



**KEYSIGHT
WORLD 2020**

Validating the Ecosystem: E-Mobility, Autonomous Driving, Connected Vehicle & Security

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Mobility Concepts Of The Future

THE EVOLUTION OF THE CAR



Based on ...

... more stringent CO₂ regulations around the world, our future mobility will be increasingly use alternative powertrain concepts.

Based on ...

... an increasing number of people – mainly in urban as well as sub-urban areas – who are using individual transportation options, autonomous driving will become a requirement in order avoid grid-locks and optimize the use of our infrastructure.

Based on ...

... the consumer behavior of today's and generations to come, being connected to the network in a safe and secure way is no longer optional and expected anytime, anywhere.

Validating The Mobility Ecosystem

WE ALL WOULD HAVE THOUGHT TO BE FURTHER ALONG BY NOW...

The Revolutionary Development of Self-Driving Vehicles and Implications for the Transportation Engineering Profession

Significant numbers of self-driving vehicles are expected to be on the roads within the next decade. This paper documents current technology developments and potential safety and mobility benefits.

Introduction

Highway travel is about to undergo a dramatic transformation that is unprecedented in the history of transportation, and the Institute of Transportation Engineers (ITE) and its membership will face both opportunities and challenges that will reshape the future for our discipline.

As this paper is being written, the rapid development of autonomous vehicles—self-driving cars—is under way, and there is some urgency for the transportation engineering profession to become actively

When will we see autonomous vehicles as a significant component of road traffic? Google sources reportedly have said three to five years.²⁵ Audi, BMW, GM, and Nissan reportedly expect to introduce self-driving cars by 2020.²⁶ Continental Automotive Systems expects to produce highly automated cars by 2021.²⁷ Using fleet turnover projections for alternative powertrains/fuels as a model, market penetration could range from 11 to 34 percent in five years to 22 to 59 percent in 10 years, which means that self-driving cars could plausibly be present on the roads in significant numbers within a decade.²⁸

Source: The Revolutionary Development of Self-Driving Vehicles and Implications for the Transportation Engineering Profession - July 2013

CARS & TRAFFIC

Could driverless cars reshape our major cities?

Car makers say autonomous vehicles are imminent. If so, they could dramatically reshape our cities, yet current long-term planning for our biggest cities assumes they'll never happen

ALAN DAVIES APR 22, 2013 22



Source: <https://blogs.crikey.com.au/theurbanist/2013/04/22/could-driverless-cars-reshape-our-major-cities/>

News

2015: the year electric vehicles went mainstream

5 October 2016

This year's Paris Motor Show has been electric, as automakers from around the world have gathered to show their newest - and strongest - concept and production models of hybrid and electric vehicles (EV). What was once a niche market has now become mainstream: over one million EVs are on the road today according to the IEA's *Global EV Outlook 2016*.

This is welcome news, particularly this week as the Paris Agreement is likely to come into force. IEA's *Tracking Clean Energy Progress 2016* shows how electric cars are one of the few low-carbon energy technologies that are on track to meet climate goals.

Source <https://www.iea.org/news/2015-the-year-electric-vehicles-went-mainstream>

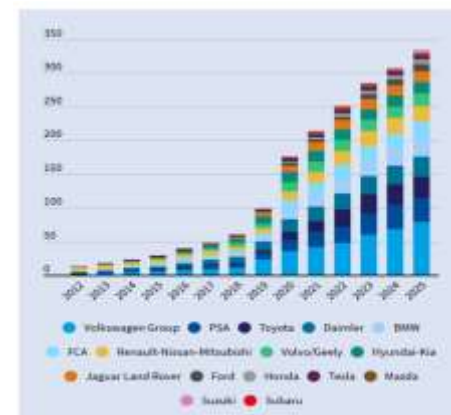


Figure 1: Total number of available EV models on the market in Europe

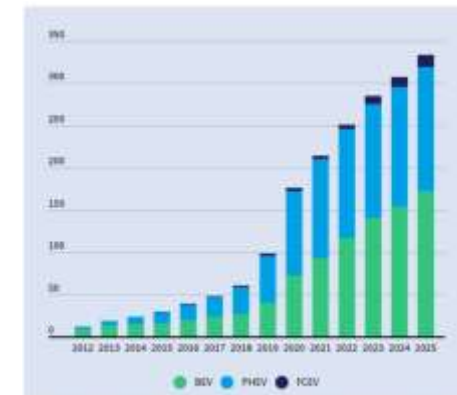


Figure 10: Total number of available EV models on the market in Europe

Source: https://www.transportenvironment.org/sites/te/files/publications/2019_07_TE_electric_cars_report_final.pdf

Validating The Mobility Ecosystem

WE ALL WOULD HAVE THOUGHT TO BE FURTHER ALONG...

