Feature Document (FD)

CE-DTE

(CE-DTE)

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1 INTRODUCTION

1.1 Document Purpose

A Feature Document (FD) document specifies **what** the feature shall do and how it shall behave from customer perspective. It should also provide reasoning and background **why** we have the feature in the vehicle.

The FD also serves as an Item Definition as defined by ISO26262 for those features, which follow the Ford Functional Safety process.

To get more information about the concept of feature, function and component level abstraction refer to the Ford RE Wiki. For details on the Ford Functional Safety (ISO26262) process refer to the Ford Functional Safety Sharepoint.

1.2 Document Scope

This Feature Document (FD) specifies the following features:

Feature ID	Feature Name	Owner	Reference
<Add VSEM Global Feature Dictionary ID>	Cloud-Enhanced Distance to Empty	Sena Hermiz	<Add VSEM Link>

Table 1: Features described in this FD

1.3 Document Audience

The FD is written by the feature owner of CE-DTE. All Stakeholders, i.e., all people who have a valid interest in the feature should read and, if possible, review the FD. It needs to be guaranteed, that all stakeholders have access to the currently valid version of the FD.

*#**Hint:** The FD template has the IP Classification "Proprietary" by default. IP Classification "Confidential" might be required in some cases, e.g. by Ford Functional Safety.*
*#**Macro:** Add Ins -> Edit Document Properties macro (select "Proprietary" for "Document Classification")*

1.3.1 Stakeholder List

For the latest list of stakeholder of the feature and their influence refer to <Put VSEM Link here>.

*#**Hint:** Refer to Ford RE Wiki – Stakeholder List on how to create a stakeholder list. The stakeholder list should be stored in VSEM in the pseudo folder "General Data Artifacts" of the corresponding feature.*

CE-DTE Stakeholderlist_template_v5_20161129.xlsx

1.4 Document Organization

1.4.1 Document Context

Refer to the Specification Structure page in the Ford RE Wiki to understand how the FD relates to other Ford Requirements Documents and Specifications.

1.4.2 Document Structure

The structure of this document is explained below:

Section 1 – Introduction how to use this document including responsibilities and requisite documents. Explains the terminology. Gives a clarification of the definitions, concepts and abbreviations used in the document.
Section 2 – Feature Description. States briefly the background and the purpose of the feature, feature variants and corresponding regions and markets. Also includes input requirements, assumptions and constraints.
Section 3 – Feature Context describes all external entities, which have an influence on the feature.
Section 4 – Feature Modeling. Contains Use Case, Driving Scenarios, State Charts to describe the functional behavior of the feature.
Section 5 – Safety. Lists System Behaviors and Safety Goals of the feature.
Section 6 – Feature Requirements. Lists functional and non-functional requirements of the feature.
Section 7 – Architecture. Shows the coarse architecture, which the feature requirements are deployed to. Describes the elements and the boundary of the feature as well as the decomposition and distribution of associated functions.
Section 8 – List of Open Conerns
Section 9 – Document Change History including a list of new or modified requirements. The requirements in this document are tagged, and this section contains different types of tables listing all, new, or changed requirements by their title and page no.
Section 10 – Appendix

*#**Hint:** All sections are mandatory, unless explicitly marked by the tag "#Classification" as "optional" or as applicable e.g. to certain domains like "Functional Safety".*

1.5 Document Conventions

1.5.1 Requirements Templates

Each requirement, use case or scenario in this specification shall follow the corresponding template given in the document template *Specification_Macros.dotm* at RE Wiki - Specification Templates.

*#**Hint:** The Specification_Macros.dotm template also provides macros to insert the requirement templates. Refer to "How to use the Specification Templates" on how to enable the macros and the requirements templates in this specification.*
The requirements macro and requirements templates also enable the import of the specification to VSEM (refer to "How to import specifications into VSEM as separate requirements").

1.5.1.1 Identification of requirements

The unique requirement ID given in the headline of any requirement follows the requirement throughout the development process. The requirement ID format follows a well-defined syntax.

All identifiers in a FD shall be composed of 4 parts:

- A leading prefix, which indicates the type of requirement (R=Requirement, UC=Use Case, SC=Scenario, …)
- A prefix, which indicates the abstraction level (F=Feature, FNC=Function, CMP = component).
- Followed by a name, indicating the scope, which the requirement belongs to (e.g. feature or function name)
- Ending with the actual requirement number

Example:
R_F_AutoLamps_00004 This is the fourth requirement on feature level for the feature Autolamps.

1.5.1.2 Requirements Attributes

The templates provided by *Specification_Macros.dotm* define a list of attributes for each requirement. This helps to classify the requirement. The attributes are explained at RE Wiki - Requirements Attributes.

