Mahindra & Mahindra BT SPP Definition

E2E Requirement Specification

Owner	**Balakrishnan Muthukrishnan**
Author	Sumanthkumar Mara , Amit Vyas
Reviewer	PERUMALLA SIVARAM
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1. Executive Summary

The purpose of the document is to capture requirements to develop E2E system for syncing applications between Vehicle IVI system and Mobile Devices.

In first phase Android and iOS based mobile devices are targeted.

2. Terminology

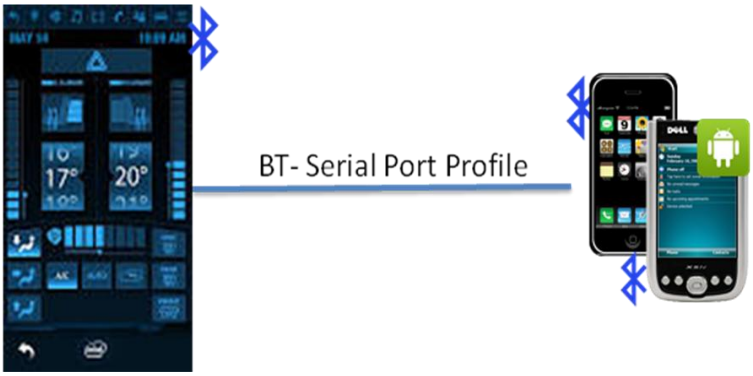
BT	Bluetooth
SPP	Serial Port Profile
PRD	Product Requirement Document
DTE	Distance To Empty
CAN	Controller Area Network
GSM / GPRS / UMTS	Cellular Networks
OE	Original Equipment (Automotive Vehicle) Manufacturer Mahindra Automotive
APP_ID	Application ID
MSB	Most Significant Bit
LSB	Least Significant Bit
CRC	Cyclic Redundancy Check
A/C	Air Condition
ECON	Economy
ACK	Acknowledgement
NAK	Negative Acknowledgement
KMPL	Kilometer Per Liter
IVI	In-Vehicle Infotainment

3. References

1. M&M_BTSPP_Doc_v1.0.pdf

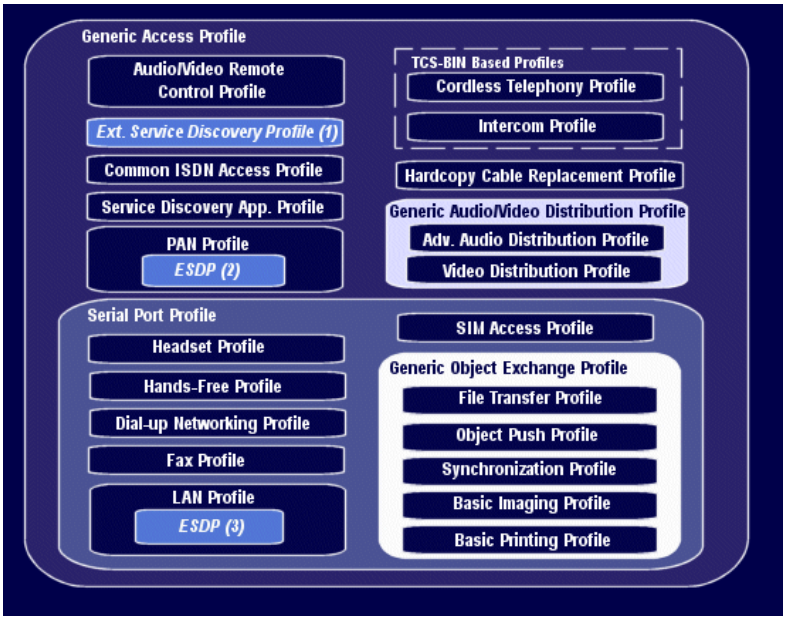
4. E2E System Overview

To enable seamless and easy syncing of applications/data between Vehicle IVI system and Mobile Devices **'Bluetooth *Serial Port Profile*'** will be used as wireless communication protocol.

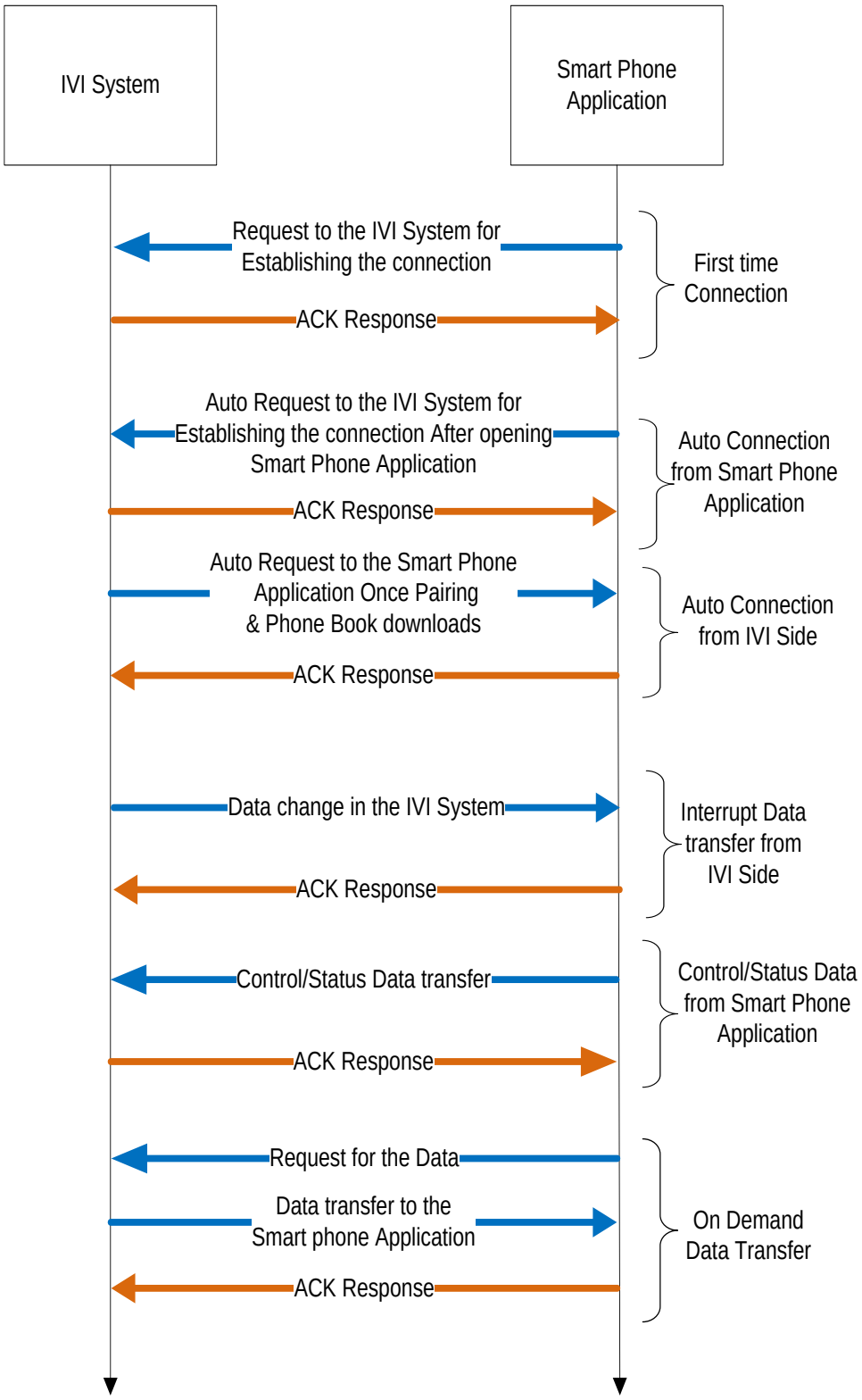


5. Vehicle IVI system and Mobile Device Communication

IVI system and Mobile devices will communicate using ***BT Serial Port Profile***.



5.0 IVI & Device Application Communication Sequences



5.1 About BT-Serial Port Profile Specification

A Bluetooth profile is a specification regarding an aspect of Bluetooth based wireless communication between devices.

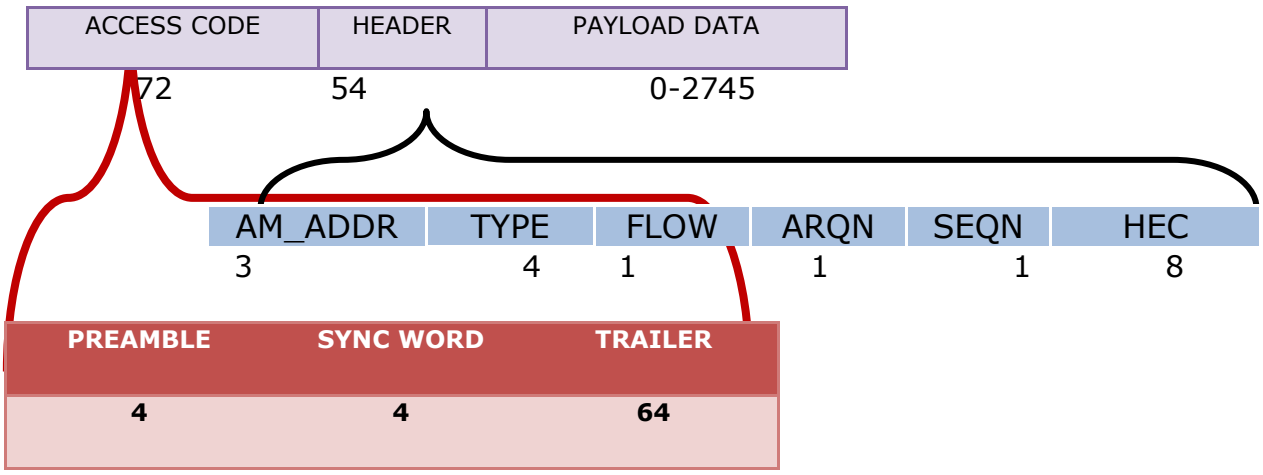
A profile specifies a list of mandatory and optional features that a device should implement. It also specifies the communication procedure to guarantee interoperability between different products.

5.2 Serial Port Profile Procedure Requirements

Vehicle IVI system and Mobile device shall communicate using Bluetooth by Serial Profile Protocol (SPP).The procedure of the SPP shall follows structured data communication a.k.a. payload structure.

