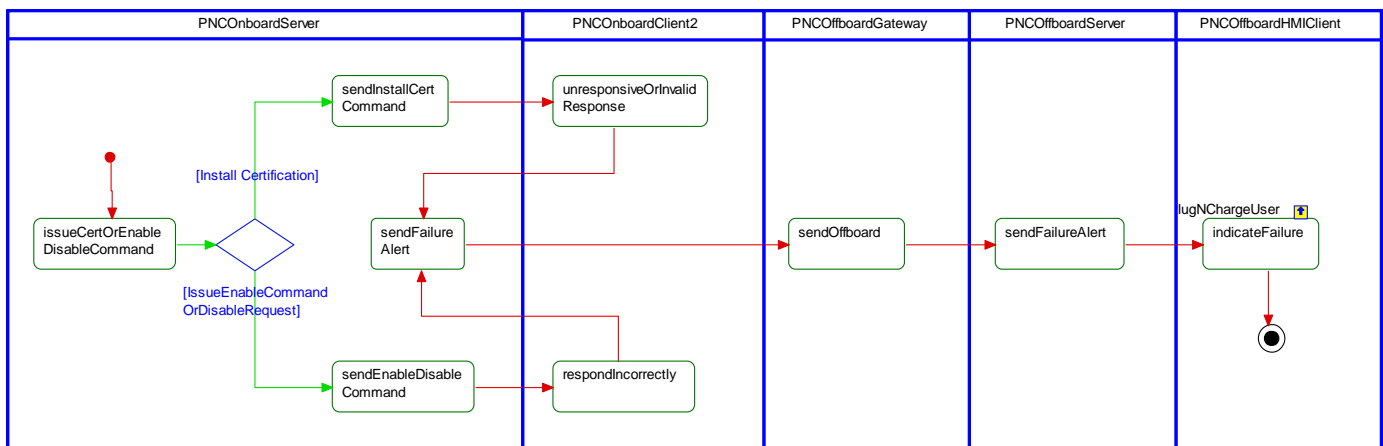
2.1.3 White Box Views

2.1.3.1 Activity Diagrams

2.1.3.1.1 PNC-ACT-REQ-326382/B-Enabling PnC



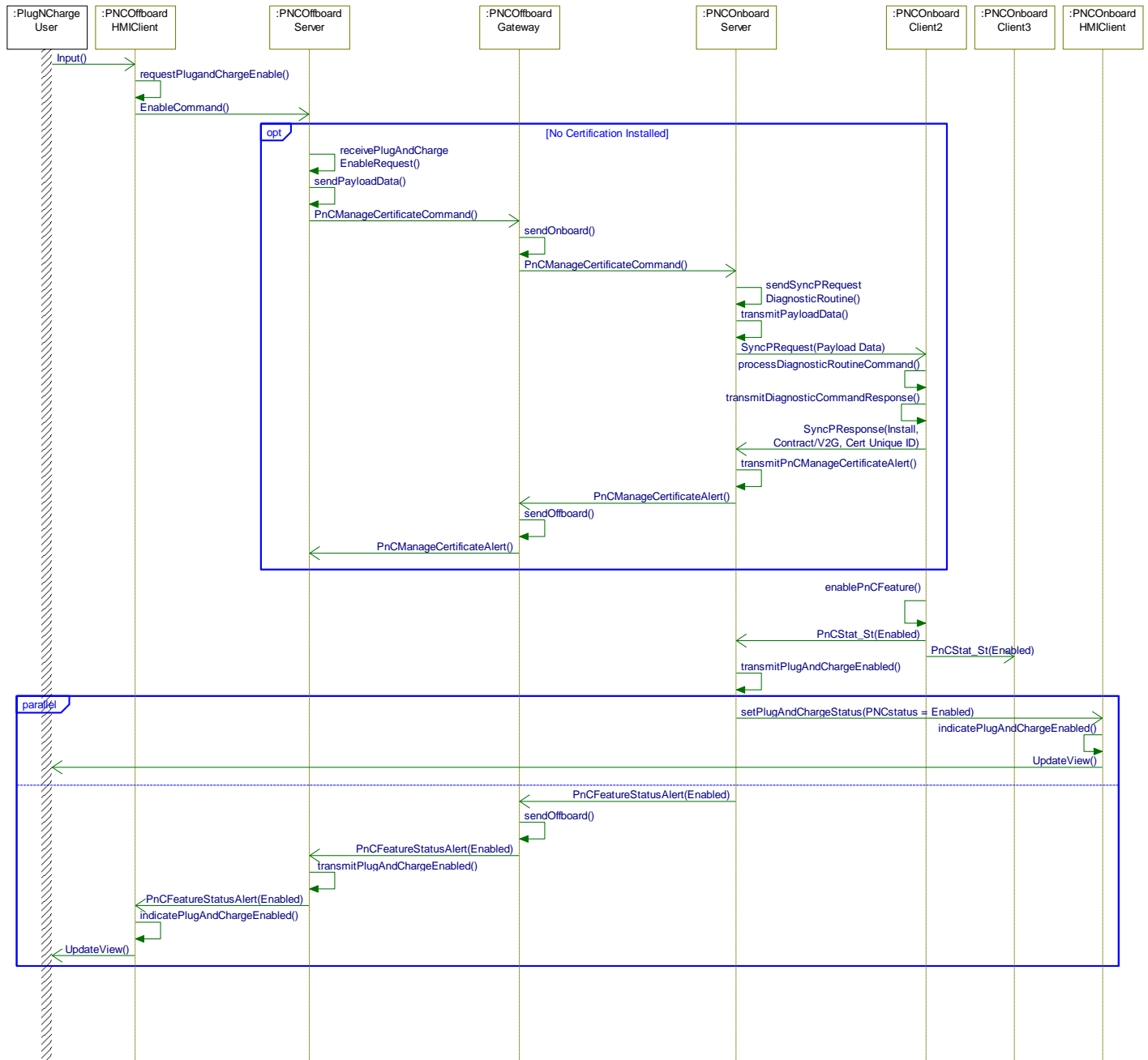
2.1.3.1.2 PNC-ACT-REQ-326383/B-Enabling Disabling Or Certification In Vehicle failure





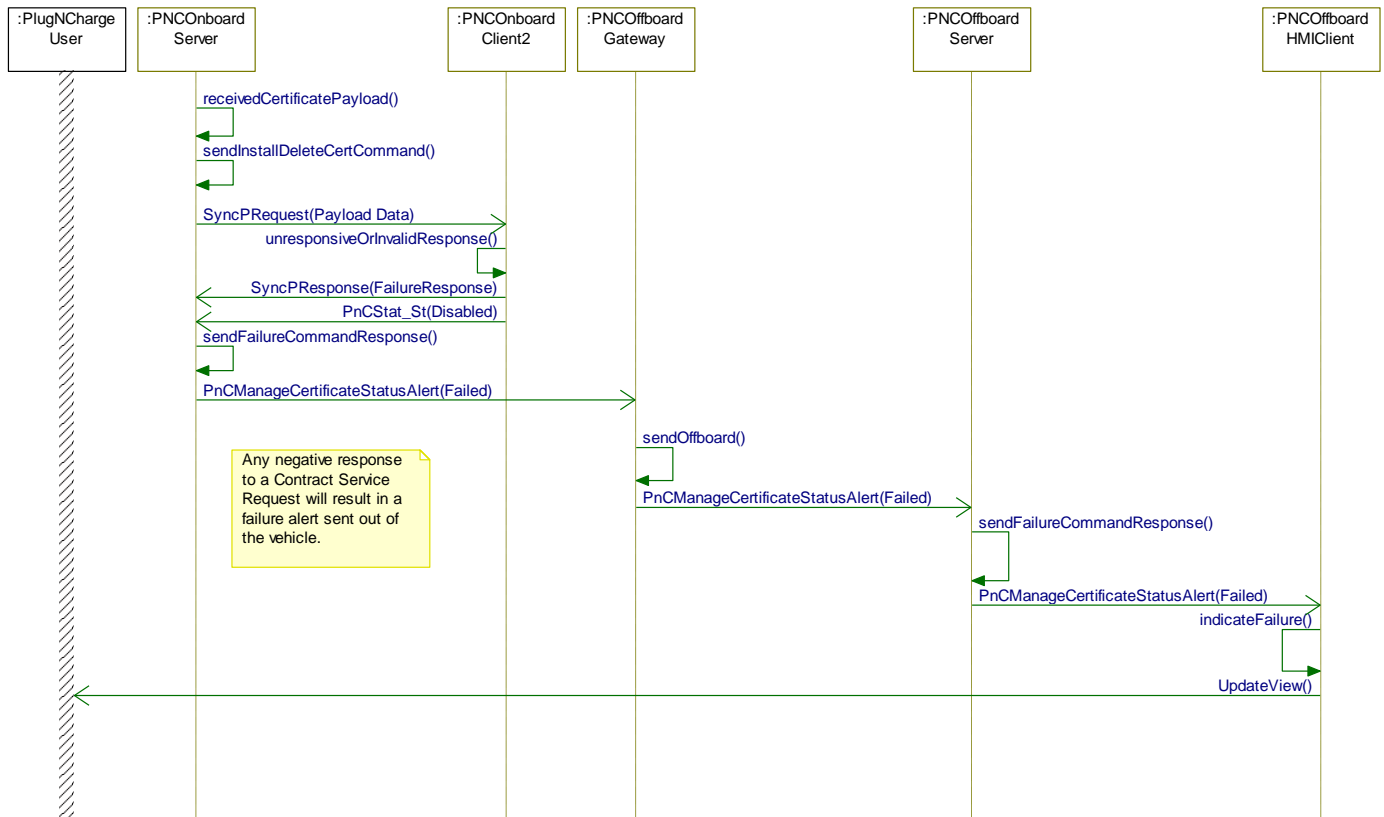
2.1.3.2 Sequence Diagrams

2.1.3.2.1 PNC-SD-REQ-326490/B-Onboarding and Enabling Plug and Charge





2.1.3.2.2 PNC-SD-REQ-326533/B-Onboarding or Enabling-Disabling Failures



2.2 PNC-FUN-REQ-324739/A-Warm Welcome

2.2.1 Requirements

2.2.1.1 PNC-REQ-326855/A-Warm Welcome/Geofencing

A Warm Welcome occurs when the driver navigates to one of the following using the in-vehicle Nav HMI:

- A charging station
- ANY destination with a charging station within X meters, where X is a configurable value

When the user gets close to the station, the Nav HMI will guide the user to charge by displaying useful information such as how much it will cost to charge and what stations are available. This feature will be an enhancement to the existing welcome feature Nav currently offers.

The flowchart below displays the process of receiving a Warm Welcome when approaching a charge station.



Warm Welcome

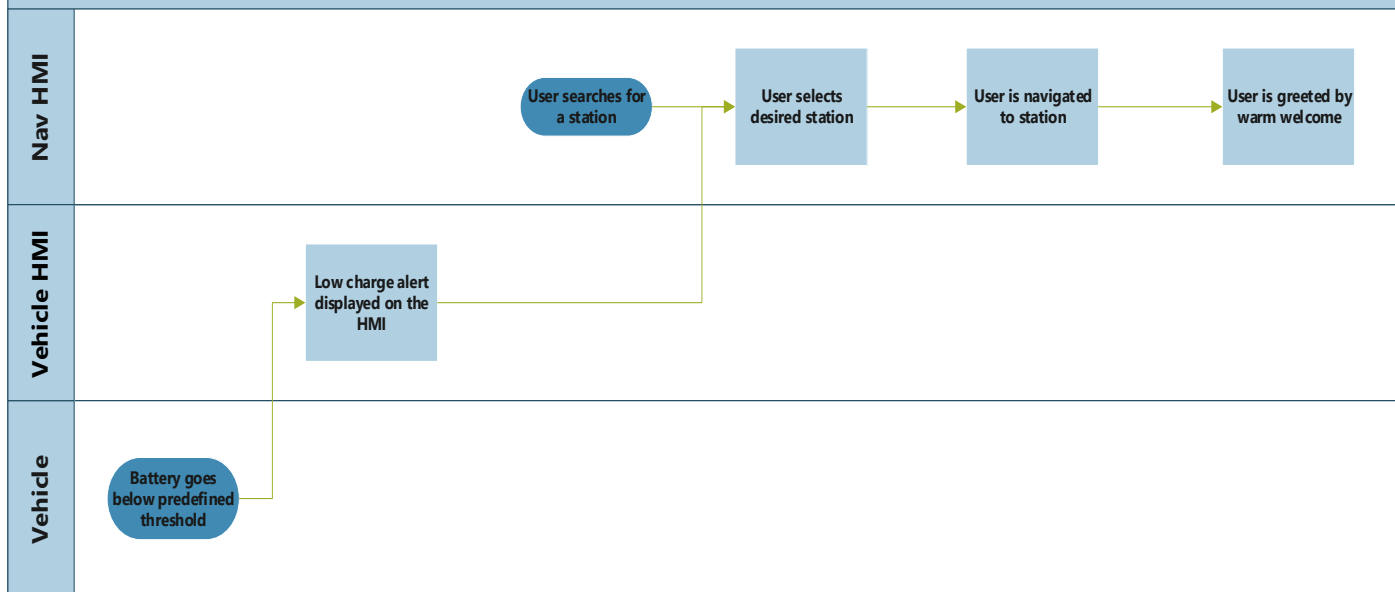


Figure 1: How User Can Receive Warm Welcome

2.2.1.2 PNC-REQ-326856/A-Receiving Warm Welcome

When the user is within a predefined distance of the station, they will be prompted with the Warm Welcome. A Warm Welcome will be received regardless of whether the station type is Plug & Charge capable. The user will receive a warm welcome when navigating to a station. If the user is not using in-vehicle navigation to get to a station, he/she will not see the warm welcome screen.

When the user is within the defined distance from the station, the following will occur:

1. Mobility operator sends charge station information to Nav cloud
2. Nav cloud sends charge station information to Nav HMI via IP pass through
3. Nav HMI displays relevant information, as detailed in the next section

2.2.1.3 PNC-REQ-326857/A-Warm Welcome Display Content

The Warm Welcome will display the following information in the HMI:

- Which station is available
- Charger speed
- Connector Type
- EV Charger-based pricing
- Estimated time to full charge, which will be based on the charger speed information provided (if user is on an active EV trip planner route, also display estimated charge time to target SOC required by EV trip planner to reach next waypoint, and target SOC %)
- Charging speed
- Plug & Charge capable
- In-network versus out of network



2.2.2 Use Cases

2.2.2.1 PNCv1-UC-REQ-329369/A-Customer wants charge location information to automatically appear at destination arrival

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Electric Vehicle Ignition switch is in RUN / Accessory Infotainment system is ON Navigation application equipped Navigation route is active Connectivity available Current vehicle range, "DTE" Maximum vehicle range when fully fueled |
| Scenario Description | User plans a route and arrives at charge Station POI |
| Post-conditions | At x distance before destination, the system displays warm welcome screen to include the following information: <ul style="list-style-type: none">- Station availability (hours of operation)- Charger speed- Connector Type- EV Charger-based pricing- Estimate time to full charge, which we be based on the charger speed- Charging speed- Plug & Charge capable- In-network versus out of network |
| List of Exception Use Cases | E1- No charging station data available E2- Non Charge Station POI E3- x distance is not detected due to errors in map |
| Interfaces | Connection Manager TCU/Ford Mobility Cloud interface Premium data provider in Cloud Navigation services G-HMI (Graphic HMI) Map data Voice services |

2.2.2.2 PNCv1-UC-REQ-329370/A-E1 - No Charge Station Data Available

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Same as normal use case |
| Scenario Description | Same as normal use case |
| Post-conditions | Welcome screen information will not be displayed |
| List of Exception Use Cases | n/a |
| Interfaces | Same as normal use case |

**2.2.2.3 PNCv1-UC-REQ-329371/A-E2 - Non Charge Station POI**

| | |
|------------------------------------|--|
| Actors | Vehicle occupant |
| Pre-conditions | Same as normal use case |
| Scenario Description | Same as normal use case |
| Post-conditions | Welcome screen information will not be displayed |
| List of Exception Use Cases | n/a |
| Interfaces | Same as normal use case |

2.2.2.4 PNCv1-UC-REQ-329372/A-E3 - X Distance is Not Detected Due to Errors in Map

| | |
|------------------------------------|--|
| Actors | Vehicle occupant |
| Pre-conditions | Same as normal use case |
| Scenario Description | Same as normal use case |
| Post-conditions | Welcome screen information will not be displayed |
| List of Exception Use Cases | n/a |
| Interfaces | Same as normal use case |

2.3 PNC-FUN-REQ-324745/A-Plug In and Charge Begin**2.3.1 Requirements****2.3.1.1 PNC-REQ-326846/A-Plug And Charge Begin**

When the user plugs in, a certificate exchange will occur in the background and once the process has successfully completed, charging will begin. The process between plugging in and charge beginning will take no more than 5 seconds. The assessment of whether charging should be permitted needs to be completed before charging begins based on business rules that need to be defined later.

When Plug & Charge is on, after the user plugs into a P&C capable charging station, the following can occur:

1. Charge begin is successful
2. Charge begin is unsuccessful

2.3.1.2 PNC-REQ-326848/A-Vehicle Trust of EVSE

The vehicle must first authenticate the EVSE through the following steps:

- The Vehicle's OBCC Authenticates the EVSE leaf Certificate and Validity of the public key by checking the signature with the V2G Root Certificate authority (note: a message encrypted with a public key can only be decrypted using its private key)
- The Vehicle's OBCC checks signatures of the Leaf Provisioning Certificate against the V2G Root certificates stored onboard the Vehicle



- After authenticating the vehicle can trust that this part of the message element originated from an Authorized Counterpart

The vehicle time signals will ensure that the charging station certificate expiration date will be compared against an accurate time and date.

2.3.1.3 PNC-REQ-326845/D-Charge Begin Unsuccessful

After the user plugs in the vehicle, if charging does not immediately begin, the user will receive a notification on FordPass and will see a charging status display in the vehicle. See below for list of possible errors.

8 second auto-dismiss messages (no sound alert)

| Reason for Error | Auth. Types | Region (NA/EU/Both) | In Vehicle status/notification (center stack HMI) | Sample Copy |
|---|----------------|---------------------|---|---|
| ISO, out of network station | P&C | Both | Message displayed (Show only when the Feature is Enabled in the Vehicle) | This charging station is out of the Ford network. To charge here, please plug in again and follow the instructions on the station. |
| Non-ISO, out of network station | App, RFID | Both | No In-Vehicle Notification | This charging station is out of the Ford network. To charge here, please follow instructions on the station. |
| Non-ISO station, in network station | P&C | EU | No In-Vehicle Notification | To charge here, please use the FordPass app or your RFID card. |
| Non-ISO station, in network station | P&C | NA | No In-Vehicle Notification | To charge here, please use the FordPass app. |
| Backend system failures | P&C, App, RFID | EU | Error message displayed on screen | Something went wrong. To charge here, please plug in again and use the FordPass app or your RFID card. If this continues, follow the instructions on the station to start charging. |
| Backend system failures | P&C, App | NA | Error message displayed on screen | Something went wrong. To charge here, please plug in again and use the FordPass app. If this continues, follow the instructions on the station to start charging. |
| EVSE or vehicle failure in authorization process (e.g. certificate) | P&C | EU | Error message displayed on screen telling user to use other means to authenticate | Something went wrong. To charge here, please plug in again and use the FordPass app or your RFID card. |



| | | | | |
|--|-----|----|---|--|
| rejected by EVSE) | | | | |
| EVSE or vehicle failure in authorization process (e.g. certificate rejected by EVSE) | P&C | NA | Error message displayed on screen telling user to use other means to authenticate | Something went wrong. To charge here, please plug in again and use the FordPass app. |

The logic for notifications above is detailed in the sections below.

2.3.1.4 PNC-REQ-330368/B-Disabling or Re-Enabling PnC due to failure

Plug & Charge is disabled if there are any failure states reported by the charging station (EVSE) so that the user can utilize external means of payment.

OBCC:

1. OBCC Reports EVSE fault to ECG via DgtlCommGtwy_D_Falt does not equal to No Fault State
2. OBCC Disable the feature and Send DgtlCommPnc_D_Stat = Faulty Status to BCCM and ECG

ECG:

ECG Receives DgtlCommPnc_D_Stat = Faulty Status Signal from OBCC

No alert sent to the cloud and the user is not notified in the vehicle HMI and FordPass that PnC has been disabled.

