CONNECTS2

Communication protocol for CAN Adapter with Pioneer Head Unit as host

History Log:

Revision 1: Initial version
Revision 2: Modifications as per Pioneer request (SCR#1) 17/6/2010.
Revision 3: Modifications as per Pioneer request (SCR#2) 22/10/2010.

Referenced Documents

Name	Description
SCR#1	CanBusCommSpecChangeRequest_20100617.xls
SCR#2	CanBusCommSpecChangeRequest_20101022.xls

Approvals

Company	Full Name Of Approver(s)
Connects2	
Pioneer	

Overview

This document describes a communication protocol for CAN Adapter over UART.

Hardware description

The CAN Adapter is connected to Main CPU through a UART, the UART work at 8N1 mode; baud rate is fixed at 115200bps, full duplex, 5V.

Communication format

<Format of command and message>

Send/Receive data	The contents of Send/Receive frame	comment
1	Head Code	SOF, fixed to 0xE2
2	Data Type	Data type of the frame
3	Length	Data length of contents (does not include checksum, so value 0x01 here would mean exactly 1 data byte.)
4	Data0	Contents
5	Data1	
…	….	
N	DataN	
N+1	Checksum	SUM(DataType, Length, Data0,… DataN)^ 0xFF

<Format of ACK and NACK>

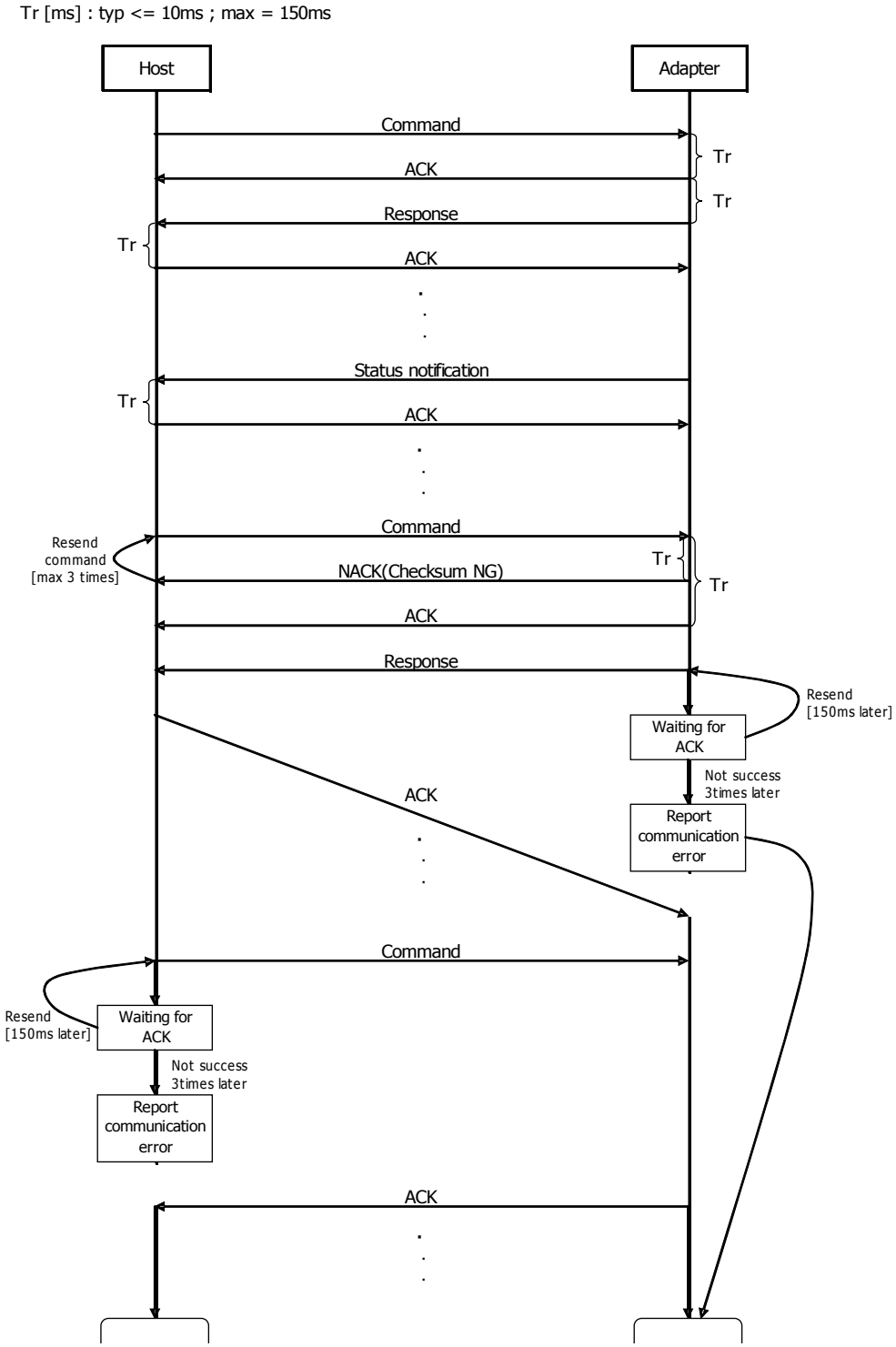
Send/Receive data	The contents of Send/Receive frame	comment
1	ACK/NACK	0xff------ACK 0xf0-----NACK(Checksum NG) 0xf3-----NACK(Not support)
2	Data type	Data type which this (N)ACK is for