2 FEATURE OVERVIEW

2.1 Purpose and Description of Feature

Cloud-Enhanced Distance to Empty (CE-DTE) is an enhancement to the current Distance to Empty (DTE) feature. It uses a microservice in the cloud and data learned from the vehicle to estimate the future energy consumption of the vehicle. DTE has been the source of TGWs for past Ford plug-in vehicles. CE-DTE uses real-time conditions along a planned route and by learning vehicle usage patterns. CE-DTE adjusts the current calculation of distance to empty based on known route, considering factors such as traffic, elevation and temperature. CE-DTE supports EV Trip Planner to improve energy usage estimates (charging is sufficient to reach each waypoint and final destination). It will also learn driver efficiency by road class (speed bins, grade) and learn across users to improve algorithm estimates, and energy usage by temperature. Changes to CE-DTE will be communicated with customers to address issues discovered from past product generations.

2.2 Feature Variants

Variant Name	Variant Description	Remarks
Not Applicable		

Table 2: Feature Variants

2.2.1 Regions & Markets

*#**Hint:** Description of purpose and functionality of the feature. If there is no variant, give feature name in first column.*

Market / Region / CE-DTE	North America	South America	Europe	Middle East / Africa	Asia / Pacific	China
	x		x			x - Need to investigate

Table 3: Regions & Markets

2.3 Input Requirements

*#**Hint:** List all input requirements, which are relevant for the feature. Typically, attribute requirements, legal requirements as well as national and international standards have to be considered.*

2.3.1 Legal Requirements

GPS shifting requirement for China - Consent to gather location information.
Consent for OTA update.

2.3.2 Trustmark Requirements

~~2.3.2~~ Not Applicable

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2.3.3 Industry Standards

GPX (GPS exchange) – format for how the route is communicated.

2.4 Lessons Learned

*#**Hint:** Additional information and lessons learned from previous development or related features. A typical source for Lessons Learned is the FMA Quality History.*

*#**Functional Safety:** In context of Functional Safety Lessons Learned and similar information will be used to check the completeness of the Functional Safety Goals and assumptions in the Hazard Analysis and Risk Assessment (HARA).*
*#**Link:** Ford Functional Safety Sharepoint*

Customers do not understand the range calculation and are frustrated with DTE experience in current Ford and industry EVs. DTE is important in building trust with new BEV adopters.
"I don't understand the inconsistency."
"it's very confusing to me."
"The meter always drops two miles within the first half mile."
"We have had the car for over three months. I think the car should have gotten used to our driving habits by now."

GQRS Data:
2016 Focus BEV: "The battery has about one third of a truly useful range."
2015 Focus BEV: "Charging system appears irregular, maxing out at various level - from 62 miles to 82 miles. Re-generative braking sometimes works - sometimes not. Can't seem to find a pattern."

Customer Clinic Data:
A survey was performed that collected data from 25 participants. A Likert scale was used to compactly capture a range of attitudes. Three questions relate to the distance to empty calculation: "After a trip my remaining range is what I expect it to be," "I notice that miles driven and distance to empty are not in sync" and "My range suddenly dropped and I need to charge."
Results:

My range is what I expect	3.8 of 5.0
I notice delta between miles and DTE	3.1 of 5.0
My range suddenly dropped	1.7 of 5.0

Customer Clinic BEV driver quote: "When the temperature is below 32 degrees, I automatically deduct 30% from my range."

Commented [HS(1]: Get research data from Ralph and include customer clinic verbatims

Commented [HS(2R1]:

2.5 Assumptions & Constraints

2.5.1 Assumptions

- This document covers CX727, an updated version will contain P702.
- To utilize the CE-DTE feature, the user has a FordPass/LincolnWay account
- EV Customers will use FordPass and LincolnWay for their connected experience
- CE-DTE Consent is available via FordPass/Lincoln Way Mobile Apps
- Users must be fully authorized to their vehicle to access CE-DTE. This means the user has met the following conditions:
  - User has installed and created a valid login account for the Ford owner mobile app
  - User has registered an eligible vehicle VIN (define as a VIN which is known to have a TCU installed and has sent a provisioning message to NGSDN)
  - User has completed the authorization process for the eligible VIN
- Designs and concepts of UI/UX shown in FD are not finalized content. UI/UX team to define the right experience
- FordPass team will determine how the experience will differ on the web and the mobile app. For the purpose of this document, any reference to "FordPass" could mean via any of the defined FordPass channels
- The user experience for this feature will be consistent across FordPass, HMI and web
- ~~Payment & Subscriptions are not required for the CE-DTE feature~~
- CE-DTE will be available per-VIN and not per-user
- Reliable real-time weather and traffic data will be available to the micro-service.
- The micro-service will be able to differentiate drivers across vehicles to utilize personalized driving data.
- Navigation vendor can support integration to provide route to Ford cloud and is able to call Ford cloud to receive adjusted (cloud-enhanced) DTE value for Trip Planner.