Re-enabling PnC:

OBCC:

1. When TrnRng_D_Rq changes state from 0x0: Park, to any other state Considering Vehicle moves from the Current Charging Station.
2. OBCC Re-enable the PnC Feature and Sends DgtlCommPnc_D_Stat = Enable Status to ECG and BCCM

ECG:

ECG Receives DgtlCommPnc_D_Stat = Enable Status Signal from OBCC

APIM:

If DgtlCommPnc_D_Stat Signal Changes from faulty to enable don't show any Notification on Vehicle HMI

No alert sent to the cloud and the user is not notified in the vehicle HMI and FordPass App that PnC has been enabled

2.3.1.5 PNC-REQ-330365/B-Notifications at Public Stations

The notification logic for the following notifications will only occur if the user plugs into a station that is contained by the VPOI data.

- PnC capable, in network
- PnC capable, out of network
- Non PnC capable, in network
- Non PnC capable, out of network

2.3.1.6 PNC-REQ-330367/C-EVSE ID and Station Charge Schedule Information

The vehicle will capture EVSE ID and deliver it to the Cloud when the user plugs into any type of digital charging station regardless of whether PnC is on.

Rule:



ECG shall monitor ChrgInPwMde_D_Actl CAN Signal with 0x4= AcDigital, 0x5= DcCharging and send Request ChargeStationID_Rq TP signal to OBCC Module and OBCC Module shall send ChargeStationID_St TP Signal with EVSE ID and TLS charging info and ChargeStationSchedule_St TP Signal with Station Schedule information to ECG. ECG sends PnCChargingStationInfo alert which includes the ChargeStationID_St and ChargeStationSchedule_St TP Messages.

2.3.1.7 PNC-REQ-337332/B-Sending whether Vehicle is Charging using TLS or No TLS

When the user plugged In at EVSE which supports digital communication the OBCC shall report to the ECG, whether or not each connection to an EVSE is using TLS using ChargeStationID_St TP

ECG Logic:

ECG shall monitor ChrgInPwMde_D_Actl CAN Signal with 0x4= AcDigital, 0x5= DcCharging and send Request ChargeStationID_Rq TP signal to OBCC Module and OBCC Module shall send ChargeStationID_St TP Signal with EVSE ID and TLS charging info and ChargeStationSchedule_St TP Signal with Station Schedule information to ECG. ECG sends PnCChargingStationInfo alert which includes the ChargeStationID_St and ChargeStationSchedule_St TP Messages.

2.3.1.8 PNC-REQ-372234/A-Send GPS Signal in PnCChargingStationInfoAlert

When ECG triggers "PnCChargingStationInfoAlert" has planned need to include latest GPS coordinate signals as additional enumeration in this alert payload.

2.3.1.9 PNC-REQ-330369/D-ISO/In network HMI error

The vehicle HMI and FordPass will display an error message when the user plugs into a station that is not both ISO compliant and in-network.

ECG shall monitor ChrgInPwMde_D_Actl CAN Signal with 0x4= AcDigital, 0x5= DcCharging and DgtlCommGtwyMde_D_Stat = 0x2: DC PnC OR 0x5: AC PnC OR 0x3: DC EIM/PnC OR 0x6: AC EIM/PnC, all of which signify ISO stations and Send a "PnCChargingStationInfo" alert with this Encoder states to the cloud.

And Station is out of network, as determined by Nav VPOI data then cloud shall send PnCStationType command to the Vehicle.

AND ChrgLocIDCurnt_D_SAV and ChrgLocIDCurnt_D_Uns do not return a number between 1 and 10, indicating user is NOT at a recent or saved location and DgtlCommPnc_D_Stat = 0x3: Enable then ECG sends SoaHmiMessage

"DISPLAY_STATION_TYPE = 0x0: PnC Supported, Out of Network" to APIM then SYNC shall display "ISO, Out of network station" notification.

ECG shall monitor ChrgInPwMde_D_Actl CAN Signal with 0x4= AcDigital, 0x5= DcCharging and DgtlCommGtwyMde_D_Stat = 0x1: DC EIM OR 0x4: AC EIM, both of which signify non PnC stations and Send a "PnCChargingStationInfo" alert with this Encoder states to the cloud.

ECG shall monitor ChrgInPwMde_D_Actl CAN Signal with 0x4= AcDigital, 0x5= DcCharging and DgtlCommGtwyMde_D_Stat = 0x1: DC EIM OR 0x4: AC EIM, both of which signify non PnC stations and Send a "PnCChargingStationInfo" alert with this Encoder states to the cloud.

If you receive Non PNC Supported In Network or Non PNC Supported Out Of Network ECG shall ignore these command encoding types from the Cloud.

2.3.1.10 PNC-REQ-330371/B-Payment or Backend issues

When there is a Payment error Cloud shall send PnCAuthorizationError command to the vehicle indicating the failure type. When the Vehicle Receives the PnCAuthorizationError Command, the Ethernet message relays the same failure information to the APIM.

- 0x1: Payment subscription balance is low
- 0x2: Payment balance has run out
- 0x3: Charging account is overdue, but charging is still allowed (post-pay account)
- 0x4: Charging account is overdue and charging is suspended (post-pay account)



- 0x5: Payment method issue for variable fees or monthly subscription fees
- 0x6: Backend system failure has occurred

2.3.1.11 PNC-REQ-330373/C-EVSE or vehicle failure in charging setup process (e.g. certificate rejected by EVSE)

APIM:

- IF DgtlCommGtwy_D_Falt does not equal 0x0: no fault
SYNC shall detect Signal Change and display "EVSE or vehicle failure in charging set up" error message in vehicle HMI by subscribing to the ECG's VIM CAN signals directly.
- SYNC shall Persist last received CAN Signal value and compare with new incoming CAN Signal value upon every vehicle Key-on events.

ECG:

IF DgtlCommGtwy_D_Falt does not equal 0x0: no fault
THEN send PnCChargeStationFault alert to the cloud indicating failure reason
(FordPass notification: "EVSE or vehicle failure in charging set up")

2.3.1.12 PNC-REQ-330374/B-Clearing charging related errors

Any vehicle HMI error message related to charging will be cleared in the center stack if charging successfully begins before the user turns on the vehicle.

APIM:

IF ChrgStat_D2_Dsply changes from 0x0: Not ready
TO
0x7: Charging – AC, 0x8: Charging – DC, 0x9: Charging - Inductive, or 0xA: Charging – System Maintain, before next ignition cycle
THEN SYNC shall cleared error notifications in Vehicle HMI

2.3.2 Use Cases

2.3.2.1 ***PNCv1-UC-REQ-324838/B-User is Authorized to Charge - Charge Begin is Successful***

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is on4. Vehicle is Keyed on, and Center Stack is activated5. Vehicle configured for NA or EU region |
| Scenario Description | User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq = 0x1: AttemptDgtlComm5. OBCC starts communication with EVSE6. EVSE sends leaf certificate with public key to the OBCC Via PLC and Establish TLS communication7. OBCC Authenticates the leaf certificate and Validity of the Public key8. EVSE Informs OBCC that it supports PnC9. OBCC reports to BCCM that EVSE supports PnC via DgtlCommGtwyMde_D_St |



| | |
|------------------------------------|--|
| | <ol style="list-style-type: none">10. Since PnC is Enabled, OBCC continues with PnC mode via DgtlCommGtwyMde_D_Rq11. OBCC Sends "PaymentDetailsREQ message" to the EVSE, which includes the Vehicle Contract Certificate and eMAID12. EVSE receives PaymentDetailsREQ message13. EVSE Authenticates the contract certificate Credentials locally by use one of its Stored MO Root Certificates14. EVSE sends eMAID of the request message to the Mobility Operator15. Mobility operator authorizes eMAID and sends eMAID to the Ford monetization platform16. Monetization platform verifies payment method17. Monetization platform sends authorization response to MO18. Mobility operator tells EVSE to start charging19. EVSE starts charging the Vehicle20. Cloud Receives Alert from the Vehicle Indicating Charging has begun along with EVSE ID21. User is Notified that Charging has Begun in Vehicle (Out of Scope for PnC)22. User receives Charge Begin Notification and Charge Status in FordPass |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.2 PNCv1-UC-REQ-324843/B-User Plugs into Network ISO station and EVSE Failure in Charging Authentication and Authorization Process (EU)

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Enabled4. Vehicle is Keyed on, and Center Stack is activated5. Vehicle Configured for EU Region |
| Scenario Description | EVSE Failure in Charging Authentication and Authorization Process (EU) |
| Post-conditions | <ol style="list-style-type: none">1. User Plugs into In Network ISO Station2. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)3. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)4. BCCM detects Pilot indicative of digital communications5. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq = AttemptDgtlComm6. OBCC starts communication with EVSE7. EVSE Informs OBCC that it supports PnC8. OBCC reports to BCCM that EVSE supports PnC via DgtlCommGtwyMde_D_St9. Since PnC is Enabled, OBCC continues with PnC mode via DgtlCommGtwyMde_D_Rq10. EVSE sends leaf certificate with public key to the OBCC Via PLC Communication11. OBCC fails to Authenticates the leaf certificate and validity of the Public key12. OBCC Send failure Signal to ECG, ECG to APIM and backend |



| | |
|------------------------------------|--|
| | <ol style="list-style-type: none">13. Message on Centerstack (8 Sec Auto Dismiss Message) tells user “There was an error with the transaction. To charge at this station, please plug in again and use FordPass or RFID card.”14. Vehicle Sends an Alert to the Cloud15. User receives a Notification in FordPass that tells “There was an error with the transaction. To charge at this station, please plug in again and use FordPass or RFID card.” |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.3 PNCv1-UC-REQ-325360/B-User Plugs into Network ISO station and EVSE Failure in Charging Authentication and Authorization Process (NA)

| | |
|------------------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Enabled4. Vehicle is Keyed on, and Center Stack is activated5. Vehicle Configured for NA Region |
| Scenario Description | EVSE Failure in Charging Authentication and Authorization Process (NA) |
| Post-conditions | <ol style="list-style-type: none">1. User Plugs into In Network ISO Station2. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)3. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)4. BCCM detects Pilot indicative of digital communications5. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq = AttemptDgtlComm6. OBCC starts communication with EVSE7. EVSE Informs OBCC that it supports PnC8. OBCC reports to BCCM that EVSE supports PnC via DgtlCommGtwyMde_D_St9. Since PnC is Enabled, OBCC continues with PnC mode via DgtlCommGtwyMde_D_Rq10. EVSE sends leaf certificate with public key to the OBCC Via PLC Communication11. OBCC fails to Authenticates the leaf certificate and validity of the Public key12. OBCC Send failure Signal to ECG, ECG to APIM and backend13. Message on Centerstack (8 Sec Auto Dismiss Message) tells user “There was an error with the transaction. To charge at this station, please plug in again and use FordPass.”14. Vehicle Sends an Alert to the Cloud15. User receives a Notification in FordPass that tells “There was an error with the transaction. To charge at this station, please plug in again and use FordPass.” |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

**2.3.2.4 PNCv1-UC-REQ-324847/B-User Plugs into ISO, Out of Network Station**

| | |
|------------------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Enabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | User Plugs into ISO, out of network station (Do not display at known charging locations) |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq = AttemptDgtlComm5. OBCC starts communication with EVSE6. EVSE Informs OBCC that it supports PnC7. OBCC reports to BCCM that EVSE supports PnC via DgtlCommGtwyMde_D_St8. Since PnC is Enabled, OBCC continues with PnC mode via DgtlCommGtwyMde_D_Rq9. EVSE sends leaf certificate with public key to the OBCC Via PLC10. OBCC rejects the leaf certificate and Contract Certificates11. Message on Centerstack (8 Sec Auto Dismiss Message) tells user "This charging station is not part of the Ford network. To charge at this station, please plug in again and follow instructions on the station."12. Vehicle Sends an Alert to the Cloud13. User receives a Notification in FordPass that tells "This charging station is not part of the Ford network. To charge at this station, please plug in again and follow instructions on the station." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.5 PNCv1-UC-REQ-325364/C-User Plugs into Non ISO, Out-of-Network Station

| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Enabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | User Plugs into Non ISO, out of network station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq (AttemptDgtlComm)5. OBCC starts communication with EVSE6. EVSE informs OBCC that it supports only EIM7. OBCC reports to BCCM that EVSE supports only EIM via DgtlCommGtwyMde_D_St.8. OBCC continue with EIM mode via DgtlCommGtwyMde_D_Rq |



| | |
|-----------------------------|--|
| | 9. Vehicle Sends an Alert to the Cloud 10. User receives a Notification in FordPass that tells "This charging station is not part of the Ford network. To charge at this station, please follow instructions on the station." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.6 PNCv1-UC-REQ-324848/C-User Plugs into an In-Network, Non ISO Station (EU)

| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | 1. Onboarding has been successfully completed 2. Cloud connectivity is available 3. PnC is Enabled 4. Vehicle is Keyed on, and Center Stack is activated 5. Vehicle Configured for EU Region |
| Scenario Description | Non ISO station, in network station (EU) |
| Post-conditions | 1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM) 2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp) 3. BCCM detects Pilot indicative of digital communications 4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq (AttemptDgtlComm) 5. OBCC starts communication with EVSE 6. EVSE informs OBCC that it supports only EIM 7. OBCC reports to BCCM that EVSE supports only EIM via DgtlCommGtwyMde_D_St. 8. OBCC continues with EIM mode via DgtlCommGtwyMde_D_Rq 9. Vehicle Sends an Alert to the Cloud 10. User receives a Notification in FordPass that tells "To charge at this station, please use the FordPass or RFID card." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.7 PNCv1-UC-REQ-325363/C-User Plugs into an In-Network, Non ISO Station (NA)

| | |
|----------------------|---|
| Actors | FordPass user |
| Pre-conditions | 1. Onboarding has been successfully completed 2. Cloud connectivity is available 3. PnC is Enabled 4. Vehicle is Keyed on, and Center Stack is activated 5. Vehicle Configured for NA Region |
| Scenario Description | Non ISO station, in network station (NA) |
| Post-conditions | 1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM) 2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp) |



| | |
|-----------------------------|---|
| | <ol style="list-style-type: none">3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq (AttemptDgtlComm)5. OBCC starts communication with EVSE6. EVSE informs OBCC that it supports only EIM7. OBCC reports to BCCM that EVSE supports only EIM via DgtlCommGtwyMde_D_St.8. OBCC continues with EIM mode via DgtlCommGtwyMde_D_Rq9. Vehicle Sends an Alert to the Cloud10. User receives a Notification in FordPass that tells "To charge at this station, please use the FordPass." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.8 PNCv1-UC-REQ-335765/B-User Plugs into an Out of Network, ISO Station when PnC is disabled

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated5. Vehicle configured for NA Region/EU Region |
| Scenario Description | User Plug In ISO, Out of network station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq (AttemptDgtlComm)5. OBCC starts communication with EVSE6. EVSE sends leaf certificate with public key to the OBCC Via PLC and Establish TLS communication7. OBCC Authenticates the leaf certificate and Validity of the Public key8. OBCC reports to BCCM that EVSE supports PnC and EIM via DgtlCommGtwyMde_D_St9. Since PnC is Disabled, OBCC continues with EIM mode via DgtlCommGtwyMde_D_Rq10. Vehicle Sends an Alert to the Cloud11. User receives a Notification in FordPass that tells "This charging station is out of the Ford network. To charge here, please plug in again and follow the instructions on the station." |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface |

2.3.2.9 PNCv1-UC-REQ-335766/B-User Plugs into an Non-ISO, Out of network when PnC is disabled

| | |
|--------|---------------|
| Actors | FordPass user |
|--------|---------------|



| | |
|------------------------------------|---|
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated5. Vehicle configured for NA Region/EU Region |
| Scenario Description | User Plug In Non-ISO, Out of network |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq (AttemptDgtlComm)5. OBCC starts communication with EVSE6. EVSE sends leaf certificate with public key to the OBCC Via PLC and Establish TLS communication7. OBCC Authenticates the leaf certificate and Validity of the Public key8. OBCC reports to BCCM that EVSE supports PnC and EIM via DgtlCommGtwyMde_D_St9. Since PnC is Disabled, OBCC continues with EIM mode via DgtlCommGtwyMde_D_Rq10. Vehicle Sends an Alert to the Cloud11. User receives a Notification in FordPass that tells "This charging station is out of the Ford network. To charge here, please follow instructions on the station." |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface |

2.3.2.10 PNCv1-UC-REQ-335767/B-User Plugs into an Non-ISO, In Network (NA) when PnC is disabled

| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated5. Vehicle configured for NA region |
| Scenario Description | User Plug In Non-ISO, In network |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq (AttemptDgtlComm)5. OBCC starts communication with EVSE6. EVSE sends leaf certificate with public key to the OBCC Via PLC and Establish TLS communication7. OBCC Authenticates the leaf certificate and Validity of the Public key8. OBCC reports to BCCM that EVSE supports PnC and EIM via DgtlCommGtwyMde_D_St |



| | |
|-----------------------------|--|
| | <ul style="list-style-type: none">9. Since PnC is Disabled, OBCC continues with EIM mode via DgtlCommGtwyMde_D_Rq10. Vehicle Sends an Alert to the Cloud11. User receives a Notification in FordPass that tells "To charge here, please use the FordPass app". |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface |

2.3.2.11 PNCv1-UC-REQ-335768/B-User Plugs into a Non-ISO, In Network (EU) when PnC is disabled

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ul style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated5. Vehicle configured for EU region |
| Scenario Description | User Plug In Non-ISO, In network |
| Post-conditions | <ul style="list-style-type: none">1. EVSE Wakeup the BCCM with Hardwire Pilot line. (Pilot is a line from connector to BCCM)2. BCCM wakes up OBCC using Hardwire Signal (AuxChrgWakeUp)3. BCCM detects Pilot indicative of digital communications4. BCCM asks OBCC to attempt digital communications via DgtlCommMde_d_Rq (AttemptDgtlComm)5. OBCC starts communication with EVSE6. EVSE sends leaf certificate with public key to the OBCC Via PLC and Establish TLS communication7. OBCC Authenticates the leaf certificate and Validity of the Public key8. OBCC reports to BCCM that EVSE supports PnC and EIM via DgtlCommGtwyMde_D_St9. Since PnC is Disabled, OBCC continues with EIM mode via DgtlCommGtwyMde_D_Rq10. Vehicle Sends an Alert to the Cloud11. User receives a Notification in FordPass that tells "To charge here, please use the FordPass app or your RFID card". |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface |

2.3.2.12 PNCv1-UC-REQ-324841/A-User Plugs into Network ISO station and Payment Subscription Balance is Low (NA)

| | |
|----------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | <ul style="list-style-type: none">Onboarding has Successfully CompletedPnC EnabledUser has SubscriptionCloud Connectivity is AvailableVehicle is key on and Center Stack is Activated |



| | |
|------------------------------------|--|
| Scenario Description | Payment Subscription Balance is Low (NA), When User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and sends eMAID to the Monetization Platform3. Monetization Platform verifies payment method4. Monetization Platform Shall Sends Subscription balance is low to SDN5. SDN Shall Sends a Payment Subscription Balance is low to Vehicle and notification to the FordPass6. Message on Centerstack tells the user "Your charging subscription balance is low. When the balance is exhausted, additional usage will be billed to your FordPay wallet."7. User receives a Notification in FordPass that tells "Your charging subscription balance is low. When the balance is exhausted, additional usage will be billed to your FordPay wallet." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.13 PNCv1-UC-REQ-324851/A-User Plugs into Network ISO station and Payment Subscription Balance is Low (EU)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available Vehicle is key on and Center Stack is Activated |
| Scenario Description | Payment Subscription Balance is Low (EU), When User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and sends eMAID to the Monetization Platform3. Monetization Platform verifies payment method4. Monetization Platform Shall Sends Subscription balance is low to SDN5. SDN Shall Sends a Payment Subscription Balance is low to Vehicle and notification to the FordPass6. Message on Centerstack tells the user "Your charging account balance is low. When the balance is exhausted, you will not be able to start a charging session. Please use the FordPass app to add additional funds to your account."7. User receives a Notification in FordPass that tells "Your charging account balance is low. When the balance is exhausted, you will not be able to start a charging session. Please use the FordPass app to add additional funds to your account." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

**2.3.2.14 PNCv1-UC-REQ-324849/A-User Plugs into Network ISO Station and Charging account is overdue and Charging is suspended (EU)**

