

TECHNICAL REPORT

Conceptual model of standardization for multimedia car systems and equipment



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TECHNICAL REPORT

Conceptual model of standardization for multimedia car systems and equipment

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**CONCEPTUAL MODEL OF STANDARDIZATION
FOR MULTIMEDIA CAR SYSTEMS AND EQUIPMENT**

FOREWORD

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IEC TR 63038, which is a technical report, has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
100/2628/DTR	100/2692/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This document is initiated by the study session 5 in TC 100/AGS and made by stage 0 project, PT100-9. The study session 5 was formed to study car related issues of TC 100, the study session 5 proposed stage 0 project, it was approved and assigned as PT 100-9.

The equipment and systems under the scope of TC 100 are firstly used in residential domains such as in home, school, office, etc. And now these are used in mobile domains such as in car, train, airplane, ships and with individuals as movable, carryable or wearable device. These new domains require different specifications from the conventional residential domains.

PT100-9 focuses on the car domain. As a preliminary, this document provides an example of the conceptual model of car related issues under the scope of TC 100, and then it details possible standardization items that are car related.

CONCEPTUAL MODEL OF STANDARDIZATION FOR MULTIMEDIA CAR SYSTEMS AND EQUIPMENT

1 Scope

This document specifies the conceptual model of multimedia systems and equipment utilized for cars and describes possible standardization items.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TR 61998:2015, *Model and framework for standardization in multimedia equipment and systems*

IEC TS 62045-1:2006, *Multimedia security – Guideline for privacy protection of equipment and systems in and out of use – Part 1: General*

IEC 62227:2008, *Multimedia home server systems – Digital rights permission code*
IEC 62227:2008/AMD1:2012

IEC 62443 (all parts), *Industrial communication networks – Network and system security*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

Infotainment system

system for integration of Information and entertainment

3.1.2

main AV system

<car> main audio, video and multimedia system installed in cars

3.1.3

working and functional mode

<car> mode in which various cars work and function correctly

3.1.4

UX mirroring

user experience mirroring

3.1.5

picture navigation

<car> navigation with geotagged pictures

3.1.6**smart device**

mobile computing device with communication function

3.1.7**smart car**

car containing computing and communication functions, interfaces, and sensors to provide advanced user interface and user experience

3.2 Abbreviated terms

CAN	Controller Area Network
DRM	Digital Radio Mondiale
HUD	Head Up Display
IP	Internet Protocol
ITS	International Temperature Scale
LAN	Local Area Network
OBD	On Board Diagnostics
SDO	Standards Development Organization
UX	User eXperience

4 Overview of the car system

The TC 100 system model as described in IEC TR 61998:2015, is basically similar to the model as used for cars. However, specific attention has been paid to the specificities related to cars.

One model from the viewpoint of data communication is described in Figure 1. Whether the application area is car, home or any other kind of domain, this model is applicable. The system model for cars, as described in this document, basically uses this model as audio, video and multimedia systems and equipment, and as infotainment system.