Commented [MP3]: Not intended to be a standalone product sold to customer, but feature will run through Monetization Platform in case it is bundled to recover cellular data and other operating costs

Commented [MP4]: Across vehicles (don't want to confuse that we can differentiate drivers)

2.5.2 Constraints

- CE-DTE is a BEV-only feature
- CE-DTE will be available globally to registered owners, unless country-specific regulations prohibit the use of the feature
- There must be modem connectivity for CE-DTE to work

2.5.3 Dependencies

- All vehicles have at least FNV2 architecture.
- Assumes navigation vendor can support integration to provide route to Ford cloud, and also to call Ford cloud to receive adjusted (cloud-enhanced) DTE value for Trip Planner
- Mobile app availability (for download) will depend on mobile application store (Apple Store and Google Play).
- Detailed logical functions related to the requirements in the FD are captured in the FS document
- Cluster – to show accurate prediction for CE-DTE & Notifications causing variation in DTE.
- Cloud Micro-service- to collect data from the following entities to calculate accurate DTE.
    - Vehicle data
    - Cloud entities
        - Navigation data.
        - Traffic data.
        - Weather data.
        - Elevation data.

2.6 References

2.6.1 Ford Documents

List here all Ford internal documents, which are directly related to the feature.

Reference	Title	Doc. ID	Document Location	Revision
CE-DTE algorithm document 3.0.docx	Algorithm Document		CE-DTE Sharepoint	
HPCM SPSS			VSEM	
ECG SPSS			VSEM	
CE-DTE Gibhub documentation	CE-DTE Gibhub documentation			
FMEA-Distance to Empty DFMEA-61148.xlsx	FMEA-Distance to Empty DFMEA			
CEDTE HLF				

Table 4: Ford internal Documents

2.6.2 External Documents and Publications

The list of external documents could include books, reports and online sources.
***#Hint:** You may refer to IEEE Citation Reference on how to format a reference.*

Reference	Document / Publication	Document Location
84116901	Patent ~~– once published~~	

Table 5: External documents and publications

Commented [MP5]: Patent Application 84116901

2.7 Glossary

***#Hint**: Terms, concepts and abbreviations used in the document shall be defined and illustrated here. Note that changes to terms and/or concepts described in this section tend to cause major updates to this document.*
The tables below have feature specific definitions and abbreviations. For additional, non-feature specific terms please refer to the RE Glossary

2.7.1 Definitions

Definition	Description
Cloud-Enhanced Distance to Empty	Algorithm that uses navigation, weather, traffic, elevation data as well as vehicle driving pattern to calculate new DTE

Table 6: Definitions used in this document

2.7.2 Abbreviations

Abbr.	Stands for	Description
CE-DTE	Cloud-Enhanced Distance to Empty	Algorithm that uses navigation, weather, traffic, elevation data as well as vehicle driving pattern to calculate new DTE
DTE	Distance to Empty	Provides user with miles remaining to drive
EV	Electric Vehicle	Vehicle that has an electric battery power
PHEV	Plugin Hybrid Electric Vehicle	Electric Vehicle that has a battery and a gas engine
BEV	Battery Electric Vehicle	Electric Vehicle that only operates on a battery
TMC	Transportation Mobility Cloud	A combination of services from Autonomic coupled with Ford IT services to offer device connectivity and transformative functions for Fleet, Retail and Analytic applications
HPCM	Hybrid Powertrain Control Module	In-vehicle module that holds Departure Times and Charge Settings
TCU	Telematics Control Unit	
SCA-V	Single Complete Actionable View of the Vehicle	A sub-group of the Global Data Insights and Analytics practice, SCA-V houses the Vehicle Efficiency Learned parameters. It is responsible for recalculating the settings based on user routine learning and publishes new settings to be sent to the vehicle.
ECG	Enhanced Central Gateway	The Enhanced Central Gateway is an Ethernet enabled component with excess computing capability to house and /or bridge next generation technology.

Table 7: Abbreviations

2.7.3 Parameters / Values

Name	Description	Range / Resolution
Calibrate-able Value (Cal Value)	Value that will be determined and updated based on testing done using the CE-DTE algorithm.	TBD

Table 8: Parameters / Values used in this document

3 FEATURE CONTEXT

3.1 Feature Context Diagram

*#**Hint:** High level diagram of feature interactions with the environment, people or other feature or other external entities.*
*#**Link:** RE Wiki - Context Diagram*

