((Infotainment))
Flexible Radio Platform Based on SoC Design: One for All

New functions, flexibility, and updates throughout the entire lifecycle of a vehicle – all at an attractive price. These are the requirements of today's automotive manufacturers and end users for infotainment systems. The new car radio platform from Continental rises to these challenges with a sophisticated concept and intelligent architecture.

By Abdul Khaliq

The market trend for in-vehicle infotainment is clear. The U.S. market research company IHS Automotive predicts that, by 2020, 25.4 million vehicles will be equipped with audio infotainment systems –a steep increase compared to 2014, when IHS counted only 14.4 million vehicles with such systems. Customers and manufacturers are increasingly expecting features such as smartphone connectivity via CarPlay and Android Auto to be standard features. Increasingly larger (touch) screens in the cockpit, app functions and a connection to the cloud will soon be considered as standard features. Despite these increased requirements, customers and OEMs expect lower prices for such products.
Automotive manufacturers appreciate flexible solutions that can easily be adapted to various vehicle models, trim levels, and markets. Here, another challenge is posed by the varying standards for digital and satellite radio across the world and the rapid technical development within the consumer electronics market with regard to mobile devices. The infotainment system of the future must be able to adapt to changing market requirements and user behavior, while remaining reliable, easy to use, and ideally upgradeable via a software update.

Support of various market segments and regions

Continental is rising to these diverse challenges with a new radio platform, which fits into a flat panel housing only 40 mm in depth, therefore giving automotive manufacturers maximum flexibility for interior design (**Figure 1**). The platform also supports a color touchscreen and, depending on the target market, can receive AM/FM, DAB/DAB+/DMB, DRM, and HD radio via software-defined radio technology. It also supports smartphone connectivity via MirrorLink, CarPlay, Android Auto and Baidu CarLife. In addition, it enables speech input and text-to-speech output, and is equipped with Bluetooth, iPod/USB connection, and an SD card slot to support multimedia players. A rear-view camera can also be connected thanks to a video-in interface and an Ethernet-based audio/video bridge (AVB) supports the connection of a surround-view ECU to the system classified as an entry platform in the multimedia field. Apps, cloud services and even the integration of a navigation system are major features of this platform.
The platform was developed by Continental with four core requirements in mind:

- Maximum flexibility through software-defined radio functions with worldwide reception options
- Secure smartphone integration
- Compact flat panel design
- High degree of scalability to ensure that one hardware platform can be used for various market segments and regions

To achieve these development goals, Continental's radio platform uses a System-on-Chip (SoC) design, as shown in **Figure 2**. This SoC is a multiprocessor system, in which two cores are responsible for the human-machine interface, the connectivity function, and audio post-processing including decoding, echo cancellation and noise reduction. An additional embedded CPU used as a "vehicle controller" allows connection to the CAN and, if necessary, the MOST bus, processes system wake-up events, and performs other similar functions. Furthermore, the SoC also includes integrated analog-to-digital (ADC) and digital-to-analog (DAC) converters for converting both analog and digital audio

signals. Graphics is handled by a 2D engine, a 3D graphics processor, and a H.264 video decoder. A digital signal processor (DSP) serves as a baseband processor for the software-defined radio. Multi-standard front-end modules that ensure reception and diversity, station search functions for AM/FM, DAB, and HD radio are connected to this SoC depending on target market. These front-end modules are connected to the core system via a standard broadband interface.

Combination of front-end and antenna modules

The multi-standard front-end modules combined with the software-defined radio platform enable the system to work in markets around the world. The architecture supports up to seven tuners and enables complex applications such as dual-FM reception with phase diversity, dual DAB with maximum ratio combining (MRC), FM data reception, dedicated TMC, and dedicated DAB data reception.

Continental has been developing DSP-based infotainment systems since 2006. SDR-based DAB was first used by the company in 2012 and has been continually developed for various OEMs ever since.

Continental has also developed an Intelligent Antenna Module (IAM) for this platform, which brings the tuners close to the antenna and is connected to a head unit via ethernet. Actual implementation is performed in close cooperation with the OEM.

One of the challenges in designing this type of antenna module is the wide range of temperatures tolerance needed. Since this part is exposed to the outside, for example on the roof like a shark fin or as an antenna module integrated in the trunk lid, the IAM is subject to high temperatures in summer and low temperatures during winter. Therefore, the electronic components used must be designed to perform under such diverse circumstances.

Integrated hardware architecture and open-source software

A comparison of conventional infotainment architectures and the watt platform presented here, as shown in **Figure 3**, illustrates the differences and the advantages gained as a result in the areas of system design and cost optimization. Conventional solutions use independent components for the application processor (typically single-core), the vehicle controller, and signal processing for analog and digital reception paths, whereas the Continental radio platform combines all of these functions in one SoC. This reduces the number of components required significantly, facilitates more compact hardware designs, decreases the amount of heat created, and – if an energy-efficient, class-D amplifier is used – allows for implementation without separate fans. These technical advantages also entail a perceptible optimization of costs for the entire system.

A high level of efficiency and flexibility combined with a reduction in development costs and times were also important criteria in selecting the software architecture. Continental therefore decided to use the open-source operating system Linux, which is already used in various Continental multimedia systems. The system also benefits from an extensive and growing developer community that works on the individual components of the open-source software, meaning that it is regularly improved and expanded. The modular software architecture supplements the operating system with middleware components, which connect the system to the vehicle infrastructure and the watt platform. This enables system- or OEM-specific software components – notably graphics and HMI – audio, video, and multimedia functions, and – if applicable – third-party navigation software to be easily integrated. The scalability required of the overall concept and the capability to adapt to new market requirements can be achieved via software updates.

