Challenges of Connected and Autonomic Vehicles

Moderator
Markus Ullmann, BSI & H-BRS, Germany

Panelists
• Dirceu Cavendish, Kyushu Institute of Technology, Japan
• Manabu Tsukada, University of Tokyo, Japan
• Yasuhiko Watanabe, Yukoku University, Japan
• Rajat Kochhar, Ericsson, India
• Hamid Menouar, Qatar Mobility Innovations Center, Qatar
• Antonio Martin, Universidad de Sevilla, Spain
Topics of the discussion

• Will there be a shift in the buying behavior of vehicles in future?
  - Western cities: Young people don‘t like buying vehicles. Reasons are manifold: Costs, lack of parking space, reliable public transportation services, horrible motor traffic in cities etc. If a vehicle is really needed by young people, they will use vehicle sharing platforms. Connected and autonomous vehicles will not change buying behavior of young people.
  - India: Vehicles are still status symbols. The ownership of a vehicle is an important issue. But cheap prices are important as well.

• Who pushes connected and autonomous driving?
  - Autonomous Driving is pushed by semiconductor industry to enhance the complexity of vehicles.

• Who needs autonomous driving?
  - Autonomous Driving is only interesting for old people, people with physical deficiency and people without driving license.
Thanks For The Discussion

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https://isf.h-brs.de/en/
CHALLENGES OF CONNECTED AND AUTONOMIC VEHICLES

Nice, July 2017

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• Introduction to Connected and Autonomous Vehicles (CAVs).
• Outstanding challenges related.
• Main open issues.
CAVs Future Opportunities

- **Greater efficiency**
  - Reduced congestion with fewer traffic incidents comes fewer reasons to slow traffic.
  - With the ability to operate at higher speeds and reduced space between vehicles,
  - Real-time route optimization to follow the best routes according to real-time information.

- **Increased safety**, 94% of accidents are related to human error.
  - Automated vehicles can remove human error and prevent a huge majority of accidents.
  - With AVs, humans’ slower reaction time, distracted driving, etc. can be eliminated.

- Less energy consumption and greater efficiencies lead to more energy savings for your fleet.
- More productivity due to the power of multi-tasking.
The more advanced levels only require the driver to monitor the drive to make sure it goes smoothly.
Defined levels of Automation

- **0. No automation.**
- **1. Limited automation**, but with driver controlling all driving situations.
- **2. Partial automation**, where software can control acceleration and braking.
- **3. Conditional autonomy**, where the software and sensors accelerate and brake and monitor the vehicles' environment, but the driver to take control when needed.

- **4. High automation**, where the sensors, cameras and software can guide the car to a safe position if the driver fails to re-engage.
- **5: Full automation** where the technology can navigate and manage any situation and the driver need not be engaged.

- The government is setting aside its four-level gradation of autonomy and in its place will adopt the five-level definition of the Society of Automotive Engineers
Challenges of Autonomous Vehicles

- States will have different rules. Safety, need to work with the government and automotive industry to develop standards.

- Supporting infrastructure must support CAVs. Need to work with industry to develop framework for CAVs on public roads. Who will own it? Who will fund it?

- Privacy and Data, connected cars create vast quantities of data. Who owns it? Who has the right to use it?

- The human factor, Ethical Considerations, social Impact, telecoms regulations, etc.

- How do we transition from analogy to digital? Are autonomous software systems vulnerable to cyber hacking?
- Connected car raises new world of data management, privacy, ownership and emerging cyber-physical risks.
Privacy and Data,

- **New obligations on confidentiality.** Regulation to apply the communications between connected cars and other vehicles or road infrastructure.

- **Data protection.** In most jurisdictions, data protection regulations have not been developed to deal with the specific implications of connected and autonomous cars.

- In this context a **whole range data could be gathered.** Who is the data ownership?

- The **data is stored in the car or in a cloud DD.BB.** effective security measures will need to be in place to protect the data.

- Traditionally most vehicle manufacturers have had very limited information about their customers and managing customer data has not been a key priority.

- The connected car raises a new world of data management, privacy and ownership. This brings significant new challenges and obligations relating to the collection, use and protection of such data.
Supporting infrastructure must support CAVs

- New technical standards are needed for the large quantity of new telecommunications technology specific to the developments in autonomous cars.
- Car manufacturers recognize that they need to collaborate to access all the technologies needed to develop connected cars and it is driving changed the technology infrastructure.