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available Vehicle is key on and Center Stack is Activated Configured for EU |
| Scenario Description | Charging account is overdue and Charging is suspended (EU), When the User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and Sends eMAID to the Monetization Platform3. Monetization Platform verifies payment method4. Monetization Platform Shall Sends Charging account is overdue and Charging is suspended to SDN5. SDN Shall Sends Charging account is overdue and Charging is suspended to Vehicle and notification to the FordPass6. Message on Centerstack tells the user "Your charging account is overdue and your account has been suspended. Please pay the bill to reactivate your account."7. User receives a Notification in FordPass that tells "Your charging account is overdue and your account has been suspended. Please pay the bill to reactivate your account." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.15 PNCv1-UC-REQ-324845/A-User Plugs into Network ISO station and Charging account is overdue, but charging is still allowed (EU),

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available Vehicle is key on and Center Stack is Activated Configured for EU |
| Scenario Description | Charging account is overdue, but charging is still allowed (EU), When the User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and Sends eMAID to the Monetization Platform3. Monetization Platform verifies payment method4. Monetization Platform Shall Sends Charging account is Overdue, but Charging is Still allowed to SDN5. SDN Shall Sends Charging account is Overdue, but Charging is Still allowed to Vehicle and notification to the FordPass |



| | |
|------------------------------------|---|
| | <ol style="list-style-type: none">6. Message on Centerstack tells the user “Your charging account is overdue. Please pay the bill to ensure your account remains active.”7. User receives a Notification in FordPass that tells “Your charging account is Overdue. Please pay the bill to ensure your account remains active.” |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.16 PNCv1-UC-REQ-324850/A-User Plugs into Network ISO Station and Payment Balance has run out (EU)

| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available Vehicle is key on and Center Stack is Activated |
| Scenario Description | Payment Subscription balance has run out (EU), When the User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and Sends eMAID to the Monetization Platform3. Monetization Platform verifies payment method4. Monetization Platform Shall Sends Subscription balance has run out to SDN5. SDN Shall Sends to Subscription balance has run out to Vehicle and notification to the FordPass6. Message on Centerstack tells the user “Your charging account balance is not sufficient to start a charging session. Please use the FordPass app to add additional funds to your account.”7. User receives a Notification in FordPass that tells “Your charging account balance is not sufficient to start a charging session. Please use the FordPass app to add additional funds to your account.” |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.17 PNCv1-UC-REQ-324842/A-User Plugs into Network ISO station and Backend system failures (EU)

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available Vehicle is key on and Center Stack is Activated Configured for EU |
| Scenario Description | Backend system failures (EU), When the User Plugs into In Network ISO Station |



| | |
|------------------------------------|--|
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and Sends eMAID to the Monetization Platform3. Monetization Platform Fails to Authenticates eMAID and fails to Verifies Payment Method4. Monetization Platform Shall Sends Failure Response to CPO and SDN5. SDN Shall Sends Backend System Failure to Vehicle and notification to the FordPass6. Message on Centerstack tells the user "There was an error with the transaction. To charge at this station, please plug in again and use FordPass or RFID card. If the error persists, follow the instructions on the charger to activate charging."7. User receives a Notification in FordPass that tells "There was an error with the transaction. To charge at this station, please plug in again and use FordPass or RFID card. If the error persists, follow the instructions on the charger to activate charging." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.18 PNCv1-UC-REQ-320377/A-User Plugs into Network ISO station and Backend system failures (NA)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available Vehicle is key on and Center Stack is Activated |
| Scenario Description | Backend system failures (NA), When the User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and Sends eMAID to the Monetization Platform3. Monetization Platform Fails to Authenticates eMAID and fails to Verifies Payment Method4. Monetization Platform Shall Sends Failure Response to CPO and SDN5. SDN Shall Sends Backend System Failure to Vehicle and notification to the FordPass6. Message on Centerstack tells the user "There was an error with the transaction. To charge at this station, please plug in again and use the FordPass app. If the error persists, follow the instructions on the charger to activate charging."7. User receives a Notification in FordPass that tells "There was an error with the transaction. To charge at this station, please plug in again and use the FordPass app. If the error persists, follow the instructions on the charger to activate charging." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

**2.3.2.19 PNCv1-UC-REQ-320378/B-Failure Corrected, Then Charging Begins Successfully While Centerstack is off**

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available User has Plugged In at Any EVSE Vehicle is Turn off and Center stack is deactivated Any Failure occurred after user Plugged In |
| Scenario Description | Failure Corrected, Then Charging Begins Successfully While Centerstack is off |
| Post-conditions | <ol style="list-style-type: none">1. The Failure Message Shall Sends Both APIM and FordPass2. When the Vehicle is turnoff, The User sees the Failure message in FordPass and Correct the issue and Vehicle Starts Charging Successfully3. Once Charging begins Successfully and Sync will Clear failure message Notifications on Center stack in next ignition cycle |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.3.2.20 PNCv1-UC-REQ-324840/A-User Plugs into Network ISO station and Payment Balance has run out (NA)

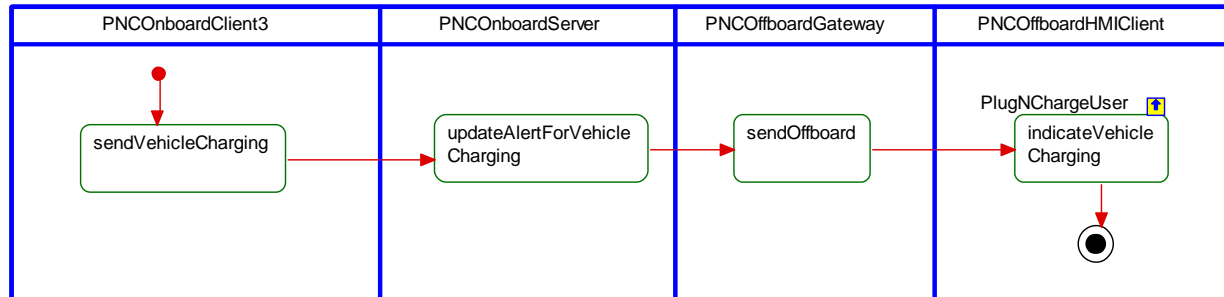
| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available Vehicle is key on and Center Stack is Activated |
| Scenario Description | Payment Subscription balance has run out (NA), When the User Plugs into In Network ISO Station |
| Post-conditions | <ol style="list-style-type: none">1. EVSE Authorized the Contract Certificates and Sends eMAID to Mobility Operator2. Mobility operator authorizes eMAID and Sends eMAID to the Monetization Platform3. Monetization Platform verifies payment method4. Monetization Platform Shall Sends Subscription balance has run out to SDN5. SDN Shall Sends to Subscription balance has run out to Vehicle and notification to the FordPass6. Message on Centerstack tells the user "You have exhausted your charging subscription balance. Transactions will be billed to your FordPay wallet until the next renewal period."7. User receives a Notification in FordPass that tells "You have exhausted your charging subscription balance. Transactions will be billed to your FordPay wallet until the next renewal period." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |



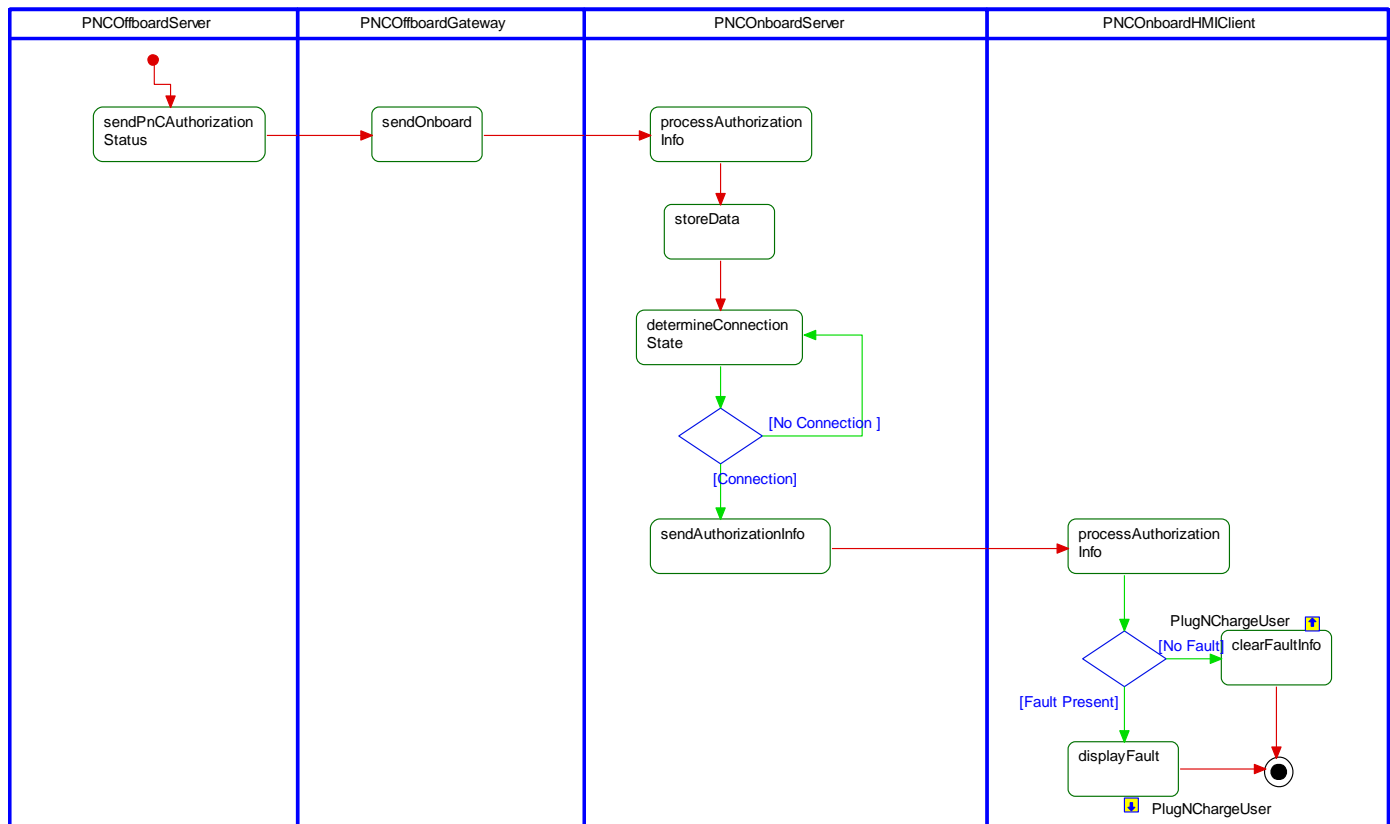
2.3.3 White Box Views

2.3.3.1 Activity Diagrams

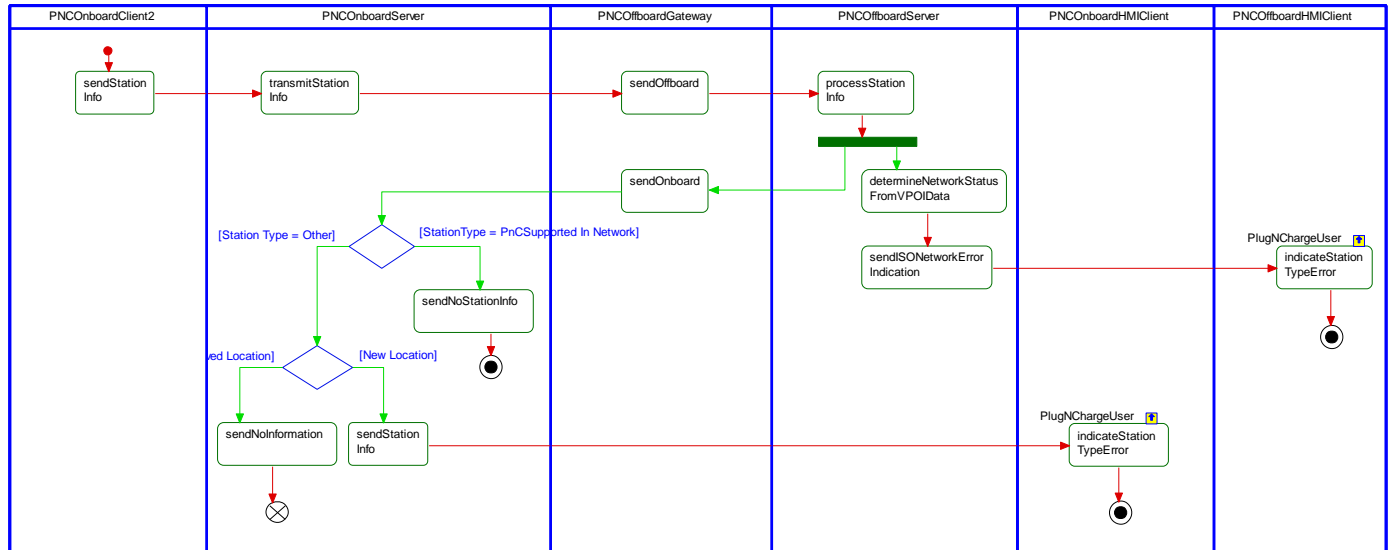
2.3.3.1.1 PNC-ACT-REQ-326581/A-Plug In and Charge Begin



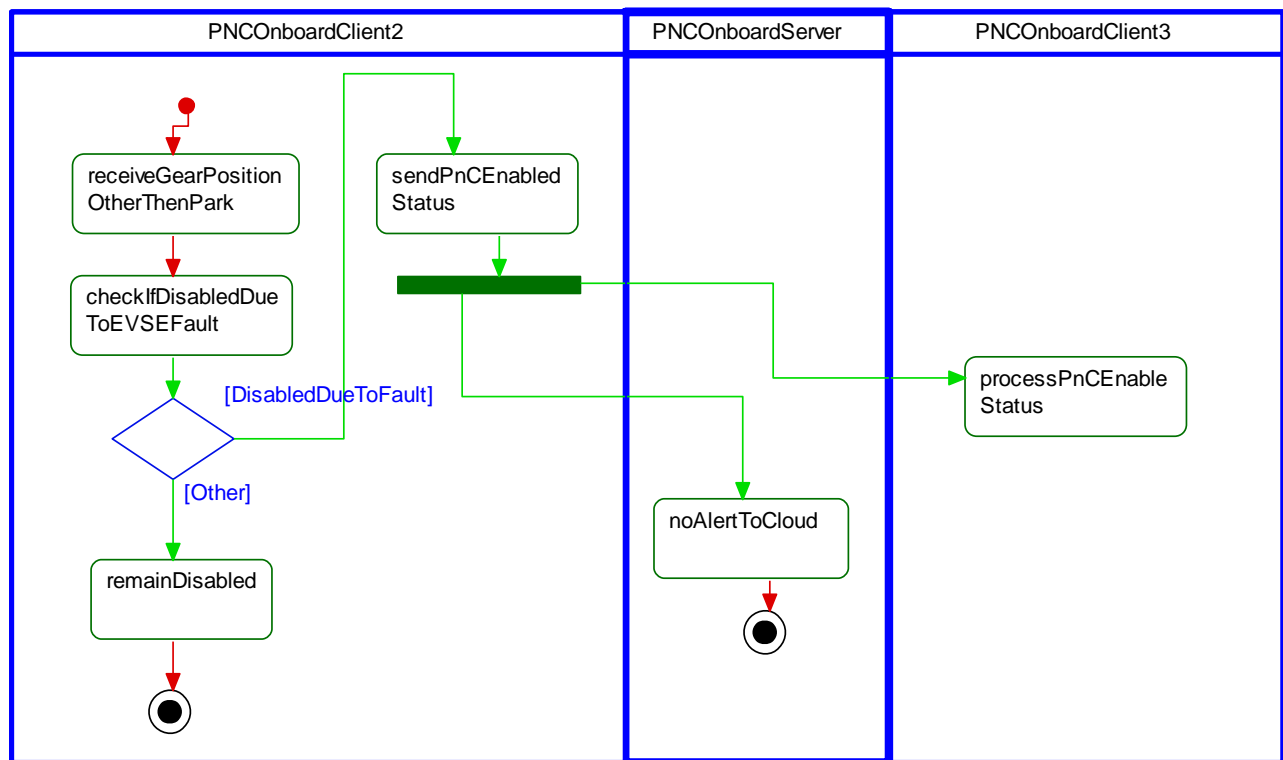
2.3.3.1.2 PNC-ACT-REQ-329240/A-Plug In And Charge Authorization Failures



