

# Positioning Paper

## EG Terminal Mode

# Functional Mobile Device Integration

Version 0.6



DAIMLER



PORSCHE



## Content

1. Mobile Devices .....	3
1.1. CE4A and EG Terminal Mode.....	3
1.2. Goals of CE4A EG Terminal Mode.....	4
2. Approach for Mobile Device Integration .....	5
2.1. Basic consideration .....	5
2.2. Possible user scenarios .....	6
2.3. Control concepts.....	6
3. Integration technologies .....	6
3.1. UI Transmission Protocols .....	7
3.1.1. X11 .....	7
3.1.2. VNC .....	7
3.1.3. RDP .....	7
3.1.4. (X)HTML .....	7
3.1.5. Web4CE .....	7
3.2. Configuration Protocols .....	8
3.2.1. UPnP.....	8
3.2.2. UPnP RemoteUI.....	8
3.2.3. UPnP AV.....	8
3.3. Transmission Technologies (logical layer) .....	9
3.3.1. IP .....	9
3.3.2. Bluetooth Profiles.....	9
3.3.3. USB Device classes.....	9
3.4. Transmission Technologies (physical layer).....	9
3.4.1. Bluetooth .....	9
3.4.2. Wireless LAN / Wi-Fi .....	10
3.4.3. USB .....	10
3.4.4. UWB, Wireless USB / Bluetooth 3.0.....	10
4. Interoperability Requirements for MD Integration .....	10
4.1. General Requirements .....	10
5. Interoperability Test Sessions .....	11
6. Contact and further Information.....	11
7. Abbreviations .....	11

## 1. Mobile Devices

The modern world is getting mobile and due to the efforts in micro electronic and the increasing capacity of batteries, more and more devices are getting portable. Because of the increasing number of such devices and the constantly growing feature list, Mobile Devices (MD) are entering more and more domains even in the daily life. There is no wonder that the wish comes up to have the same applications from the PC at home or at work wherever you are. Having the possibility to use these applications on a MD is quite good with a small display and probably complicated input devices like tiny, multiple occupied buttons. But having them in the vehicle environment on the large screen of the Infotainment System (IS) and using the comfortable vehicle's control concept is even better.

The term of integrating MDs in the vehicle environment means to provide the user the technology to take his MD into his car and let it integrate itself without the need of configuration.

The advantages for the customer are obvious multifarious. A bigger screen, more comfort in interaction and furthermore the potential of using the vehicle's data is provided to the customer. Regarding the safety, the integration of mobile devices leads to less driver distraction and due to the possibility to hide the device in compartments like arm rest or glove box to a better crash behavior than with aftermarket solutions like suction holders.

The production life cycle of vehicles is about six to eight years in comparison to MDs where the range is few month up to two years. Hence, new features will be available during a vehicle's life cycle and there is no possibility to include them yet. With MD integration it would be possible to update the vehicle's features with external applications running on the MD. Again, controlling the applications is more comfortable in the car environment and the user information is stored just once on a single device and not being shared between different platforms.

Additionally, the user is able to type in certain information at home like the target for the navigation application. Coming to the vehicle, he can start the travel immediately without a delay of programming the navigation system. Hence, the gap between being in- and outside the vehicle is closed (seamless navigation).

For mobile device integration different approaches can be distinguished:

One general approach is to access the data on the mobile device. The IS processes this data with its own application. Examples for this kind of integration are the Bluetooth SIM access profile and a PIM application.

