Interface Document

AWS Extended Log Data Protocol 2

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1. Introduction

This document describes the Extended Log Data Number 2 Protocol of the Mobileye AWS system. The ExtLogData2 Protocol is used to send out internal information and measurements from the AWS technologies – Vehicle Detection, Lane Departure Warning and Forward Collision Warning. The Protocol may be used by OEM's evaluating Mobileye's technologies, or by third party that wants to integrate Mobileye's system into their system (such as Fleet Management, fusion systems, Vision ACC systems, etc…).

In October 2009 the protocol was enhanced to include also reporting of traffic signs detection and Beam control.

In order to enable those, the configuration file needs to include not only "extLogData2" value but also:

- "meAWS" for message 0x700
- "meAHBC" for messages 0x728,0x729
- "meTSR" for messages 0x720-0x727

1.1. Purpose

The purpose of this document is to define the format of a CAN message that is used to send the results of the AWS calculations out.

1.2. Roles

Provide Stakeholder regarding document

Name	Responsibilities
Tal Babaioff, Noa Seri	PM
Eyal Bagon	PSW Manager
Omer Burshtein	QA

1.3. Acronyms and Terminology

Term	Description
CAN	Controller Area Network
CIPV	Closest In Path Vehicle

1.4. References

Document relevant to this document

#	**Document**	**Location**
1	CSV of extLogData2 Protocol	KT

2. CAN messages

2.1. CAN Parameters

- The message is transmitted in an 11bit CAN header format.
- The baud rates is configurable (250, 500 or 1000kbps). Default baud rate is 500Kbps
- The CAN message is transmitted approximately every 66-100 ms.
- ExtLogData2 Protocol activation value in calibration (meio.cfg):
protocol: ”extLogData2”
- TSR and AHBC messages are sent periodically, upon detection (not every frame)

CAN Interface

2.2. ExtLogData2 Protocol

2.2.1. CAN Message 0x650 – Fixed FOE signals

This message contains the fixed FOE X & Y (mainly for visualization purposes)

Bit	*7 (MSB)*	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Fixed Yaw							
Byte 1	Fixed Yaw							
Byte 2	Fixed Yaw							
Byte 3	Fixed Yaw							
Byte 4	Fixed Horizon							
Byte 5	Fixed Horizon							
Byte 6	Fixed Horizon							
Byte 7	Fixed Horizon							

2.2.1.1. Fixed Yaw

Type: Float

Meaning: The fixed FOE X in pixels

2.2.1.2. Fixed Horizon

Type: Float

Meaning: The fixed FOE Y in pixels

2.2.2. CAN Message 0x700 Details – AWS Display

This message contains the Display and Warnings signals.

Bit	*7 (MSB)*	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Suppress	*Reserved*		Night Time	Dusk Time	Sound Type		

Bit	7 (MSB)	6	5	4	3	2	1	0 (LSB)
				Indicator	Indicator			
Byte 1	*Reserved*							
Byte 2	Headway Measurement							HW valid
Byte 3	*Reserved*							0x1
Byte 4	Failsafe	Maintenance	Right Crossing	Left Crossing	FCW on	Right LDW on	Left LDW on	Lanes On
Byte 5	*Reserved*					Ped in DZ	Ped FCW	*Reserved*
Byte 6	*Reserved*							
Byte 7	*Reserved*						Warning Level	

2.2.2.1. Suppress

- Type: bool
- Meaning: When new sound should be played and the old sound stopped, the suppress bit will turn on. Also when a sound should be suppressed, the suppress bit will turn on.

2.2.2.2. Night Time Indicator

- Type: bool
- Meaning: indicates if the system is in night mode (1) or not (0).

2.2.2.3. Dusk Time Indicator

- Type: bool
- Meaning: indicates if the system is in dusk mode (1) or not (0).

2.2.2.4. Sound Type

- Type: unsigned char
- Unit: Enum

0	silent

0	silent
1	LDWL
2	LDWR
3	Far_HW (=HW1/HW2/HW3)
4	Near_HW
5	Soft FCW
6	Hard FCW + Peds FCW
7	Reserved

2.2.2.5. Headway Valid

- Type: bool
- Meaning: When Headway Valid bit is on, the HW measurement field will contain the Headway value.

2.2.2.6. Headway measurement

- Type: unsigned char
- Unit: 0.1 s
- Range: 0 … 9.9

2.2.2.7. Lanes On

- Type: bool
- Meaning: When Lane Detection algorithms are functioning (speed condition), Lanes On bit is on.