2.3.3.1.3 PNC-ACT-REQ-330591/B-Charge Station Network and ISO Errors

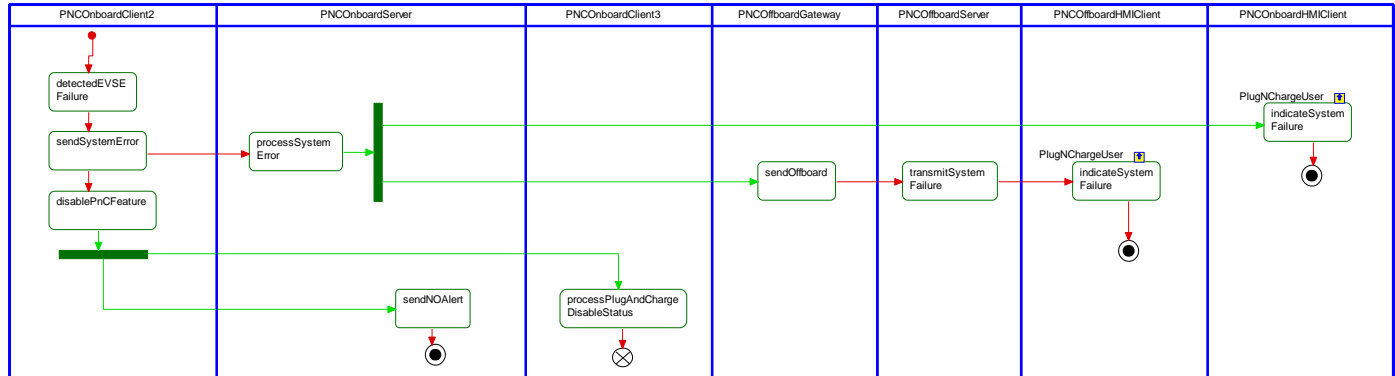


2.3.3.1.4 PNC-ACT-REQ-330592/B-Enable PnC Once Vehicle is Shifted Out of Park

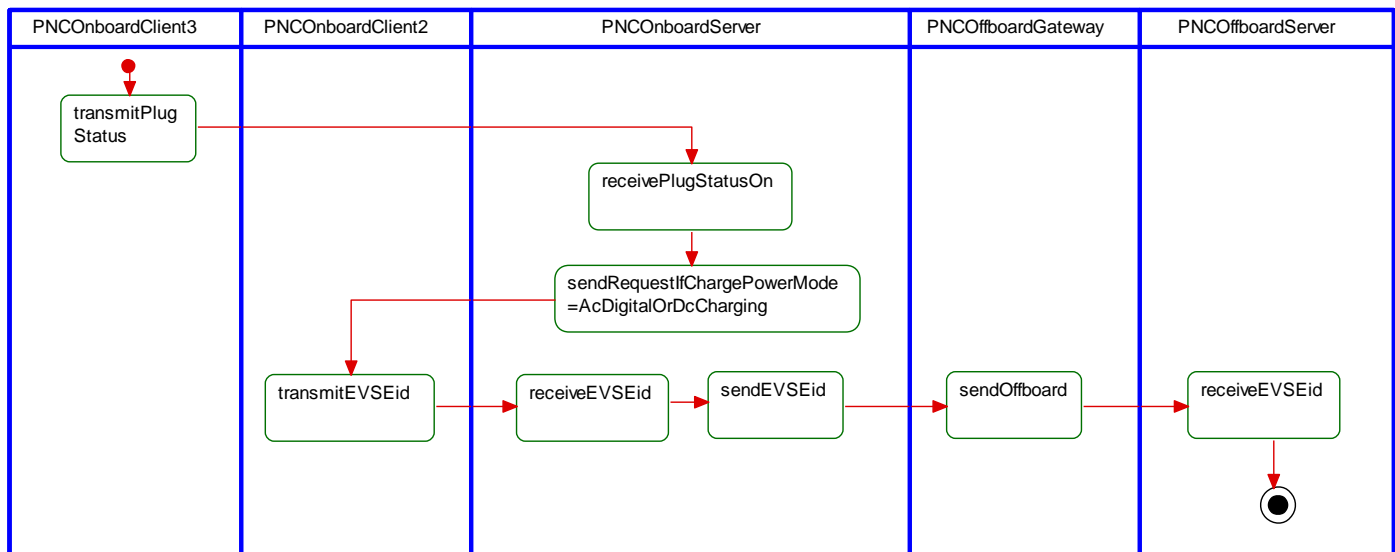




2.3.3.1.5 PNC-ACT-REQ-330593/B-Plug In and EVSE Failure



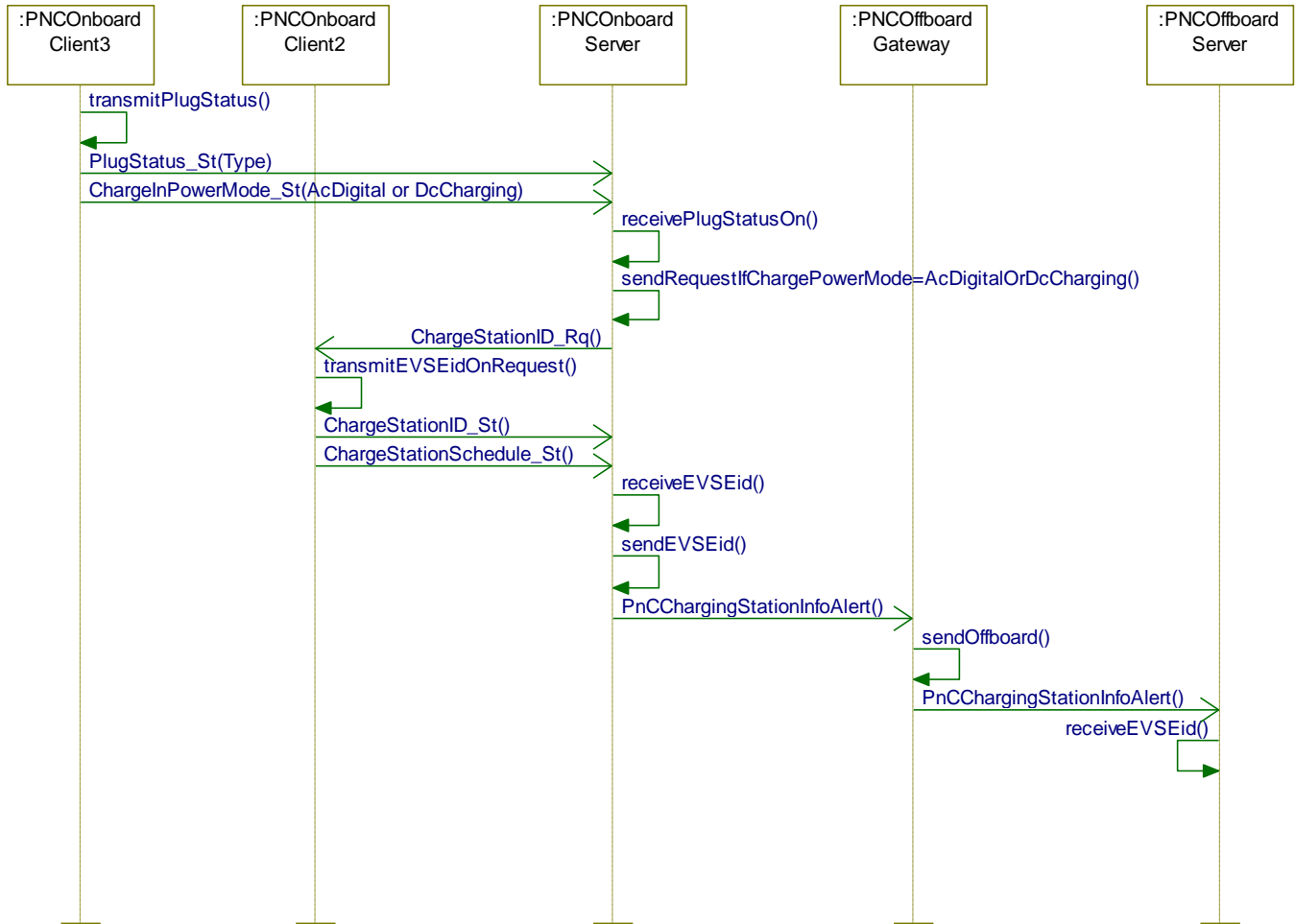
2.3.3.1.6 PNC-ACT-REQ-330594/B-Plugged In and Charging Has Not Begun Transmit EVSEid





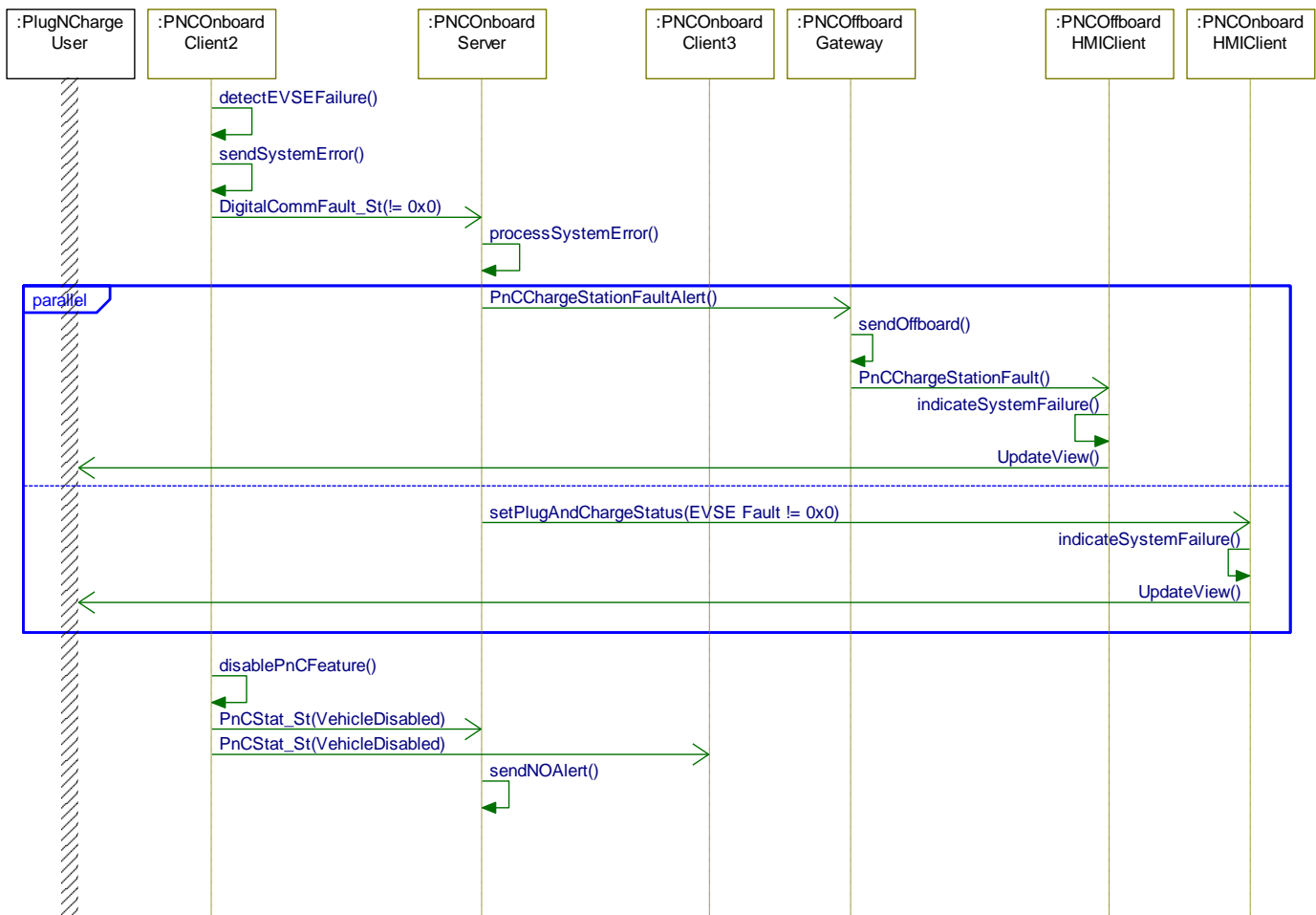
2.3.3.2 Sequence Diagrams

2.3.3.2.1 PNC-SD-REQ-330599/B-Plugged In and Charging Has Not Started Transmit EVSEid



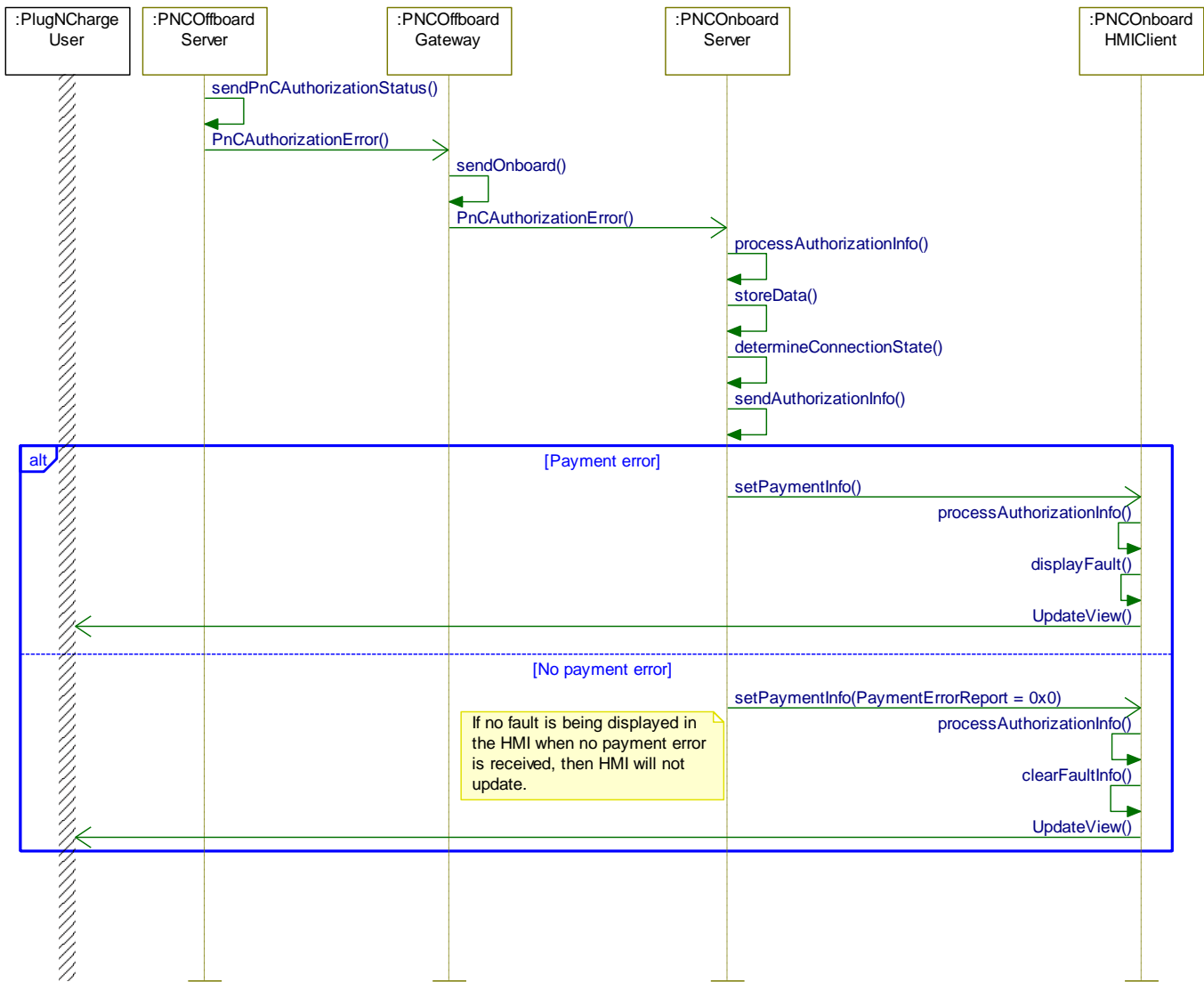


2.3.3.2.2 PNC-SD-REQ-326580/B-Plug in and Charge Failed to Begin



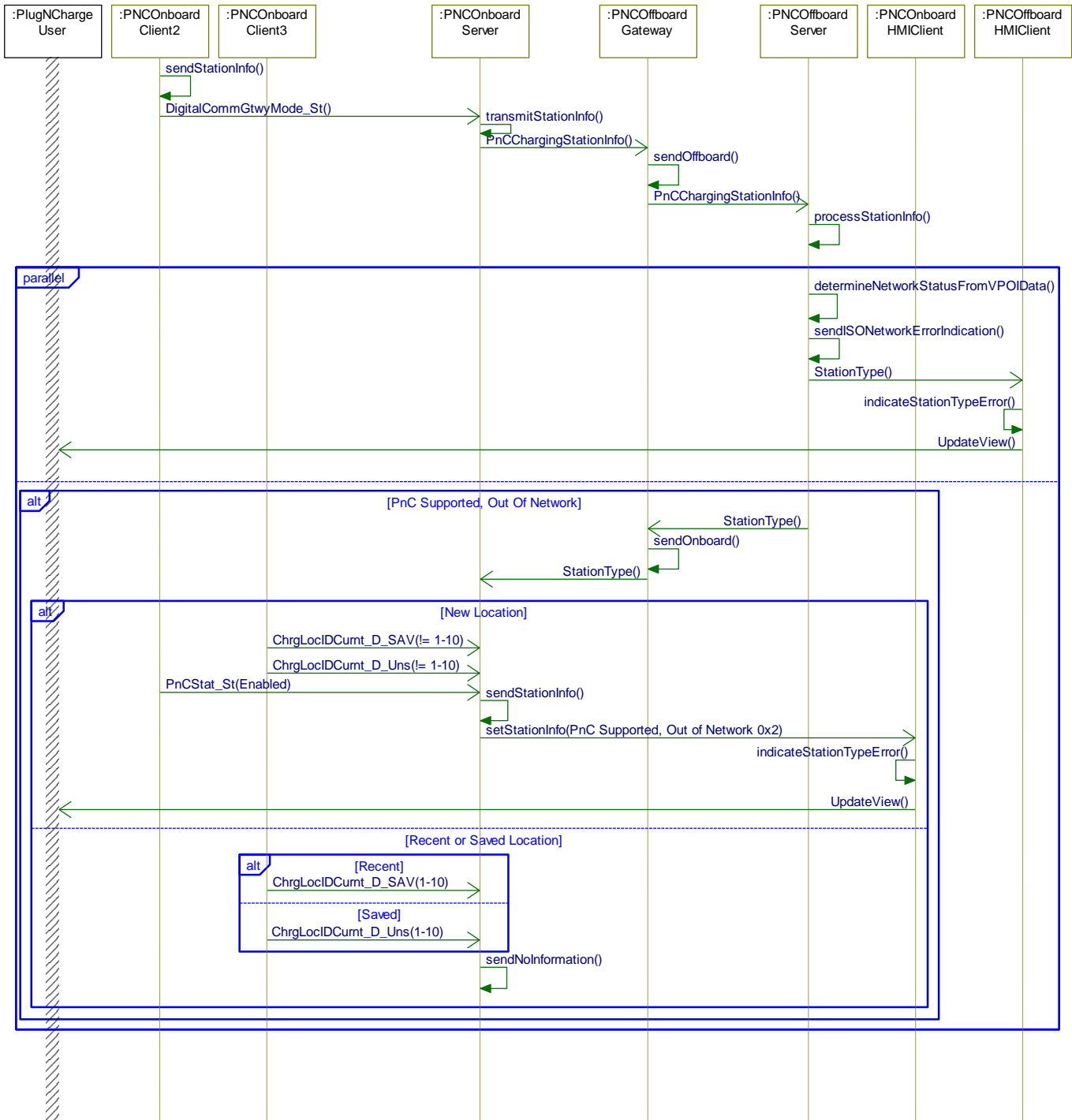


2.3.3.2.3 PNC-SD-REQ-329239/B-Plug In and Plug Authorization Failures



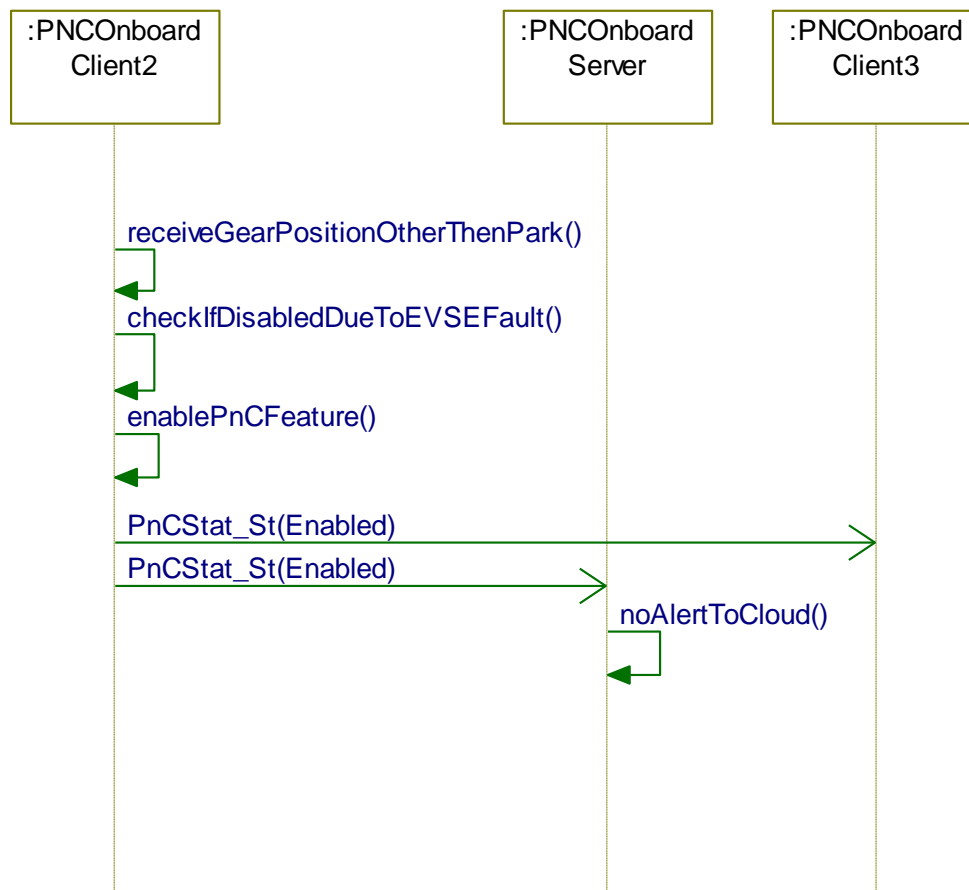


2.3.3.2.4 PNC-SD-REQ-330597/C-Charge Station ISO and Network Errors





2.3.3.2.5 PNC-SD-REQ-330598/B-Enable PnC Once Vehicle is Shifted Out of Park



2.4 PNC-FUN-REQ-324747/A-Charge Complete

2.4.1 Requirements

2.4.1.1 PNC-REQ-326849/A-Charge Complete

When the vehicle reaches target charge, as defined in the EV settings, or the user unplugs, the following will occur:

- User receives notification/status in vehicle
- User receives notification via FordPass
- Trip & Charge Log is updated

2.4.1.2 PNC-REQ-326850/D-Charge Complete - In Vehicle

The following information shall be displayed in vehicle HMI with units after the user unplugs:

8 second auto-dismiss messages (no sound alert)

- SOC (Percentage)
- Total time Plugged In (Seconds)
- Total distance added (Miles/Kilometers, based on the user setting in the Centerstack)
- Total cost for the charging session (USD, EUR..., kWh a string value from the cloud and no translation is required)
- Balance on subscription, if user has subscription (capped subscription balance remaining [kWh] or stored value monetary value)



Display receipt without cost and balance information if charging cost and balance are not received as of key-on. Display with cost and balance information if data received by CMS as of key-on.

If charging cost has not been received by the APIM at key-on, cost and balance will be displayed as "Not yet available" (even if the most recent balance value is available, balance will be displayed as "not yet available" because the balance does not yet reflect the recent charging session.)

A note will be included at the end of the receipt if the charging session cost information is not available: "Charging cost and updated balance information will generally be available in FordPass within 24 hours after the charging event."

ECG Rule:

- If ECG receives PnCStationType command from the cloud with any of this 0x1: PnC capable, in network 0x2: PnC capable, out of network, 0x3: non PnC capable, in network, 0x4: non PnC capable, out of network we can assume charging station is Public charging station and ECG shall aggregate Charging complete data and Payment receipt in the charging receipt message and send to the Vehicle HMI via SOA API at vehicle ignition-on.

- ECG shall store PnCStationType command for one ignition cycle.