- Connected and autonomous vehicles raise many IP issues. The volume of new technology required, and the fact that much of this technology needs to be shared widely.
- Maximum benefit of Cavs will require significant investment in new road and communications infrastructure.
Emerging CAVs technologies raise questions about the readiness of current regulatory approaches to vehicle safety, data protection and cybersecurity.

- Rigorous cybersecurity technologies and policy frameworks are needed to protect connected vehicles and infrastructure.
  - Regulatory Implications, Legal frameworks and guidance for managing cyber risk, etc
  - How do we transition from analogy to digital? Are autonomous software systems vulnerable to cyber hacking?

- Car companies do not have a long tradition of cybersecurity expertise, writing requirements for suppliers and ensuring that they meet minimum security and protection can be a challenging task.
- Connected car raises a new data management world, privacy, ownership and emerging cyber-physical risks.
Main issues addressed.

Which of these issues to we feel is the most important?

1. Trust in the technology and infrastructure.
2. Data privacy and ethical questions
3. Governments and regulations
4. Insurance and liability
5. Cyber security

- Smooth adaption of the driverless technology is by no means certain. There are many practical, legal and ethical issues, which need to be addressed.
- Driverless cars are part of a broader mobility revolution, which transform the cities of the future
- The driverless future will bring many benefits but also possibility of social and political upheaval due to loss driving as a source of employment
“Anything one man can imagine, other men can make real.”

Jules Verne

Thank for your attention
Merci beaucoup

CHALLENGES OF CONNECTED AND AUTONOMIC VEHICLES
Challenges in Connected and Autonomic Vehicles

The Road to Secure/Safe Transportation

Dirceu Cavendish, Kyushu Institute of Technology, Japan
Our vehicles are undergoing significant changes

**Intra-communication**
- CAN bus
- Infotainment system

**Inter-communication**
- Key fob system
- Mobile to vehicle apps

**Connected and Autonomous Vehicles**
- Vehicle to server systems - ADAS
- Vehicle to vehicle communication
# Autonomous Driving & Threats

## Threat types

<table>
<thead>
<tr>
<th>Vehicular sensing</th>
<th>Mitigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS: spoofing</td>
<td>Multiple sensor sources with consistency checks</td>
</tr>
<tr>
<td>Radar: Small dangerous objects</td>
<td>Multiple position camera sources and checks</td>
</tr>
<tr>
<td>Camera: object occlusion; object distraction; non-standard road demarcation</td>
<td>Secure communication protocols</td>
</tr>
<tr>
<td>Proximity: position/range attacks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Autonomous Driving Aided System</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Image processing pattern recognition failures (e.g. stop sign miss)</td>
<td>Emergency procedures: collision avoidance procedures</td>
</tr>
<tr>
<td>Auto driving logic failure: unexpected scenario; software error</td>
<td>Self-learning: crowdsourcing driving performance, near misses, and collision events;</td>
</tr>
</tbody>
</table>
### Vehicle to Vehicle Comm & Threats

<table>
<thead>
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<th>Threat types</th>
<th>Mitigations</th>
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</thead>
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<td>Secure communication protocols</td>
</tr>
<tr>
<td><img src="image" alt="Proximity: position/range attacks" /></td>
<td></td>
</tr>
<tr>
<td>Autonomous Driving Aided System</td>
<td>Emergency procedures:</td>
</tr>
<tr>
<td><img src="image" alt="Auto driving logic failure: unexpected scenario; software error" /></td>
<td><img src="image" alt="Collision avoidance procedures" /></td>
</tr>
<tr>
<td><img src="image" alt="Human handoff" /></td>
<td><img src="image" alt="Human handoff" /></td>
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</tbody>
</table>
Vehicle Crowdsourcing

- Safety: unpredictable situations; failures
  - ADAS algorithm design and tuning
- Performance: Accuracy verification and performance improvements
- Insurance
  - Risk assessment
  - Crash forensics

How Tesla Fixed a Deadly Flaw in Its Autopilot

CEO Elon Musk on Sunday announced a software update for its vehicles that significantly changes how autopilot works, without changing any of the hardware involved. Until now, the autopilot feature—which can self-pilot the car for stretches of highway driving—has relied primarily on a video camera and image-processing software to see the road ahead. A radar system and ultrasonic sensors provided additional data, but the system was programmed not to act on radar data alone due to some fundamental limitations of the technology.