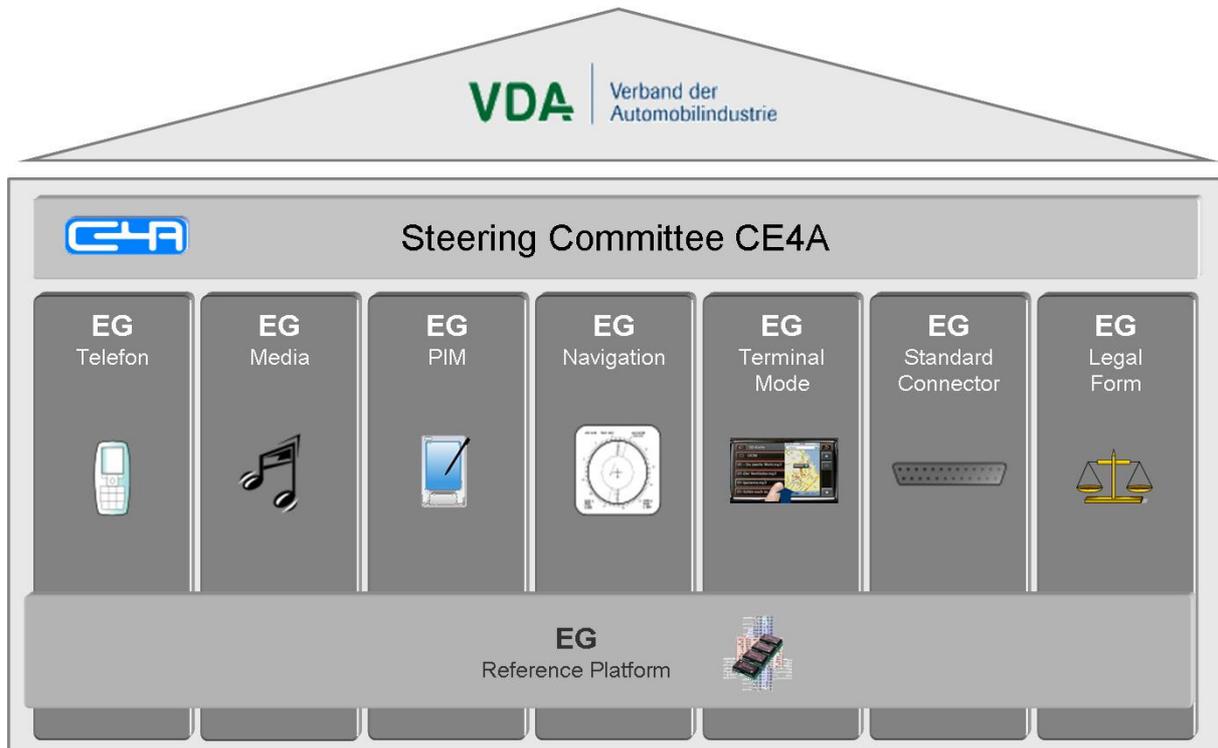
Another approach is to let the mobile application reside on the MD and control them from the IS side remotely like in Bluetooth Handsfree or iPod remote control (accessory protocol). With this approach the user can add new functionality to his car. For the access of this functionality, the IS has to be updated - at least software changes have to be implemented.

To avoid development and update efforts, it's necessary to create an use-case independent interface.

### 1.1.CE4A and EG Terminal Mode

The common initiative *Consumer Electronics for Automotive* (CE4A) driven by Audi, BMW, Daimler, Porsche, and Volkswagen has been formed to facilitate seamless integration and

interoperability of CE devices in a vehicular environment<sup>1</sup>. To account for the various infotainment and communication use cases, the CE4A is structured into Expert Groups (EG). Currently, EGs are operative for Telephone, Media, PIM, Navigation, Terminal Mode, Standard Connector, Legal Form and Reference Implementation. This organization is shown in Fig. 1.



**Fig. 1: Organisation of CE4A**

CE4A wants to pave the way to meet our customer's expectations with automotive-friendly integration and a wide interoperability of CE devices. In order to achieve this we opt for a synergetic reuse of all device capabilities with a well-defined and stable standardized interface to the car.

CE4A is ready to support initiatives leading in this direction by, e.g., participation in standardization efforts, performing common tests with CE device manufacturers, evaluation of CE devices in our prototyping platforms, etc.