Edge case:

- If ECG don't receives PnCStationType command from the cloud at ignition-on we can assume it is private charging station ECG don't send charging receipt message to vehicle HMI.

- If ECG receives ChargeSummaryCommand from the cloud at private charging station don't show payment info in Vehicle HMI.

- When PlgActvArb_B_Actl changes from on-Plug to off-Plug AND a charge event has occurred, the ECG will aggregate the payment receipt and charge complete data:
 - BattTracSoc_Pc_Dsply to capture SOC
 - Total distance added will be calculated in the ECG by VehElRnge_L_Dsply (after charge) - VehElRnge_L_Dsply (before charge) at vehicle unplugs from the charger.
 - Total time Plugged In will be captured by calculating time from PlgActvArb_B_Actl = 0x1: On Plug (Connected) to PlgActvArb_B_Actl = 0x0: Off Plug (Disconnected)
 - ECG shall send a PnCChargeComplete alert which includes Total distance added, Total time Plugged In and SOC shall be calculated by ECG PnC app for every charging event When the Vehicle Unplugged.
 - The following information shall be captured by ChargeSummary command from the cloud
 - 0x1 = Total Cost of Charge
 - 0x2 = Balance on Subscription
 - 0x3 = Charging Session cost info not available (Charging cost and updated balance information will generally be available in FordPass within 24 hours after the charging event)
 - 0x4: CurrencyType (string)

2.4.2 Use Cases**2.4.2.1 PNCv1-UC-REQ-324852/B-Charging Completed Successfully**

| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. User Plugs into public charging station that is contained in VPOI data4. Vehicle is Unplugged5. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | PnC Charge Complete Successful |



| | |
|------------------------------------|--|
| Post-conditions | Vehicle Sends Alert to the SDN with SOC, Total time Plugged In and total distance added Charge Point Operator Sends Charge Event Data to Mobility Operator Mobility Operator Sends Charge Event Data to Monetization Platform Monetization Platform Calculates Cost of Charge/Update Subscription Balance Monetization Platform Sends Payment Info to SDN SDN Shall Sends Payment Summary to Vehicle The Centerstack HMI Displays the following information: <ul style="list-style-type: none">- Charge is Complete/SOC- Total Cost- Total time Plugged In- Total Distance added- Balance on Subscription, if user has subscription SDN Shall Sends a Notification to FordPass In FordPass, Following will be added to existing Trip and Charge logs <ul style="list-style-type: none">- Total Cost of Charging- Total Distance added- Total time Plugged In- Balance on Subscription (If user has Subscription) |
| List of Exception Use Cases | |
| Interfaces | Vehicle System interface HMI |

2.4.2.2 PNCv1-UC-REQ-330860/C-PnC Charge Summary Delay/Failed

| | |
|-----------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. User Plugs into public charging station that is contained in VPOI data4. Vehicle is Unplugged5. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | PnC Charge Complete Successful, Charging Session Cost information is not Available at Key-on. |
| Post-conditions | <ol style="list-style-type: none">1. Vehicle Sends Alert to the SDN with SOC, Total time Plugged In and total distance added2. Charge Point Operator Sends Charge Event Data to Mobility Operator3. Mobility Operator Delay to Sends Charge Data Record to Ford Monetization Platform4. Monetization Platform fails to Calculates Cost of Charge/Update Subscription Balance before vehicle key on.5. The Centerstack HMI Displays the following information:<ul style="list-style-type: none">- Charge is Complete/SOC- Total Cost- Total time Plugged In- Total Distance added- "Charging cost and updated balance information will generally be available in FordPass within 24 hours after the charging event."6. SDN Shall Sends a Notification to FordPass7. In FordPass, Following will be added to existing Trip and Charge logs<ul style="list-style-type: none">- Total Cost of Charging- Total Distance added- Total Time Plugged In |

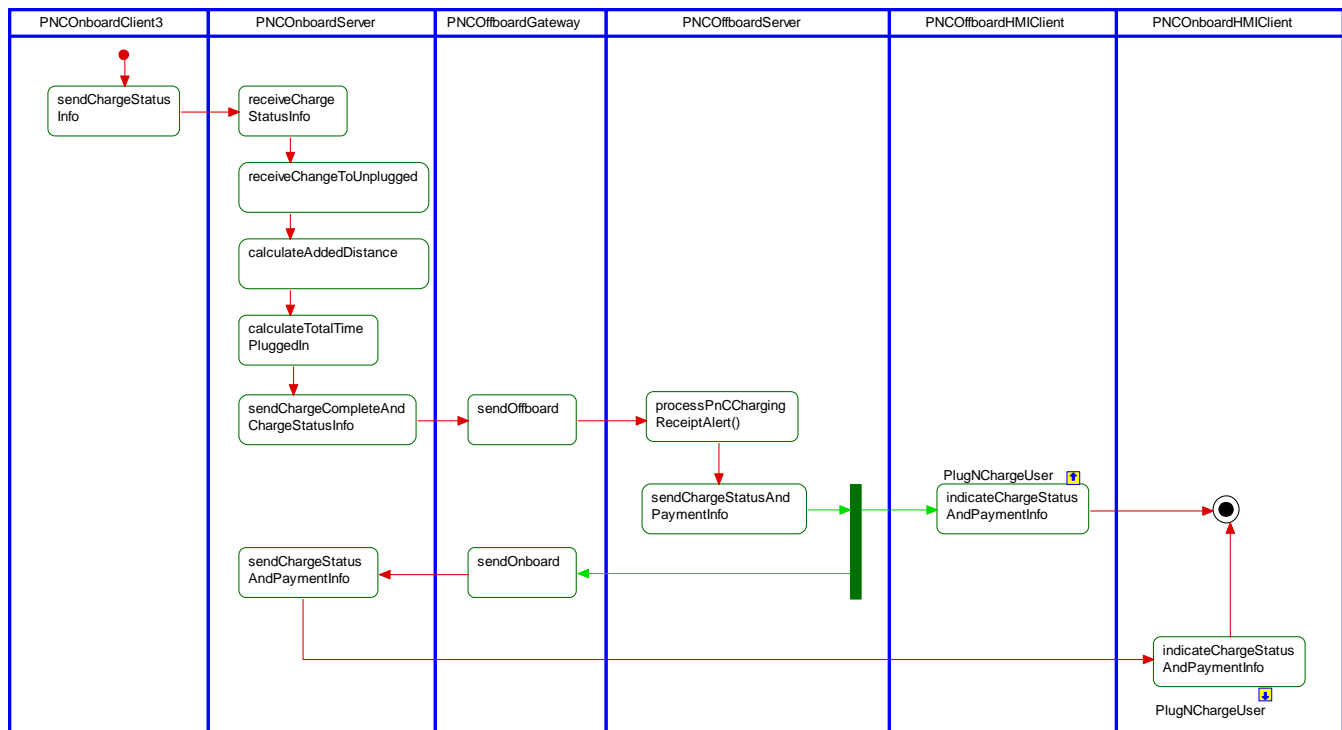


| | |
|-----------------------------|---|
| | - "Charging cost and updated balance information will generally be available in FordPass within 24 hours after the charging event." |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface, Offboard interface, Centerstack HMI |

2.4.3 White Box Views

2.4.3.1 Activity Diagrams

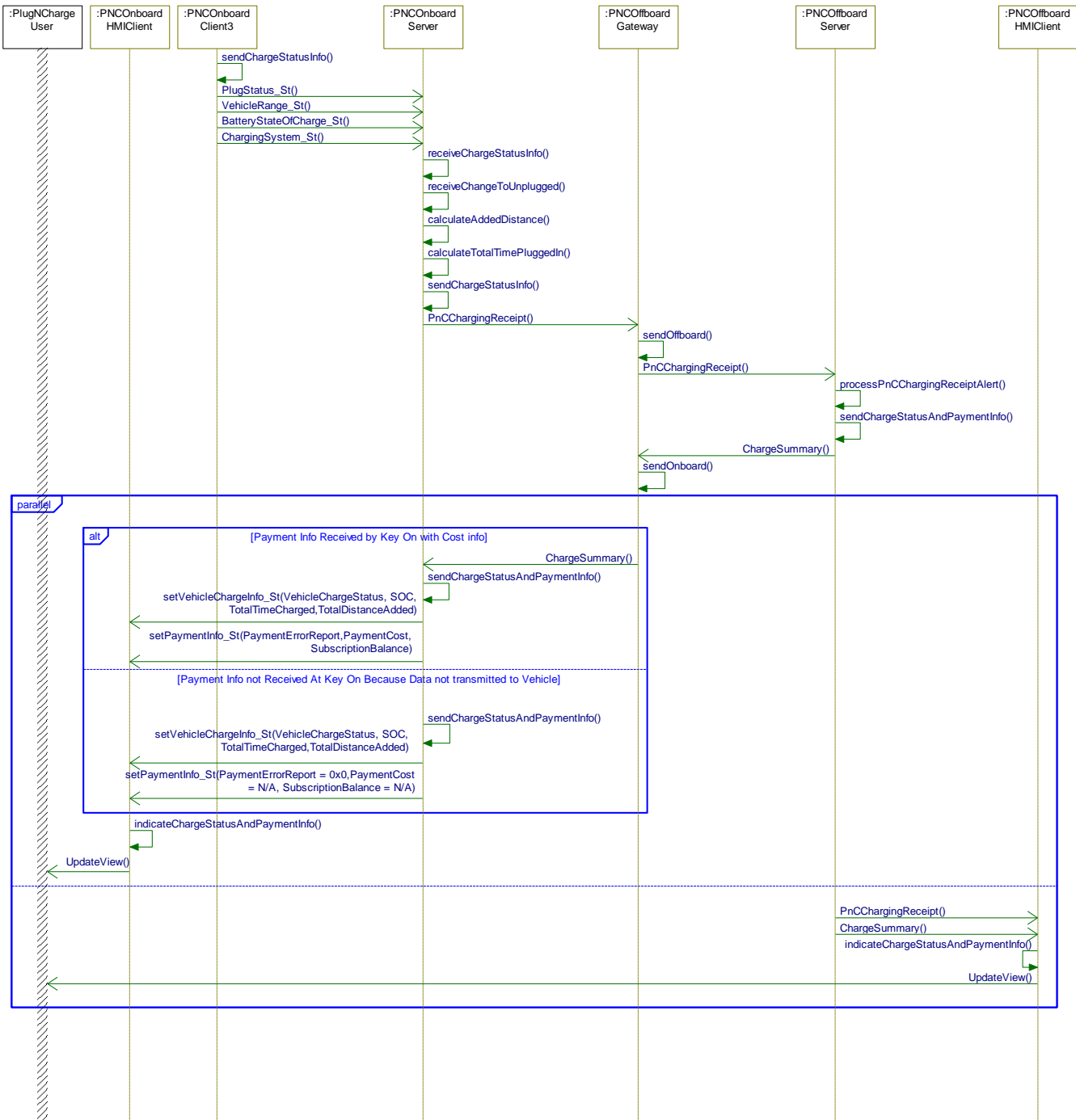
2.4.3.1.1 PNC-ACT-REQ-326582/B-Charging Complete





2.4.3.2 Sequence Diagrams

2.4.3.2.1 PNC-SD-REQ-326575/B-Charge Complete



2.5 PNC-FUN-REQ-324755/A-Disabling and Re-Enabling Plug and Charge

2.5.1 Requirements

2.5.1.1 PNC-REQ-330759/B-Notifications for Plug and Charge Status Change

HMI Rule:

8 second auto-dismiss messages (no sound alert)



| Reason for Notification | Region (NA/EU/Both) | In Vehicle status/notification | FordPass Notification | Sample message | |
|---|---------------------|--------------------------------|-------------------------|---|--|
| Plug & Charge setup or re-enable successful | Both | Success message displayed | Notification sent to FP | "Plug & Charge is now active on this vehicle. When you plug in to a Plug & Charge-enabled station in the Ford network, charging will start automatically and your charging account will be billed." | Plug & Charge is now active on this vehicle. Charging will now start automatically when you plug in to a Plug & Charge-enabled station in the Ford network, and your account will be billed. |
| Plug & Charge setup or re-enable failed | Both | Not displayed | Notification sent to FP | [Notification to be written by FordPass designers] | |
| Plug & Charge disable was successful | EU | Success message displayed | Notification sent to FP | "Plug & Charge is no longer active on this vehicle. Please use FordPass or RFID card to charge at stations in the Ford network." | Plug & Charge is no longer active on this vehicle. Please use the FordPass app or your RFID card to charge at stations in the Ford network. |
| Plug & Charge disable was successful | NA | Success message displayed | Notification sent to FP | "Plug & Charge is no longer active on this vehicle. Please use the FordPass app to charge at stations in the Ford network." | Plug & Charge is no longer active on this vehicle. Please use the FordPass app to charge at stations in the Ford network. |
| Plug & Charge disable failed | Both | Not displayed | Notification sent to FP | [Notification to be written by FordPass designers] | |

2.5.1.2 PNC-REQ-330377/C-Disabling PnC

The Cloud will send a SyncP Disable Payload Command to turn off PnC in the Vehicle when the user disables via FordPass.

ECG:

OptOutPnC Command with SyncP Payload is received by the ECG, ECG sends to OBCC via SyncP Diagnostic Routine

OBCC:

After Completing the PnC Disable Service Request by SyncP Request, OBCC Shall Disable the PnC Feature and Sends a Positive SyncP Diagnostic Response with a Payload of a SyncP Packet and DgtlCommPnc_D_Stat with Disable State to ECG

ECG:

SUCCESS:

ECG Receives SyncP response from OBCC module and Sends Encrypted SyncP Response as an "OptOutPnC Alert" to the Cloud AND

IF DgtlCommPnc_D_Stat changes from enabled to disabled



THEN send PnCFeatureStatus alert to the Cloud with DgtlCommPnc_D_Stat state
(FordPass Notification: "Plug & Charge disable was successful")

Retry Strategy:

ECG shall do Retry 3 times if SyncP Request Diagnostic Routine timeout or fail to Receive Command Response after 10 sec and 10s will be calibrated value.

In-Vehicle HMI notification:

The user will receive a notification in the Vehicle HMI if the disabling PnC was successful.
Shown in vehicle ONLY if successful; no message for failure

APIM:

- IF DgtlCommPnc_D_Stat changes from enable to Disable, indicating PnC been disabled in the vehicle SYNC shall detect Signal Change and display "Plug & Charge disable" notification to the user in the Vehicle HMI by subscribing to the ECG's VIM CAN signals directly.
- SYNC shall Persist last received CAN Signal value and compare with new incoming CAN Signal value upon every vehicle Key-on events.

2.5.1.3 *PNC-REQ-330378/D-Re-Enabling PnC*

The Cloud will send a SyncP Enable Payload Command to turn off PnC in the Vehicle when the user enables via FordPass. When contract certificates are already installed in the vehicle (as determined by the Cloud):

ECG:

OptnPnC Command with SyncP Payload is received by the ECG, ECG sends to OBCC via SyncP Diagnostic Routine.

OBCC:

After Completing the PnC Enable Service Request by SyncP Request, OBCC Shall Enable the PnC Feature and Sends a Positive SyncP Diagnostic Response with a Payload of a SyncP Packet and DgtlCommPnc_D_Stat with Enable State to ECG

ECG:

SUCCESS:

ECG Receives SyncP response from OBCC module and sends Encrypted SyncP Response as an "OptnPnC Alert" to the Cloud AND

IF DgtlCommPnc_D_Stat changes from Disabled to Enabled

THEN send PnCFeatureStatus alert to the Cloud with DgtlCommPnc_D_Stat state
(FordPass Notification: "Plug & Charge Enable was successful")

Retry Strategy:

ECG shall do Retry 3 times if SyncP Request Diagnostic Routine timeout or fail to Receive Command Response after 10 sec and 10s will be calibrated value.

APIM:

- IF state of signal changes from any other values to DgtlCommPnc_D_Stat = Enable, indicating PnC is now enabled in-vehicle SYNC shall detect Signal Change and display "Plug & Charge Enable" notification to the user in the Vehicle HMI by subscribing to the ECG's VIM CAN signals directly.
- SYNC shall Persist last received CAN Signal value and compare with new incoming CAN Signal value upon every vehicle Key-on events.

2.5.2 Use Cases

2.5.2.1 *PNCv1-UC-REQ-324854/B-Plug and Charge Re-Enabling*

| | |
|-----------------------|---|
| Actors | FordPass user |
| Pre-conditions | 1. Onboarding has been successfully completed |



| | |
|------------------------------------|--|
| | <ol style="list-style-type: none">2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Re-enabling |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Cloud will Check Whether Contract Certs are installed in vehicle3. If yes, Cloud Sends PnC Enable Command with SyncP Payload to the vehicle's ECG4. ECG Sends PnC Enable SyncP Payload to OBCC via SyncP Request Diagnostic Routine5. OBCC enable PnC and Send PnC Feature status signal to BCCM and ECG6. ECG Sends PnC Enable response to APIM and backend7. Message on Centerstack tells user "Plug & Charge is now active on this vehicle. When you plug in to a Plug & Charge-enabled station in the Ford network, charging will start automatically and your charging account will be billed."8. Vehicle Sends an Alert to the Cloud9. User receives a Notification in FordPass that tells "Plug & Charge is now active on this vehicle. When you plug in to a Plug & Charge-enabled station in the Ford network, charging will start automatically and your charging account will be billed." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.5.2.2 PNCv1-UC-REQ-324855/A-Plug and Charge Re-Enabled - No Ford Pass To Cloud Connectivity

| | |
|------------------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Re-enabling, No FordPass to Cloud Connectivity |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Command in Progress for 120 sec in FordPass3. FordPass receives PnC enable failure Notification |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.5.2.3 PNCv1-UC-REQ-324856/A-Plug and Charge Re-Enabled - No Cloud to Vehicle Connectivity

| | |
|---------------|---------------|
| Actors | FordPass user |
|---------------|---------------|



| | |
|------------------------------------|--|
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Re-enabling, No Cloud to Vehicle Connectivity |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Cloud receives the Command and failed to connect Vehicle, Command times out after 90 sec3. FordPass receives PnC enable failure Notification |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.5.2.4 PNCv1-UC-REQ-324857/B-Plug and Charge Re-Enabled - Downstream Module Error

| | |
|------------------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Re-enabling, Downstream module error |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Enable Command to the Cloud2. Cloud will Check Whether Contract Certs are installed in vehicle3. If yes, Cloud Sends PnC Enable Command to vehicle's ECG4. Vehicle ECG/OBCC fails to process PnC Enable Command5. Vehicle Sends failure alert to Cloud6. FordPass receives PnC enable failure notification |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.5.2.5 PNCv1-UC-REQ-325313/B-Plug and Charge is Disable (EU)

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Enabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Disable (EU) |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Disable Command to the Cloud2. Cloud Sends PnC Disable Command with SyncP Payload to the vehicle's ECG3. ECG Sends PnC Disable SyncP Payload to OBCC via SyncP Request Diagnostic Routine4. OBCC Disables PnC and Send PnC Feature status signal to BCCM and ECG5. ECG Sends PnC Disable response to APIM and backend |



| | |
|-----------------------------|--|
| | <ol style="list-style-type: none">6. Message on Centerstack tells user "Plug & Charge is no longer active on this vehicle. Please use FordPass or RFID card to charge at stations in the Ford network."7. Vehicle Sends an Alert to the Cloud8. User receives a Notification in FordPass that tells "Plug & Charge is no longer active on this vehicle. Please use FordPass or RFID card to charge at stations in the Ford network." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.5.2.6 PNCv1-UC-REQ-325314/B-Plug and Charge is Disable (NA)

| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Enabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Disable (NA) |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Disable Command to the Cloud2. Cloud Sends PnC Disable Command with SyncP Payload to the vehicle's ECG3. ECG Sends PnC Disable SyncP Payload to OBCC via SyncP Request Diagnostic Routine4. OBCC Disables PnC and Send PnC Feature status signal to BCCM and ECG5. ECG Sends PnC Disable response to APIM and backend6. Message on Centerstack tells user "Plug & Charge is no longer active on this vehicle. Please use the FordPass app to charge at stations in the Ford network."7. Vehicle Sends an Alert to the Cloud8. User receives a Notification in FordPass that tells "Plug & Charge is no longer active on this vehicle. Please use the FordPass app to charge at stations in the Ford network." |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.5.2.7 PNCv1-UC-REQ-325316/A-Plug and Charge is Disable - No Ford Pass to Cloud Connectivity

| | |
|----------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Disabling, No FordPass to Cloud Connectivity |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Disable Command to the Cloud |



| | |
|------------------------------------|--|
| | <ol style="list-style-type: none">2. Command in Progress for 120 sec in FordPass3. FordPass receives PnC Disable failure Notification |
| List of Exception Use Cases | |
| Interfaces | Vehicle HMI, Vehicle interface |