- After completing to receive the data, the receiver should return ACK signal within 150ms.
- If ACK signal is not returned within 150ms (or NACK signal <checksum error> is returned), the data should be re-sent. If ACK signal is not returned after re-sending 3 times, the transmit should be stopped.
- If data that doesn't conform to the above-mentioned communication format is sent, do not return any ACK or NACK signals.

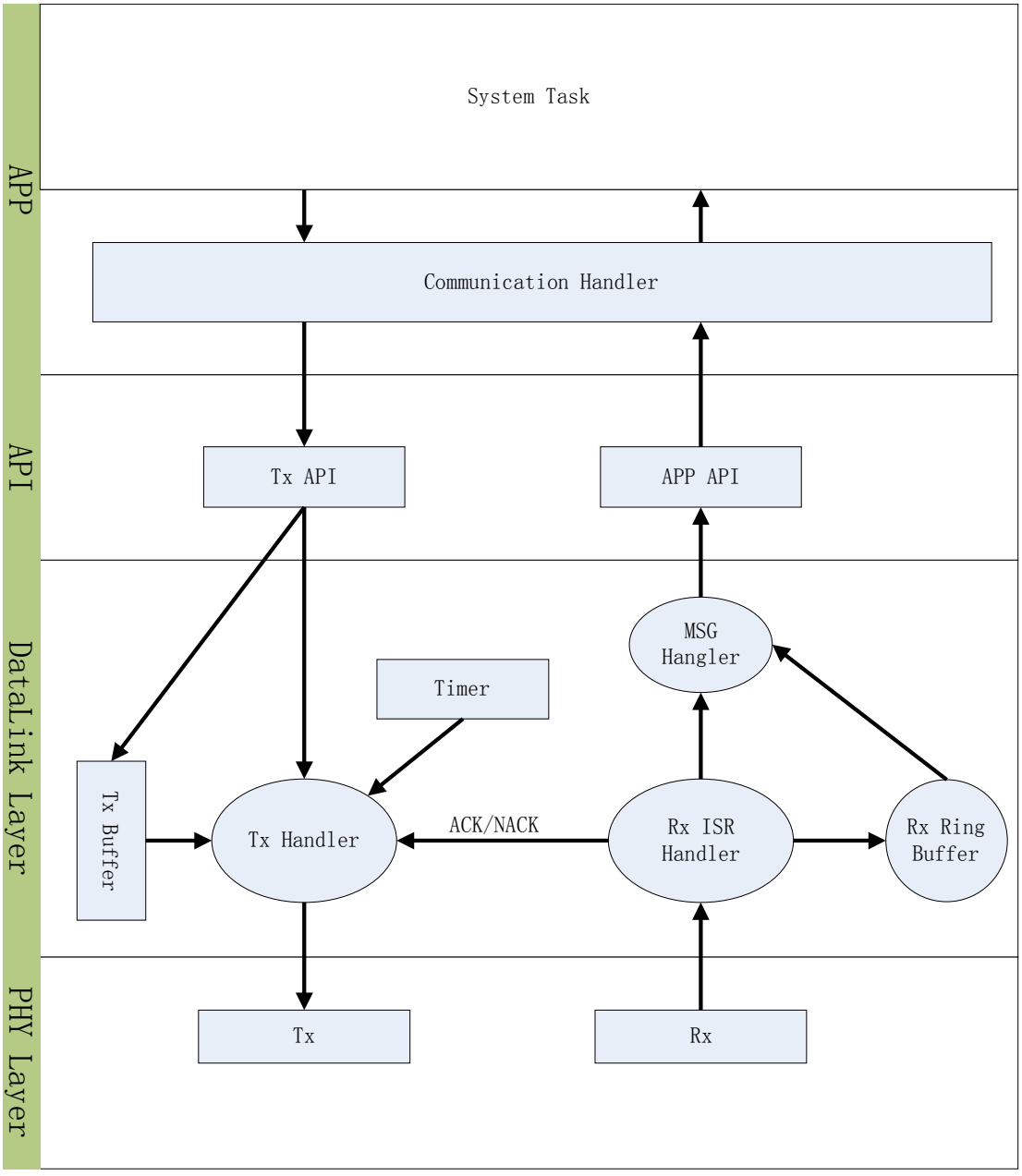
<Definition of DataType>

Description	Code of Data Type	Comment
ADAPTER→HOST (MSB Clear)		
Reserved	0x01~0x0f	Reserved for AVC LAN application
Version Info	0x17	Version Information to host
Car Configuration	0x18	Configuration of the car (Navigation type supported, etc)
Parking sensor data	0x19	Front and rear parking sensors
Air con data	0x1A	
Boot loader notification	0x60	Notification that adaptor will be entering boot loader mode shortly
	0x70~0x7f	Reserved for IAP
HOST→ADAPTER (MSB Set)		
Reserved	0x81~0x8f	Reserved for AVC LAN application
Request Adapter Info	0x90	
Source	0xC0	Current source
Icons	0xC1	Icons / Status
Tuner Status	0xC2	Tuner Status
Media Status	0xC3	Status of media
Phone Status	0xC4	Phone status
Text	0xC5	Text
Navigation	0xC6	Navigation status
Reset to boot loader mode	0xE0	For updating of adaptor firmware