The Expert Group Terminal Mode is working on an approach for the standardized transparent and use-case-independent integration of mobile device applications

## 1.2.Goals of CE4A EG Terminal Mode

The main goal of the working group Terminal Mode is to provide the user an improved usability of MDs in vehicles and to reach therefore a higher customer satisfaction. That comes along with the following topics:

- Definition of a common interface for MDs and vehicles for interoperability. Goal: Wide interoperability of MD and IS
- Easy integration of MDs via self configuring connection and service exchange

<sup>1</sup> see <http://www.ce4a.org> for further details

- Use case independency and therefore being prepared for future applications and scenarios
- The control of integrated MDs shall be intuitive and straightforward (the user probably wouldn't accept to learn a completely different control for already known applications)
- Definition of integration solution to meet requirements concerning driver distraction
- Create standardized wireless and wired interfaces for seamless and zero-configuration integration of any mobile device application
- The control of the mobile device via a transparent, protocol-invariant integration enhances usability of mobile devices in the car environment
- Enable functional updates to extend the capabilities of the in-car infotainment and keep them up to date easily

To achieve these goals, CE4A wants to initiate closer contacts and start discussions with the stakeholders of the CE devices industry with the aim of working together on a joint standardized approach.

To drive this vision, CE4A supports the definition and promotion of open and future-proof standards. A further important action of CE4A will be the promotion of joint interoperability (IOP) test sessions between CE device manufacturers and automotive industry on a regular 6-month basis. Within these IOP tests new and existing MDs can be tested with OEM telematics systems provided by the CE4A participants. Details about the proposed IOP tests are provided in Chapter 5.

## 2. Approach for Mobile Device Integration

The following roles are identified to simplify the understanding of the following considerations:

Mobile Device: The group of MDs which are mentioned in this document includes Mobile Phones, Personal Digital Assistants (PDA), Audio-/Video-Player, Personal Navigation Devices (PNDs), Laptops and every device which provides information to the user, which is small enough to get carried around and which is at least temporarily battery driven.

Infotainment System: IS is the term for a system in a vehicle which provides information requested from the user and which is able to interact by a specific control concept. Due to the large screen of a common IS it is used to display the graphical information of the MD. Basic elements of IS are touch screens, keys, rotary knobs, multi function steering wheels and speech control.

User: The user takes the MD into the car to integrate it into the vehicle environment. He has the advantage of the technology and doesn't take care of the configuration. He controls the application via the vehicle specific controller.

### 2.1. Basic consideration

By functional integration of MDs into vehicle's environment one has to consider three main parts:

- UI Transmission
- Configuration (Addressing, Discovery, Description)
- User Interaction (Event Notification, Presentation)

The UI Transmission has to transport all information of the Graphical User Interface (GUI) of the complete device or a single application. The configuration has to take care of configuring the network,

finding other MDs or the IS and to provide the user an easy integration without any configuration effort. Furthermore, the interaction between the user and the IS has to be handled and the input events have to be forwarded to the application running on the MD.

On the other hand, vehicle information or an UI can be transferred to the MD. This applies in general for low end equipped cars.

## 2.2. Possible user scenarios

For the selection of the protocols the data to be transmitted as well as the bandwidth of the transport medium have to be taken into account. Therefore one has to think about possible user scenarios and realistic demands from the customers. The following list contains a choice of possible user scenarios which can be identified:

- Using generic applications like e-mail, navigation, PIM
- Transport of still image and video
- Audio transmission

There are different levels of functional integration:

Level 1: Basic integration with at least mechanical holder and power supply. In this scenario, the mobile device is directly controlled by the user.

This level is not in scope of the EG Terminal Mode

Level 2: Transfer of the MD's HMI to the IS and control of the device via the IS's control concept. Can be realized through analog or digital video transfer, remote keyboard / pointing device and implies Pixel-Transfer.