2.2.2.8. Left/Right LDW On

- Type: bool
- Meaning: Indicator of Left/Right LDW event.
- Note: The LDW will be ON for 5 consecutive frames, no matter how long the event really is

2.2.2.9. Left/Right Crossing

- Type: bool
- Meaning: Indicator of Left/Right Crossing event.
- Note: The indicator will be given to ONE frame, when the internal Lanes Detection algorithm decides on lane switch

2.2.2.10. Maintenance

- Type: bool

- Meaning: Indicator of internal error. See User Manual.

2.2.2.11. FailSafe

- Type: bool
- Meaning: Indicator of one of the internal FailSafe modes (blur image, saturated image, low sun, partial blockage, partial transparent)

2.2.2.12. FCW on

- Type: bool
- Meaning: There is an FCW warning on a vehicle.

2.2.2.13. Ped FCW

- Type: bool
- Meaning: There is an FCW warning on a pedestrian.

2.2.2.14. Ped in DZ

- Type: bool
- Meaning: There is a DZ warning on a pedestrian (meaning, ped is in Danger zone).

2.2.2.15. Headway Warning Level

- Type: unsigned char
- Unit: HW Level (0-3 which is vehicle warning color).
- Note: changes according to warning scheme setup. Default values:
  - When no CIPV is present, HW Level = 0 (Off)
  - When a CIPV is present with HW >1.0, HW Level = 1 (Green)
  - When a CIPV is present with 0.6 > HW >1.0, HW Level = 2 (Orange)
  - When a CIPV is present with HW < 0.6, HW Level = 3 (Red)

2.2.3. CAN Message 0x720,0x721,…,0x726 Details - TSR

This message contains the TSR recognition.
7 messages are sent to support up to 7 signs in a specific frame.

The number of reported messages will be the number of detected signs in this frame + one additional message with "Vision only Sign Type" = "No sign detected" (unless 7 signs were detected).

This message will be reported for only one frame for each sign. This frame is one frame after the last detection of this sign.

Bit	***7 (MSB)***	***6***	***5***	***4***	***3***	***2***	***1***	***0 (LSB)***
Byte 0	Vision only Sign Type							
Byte 1	Vision only Supplementary Sign Type							
Byte 2	Sign Position X							
Byte 3	Sign Position Y							
Byte 4	Sign Position Z							
Byte 5	Filter Type							
Byte 6	N/A							
Byte 7	N/A							

2.2.3.1. Vision only Sign Type

- Type: Enum
- Values:

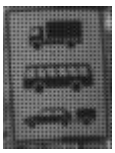
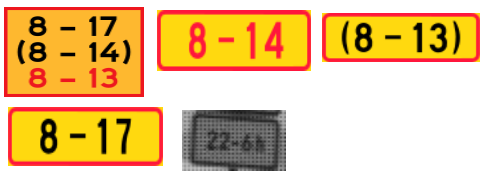
Enum	**Meaning**
0	standard regular 10 kph
1	standard regular 20 kph
2	standard regular 30 kph
3	standard regular 40 kph
4	standard regular 50 kph
5	standard regular 60 kph
6	standard regular 70 kph
7	standard regular 80 kph
8	standard regular 90 kph

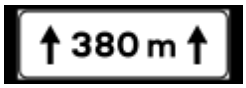
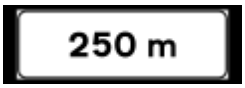
9	standard regular 100 kph
10	standard regular 110 kph
11	standard regular 120 kph
12	standard regular 130 kph
13	standard regular 140 kph
20	standard regular end restriction of number e.g 60 end of restriction.
28	standard electronic 10 kph
29	standard electronic 20 kph
30	standard electronic 30 kph
31	standard electronic 40 kph
32	standard electronic 50 kph
33	standard electronic 60 kph
34	standard electronic 70 kph
35	standard electronic 80 kph
36	standard electronic 90 kph
37	standard electronic 100 kph
38	standard electronic 110 kph
39	standard electronic 120 kph
40	standard electronic 130 kph
41	standard electronic 140 kph
50	standard electronic end restriction of number e.g 60 end of restriction.
64	standard regular general end all restriction.
65	standard electronic general end all restriction.
100	standard regular 5 kph
101	standard regular 15 kph
102	standard regular 25 kph
103	standard regular 35 kph
104	standard regular 45 kph
105	standard regular 55 kph
106	standard regular 65 kph
107	standard regular 75 kph
108	standard regular 85 kph
109	standard regular 95 kph
110	standard regular 105 kph
111	standard regular 115 kph
112	standard regular 125 kph
113	standard regular 135 kph
114	standard regular 145 kph
115	standard electronic 5 kph
116	standard electronic 15 kph
117	standard electronic 25 kph
118	standard electronic 35 kph
119	standard electronic 45 kph
120	standard electronic 55 kph
121	standard electronic 65 kph

