

Infotainment

What is Infotainment?

- It can be described as a blend of vehicle systems used to provide entertainment as well as information to the driver through videos, audios, button panel, voice commands, touch screen displays, and much more. The increasing demand for luxurious cars and rising technological advancements are the main reasons to boost the production and sales of in-car infotainment.

Where the infotainment is used?

- Mainly infotainment is used in the vehicles and it is also called as In-Vehicle Infotainment (IVI) or In-car entertainment (ICE).
- An automotive infotainment system consists of multiple integrated systems and also utilizes some external devices to offer entertainment and information to the driver and passengers.

Some of the main components of the System are:

1. **Heads-up Display :** One of the integral parts of the automotive infotainment, a heads-up display shows vehicle's real-time information on a transparent screen that's integrated with the car's windshield. These displays help drivers by reducing distraction while driving and assists with navigation maps, electronic digital cluster, climate, multimedia options, and more.
2. **Integrated Head-unit :** A head unit is a tablet like touch screen-based device mounted on the car's dashboard that acts as a connected control center for the entire infotainment system.
3. **Operating System :** Just like a computer is nothing without an OS, an automotive infotainment system is nothing without operating system like QNX, Windows, Linux, and Android. An OS is responsible for supporting connectivity, integration of new functions, convenience functions, etc.
4. **GPUs and DSPs for Multiple Displays :** GPU and digital signal processing are types of processors that are designed for advanced infotainment systems and can display content on multiple screens like connected smartphones, heads-up display, head-unit, etc.
5. **Connectivity Modules :** Connectivity modules like Wi-Fi, Bluetooth, GPS, etc. offer easy connectivity with outside networks and devices and also helps in establishing services like internet connectivity, smartphone connectivity, navigation, and much more.
6. **Digital Instrument Cluster :** The digital instrument cluster consists of digital displays of the traditional analog gauges like odometer, speedometer, RPM, and others.
7. **Automotive Sensors Integration :** This component consists of gesture recognition sensors, proximity sensors, and camera sensors that integrate well with the infotainment system to provide safety-related information to the driver.

Features of an in-vehicle infotainment system

- High Resolution Touch Screen.
- Smartphone Pairing.
- Analog and digital tuners for multi-standard radio reception.
- Multimedia Support.

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- Advanced Vehicular functions.
- Android Auto and Apple CarPlay Compatibility.

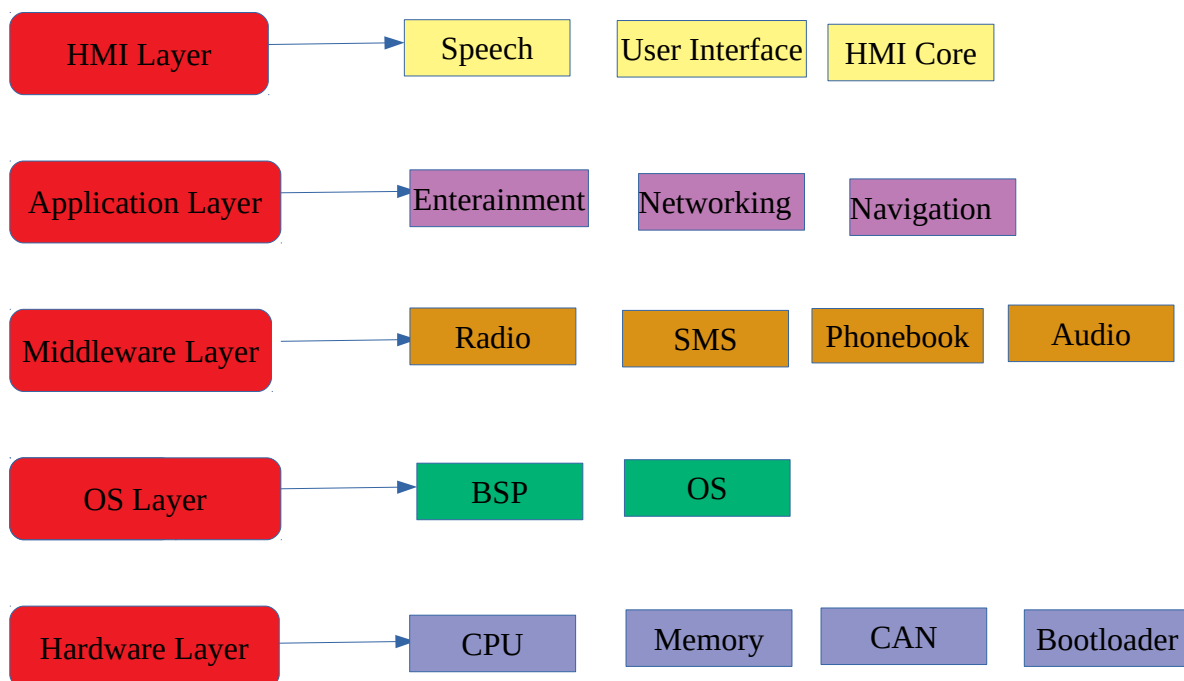
The Main components used for the internal communication of the vehicle are ECU