2.5.2.8 PNCv1-UC-REQ-325317/A-Plug and Charge is Disable - No Cloud to Vehicle Connectivity

| | |
|------------------------------------|--|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Disable, No Cloud to Vehicle Connectivity |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Disable Command to the Cloud2. Cloud receives the Command and failed to connect Vehicle, Command times out after 90 sec3. FordPass receives PnC Disable failure Notification |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface |

2.5.2.9 PNCv1-UC-REQ-325318/B-Plug and Charge is Disable - Downstream Module Error

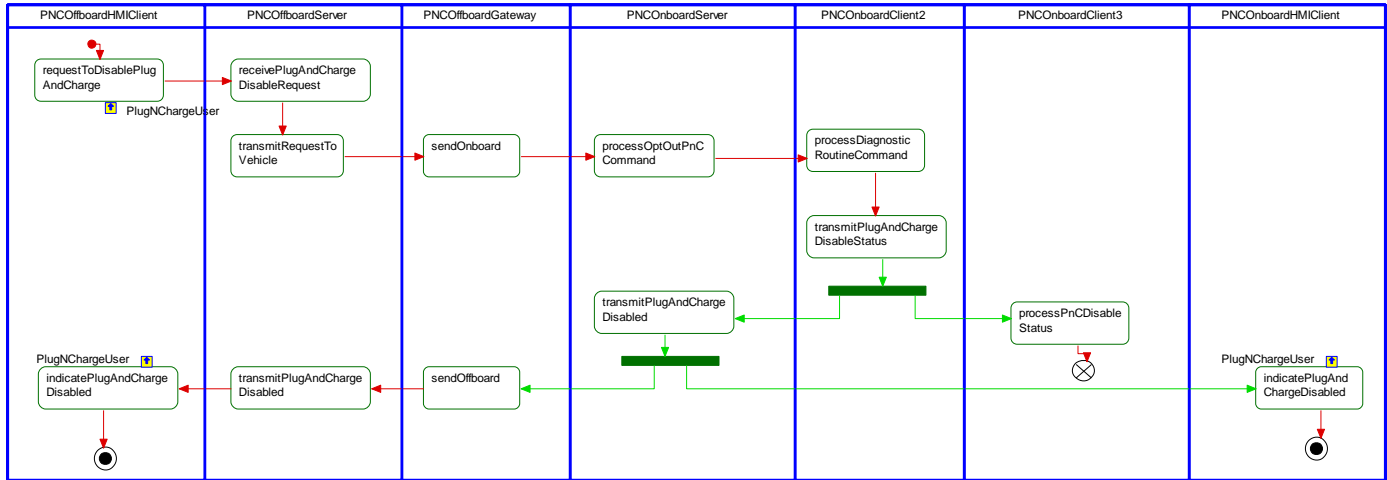
| | |
|------------------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Disabled4. Vehicle is Keyed on, and Center Stack is activated |
| Scenario Description | Plug and Charge Disable, Downstream module error |
| Post-conditions | <ol style="list-style-type: none">1. FordPass Sends a PnC Disable Command to the Cloud2. Cloud Sends PnC Disable Command to vehicle's ECG3. Vehicle ECG/OBCC fails to process PnC Disable Command4. Vehicle Sends failure alert to Cloud5. FordPass receives PnC Disable failure notification |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface |



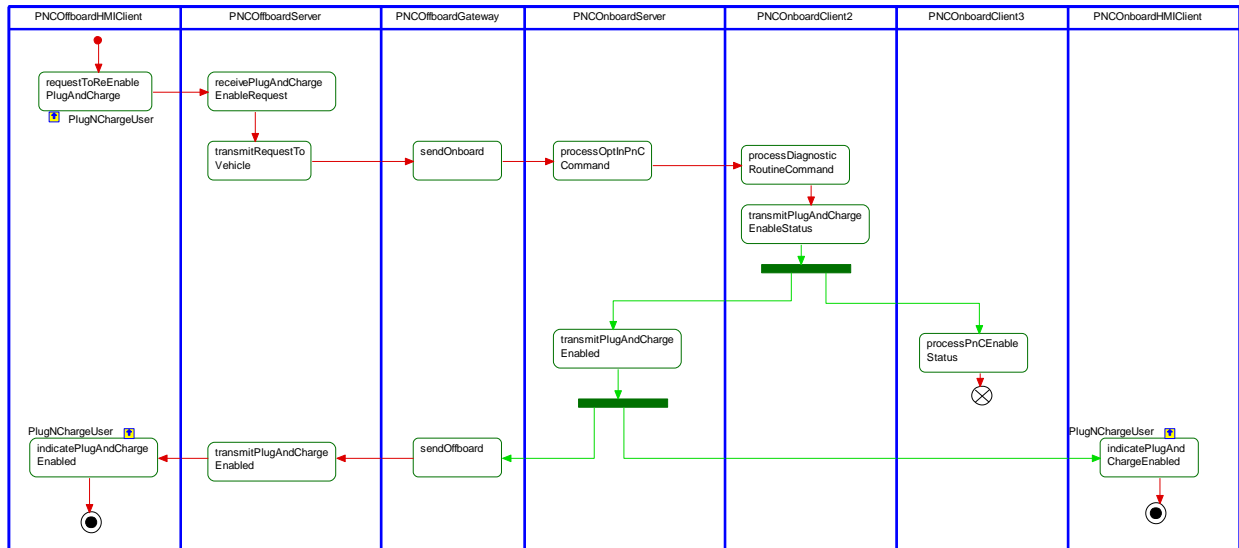
2.5.3 White Box Views

2.5.3.1 Activity Diagrams

2.5.3.1.1 PNC-ACT-REQ-326554/B-Disabling Plug and Charge



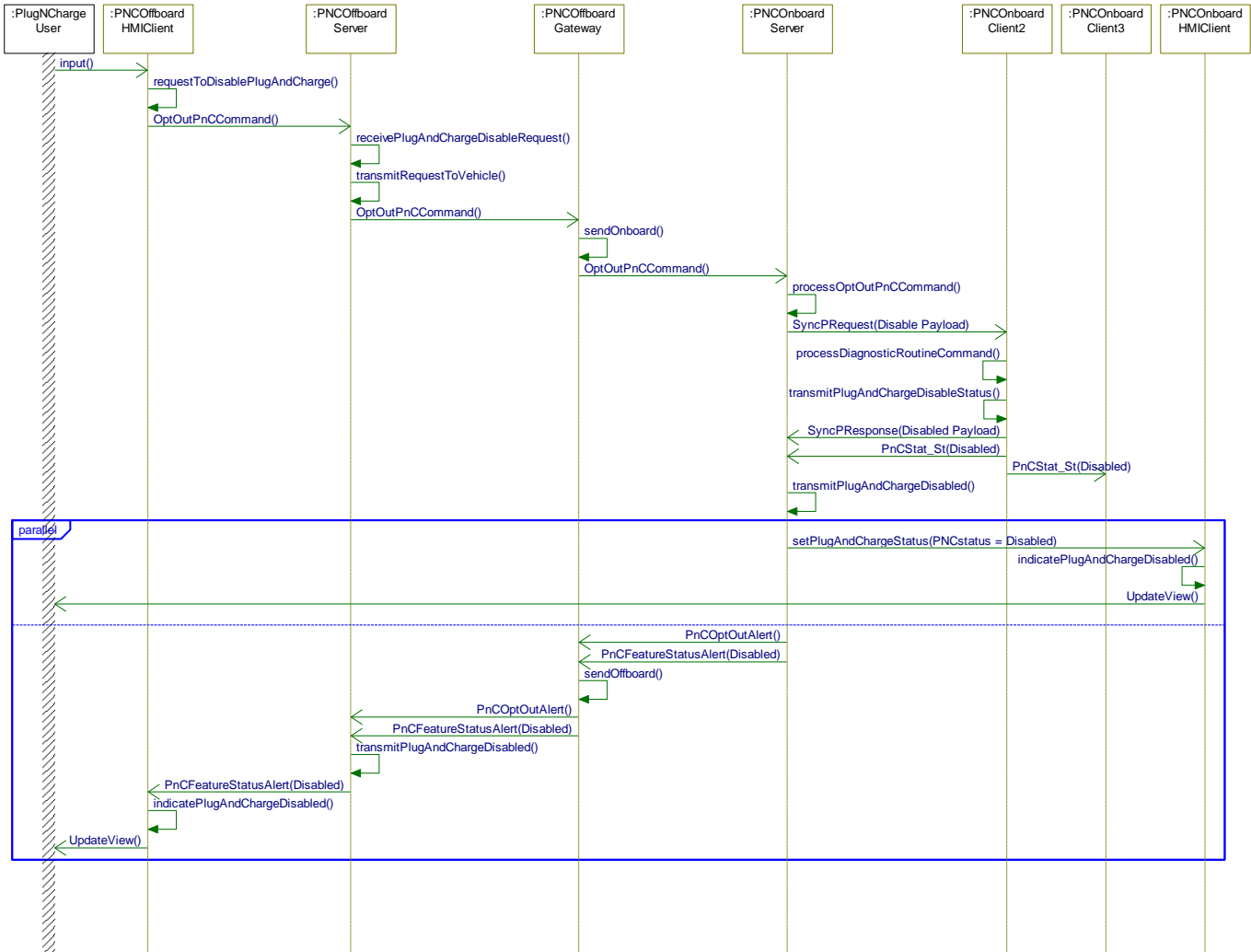
2.5.3.1.2 PNC-ACT-REQ-326555/B-Re-Enabling Plug and Charge





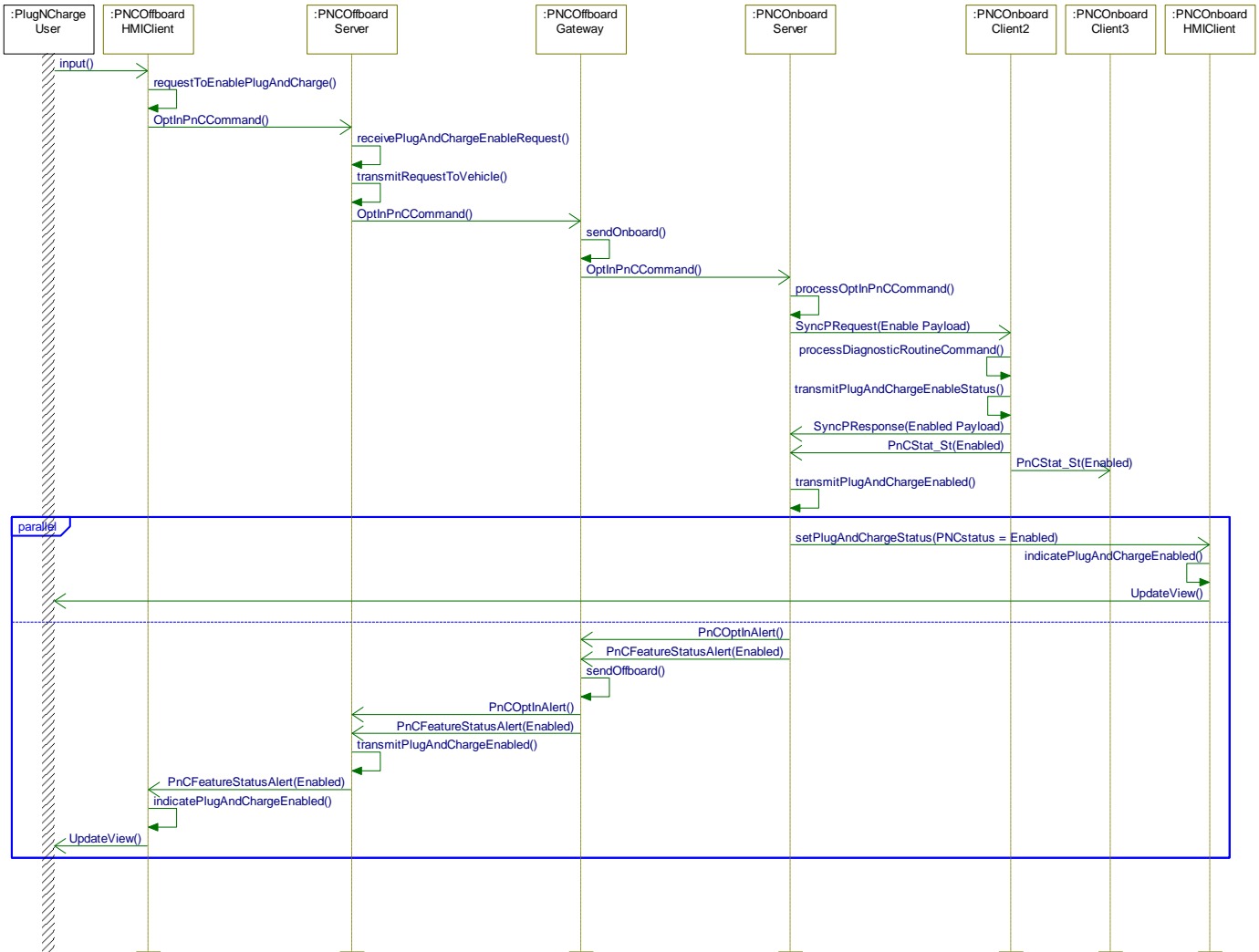
2.5.3.2 Sequence Diagrams

2.5.3.2.1 PNC-SD-REQ-326553/B-Disabling Plug and Charge





2.5.3.2.2 PNC-SD-REQ-326556/B-Re-Enabling Plug and Charge



2.6 PNC-FUN-REQ-326626/A-Managing Expired Contract Certificates

2.6.1 Requirements

2.6.1.1 PNC-REQ-326853/B-Managing Expired Contract Certifications - Success

Once installed in the vehicle, the maximum length of time contract certificates can be valid for is 2 years, according to the ISO standard. The cloud will store and track the expiration date of the contract certificate. One month before the contract certificate expires, the cloud will initiate a command to install new certificates and delete the expired ones.

If successful, the user is not notified, as this is a background process.

Installing New Contract Certificates:

One month Before Certificate Expiration data, Cloud will initiate Install new certificate Payload. If user using PnC feature actively.

Rule:

Cloud will initiate PnCManageCertificate Command with Install New Cert/Replace Certificate with SyncP Payload to ECG, ECG Sends SyncP Payload to OBCC Module by using SyncPRequest Diagnostic Routine

Response:

After completing the certificate Service request by SyncP Request, OBCC shall send a Positive Diagnostic Routine to the control Routine with a Payload of a SyncP packet.

**ECG:**

ECG receives SyncP response from OBCC module and sends Encrypted SyncP response as an "PnCManageCertificatestatus alert" to the Cloud

Delete cert Request:

Cloud will initiate PnCManageCertificate Command with Delete Cert SyncP Payload to ECG, ECG Sends SyncP Payload to OBCC Module by using SyncPRequest Diagnostic Routine.

Delete cert Response:

If successful:

ECG receives SyncP response from OBCC module and sends Encrypted SyncP response as an "PnCManageCertificatestatus alert" to the Cloud

If failed:

New Certificate Installation and delete of Expired certs are failed due to any Reason. Vehicle OBCC disables PnC Feature and notify the user to take vehicle to dealership

Failure:

If contract certificate deletion/Installation of New Certificate was not successful and cloud connectivity exists, the user will notify Via FordPass.

2.6.1.2 PNC-REQ-326854/A-Managing Expired Contract Certifications - Failure

If the contract certificate deletion and installation is not successful, given that the vehicle still has connectivity, the following will occur:

- If unable to update contract certs before the expiration date, Cloud will retry until successful
- If unable to update contract certs after expiration date, assuming cloud connectivity:
 - o Notify customer to go to the shop,
 - o Disable PnC

2.6.2 Use Cases**2.6.2.1 PNCv1-UC-REQ-320374/B-Deletion of Expired Contract Cert's and Install New Contract Cert's**

| | |
|-----------------------------|---|
| Actors | FordPass user |
| Pre-conditions | <ol style="list-style-type: none">1. Onboarding has been successfully completed2. Cloud connectivity is available3. PnC is Enabled4. Contract Cert's are Installed in the Vehicle |
| Scenario Description | Deletion of Expired Contract Cert's and Install New Contract Cert's |
| Post-conditions | <ol style="list-style-type: none">1. Contract Cert's will Expires Every two years2. The Cloud will track the Expiration date of the Contract Certificates3. One month Before Expiration data, Cloud will send Delete Expired Certificate payload to ECG4. ECG will Send Payload to OBCC via Diagnostic Routine5. OBCC Process the Diagnostic Routine and Send Success Response to ECG6. ECG Tigger's an Alert to off board7. Cloud Shall sends New Certificate Payload to ECG, ECG sends Payload to OBCC via Diagnostic Routine8. OBCC Shall Sends Success Response to ECG |



| | |
|-----------------------------|--|
| | 9. ECG Tigger's an Alert to off board 10. If the Entire Process is Successfully Complete, the user is not notified and this is a background process |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface, Offboard interface, Centerstack HMI |

2.6.2.2 PNCv1-UC-REQ-320376/B-Failed to Delete Expired Contract Cert's and Install New Contract Cert's

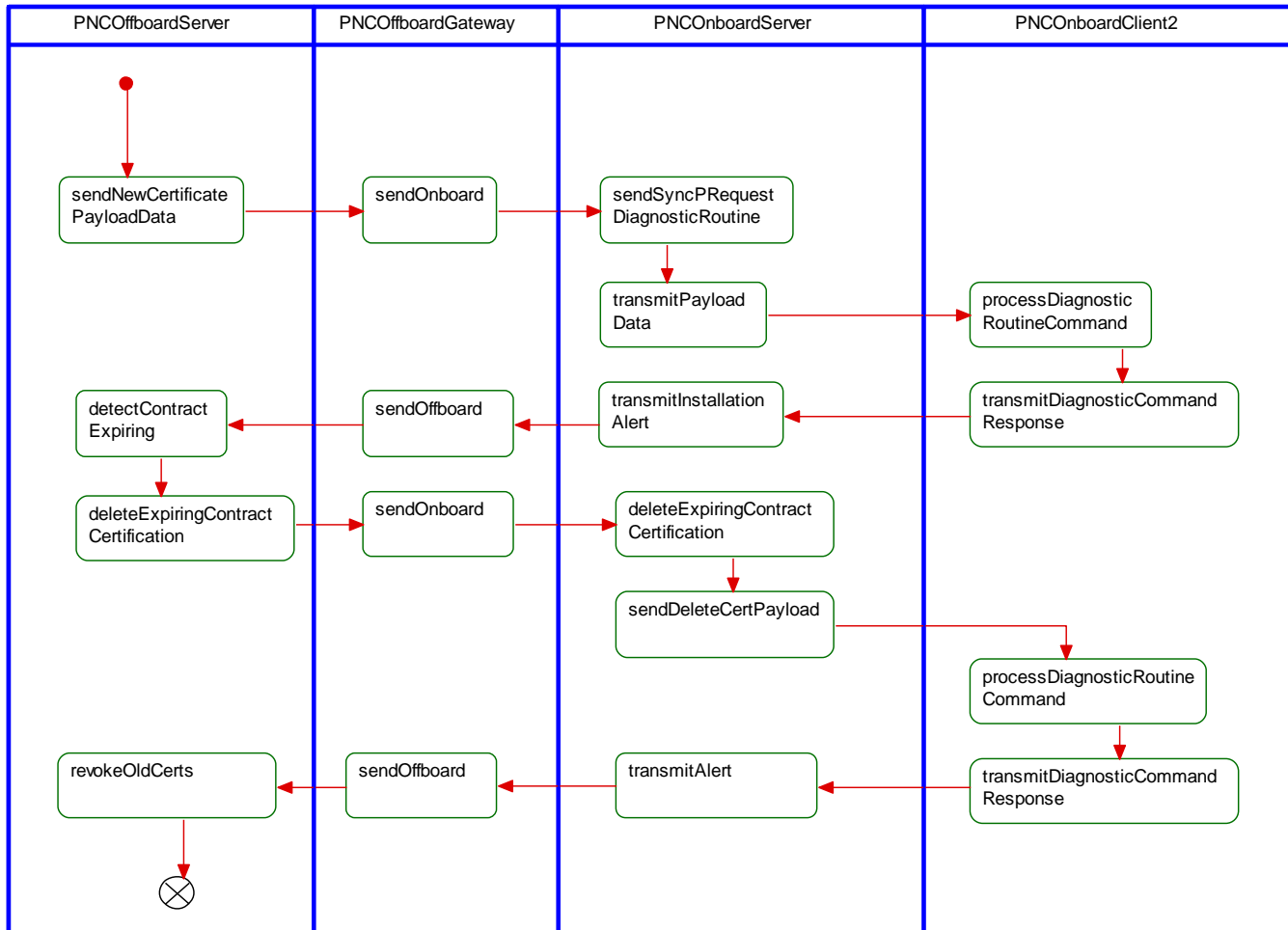
| | |
|-----------------------------|--|
| Actors | FordPass user |
| Pre-conditions | 1. Onboarding has been successfully completed 2. Cloud connectivity is available 3. PnC is Enabled 4. Contract Cert's are Installed in the Vehicle |
| Scenario Description | Failed to Delete Expired Contract Cert's and Install New Contract Cert's |
| Post-conditions | 1. If Deletion of Expired Contract Cert's or installation of New Contract Cert's is Unsuccessful before the Expiration Data, Cloud will retry until Successful 2. If failed to Update delete Expired Contract Cert's and New contract Cert's 3. User get notify in FordPass and Disable PnC in Both Vehicle and FordPass |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface, Vehicle HMI, Offboard HMI |