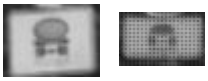
122	standard electronic 75 kph
123	standard electronic 85 kph
124	standard electronic 95 kph
125	standard electronic 105 kph
126	standard electronic 115 kph
127	standard electronic 125 kph
128	standard electronic 135 kph
129	standard electronic 145 kph
171	standard regular motorWay begin
172	standard regular end of fMotorWay
173	standard regular expressWay begin
174	standard regular end of ExpressWay
175	standard regular Playground area begin
176	standard regular End of playground area
200	standard regular no passing start
201	standard regular end of no passing
220	standard electronic no passing start
221	standard electronic end of no passing
254	No sign detected
255	e_invalid_sign

2.2.3.2. Supplementary Signs Types

- Type: Enum
- Values:

Name	Number	Examples	Comments
Rain	1		
Snow	2		
Trailer	3	 	
Time	4		

Arrow_left	5		Not yet supported. Not enough samples to train.
Arrow_right	6		
BendArrow_left	7		Not yet supported. Not enough samples to train.
BendArrow_right	8		In version 2.7 reported as arrow.
Truck	9		
Distance_arrow (distance for)	10	 	The restriction is for x KM. In version 2.7 reported as distance.
Weight	11	 	
Distance_in	12	 	Restriction in X meters from the sign. In version 2.7 reported as distance.
Tractor	13		New sign for 2.8. Not supported in 2.7. Overtake allow only for tractor.
Snow_rain	14		
School	15		Only for USA mode.

Rain_cloud	16		
Fog	17	Nebel	Not yet supported. Not enough samples to train.
Hazardous_materials	18		Reported as e_truck(9). No special class for this supplementary sign. We keep a place for future request.
Night	19		Not yet supported. Not enough samples to train. Only for USA mode.
Supp_sign_generic	20	A small rectangle below the circular sign. Good feature for fusion projects. We find a supplementary sign but we don't know the type of the supplementary sign.	Enable in version 2.8.
e_rappel	21		Support it for internal use. We do not want to declare it as generic supplementary sign since this is only a reminder. Enable in version 2.9.
e_zone	22		Detect the zone word below the sign. Enable in version 2.9.
Invalid_supp	255	Invalid value (should not occur).	
None	0	No supplementary sign was detected.	

2.2.3.3. Sign Position X

- Type: unsigned Int
- Range:0 122
- Resolution: 0.5 meter
- Meaning : The longitudinal position of the sign in the real world in meters.

2.2.3.4. Sign Position Y

- Type: Signed Int

•Range: -32… 31

•Resolution: 0.5 meter

•Meaning：The lateral position of the sign in the real world in meters. Negative refers to left and positive to right.

2.2.3.5. Sign Position Z

•Type: signed Int

•Range: -16… 16

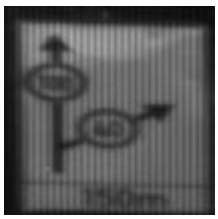
•Resolution: 0.5 meter

•Meaning：The height of the sign in the real world in meters, relative to the camera location. Positive value refers to above the camera. Negative is below the camera.

2.2.3.6. Filter Type

- Type: Enum
- Meaning: The reason for filtering the sign. External filter, filtering visible signs to due irrelevance.
- Values:

Value	**Sign**
0000	Not filtered
0001	Irrelevant to the host driver. I.e.: highway exits, 

	parallel roads, lane assignment sign,  etc.
0010	On vehicle/Truck 
0011	Embedded  

2.2.4. **CAN Message 0x727 Vision only TSR – Continues**

This message contains the TSR Vision only decision – continues value based on real decision.

This message will be reported as long as the sign is relevant.

Bit	*7 (MSB)*	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Vision only Sign Type – Display 1							
Byte 1	Vision only Supplementary Sign Type – Display 1							
Byte 2	Vision only Sign Type – Display 2							
Byte 3	Vision only Supplementary Sign Type – Display 2							
Byte 4	Vision only Sign Type – Display 3							
Byte 5	Vision only Supplementary Sign Type – Display 3							
Byte 6	Vision only Sign Type – Display 4							
Byte 7	Vision only Supplementary Sign Type – Display 4							

2.2.4.1. Vision only Sign Type – Display 1 - 4

Type: Enum

Range: 0-255

Meaning: The speed value is represented according to the speed sign, which is decoded according to the " Vision only Sign Type" table.

2.2.4.2. Vision only Supplementary Sign Type – Display 1-4

Type: Enum

Range: 0-255

Meaning: The supplementary sign type is represented in "Supplementary Signs Types" Table.