ECU: Electronic control unit which takes of the particular function. Now a days the min. ECU are 25-30 and in the Highly cost vehicle which has more features uses of maximum of 100-120 ECU units.

- Door control Unit (DCU)
- Engine Control unit (ECU)
- Electric power steering control unit (PSCU)
- Human Machine Interface (HMI)
- Powertrain Control Module (PCM): Sometimes the functions of the Engine Control Module and transmission Control Module (TCM) are combined into a single unit called the Powertrain Control Module.
- Seat Control Unit
- Speed Control Unit (SCU)
- Telematic Control Unit (TCU)
- Transmission Control Module (TCM)
- Brake Control Module (BCM; ABS or ESC)
- Battery Management System (BMS) etc.

These are some kinds of ECU's for this communication. For the communication of ECU CAN controller is used.

Architecture : The architecture consists of five layers.



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- **Human Machine Interface (HMI) Layer** : The HMI is the interface to the user of the IVI system and controls the display of the IVI system's head unit. It is responsible for processing and responding to user inputs like touch screen input, speech recognition input and knob/button-based input.
- **Speech** : When the commands given with touching the screen are giving input from the button present on the infotainment. The input are only given the vocal speech or voice speech is comes under speech of HMI.
 - **User Interface** : User interface is the first impression of a software system from the user's point of view. Therefore any software system must satisfy the requirement of user. UI mainly performs two functions – (i) Accepting the user's input and (ii) Displaying the output.
 - **HMI Core** : A Human Machine Interface, or HMI for short, is a device that allows a human to give directions and receive feedback from the PLC that is controlling the manufacturing process. In other words, it is a means to input commands into your machines and earn feedback about their status.
 - **Application Layer** : The application layer contains a mix of applications, all designed to provide a specific function to the benefit of the user. Applications are dependent on other software referred to as system software to be able to execute. System software differentiates from application software in the sense that the it serves the latter (which in turn serves the user).
 - **Identifying communication partners**: The application layer identifies the availability of communication partners for an application with data to transmit.
 - **Determining resource availability**: The application layer determines whether sufficient network resources are available for the requested communication.
 - **Synchronizing communication**: All the communications occur between the applications requires cooperation which is managed by an application layer.
 - **Entertainment** : Here the Entertainment is nothing but the application regarding the enjoyment or relaxation purpose used those are comes under this categories. The application like music, video, Radio etc, comes under this. Here it can also runs under stereo mode which means it can be accessed with vechile stereo by pause, resume, forward, turn off, turn on etc. Usb, multimedia etc
 - **Networking**: It is used for the for the connectivity of the bluetooth and wifi. The concept network is used in vechiles to connect with each other through the ECUs ,sensors we can also track the vechiles through vechile networking because they could not get collied when they are coming same without knowing them. The networking can also be used to communication internally between the protocols and some the other sensor when to turn on and off.
 - **Navigation** : This can be takes care of the location of the vechiles where they are present. With feature we can access send our location or we can route of ways where we are going or we are present at. Navigation system helps to find location using GPS and Inbulit Maps which can drawn from the mobile or saved in the memory can also be Accessed.