Tesla shares fall after driver claims car crashed while using autopilot

NEW YORK: Tesla Inc shares dropped on Monday after a Minnesota man claimed his vehicle suddenly accelerated after he engaged the car’s driver-assistance system and crashed into a marsh.

Will Road Safety get worst before better?

Non-interactive legacy features

Electronic Stability Control

<table>
<thead>
<tr>
<th>Year</th>
<th>Passenger Cars</th>
<th>Light Trucks/Vans</th>
<th>Total = (1) + (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>857</td>
<td>1,091</td>
<td>1,949</td>
</tr>
<tr>
<td>2014</td>
<td>657</td>
<td>918</td>
<td>1,575</td>
</tr>
<tr>
<td>2013</td>
<td>551</td>
<td>829</td>
<td>1,380</td>
</tr>
<tr>
<td>2012</td>
<td>466</td>
<td>759</td>
<td>1,225</td>
</tr>
<tr>
<td>2011</td>
<td>329</td>
<td>567</td>
<td>896</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,860</td>
<td>4,164</td>
<td>7,024</td>
</tr>
</tbody>
</table>


Vehicle Interactive features

Automatic Collision Avoidance

- Parking lot driveway crashes
- Stop sign/traffic light roll over crashes
- Automatic speed reduction for pedestrians
- Highway crash avoidance

<table>
<thead>
<tr>
<th>Legacy</th>
<th>Autonomous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterogeneous Driving</td>
<td>Driver skills; aggressiveness; mood swings</td>
</tr>
<tr>
<td></td>
<td>HW quality; SW versions Manufacturer’s features/styles</td>
</tr>
<tr>
<td>Map dependency</td>
<td>Static routes/driving conditions; Simple objective function</td>
</tr>
<tr>
<td></td>
<td>Real time conditions; Dynamic routing (stability); Multiple objective/diverse functions</td>
</tr>
<tr>
<td>Server dependency</td>
<td>None/limited</td>
</tr>
<tr>
<td></td>
<td>Navigation (traffic); Crowdsourcing; SW upgrades;</td>
</tr>
<tr>
<td>Environmental dependencies</td>
<td>Road and traffic conditions; Weather conditions</td>
</tr>
<tr>
<td></td>
<td>Expert system perception of: road and traffic conditions Weather impact on expert system</td>
</tr>
</tbody>
</table>
Connected Automated Vehicles (CAV) in Qatar: Challenges & Implications

February 9th, 2017

Dr. Hamid Menouar
Senior R&D Expert - Product Manager
Qatar Mobility Innovations Center – www.qmic.com

Nice, France
About QMIC

Qatar Mobility Innovations Center

First Independent Innovations Center in Region
Founded in 2009

Innovations Model Optimized for the Region
System Innovations
Idea to Market
User-Centric

Leadership in Key Emerging Market Domains
Intelligent Mobility
Smart Living (IoT)
V2X Field Demo in Qatar by QMIC

Back in April 2014, QMIC has deployed and demonstrated the First MENA Field V2X Demo.
Technology & Standardization Expertise

Participated in Plugtests Events held in Europe

Participants include:

- SIEMENS
- RENESAS
- HITACHI
- qmic
- DENSO
- kapsch
- NEC
- Unex
- Fraunhofer
- NXP

QMIC’s V2X Equipment under test during an ETSI TC ITS Plugtests

QMIC’s team attending an ETSI TC ITS Plugtests event to test the conformance and interoperability of QMIC’s V2X technology
QMIC is preparing to deploy a large scale V2X Pilot in Doha.