2.2.5. CAN Message 0x728 Details – AHBC - high low beam

This message contains the control for high / low beam

	7 (MSB)	6	5	4	3	2	1	0 (LSB)
Byte 0	**Reserved**						**Binary high/low beam decision**	
Byte 1	**Reasons for switch to low beam**							
Byte2	**Reserved**							**Reasons for switch to low beam**

2.2.5.1. Binary high/low beam decision

- Type: enum, 2 bits
- Meaning :

00	0	No recomendation
01	1	Recommendation : high beam OFF
10	2	Recommendation : high beam ON
11	3	Signal invalid

2.2.5.2. Reasons for switch to low beam

- Type: enum, 9 bits
- Meaning : it could be few reason for switching low beam

0 0000 0000	No switch reason
bit 0	Oncoming vehicle
bit 1	Preceding vehicle
bit 2	Speed limit
bit 3	Ambient light
bit 4	Village detection
bit 5	Fog detection – Currently identified on High beam only

bit 6	Highway mode (note: no reason for low beam)
bit 7	Delay (hysteresis)
bit 8	Too many lights

2.2.6. CAN Message 0x729 Details – AHBC Gradual

The message contains information about lights locations and angles to them

	7 (MSB)	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Boundary domain bottom non-glare HLB							
Byte 1	Boundary domain non-glare left hand HLB (LSB)							
Byte 2	Boundary domain non-glare right hand HLB (LSB)				Boundary domain non-glare left hand HLB (MSB)			
Byte 3	Boundary domain non-glare right hand HLB (MSB)							
Byte 4	Object Distance HLB							
Byte 5	Status Boundaries and Object Distance							
Byte 6					BusyScene	TooManyCars	RTargetChange	LTargetChange
Byte 7								

2.2.6.1. Boundary_Domain_Bottom_Non-Glare_HLB

Lower boundary of the glare free area (GFA) in the image, given as angle with respect to the camera coordinate system.
The point of horizon defines 0°; positive angles shall be counted upwards. If no object has been detected, BNDRY_DOM_BOT_NGL_HLB shall be set to 0 and ST_BNDRY_DOM_BOT_NGL_HLB shall be set to 'No object detected'.

Short name: BNDRY_DOM_BOT_NGL_HLB
Invalidity indicator: FFhex
Signal type: 8 Bit, unsigned Integer (Byte 0, Bit 0...Byte 0, Bit 7)
Range: -10 ... 10 deg
Conversion: (PH) = 0.1 * (HEX) - 10 [deg]

2.2.6.2. Boundary_Domain_Non-Glare_Left-Hand_HLB

Left boundary of the glare free area (GFA) in the image, given as angle with respect to the camera coordinate system. The point of horizon defines 0°; positive angles are counted counter clockwise. If no object has been detected, BNDRY_DOM_BOT_NGL_HLB shall be set to 0 and ST_BNDRY_DOM_BOT_NGL_HLB shall be set to 'No object detected'.

Short name: BNDRY_DOM_NGL_LH_HLB
Invalidity indicator: FFhex
Signal type: 12 Bit, unsigned Integer (Byte 1, Bit 0...Byte 2, Bit 3)
Range: -20.0 ... 20 deg
Conversion: (PH) = 0.1 * (HEX) - 20.0 [deg]

2.2.6.3. Boundary_Domain_Non-Glare_Right-Hand_HLB

Right boundary of the glare free area (GFA) in the image, given as angle with respect to the camera coordinate system.
The point of horizon defines 0°; positive angles are counted counter clockwise. If no object has been detected, BNDRY_DOM_BOT_DOM_NGL_HLB shall be set to 0 and ST_BNDRY_DOM_BOT_NGL_HLB shall be set to 'No object detected'.

Short name: BNDRY_DOM_NGL_RH_HLB
Invalidity indicator: FFhex
Signal type: 12 Bit, unsigned Integer (Byte 2, Bit 4...Byte 3, Bit 7)
Range: -20 ... 20.0 deg
Conversion: (PH) = 0.1 * (HEX) - 20 [deg]

2.2.6.4. Object_Distance_HLB

Range of the closest object ahead of the vehicle defining the lower boundary of the glare free area (GFA). If no object has been detected, OBJ_DIST_HLB shall be set to 0 and ST_OBJ_DIST_HLB shall be set to 'No object detected'. If range measurement is not available or not implemented, ST_OBJ_DIST_HLB shall be set to 'signal invalid'.

Short name: OBJ_DIST_HLB
Invalidity indicator: FFhex
Signal type: 8 Bit, Unsigned Integer (Byte 4, Bit 0...Byte 4, Bit 7)
Range: 0 ... 400 m
Conversion: (PH) = (HEX)*2 [m]

2.2.6.5. Status_Boundary_Domain_Bottom_Non-Glare_HLB

State of the lower boundary of the glare free area.