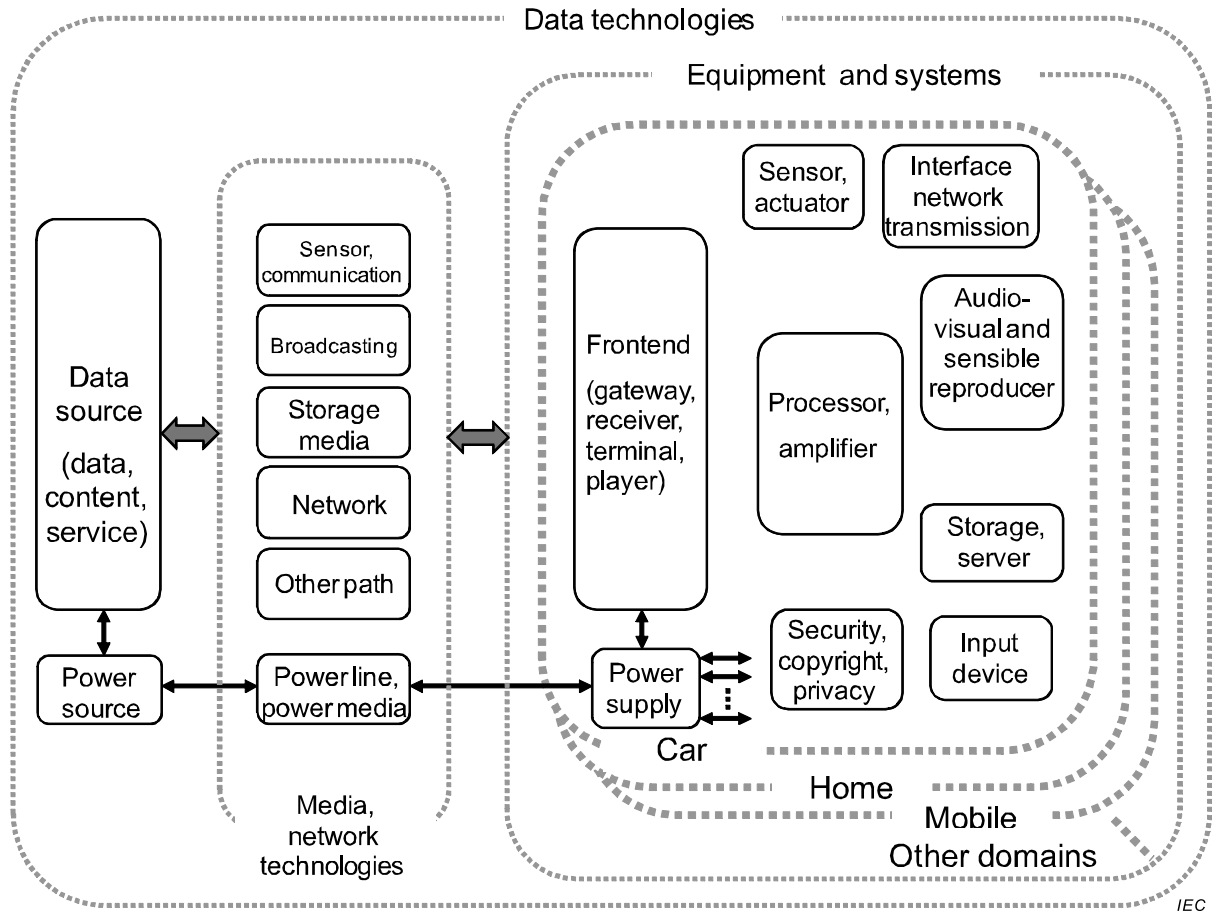


Figure 1 – TC 100 system model for data communication

The communication model between the system and user is described in Figure 2. In this document the TC 100 model is applied to cars. Typical users are drivers, passengers, and pedestrians as well as users in other domains.

The communication between TC 100 models is described in Figure 3. This communication is between the TC 100 model via user and TC 100 model, the TC 100 model via user and the TC 100 model via use, and the TC 100 model and the TC 100 model.