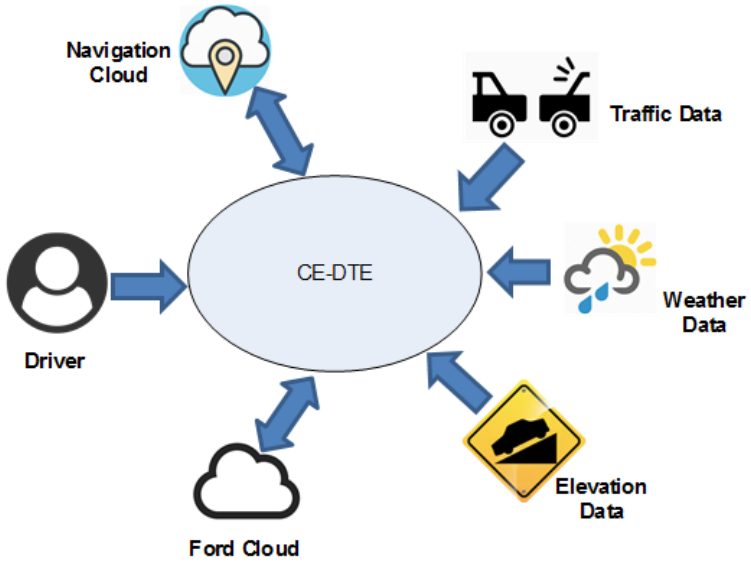

Figure 1: Feature Context Diagram

3.2 List of Influences

ID	External Entity	Influence Description
I1	Driver	The driver's patterns/behaviors impact CE-DTE calculations. When the driver starts a route, navigation software sends the route to ECG so it can be analyzed in the cloud and CE-DTE can be calculated.
I2	Environment	DTE can be made predictive using real-time conditions (traffic, weather, elevation) along a planned route
I3	Navigation Cloud (EV Trip Planner)	Navigation cloud will call CE-DTE to obtain more accurate DTE estimate for trip plan.

Table 9: List of Influences

4 FEATURE MODELING

4.1 Operation Modes and States

*#**Classification:** Optional (Mandatory for Functional Safety)*
*#**Link:** RE Wiki – State Charts*
*#**Hint:** State Charts are a popular means to express feature behavior in terms of states and modes. An advantage of this state machine like approach is that consistency can be easily verified.*

Not Applicable.

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4.2 Use Cases

*#**Classification:** Optional*
*#**Link:** RE Wiki – Use Cases*

4.2.1 Use Case Diagram

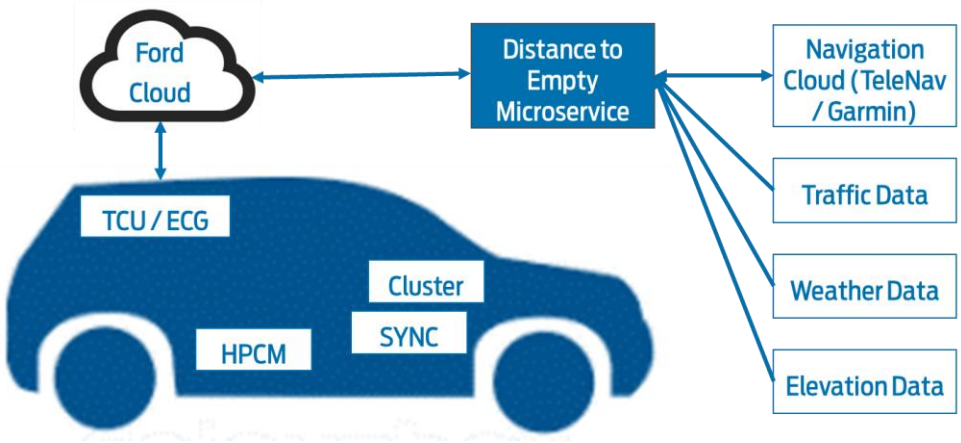

Figure 2: Use Case Diagram

4.2.2 Actors

Actor	Description
User	The user who is driving the EV.
ECG	The Enhanced Central Gateway is an Ethernet enabled component with excess computing capability to house and /or bridge next generation technology.
HPCM	In-vehicle module that holds Departure Times and Charge Settings
Navigation Cloud	Routing service that generates a route considering real-time traffic and automatically routes the customer to charging stations when charging is required to reach their destination
SYNC	Center stack user interface inside the vehicle
IPC	Instrument Panel Cluster user interface inside the vehicle
SCA-V	A sub-group of the Global Data Insights and Analytics practice, SCA-V houses the Vehicle Efficiency Learned parameters. It is responsible for recalculating the settings based on user routine learning and publishes new settings to be sent to the vehicle.

Table 10: List of Actors

Commented [MP6]: Added proposed language to fill in this blank

4.2.3 Use Case Descriptions

*#**Classification:** Optional*
*#**Macro:** Add Ins -> Add Requirement macro (select "Use Case" as type)*

###UC_F_CE-DTE_0021### Enrollment

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	User activates modem for the first time
Main Flow	M1	The vehicle will be auto enrolled in CE-DTE
	M2	The enrollment status will be maintained within the CE-DTE microservice and verified each time before processing a request
Alternative Flow 1		
Alternative Flow 2		
Post-condition		

###UC_F_CE-DTE_0022### Master Reset

Purpose		
Actors		User
Precondition	P1	Vehicle is enrolled in CE-DTE
	P2	User performs a master reset
Main Flow	M1	Vehicle enrollment status is reset
	M2	CE-DTE enrollment is deactivated
	M3	User's personal data is deleted
Alternative Flow 1		

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Alternative Flow 2		
Post-condition		

###UC_F_CE-DTE_00001### Route Set in vehicle: CE-DTE Calculation

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	User planned a route in vehicle
	P2	User starts the route in navigation
Main Flow	M1	Vehicle sends navigation route to CE-DTE microservice
	M2	CE-DTE microservice incorporates traffic, elevation and temperature data to calculate CE-DTE
	M3	If DTE is < [Cal Value] CE-DTE responds with vehicle adjustment parameters that are incorporated into the HPCM DTE calculation
	M4	CE-DTE is displayed to user using standard method to display DTE
Alternative Flow 1	AF1	If DTE change is >= [Cal value] then HPCM updates DTE as a step change
	AF2	CE-DTE is displayed to user using standard method to display DTE
	AF3	A pop-up is displayed to customer with an explanation of the change
Alternative Flow 2		
Post-condition		