Example use-case of Road Work Warning
Executed in Doha by QMIC’s Connected Vehicle

Deployment by middle of 2017
WASTED SPACE & MONEY

Source: http://www.motherjones.com/environment/2016/01/future-parking-self-driving-cars

PAST

FUTURE

DIFFERENT EXPECTATIONS
There is one trend of mobility that young people have embraced, though:

**Mobility as a Service**

Qatar Mobility Innovations Center (QMIC)
Expected Impacts

- Less spaces for roads and parking
- Dynamic & Intelligent fleet

Fleet of Taxi ROBOTS
TRAFFIC Simulation & NETWORK Simulation Combined
VIRTUAL SIGNAGE DEPLOYMENT & MAINTENANCE COST
The 5 levels of driving automation

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Human driver</th>
<th>Automated system</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Automation</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>N/A</td>
<td>SOME DRIVING MODES</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation</td>
<td>N/A</td>
<td>SOME DRIVING MODES</td>
</tr>
<tr>
<td>3</td>
<td>Conditional Automation</td>
<td>N/A</td>
<td>SOME DRIVING MODES</td>
</tr>
<tr>
<td>4</td>
<td>High Automation</td>
<td>N/A</td>
<td>SOME DRIVING MODES</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

For on-road vehicles

- **Steering and acceleration/deceleration**
- **Monitoring of driving environment**
- **Fallback when automation fails**
- **Automated system is in control**

**Source:** SAE International
TRANSITION PERIOD

Deal well with the transition period

- Allocate Parts of your Infrastructure for CAVs

Plan your infrastructure in a way it Can be Easily Transformed and reused to fit future needs.

Support your planning with the right Regulations and Law Enforcements
We plan our cities for tomorrow; let's plan them for Tomorrow's Users.

Connected & Autonomous Vehicles will change our cities

Dr. Hamid Menouar (menouar.com)
Senior R&D Expert - Product Manager @QMIC

Thank You
Self Introduction

• 2007—2013 Ph.D & Post-doc
  – Expert Engineer, Inria, France
  – 2011 Ph.D at Mines ParisTech

• 2013 – current, Assistant professor
  – Graduate School of Information Science and Technology, The University of Tokyo

With GeoNet team 2010

With IMARA team 2010
GCL Camp in May

• 3 days near lake Yamanaka (Friday + Weekend)
• There are about 100 members in GCL
• 70% are participated in the camp
• To know the new members and each other
Next Generation Mobility Platform

• Validations, experiments, and demonstrations
• Of each GCL course students,
• On common mobility platform,
Autonomous Vehicle

http://www.zmp.co.jp/products/robocar-mv
Smart Campus & Mobility

- Beyond road mobility
- Harmonization of human and mobility device in the life
- Focus on mobility service constricted upon autonomous driving but not autonomous driving it self
Point Cloud Measurement

mobile mapping system

Hongo Campus, University of Tokyo
Point Cloud
Point Cloud
Vector data (ADASMap)
Field Test
System Configuration

- **Sensing**
  - Acceleration
  - Braking
  - Steering

- **Detection**
  - Localization

- **Planning**

- **3D map** (Point Cloud & Vector data)

- **Components**
  - Velodyne VLP-16
  - Stereo camera
  - USB
  - Ethernet
  - Controller
  - CAN

- **System Functions**
  - Sensing: Acceleration, Braking, Steering
  - Detection: Localization
  - Planning

- **Environment**
  - 2017-07-25
  - Challenge of Connected Autonomous Vehicle

- **Diagram**
  - Diagram showing the system configuration with the mentioned components and functions.
- Open-source software for urban autonomous driving
- Providing basic autonomous driving function based on ROS
- [https://github.com/CPFL/Autoware](https://github.com/CPFL/Autoware)
Thanks

Manabu Tsukada

tsukada@hongo.wide.ad.jp

http://www.hongo.wide.ad.jp/~tsukada/
CONNECTED AND AUTOMATED VEHICLES IN INDIA

Rajat Kochhar
Ericsson, India
ICWMC’17
Nice, France
July 23-27 2017
AGENDA

1. BACKGROUND AND STATISTICS
2. INDIA'S READINESS FOR CONNECTED AND AUTOMATED VEHICLES
3. CHALLENGES AND REGULATORY HURDLES
4. ONGOING PROGRESS BY INDIAN COMPANIES
5. FUTURE..
BACKGROUND AND STATISTICS

• In last 15 years, we have seen entry of numerous global automotive players in India

• In 2000, only 16 car manufacturers were present in India and we will expect by 2020 around 55 car manufacturers to compete for business in India.