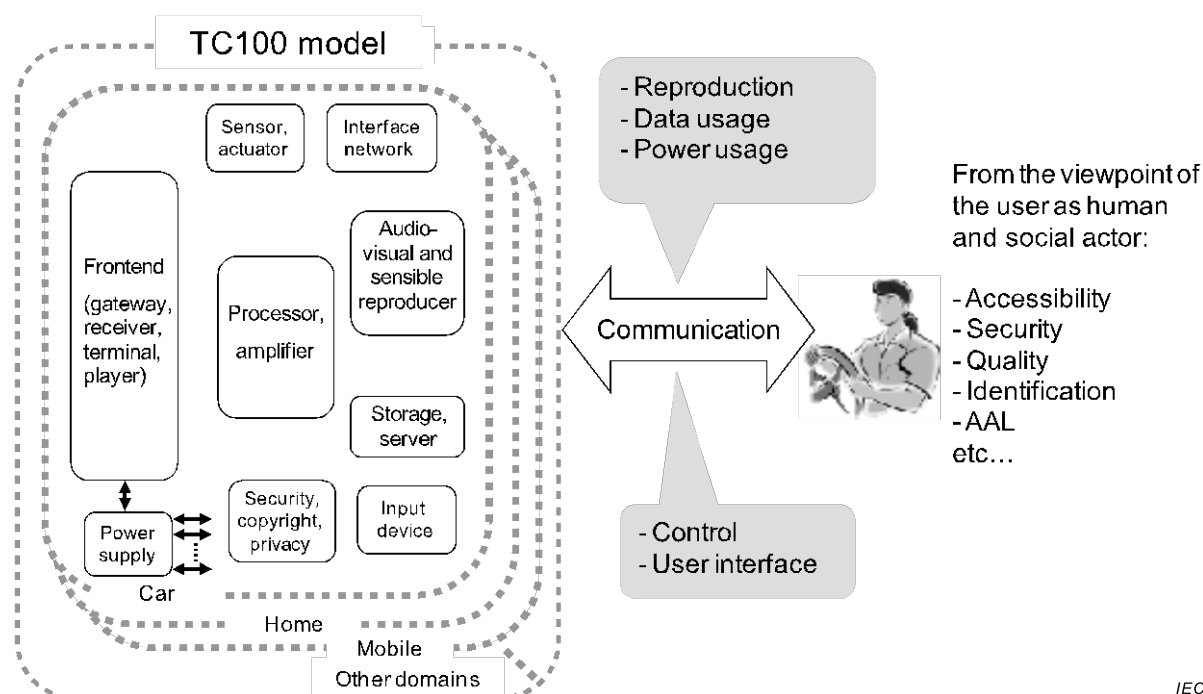


Figure 2 – User communication model

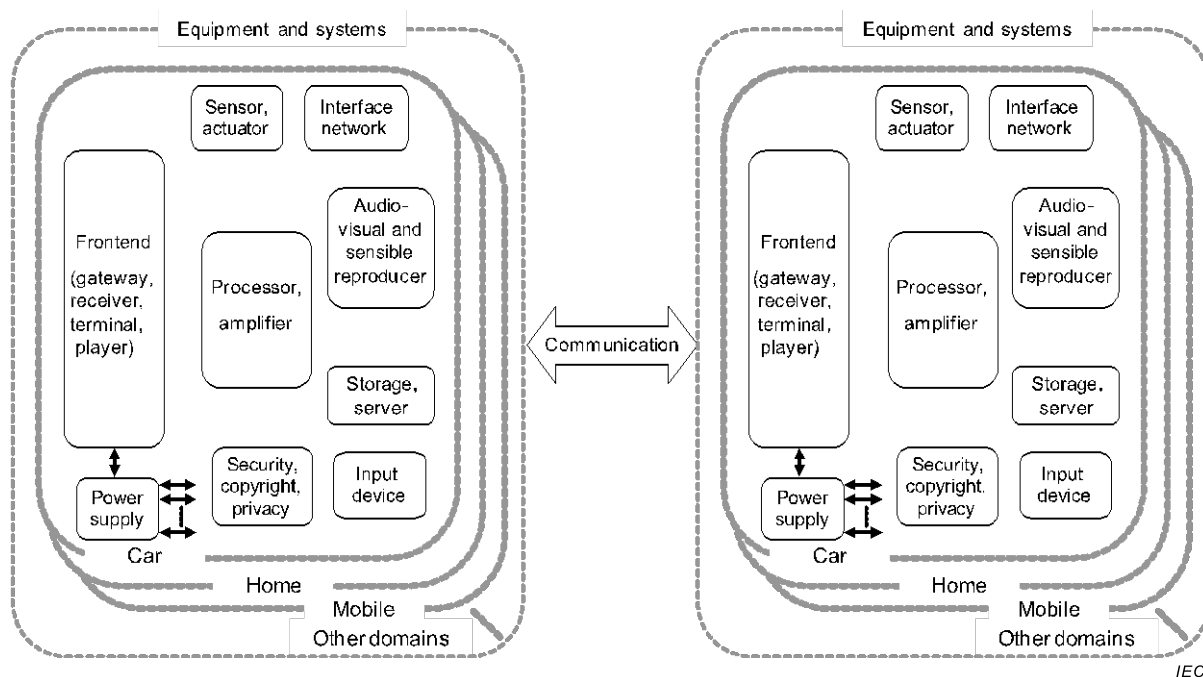
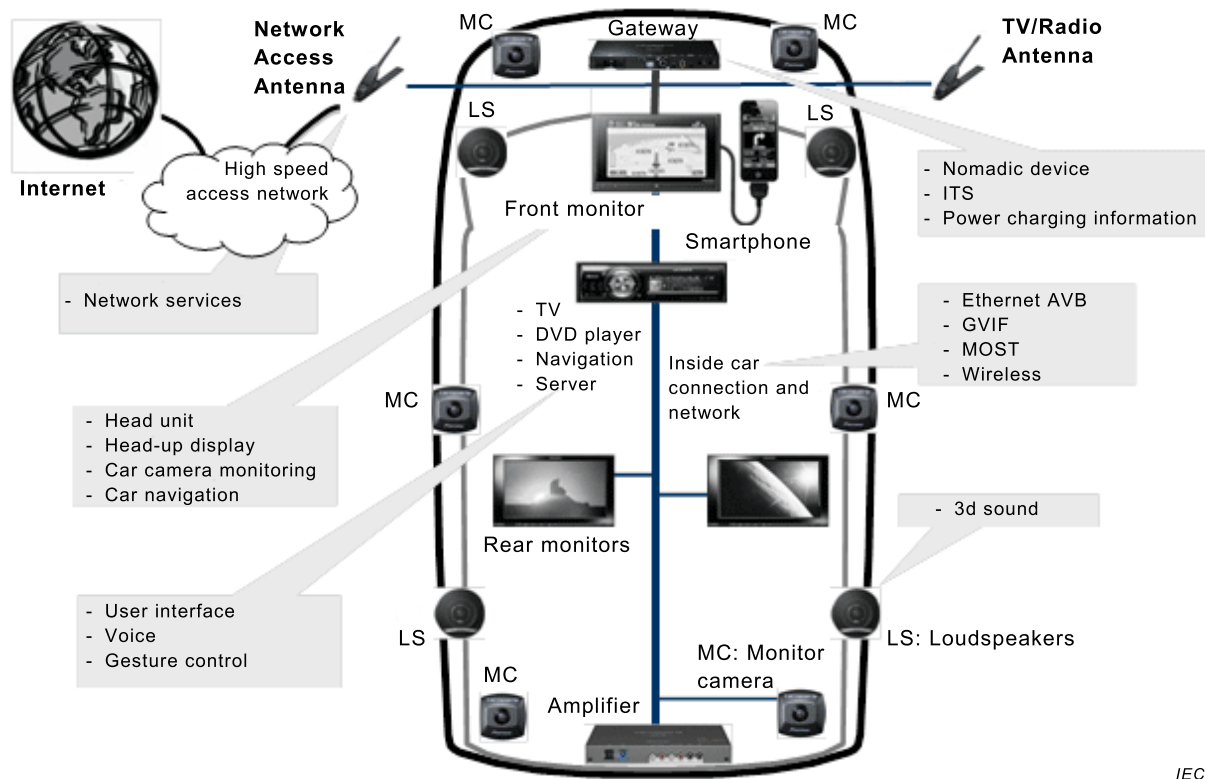
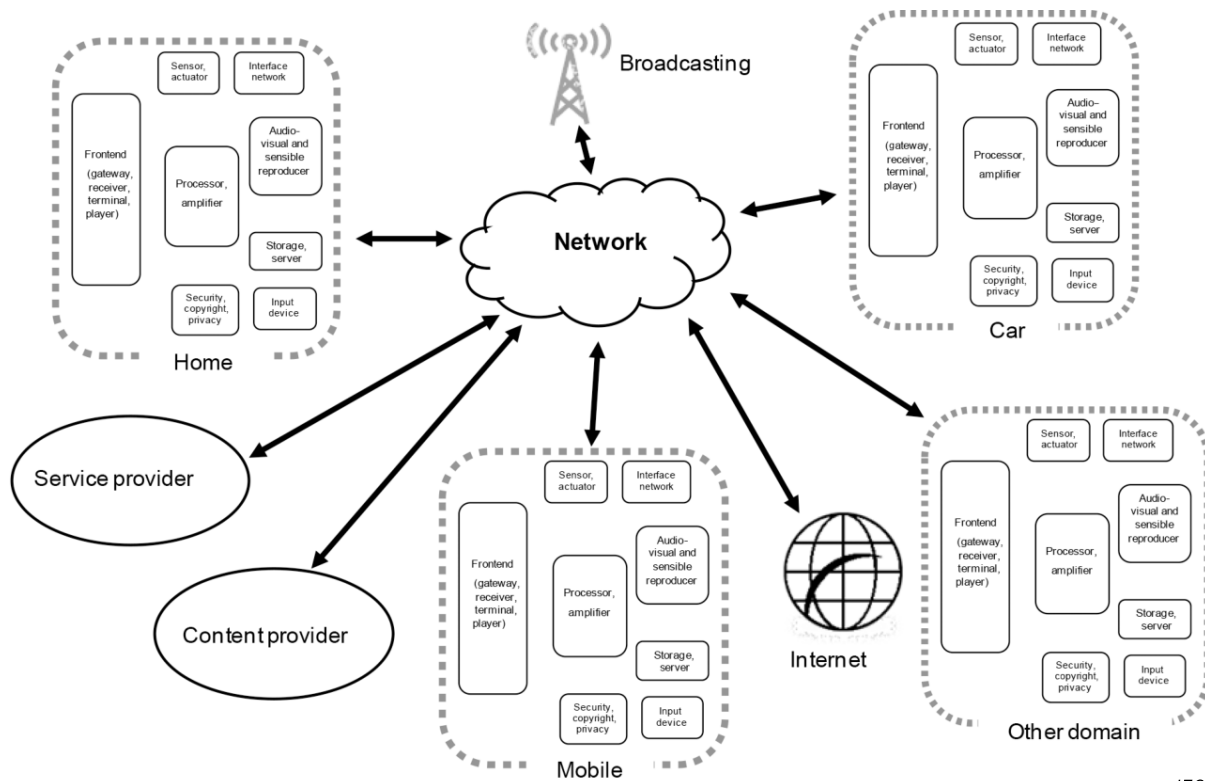