###UC_F_CE-DTE_0012### Future Route: CE-DTE Calculation

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	User planned a route using Fordpass / Web
	P2	
Main Flow	M1	Nav cloud sends navigation route to CE-DTE microservice
	M2	CE-DTE microservice incorporates traffic, elevation and temperature data to calculate CE-DTE
	M3	Trip Plan is displayed that reflects CE-DTE calculation~~CE-DTE value is displayed to the user on Fordpass / Web~~
Alternative Flow 1		
Alternative Flow 2		
Post-condition		

Commented [MP7]: Replace with "Trip Plan is displayed that reflects CE-DTE calculation"? Note that CE-DTE value is not actually displayed to customer

###UC_F_CE-DTE_00002### Route Set: Cancel Route

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		
Precondition	P1	User is a BEV driver
	P2	User planned a route using Trip Planner

	P3	User starts the route in navigation
Main Flow	M1	User cancels active route
	M2	CE-DTE is recalculated based on temperature data
	M3	DTE in vehicle will be updated by filtering in new CE-DTE calculation over time
	M4	Updated CE-DTE is displayed to user using standard method to display DTE
Alternative Flow 1		
Alternative Flow 2		
Post-condition		

Commented [HS(8]: Need to discuss further whether there will be a step change or if it will be filtered in

Decision made with Ryan H. and Mark P. to filter in new calculation over time

Commented [MP9R8]: Confirmed in recent discussions week of April 8

###UC_F_CE-DTE_00003### No Route: Ignition On

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	Ignition on
Main Flow	M1	Customer starts vehicle
	M2	Vehicle queries CE-DTE microservice for impact of current temperature (if vehicle is parked in conditioned environment) and forecasted temperature for upcoming days
	M3	If DTE is < [Cal Value] CE-DTE responds with vehicle adjustment parameters that are incorporated into the HPCM DTE calculation
	M4	CE-DTE is displayed to user using standard method to display DTE
Alternative Flow 1	AF1	If DTE change is >= [Cal value] then HPCM updates DTE as a step change
	AF2	CE-DTE is displayed to user using standard method to display DTE
	AF3	A pop-up is displayed to customer with an explanation of the change
Alternative Flow 2		
Post-condition		

###UC_F_CE-DTE_0005### Route Change Due to Recalculation

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	User planned a route using Trip Planner
	P2	User starts the route in navigation
	P3	The route changed due to a recalculation
	P4	Navigation feature has requested a new route
Main Flow	M1	If DTE is < [Cal Value] CE-DTE responds with vehicle adjustment parameters that are incorporated into the HPCM DTE calculation
	M2	CE-DTE is displayed to user using standard method to display DTE
Alternative Flow 1	AF1	If DTE change is >= [Cal value] then HPCM updates DTE as a step change
	AF2	CE-DTE is displayed to user using standard method to display DTE
	AF3	A pop-up is displayed to customer with an explanation of the change
Alternative Flow 2		

Post-condition		

###UC_F_CE-DTE_0006### New Destination along Route

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	User planned a route using Trip Planner
	P2	User starts the route in navigation
Main Flow	M1	User enters a new destination along route
	M2	If DTE is < [Cal Value] CE-DTE responds with vehicle adjustment parameters that are incorporated into the HPCM DTE calculation
	M3	CE-DTE is displayed to user using standard method to display DTE
Alternative Flow 1	AF1	If DTE change is >= [Cal value] then HPCM updates DTE as a step change
	AF2	CE-DTE is displayed to user using standard method to display DTE
	AF3	A pop-up is displayed to customer with an explanation of the change
Alternative Flow 2		
Post-condition		

###UC_F_CE-DTE_0015### Lost Modem Connectivity

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	Modem connectivity is lost
Main Flow	M1	Filter back to on-board DTE data
Alternative Flow 1		
Alternative Flow 2		
Post-condition		

###UC_F_CE-DTE_0010### Vehicle Data Transfer

Purpose		Build higher trust with the user and reduce range anxiety by providing a more accurate DTE number
Actors		User
Precondition	P1	Historical Efficiency, Vehicle Status, and Driving Habits Data are tracked in the vehicle
	P2	Ignition off
Main Flow	M1	Vehicle transfers Historical Efficiency, Vehicle Status, and Driving Habits Data to CE-DTE microservice
Alternative Flow 1		

Commented [HS(10]: Need to study the size of the data and if it's significant then we need to find an alternate method

Commented [HS(11R10]: Ryan Hunt confirmed values. worst case: 4995 bits from vehicle to cloud (625 bytes), and 1600 bits (200 Bytes) from cloud to vehicle

Alternative Flow 2		
Post-condition		

4.3 Driving and Operation Scenarios

*#**Classification:** Optional (Mandatory for Functional Safety)*
*#**Macro:** Add Ins -> Add Requirement macro (select "Scenario" as type)*
*#**Functional Safety:** Driving and operating scenarios which impact the functionality of the feature can be used to check, if the situation analysis in the HARA is complete*
*#**Link:** RE Wiki – Driving Scenarios*

Not Applicable.