Appropriate Technologies: USB-Standard device classes, VNC (Wifi, USB)

Level 3: OEM specific rendering with corporate identity, HMI abstraction (rendering on IS or MD)

Appropriate Technologies: IP-based, X11, Web-Technologies (XHTML, CEA2014)

## 2.3. Control concepts

There exist mainly four distinct control concepts for different vehicles which have to be mapped to the applications:

- Touch screen
- Hardkeys
- Joystick
- Speech Dialog System (SDS)

The CE4A claims that the MD integration approach supports every of these control concepts.

Therefore, a sophisticated mapping mechanism is needed.

## 3. Integration technologies

In this chapter different integration technologies are presented. For every topic of chapter 2.1 an overview of existing technologies is given.

The preference for one or the other technology is based on the characteristics, envisioned introduction time frame, scenario requirements and standardization progress.

### 3.1. UI Transmission Protocols

In the following a couple of different protocols will be introduced. It is just a short overview and there is no demand of completeness.

#### 3.1.1. X11

X-Window<sup>2</sup> is a protocol which has been designed for client and server communication, originally for Unix systems. Instead of complex image transfer, X-Windows transfers simple primitives, which are concatenated with a toolkit to a graphical user interface. Because of the small binary instructions X-Windows is very efficient in bandwidth. When transferring bitmaps, X-Windows doesn't use compression; hence it takes more bandwidth and is similar to VNC.

#### 3.1.2. VNC

Virtual Network Computing<sup>3</sup> is designed for transfer of image data from a client device to a server device. There exist a couple of different specified compression algorithms which make the graphical data exchange more efficient. If none of these algorithms is used every single pixel has to be transferred and the transmission is less efficient. VNC is usually used for remote desktop access, for example in helpdesk applications.

#### 3.1.3. RDP

The Remote Desktop Protocol<sup>4</sup> is a proprietary Protocol from Microsoft, which is primarily used for Microsoft Terminal Services. The user can connect to a computer running Microsoft Terminal Services. The client application is available for most of current Windows versions and other operating systems.

#### 3.1.4. (X)HTML

(X)HTML<sup>5</sup> is commonly known as a markup language used in the internet. It's used to describe websites and combined with technologies like JavaScript or Flash one can develop powerful applications which are very flexible. Using further technologies like Cascading Style Sheets (CSS) the design can be adapted for different platforms. Regarding upcoming web browsers in the automotive area it could be an efficient and effectively technology which meets the requirements. Therefore the CE4A investigates corresponding technologies.

#### 3.1.5. Web4CE

Web4CE (a.k.a. CEA-2014<sup>6</sup>) is a standard designed by Consumer Electronics Association's R7 Home Network Committee<sup>7</sup>, defining a protocol and framework for remote user interfaces on UPnP

---

<sup>2</sup> <http://www.x.org/wiki/>

<sup>3</sup> [http://en.wikipedia.org/wiki/Virtual\\_Network\\_Computing](http://en.wikipedia.org/wiki/Virtual_Network_Computing)

<sup>4</sup> [http://en.wikipedia.org/wiki/Remote\\_Desktop\\_Protocol](http://en.wikipedia.org/wiki/Remote_Desktop_Protocol)

<sup>5</sup> <http://www.w3.org/TR/xhtml1/>

<sup>6</sup> CEA-2014-A Web-based Protocol and Framework for Remote User Interface on UPnP™ Networks and the Internet (Web4CE), July 2007, <http://www.ce.org/standards/StandardDetails.aspx?Id=2865&number=CEA-2014>

---

Networks and the Internet. Based on XHTML with Cascading Style Sheets and ECMA scripting, a capable device presents its user interface as a web page delivered via HTTP 1.1 to a remote device. Thereby the remote UI server adjusts the content of the user interface depending on the remote UI client's capability profile. To enable dynamic updates of the user interface, Web4CE also describes several notification mechanisms for home and internet domains. The standard "has been accepted as the baseline remote user interface technology within the Digital Living Network Alliance (DLNA)".<sup>8</sup>

## 3.2. Configuration Protocols

There is generally the need for a mechanism which takes care of the configuration of the network between the MDs and the IS. This includes addressing which means that every device has to have a unique ID, discovery which means that the devices have to find each other and description which means, that the devices have to know what to expect from each other. In the following a couple of different protocols are described which meet the requirements of these three aspects.