Figure 3 – Communication between TC100 models

For the car system model, an example of a more concrete model is described in Figure 4.



The car system, the home system and the mobile system are related to each other with respect to the network communication and services. The networked systems are described in Figure 5.



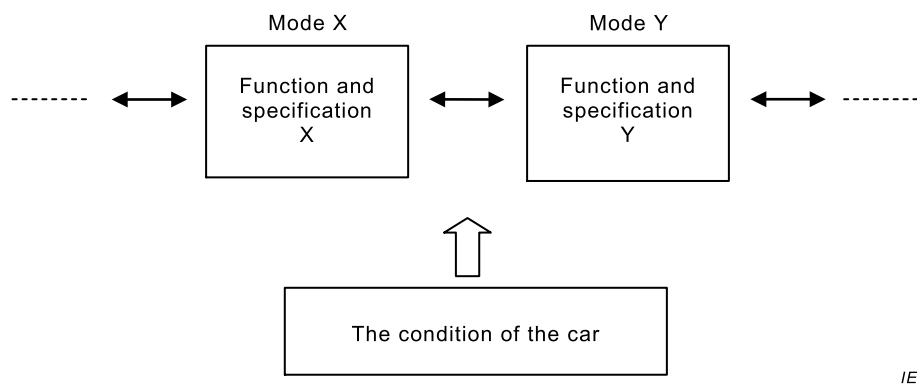
5 Use case

5.1 General

As one of the TC 100 systems, the car system has a similar use case as the home system. The difference is that the car system is movable on road and land, and autonomous. The use case should take the following characteristics of a car into account. A car

- is movable and autonomous, and has a self energy supply,
- has various car working and functional modes of the main AV system depending on the condition of the car such as drive, cruise, stop, park and refuel or charge,
- has human users as drivers, passengers, pedestrians in and around the car, and remote users away from the car,
- has users remote from the car such as other human beings and non human influences such as the TC 100 model over the network.

The working and functional mode of a car is specific to the car system and its main AV system. Each device has a specific function and specification depending on that mode. Each mode has its function and specification relating to the condition of the car. The mode will shift to other modes depending on the use of the car, see Figure 6.



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Figure 6 – Modes

For instance, using e-mail in each mode is executed as follows:

- when a car is stationary, all functions of e-mail are available to the driver;
- when a car is in motion, some restricted functions are available for the driver's safety, such as text-to-speech to read e-mails, speech-to-text to send e-mails, or only e-mail notifications on the display device;
- when the car is parked, all e-mails are stored and forwarded, if necessary,
- when some urgent event has occurred, an alert e-mail is sent automatically.

Any other infotainment and services have a similar mode-dependent function and specification.

5.2 Use experience system

5.2.1 General

The use experience system provides user integrated services and experiences. This system consists of a mixture of other systems.

5.2.2 Smart start

Users can remotely control infotainment or audio-visual systems with a smart device before getting in a car, also, if accessing to the CAN and car control system, a user can adjust the temperature inside the car, unlock or lock the car doors, or start a car.

5.2.3 UX mirroring

UX mirroring is one of the user-convenient functions provided by smart devices including a smart car, and it provides users with personalized experience such as reorganizing or reordering user interfaces and relevant contents by sharing a user's personal preference and usage information in advance among these smart devices.

Once a smart car is connected to the user's smart device via wireless communications such as Bluetooth®¹ or Wi-Fi®², the user can choose to start the UX mirroring service. Then a personalized menu screen is displayed on a display device of a smart car based on the usage pattern of the smart device. For example, icons for frequently used applications appear bigger.

5.2.4 Data synchronization

Smart devices and a smart car can synchronize in real time between various user data, including the navigation system setting, time schedule, and so on.

5.3 Infotainment system

5.3.1 General

The infotainment system entails the adoption of any information service that is online and offline, such as e-mail, web, social networks, information services and any Internet services.

The function and specification of an infotainment system vary depending on the working and functional mode of a car and the users. The mode will shift to the other mode as it is required and needed by a user or another function.

5.3.2 Picture navigation

Picture navigation is an infotainment service that allows users to find a location with geotagged pictures, which contain the latitude and longitude coordinates of this place. The location can be set as a point of departure or destination.

5.3.3 Under traffic signal office

Users make a list of tasks with the estimated time. The office system will let them implement tasks whose estimated time is short while they await traffic signals.

5.3.4 Car social network

Communication among cars can give users the opportunity to exchange traffic information such as car speed, traffic accidents and congestion ahead. A smart car can gather or get such

¹ Bluetooth is the trademark of a product supplied by Bluetooth SIG.

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² Wi-Fi is a trade name of a product supplied by Wi-Fi Alliance.

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information by experience or other smart cars running on the opposite lane. This information can be visualized on a display device, or verbalized, or given to users in other optimized ways.