4.4 Decision Tables

*#**Classification:** Optional*
*#**Link:** RE Wiki – Decision Tables.*
*#**Hint:** Use decision table, if behavior is not state based (in that case prefer state chart from ch. 4.1) and based purely on current inputs.*

Not Applicable

~~Input Signal 1~~	~~Input Signal 2~~	~~Input Signal 3~~	~~Input Signal 4~~	~~Output Signal~~
~~Value I1~~	~~Value I2~~			~~Value O1~~

Table 11: Sample Decision Table

5 FEATURE REQUIREMENTS

*#**Macro:** Add Ins -> Add Requirement macro (select "Requirement" as type)*
*#**Functional Safety:** In general, safety requirements are not listed here. However, it is possible that later in the development process, a non-safety requirement becomes a safety requirement. In such a case it may remain on this list.*
*#**Link:** RE Wiki – How to write good requirements.*

5.1 Functional Requirements

###R_F_CE-DTE_0012### Enrollment

When the user activates modem for the first time the vehicle will be auto enrolled in CE-DTE.

End of Requirement

###R_F_CE-DTE_0014### Master Reset

When a master reset is performed the vehicle enrollment status is reset and CE-DTE enrollment is deactivated.

End of Requirement

###R_F_CE-DTE_0013### Enrollment Status

The enrollment status will be maintained within the CE-DTE microservice and verified each time before processing a request.

End of Requirement

###R_F_CE-DTE_0001### Feedback to Customer

User shall be notified within 1 second if change in energy consumption is greater than or equal to [Cal Value].

End of Requirement

###R_F_CE-DTE_0002### Calculating CE-DTE with route

If a route has been set by the user, CE-DTE microservice shall incorporate information learned from the vehicle historical operation, information about the map and elevation obtained either onboard or from the cloud, as well as information obtained from cloud about traffic and weather forecast data to calculate CE-DTE.

End of Requirement

###R_F_CE-DTE_0003### Data Transfer

The vehicle shall transfer Historical Efficiency, Vehicle Status, and Driving Habits Data to CE-DTE microservice at every ignition off.

End of Requirement

###R_F_CE-DTE_0004### Cancel Route

If the user cancels an active route, CE-DTE shall be recalculated based on temperature data and the DTE in vehicle will be updated by filtering in new CE-DTE calculation over time.

End of Requirement

###R_F_CE-DTE_0005### Route Change

If the route changes due to a recalculation, the navigation feature shall request a new route and CE-DTE responds with vehicle adjustment parameters that are incorporated into the HPCM DTE calculation. The new CE-DTE value shall be displayed to the user in the vehicle HMI.

End of Requirement

###R_F_CE-DTE_0007### Calculating CE-DTE with No Route Set

If no route has been set by the user, the vehicle shall query CE-DTE microservice for impact of current temperature (if vehicle is parked in conditioned environment) and forecasted temperature for upcoming days. CE-DTE shall respond with vehicle adjustment parameters that are incorporated into the HPCM DTE calculation.

End of Requirement

5.1.1 Error Handling

- If modem connectivity is lost while user is following route, CE-DTE calculation continues on previously received information.

5.2 Non-Functional Requirements

*#**Hint:** Non-functional requirements specify some performance criteria in addition to the functional behavior given defined by the functional requirements. Timing (if not already included in the functional requirements), security details (e.g. how secure does an algorithm have to be) reliability (e.g. mean time between failure) or maintainability could be specified in this section.*

Not Applicable

5.2.1 Safety

*#**Hint:** Only those safety requirements, which are not related to Functional Safety (ISO26262) should go here. For Functional Safety refer to chapter 6 "Functional Safety~~Functional Safety~~".*

Not Applicable

Formatted: Subtle Emphasis

5.2.2 Security

Not Applicable

5.2.3 Reliability

Not Applicable

5.3 HMI Requirements

*#**Hint:** Requirements in this section could specify details of e.g. the icons, the GUI or the sounds.*

~~A pop-up shall be displayed~~The customer shall be notified in the HMI ~~to the user to indicate~~when there is a significant change in the DTE value based on:

- Destination/Route
- Hilly Terrain
- External Temperature
- Traffic

The ~~pop-up~~notification should include the new DTE, the offset DTE, and the reason for change~~, the new DTE, and previous DTE~~. This information has not been finalized and will be updated based on customer clinic feedback.
A sample pop-up is shown below that is not production intent:

5.4 Other Requirements

5.4.1 Design Requirements

*#**Hint:** Requirements of a Logical Function should be typically agnostic of their SW/HW implementation. If for specific reasons the function owner needs to define explicitly design constraints on the solution, it can be done in this chapter.*

Not Applicable.