EV/HEV offerings address urban driving patterns – other consumer requirements are still not sufficiently met

On a large scale, autonomous driving is transitioning from level 2 to level 3 – mainstream level 4 or 5 is still years away

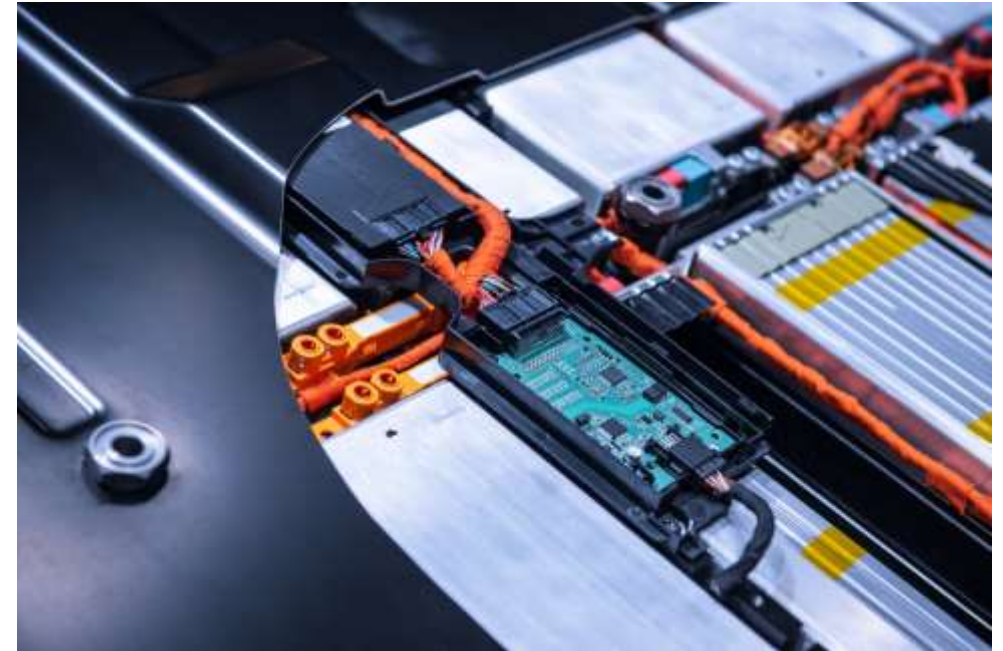
While cars today can be labeled ‘connected cars’, the introduction of 5G will provide the next boost in regards to new services and capabilities

A Closer Look Into The Ecosystem

E-MOBILITY

All major OEMs have an active EV/HEV strategy in place to meet environmental goals for their portfolio in order to avoid penalties and/or restrictions in some of the target markets. There are still challenges which need to be addressed:

- The financial attractiveness for consumers is still limited without subsidies and other forms of incentives
- Range anxiety, charging availability and the required time is still a concern, longevity of batteries are still not synchronous to the rest of the car
- Profitability of current Li-ion batteries is still a concern across the supply chain
- Re-use and recycling needs to be improved to deal with limited resources



A Closer Look Into The Ecosystem

AUTONOMOUS DRIVING

Investments in autonomous driving concepts and associated Artificial Intelligence systems has been accelerated over the past years, the path to full autonomy is still taking a few more years. There are stills challenges which need to be addressed:

- Integration of all sensor types – line-of-sight and none-line-of-sight – to obtain a realistic image of reality while driving
- Enhance drive scenarios and testing concepts to address repeatable and realistic threat scenarios
- Agree on conformance and compliance regime to fulfill regulatory requirements
- Resolve insurance and ethical questions to allow autonomous driving to progress towards level 4 / 5



A Closer Look Into The Ecosystem

CONNECTED VEHICLES

While connected cars are a reality today, the possibilities they present are still largely untapped and associated services are still in their infancy. There are still challenges which need to be addressed:

- Connectivity today is still dominated by tethered connections – embedded infrastructure starts to dominate new car shipments
- With 5G on the horizon, bandwidth improvements will allow different experiences and use models
- In-car networks will become more important as cars become more autonomous as priority management will be crucial
- The use of telemetric data will allow new concepts for fleet management, insurance and asset optimization