5.3.5 Panoramic vision

360-degree panoramic view around a smart car can be reconstructed from video images from cameras installed around a smart car, which helps users to see behind blind spots and thus drive more safely.

5.3.6 OBD based car maintenance service

OBD systems give users access to the status of various vehicle sub-systems through their smart device. Users can manage their cars on their own.

5.4 Navigation system

5.4.1 General

Navigation is a guidance system for the driver to drive the car. It is a useful or necessary information system. The information system consists of the elements as described below. Any combination of the various types of information provides the navigation system.

5.4.2 Surrounding information

The surrounding information consists of visual and audio aspects, atmospheric details such as temperature and air pressure, and finally geographical information such as the topography and the road condition.

For instance, the visual monitor of the surrounding provides a complete view of the area around the car. This monitor has the same variety of function modes and their specification. This function is unlike the mirror function (see 5.2.3), but it provides visual information to the user as infotainment.

Other sensors also provide information of the surrounding with the same variety of functions and specification modes.

All of these elements of information can be used for car navigation including auto drive support.

5.4.3 Geographical information

The position of the car is one of the factors of navigation, it is provided by GPS, gyrocompass, and the network system.

5.4.4 Drive information

This information includes the history and plan or the projected journey on the geographical map. The driver uses this information of the navigation system. Drive information has the same variety of functions and specification modes.

5.4.5 Car information

This information is a condition and status of the car such as temperature, humidity, speed and fuel status of the car system. The ambiance in the car can be supplied by the TC 100 model but the information of the car system exists also inside the car. If the secure gateway allows access to CAN the TC 100 model can get information.

This information can be monitored over the network by other users.

5.4.6 Event information

Event means various status changes of the car that are caused by incidents on the car from outside and inside, such as change of acceleration, turning on/off of the lights as well as weather conditions. These are recognized by the sensor or the car control system, and this information can be used to trigger the shifting of the working and functional mode of the car.

5.5 Audio-visual entertainment system

5.5.1 General

The audio-visual entertainment is the same as the system provided for homes, however, in addition the function and specification mode is applied.

5.5.2 3D audio system

The inside of a car is suitable for a 3D audio system. The characteristic of a 3D audio system is used when listening to music. Similarly, a 3D audio system can provide a warning sound effectively.

5.5.3 Emotion-based music streaming

A smart car can recommend users to listen to a series of songs, selected based on their emotion, which can be detected by measuring the heart-rate or sensed by a wearable device.

5.6 Parking concierge system

When a smart car enters a parking lot where an advanced beacon system provides an indoor positioning function, an application program on the smart car starts automatically and displays a map of the parking lot with empty parking spaces highlighted on a display. As soon as the car is parked, the application program stores the exact location and shares it with the user's smart device.

5.7 Car monitoring system

Even when users are away from their smart cars, they can watch what is happening around their cars through their smart device connected to a black box installed in the smart car. Users can also get various types of alarm messages from their smart car.

5.8 Self-emergency call system

If a user gets severely injured in a traffic accident, a smart car can trigger a self-emergency call for rescue. To activate this function, a smart car is able to make out the degree of collision and evaluate the user's condition.

6 Networked system

6.1 General

The car system is networked as described in Figure 5. With this networked system, the car system acts as an integrated system with other car systems, home systems, mobile systems and network services.

6.2 Network inside a car

6.2.1 Car status information

The electric and electronic system of a car has its own information, which is mainly information regarding car control and driving. These elements are important with respect to the safety and security of the car. They shall be secured from outside access to the car

information system. This car information includes the environment status information such as the condition of the air, the temperature, and the status of the doors and windows, as well as the actual driving status such as speed, and the condition of the tires. This car status information may be accessible from outside if security and safety is guaranteed by, for example, a secure gateway, as shown in Figure 7.

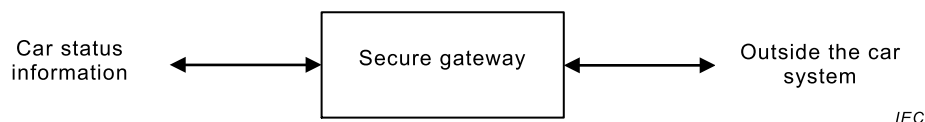


Figure 7 – Car status information

6.2.2 Infotainment system network

The network of an infotainment system is used for various devices and equipment inside a car. The network or interface is used for audio-visual and information reproduction devices, and it is also used for video, audio and other environment information from outside and from within the car, as well as the car itself. These elements of information are networked or interfaced to the processor or any other devices.

For instance, sensors capture information regarding the driving details, e.g. view of the car front, audio signals around the car, acceleration, and geographical information. These elements are fed into the network. Furthermore, these elements of information are monitored or recorded in the car, and also communicated to the outside of the car through a gateway, as presented in Figure 8.

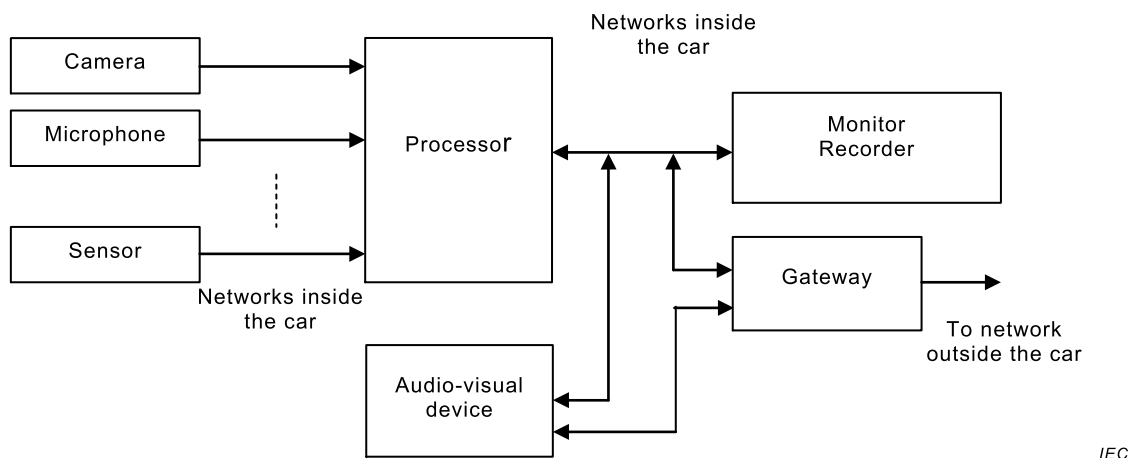


Figure 8 – Infotainment system network

The network inside a car may be based either on a CAN or LAN network or any other dedicated network. The network should have the ability to be applied to all kinds of information and control systems inside a car.