5.4.2 Manufacturing Requirements

Not Applicable.

5.4.3 Service Requirements

*#**Hint:** Requirements in this section could specify, e.g. what needs to be considered, if individual ECUs are replaced or new SW is flashed to ECUs (parameter set in non-volatile memory might get inconsistent and needs also to be updated).*

5.4.4 After Sales Requirements

*#**Hint:** Requirements in this section could specify, e.g. input for the Owner's Manual could be gathered.*

5.4.5 Process requirements

*#**Hint**: Requirements in this section are relevant for the development process of the feature, e.g. ISO26262 compliance.*

Not Applicable.

6 FUNCTIONAL SAFETY

*#**Classification**: Functional Safety only*
*#**Hint:** This section is dedicated to the Ford Functional Safety (ISO26262) process. For details of this process refer*
*#**Link:** Ford Functional Safety Sharepoint*
*#**Contact:** RE Wiki Roles & Responsibilites page – Role: Application Functional Safety Engineer*

6.1 System Behaviors for HARA

*#**Classification**: Functional Safety only*
*#**Hint:** List of selected system behaviors is an input to the Hazard Analysis and Risk Assessment (HARA). There needs to be a rationale why other system behaviors / functions are not considered.*

Not Applicable.

ID	Name
~~F_ATC_U0002~~	~~Tilt the vehicle body~~

Commented [MP12]: Remove example?

Formatted Table

Table 12: System Behaviors for HARA

6.2 Safety Assumptions

*#**Hint:** Copy the assumptions from the document "FFSD 02 Hazard Analysis and Risk Assessment", Tab. "2 - Assumptions" with "Ref/ID", "Name", "Category", "Description", "Purpose". In this document, additionally a reference to the requirement ID is inserted.*
*#**Link:** Functional Safety Sharepoint – HARA*

Not Applicable.

ID	Assumption	
1	**Name**	
	Description	
	Purpose	
	Category	
	Related Requirements IDs	
2	**Name**	
	Description	
	Purpose	
	Category	
	Related Requirements IDs	

Table 13: Functional Safety Assumptions

6.3 Safety Goals

*#**Classification**: Functional Safety only*
*#**Hint:** The list of Functional Safety Goals is an output of the Hazard Analysis and Risk Assessment (HARA) and therefore not required during the initial creation of the Feature Document.*
*#**Link:** Functional Safety Sharepoint – HARA*

Not Applicable.

ID	Goal			
1	**Goal Name**			
	Description			
	Safety Goal Concept	<fill in Safety Goal Concept incl. the Warning & Recovery Concept and also the Safe Statel>		
	ASIL		**FTTI**	
	Related FSR IDs			
2	**Goal Name**			
	Description			
	Safety Goal Concept	<fill in Safety Goal Concept incl. the Warning & Recovery Concept and also the Safe State>		
	ASIL		**FTTI**	
	Related FSR IDs			

Table 14: Functional Safety Goals

6.4 Functional Safety Requirements

*#**Classification**: Functional Safety only*
*#**Hint:** The section lists the Functional Safety Requirements (FSRs) derived from a Safety Goal and Assumptions.*
The following should be noted for the use of the attribute fields for FSRs
- The "Source Req" trace link field in each FSR should have a reference to
- a safety goal in ch. 6.3 "Safety Goals" or
- an assumption in ch. 6.2 "Safety Assumptions"

*#**Link:** Functional Safety Sharepoint – Functional Safety Concept*
RE Wiki - Requirements Attributes

6.4.1 <Goal 1 Name>

Not Applicable.

6.4.2 <Goal 2 Name>

Not Applicable.

6.4.3 Derivation of Requirements on Assumptions

*#**Classification**: Functional Safety only*
*#**Hint:** Derive requirements from the Assumptions (refer to section "Safety Assumptions"*
Not Applicable.

6.5 (Decomposed) Functional Safety Requirements

*#**Classification:** Functional Safety Only*
*#**Hint:** For ASIL D features additional measures like a requirements decomposition might be required. Fill out the following table for each ASIL D decomposition applied in the feature. The decomposition rationale is the reason why the decomposition was performed, whereas the rationale for each requirement expresses the reason and thought behind that particular requirement and should include how the requirement is able to independently fulfill the needs of the parent requirement.*
*#**Link:** Functional Safety Sharepoint - Functional Safety Concept*
Not Applicable.