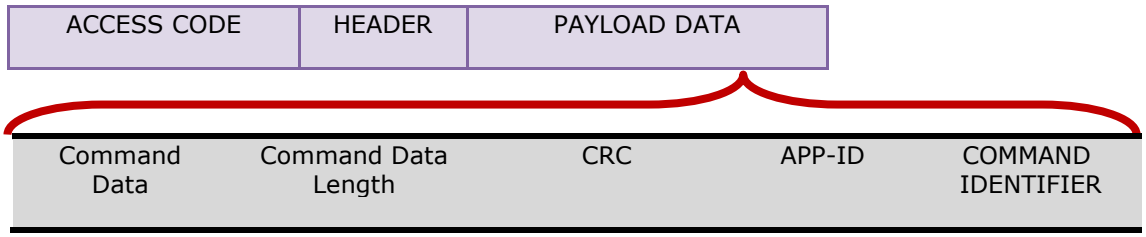
5.2.1 Payload Structure Requirements

General Payload Structure



Header	Key	Description
	AM_ADDR	3 Bit active member address
	TYPE	4 Bit type code (SCO, ACL, …)
	FLOW	Flow Control
	ARQN	1 Bit Acknowledge Indication
	SEQN	1 Bit Sequence Number
	HEC	8 Bit Header Error Check.
ACCESS CODE		

Preamble	'0101'or '1010'. '0101'on sync word's beginning is 0 and vice versa.
Trailer	'0101'or '1010'. '0101'on sync word's beginning is 0 and vice versa. ID Packets do not have trailers.
Sync Word	Generated from 24-bit LAPs



PS.REQ-01: Payload structure shall have ***Command Identifier***, ***App-ID, Reserved Bit(s)***, ***Cyclic Redundancies Check (CRC),Command Data length and Data***. **Refer Appendix A** for definition.

PS.REQ-02: Payload structure shall have data in binary format to have platform interoperability.

PS.REQ-03:Contains data or command to request.

PS.REQ-04: Payload structure attributes with alpha numeric values shall be converted to ASCII and then Binary format.

Alphanumeric Value -> Decimal -> Binary

PS.REQ-05: Reserved bits in Payload structure shall be filled with 0 (Zero).

PS.REQ-06: Payload structure empty allocated values shall be shall be filled with NULL value.

PS.REQ-07: Payload structure shall provide bits to represent Negative values.

MSB of that particular Payload data will represent the signature of the data. MSB:{0} Positive values. MSB:{1} Negative values.

5.2.2 Device (IVI & Mobile) Communication Requirements

There are three ways of data communication between Mobile Application and IVI system viz. Initial, Interrupt and OnDemand.

IVI to Mobile

DC.Req-01: IVI system shall be able to auto discover and connect with BT enabled mobile device(s).

DC.Req-02: IVI system shall have ability to interrupt data transfer to BT enabled Mobile Device.

DC.Req-01: Mobile application shall be able to establish connection with IVI system.
DC.Req-02: Mobile devices shall have ability to auto discover and connect with IVI system.
DC.Req-03: Mobile devices shall have ability to control data transfer to IVI system.
DC.Req-04: Mobile devices shall have ability to make On Demand data transfer to IVI system.
DC.Req-04: Mobile devices shall have ability to retry for failed communication with IVI system.
DC.Req-04.1: Mobile devices shall have configurable timeout value for IVI system response.
DC.Req-04.2: Mobile devices shall have configurable number of retires.
DC.Req-04.3: Mobile devices shall have configurable retry frequency time.
DC.Req.-05: In case IVI fails to respond for the first time, application status shall be retry in 5 seconds.

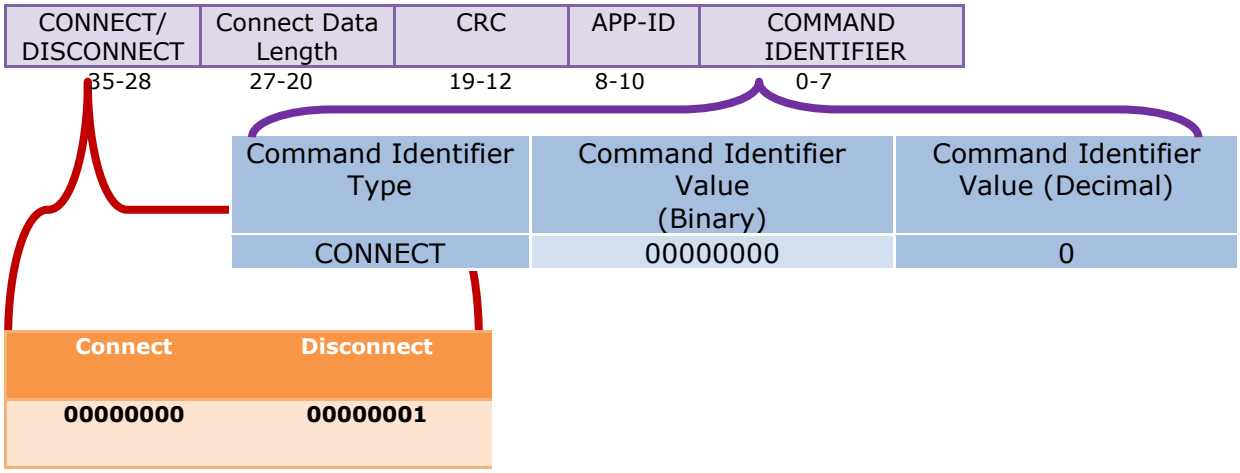
5.2.3 Device (IVI & Mobile) Communication Message Type Requirements

The communication between IVI system and Mobile Device Applications are logically segregated in various messages. All messages shall have below mandatory attributes

Command Identifier	**Describes the type of message between IVI and Mobile Device App.**	**8 Bit**
CRC	Cyclic Redundancy check code.	8 Bit
APP-ID	Assign IVI system for the Mobile Device App.	3 Bit

5.2.4 Connect Message

Connect message required to initiate connection from Mobile Device to IVI system and Vice Versa.



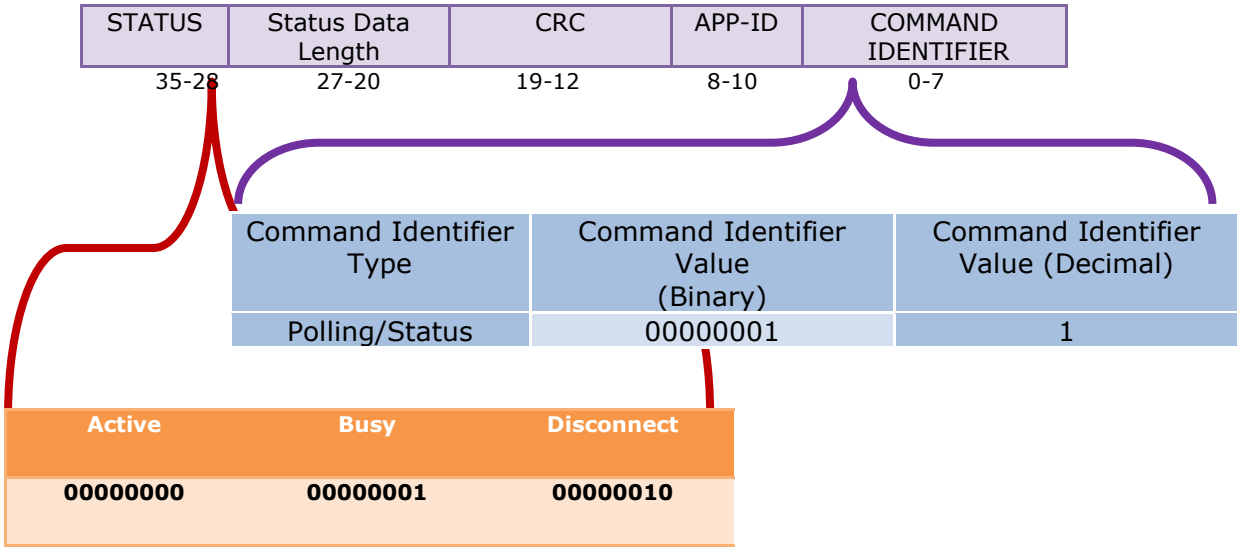
Example:

Command Value & Reserved Bits	Data Length	CRC	APP-ID	COMMAND IDENTIFIER
00000000	00000001	CRC	001	00000000

5.2.5 Polling/Status Message

Status Message will describe whether the connection status is in on-line/off-line. The mobile device application shall update its status in every 30 sec, consequently IVI responds acknowledgement of the status.

Status message shall communicate like polling mechanism between IVI and mobile device application.



Example:

Command Value & Reserved Bits	Data Length	CRC	APP-ID	COMMAND IDENTIFIER
00000000	00000001	CRC	001	00000001

5.2.6 Data Message (Control/Status)

Data message will describes the original data flow message between the IVI and Smart Phone Application for different features describes in the other section.

Data	Data Length in Bytes	CRC	APP-ID	COMMAND IDENTIFIER
(Variable)	8 bits	8 bits	3 bits	8 bits

5.2.7 Request Message (Control/Status)

IVI will send a request message to the infotainment for getting the respective information based on the request command identifier and vice versa.

REQUEST FOR IDENTIFIER	CRC	APP-ID	REQUEST COMMAND
27-20	19-12	8-10	0-7

5.2.8 Acknowledgment Message

Acknowledgment message to update requested data successfully delivered or not.

ACK /NAK	ACK/NAK Data Length	CRC	APP-ID	COMMAND IDENTIFIER
35-28	27-20	19-12	8-10	0-7

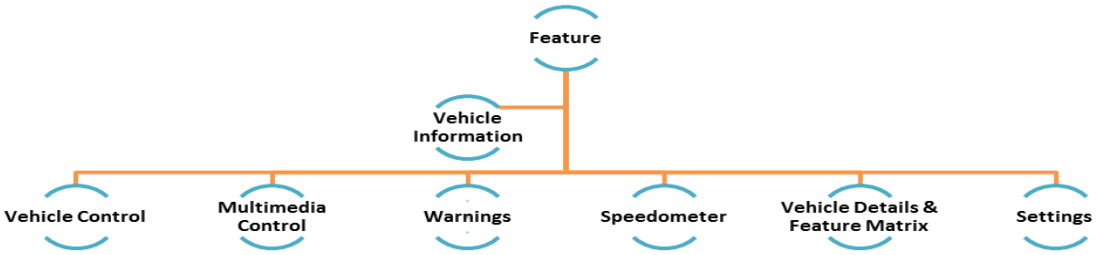
Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
ACKNOWLEDGMENT	00000010	2

ACK	NAK
00000000	**00000001**

Example:

Command Value & Reserved Bits	Data Length	CRC	APP-ID	COMMAND IDENTIFIER
00000000	00000001	CRC	001	00000010

6. Feature List (IVI and Mobile Devices)



6.1 Vehicle Information

Vehicle Information contains all above sub features. IVI system shall send initial vehicle information and later notify the updates.

IVI System and Mobile Device message payload structure.

6.1.1 Tiretronics

Tiretronics contains pressure and temperature data of tires.