A good example of the seamless adaptation to developing market requirements is smartphone integration on the platform. With a capacitive touchscreen in resolutions of up to 1280 x 720 (HD), support for USB and Bluetooth connectivity, and hardware-based H.264 decoding, all technical requirements for the support of "mirroring concepts" are met. MirrorLink, Apple CarPlay, and Android Auto specifications are implemented according to the protocols defined by the respective

license holders, notably Apple and Google. This allows smartphone-based apps to access the touchscreen of the head unit, the transfer of audio signals in both directions, and the support of smartphone-based navigation functions as well as other applications when they become available. New market-specific requirements, such as the support of Baidu CarLife for the Chinese market, can also be implemented in this way. The flexible architecture of the infotainment system means that it can respond to the diversity, rapid changes, and further developments on the smartphone market without a high development outlay. Even future functional enhancements to the smartphone mirroring standards currently dominating the market can be implemented using software updates.

Flexible architecture for various application scenarios

The new platform also offers a high level of flexibility and scalability. Depending on the requirements of the automotive manufacturers, the head unit can be configured as a “high radio” with extensive media support including Bluetooth and WiFi as well as smartphone integration up to an entry multimedia system with 2D or 2.5D navigation

Another possible system design is to use the platform as a companion chip for a high-end SoC application. In this case, the platform would provide multi-standard radio reception, while the external high-end application system would typically provide high end navigation, Bluetooth/WiFi, control of the multiple displays as well as of the HMI. It is also possible to connect the Continental platform to existing or external head units as a tuner box to provide radio reception and audio functions.

The space-saving design of the platform provides a particular advantage when it is used as an IAM. In this way, the radio platform can be integrated directly into the IAM, saving costs on antenna cabling and by connecting the platform to the head unit via ethernet.

Meeting market requirements

A wide selection of features combined with best possible cost optimization, broad-based scalability for a variety of markets and models, reducing the number of variants to target markets across the world thanks to software-defined radio, maximum freedom for interior design due to flat panel design, and future viability to implement new functions or services via software updates or upgrades throughout the lifetime of the vehicle – these are the main advantages of the new radio platform. With its new flexible radio platform design, Continental is perfectly equipped for the challenges of the next radio generations.

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Figure 1. The radio platform fits into housing with a thickness of 40 mm and, depending on the target market, can receive AM/FM, DAB/DAB+/DMB, DRM, and HD radio via software-defined radio technology.

Figure 2. The radio platform is based on an SoC design with an integrated multiprocessor system, which is responsible for the human-machine interface, the connectivity function, and audio post-processing including decoding, echo cancelation, and noise reduction.

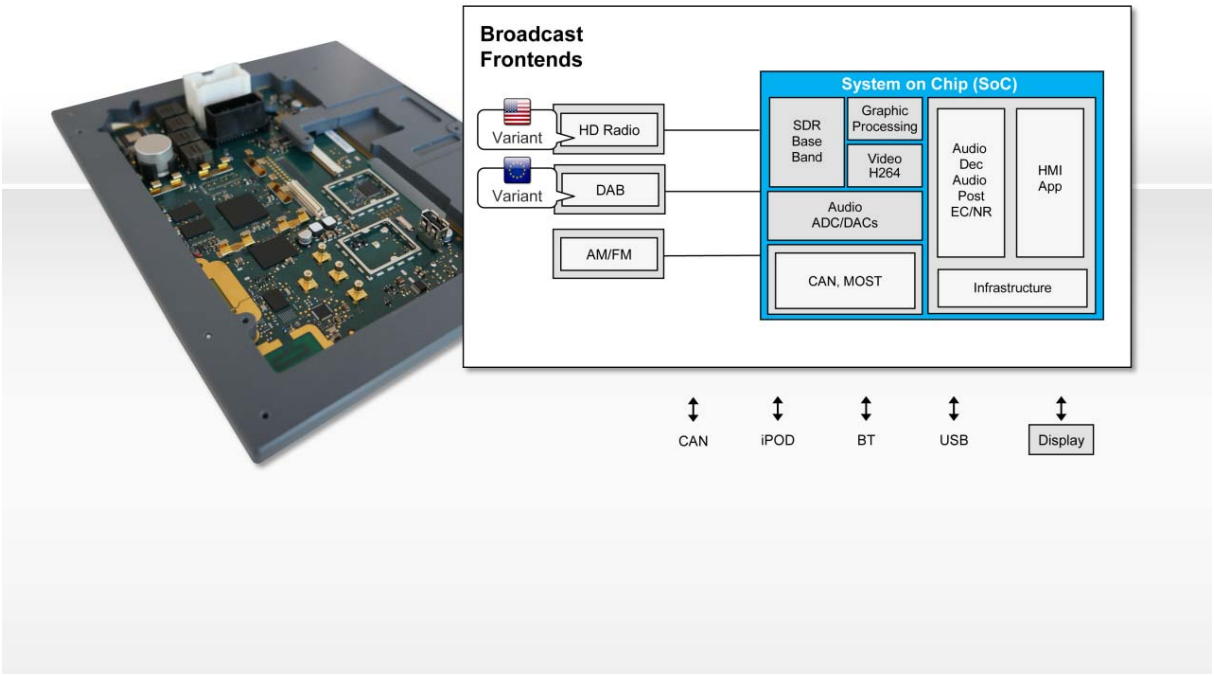

Figure 3. Differences between conventional and integrated approaches to infotainment architectures.