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CURRENT TRENDS

THE TRENDS DRIVING ANTENNA DESIGN FOR THE FUTURE AUTOMOTIVE INDUSTRY

HOW ANTENNAS WILL BE VITAL TO THE FUTURE OF AUTOMOTIVE DESIGN

Introduction

The modern family car is filled with technology. From the simplest in-car stereo to the most sophisticated navigation system, the automotive industry provides drivers and operators with a huge range of features, many of which requires connection to the outside world. Despite this increase in functionality, the way in which vehicles are made and connected has changed little in decades.

This combination of new technology and established techniques presents considerable challenges to designers and manufacturers. As the need for more communication grows, the existing methods for providing connectivity within the vehicle are unable to deliver the performance required by the latest technology.

A recent study was co-sponsored by Molex to understand the future of automotive design. Entitled "The Data Center on Wheels," this study surveyed more than 500 automotive professionals, and asked about the trends that will shape the industry over the coming decades. As the name of the study implies, information and computing power will be critical to the vehicles of the future, and connectivity – especially wireless connectivity – will be play a key role in the success of the automotive industry.

Antennas are already common fixtures in modern automotive design. There are already as many as two-dozen antennas fitted to every vehicle, and their importance will only increase as the latest trends in automotive electronic design mature. Let's look at how these trends affect the need for antennas.

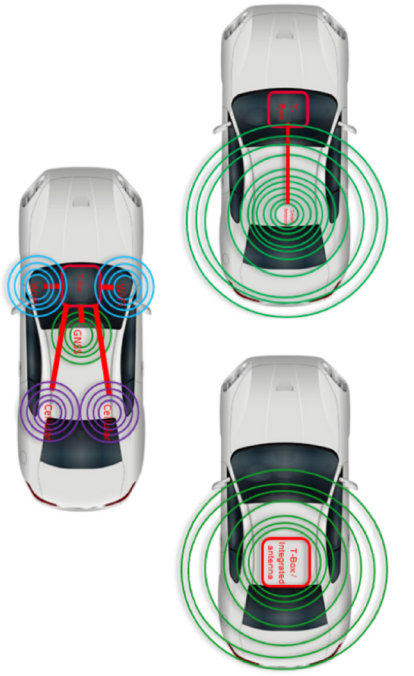
Trend #1

The Smartphone Revolution

Smartphones have become an essential everyday accessory, and the true power of the smartphone comes with its configurability. When a smartphone is manufactured, it has no personality. With the exception for some standard functions, it is completely devoid of anything that makes it different from the millions of others that emerge from the same production line. Manufacturers can create a single model for the global market because it is with the software that the smartphone is customized by its user. The smartphone therefore delivers a platform that can be personalized with a set of software tools that we know as apps, making each user's handset unique. It is the combination of software and hardware that makes the smartphone so powerful.

The expectation of the next generation of drivers will be that smartphones play a key role in their driving experience. Whether as a driver or a passenger, car users will want to integrate the functions of their smartphones in the car itself, whether for entertainment and navigation or other purposes such as dashboard cameras (dashcams). This will be even more important in the short term as the functions available on the average vehicle are brought in line with those offered by smartphones.

Designers need to enable both the seamless integration of smartphone app technology with the onboard vehicle systems, and the improvement of 5G communications for the smartphone within the car's body. These complex and sometimes conflicted requirements can be solved with different technologies, including both distributed antenna for mounting around the driver cabin and integrated antenna to allow better connection to the 5G network. With the right connection, the hardware of the car becomes an extension of the advanced software of the smartphone.