Key code	0xE3	Virtual key code from host
User Configuration	0xE4	User configuration
	0xf0~0xff	Reserved for IAP

Sequence of communication



Protocol implement diagram



1 Format of message [Adapter→Host]

All command descriptions contain the data part only. They need to be packetised as appropriate using the communication format.

1.1 Send Version information to host [0x17]

This message is only sent when requested by 0x90 command. Display as “ADP-Major.Minor” or “Major.Minor-ADP”. Eg. “245-1.2”.

<Format >

No.	Contents	Comment
1	0xnn	Major version number
2	0xnn	Minor version number
3	0xnn	ADP number (Low Byte)
4	0xnn	ADP number (High byte)

ADP Number reference: Low byte is vehicle make. High byte is vehicle type or platform identification for that make.

ADP Number Low Byte	Description
1	Volkswagen
2	Ford
3	Vauxhall / Opel

Volkswagen identification:

ADP Number High Byte	Description
1	PQ35/PQ46 DDP Platform (eg. Golf 5)
2	PQ35/PQ46 BAP Platform (eg. Golf 6)
3	DDP Instrument cluster/MFD with BAP A/C + Park Radar
4	New Polo
5	T5
6	New Skoda

Ford identification:

ADP Number High Byte	Description
1	EUCD Platform (eg. Mondeo)

Vauxhall/Opel identification:

ADP Number High Byte	Description
1	Epsilon II Platform (eg. Insignia)

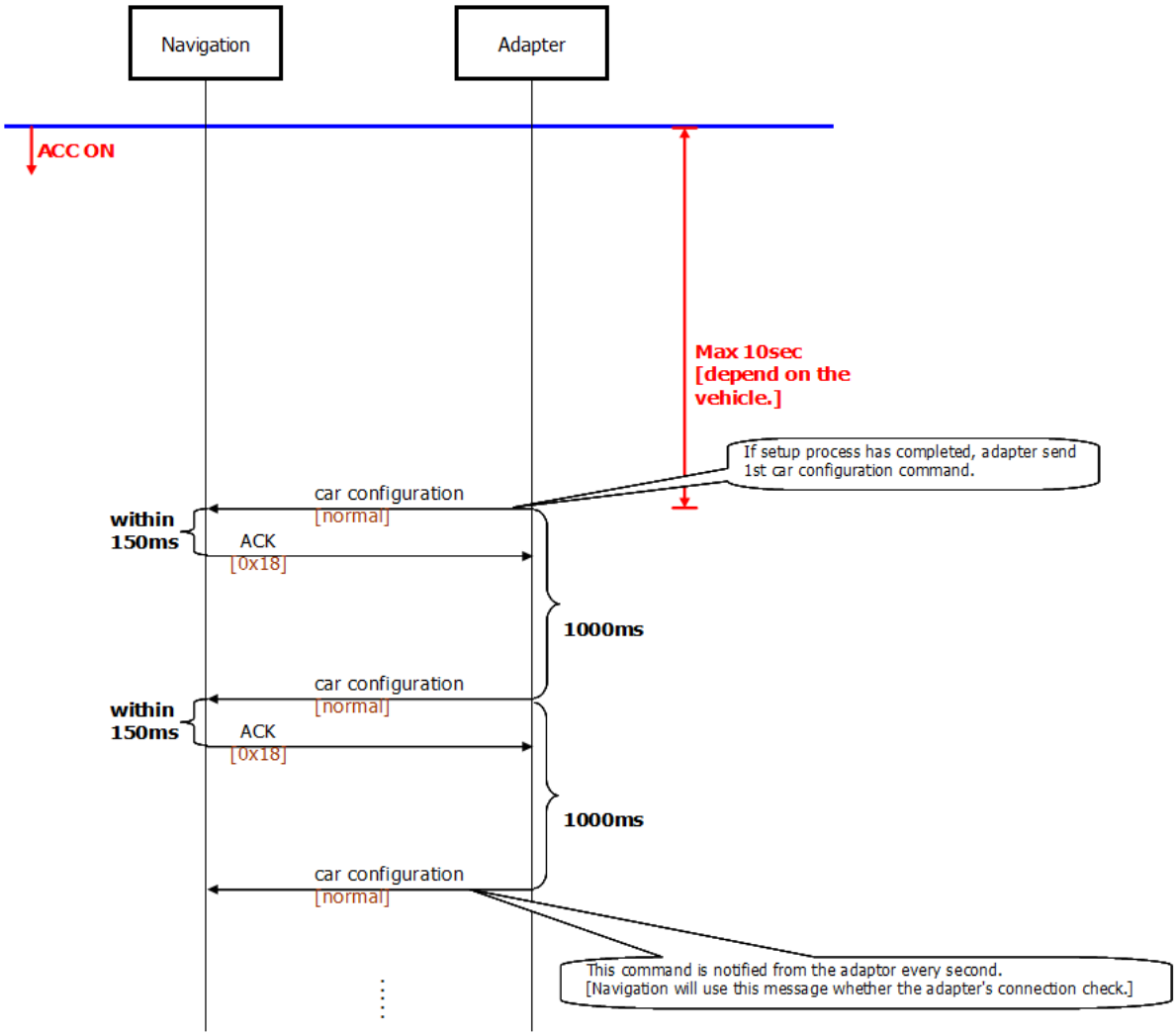
1.2 Car configuration [0x18]