A Closer Look Into The Ecosystem

CYBER SECURITY

Minimizing Cyber vulnerability in a car is becoming mission critical as the number of wired and wireless interfaces are rapidly growing and becoming increasingly connected through in-car networks . There are stills challenges which need to be addressed:

- To minimize structural threat scenarios, cyber security needs to be already considered during the design phase
- As vulnerabilities may not only be present at the time of shipment, it is imperative to develop a concept to perform testing repeatably and on an ongoing basis
- As systems will be imperfect, cyber concepts needs to be able to detect intrusions and alert drivers and / or securely bring a vehicle to a safety stop



Predictions Going Forward

WHERE DO WE GO FROM HERE



51%

EV CONSIDERATION

On average 51% of drivers who are aware of EV / HEV products are considering a purchase

Actual purchases are still remain in single-digit % ranges in most major markets

Source: McKinsey & Co – The road ahead for e-mobility – Jan 2020



44%

AV SAFETY

According to an international study 44% of the surveyed population felt that current AV product are safe or somewhat safe

The major driver towards this perception is experience as the majority was driving in a car with AV features

Source: J. Moody et al. – Public perceptions of autonomous vehicle safety: An international comparison – Safety Science, Vol 121 - Jan 2020



90%

CONNECTIVITY RATE

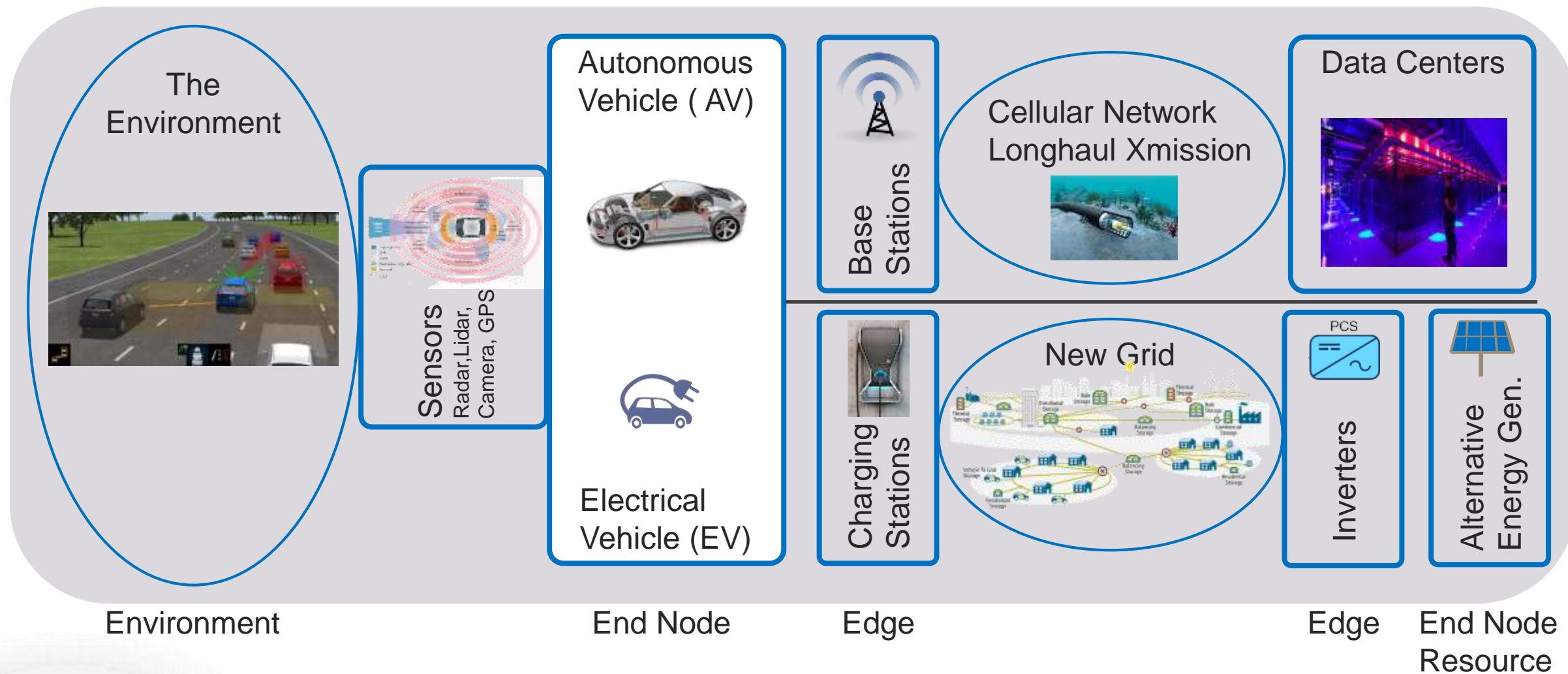
By 2023, 90% of all shipped passenger vehicles in the US will have an embedded connectivity infrastructure