Temperature and Pressure use 4 bytes in which 1 bit (MSB) represents positive/negative, 2 byte Decimal, 1 byte for ASCII (.) and 1 byte for fraction part.
e.g. + 35.5 – 00000000 00100011 00101110 00000101

Request from Mobile Application:

TIRETRONICS	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
TIRETRONICS	00001000	8

Response from IVI:

TIRETRONICS RESPONSE	TIRETRONICS DATA LENGTH	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

Front Left Temperature Data	**Front Left Temperature Length**	**Front Left Temperature Command (00000001)**	**Front Left Pressure Data**	**Front Left Pressure Length**	**Front Left Pressure Command (00000000)**
122-92	91-84	83-76	75-44	43-36	35-28

Front Right Temperature Data	**Front Right Temperature Length**	**Front Right Temperature Command (00000011)**	**Front Right Pressure Data**	**Front Right Pressure Length**	**Front Right Pressure Command (00000010)**
217-186	185-178	177-170	169-138	137-130	129-122

Rear Left Temperature Data	**Rear Left Temperature Length**	**Rear Left Temperature Command (00000101)**	**Rear Left Pressure Data**	**Rear Left Pressure Length**	**Rear Left Pressure Command (00000100)**
313-282	281-274	273-266	265-234	233-226	225-218

Rear Right Temperature Data	**Rear Right Temperature Length**	**Rear Right Temperature Command (00000111)**	**Rear Right Pressure Data**	**Rear Right Pressure Length**	**Rear Right Pressure Command (00000110)**
385-354	353-346	345-338	337-330	329-322	321-314

Spare Temperature Data	**Spare Temperature Length**	**Spare Temperature Command (00001001)**	**Spare Pressure Data**	**Spare Pressure Length**	**Spare Pressure Command (00001000)**
481-450	449-442	441-434	433-402	401-394	393-386

Example:

Decimal Value	MSB	Data
FLP = 30.25 psi	**0**	**000000000011110 00101110 00011001**
FLT = 100.0 degree	**0**	**000000001100100 00101110 00000000**
FRP = 30.25psi	**0**	**000000000011110 00101110 00011001**
FRT= 100.0 degree	**0**	**000000001100100 00101110 00000000**
RLP= 32.50 psi	**0**	**000000000100000 00101110 00110010**

RLT = 100.0 degree	**0**	**000000001100100 00101110 00000000**
RRP = 32.50 psi	**0**	**000000000100000 00101110 00110010**
PRT= 100.0 degree	**0**	**000000001100100 00101110 00000000**
SPAREP = 30.25 psi	**0**	**000000000011110 00101110 00011001**
SPARET= 100.0 degree	**0**	**000000001100100 00101110 00000000**

00001000|001|8-bit CRC |00111100|00000000|00000100|0000000000011110
0010111000011001|00000001|00000100|00000000011001000010111000000000000
00010|00000100|00000000000111100010111000011001000000011|00000100|00000
0000110010000101110000000000000100|00000100|00000000001000000010111000
011001000000101|00000100|00000000011001000010111000000000000000111|0000
0100|00000000001000000010111000110010000010000|00000100|000000000110010
0001011100000000000010001|00000100|00000000000111100010111000011001000
01010|00000100|00000000011001000010111000000000

6.1.2 Fuel Statistics

Fuel Statistics provides information of Average fuel economy (KMPL) and Distance to empty (KM).

Request from Mobile Application:

FUEL STATISTICS	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
FUEL STATISTICS	0000 1010	10

Response from IVI:

FUEL STATISTICS Response	FUEL STATISTICS DATA LENGTH	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

DTE Data	**DTE Length**	**DTE Command (00000001)**	**Average Fuel Economy Data**	**Average Fuel Economy Data Length**	**Average Fuel Economy Command (00000000)**
99-84	83-76	75-68	67-44	43-36	35 -28

Example:

Decimal Value	Data
AVG Fuel Economy= 50.5 KMPL	**00110010 00101110 00000101**
DTE = 10Km	**00000000 00001010**

00001010|001|8bitCRC|00001001|00000000|00000011|0011001000101110000000101|00000001|00000010|0000000000001010

6.1.3 MBFM Status

MBFM status provides ON/OFF status of Auto wiper, Auto lamp, Park lamp and Out Temperature.

Request from Mobile Application:

MBFM STATUS	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
MBFM STATUS	00001011	11

MBFM Status payload from IVI/Mobile Application:

MBFM STATUS Response	MBFM STATUS DATA	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

Auto Lamp Data	**Auto Lamp Length**	**Auto Lamp Command (00000001)**	**Auto Wiper Data**	**Auto Wiper Data Length**	**Auto Wiper Command (00000000)**
75-68	67-60	59-52	51-44	43-36	35 -28

Out Temperature Data	**Out Temperature Data Length**	**Out Temperature Command (00000011)**	**Park Lamp Data**	**Park Lamp Data Length**	**Park Lamp Command (00000010)**
147-116	115-108	107-100	99-92	91-84	83-76

Example:

Decimal Value	MSB	Data
AUTO WIPER = ON	**-**	**00000001**
AUTO LAMP = ON	**-**	**00000001**
PARK LAMP =ON	**-**	**00000001**
OUT TEMPERATURE=40.0	**0**	**0000000 00101000 00101110 00000000**

00001011|001|8bitCRC|00001111|00000000|0000001|00000001|00000001|0000001|00000001|00000010|0000001|00000011|00000100|0000000000101000001011100000000

6.2 Vehicle Control

6.2.1. Climate Control

Climate Control contains set temperature, Vent Mode, A/C mode (Econ/Auto), HVAC display, Air Circulation.

Request from Mobile Application:

CLIMATE CONTROL	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
CLIMATE CONTROL	00001001	9

Climate Control payload from IVI/Mobile Application:

CLIMATE CONTROL	CLIMATE CONTROL DATA LENGTH	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

ECON Data	**ECON Length**	**ECON Command (00000001)**	**A/C Data**	**A/C Data Length**	**A/C Command (00000000)**
75-68	67-60	59-52	51-44	43-36	35 -28

Set Temp Data	**Set Temp Length**	**Set Temp Command (00000011)**	**Blower Speed Data**	**Blower Speed Data Length**	**Blower Speed Command (00000010)**
147-116	115-108	107-100	99-92	91-84	83-76

HVAC Data	HVAC Length	HVAC Command (00000101)	Air Circulation Data	Air Circulation Data Length	Air Circulation Command (00000100)
195-188	187-180	179-172	171-164	163-156	155-148

Vent Mode Data	Vent Mode Length	Vent Mode Command (00000111)	Auto Data	Auto Data Length	Auto Command (00000110)
243-236	235-228	227 -220	219-212	211-204	203-196

OFF	DEFROST	VENT	FLOOR	VENT FLOOR	FLOOR & DEFORST
00000000	00000001	00000010	00000011	00000100	00000101

Example:

Decimal Value	MSB	Data
AC = ON	-	00000001
ECON = ON	-	00000001
BLOWER SPEED =5	-	00000101
SET TEMPERATURE=16.5	0	0000000 00010000 00101110 00000101
AIR CIRCULATION = ON	-	00000001
HVAC DISPLAY = ON	-	00000001
AUTO = ON	-	00000001
VENT MODE = DEFROST	-	00000001

00001001|001|8bitCRC|00011011|00000000|0000001|00000001|00000001|0000001|00000001|00000010|0000001|00000101|00000011|00000100|0000000000100000101111000000101|00000100|0000001|00000001|00000101|0000001|00000001|00000111|0000001|00000001|00001000|0000001|00000001

6.2.2 MBFM Control

MBFM control provides information about Mahindra body functional controls status contains Rear Defogger status.

Request from Mobile Application:

MBFM CONTROLS	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
MBFM CONTROLS	00001100	12

MBFM Control payload from IVI/Mobile Application:

MBFM CONTROLS Response	MBFM CONTROLS DATA LENGTH	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

Rear Defogger Data	**Rear Defogger Data Length**	**Rear Defogger Command (00000000)**
51-44	43-36	35 -28

Example:

Decimal Value	Data
REAR DEFOGGER = ON	**00000001**

00001100|001|8bitCRC|00000011|00000000|00000001|00000001

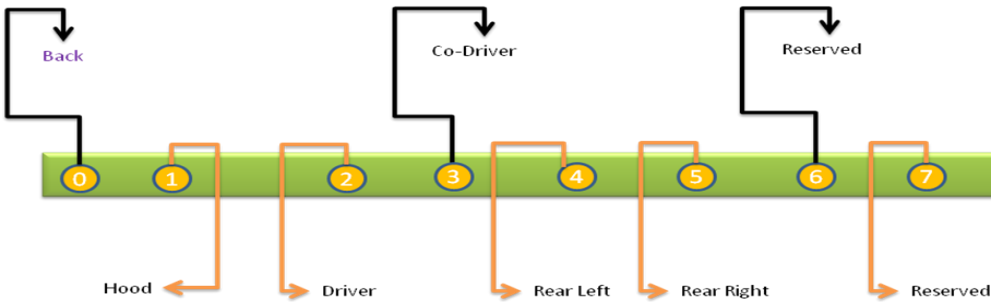
6.3 Warnings

Warnings are list of alerts which are subscribed by Mobile applications. The alert shall popped if application is in foreground, shall appear as notification if application is in background and same alert shall be displayed on IVI system screen too.

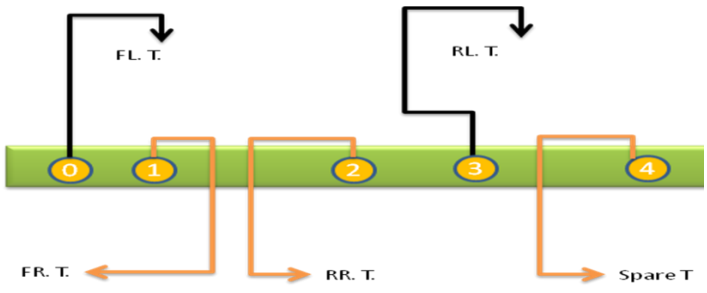
Warnings like Tyre pressure, Tyre Temperature, Tyre malfunctions occupy 1-bit each in given data.