Short name: ST_BNDRY_DOM_BOT_NGL_HLB
Invalidity indicator: 11b
Signal type: 2 Bit, Enum (Byte 5, Bit 0...Byte 5, Bit 1)

Code	Name/Description
00	No object detected (lower boundary not defined)
01	Lower boundary defined by preceding vehicle
10	Lower boundary defined by oncoming vehicle
11	Invalid signal

2.2.6.6. Status_Boundary_Domain_Non-Glare_Left-Hand_HLB

Short name: ST_BNDRY_DOM_NGL_LH_HLB
Invalidity indicator: 11b
Signal type: 2 Bit, Enum (Byte 5, Bit 2...Byte 5, Bit 3)

Code	Name/Description
00	No object detected (left boundary not defined)
01	Left boundary defined by preceding vehicle
10	Left boundary defined by oncoming vehicle
11	Invalid signal

2.2.6.7. Status_Boundary_Domain_Non-Glare_Right-Hand_HLB

Short name: ST_BNDRY_DOM_NGL_RH_HLB
Invalidity indicator: 11b
Signal type: 2 Bit, Enum (Byte 5, Bit 4...Byte 5, Bit 5)

Code	Name/Description
00	No object detected (right boundary not defined)
01	Right boundary defined by preceding vehicle
10	Right boundary defined by oncoming vehicle
11	Invalid signal

2.2.6.8. Status_Object_Distance_HLB

Short name: ST_OBJ_DIST_HLB
Invalidity indicator: 11b
Signal type: 2 Bit, Enum (Byte 5, Bit 6...Byte 5, Bit 7)

Code	Name/Description
00	No object detected (object range not defined)
01	Preceding vehicle detected
10	Oncoming vehicle detected
11	Invalid signal

2.2.6.9. Left Target Change

- Type: 1 bit, boolean
- Range 0:1
- Default value: 0

Indicates when the extreme left target has changed.

0	the extreme left target is the same as before
1	the extreme left target has changed since last frame.

2.2.6.10. Right Target Change

- Type: 1 bit, boolean
- Range 0:1
- Default value: 0

Indicates when the extreme right target has changed.

0	The extreme right target is the same as before
1	The extreme right target has changed since last frame.

2.2.6.11. Too Many Cars

- Type: 1 bit, boolean
- Range 0:1
- Default value: 0

When the number or relevant light sources or vehicles detected by the camera is higher than 12 – this flag is turned on. The flag will be turned off only once then number is 6 or below (these numbers are configurable)

0	The number of relevant light sources and the number of vehicles detected by the camera don't exceed the specified thresholds
1	Too many light sources or vehicles are detected by the camera

2.2.6.12. Busy Scene

- Type: 1 bit, boolean
- Range 0:1
- Default value: 0

The following conditions need to be met for a Busy scene:

- The non-dazzling-area (The U-shape bounding all the approved oncoming and preceding objects in the image) covers at least ~4 degrees, both left and right of the image.
- There are a few vehicles (at least 3) approved by Vehicles Detection technology
- At least one of them is closer than 60m. (If there are more than 5 vehicles detected this condition doesn’t have to be met)

2.2.7. CAN Message 0x737 Details - Lane

The message contains the Lane information and measurements.

	7 (MSB)	6	5	4	3	2	1	0 (LSB)
Byte 0	Lane Curvature (LSB)							
Byte 1	Lane Curvature (MSB)							
Byte 2	Lane Heading (LSB)							
Byte 3	NA	Left LDW Availability	Right LDW Availability	CA	Lane Heading (MSB)			
Byte 4	Yaw Angle (LSB)							
Byte 5	Yaw Angle (MSB)							
Byte 6	Pitch Angle (LSB)							
Byte 7	Pitch Angle (MSB)							

2.2.7.1. Lane Curvature

- Type: signed integer
- Units: 1/m
- Range -0.12 : 0.12 [1/m]
- Conversion: (HEX)*3.81*10^{-6}
- Invalid value: 8000h
- Note: The Curvature (a) parameter in the equation: y= ax^2 + bx+ c
- To extract the road radius (r) from curvature (a): r = 1/(2*a).

2.2.7.2. Lane Heading

- Type: signed integer
- Range: -1.0 : 1.0
- Conversion: (HEX)*0.0005

- Invalid value: 800h
- Note: The Heading (b) parameter in the equation: y= ax^2 + bx+ c

2.2.7.3. CA – construction area

- Type Boolean .