Details the configuration/capabilities of the car and/or adaptor. This packet is sent by the adaptor each time it wakes up the host by means of the accessory wire. It may also be requested by the host at any time.

<Format >

No.	Contents	Comment
1	0xnn	Navigation configuration 0x00 – Not yet initialized. Try again later (>= 1 second) 0x01 – Navigation data should be sent as normal (eg. As previous to this protocol) and optionally over 0xC6. 0x02 – Navigation data should be sent using 0xC6 exclusively. Source should not be changed to navigation and no navigation commands should be sent over any other commands. For example, if tuner was selected previously to navigation, then the tuner information should continue to be sent normally.
2	0xnn	Parking sensor configuration 0x00 – No parking sensors supported 0x01 – Rear parking sensors supported 0x02 – Front parking sensors supported 0x03 – Both parking sensors supported **Note** that this is what the adaptor supports, not what is present on the vehicle (That information is unknown until such time that the parking sensors are activated, and thus not communicated to host)

Timing: This command will be sent to host within 10 seconds of ACC-on. The exact timing is based on communication with the vehicle. The command will be repeated thereafter at 1 second intervals as shown in the diagram on the next page.


Navigation
Adapter
ACC ON
Max 10sec
[depend on the
vehicle.]
If setup process has completed, adapter send
1st car configuration command.
car configuration
[normal]
within
150ms
ACK
[0x18]
1000ms
car configuration
[normal]
within
150ms
ACK
[0x18]
1000ms
car configuration
[normal]
This command is notified from the adaptor every second.
[Navigation will use this message whether the adapter's connection check.]