Warning Types

ABS/ESPMalfunctions	**High Tyre Temperature**	**Low Tyre Pressure**	**High Tyre Pressure**	**Low Tyre Temperature**	**TPME Leakage Alert**
Brake ware Alert	**Water in fuel**	**Brake Vacuum Pressure**	**Distance to Empty**	**Engine Lamp**	**Check Lamp**
High Engine Temperature Alert	**Low Oil Pressure**	**Reserve Fuel Warning**	**Hand Brake**	**Air Filter Clog**	**Brake Fluid Alert**
TPME Malfunction Alert	**TPME Program Mode**	**TPMS Signal Missing**	**TPMS ID not learnt**	**Low Break Fluid Alert**	**Seat Belt Alert**
Door Open	**Air Bag Lamp**				

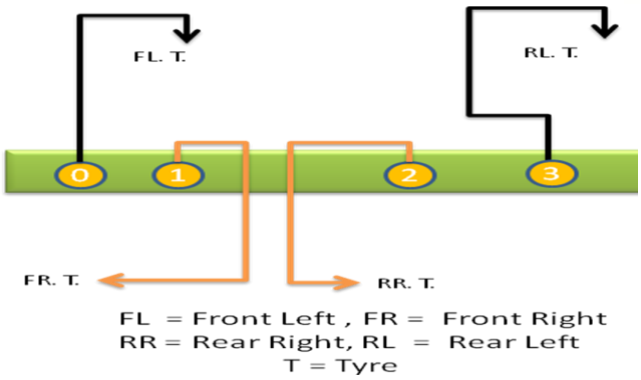


Door Open: 8 Bits Value Pattern

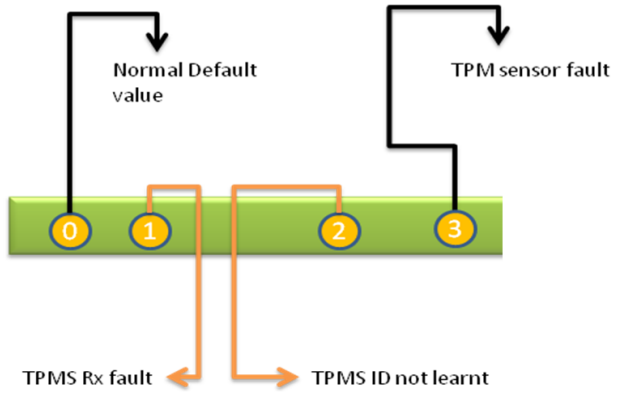


FL = Front Left , FR = Front Right
RR = Rear Right, RL = Rear Left
T = Tyre

High/Low Tyre Pressure/Temprature and TPMS Learn/No Learn: 5 Bit Value Pattern



TPMS Signal Missing Alert / Spare Tyre Swapped: 4 Bit Value Pattern



TPMS Malfunction Alert: 4 Bit Value Pattern

Request from Mobile Application:

WARNINGS	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
WARNINGS	00001101	13

Response from IVI:

Warnings Response	Warnings data Length	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

High Tyre Pressure Data	**High Tyre Pressure Data Length**	**High Tyre Pressure Command (00000001)**	**Door Open Data**	**Door Open Data Length**	**Door Open Command (00000000)**
91-76	75-68	67-60	59-44	43-36	35-28

High Tyre Temperature Data	**High Tyre Temperature Data Length**	**High Tyre Temperature Command (00000011)**	**Low Tyre Pressure Data**	**Low Tyre Pressure Data Length**	**Low Tyre Pressure Command (00000010)**
155-140	139-132	131-124	123-108	107-100	99-92

TPMS Leakage Alert Data	**TPMS Leakage Alert Data Length**	**TPMS Leakage Alert Command (00000101)**	**Low Tyre Temperature Data**	**Low Tyre Temperature Data Length**	**Low Tyre Temperature Command (00000100)**
218-203	203-196	195-188	187-172	171-164	163-156

TPMS Program Mode Data	**TPMS Program Mode Data Length**	**TPMS Program Mode Command (00000111)**	**TPMS Malfunction Alert Data**	**TPMS Malfunction Alert Data Length**	**TPMS Malfunction Alert Command (00000110)**
274-259	258-251	250-243	242-235	234-227	226-219

TPMS ID Not Learnt Data	**TPMS ID Not Learnt Data Length**	**TPMS ID Not Learnt Command (00001001)**	**TPMS Signal Missing Data**	**TPMS Signal Missing Data Length**	**TPMS Signal Missing Command (00001000)**
338-323	322-315	314-307	306-291	290-283	282-275

Seat Belt Alert Data	**Seat Belt Alert Data Length**	**Seat Belt Alert Command (00001011)**	**Low Break Fluid Alert Data**	**Low Break Fluid Alert Data Length**	**Low Break Fluid Alert Command (00001010)**
386-379	378-371	370-363	362-355	354-347	346-339

Low Oil Pressure Data	Low Oil Pressure Data Length	Low Oil Pressure Command (00001101)	High Engine Temperature Alert Data	High Engine Temperature Alert Data Length	High Engine Temperature Alert Command (00001100)
434-427	426-419	418-411	410-403	402-395	394-387

Hand Brake Data	Hand Brake Data Length	Hand Brake Command (00001111)	Reserve Fuel Warning Data	Reserve Fuel Warning Data Length	Reserve Fuel Warning Command (00001110)
482-475	474-467	466-459	458-451	450-443	442-435

Brake Fluid Data	Brake Fluid Data Length	Brake Fluid Command (00010001)	Air Filter Clog Data	Air Filter Clog Data Length	Air Filter Clog Command (00010000)
530-523	522-515	514-507	506-499	498-491	490-483

Water In Fuel Data	Water In Fuel Data Length	Water In Fuel Command (00010011)	Brake ware Alert Data	Brake ware Alert Data Length	Brake ware Alert Command (00010010)
578-571	570-563	562-555	554-547	546-539	538-531

Distance To Empty Data	Distance To Empty Data Length	Distance To Empty Command (00010101)	Brake Vaccume Pressure Data	Brake Vaccume Pressure Data Length	Brake Vaccume Pressure Command (00010100)
626-619	618-611	610-603	602-595	594-587	586-579

Check Lamp Data	Check Lamp Data Length	Check Lamp Command (00010111)	Engine Lamp Data	Engine Lamp Data Length	Engine Lamp Command (00010110)
674-667	666-659	658-651	650-643	642-635	634-627

Airbag Lamp Data	Airbag Lamp Data Length	Airbag Lamp Command (00011001)	ABS/ESP Malfunction Lamp Data	ABS/ESP Malfunction Lamp Data Length	ABS/ESP Malfunction Lamp Command (00011000)
724-717	716-707	706-699	698-691	690-683	682-675

Example:

Decimal Value	Data
Door Open	00000000 00011000
High Tyre Pressure	00000000 00000100
Low Tyre Pressure	00000000 00001000
High Tyre Temperature	00000000 00000000
Low Tyre Temperature	00000000 00000000
TPMS Leakage Alert	00000000 00001000
TPMS Malfunction Alert	00000000
TPMS Program Mode	00000000 00000001
TPMS Signal Missing	00000000 00000000
TPMS ID not learnt	00000000 00000000
Low Break Fluid Alert	00000000
Seat Belt Alert	00000001
High Engine Temperature Alert	00000000
Low Oil Pressure	00000001
Reserve Fuel Warning	00000001
Hand Brake	00000000
Air Filter Clog	00000000
Brake Fluid Alert	00000000
Brake ware Alert	00000000

Water in Fuel	**00000000**
Brake Vacuum Pressure	**00000000**
Distance to Empty	**00000000**
Engine Lamp	**00000000**
Check Lamp	**00000000**
ABS/ESP Malfunction Lamp	**00000000**
Air Bag Lamp	**00000000**

00001101|001|8bitCRC|01011101|00000000|00000001|0001100000000000|00000001|00000001|0000010000000000|00000010|00000001|0000100000000000|00000011|00000001|0000000000000000|00000100|00000001|0000000000000000|00000101|00000001|0000100000000000|00000111|00000001|00000000|00001000|00000001|0000000100000000|00001001|00000001|00000000|00001010|00000001|00000000|00001011|00000001|00000000|00001100|00000001|00000001|00001101|00000001|00000000|00001110|00000001|00000001|00001111|00000001|00000001|00010000|00000001|00000000|00010001|00000001|00000000|00010010|00000001|00000000|00010011|00000001|00000000|00010100|00000001|00000000|00010101|00000001|00000000|00010110|00000001|00000000|00010111|00000001|00000000|00011000|00000001|00000000|00011001|00000001|00000000|00011010|00000001|00000000

6.4 Speedometer Details

Speed data is sent to mobile application on connected to IVI system. Mobile application sends speedometer request with time interval (seconds) to update speed data. Speed need to update for every 5 second or per user inputs.

Request from Mobile Application:

SPEEDOMETER Update (in Secs)	SPEEDOMETER	CRC	APP-ID	REQUEST COMMAND
41-27	26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
SPEEDOMETER	00000110	6

Response from IVI:

SPEEDOMETER Response	SPEEDOMETER DATA	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

Speed Info Data	**Speed Info Data Length**	**Speed Info Command (00000000)**
59-44	43-36	35 -28

Example:

Decimal Value	Data
Speed value - 100	**00000000 01100100**

00000110|001|8bitCRC|00000100|00000000|00000010|0000000001100100|

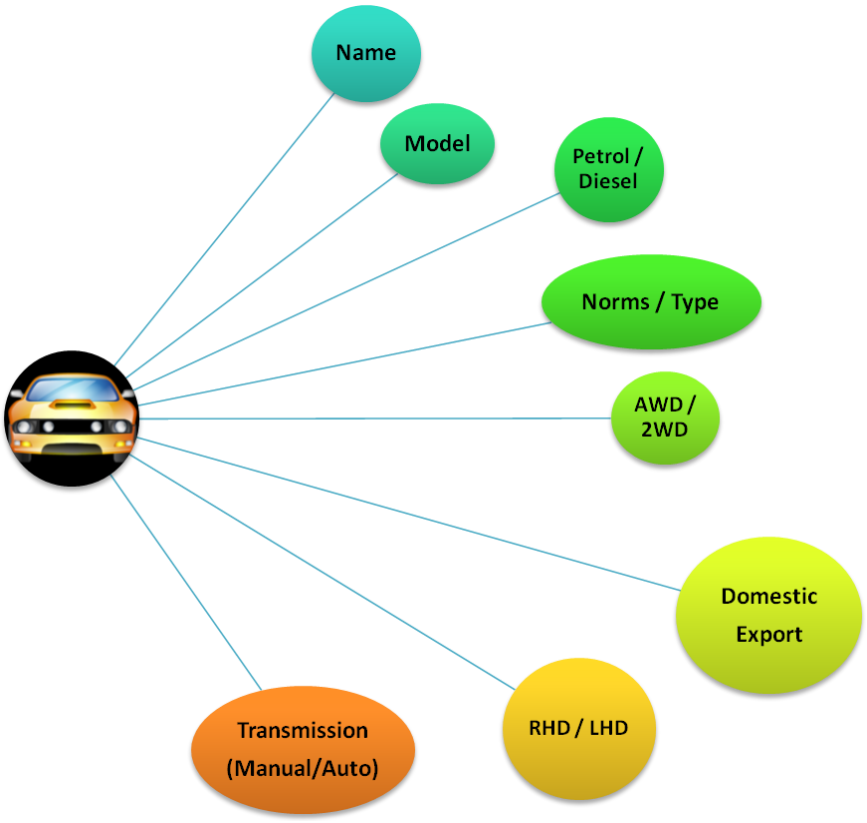
6.5 Vehicle Details & Feature Matrix

Vehicle Details

Vehicle model provides below details.