2.6.3 White Box Views

2.6.3.1 Activity Diagrams

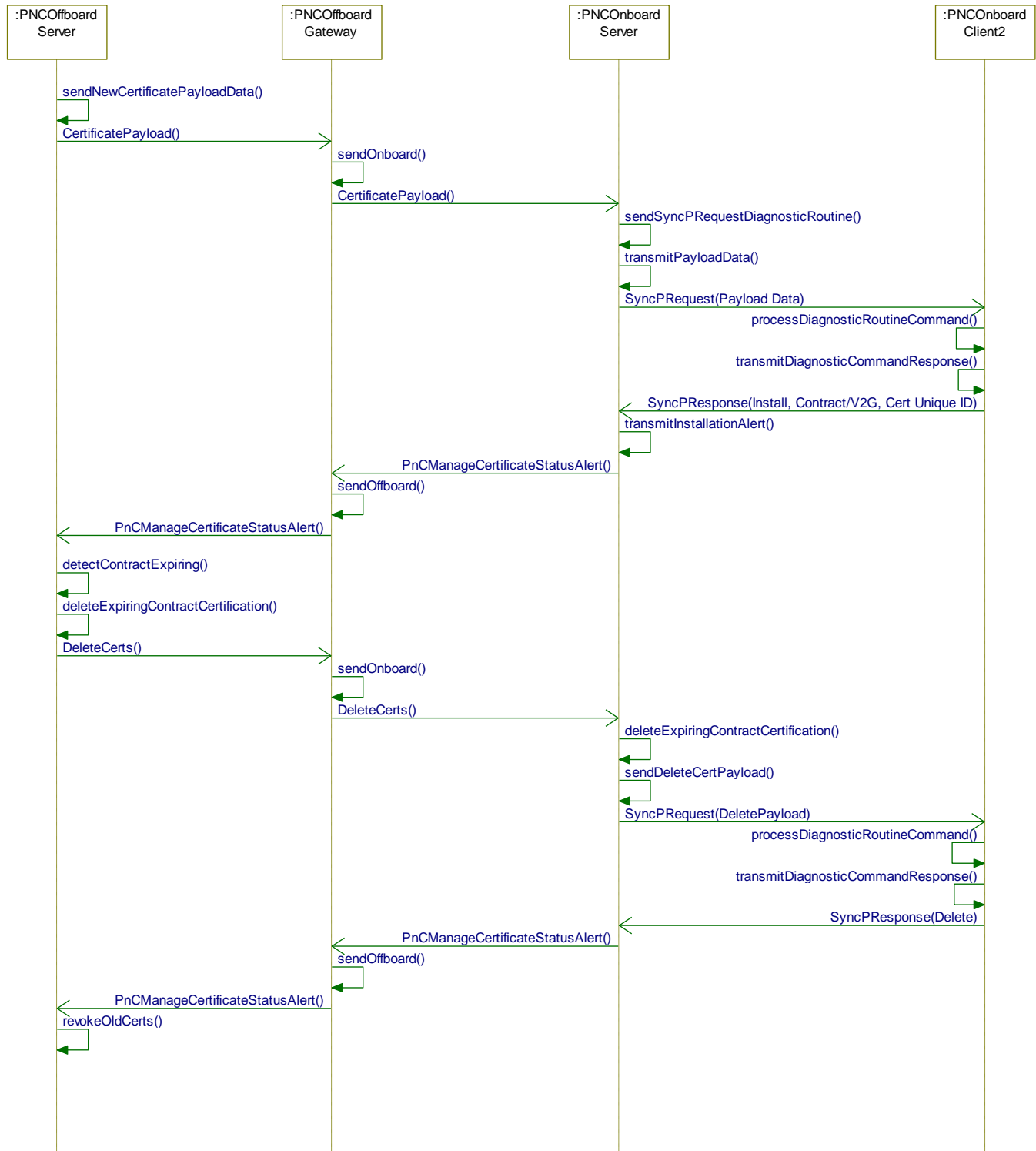
2.6.3.1.1 PNC-ACT-REQ-326781/B-Delete Expiring Contract Certifications And Reinstall





2.6.3.2 Sequence Diagrams

2.6.3.2.1 PNC-SD-REQ-326782/B-Delete Expiring Certs and Installing New Cert





2.7 PNC-FUN-REQ-326625/A-Master Reset

2.7.1 Requirements

2.7.1.1 *PNC-REQ-330380/D-Master Reset*

If ECG receives any Reset Signals from SYNC and Cloud, ECG Sends PnC Reset CAN Signal to OBCC, OBCC shall delete all certificates and the respective Private Keys and Disables PnC Feature and send Feature status to ECG and BCCM

ECG PnC App will do the following upon master when ECG stores alerts while network is down and stored SOA message while SYNC is off:

1. Clear pending SOA messages from cache and storage during master reset
2. Clear pending queued alerts from cache and storage during master reset
3. Will not need to remove the persistent storage files as it is already empty anyway.

Delete All certificates and Disable PnC Feature in OBCC:

Requests will be sent to the OBCC to turn off PnC and delete all certificates when there is a Master Reset/Brand Connect Reset in the vehicle

ECG will do the following logic:

Upon ECG Receiving the FactoryReset_Rq=0x1 or ModemReset_D_Rq = 0x5 or ModemReset_D_Rq = 0x6, send DgtlCommPnc_D_Rq = Reset to OBCC module.

OBCC:

OBCC shall Resets memory by deleting all certificate, disable the PnC feature and increments server message ID counter to +1000.

SUCCESS

ECG and OBCC:

After Deleting all Contract Certificates and Disable PnC Feature, OBCC shall sends DgtlCommPnc_D_Stat = NoContractsInstalled to ECG, the ECG Sends a PnCManageCertificatestatus alert with PnCCertRevokeReason and PnCFeatureStatus alert with NoContractsInstalled state to the Cloud

ECG shall wait for 10s for a response from OBCC and 10s will be a calibrated value.

Last user removes VIN from FordPass app:

The last user remove VIN from FordPass account shall remove all EV Plug and Charge Functionally in the Vehicle.

- a. A VIN removal command will be triggered by the user and the backend will transmit clearUserSettings Command to the ECG. The ECG shall transmit DgtlCommPnc_D_Rq = DeleteAll to OBCC module.
- b. The OBCC shall delete all Contract certificates and the respective Private Keys, Disable the PnC Feature and doesn't increment their sever message ID Counter to +1000.
- c. OBCC Sends DgtlCommPnc_D_Stat = NoContractsInstalled to ECG, the ECG Sends a PnCManageCertificatestatus alert with PnCCertRevokeReason and PnCFeatureStatus alert with NoContractsInstalled state to the Cloud.

ECG shall wait for 10s for a response from OBCC and 10s will be a calibrated value.

2.7.2 Use Cases

2.7.2.1 *PNCv1-UC-REQ-325271/C-Master Reset Initiated from APIM*

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | The Infotainment System is Power on |
| Scenario Description | Mater Reset/Brand Connect Reset Initiated from APIM |
| Post-conditions | 1. The customer Initiates Master Reset via SYNC HMI. |



| | |
|------------------------------------|---|
| | <ol style="list-style-type: none">2. A first popup will be displayed for Master Reset warning the customer3. ECG send PnC master reset signal to OBCC4. OBCC delete all contract certificates and Disable PnC Feature and Sends PnC Disable Command response to ECG5. ECG Shall sends an alert to Cloud6. CVFMA de-enrolls VIN in PaaK FI and subscription cancellation status is updated in the Subscription Management.7. IVSS Core sends a revoke request to the Mobile App via the cloud8. Authorized users are notified about a Master Reset event in FordPass app |
| List of Exception Use Cases | |
| Interfaces | HMI |

2.7.2.2 PNCv1-UC-REQ-325272/C-Last User Removes Vehicle from Mobile App

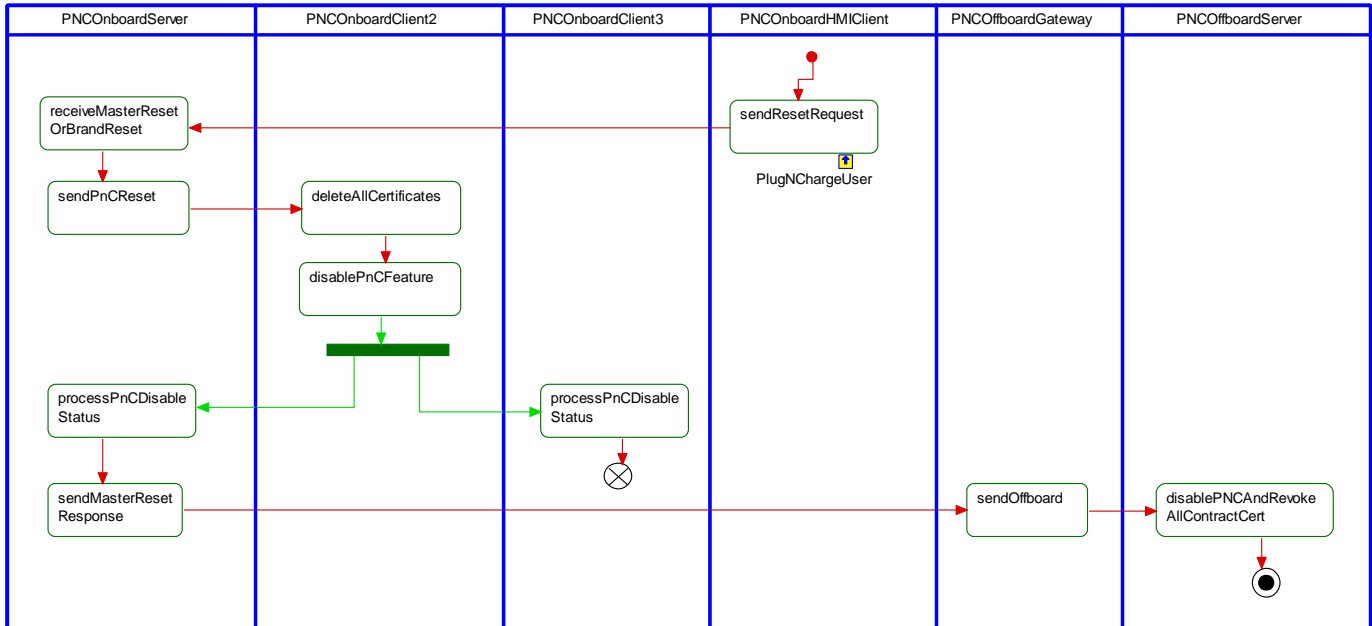
| | |
|------------------------------------|---|
| Actors | Mobile App User |
| Pre-conditions | The Vehicle is Authorized and Account is Activated |
| Scenario Description | Last User Removes Vehicle From Mobile App |
| Post-conditions | <ol style="list-style-type: none">1. Clear User Setting Command is Initiated from the SDN to TCU/ECG2. ECG send PnC master reset signal to OBCC3. OBCC delete all contract certificates and Disable PnC Feature and Sends PnC Disable Command response to ECG4. ECG Shall send an alert to Cloud |
| List of Exception Use Cases | |
| Interfaces | Mobile App, OBCC, BCCM |



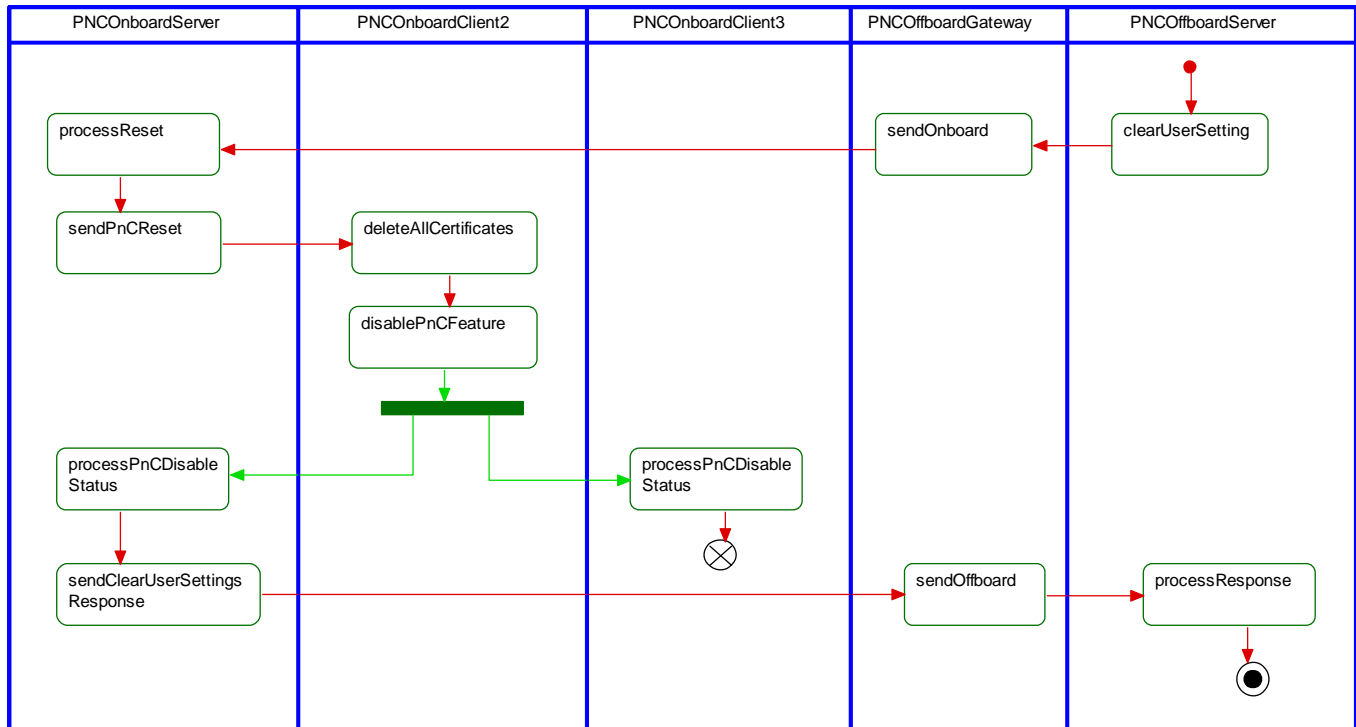
2.7.3 White Box Views

2.7.3.1 Activity Diagrams

2.7.3.1.1 PNC-ACT-REQ-326783/B-Master Reset from PnC Onboard HMI Client



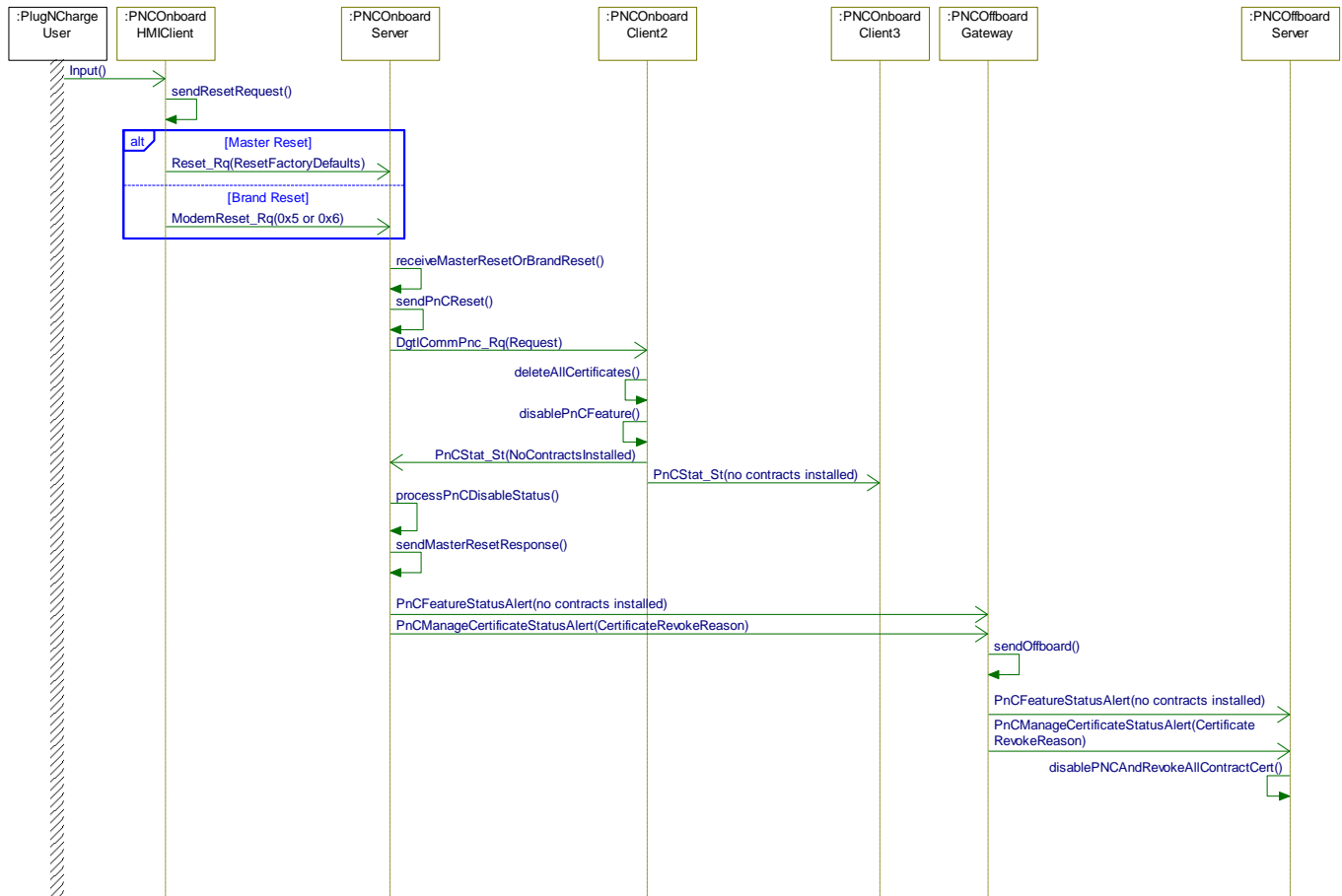
2.7.3.1.2 PNC-ACT-REQ-330600/B-Last User has Removed Vehicle from App