1.3 Parking sensor data [0x19]

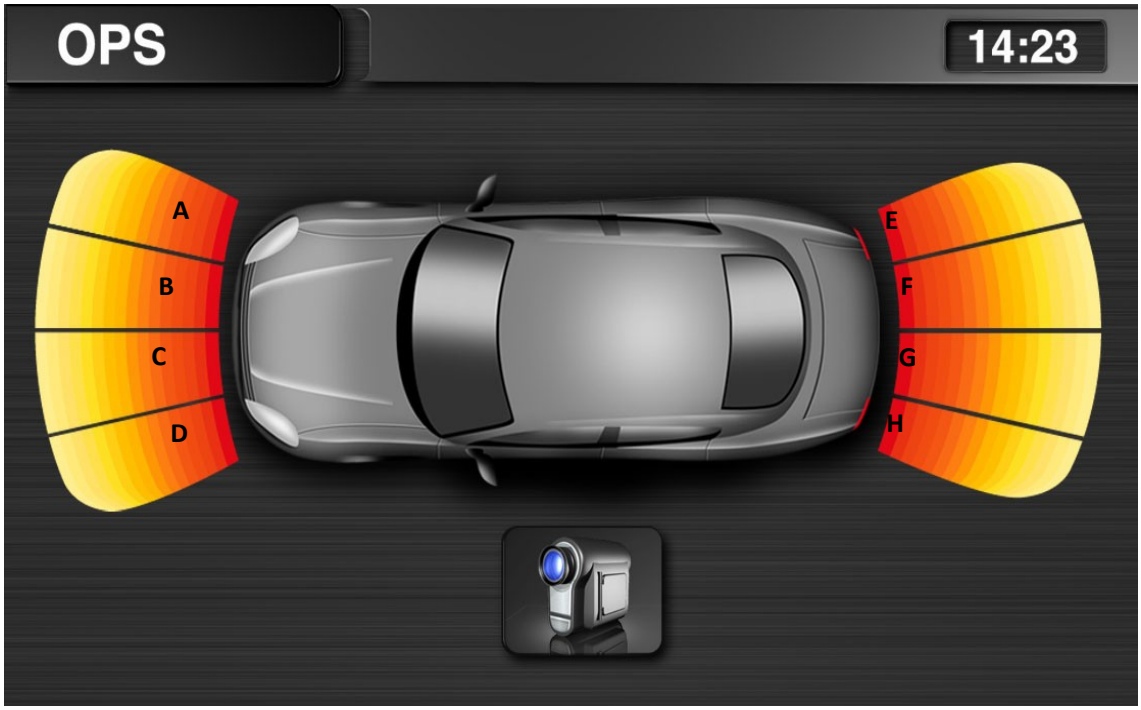
0xF – No data/Not present/Far away from the sensor.
0x0 – Very close to the sensor.
This data is sent each time it changes. It can be requested at any time.

Active flag will be reset to zero for at least one packet when exiting parking mode.

Timing: The minimum interval of the data transmission is 100ms.

<Format >

No.	Contents	Comment	
1	0xnn	Front	High Nibble:Zone A Low Nibble:Zone B
2	0xnn		High Nibble:Zone C Low Nibble:Zone D
3	0xnn	Rear	High Nibble:Zone E Low Nibble:Zone F
4	0xnn		High Nibble:Zone G Low Nibble:Zone H
5	0xnn	Active 0x00 – Parking system is disabled 0x01 – Parking system is enabled	



1.4 Air con status [0x1A]

If the configuration states that only single zone air con information is supported, then the left and right temperature data will be the same. If no air con information is available, the entire field will be zero if requested.

Toggle status is 2-bits per toggle. Upper bit states whether feature is available or not. Lower bit states value.

Temperature format – A single byte specifies the temperature in 0.1°C steps from a base temperature of 10°C. For example, 0x01 = 10.1°C, 0x50 = 18.0°C. The maximum temperature that can be reported is 0xFA or 35°C. 0xFF is reserved as "As high as possible" and 0x00 is reserved as "As low as possible".

Timing: The minimum interval of the data transmission is 100ms.

<Format >

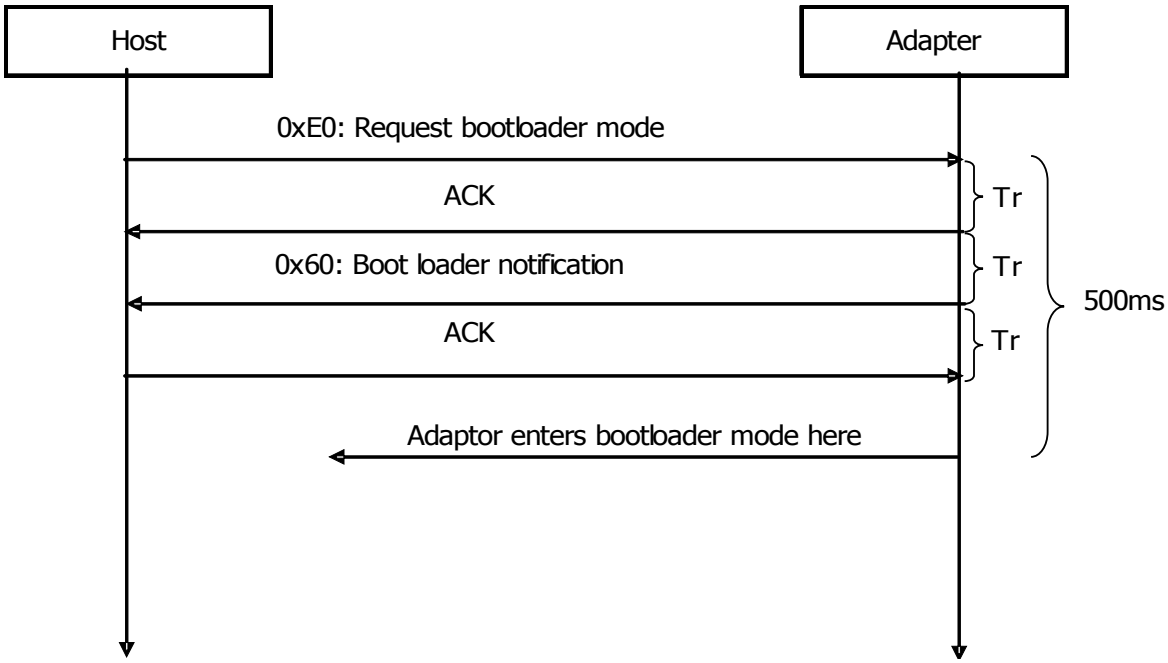
No.	Contents	Comment	
1	0xnn	Left temperature	See "Temperature format"
2	0xnn	Right temperature	
3	0xnn	Indicators B7-6: Toggle: Recirculation B5-4: Toggle: Front window heating B3-2: Toggle: Rear window heating B1-0: Toggle: A/C On/Off	
4	0xnn	B1: 0 = No temperature control, 1 = Temperature control B0: 0 = Single zone control, 1 = Dual zone control	
5	0xnn	Seat heating (0 = off or not available, else value) Upper nibble: Left seat Lower nibble: Right seat	
6	0xnn	Fan direction (Bit pattern. Auto if none set.) • B0 = Windscreen • B1 = Face • B2 = Feet	
7	0xnn	Fan speed 0x00 – Speed unknown or automatic 0x01 – 0xFF – Fan speed	