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Trend #2

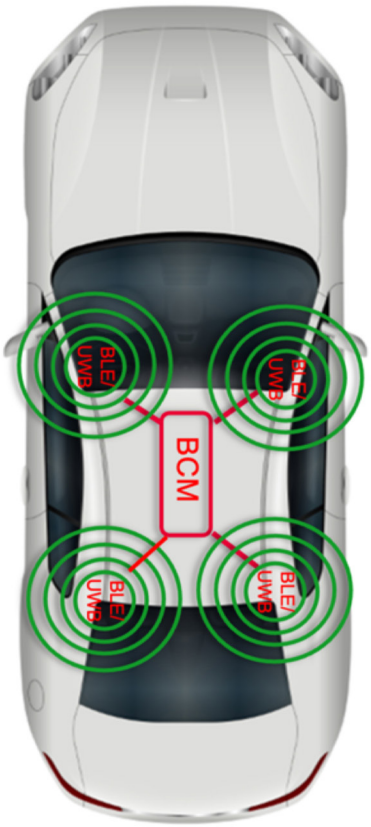
The In-Vehicle Experience

The technology that has made smartphones so successful will also change how we use our car. The use of touchscreen displays has combined with new methods to provide data to drivers, including head-up displays (HUD) and the use of augmented reality (AR). The car of the future has been described as the "third living space," an environment in which drivers enjoy the same level of functionality that they might experience in the home or the office.

There is also the evolution of the keyless entry and keyless start systems that are providing even greater convenience for the driver. With the widespread adoption of smartphones, digital keys are replacing the traditional car key with which we are so familiar. The digital key held on a smartphone will not only open and lock the vehicle itself, but will integrate with the in-car systems to provide a personalised experience. Features such as seating position, environmental preferences and driver displays can be automatically configured as the car detects the identity of the digital key.

Antennas need to be installed at strategic positions both inside and outside the safe environment of the cabin. These will link to a system known as the body control module (BCM), which in turn will communicate with the onboard functions to prepare the vehicle for use.

Designers will need to have access to a range of both internal and external antenna solutions that will enable the keyless functionality of modern vehicles. The secure communications needed for these keyless systems will use the latest near-field communication (NFC), Bluetooth and Ultra-Wideband (UWB) technologies. These will deliver robust and reliable connection for keyless entry and start functions, and to make these into practical solutions, designers will need both a PCB-mounted antenna with a small footprint, and a sealed external antenna for non-cabin installation.



Trend #3

The Internet of Things

The widespread adoption of 5G connectivity that will allow the car itself to become a connected device. High-speed, high bandwidth communications will enable V2V (vehicle-to-vehicle) communications and will also make possible the update of vehicle software remotely, allowing cars to use the latest technology without having to be taken to a service centre.

Maintenance will also become more focussed and cost effective. The in-car systems will monitor the condition of the vehicle, communicating in real-time using 5G technology with the manufacturer. Preventative maintenance can be carried out only when necessary, and potential problems can be identified before they become serious.

The rise of alternative power sources, in particular the electric vehicle, also presents intriguing possibilities for reliability. From a mechanical perspective, electric vehicles are much simpler than traditional petrol-powered cars, with fewer moving parts and fewer high-pressure systems. This means that there is less wear and tear on vehicles. When combined with remote monitoring of maintenance requirements, some industry experts are speculating that new cars will offer a far greater lifespan than those using traditional power sources.

The vehicle with thus become part of what is known as the Internet of Things (IoT). This is the name that is given to developments that allow the internet to integrate devices into a vast, global network. At the heart of the connected vehicle will be the antenna solutions, providing high-speed data link to the outside world.

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Trend #4

The Driverless Vehicle

Many predict the day that driverless or autonomous cars become the preferred mode of travel. Using technology to replace the human element promises a range of advantages from improved road safety to a fundamental shift in vehicle usage. The rise of Transportation as a Service (TaaS) offers road users an alternative to the costs associated with traditional vehicle ownership. Travelers can rent vehicles for the duration of a single trip, and autonomous technology will provide users with even greater convenience. Self-driving vehicles can navigate to the user, conduct the journey required and then depart, ready for the next customer to request the service.