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- **Middleware Layer** : The middleware layer consists of components and interfaces in Software that supplies services to the application that are not available from the operating system layer, so that the functional areas of the application layer can be realized. Consequently, the middleware layer simplifies the communication and input/output of data between the application layer and the operating system layer, as a result application developers can focus on the particular purpose and functionality of their application.
- Middleware layer its servers the purpose of the application the standard codes or Standard API's are present in the middleware .
 - When the request from the application comes the required service or that is already registered with the system bus are interfaced with middleware through session bus and serves the purpose of it.After the completion of its service the session for that is the interfaced is removed and the session get destroyed.
 - Here Middleware acts as the middle person in between the application and the OS layer the input from the both layers can be serviced by it. Where to transform the information .
 - In the middleware the modules can be created based on the system requirement of the system and modules change from project to project .Based on the the developers design the modules.The modules used by us are Bluetooth,Audio,Phonebook,SMS,Radio etc.
 - For different types of functionalities different types of middleware`s are used.
- **Operating System (OS) Layer** : The operating system layer generally constitute the operating system along with a Board Support Package (BSP) and drivers. The operating system itself typically manages hardware and software resources and provides applications with common services.The BSP provides essential support code that facilitates the porting of an OS to a new hardware environment. The drivers operates and manages attached hardware devices by providing software interfaces to hardware devices. Thus, the operating system can access hardware functions without having to know any detailed information about the hardware currently in use.
 - **BSP**: Board Support Package which consist of software containing hardware based boot firmware and device drivers. In this the code which will support the hardware is present according to the hardware the software is written for the emdedded devices. It supplies the codes the codes to the boot process at the start of the device.Mainly for BSP Embedded C code is written.
 - **OS**: In vehicle infotainment systems require operating systems that are capable of supporting connectivity, convenience functions, and downloadable software applications to integrate new functions in the system. Operating systems like Android, Linux, QNX, Windows are leading the infotainment segment.
 - **Hardware Layer** : The hardware layer is composed of a processor with additional essential hardware and firmware to boot the OS. Additionally, this layer is often equipped with a set of automotive I/O devices like CAN etc.What type of system is being used can be bulit. The devices which are mounted according we can write basic software to run.

Main components of Hardware Layer are CAN ,CPU,Memory and Bootloader.

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CAN : CAN stands for **controller area network**. They are designed specially to meet the Automobile Industry needs. Before CAN was introduced, each electronic device is connected to other devices using many wires to enable communication. But when the functions in the automobile system increased, it was difficult to maintain because of the tedious wiring system. With the help of the CAN bus system, which allows ECUs to communicate with each other without much complexity by just connecting each ECU to the common serial bus. Hence when compared with the other protocols used in automotive systems i.e., CAN vs LIN, CAN is robust due to less complexity.

CPU : CPU stands for Central processing unit. Now a days 32-bit processor are used in the Automotives along with the 10MB of flash memory. It maintain all the processes the enire system. The majory operation regards regarding the hardware devices can be done and processes the work among them.

Memory : Memory used in the infotainment for the purpose of the storage of the data which in the form of source code and also stores the the download file, saved playlists and many more based the storage requirement the memory size depends.

Bootloader : it is software module which load the OS into the kernel.it locates takes the location of the OS which is present in theMastre Boot Loader(MBR).It loades the multiple operating systems present in the system can loaded and depends on the user the refered OS is loaded into the kernel.if only one OS is present then bootloader directly loads that without the user choice.Different types of bootloaders are present.Depends on the system environment.

Ex:GRUB,LILO,U-boot,Redboot,Barebox.

The module described is one type of module which we have used and who that is interfaced and connectivity and how services are registered.

- **Bluetooth**:Bluetooth is a wireless technology which is used to connect the short range devices and used to exchange data between them.To know how the data Exchange internally we used know the term D-BUS which used as the path between devices to process data.
- **D-BUS** : It is open source software which consists of services **D-Bus** (short for "**Desktop Bus**") is a Message oriented middleware mechanism that allows communication between multiple process running concurrently on the same machine.It is developed from the scratch which means it is unique from other IPC. D-BUS can perform basic application IPC, allowing one process to shuttle data to another. Second, D-BUS can facilitate sending events, or signals, through the system, allowing different components in the system to communicate and ultimately to integrate better.D-BUS is unique from other IPC mechanisms in several ways. First, the basic unit of IPC in D-BUS is a message, not a byte stream. In this manner, D-BUS breaks up IPC into discrete messages, complete with headers (metadata) and a payload (the data).libdus is used for the one to one communiocation between the services to exchange messages.Here D-bus is a low-level IPC Protocol.Full form D-bus is Desktop Bus.