1.2 Boot loader notification [0x60]

This message is only sent when requested by 0xE0 command. It notifies the host that the boot loader will be executed shortly. It will be ready to communicate with within 500ms of receiving this command. Do not send further commands from this protocol after receiving this notification.

Byte No.	Length	Comment
1+	14	Must be the null terminated, uppercase string "C2BOOTRUNNING" (excluding quotes), otherwise the command will be ignored. Equivalent hex codes: 43 32 42 4F 4F 54 52 55 4E 4E 49 4E 47 00.

Usage and Sequence diagram :



2 Format of message [Host→Adapter]

0x90 – 0xBF - Requests

2.1 Request adapter information [0x90]

Send it if host need the information, the adapter will send back proper reply.
<Format >

No.	Contents	Comment
1	0xnn	Data type to be requested: 0x17: Version information 0x18: Car configuration 0x19 : Parking sensor data 0x1A: Air con information

2.2. 0xC0 – 0xDF - Display commands.

Note that in all circumstances where a text string is sent, the null terminator 0x00 is NOT included in the data. Text strings are invalidated when source, media type, frequency, band, or the info block is changed. The host is required to resend appropriate text strings.

Command ID	0xC0
Description	Current Source
Applicable Sources	All

Byte No.	Length	Comment
1	1	Source
2	1	Media type
3	Variable	Source name. This is what the user will see on the display when they change source

<Source>

Source	Description
0x00	OFF
0x01	Tuner
0x02	Disk (CD, DVD)
0x03	TV (Analog)
0x04	NAVI *
0x05	Phone
0x06	iPod
0x07	AUX
0x08	USB
0x09	Memory Card
0x0a	DVB-T
0x0b	Phone A2DP
0x0c	Other

* Navigation source should only be sent if the Navigation configuration (byte 1 of command 0x18) is 0x01.

<Media type>

Type Identifier	Description	Example of supported text
0x01	Tuner	Station name & radio text (eg. FM, DAB, etc).
0x10	Simple Audio Media	Optional track name and disk name (eg. CDDA)
0x11	Enhanced Audio Media	Device supporting audio files* (eg. USB), optionally supporting Artist / Album / Title (eg. MP3)
0x12	iPod	Supports Artist / Album / Title
0x20	File based video	Title, Filename
0x21	DVD Video	Title
0x22	Other video	Title / Station name (DVB-T)
0x30	Navi, Aux, Other	Free text
0x31 *	Navi Turns	Distance and unit (eg. “200 Yards”)
0x40	Phone	Current status, Phone number, Phone name

Command ID	0xC1
Description	Icon description and mute
Applicable Sources	All

Byte No.	Length	Comment
1	1	Icons (Set = Active, Clear = Inactive/Not Available)

<Icons>

Bit0	MUTE
Bit1	TP
Bit2	EON
Bit3	TA
Bit4	AF
Bit5	RDS
Bit6	STEREO
Bit7	DISK IN (For internal CD, if present. Always clear if no internal CD)

Command ID	0xC2
Description	Tuner Status (Band, Freq, etc)
Applicable Sources	Tuner

Byte No.	Length	Comment	
1	1	Band/Type	
2	1	Frequency (Low byte)	Analogue Only (Zero if digital)
3	1	Frequency (High byte)	
4	1	Preset/Station number (0 = No preset)	

Frequency is stored as an unsigned 16-bit number, ignoring the decimal point. Eg. The frequency 87.50 would be stored as 8750 decimal, so the hex bytes would be high byte = 0x22 and low byte = 0x2E.