VIN is Vehicle Identity Number which is 17 alphanumeric in length. Considering 20 alphanumeric in which 3 alphanumeric as reserved. VIN number maximum length 20 Alphanumeric.
e.g. MA1YL2HJUB6D6XXXX.

Model Number is 18 alphanumeric in length. Considering 21 alphanumeric in which 3 alphanumeric as reserved. Model number maximum length 21 Alphanumeric.
e.g. AAW2DPEH7TU01JA0ZZ.



RHD: Right Hand Driving, LHD: Left hand Driving

VD-Req-01: Whenever Mobile Device Application gets connected to IVI system it sends VIN and Model number to device and application on mobile device shall persist this information.

VD-Req-02: Mobile Device Application shall have updated information on every pairing.

Feature Matrix

Feature Matrix provides mobile application to which feature are enabled or disabled.

Vehicle controls like Climate Control and MBFM Controls can be controls from mobile application where user provided read and write options.

Read and write occupy two bits each for each control.

It occupies 2 bit each.1 bit for read and other 1 bit for write.

Warnings occupy each bit in given data. Each bit represent different type of warnings.

Value	Description
00	Read & Write disabled.
01	Read disabled & Write enabled
10	Read enabled & Write disabled
11	Read & Write enabled.

Vehicle Name Table

Vehicle Name	Vehicle Name (Binary)	Vehicle Name (Decimal)
Bolero	00000000	0
Scorpio	00000001	1
XYLO	00000010	2
Verito	00000011	3
XUV 500	00000100	4

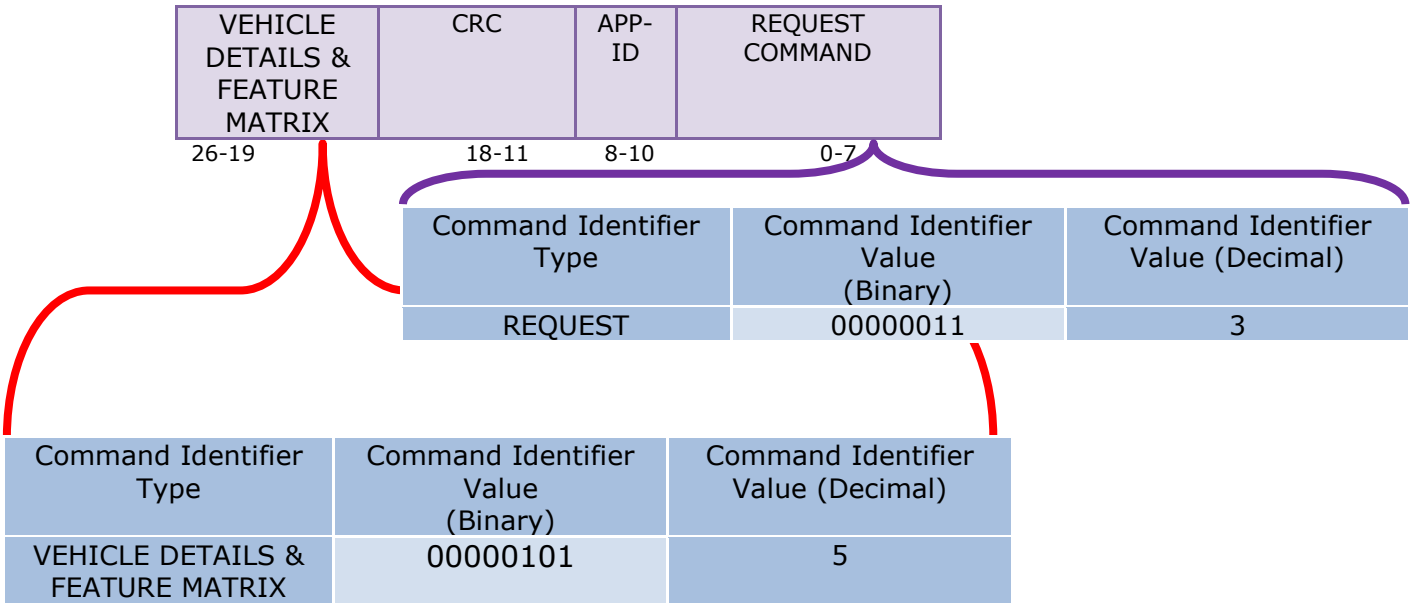
Variant Model Table

Variant Model	Variant Model (Binary)	Variant Model (Decimal)
High	00000000	0
Medium	00000001	1
Low	00000010	2

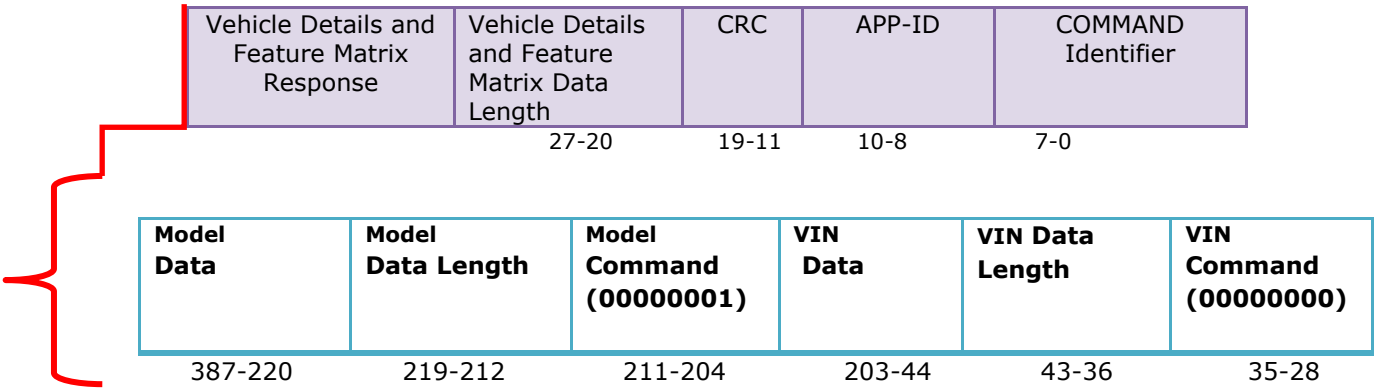
Norm Table

Norm Type	Norm Value (Binary)	Norm Value (Decimal)
BS-II	00000000	0
BS-III	00000001	1
BS-IV	00000010	2
BS-V	00000011	3
E-II	00000100	4
E-III	00000101	5
E-IV	00000110	6
E-V	00000111	7

Request from Mobile Application:



Response from IVI:



Model Data	Model Data Length	Model Command (00000011)	Vehicle Name Data	Vehicle Name Data Length	Vehicle Name Command (00000010)
435-428	427-420	419-412	411-404	403-396	395-388

Driving Type Data	Driving Type Data Length	Driving Type Command (00000101)	Norms Data	Norms Data Length	Norms Command (00000100)
483-476	475-468	467-460	459-452	451-444	443-436

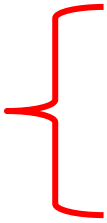
Auto/Manual Transmission Data	Auto/Manual Transmission Data Length	Auto/Manual Transmission Command (00000111)	Domestic/ Export Data	Domestic/ Export Data Length	Domestic/ Export Command (00000110)
530-523	522-515	514-508	507-500	499-492	491-484

AWD/2WD Data	AWD/2WD Data Length	AWD/2WD Command (00001001)	Petrol/Diesel Data	Petrol/Diesel Length	Petrol/Diesel Command (00001000)
578-571	570-563	562-555	554-547	546-539	538-531

Climate Control Data	Climate Control Data Length	Climate Control Command (00001011)	Tiretronics Data	Tiretronics Data Length	Tiretronics Command (00001010)
649-619	618-611	610-603	602-595	594-587	586-579

MBFM Status Data	MBFM Status Data Length	MBFM Status Command (00001101)	Fuel Statistics Data	Fuel Statistics Data Length	Fuel Statistics Command (00001100)
697-690	689-682	681-674	673-666	665-658	657-650

Warnings Data	Warnings Data Length	Warnings Command (00001111)	MBFM Control Data	MBFM Control Data Length	MBFM Control Command (00001110)
802-763	762-755	754-747	746-714	713-706	705-698



Speedometer Data	Speedometer Data Length 1-byte	Speedometer Command (00010000)
826-819	818-811	810-803

Example:

Decimal Value	Data
VIN	MA1YL2HJUB6D6XXXX
MODEL Number	AAW2DPEH7TU01JA0ZZ
Vehicle Name – XYLO	00000010
Model – High	00000000
Norms – V	00000000
RHD	00000000
Domestic	00000000
Auto	00000000
Petrol	00000000
AWD	00000000
Tiretronics	00000000
Climate Info	00000000 00000000 10101010 10101010
Fuel Statistics	00000000
MBFM Status	00000000
MBFM Control	00000000 00000000 00000000 00000010
Warnings	00000000 00000000 00000000 00000000 10111110
Speedometer	00000000

00000101|001|8bitCRC|01100100|00000000|00010001|0100110101000001000000010101100101001100000000100100100001001010010101010100001000000110010001000000110010110000101100001011000010110000101100000000000000000000000000000|00000001|00010010|0100000101000001010101110000001001000100010100000100010101001000000001110101010001010101000000000000000010100101001000000100000000101101001011010000000000000000000000000000|00000010|00000001|00000010|00000011|00000001|00000000|00000100|00000001|00000000|00000101|00000001|00000000|00000111|00000001|00000000|00001000|00000001|00000000|00001001|00000001|00000000|00001010|00000001|00000000|00001011|00000001|00000000|00001100|00000100|00000000000000001010101010101010|00001101|00000001|00000000|00001110|00000001|00000000|00001111|00000100|0000000000000000000000000010|00010000|00000101|00000000000000000000000000000000010111110|00010001|00000001|00000000