6.2.3 Network of devices

6.2.3.1 AV devices and smart devices

AV devices, especially mobile devices, and smart devices can be used inside a car as shown in Figure 9. These devices are connected to the car's main AV system. The car's main AV system controls and uses these devices with more efficient controller and reproduction devices. The network and interface to the car's main AV system may be dedicated to one or any other existent system. The network used for smart devices is described in Annex A.

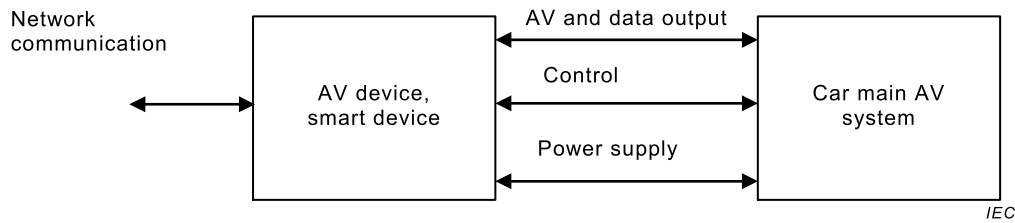


Figure 9 – AV devices

6.3 Network outside a car

6.3.1 General

The network may be an IP based network. The data model, format and protocol needs a car specific specification.

6.3.2 Network between two cars

Car-to-car communication is achieved by a peer-to-peer and client-server system. One car's system and equipment communicates with another car's system and equipment when two users of a car mutually exchange AV and IT resources, as shown in Figure 10.

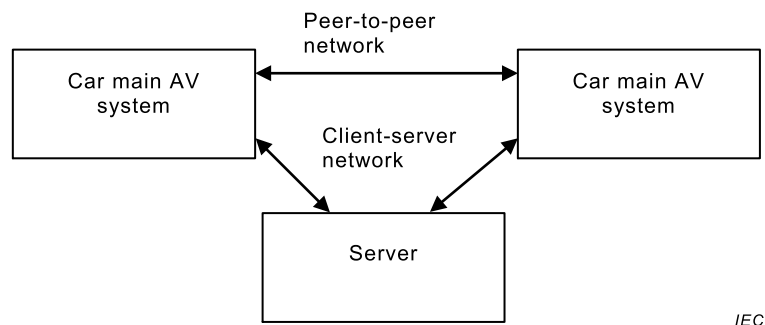


Figure 10 – Network between two cars

6.3.3 Network between a car and another TC 100 system

Communication between a car and a TC 100 system is done by a peer-to-peer and client-server in that a car's system and equipment communicates with a system and equipment in another TC 100 system, as shown in Figure 11.

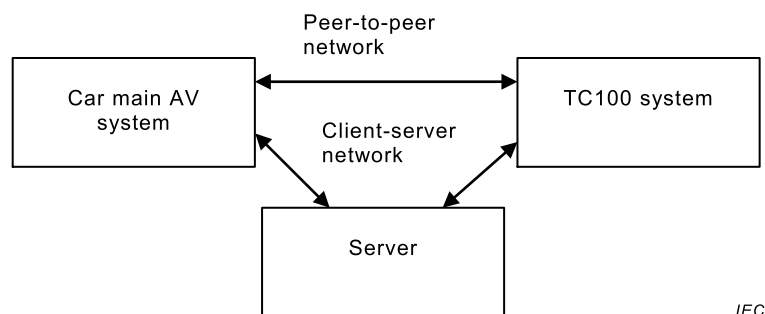
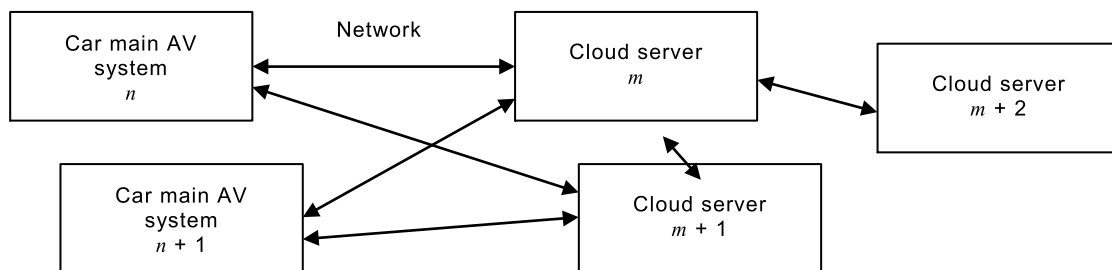


Figure 11 – Network between car and home

6.3.4 Network with cloud servers

A network with cloud signifies all networks except for peer-to-peer networks. Any kind of services can be operated through these networks. Therefore, many kinds of data formats and protocols can be involved. Thus, in order to share services between cars, the minimum compatibility should be considered, as shown in Figure 12.



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Figure 12 – Network with cloud

7 System elements

7.1 Device

7.1.1 Source device

The source device provides audio-video and information data of content. It is a dedicated or not dedicated device to a specific car and is installed/downloaded in it. Both devices depend on the environmental condition of the car, that is moving and subjected to a large range of circumstance parameters.

