

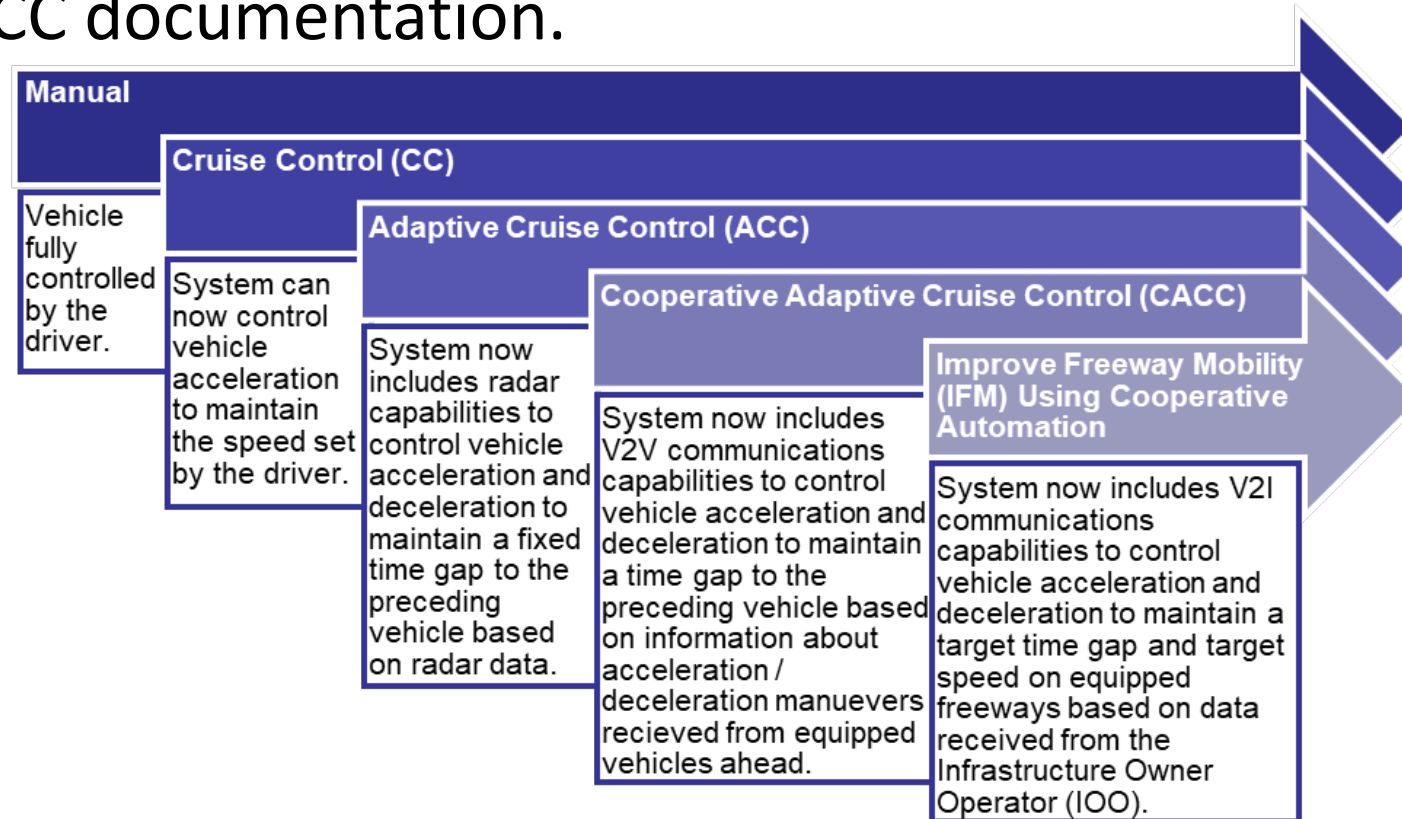
Improving Freeway Mobility Using Cooperative Automation

Concept of Operations and High-Level Requirements

February 19, 2020

Approach

- The IFM concept enhances CACC capabilities by providing infrastructure information to vehicles using secure V2I communications.
- Details about CACC features that IFM will build on can be found in existing CACC documentation.



Identified IFM User Needs

1. All roadway participants (both with or without IFM) to safely co-exist on the same road network.
2. IOOs and all road users drivers need mobility to be maintained or improved.
3. Drivers in vehicles with IFM need to understand IFM modes/functions (CACC/ACC/CC mode, or full manual control).

Identified IFM User Needs

4. To operate in IFM mode, the vehicle needs:
 - a) An IOO-provided current target speed with segment information to indicate the freeway segment for which the target speed applies.
 - i.e. posted speed limit or target speed greater or less than the posted speed limit to increase throughput.
 - b) To receive an IOO-provided current target time gap with segment information to indicate the freeway segment for which the target time gap applies.
 - c) To be aware of nearby downstream vehicles
 - Including information regarding nearby vehicles operating in either CACC or IFM mode to form or join a CACC string of vehicles on an ad-hoc basis.

ConOps Content

Four Perspectives:

IFM Driver's
Perspective

Non-IFM Driver's
Perspective

IFM Vehicle System's
Perspective

Infrastructure Owner-
Operator Perspective

Examples:

IFM driver may notice the speed increasing or decreasing without their input in order to maintain the target time gap.

Drivers in a vehicle without IFM will operate their vehicle as they do now.

Vehicles in IFM mode will adjust speeds to maintain IOO-provided target speed and time gaps.

IOOs will determine and provide a target speed and time gap for specified segments.