Initial Safety Requirement	Functional Safety Requirement X	
Decomposition Rationale		
Method for Decomposition	Choose a Method	
Functional Safety Requirement 1 after Decomposition	**F-S-Req-ID**	
	F-S-Req. Title	
	ASIL	
	Rationale	
	Allocated to	
Functional Safety Requirement 2 after Decomposition	**F-S-Req-ID**	
	F-S-Req. Title	
	ASIL	
	Rationale	
	Allocated to	
Functional Safety Requirement for Independence *Note: should consider commonly used input, output and processing* *Note: additional row should be added if additional requirements for Independence are necessary*	**F-S-Req.-ID**	
	F-S-Req. Title	
	ASIL	
	Rationale	

Table 15: Requirements Decomposition Table

7 FUNCTIONAL ARCHITECTURE

*#**Classification:** Optional (mandatory for Functional Safety)*
*#**Hint**: This section depicts the coarse Functional Architecture. This architectural step is needed to find the right functional partitioning for the function level. The function shown here are those, which are specified on function level. Either SysML activity diagrams or Data Flow Diagrams could be used to depict such a Functional Architecture. For bigger features, which are decomposed in a hierarchical manner down to atomic functions (and which do not follow the Functional Safety process), a function tree could be given here.*
*#**Links:***
- *Functional Decomposition: RE Wiki – Functional Decomposition*
- *SysML - Activity Diagrams or RE Wiki - Data Flow Diagrams*
- *Data Flow Diagram: RE Wiki – Data Flow Diagram*

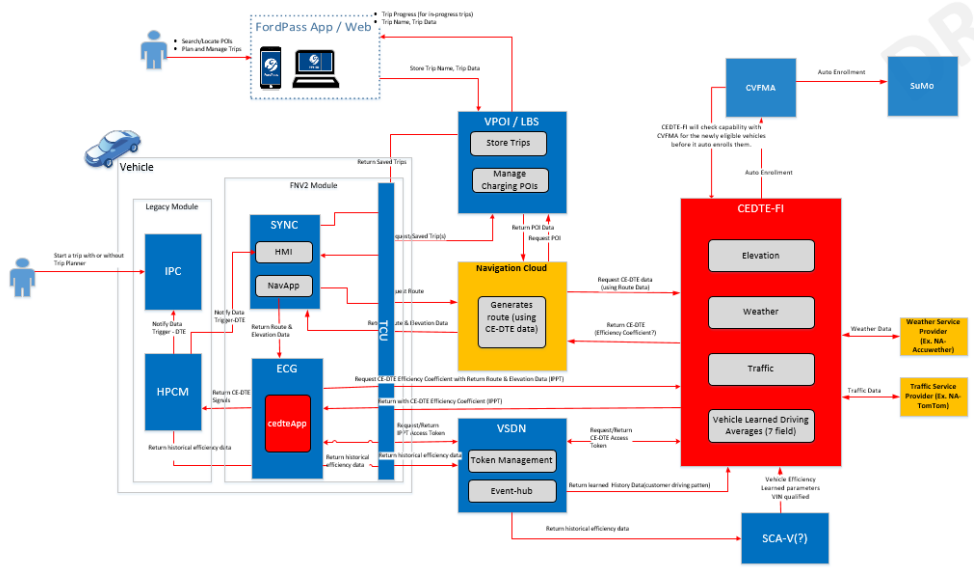

Figure 3: Functional Boundary Diagram

7.1 List of Functions

*#**Hint:** The funcions shown in the Functional Architecture should be listed and described in the table below*

Function Name	Description	Comments
DTE Auto Enrollment and Verification	Get user consent to use vehicle data and verify enrollment before processing CE-DTE requests	
No Route DTE Calculation	CE-DTE calculated using cloud microservice without route and current weather data when no route at key on	
Nav Cloud DTE Calculation	CE-DTE calculated using cloud microservice upon request from Nav Cloud with active route and current data	
Future Route DTE Calculation	CE-DTE calculated using cloud microservice upon request from Nav Cloud with future predicted weather and traffic	
Cancel Route DTE Recalculation	User cancels active route through HMI	
Update Onboard DTE	Update the IPC and HMI based on change to DTE as calculated by HPCM	
Upload Historical Efficiency Data	Upload historical efficiency data to cloud microservice at key off	
Upload Vehicle Status Data	Upload vehicle status data to cloud microservice at key off	
Upload Driving Habits Data	Upload driving habits table data to cloud microservice at key off	

Table 16: List of Functions

8 OPEN CONCERNS

*#**Hint:** The following list presents open concerns, which have to be discussed or clarified over the course of the on-going requirements engineering.*

ID	Concern Description	e-Tracker / Reference	Responsible	Status	Solution
1					
2					
3					
4					
5					
6					
7					
8					
9					

Table 17: Open Concerns

9 REVISION HISTORY

*#**Hint:** A new version number is assigned to a document with a given revision each time it is checked in to Team Center (TCSE). After release of a revision, the document cannot be edited and no new versions can be created on that revision. When updating the document after that, a new revision has to be created and new versions on that revision will be created upon checking in.*

Rev. (revision)	Date	Description	Approved by	Responsible
001	*4/16/2019*	*Initial version*		*shermiz*
002	*4/17/2019*	*Revised based on feedback from Mark Poll* *Added Enrollment use case (###UC_F_CE-DTE_0021### Enrollment)* *Added Enrollment requirement ###R_F_CE-DTE_0012### Enrollment*		*shermiz*
003	*7/23/2019*	*Added Master reset use case ###UC_F_CE-DTE_0022### Master Reset* *Added Master reset requirement ###R_F_CE-DTE_0014### Master Reset*		*shermiz*

10APPENDIX

Document ends here.