Moving cars require source devices with a sufficient tolerance to vibration, acceleration and a large range of other circumstance parameters, such as the range of temperature, humidity and luminance.

7.1.2 Sink device

The sink device receives content data and reproduces it. It is a dedicated or not dedicated device for a specific car and is installed/downloaded in it.

The environmental conditions are the same as for the source device, and therefore the requirements are the same.

7.1.3 Sensor device

7.1.3.1 Camera and microphone

Audio and visual information is captured by sensors such as cameras and microphones for both inside and outside the car.

7.1.3.2 Geographical sensor

Sensors can be used by moving cars to obtain geographical information on environments and other issues. Sensors capture signals from radars and GPS, as well as signals from cellular stations and Wi-Fi, and from geomagnetic sensors. In addition, information from navigation and signage systems are used to supply geographical data.

7.1.3.3 Circumstance sensor

Sensors capture environmental information of moving cars. These elements include temperature, air pressure, luminance, and acceleration.

7.1.4 Output device

Audio-visual reproduction devices and other reproduction devices provide human sensible information to drivers and passengers, such as audible and visible information as well as scented and tactile information.

7.1.5 Car black box device

Car black box devices are used to record information such as video recordings around the car and the event video data in case of crash accidents.

7.1.6 Mobile and wearable device

Mobile, wearable and carryable devices can be downloaded in a car, and the user can use them as an interface or control device, an output or input device and a sensor device.

7.2 Network and interface

7.2.1 Inside a car

For multimedia car systems and equipment, all networks and interfaces that are used for home systems can be applied.

The interface between a car control system and multimedia car systems and equipment should have a secure gateway to prevent interference with the car control system.

7.2.2 Outside a car

For multimedia car systems and equipment, all network and interfaces that are used for home systems can be applicable.

The gateway to the outside of a car is comparable to a home system. The gateway security should be better than for the home system. The path from outside to the car control system should be strictly inhibited.

7.3 General information

7.3.1 File format

All file formats that are used for home systems can be applied.

7.3.2 Metadata

All file formats with metadata that are used for home systems can be applied. In addition, car system specific metadata is specified. This is necessary because of the specificity of a car, i.e. the fact that it is movable and autonomous. An autonomous system senses the environment and continuously adapts to it. The metadata is specified accordingly.

7.4 User interface device

7.4.1 General

Users, that is drivers, passengers and pedestrians, communicate with a car system by means of an interface device.

7.4.2 Audio reproduction device

Loudspeakers are used, and they are employed to provide a well balanced sound space for listeners inside a car.

7.4.3 Video reproduction device

7.4.3.1 Monitor

The monitor used for visual content is the same as for a home and mobile system.

7.4.3.2 HUD

Head-up displays are especially used for cars. They consist of the car glass attached type and the car glass installed type.

7.4.3.3 Display installed in a car body

A monitor can be a part of the car itself. The front glass can act as a display and the car body inside and outside can act as a display.

7.4.4 Input device

7.4.4.1 Voice recognition

Voice recognition is used in cars. Noisy environments and talker recognition if there are many speakers should be considered.

7.4.4.2 Gesture

Like in a home or mobile system gesture can be used in a car. However the driver's gesture should not affect car operation.

7.4.5 Output device

7.4.5.1 Audio device

An audio device is used as audible interface for the user.

7.4.5.2 Video device

A video device does not monitor, but is used as a visual interface for the user.

7.4.5.3 Device for human senses

Any device that interacts directly with human senses can be used as an interface for users, such as a vibrator, heater, and scent device.

7.4.6 Wearable device

Wearable devices are carried directly by the user. They can be used as output devices and act as user interface between the main AV system of a car and the user.

8 Measurement method

8.1 General

The measurement method for car multimedia systems and equipment is basically the same as for home systems. However, some conditions that are specific to the car environment should be considered. These specific conditions include such aspects as temperature, vibration and luminance.

8.2 Audio-video device

The measurement method for audio-video devices is the same as for a home system. In addition, conditions specific to cars such as vibration and acceleration, and high and low temperatures should be considered.

8.3 Sensor device

8.3.1 Cameras

Camera devices need to be measured under a wide range of light and luminance and other atmospheric conditions pertaining to a car.

8.3.2 Other sensor devices

Other sensor devices need to be measured under a wide range of atmospheric conditions pertaining to a car.

9 Content

9.1 General

Content used in a car system is the same content used in a home system. In addition, an infotainment system needs car specific content in some cases.

9.2 Infotainment content

9.2.1 Map

9.2.1.1 General

Map content is specific to a car system. Map content for cars needs more information than the usual maps. These types of information include car navigation, car driving and information on any kind of geography-related aspects including signage and other infotainment.

9.2.1.2 Map format

The map content format of cars needs functionalities for infotainment. There are many kinds of information regarding car maps. Electric map formats are specified by ISO and other SDOs but the map and format for car infotainment needs to be clarified.

9.2.2 Traffic and road information

This information is provided by other systems than the TC 100 system, for instance ITS and telematics. Also, any services of Internet can be used for the TC 100 system particularly those related to traffic and road information.

9.2.3 Drive information

Drive information is created by the car activities, such as view, sound, event information around and inside cars and geographical information.

9.2.4 Network service information

Content and information from network services are the same as in a home system. In addition, car specific content and information is also provided.

9.2.5 Car maintenance information

An OBD system provides various aspects of information concerning a vehicle, such as fuel economy, driving habits, diagnostic trouble codes and so on.

9.3 AV content

This is the same as for a home system.

10 Security

10.1 General

There are two security aspects concerning cars. One aspect is data security. Data of content and information in the main AV system and equipment should be secured. These data include copyright, intellectual property and privacy. In general, TC 100 security criteria guidelines and the recommendations and requirements of IEC TS 62045-1 can be applied to ensure that the main AV system and equipment of a car are secure. IEC 62227 can be applied to ensure the copyright information. The IEC 62443 series can be applied to ensure that a network is secure. Any DRM method and copy control information can be applied.