2.2.7.4. Pitch Angle

- The pitch angle information of the host vehicle (derived from lanes analysis).
- Type: unsigned 16 bits
- Unit: radians
- Range: -0.05 : 0.05
- Conversion: (HEX-0x7FFF)/1024/512

2.2.7.5. Yaw Angle

- The yaw angle information of the host vehicle (derived from lanes analysis).
- Type: unsigned 16 bits
- Unit: radians
- Conversion: (HEX-0x7FFF)/1024

2.2.7.6. Right LDW Availability

- Availability of LDW for the Right lane mark.
- Type: 1 bit, unsigned integer
- Range 0 ,1
- Invalid value: none
- 0 stands for unavailable, 1 for available.

2.2.7.7. Left LDW Availability

- Availability of LDW for the Left lane mark.
- Type: 1 bit, unsigned integer
- Range 0 ,1
- Invalid value: none
- 0 stands for unavailable, 1 for available.

2.2.8. CAN Message 0x738 Details – Obstacle Status

This message contains the number of obstacles, the timestamp and the application version. Obstacles can be vehicles, Motorcycles or pedestrians.

	7 (MSB)	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Num_Obstacles							
Byte 1	Timestamp							
Byte 2	Application_Version							
Byte 3	Go!				Right close rang cut in	Left close rang cut in	Active Version Number Section	
Byte 4	Protocol Version							
Byte 5	Reserved			Failsafe				Close Car

2.2.8.1. Num_Obstacles

- Type: unsigned integer
- Range: 0 : 255

2.2.8.2. Timestamp

- Type: unsigned integer
- Unit: milliseconds
- Range: 0 : 255 [ms]
- Note: Only the lowest 8 bits of the timestamp is given. The timestamp source is from the EyeQ image grabbing.

2.2.8.3. Application_Version

- ME software Version number – the available section for this frame.
  The version number is reported during 4 frames long, according to the active version number section (see 3.1.8.3).
  It should consists of X.Y.Z.W, where X is the major version (index 0), Y is the minor (index 1), Z is the customer (index 2), and W is pre/post version (index 3). For example: 2.2.1.15
- Type: 8 bit, unsigned integer

- Range 0 : 255
- Conversion: (Hex)*1
- Invalid value: none

2.2.8.4. Active Version Number Section

The index of the active section of Application_Version signal, which is available for this frame.

- Type: 2 bit, unsigned integer
- Conversion: (Hex)*1
- Range 0 : 3
- Invalid value: none

2.2.8.5. Left close rang cut in

- Type: Boolean
- 0 false, 1 true

2.2.8.6. right close rang cut in

- Type: Boolean
- 0 false, 1 true

2.2.8.7. Go!

- Type: Enum
- Values:
  0 – Stop
  1 – Go!
  2 – Undecided
  3 - Driver decision is required
  …. [4-14 - currently unused]
  15 – Not Calculated

- Current status of this signal:
  - Reports only values of 0 or 1 or 15
  - Reports Stop or Go decisions only when the own vehicle is standing (having ego speed of less than 0.1 meters per second). Otherwise, the value 15 is reported.

2.2.8.8. Protocol Version

The index of current protocol version.

- Type: unsigned char, 8 bit length
- Range: 0x00 .. 0xff

2.2.8.9. Close car

Indication whether we detect a close car in front of the host vehicle or not.

- Type: Boolean
- 0 No close car
  1 Close car exists

2.2.8.10. Failsafe

- Type: 4 bits, unsigned integer
- Range 0 : 7
- Invalid value: 0
- Bitwise signal, which indicates failsafe situation in this scene.

  Values:
  0000 – No Failsafe
  0001 – Low Sun
  0010 – Blur Image
  0100 – unused
  1000 - unused

2.2.9. CAN Message 0x739 + i*3 Details – Obstacle Data A

Where i = 0 : num_obstacles - 1

This message contains obstacle detection information and measurements.

Bit	*7 (MSB)*	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Obstacle_ID							
Byte 1	Obstacle_Pos_X (LSB)							
Byte 2					Obstacle_Pos_X (MSB)			
Byte 3	Obstacle_Pos_Y (LSB)							
Byte 4	Cut in and out			Blinker Info			Obstacle_Pos_Y (MSB)	
Byte 5	Obstacle_Rel_Vel_X (LSB)							
Byte 6	*Reserved*	Obstacle_Type			Obstacle_Rel_Vel_X (MSB)			
Byte 7	Obstacle_Valid		Reserved		Obstacle_Brake_Lights	Obstacle_Status		

2.2.9.1. Obstacle_ID

•Type: unsigned integer

•Range: 0 : 63

•Note: New obstacles are given the last used free ID.