• India will be world’s 3rd biggest car market by 2020.

• Also, around 39 manufacturers will be making cars in India by 2020 serving both domestic and exports market taking it 4th spot in the world.
THE FLIP SIDE

• In India, road accidents kill nearly 400 people every day.

• Traffic congestion costs the economy a whopping $11Bn (£7.63Bn).

• Despite this, only 1.4% of the total cars sold in 2015 (more than 2M) featured basic connectivity, let alone autonomous vehicles.

• Lack of 4G LTE connectivity till last year.

• Mass adoption of connectivity is tough in a cost driven market like India.

• Infrastructural roadblocks and lack of lane discipline.
THE SILVER LINING

• The Prime Minister’s ambitious plan of making 100 smart cities will give an impetus to further connected car developments in India.

• The government has also laid out plans to invest $1.7Tn by 2020 in upgrading its infrastructure to accommodate smart city projects, the majority of which will be dedicated to road networks

• Nationwide 4G LTE connectivity provided by multiple telecom operators.

• Few of the big conglomerates and a number of startups are working on making connected and autonomous cars a reality despite many infrastructural and regulatory hurdles.
THE LAW SAYS..

• The **Motor Vehicles (Amendment) Bill, 2016** : “In order to promote innovation and research and development in the fields of vehicular engineering, mechanically propelled vehicles, and transportation in general, the central government may exempt certain types of mechanically propelled vehicles from the application of the provisions of this Act.”

• The bill was introduced in the Parliament in August, earlier year. It has since been referred to a parliamentary standing committee.

• Once the law is cleared, India would harbor the capabilities to test any innovation across the transport industry, such as semi autonomous and fully autonomous vehicles, both passenger and commercial.
• Tata Elxsi, part of India’s $100B+ Tata’s group is developing software platforms, software based driving aids and assistance systems to some of the world’s largest automakers.

• Tata Elxsi has licensed its software platform to one of the top five carmakers globally that will help hasten the development of their own driverless car.

• Tata Elxsi’s middleware platform AUTONOMAI will act as an interface between the hardware such as stereoscopic cameras, radars and lidars and the artificial intelligence (AI) and machine learning algorithms that will be trained to react to complex driving scenarios.

• After training and feeding hundreds of photos, our system cannot identify 15 percent of the vehicles on the Indian road,” said Nitin Pai, senior vice president and head of strategy and marketing at Tata Elxsi. “The driverless car is ready for the road. But is the road ready for the car?
M&M DIGISENSE

- Mahindra & Mahindra Ltd (M&M Ltd), part of the $17.8-billion Mahindra Group, launched a technology platform called DiGiSENSE in August 2016.

- This technology platform connects Mahindra vehicles, tractors, trucks and construction equipment to the cloud.

- The new platform has been conceived, developed and manufactured in India in collaboration with Tech Mahindra, Bosch and Vodafone.

- This service is particularly useful for companies such as Amazon and Flipkart to track their courier delivery and optimize the cost and time involved.

- With the possibility of over the air (OTA) upgrades, the technology can also be updated to support future functionalities.
REALTY CHECK & FUTURE ..

• Self-driving cars are a LONG way off. Such vehicles would be far too expensive for most Indian consumers.

• But there's a bigger problem: autonomous cars need predictable conditions – and Indian conditions (as of now) are not.

• Connected driver assistance systems show strong potential to improve road safety, with little change to existing road infrastructure required.

• Fully autonomous shuttles could potentially operate within specific zones, such as university campuses, IT company campuses etc.
THANKS
How drivers use free time?

Yasuhiko Watanabe
Ryukoku University
free time created by autonomic vehicles is used for communication with

- specific persons
- general public
In order to promote communication, many of us disclose

- where we are
- what we like
- what we do
In order to promote communication, many of us disclose

- where we are
- what we like
- what we do

privacy risk
In order to use the INTERNET, many online users believe

benefit of disclosing personal information \(\rightarrow\) privacy risk

[ Viseu 2004 ]
• you do not disclose your personal info.
• but, your friend may disclose [he/she disclose personal info.]
  • where you are
  • what you are doing

Tom and I go together

privacy risk