Operational Concept: IFM Driver Perspective

		END STATE		
		Manual	CC / ACC / CACC ¹	IFM
CURRENT STATE	Manual		One of the following: a) Driver activation of CACC/ACC/CC; or b) Driver activation of IFM on freeway segment without supporting IOO information	Driver activation of IFM on freeway segment with supporting IOO information
	CC / ACC / CACC ¹	One of the following ² : a) Brake activation b) Driver presses accelerator pedal (temporary override) c) Driver system deactivation d) Failure of forward object detection system		One of the following: a) Driver activation of IFM with supporting infrastructure b) IFM already activated and vehicle enters freeway segment with supporting IOO information
	IFM	One of the following ² : a) Brake activation b) Driver presses accelerator pedal (temporary override) c) Driver system deactivation d) Failure of forward object detection system	One of the following: a) Vehicle no longer traveling on a freeway or freeway lane with supporting IOO information b) Failure of Infrastructure communications	

Transition from Manual to IFM:

- Driver activation of IFM on freeway segment with supporting IOO information

Operational Concept: IFM Driver Perspective

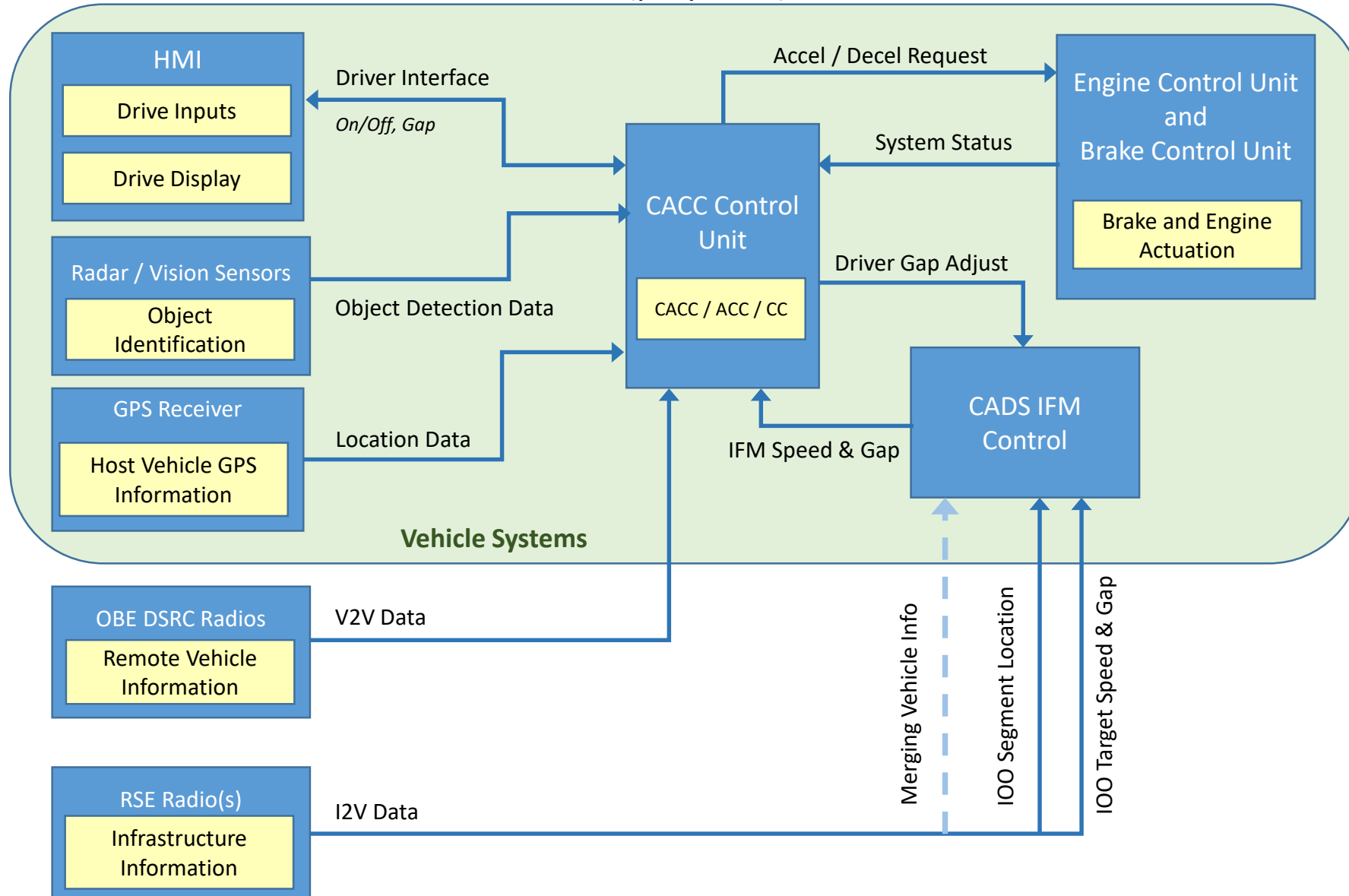
		END STATE		
		Manual	CC / ACC / CACC ¹	IFM
CURRENT STATE	Manual		One of the following: a) Driver activation of CACC/ACC/CC; or b) Driver activation of IFM on freeway segment without supporting IOO information	Driver activation of IFM on freeway segment with supporting IOO information
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Transition from CC/ACC/CACC to IFM:

- Driver activation of IFM on freeway segment with supporting IOO information
- IFM already activated and vehicle enters freeway segment with supporting IOO information

CACC + IFM High Level System-Logic Architecture

(proposed)



Improved Freeway Mobility using Cooperative Automation - Conceptual System Overview