Another security aspect regarding cars includes that car and drive systems have a responsibility for the user's safety. The main AV system of a car should not affect that safety. It may have a path to the car and its drive system. Data communication through that path should not affect a car and its drive system and should be secured.

10.2 Networked systems and equipment

A network inside and outside a car consists of a path from the outside into the car. These networks can possibly intrude via the path and influence the car and the drive system. This path is described in Figure 5, and also the paths described in Figure 1 as paths to data, content and service. This path should be secured.

Copyrighted content and private information are stored in the main AV system of a car. The system that is connected to the outside, such as a home or cloud, as well as the network and the car system should be secured and unauthorized access to the content and information in the main AV system of a car should be prevented.

The outside networked system can access the main AV system of a car through the network and can even access the driving system of the car. This may expose users such as drivers, passengers and pedestrians to serious danger. This access from outside should be prevented and the system shall be secured against unauthorized accesses.

10.3 None networked system and equipment

A none networked main AV system of a car has no path from the outside to the network, but it has a path from the outside by means of its hardware. Copyrighted content and private information in none networked systems shall also be secured against outside access, and the main AV system of a car shall be secured against these accesses. IEC 62045-1 describes this kind of paths and their security.

11 Regulations

Regulations regarding cars are established in each region and country. TC 100 standardization does not enter that regulation area.

Each country has its own car regulations. TC 100 standardization does not conflict with these regulations.

However, the items outside the realm of these regulations can be a standardization item of TC 100.

For instance, a camera and monitor system installed instead of mirrors is assimilated to a mirror in some regulations because it is accepted as a safety device. These items are out of the scope of this document.

Annex A (informative)

Network and smart device

A smart device can be the main device of the main AV system of a car including its navigation system. Also, a smart device can be part of the main AV system of a car.

If a smart device is the main device, all control and communication is done through this smart device. Audio and video reproduction and control can be done by devices of the main AV system of the car. If a smart device is part of the main AV system of the car, the control is carried out by this system. The communication between the smart device and the car's main AV system is carried out by means of an interface and an application such as web server application.

Figure A.1 shows an example where the smart device is the main device, Figure A.2 shows an example where the smart device is part of the car's main AV system.

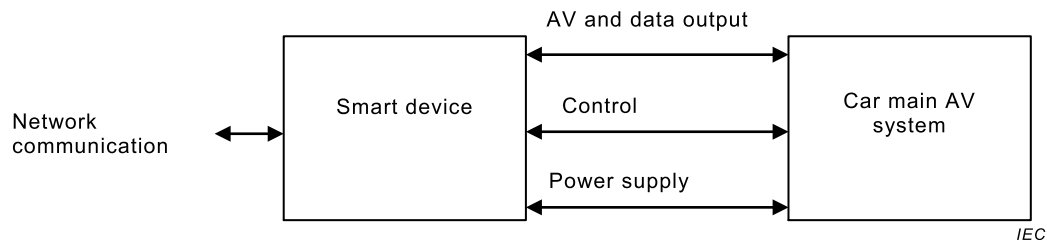


Figure A.1 – Main device case

If the smart device is the main device, the smart device is a functional centre, i.e. all network communication is carried out via the smart device. Control, interface and output are connected to an external device which has a more efficient display, loudspeaker, microphone and user interface than the smart device.

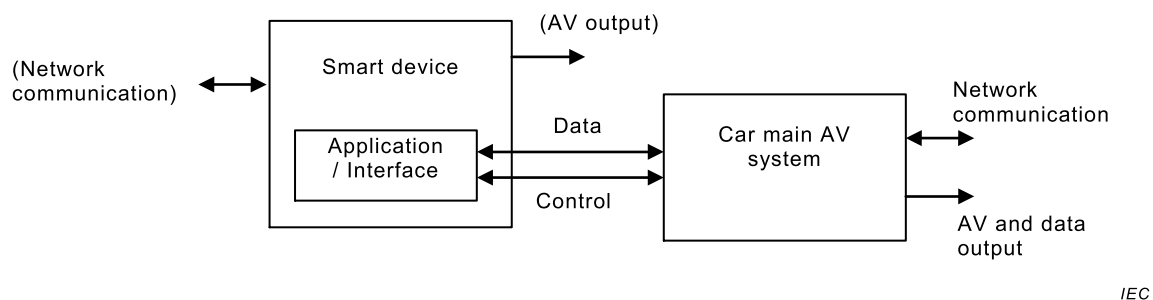


Figure A.2 – Part of the main AV system of a car

If the smart device is part of the car system, the smart device is part of the car's main AV system. The main AV system uses and controls the smart device by means of an interface or application. Network communication is carried out by the main AV system of the car, or the smart device can execute all or part of the communication. Audio, video and data reproduction and control is mainly carried out by the car's main AV system.

Annex B (informative)

IEC standard for security

Car multimedia systems and equipment should be secured for copyright, privacy and safety. Some IEC standards specify security issues as follows.

IEC TS 62045-1:2006, *Multimedia security – Guideline for privacy protection of equipment and systems in and out of use – Part 1: General*

- This Technical Specification gives guidelines for protection methods of the user's privacy and access to content of consumer equipment and systems from outside, except network access.

IEC 62227:2008, *Multimedia home server systems – Digital rights permission code*
IEC 62227:2008/AMD1:2012

- This International Standard defines the permission code and a set of permission related information in short code form. The permission code is comprised of a common ID system to control and register the rights with respect to content.

IEC 62443 (all parts), *Security for industrial automation and control systems*

- This series of International Standards, Technical Specifications and Technical Reports specifies security methods against cyber attacks through the network.

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