If the frequency or band is changed, all appropriate text strings must be re-sent by the host.

<Band/Type Table>

Band/Type	Analogue / Digital	Comment
0x00	Analogue	FM
0x01		MW
0x02		LW
0x10	Digital	

Command ID	0xC3
Description	Status of media playback
Applicable Sources	Media sources (eg. CD, USB)

Byte No.	Length	Comment	
1	1	Info 1	Contents depend on media type See <info contents>.
2	1	Info 2	
3	1	Info 3	
4	1	Info 4	
5	1	Minutes into currently playing media	
6	1	Seconds into currently playing media	

Command ID	0xC4
Description	Phone Status
Applicable Sources	Phone

Byte No.	Length	Comment
1	1	Phone Status 0x00 = Not active 0x01 = Ringing (Incoming call) 0x02 = Dialing (Outgoing call) 0x03 = Connected

Command ID	0xC5
Description	Text
Applicable Sources	All

Byte No.	Length	Comment
1	1	Format type 0x00 – ISO/IEC 8859-1 0x01 - ISO/IEC 10646
2	1	Text string identifier. 1 – 4. For description, see media type table.
3	Variable	Text. See <text contents>

As stated on Pg. 16, Text strings are invalidated when source, media type, frequency, band, or the info block is changed. The host is required to resend appropriate text strings.

Command ID	0xC6
Description	Navigation
Applicable Sources	All

Byte No.	Length	Comment
1	1	iDirectionIconIdx Low byte
2	1	iDirectionIconIdx High byte
3	1	iExitNoIconIdx Low byte
4	1	iExitNoIconIdx High byte
5	Variable	sDistanceString (ISO8859-1)

This command should be sent on change. It must be used when byte 1 of command 0x18 is 0x02. It is optional at all other values.

2.2. 0xE0 – 0xEF – Action Commands:

Command ID	0xE0
Description	Boot loader mode. Adaptor will reset and enter boot loader mode. Do not send any further commands from this protocol after receiving the notification from this command. Boot loader will be ready to receive commands **500ms** after receiving the notification from this command.
Applicable Sources	All

Byte No.	Length	Comment
1+	13	Must be the null terminated, uppercase string “C2BOOTLOADER” (excluding quotes), otherwise the command will be ignored. Equivalent hex codes: 43 32 42 4F 4F 54 4C 4F 41 44 45 52 00.

2.2 Send Virtual key code to adaptor [0xE3]

This key code is sent when a virtual key is pressed or released.

<Format >

No.	Contents	Comment
1	0xnn	Key code <Refer to key code table below>
2	0xnn	Key status: 0x00: Key released 0x01: Key pressed
3	0xnn	Counter (Incremented on each packet sent (not including resends from NACKs), rolls over on 0xFF to 0x00)

<Key code table >

Key name	Code
Up	0x01
Down	0x02
Left	0x03
Right	0x04
OK	0x05
Settings	0x06
BC	0x07
Main	0x08
Cancel OPS	0x09

2.3 User configuration request [0xE4]

Send the contents of the user configuration menu to the adaptor.

This command should be re-sent if the user configuration changes.

NOTE: This command can also be requested by the adaptor at any time via the 0x10 command (Request Host information).

<Format >

No.	Contents	Comment
1	0x01	Version number of this structure. For the current specification, this should always be 0x01. It will be increased in the future should additional items be added. Always use the value from the specification you use.
2	0xnn	Bit Pattern: Bit 0 (0x01) – 1 (set) if OBC available, 0 otherwise.

<Text contents>

Media type	Description	Text 1 contents	Text 2 contents	Text 3 contents	Text 4 contents
0x01	Tuner	Station Name	Radio text	Unused	Unused
0x10	Simple audio media	Disk name	Track name	Unused	Unused
0x11	Enhanced audio media	Album name	Artist name	Song name	Unused
0x12	iPod	Album name	Artist name	Song name	Unused
0x20	File based video	Title	Unused	Unused	Unused
0x21	DVD	Title	Unused	Unused	Unused
0x22	Other video	Title / Station Name	Unused	Unused	Unused
0x30	Navi, Aux, Other	Free text	Unused	Unused	Unused
0x31	Navi Turns	sDistanceString	Unused	Unused	Unused
0x40	Phone	Current status E.g. “Ringing”	Phone Number	Phone Name	Unused

If a text element is marked as used in the above table but is not currently available, host should supply a zero length string.