D-bus consists of majorly two types of buses SYSTEM BUS AND SESSION BUS.

- **System Bus** : System bus is type of message protocol it communicates between the system components and provides the clear idea about the particular components to do its work.All users of the system can communicate through this bus with prior permissions.

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- **Session Bus** : It is created at the session login. this bus is used for particular user who has logged in as the IPC and objects for the user application. Only one session for one login. whenever the new login is created a new session bus also created for that login and if the user is logged out automatically the session bus gets destroyed.

The Dbus is has already registered with the services from the server. The services which the system needed has to interface at the system level other than the registered services we cannot use other services. if any new service is needed for the system we have to register for that particular service.

Bluetooth: Bluetooth is application which used to exchange information between devices for short range. Bluetooth uses bluez service for the communication and it consists of supported protocols of bluetooth information.

The bluez service is open source which is developed by freedesktop and which consists of bluetooth stack.

The protocols used in the bluetooth architecture are

1. A2DP 2. AVRCP 3. PBAP 4. HFP 5. MAP

The Inbuilt ofono service is activated is when the bluetooth hfp is used. HFP is a hand free profile which acts as a device without the connected device. The functionalities are used in the device which is connected to it.

OFONO: This is service in the bluez which sends the AT commands through the server to the device regarding the sending the message or calling from the connected device directly without accessing the mobile.

The interfaces present in the bluez service are

- 1) **ORG.BLUEZ.ADAPTER1**
- 2) **ORG.BLUEZ.GATTMANAGER1**
- 3) **ORG.BLUEZ.LEADVERTISINGMANAGER1**
- 4) **ORG.BLUEZ.MEDIA1**
- 5) **ORG.BLUEZ.NETWORKSERVER1**

When ever the services are added as interfaces to the system bus the below one shows as the properties changed.

- 6) **ORG.FREEDESKTOP.DBUS.PROPERTIES**
- 7) **org.freedesktop.DBus.Introspectable**

For Every interface we have separate methods properties and signal.

Audio : Audio is some which is audible. when you play a music file in the system the convert file a audible one out of the speakers.

- Here when a file is tapped to play internally based on the format it uses some codec which is nothing but compression and decompression.
- When a file is tapped that check format and it goes to the codec after the middleware part is completed.
- The codec here acts as the source and then from codec it goes to the predefined calls based on the type of codec is suitable at first from file it is compressed and then it goes to the

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second stage after the codec conversion later it decompression and goes to the destination as sink.

- Here the hardware component also consists of some codec converters then the output comes as Audio.
- The protocol work based on the type system is supported and also referred to type of play is used. If the Audio is played for this it different protocols is used and if played through bluetooth connectivity and also used through self play it uses different.
- The codec are of two types 1.Compressed codec 2.Uncompressed codec
- **Compressed codec:** The file by this type of codec it specifies some different level of Audio output . In this lossy and Lossless are two different types.
- **Lossy:** This type of codec uses the less size and with loss of some information the file is approx.1/70 of original file size.
- **Lossless:** This type of codec has the full file information without any loss and the file size is approx.half of the original file size.
- **Uncompressed codec :** By using the uncompressed codec that size of file is same as original file without differing any format as it works as the original one.

Radio: A Radio is radiowaves technology which is used communication and signaling .Using this Module we can get signals from the near by radio station from that the information regarding the Entertainment ,News and traffic updates and many more.

- The Technology used for the radio is (RDS) Radio Data System.it is a standard communication protocol for embedding small amounts of digital information in conventional FM radio Broadcast. RDS standardizes several types of information transmitted, including time,station identification and program information.
- Radio Waves are electromagnetic waves for accessing them using two signal strengths 1.AM 2.FM
- **AM:** Amplitude modulation used in some countries.
- **FM:**Frequency Modulation for RadioWaves access FM type is used in India.
- The predefined functions are present in the Middleware which can be used from the internal functioning.
- In Radio like scanning,power on,power off,Auto scan,pause,listed channels like functionalities are defined in the middleware of radio by this we are getting.
- When from the Application the user information is caught it sends to the middleware and that functionality is worked as from source to sink.
- Likewise the Radio also the datapacket format like a message when it wants to send some message then the system.
- **Tuners :** Tuners are used for the selecting the channel of Radio.