2.2.9.2. Obstacle_Pos_X

•Type: unsigned integer

•Unit: meter

•Range: 0 : 250 [m]

•Conversion: (HEX)*0.0625

•Invalid value: FFFh

•Meaning: The longitude position of the obstacle relative to the reference point. This field is computed from the image position of the obstacle and from the detected width of the obstacle. The value is filtered to provide smooth measurements, and in order to avoid measurements outliers. In General, the value error is below 10% or 2 meters (the larger of the two) in ~85% of the cases.

2.2.9.3. Obstacle_Pos_Y

- Type: signed integer
- Unit: meter
- Range: -31.93 : 31.93 [m]
- Conversion: (HEX)*0.0625
- Invalid value: 200h
- Meaning: The lateral position of the obstacle. This field is computed from the image position of the obstacle and from the Position X value, so that we can report real world coordinates and not just angle from the camera. The value is filtered to provide smooth measurements, and in order to avoid measurements outliers. The typical error is correlated to Pos_X measurement's error.

2.2.9.4. Obstacle_Rel_Vel_X

- Type: signed integer
- Unit: meter/sec
- Range: -127.93 : 127.93 [m/s]
- Conversion: (HEX)*0.0625
- Invalid value: 800h
- Meaning: The relative longitude velocity of the obstacle. This field is computed from the obstacle scale change in the image. The value is a single frame value.

2.2.9.5. Obstacle_Type

- Type: 3 bits, unsigned integer
- Range 0 : 7
- Invalid value: none
- Enumerator signal, which indicates the object's classification
  Enumerator values:
  000 – Vehicle
  001 – Truck
  010 – Bike
  011 – Ped
  100 – Bicycle
  101 – unused
  110 – unused
  111 – unused

2.2.9.6. Obstacle_Status

- Type: unsigned integer

- Unit: Enum

0	Undefined
1	Standing (never moved, back lights are on)
2	Stopped (movable)
3	Moving
4	Oncoming
5	Parked (never moved, back lights are off)
6	Unused

2.2.9.7. Obstacle_Brake_Lights

- Type: 1 bit, boolean
- Range 0:1
- Invalid value: 0
- Conversion: (HEX)*1
- A flag indicating that the object's brake lights are on.

0	object's brake lights are off, or not identified
1	object's brake lights are on

2.2.9.8. Cut in and out

- Type: unsigned integer
- Enum :
  undefined = 0, in_host_lane = 1, out_host_lane = 2, cut_in = 3, cut_out = 4
- The signal is based on our estimation of where the target is now relatively to the lanes, its rate of change, and our estimation of where it is going to be within one second.
- The states are self explanatory. For instance, cut_in means target is now entering host lane, cut_out means it is now exiting host lane, etc.
- The cut in and out signal does not distinguish between sides, i.e. left and right.

2.2.9.9. Blinker Info

- Type: unsigned integer
- Unit: Enum : unavailable=0, off=1, left=2, right=3, both=4.
- Indicated Blinkers status

2.2.9.10. Obstacle_Valid

- Type: unsigned integer
- Unit: Enum

1	New valid (detected this frame)
2	Older valid

2.2.10. CAN Message 0x73A + i*3 Details - Obstacle Data B

Where i = 0 : num_obstacles - 1

This message contains obstacle detection information and measurements.

	7 (MSB)	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Obstacle_Legnth							
Byte 1	Obstacle_Width							
Byte 2	Obstacle_Age							
Byte 3	Radar_Pos_X (LSB)				reserved	CIPV_Flag	Obstacle_Lane	
Byte 4	Radar_Pos_X (MSB)							
Byte 5	Radar_Vel_X (LSB)							
Byte 6	reserved	Radar_Match_Confidence			Radar_Vel_X (MSB)			
Byte 7	reserved	Matched_Radar_ID						

2.2.10.1. Obstacle_Length

- Type: unsigned integer
- Units: meter
- Range: 0 : 31 [m]
- Conversion: (HEX)*0.5
- Invalid value: 3Fh
- Meaning: The length of the obstacle (longitude axis). Updated only for next lane vehicles that are fully seen, and only if the system has found the front edge of the vehicle. We don't have recent information regarding the signal's accuracy.

2.2.10.2. Obstacle_Width

- Type: unsigned integer
- Unit: meter
- Range: 0 : 12.5 [m]
- Conversion: (HEX)*0.05
- Invalid value: FFh

•Meaning: The width of the obstacle (lateral axis). This value is calculated from the width in the image and the obstacle distance. The value is filtered to avoid outliers. The expected performance is to have error < 10% of the width in 90% of the cases. At night, the width measured is between the obstacle's taillights.