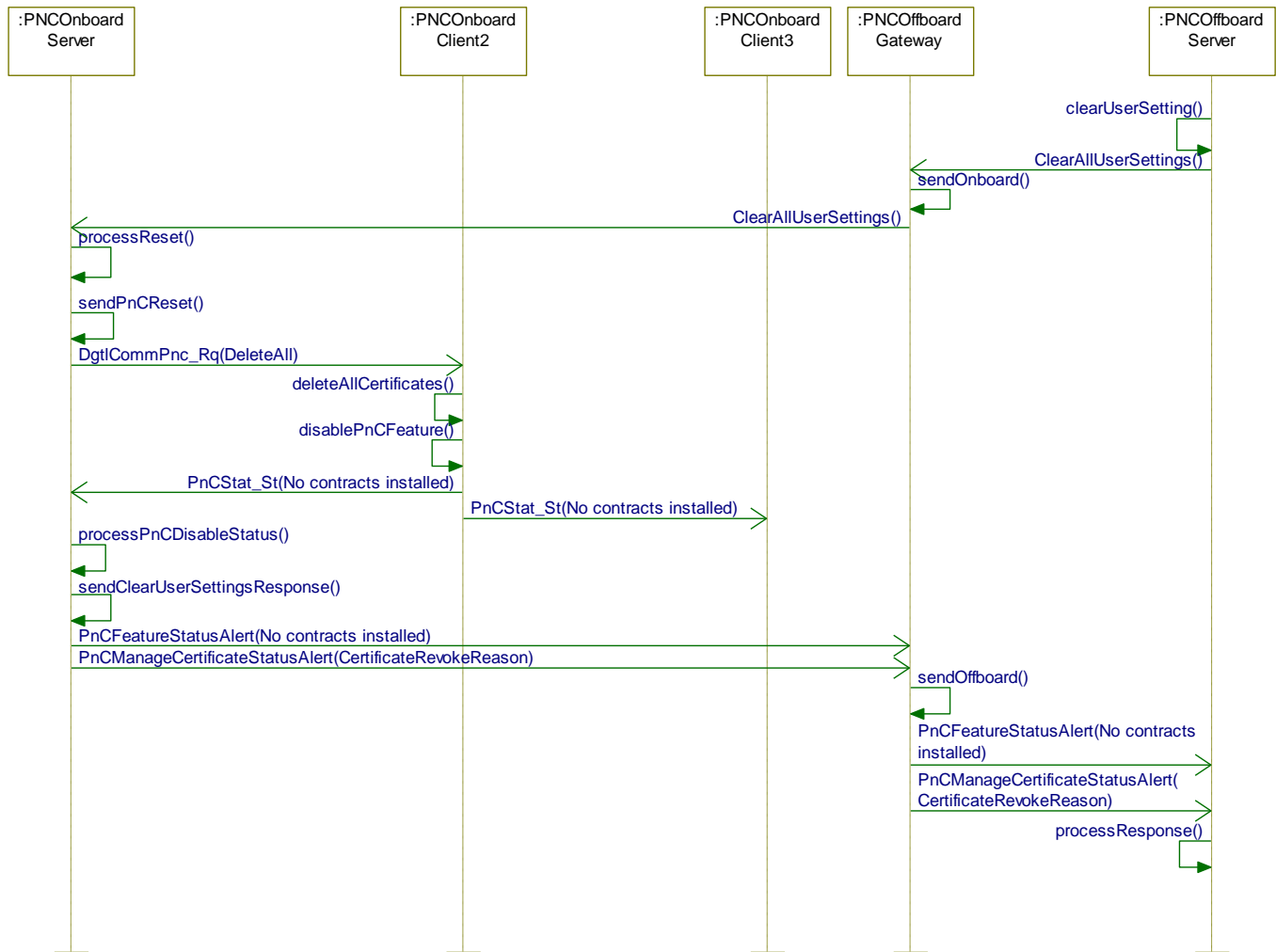
2.7.3.2 Sequence Diagrams

2.7.3.2.1 PNC-SD-REQ-326837/C-Master Reset





2.7.3.2.2 PNC-SD-REQ-330601/D-Last User has Removed Vehicle from App



2.8 PNC-FUN-REQ-326780/A-PnC Onboard Client2 Module Swap

2.8.1 Requirements

2.8.1.1 PNC-REQ-335761/B-OBCC Swap Detection

1. As defined in Provisioning Spec, If Module A is replaced with Module B then Module B has to go through self-test and start transmitting OBCC_ECG_Word_Tx TP Signal to ECG at a 1000msec event periodic rate and this condition will be Checked by ProvServer in ECG and send Provisioning alert to the cloud.
2. Cloud (GVMS) shall detect change in FESN and send swap event to downstream cloud applications

OBCC Provisioning:

- If ObccProvStat changes from 0x3B provisioned to any other state, OBCC shall delete all the contract and V2G root certificates
- If ObccProvStat is not 0x3B Provisioned, and PnCStatus = "Enable" or "Faulty", OBCC shall set PnCStatus = "Disabled"

For OBCC provisioning signals please refer to Peripheral Provisioning SPSS.

2.8.1.2 PNC-REQ-335762/B-Deleting Certificates in New OBCC Module

When OBCC module is at not provisioned state delete all certificates in OBCC Module and Disable Plug and Charge Feature. Send an alert to cloud

ECG and OBCC:



After Deleting all Certificates and Disable PnC Feature, OBCC shall sends DgtlCommPnc_D_Stat = NoContractsInstalled to ECG, the ECG Sends a PnCManageCertificateStatus alert with PnC CertRevokeReason and PnCFeatureStatus alert with NoContractsInstalled state to the Cloud

2.8.1.3 *PNC-REQ-335763/A-Installing New Certificates in New OBCC Module*

Cloud will revoke old Contract Certificates and Create new Certificates, send it to the vehicle and Enable PnC in the Vehicle.

Cloud:

Cloud will Create Secure Payload deliver to the Vehicle

ECG:

Follow On-boarding Process to install Certificates and Enabling PnC Feature in OBCC Module.

2.8.2 Use Cases

2.8.2.1 *PNCv1-UC-REQ-326621/C-Installing New Certification after OBCC Swap*

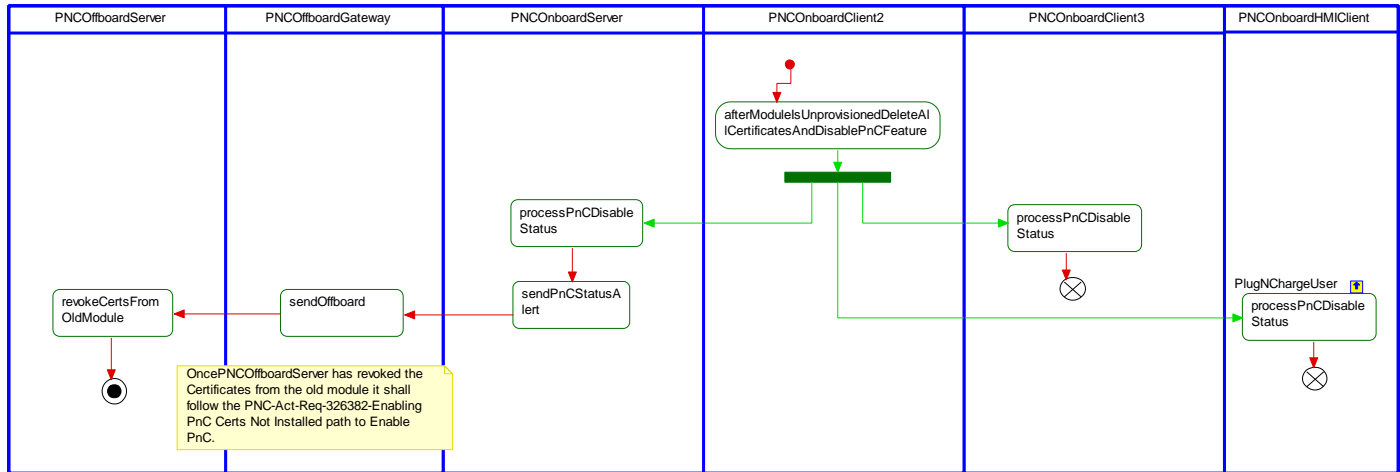
| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Onboarding has Successfully Completed PnC Enabled User has Subscription Cloud Connectivity is Available OBCC Module is Provisioned |
| Scenario Description | Installing New Cert's when OBCC Swap |
| Post-conditions | <ol style="list-style-type: none">1. When the OBCC module Swap, ECG detect change in OBCC FESN2. OBCC delete all certificates and Disables the PnC Feature, if the module is not provisioned.3. After Deleting all Certificates and Disable PnC Feature, OBCC shall sends DgtlCommPnc_D_Stat = NoContractsInstalled to ECG4. ECG Sends an alert to off board5. Cloud shall void old Certificates in the Old OBCC Module6. Cloud will send Payload to Vehicle and install new Certificates in new OBCC module and Enable PnC feature |
| List of Exception Use Cases | |
| Interfaces | Vehicle interface |



2.8.3 White Box Views

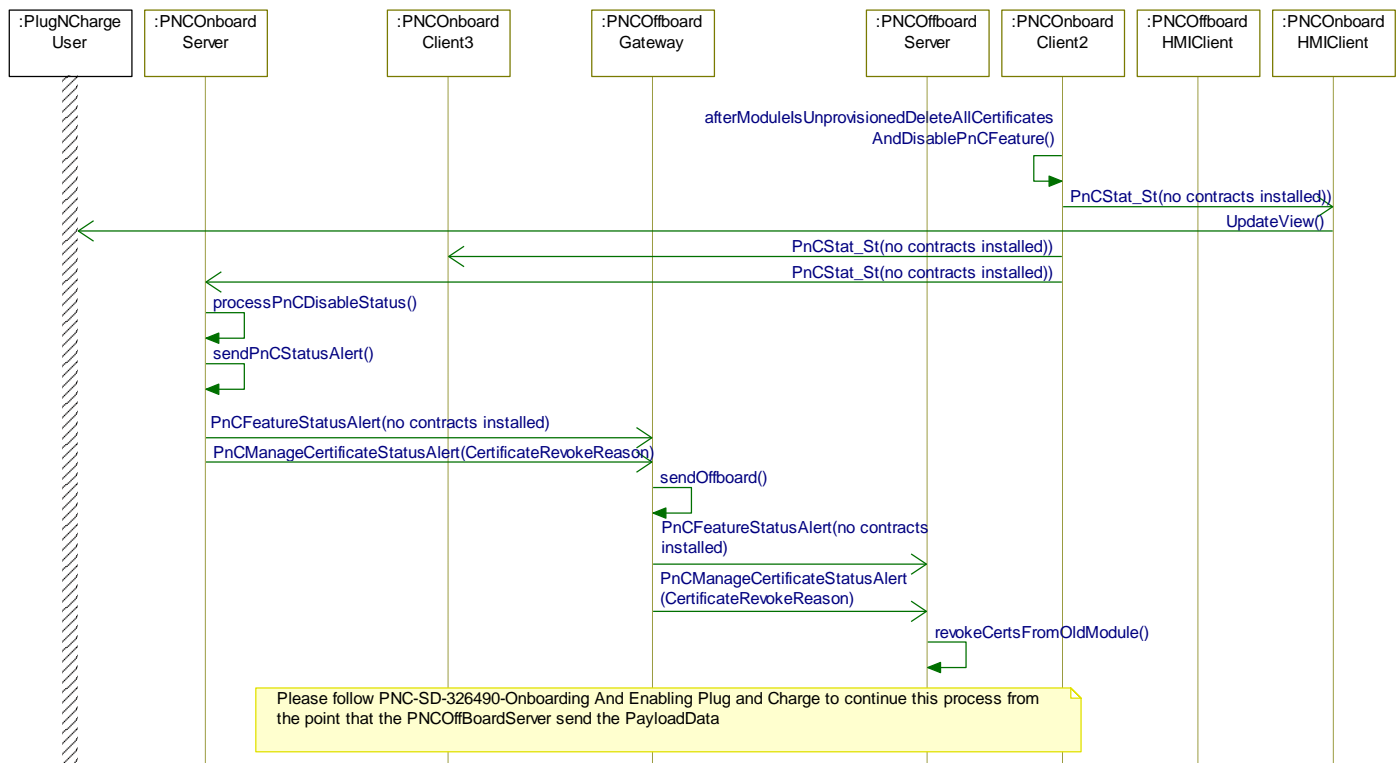
2.8.3.1 Activity Diagrams

2.8.3.1.1 PNC-ACT-REQ-326765/B-Install New Certification After Module Swap



2.8.3.2 Sequence Diagrams

2.8.3.2.1 PNC-SD-REQ-326779/C-Installing New Cert After Module Swap



2.9 PNC-FUN-REQ-334896/A-Wake Up Strategy

2.9.1 Requirements

2.9.1.1 PNC-REQ-334897/B-OBCC-BCCM Wakeup Strategy

Wake Up OBCC for PnC Certificate Installation (Install/Delete/Assign Priority) and PnC Re-Enabling and Disabling:



When Cloud sending Certificate Payload and Enable/Disable Command via FTCP when the vehicle ignition off. FTCP SMS will wakeup ECG, then ECG need to wake up BCM and BCM will Wakeup BCCM and BCCM wakeup OBCC

1. ECG send a PtWakeupActv1_B_Rq, 0x1: On Request to BCM for 5 seconds, and then resulting in a wake up to the BCCM for 5 Sec and the BCCM will be able to wake the OBCC.
2. ECG Sends Sustain "ChrgrPncSustn_B_Rq" CAN Signal to BCCM with 0x1: Active, BCCM wakeup OBCC

2.9.1.2 PNC-REQ-334898/B-Time Limit for Wakeup Strategy

- ECG need to wakeup OBCC/BCCM for Maximum 90 sec for Certificate installation Process and PnC Enable/Disable
- Rule: After 90 Sec, ECG send ChrgrPncSustn_B_Rq with Inactive state to BCCM to keep BCCM/OBCC in sleep mode

2.9.2 Use Cases

2.9.2.1 PNCv1-UC-REQ-334895/B-Wake Up for PnC Enable-Disable and Cert installs

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | <ol style="list-style-type: none">1. User registers for FordPass app2. User has Authorized Vehicle3. User sets up wallet4. User selects subscription in FordPass5. CCS are Enabled6. Cloud Connectivity is Available7. Vehicle is key off |
| Scenario Description | Wakeup OBCC/BCCM for PnC Enable/Disable and Install Certificates. When Vehicle Ignition off |
| Post-conditions | <ol style="list-style-type: none">1. For PnC requirement we want to Enable/Disable and Install Certificates even though vehicle Ignition off.2. When Cloud sending Certificate Payload/Enable/Disable Payload via FTCP Command when the vehicle ignition off. FTCP SMS will wakeup ECG, then ECG need to wake up BCM and then resulting in a wake up to the BCCM for 5 Sec and the BCCM will be able to wake the OBCC3. ECG Sends Sustain "ChrgrPncSustn_B_Rq" CAN Signal to BCCM with 0x1: Active, BCCM wakeup OBCC4. Once ECG Receives Success Response from OBCC for PnC Enable/Disable and Certificates SyncPResponse from OBCC. ECG send CAN Signal to keep OBCC/BCCM in sleep mode. |
| List of Exception Use Cases | ECG, OBCC, BCCM |
| Interfaces | ECG, OBCC, BCCM |

2.10 PNC-FUN-REQ-369804/A-V2G Certificate Delivery upon OBCC Being Provisioned

2.10.1 Requirements

2.10.1.1 PNC-REQ-369816/A-V2G Certificate Process

- Once the OBCC module gets provisioned at the End of the line, a cloud shall orchestrate V2G certificate payload to OBCC via ECG even before the customer authorized to the vehicle and customer never complete the subscription process in Fordpass App.



- Remove Authorization Pre-check for "PnCManageCertificate command, PnCManageCertificate Command Response and PnCManageCertificatestatus co-related alert" in the PnC ECG application whenever ECG receives this command from the cloud and send the Payload to OBCC module via "SyncPRequest" Diagnostic Routine.
- Once ECG receives SyncP response with status payload from OBCC then the ECG app shall trigger PnCManageCertificatestatus alert.

2.10.2 Use Cases

2.10.2.1 PNCv1-UC-REQ-369805/A-Install V2G Certificates

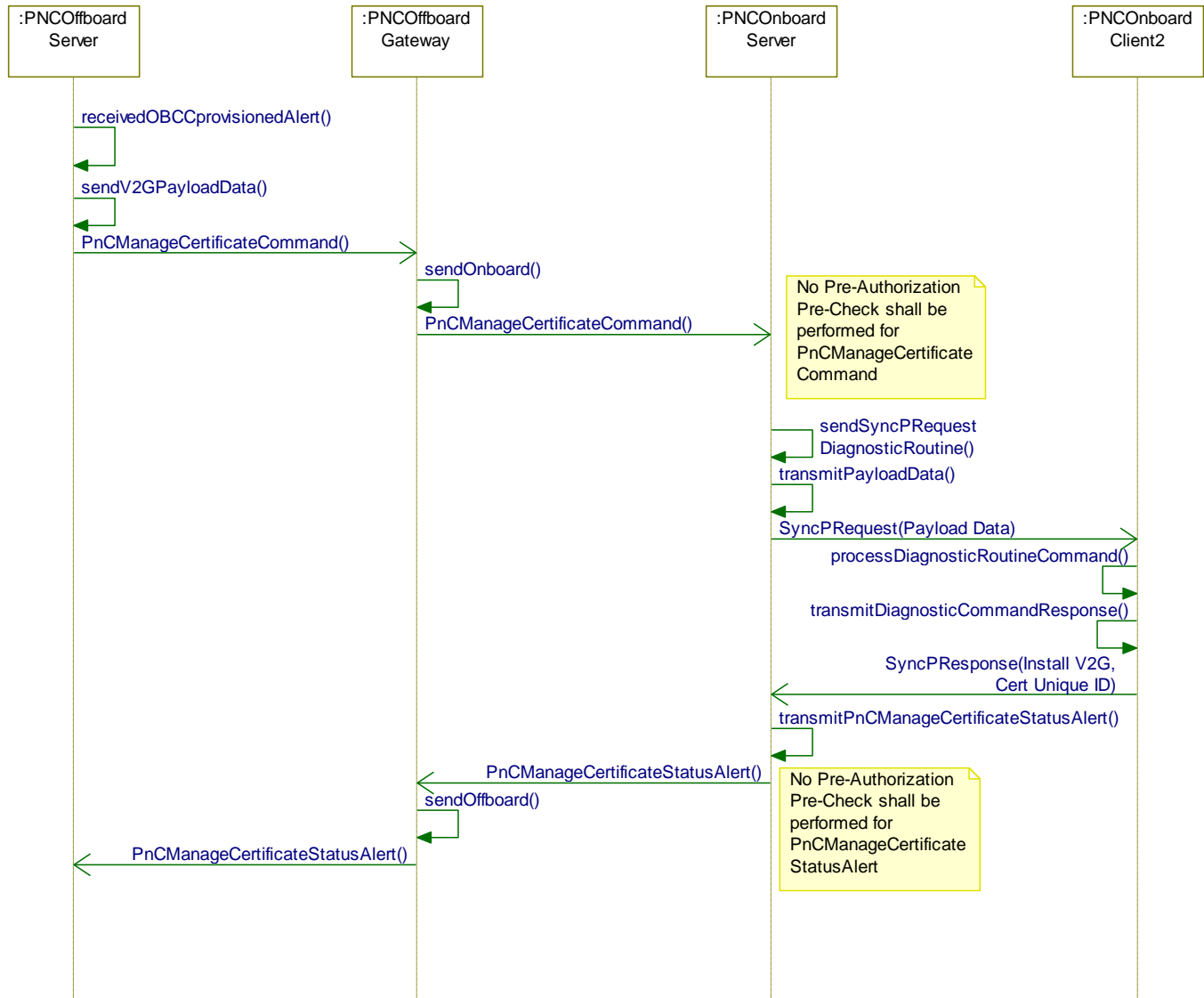
| | |
|------------------------------------|---|
| Actors | Cx727 Vehicle |
| Pre-conditions | <ol style="list-style-type: none">1. User not registered to FordPass app2. User not Authorized to the Vehicle3. CCS settings are Enabled4. Cloud Connectivity is Available5. ECG Removes Authorization Pre-check for PnCManageCertificate command6. ECG Removes Authorization Pre-check for PnCManageCertificatestatus alert7. The Vehicle is key off |
| Scenario Description | Install V2G certificates upon OBCC Provisioned |
| Post-conditions | <ol style="list-style-type: none">1. OBCC Module gets Provisioned at End of the line2. Upon OBCC Provisioning alert Cloud shall create V2G certificate Payload and send it to ECG via PnCManageCertificate command3. ECG shall send the Payload to the OBCC module via "SyncPRequest" Diagnostic Routine.4. OBCC shall Send the Diagnostic Routine Command Response to ECG5. ECG shall trigger PnCManageCertificatestatus alert with SyncP response Payload to the Cloud. |
| List of Exception Use Cases | |
| Interfaces | Cloud, ECG, OBCC |



2.10.3 White Box Views

2.10.3.1 Sequence Diagrams

2.10.3.1.1 PNC-SD-REQ-369778/A-V2G Certufucate Delivery once OBCC Provisioned





4 Appendix B: Reference Documents

| Reference | Title | Doc. ID | Revision |
|-----------|-------------------------------------|---------|----------|
| 1 | Peripheral Module Provisioning SPSS | | Latest |
| | | | |
| | | | |
| | | | |

The requirements of the documents listed in the reference table above, of the latest revision level, form a part of this Engineering Specification