The autonomous vehicle will depend on data from external source. An unconnected vehicle can use onboard sensors to create a picture of its external environment. However, to enable a truly safe system, the autonomous vehicle will connect to other road users. With every vehicle on the road forming part of a mesh network, each can share information about its immediate surroundings with others. Further, cloud-based artificial intelligence (AI) can use this information to create real-time maps that enable onboard systems to make decisions concerning routes and potential hazards.

Sharing such a massive amount of information, including video, LIDAR and navigational information, will require a robust and reliable connection. To enable this, the mesh network will be formed from a web of connected devices, using a combination of WiFi, LTE and V2X communication systems to ensure the best possible service. The massive amounts of data that each vehicle will demand the use of multiple-input multiple-output (MIMO) technology, a system that employs multiple transmitters and receivers to transfer more data at the same time.

The latest solution for this demanding requirement is the integrated, multi-in-one antenna that supports a range of MIMO technologies, including 5G NR 4x4/LTE MIMO and WiFi MIMO. This integrated box consists of a single unit that needs to be made waterproof to at least IP67, and provide good performance even when fixed to metal surfaces. Incorporating multiple WIFI, 5G antennas as well as GNSS solutions for navigation, these multi-antenna solutions will provide the bandwidth needed for the high volumes of data that are so important to autonomous vehicles.

Molex Solutions

Molex is one of the world's largest manufacturers of antenna technology. Our technical expertise, automotive experience and global footprint allows us to develop connectivity solutions for the automotive industry. However smart and sophisticated the device, Molex will be ready with a range of solutions to meet and exceed these demands and help create the vehicle of the future.

WiFi6E Balanced Flexible Antennas for infotainment and navigation

- A range of ultra-thin Ceramic and LDS/MID Antennas in cabled, flex and PCB formats
- Quick and easy RF integration into connected systems
- Ideal for embedding high-performing internet and data connectivity into compact devices.
  - https://www.molex.com/molex/products/family/wifi_and_bluetooth_antennas
    - https://www.molex.com/molex/products/part-detail/antennas/1461530050

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GNSS/GPS Antennas for telematic control units

- Providing superior RF performance for US and global satellite systems including GLONASS, Baideo and Galileo
- LDS/MID and Ceramic GNSS/GPS Antennas combine ease of integration with reduced cost of implementation
- Suitable for a variety of wireless navigation device applications
  - https://www.molex.com/molex/products/family/gnssgps_antennas
    - https://www.molex.com/molex/products/part-detail/antennas/2066400001
    - https://www.molex.com/molex/products/part-detail/antennas/2133530100

Multiple-in-One Antennas

- Sealed to IP67 and suitable for external use, these integrated units combine 5G, WiFI and GPS antenna in a single installation
- Designed to be mounted directly to a metal surface
- Ideal for use in advanced commercial and private vehicle applications.
  - https://www.molex.com/molex/products/part-detail/antennas/2165891000

WiFi Blue Tooth USB SMT Antenna for keyless entry

- Small PCB-mounted antenna ideal for keyless entry systems
- Small size and low profile to take advantage of the latest trends in miniaturization.
- SMT termination makes these small devices ideal for mass production
  - https://www.molex.com/molex/search deepSearch?pQuery=productname%253A2.4*SMT*Chip%2BOR%2Bproductname%253A2.4*Ceramic*SMT*

Sharkfin

- The latest in antenna solutions for automotive applications, Molex's antenna products are developed with industry-leading RF expertise to ensure best possible connectivity
- Molex specializes its Custom OEM Antennas to exactly fit customers' needs by offering a wide variety of single and multi-band antennas.
- Smart Antenna Solutions fulfil the growing requirements of connected vehicles
  - https://www.molex.com/molex/products/family/vehicle_antennas
  - https://www.content.molex.com/dxdam/62/622067cd-f9fe-46ba-894c-ae4b40e92750/987652-0276.pdf