### 3.2.1. UPnP

Universal Plug and Play<sup>9</sup> is a technology which provides all above mentioned aspects to devices. UPnP relies on an IP network and organizes the addressing and service discovery. While negotiating the provided services, descriptions of the services and the devices are exchanged. UPnP is widely accepted in CE devices like mobile phones or Routers.

### 3.2.2. UPnP RemoteUI

UPnP Remote UI<sup>10</sup> relies on UPnP and provides an UI Transmission Protocol compatibility negotiation to the devices. A client device can request compatible applications sending the own capabilities of supported UI Transmission Protocols. The server then responds with a list of applications supporting the provided protocols. After that procedure, the server can offer applications to the client which can be executed and displayed.

### 3.2.3. UPnP AV

UPnP AV stands for UPnP Audio and Video, and is a grouping within the UPnP standards supervised by the DLNA (Digital Living Network Alliance), which is a forum of vendors and manufacturers who work in the home entertainment industry, and offer a "DLNA CERTIFIED™" branding for those products which follow their Networked Device Interoperability Guidelines. The DLNA forum members "share a vision of a wired and wireless interoperable network of Personal Computers (PC), Consumer Electronics (CE) and mobile devices in the home enabling a seamless environment for sharing and growing new digital media and content services," and "DLNA is focused on delivering an interoperability framework of design guidelines based on open industry standards to complete the cross-industry digital convergence".

---

<sup>7</sup> <http://www.ce.org/>

<sup>8</sup> <http://www2007.org/htmlposters/poster1017/>

<sup>9</sup> <http://www.upnp.org/>

<sup>10</sup> <http://www.upnp.org/standardizeddcps/remotemui.asp>

### 3.3. Transmission Technologies (logical layer)

In the following a couple of different protocols for the transport will be introduced. It is just a short overview and there is no demand of completeness

#### 3.3.1. IP

IP (Internet Protocol)<sup>11</sup> is a logical interface that can be used over several physical interfaces (WLAN, Bluetooth, USB). For service provisioning it implies a client-server architecture between MD (server) and vehicle (client). Known approaches are UPnP and WebServices or the DLNA initiative as standardization body.

CE4A will also further investigate this technology.

#### 3.3.2. Bluetooth Profiles

The Bluetooth SIG<sup>12</sup> defines several use-case specific profiles like Hands free-Profile (HFP), SIM access profile (SAP) and many more. Additionally, some profiles provide use-case independent data transfer like the Serial Port Profile (SPP) or File Transfer Profile (FTP).

#### 3.3.3. USB Device classes

USB<sup>13</sup> defines standardized device classes like:

- Mass Storage (USB-Sticks, MP3 Player)
- Audio Class (Speaker, Headphones,...)
- Human Interface Device (Pointing device, Keyboard)
- Imaging Class (Scanner, Web-Cam)
- Printer Class (Printer)
- Video Class (Camera, DVD, Video-Streaming)
- Communication Device Class

### 3.4. Transmission Technologies (physical layer)

#### 3.4.1. Bluetooth

Bluetooth<sup>14</sup> is a proven technology and nowadays a commodity in premium OEM vehicles. The main use case is telephony (call/dial handling, PIM with phone book access). Lately more devices with music streaming functionality showed up so that one can expect Bluetooth streaming support in premium vehicles as well.