The global service market for connected vehicles will reach \$200bn by 2023 growing with a CAGR of 23%

Source: IDC - Connected Vehicle Forecast- May 2019, MarketsandMarkets, Connected Car Market – Nov 2019

Empowering The Future Mobility System

A HOLISTIC VIEW



Empowering The Future Mobility System

HOW CAN KEYSIGHT HELP EMPOWERING THE ECOSYSTEM

Unique EV
Capabilities
and
Experiences

Decades of
Wireless
Experiences

World-Leading
mmWave
Solutions

Worldwide
Service
&
Support

Global
Project Teams

Driving Innovations or Autonomous and Electric Vehicles

... Fully Connected

... Self Driving

... Electric Powered



Automotive Diagnostics



In-car Network



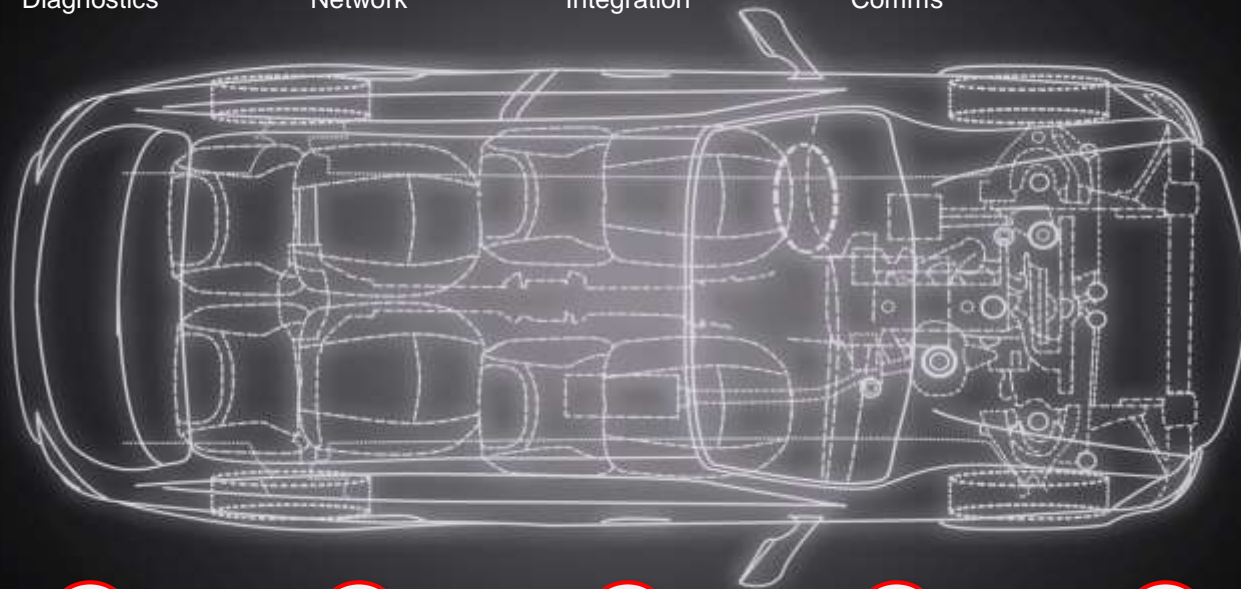
Mobile Integration



V2X Comms



Radar



Camera



ADAS



Infotainment



Security



Electric Powertrain

90+ Solutions

Across Multiple Technology Domains

- Vehicle to Everything (V2X) Communications
- Radar Collision Avoidance
 - Infotainment and Entertainment
 - Emergency Call
 - Automotive Cybersecurity Penetration Test
 - Charging Function and Interoperability Test
 - Converter and Inverter Efficiency
 - Cells Forming and Self Discharge Optimization
 - Automotive Ethernet and Serial Bus Testing
 - Engine Control Unit Security and Testing
 - Body and Safety Electronics Test Solutions
 - Electronics Functional Test Systems

ENABLING BUILDING BLOCKS THAT MAKES TOMORROW'S CAR A REALITY

Ecosystem Solutions

OUR ENGAGEMENT MODEL IS PARTNERSHIP



Workflow

Maximum Contribution

Help customers optimize workflow processes with Keysight tools. Become part of automation flow