<Info contents>

Media type	Description	Info 1	Info 2	Info 3	Info 4
0x01	Tuner	Unused	Unused	Unused	Unused
0x10	Simple audio media	Disk Number 0x00 – No disk *	Track Number 0x01 – 0xFF	Unused	Unused
0x11	Enhanced audio media	Current Song Number Low byte	Current Song Number High byte	Total Song Number Low byte	Total Song Number High byte
0x12	iPod	Current Song Number Low byte	Current Song Number High byte	Total Song Number Low byte	Total Song Number High byte
0x20	File based video	Current Video Number Low byte	Current Video Number High byte	Total Video Number Low byte	Total Video Number High byte
0x21	DVD	Current Chapter	Total Chapters	Unused	Unused
0x22	Other video	Unused	Unused	Unused	Unused
0x30	Navi, Aux, Other	Unused	Unused	Unused	Unused
0x31	Navi Turns	iDirectionIconIdx Low byte	iDirectionIconIdx High byte	iExitNoIconIdx Low byte	iExitNoIconIdx High byte
0x40	Phone	Unused	Unused	Unused	Unused

If an info element is marked as used, but is not currently available, the contents of that element should be 0.

* - Single slot CD does not have a disk number, so it should also use 0x00 here.

CAUTION: If a used part of the Info block is changed, all four text strings must be re-sent by the host.

3 Rules

No data should be transmitted whatsoever (including ack/nack) when ACC input changes from high to low. All received data should be ignored.

<Source> must be sent whenever host powers up (eg. After initialization when ACC input changes from low to high) or source/media type changes. For example, in a folder on a USB stick containing a mixture of compressed audio and video files, the media type could change from EAM (0x11) to FBV (0x20).

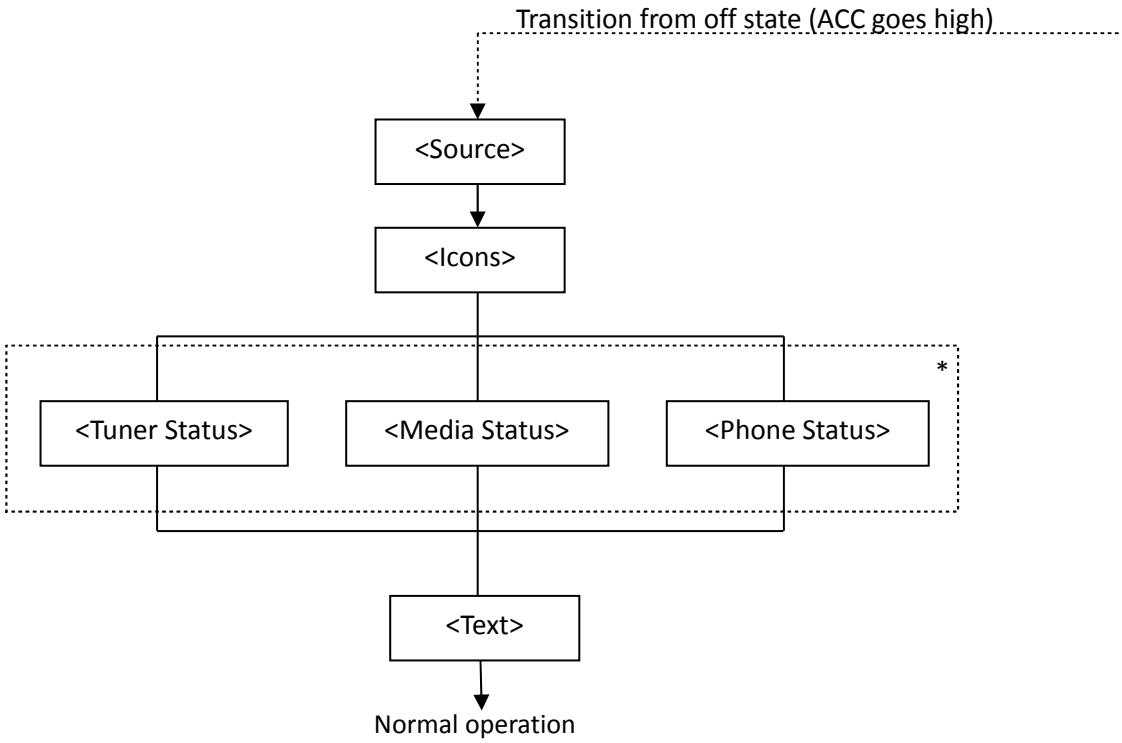
<Icons> should be sent whenever there particular state changes, regardless of source.

The status commands <Tuner Status>, <Media Status> and <Phone Status> must only be sent after a <Source> command stating the relevant source.

<Text> must only be sent after an appropriate <Source> and <Status> command. For example, station name can only be sent after both a <Source> is received to indicate Tuner mode, and a <Tuner Status> has been received. To update <Text>, at least one <Status> is needed to be sent first (e.g. on track change).

4 Diagrams

4.1. System startup diagram



* - Which status is sent is dependant on the source sent previously.

4.2. System shutdown diagram