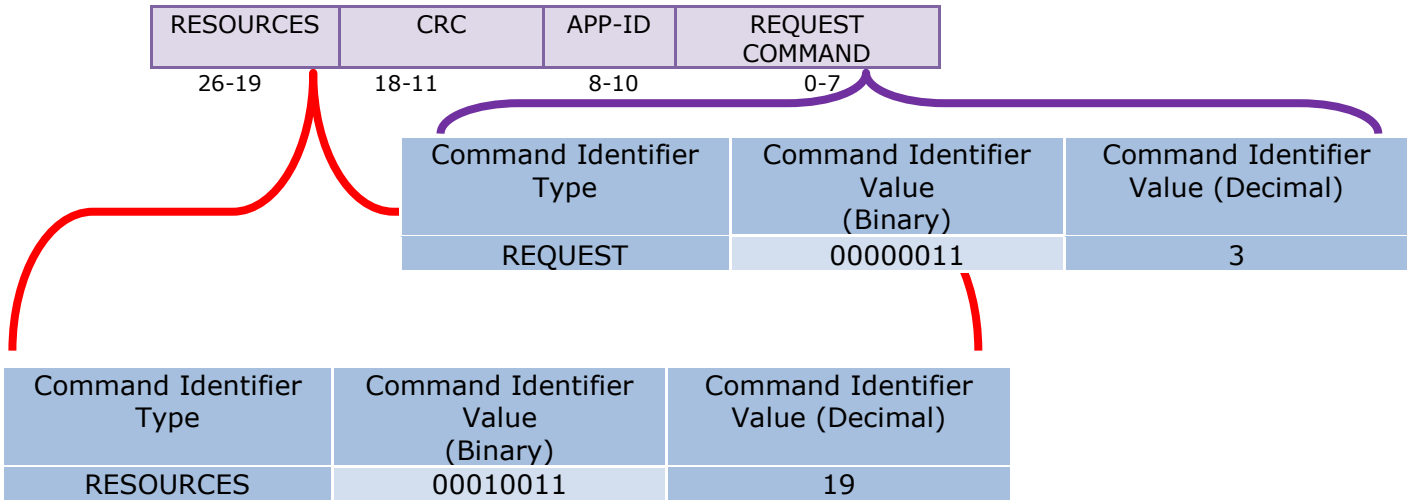
6.6 Multimedia Controls

6.6.1 Music Player Controls

Resources

Resources Payload:

Request from Mobile Application:



Response from IVI:

RESOURCES Response	RESOURCES Data Length	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

CD (00000101)	**TUNER (00000100)**	**BTAUDIO (00000011)**	**AUX (00000010)**	**USB (00000001)**	**IPOD (00000000)**

Example:

00010011|001|8bitCRC|00000110|00000000|00000001|00000010|00000011|00000100|00000101

Startup:

Startup data used to get current status of music system.
Resources occupy 2 bytes. 1 byte for source availability and 2 byte for currently resource in use or not.

Example: 00000000|00000001 – Currently not in use|USB

Startup Payload:

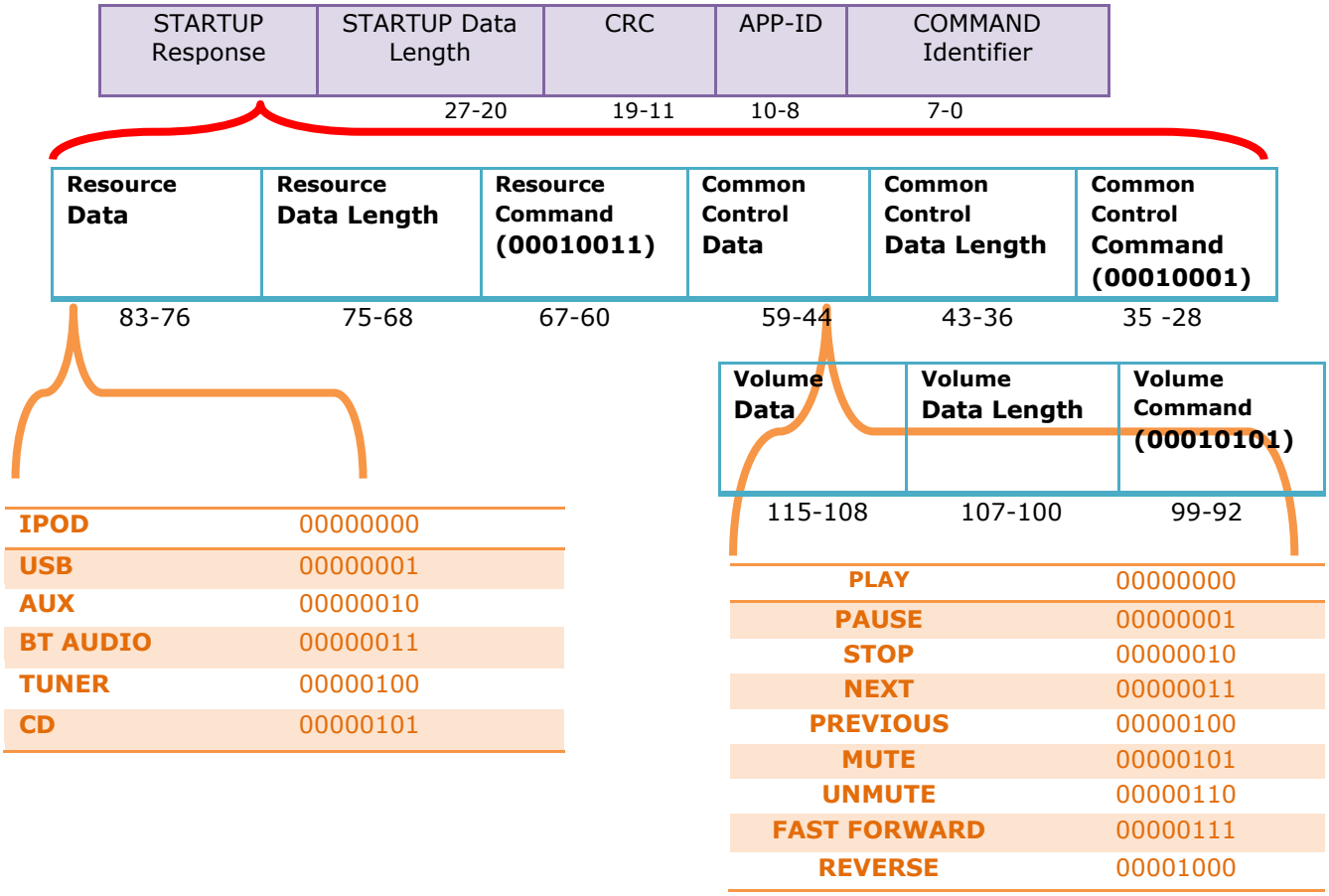
Request from Mobile Application:

STARTUP	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
STARTUP	00010100	20

Response payload from IVI/Control payload from Mobile Application:



IPOD	00000000
USB	00000001
AUX	00000010
BT AUDIO	00000011
TUNER	00000100
CD	00000101

PLAY	00000000
PAUSE	00000001
STOP	00000010
NEXT	00000011
PREVIOUS	00000100
MUTE	00000101
UNMUTE	00000110
FAST FORWARD	00000111
REVERSE	00001000

Example:

Decimal Value	Data
Pause	**00000001**
USB	**00000001**
Volume Data – 30	**00011110**

00010100|001|8bitCRC|00001010|00010001|00000001|00000001|00010011|00000001|00010101|00000001|00011110

Common Controls:

Common payload structure is used to update status like Play, Pause, Stop, Mute, Unmute, Next, Previous, Fast forward and Reverse. It occupies 1 byte

Request from Mobile Application:

COMMON CONTROL	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
COMMON CONTROL	00010001	17

Common Control Request/Response:

Common Control Request/Response	Common Control Request/Response	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

Common Control Data	**Common Control Data Length**	**Common Control Command (00010001)**
59-44	43-36	35 -28

PLAY	00000000
PAUSE	00000001
STOP	00000010
NEXT	00000011
PREVIOUS	00000100
MUTE	00000101
UNMUTE	00000110
FAST FORWARD	00000111
REVERSE	00001000

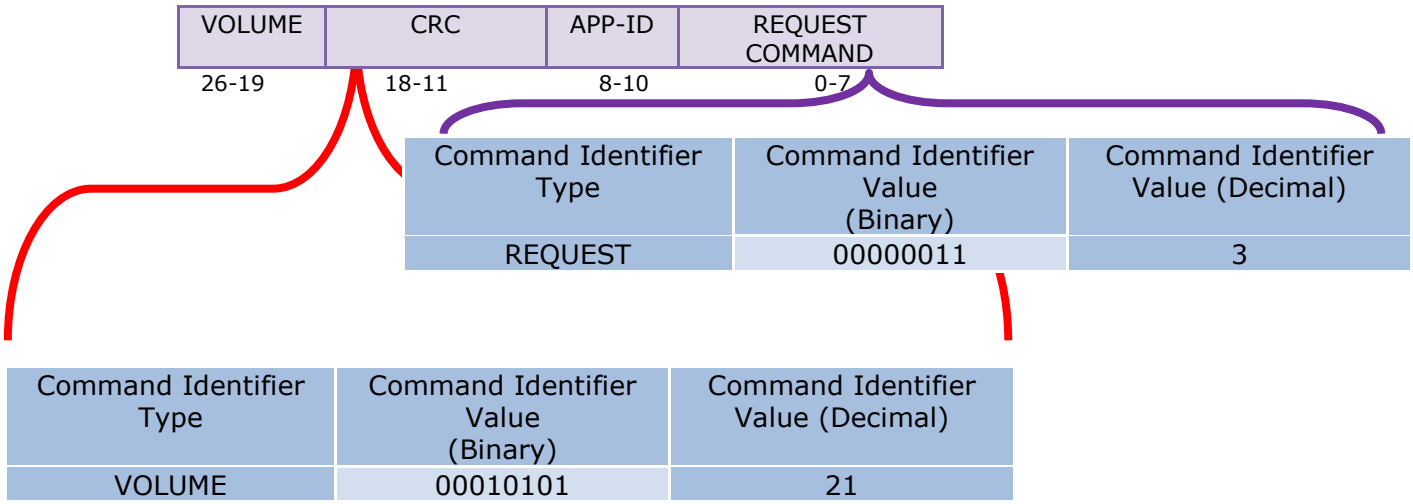
Example:

Decimal Value	Data
Stop	**00000010**

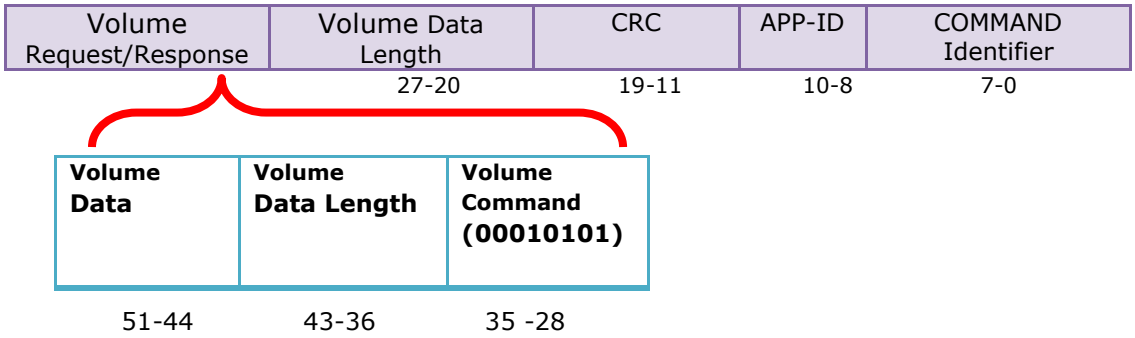
00010001|001|8bitCRC|00000100|00010001|00000001|00000010

Volume:

Request from Mobile Application:



Volume Control Request/Response:



Example:

Decimal Value	Data
Volume Data – 30	**00011110**

00010001|001|8bitCRC|00000011|00010101|00000001|00011110

Metadata

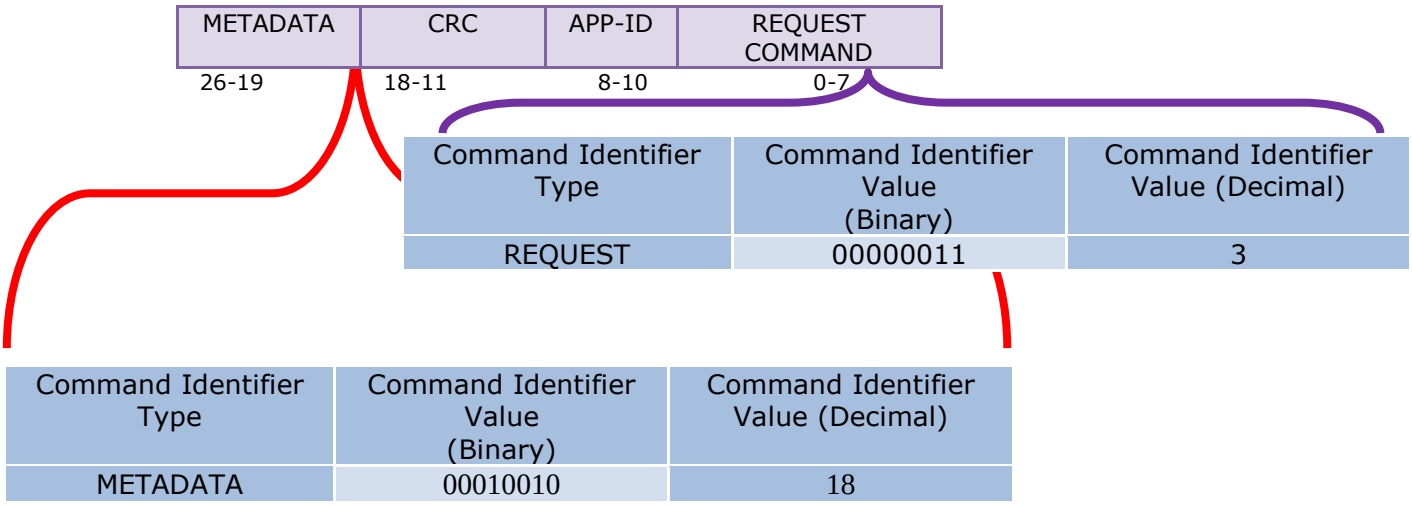
Metadata is shared between IVI system and mobile application.

Song title – 60 bytes, Song artist name – 60 bytes, Song album name – 60 bytes and genre – 30 byte.

In metadata, each character of payload should be converted into corresponding ASCII value and then binary format.

Metadata Payload:

Request from Mobile Application:

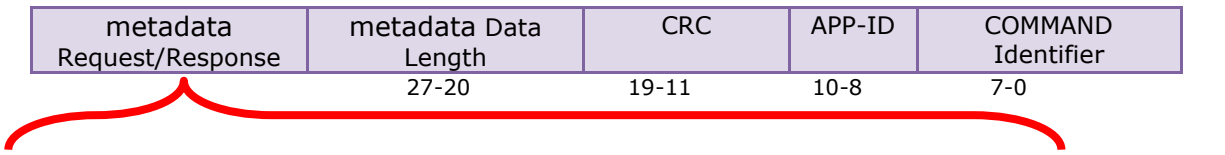


METADATA	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
METADATA	00010010	18

Metadata Update/Response:



metadata Request/Response	metadata Data Length	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

Artist Name Data	**Artist Name Data Length**	**Artist Name Command (00000001)**	**Title Name Data**	**Title Name Data Length**	**Title Name Command (00000000)**
1019-540	539-532	531-524	523-44	43-36	35 -28

Genre Data	**Genre Data Length**	**Genre Command (00000011)**	**Album Name Data**	**Album Name Data Length**	**Album Name Command (00000010)**
1771-1532	1531-1524	1523-1516	1515-1036	1035 -1028	1027-1020

Example:

Title name – Rocking, Artist name - PAUL, Album name - Rocking, Genre - A

Decimal Value	Data
R – ASCII - 82	**01010010**
o – ASCII - 111	**01101111**
c – ASCII - 99	**01100011**
k – ASCII - 107	**01101011**
i – ASCII - 105	**01101001**
n – ASCII - 110	**01101110**
g – ASCII - 103	**01100111**
P – ASCII - 80	**01010000**
A – ASCII - 65	**01000001**
U – ASCII - 85	**01010101**
L – ASCII - 76	**01001100**
A – ASCII - 65	**01000001**

00010010|001|8bitCRC|11011010|00000000|00000111|010100100110111101100011
0110101101101001011011100110011100000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000|00000001|00000100|010100000
1000001010101010100110000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000|00000010|000
00111|010100100110111101100011011010110110100101101110011001110000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000

0000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000
000|00000011|00000001|0100000100000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000|

6.6.2 Radio

The section explains how FM/AM band data is transmitted between Mobile application and IVI system. Band changing can be achieved using Next/Previous, Long Press next/Long press previous.

Frequency bandwidth is considered as a string for communication between application and IVI. It takes 4 bytes in which 2 bytes represents whole number , Decimal takes 1 byte and 1 byte for fraction number .e.g. 98.5 (98 whole number, . decimal point,5 fraction number).

Radio Band:

Request from Mobile Application:

RADIOBAND	CRC	APP-ID	REQUEST COMMAND
26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
RADIOBAND	00011000	24

Radio band Control/Response from IVI:

BAND Response	BAND Data Length	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

DAB (00000101)	DRM (00000100)	AM1 (00000011)	AM (00000010)	FM1 (00000001)	FM (00000000)

Example:

00010011|001|8bitCRC|00000110|00000000|00000001|00000010|00000011|00000100|00000101

Request Long Press Next/Previous Mobile Application:

Band	Command	CRC	APP-ID	REQUEST COMMAND
34-27	26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
LONG PRESS NEXT	00011001	25
LONG PRESS PREVIOUS	00011010	26

Example

Decimal Value	Data
Band	**00000000**

00000011|001|8bitCRC|00011001|00000000

Response for Long Press Next/Previous from IVI:

Radio Band Request/Response	Radio Band Data Length	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

Station Band Data	Radio Band Type
67-36	35-28

Example

Decimal Value	Data
FM	**00000000**
Band – 98.6	**00000000 10011000 00101110 00000110**

00011001|001|8bitCRC|000001001|00000000|00000000100110000010111000000110

Manual Tune:

Request Manual Tune from Mobile Application:

Frequency Data	Band	Command	CRC	APP-ID	REQUEST COMMAND
66-35	34-27	26-19	18-11	8-10	0-7

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
REQUEST	00000011	3

Command Identifier Type	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
Manual Tune	00011101	29

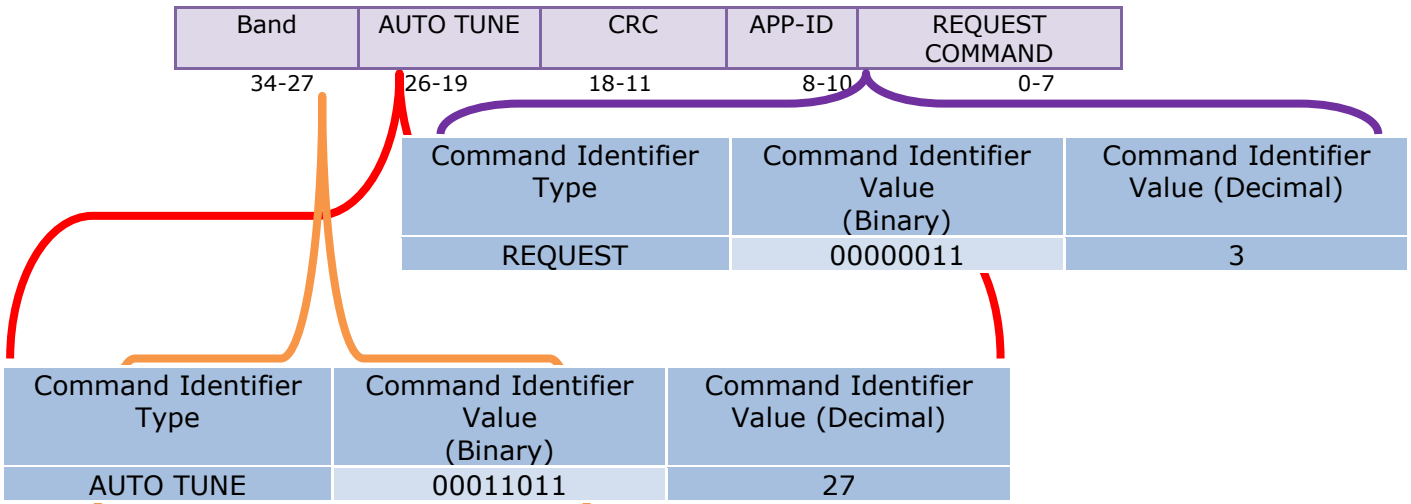
Example

Decimal Value	Data
FM	**00000000**
Band – 98.6	**00000000 10011000 00101110 00000110**

00011001|001|8bitCRC|000001001|00000000|00000000100110000010111000000110

Auto Tune:

Request Auto Tune from Mobile Application:



FM	**00000000**
FM1	00000001
AM	00000010
AM2	00000011
DRM	00000100
DAB	00000101
RESERVED	00000110
RESERVED	00000111
RESERVED	00001000