Solutions

Higher Value

Complete end-to-end answers to a customer problem
Software, Fixturing, HW & Expertise



Applications

One Supplier

Multiple Keysight products based on fit to specific customer applications.
One Stop Shopping Value



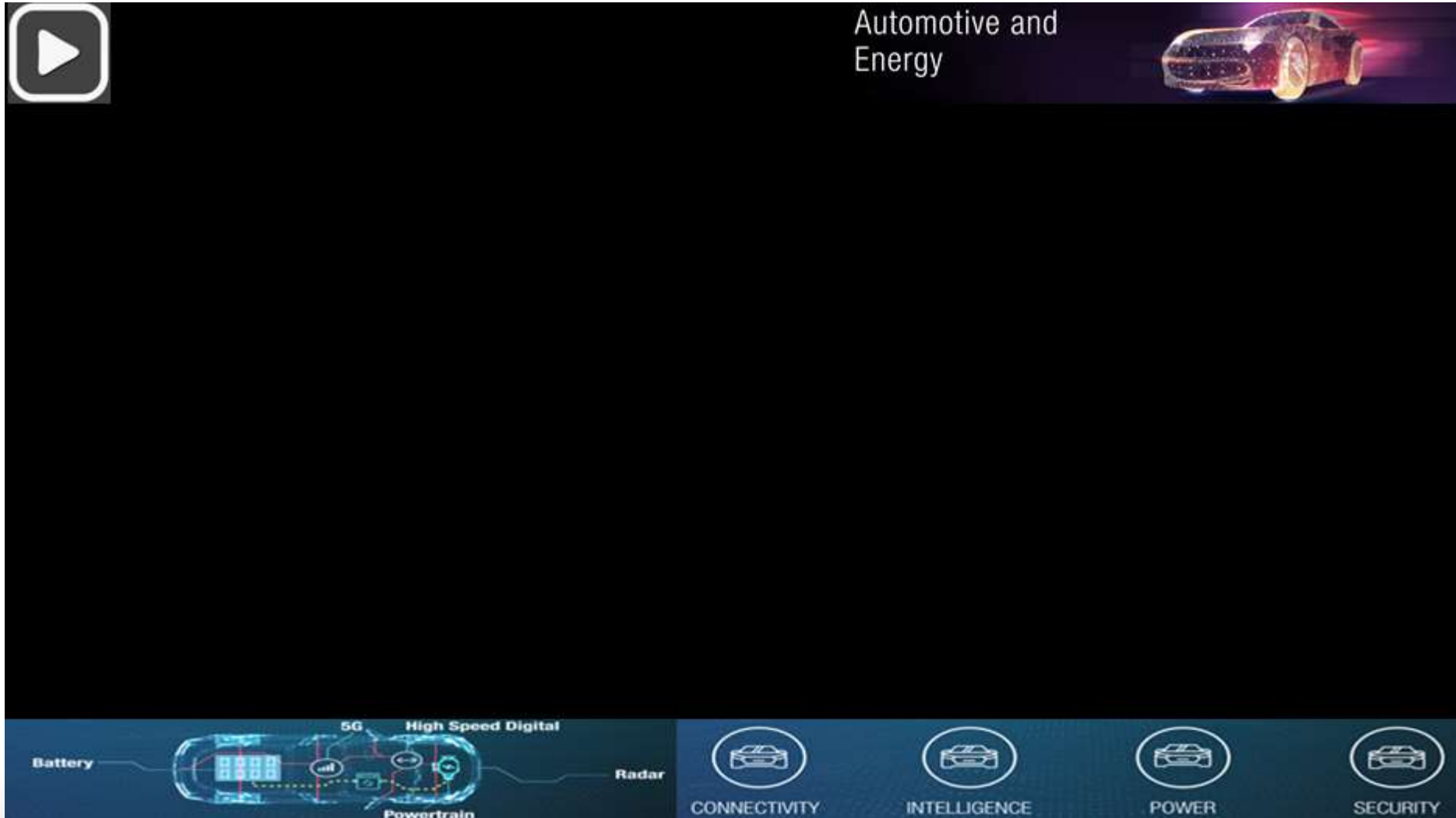
Products

Single Product

Single products based on best-in-class attributes.

THE FUTURE IS HERE

BRING THE FUTURE TO REALITY FASTER AND BETTER



Summary

- Disruptive innovations in automotive will create a new mobility ecosystem including challenges for E-Mobility, Autonomous Driving, Connected Vehicle & Security
- There is a chance to create together a more connected and better world
- Let's partner to master the technological challenges and bring your innovations to market first



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