---

<sup>11</sup> <http://tools.ietf.org/html/rfc791>

<sup>12</sup> <http://www.bluetooth.com/Bluetooth/SIG/>

<sup>13</sup> <http://www.usb.org/home>

<sup>14</sup> <https://www.bluetooth.org/apps/content/>

### 3.4.2. Wireless LAN / Wi-Fi

Wireless Local Area Network (WLAN, IEEE-802.11) enables computers to be connected IP-based without using wires to each other (ad hoc mode) or to a network (infrastructure mode).

WiFi is a certification label for WLAN enabled devices and shall enhance the interoperability of devices. This technology is spread more and more in mobile devices. In the car environment, WLAN can be used either for connection to an external infrastructure and thus to the internet or to connect MDs to the IS.

### 3.4.3. USB

USB provides high bandwidth connectivity together with power supply/charging for the CE device (if supported by the device). USB defines the electrical interface, logical data transport mechanisms and data pipes. Device classes are defined to standardize devices on a certain application protocol level (Hub, HID, Printer, MassStorage, etc.). USB often utilizes other standards that are used over USB (as data pipe) like low level SCSI commands for MassStorage devices.

Generally the level of application standardization is lower compared to Bluetooth where the complete application stack is standardized. The big advantage on the other hand is higher bandwidth and the power provisioning for the MD over USB allowing for longer operation cycles without draining the battery. Furthermore USB is getting standard connector in more and more MDs. One can expect that MicroUSB will be available at least in every Mobile Phone very soon.

The USB IF (Implementers Forum) is the technical body to promote a standardized MD integration over USB.

### 3.4.4. UWB, Wireless USB / Bluetooth 3.0

(Certified) Wireless USB<sup>15</sup> is based on Ultra Wide Band<sup>16</sup> Technology, but currently not available in mobile devices.

As it supports the same speed as wired USB, it would be suitable for the terminal mode.

## 4. Interoperability Requirements for MD Integration

### 4.1. General Requirements

- R1 The primary strategy of CE4A is the application, establishment, and enhancements of standards defining the interface required for MD integration.
- R2 All technologies considered for implementation by CE4A are required to have obtained a high degree of maturity and stability with regard to specification scale and specification alteration, respectively.
- R3 The MD integration must lead to less driver distraction and therefore more safety.
- R4 Video transfers must be detectable to be able to switch video off during driving.
- R5 The integration approach TerminalMode has to implement use-case-independent

---

<sup>15</sup> <http://www.usb.org/developers/wusb/>

<sup>16</sup> <http://en.wikipedia.org/wiki/Ultra-wideband>

## 5. Interoperability Test Sessions

CE4A carries out periodic Interoperability Test Sessions (IOTS). By attending an IOTS, CE device manufacturers are offered to carry out tests with their devices and the vehicular entertainment systems of all CE4A members.

Typically, these IOTS are held every 6 months. CE4A provides the venue for the IOTS. Furthermore, the vehicular entertainment systems are in the latest stage of development. An IOTS is arranged in test session of approximately 2 hours. In each test session one device manufacturer tests together with one CE4A member. During the test, CE4A provides experts for the vehicular entertainment systems. Subsequent to the test sessions, potential errors are analyzed and feedback is available.

CE Device manufacturers are welcome to participate in the IOTS. Detailed test procedures will be prepared when first technical proposals for implementation of the integration scenarios are available. Basically these test procedure will be used to test the previously postulated requirements for functionality and interoperability.

## 6. Contact and further Information

For further details please contact the expert group via the following email address or visit the website of the organization.

Email: [terminalmode@ce4a.org](mailto:terminalmode@ce4a.org)

Web: <http://ww.ce4a.org>

## 7. Abbreviations

CE	Consumer Electronic
CE4A	Consumer Electronic for Automotive
DLNA	Digital Living Network Alliance
EG	Expert Group
IOP	Inter Operability
IS	Infotainment System
IOTS	Inter Operability Test Session
IP	Internet Protocol
IS	Infotainment System
MD	Mobile Device
SDS	Speech Dialog System

UPnP	Universal Plug and Play
WLAN	Wireless Local Area Network