Example

Decimal Value	Data
FM	**00000000**

00011001|001|8bitCRC|00011011|00000000|

Radio Data System

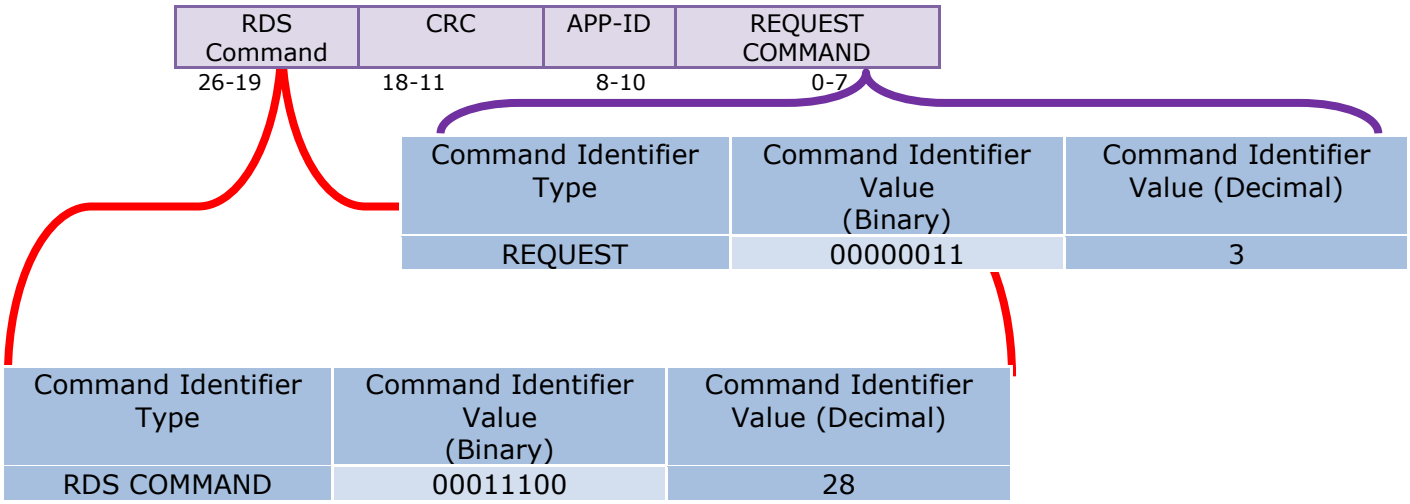
Radio Data System, or **RDS**, is a communication protocol standard for embedding small amount of digital information in conventional radio broadcast (FM). RDS contains of Relay station name, Program type, text information, etc.

Relay station name – There are 8 characters in a station name.

Program type – There are 31 pre-defined program types (which varies from country to country).e.g. In Europe program type – 4 is Sport.

Radio Text – Radio text is 64-character text information which is transmitted by the radio station. It can be either static e.g. title and artist name of the current playing song.

Request from Mobile Application:



RDS command from IVI:

RDS Command	RDS Data Length	CRC	APP-ID	COMMAND Identifier
	27-20	19-11	10-8	7-0

PTY Code Data	PTY Code Data Length	PTY Code Command (00000001)	Station Name Data	Station Name Data Length	Station Name Command (00000000)
91-76	75-68	67-60	59-44	43-36	35 -28

Radio Text Data	Radio Text Data Length	Radio Text Command (00000010)
619-108	107-100	99-92

Example:

Station Name – RED, PTY Code - 5, Radio Text – Rocking

Decimal Value	Data
PTY Code – 5	**00000101**
R – ASCII – 82	**01010010**
E – ASCII – 69	**01000101**
D – ASCII – 68	**01000100**
R – ASCII - 82	**01010010**
o – ASCII - 111	**01101111**
c – ASCII - 99	**01100011**
k – ASCII - 107	**01101011**
i – ASCII - 105	**01101001**
n – ASCII - 110	**01101110**
g – ASCII - 103	**01100111**

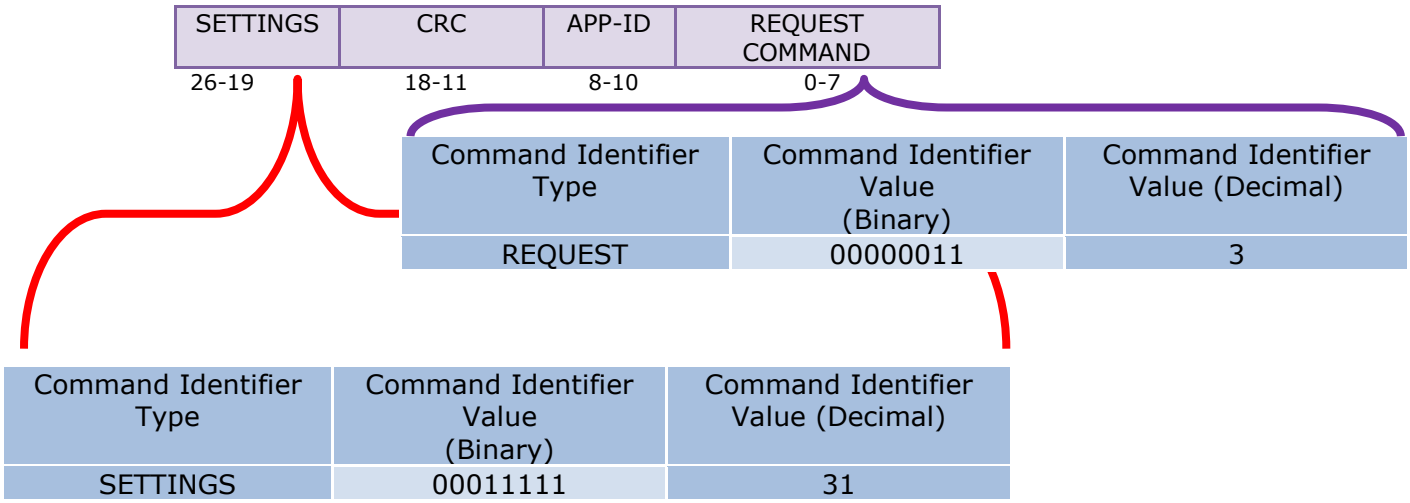
00011100|001|8bitCRC|01001000|00000000|00000011|010100100100010101000100
0000000000000000000000000000000000000000|00000001|00000001|00000101|00
000010|00000111|010100100110111101100011011010110110100101101110011001
1100000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000

000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000|

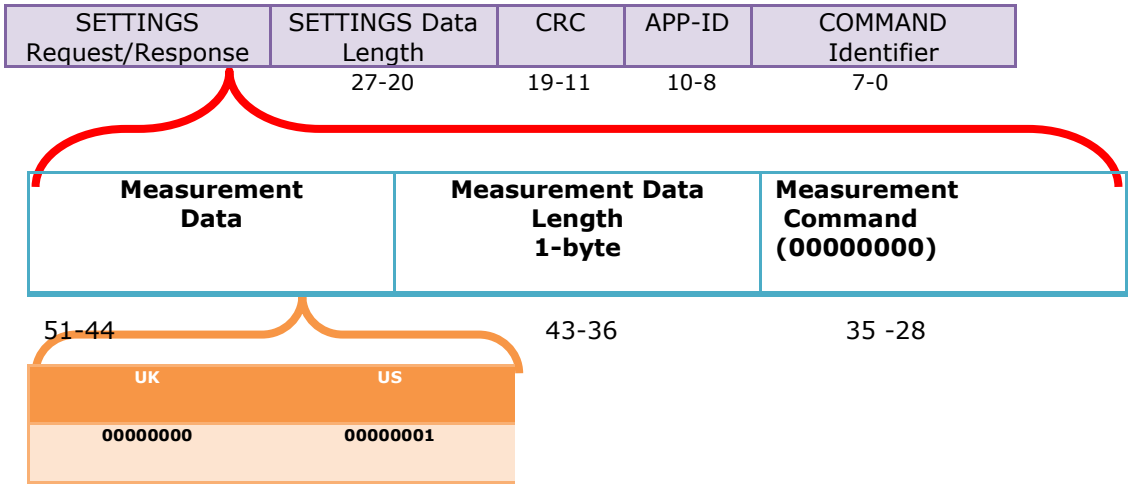
6.7 Settings

Settings are used to display/control information in selected measurements. For temperature {C/F} and gasoline {gallon/liter}.

Request from Mobile Application:



Control Settings from IVI/Mobile Application:



Example:

Decimal Value	Data
UK	**00000000**

00011111|001|8bitCRC|00000011|00000000|00000001|00000000

APPENDIX A: Payload Structure Key(s) and Definition(s)

Context	Attribute	Definition
Payload Structure	Command Identifiers	Defines Feature Data Communication. **Example:** **Tiretronics**: 00001000 **Connect:** 00000000
	App-Id	Unique identification used to manage mobile application and user pairing.
	CRC	Data verification value, Algorithm is based on cyclic codes.
	Data Length	Data length used to know how many bytes to read for data.
	Data	**Data Consists of Data Command, Data length and Data** Data Command used to identify what data it is. Data Length represents length of the data to read. Data consists of respective command data.

APPENDIX B: Command Identifier Table

Command Identifier Types	Command Identifier Value (Binary)	Command Identifier Value (Decimal)
CONNECT	00000000	0
STATUS/POLLING	00000001	1
ACKNOWLEDGMENT	00000010	2
REQUEST	00000011	3
RESERVED	00000100	4
VEHICLE DETAILS & FEATURE MATRIX	00000101	5
SPEEDO METER	00000110	6
RESERVED	00000111	7
TIRETRONICS	00001000	8
CLIMATE INFO	00001001	9
FUEL STATISTICS	00001010	10
MBFM STATUS	00001011	11
MBFM CONTROLS	00001100	12
WARNINGS	00001101	13
RESERVED	00001110	14
RESERVED	00001111	15
RESERVED	00010000	16
COMMON CONTROLS	00010001	17
METADATA	00010010	18
RESOURCES	00010011	19
STARTUP	00010100	20
VOLUME	00010101	21
RESERVED	00010110	22
RESERVED	00010111	23
RADIO BAND	00011000	24
LONG PRESS NEXT	00011001	25
LONG PRESS PREVIOUS	00011010	26
AUTO TUNE	00011011	27
RDS DATA	00011100	28
MANUAL TUNE	00011101	29
RESERVED	00011110	30
SETTINGS	00011111	31
RESERVED	00100000	32
RESERVED	00100001	33

Revision History

Version	Date (DD/MM/YYYY)	Description
1.0	02.05.2013	Initial version
2.0	05.06.2013	Reviewed Version
2.1	19.06.2013	Reviewed Version
2.4	03.09.2013	Reviewed Version. Minor changes in command Identifier.
3.0	27.09.2013	Added two features and content changes.
4.0	11.10.2013	Document re-structured and E2E system point of view information added.
4.1	15.10.2013	Minor changes in Multimedia and Vehicle Details & Matrix.
4.2	20.10.2013	Change in Payload format to support dynamic features and sub feature addition.