2.2.10.3. Obstacle_Age

•Type: unsigned integer

•Range: 0 : 255

•Meaning: The age of the obstacle (in frames). This value starts at 1 when the obstacle is first detected, and increments in 1 each frame. The value reported is min(realAge, 254), which means that it remains 254 if the age is larger than that number.

2.2.10.4. Obstacle_Lane

•Type: unsigned integer

•Unit: Enum

0	Not assigned
1	Ego lane
2	Next lane (left or right), or next next lane
3	Invalid signal

•Note: This value is calculated form the obstacle position and the lane detection or the headway model (yaw rate based or vision based) of the vehicle. The lane assignment decision usually takes up to 5 frames from the first detection of the obstacle.

2.2.10.5. CIPV_Flag

•Type: unsigned integer

•Unit: Enum

0	Not CIPV
1	CIPV

•Note: This value is calculated from the obstacle position and the lane detection or the headway model (yaw rate based or vision based) of the vehicle. The lane assignment decision usually takes up to 5 frames from the first detection of the obstacle.

2.2.10.6. Radar_Pos_X

•Type: unsigned integer

- Unit: meter
- Range: 0 : 250 [m]
- Conversion: (HEX)*0.0625
- Invalid value: FFFh (also in case on no radar target matched)
- Meaning: The longitude position of the primary radar target matched to the vision target (if applicable), distance is given in relative to the reference point and not the camera. If no radar target is matched, the value will be 0xFFFh.

2.2.10.7. Radar_Vel_X

- Type: signed integer
- Unit: meter/sec
- Range: -127.93 : 127.93 [m/s]
- Conversion: (HEX)*0.0625
- Invalid value: 800h (also in case on no radar target matched)
- Meaning: The longitude velocity of the radar target matched to the vision targets (if applicable) . If no radar target is matched, the value will be 0xFFF.

2.2.10.8. Radar_Match_Confidence

- Type: unsigned integer
- Range 0:5 over 3 bits
- Invalid value: 0h
- Meaning: confidence of the radar match:

0: No match

1: Multi match, radar does not describe well the vision obstacle.

2-4: vision - radar match, with bounded error between vision and radar measurements, higher match confidence yield smaller error

5: high confidence match, with small error between Radar and vision measurement

2.2.10.9. Matched_Radar_ID

- Type: unsigned integer
- Range 0:127
- Invalid value: 7fh
- Meaning: ID of Primary radar target matched to the vision target if applicable.

2.2.11. CAN Message 0x73B + i*3 Details - Obstacle Data C

Where i = 0 : num_obstacles - 1

This message contains obstacle detection information and measurements.

Bit	*7 (MSB)*	*6*	*5*	*4*	*3*	*2*	*1*	*0 (LSB)*
Byte 0	Obstacle_Angle_Rate (LSB)							
Byte 1	Obstacle_Angle_Rate (MSB)							
Byte 2	Obstacle_Scale_Change (LSB)							
Byte 3	Obstacle_Scale_Change (MSB)							
Byte 4	Object_Accel_X							
Byte 5	Reserved			Obstacle Replaced			Object_Accel_X	
Byte 6	Obstacle_Angle (LSB)							
Byte 7	Obstacle_Angle (MSB)							

2.2.11.1. Obstacle_Angle_Rate

- Type: signed integer
- Unit: degree
- Range: -327.68 : 327.68 [degree/sec]
- Conversion: (HEX)*0.01
- Meaning: Angle rate of Center of Obstacle in degrees/sec. A negative angle rate indicates that the obstacle has moved to the left (clockwise axis system).
This value is calculated based on delta angles reported from the reference point in two consecutive frames.

2.2.11.2. Obstacle_Scale_Change

- Type: signed integer

- Unit: pix/sec
- Range: -6.5532 : 6.5332 [pix/sec]
- Conversion: (HEX)*0.0002
- Invalid value: 7FFh

2.2.11.3. Object_Accel_X

- The longitude acceleration of the object.
- Type: 10 bit, signed integer
- Range: -14.97 : 14.97 [m/s^2]
- Conversion: (HEX)* 0.03
- Invalid value: 200h

2.2.11.4. Obstacle_Replaced

- Type: boolean

0	Not replaced in this frame
1	Replace in this frame

2.2.11.5. Obstacle_Angle

- Type: signed integer
- Unit: degree
- Range: -327.68 : 327.68
- Conversion: (HEX)*0.01
- Meaning: Angle to Center of Obstacle in degrees. 0 indicates that the obstacle is in exactly in front of us (along the longitudinal axis); a positive angle indicates that the obstacle is to the right (clockwise axis system).
This value is calculated from the reference point, and is based on the obstacle's location in the image and the distance estimation in order to provide measurements in the real world. The angle error can have errors with correlation to the distance measurements error.