

The car is connected now! But are we safe?

Cyber securing the connected car

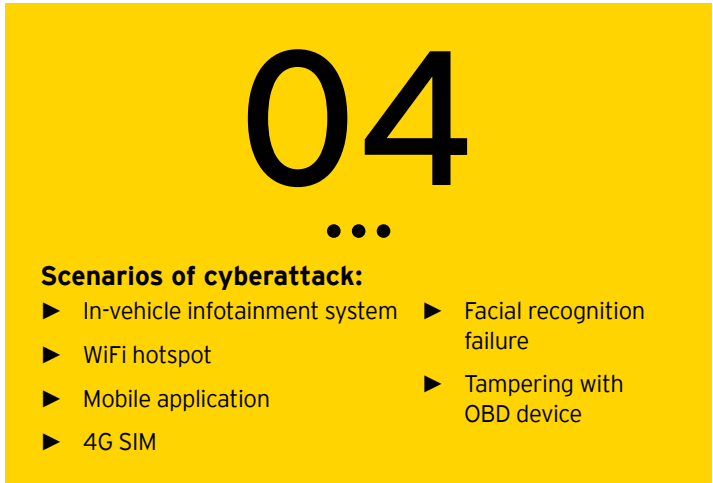
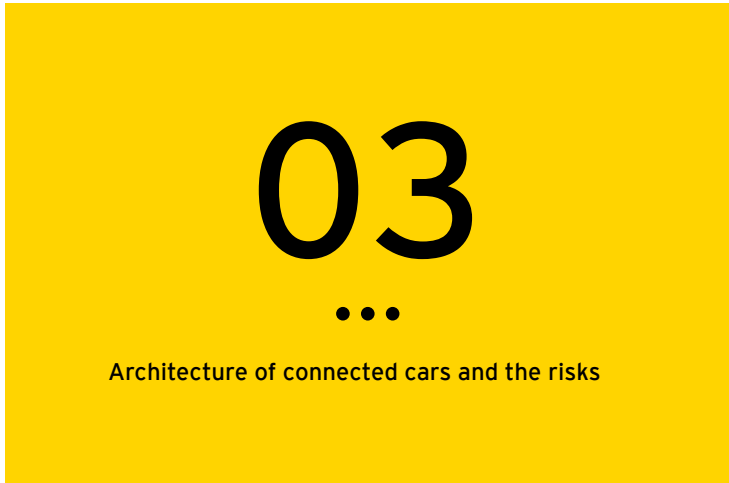
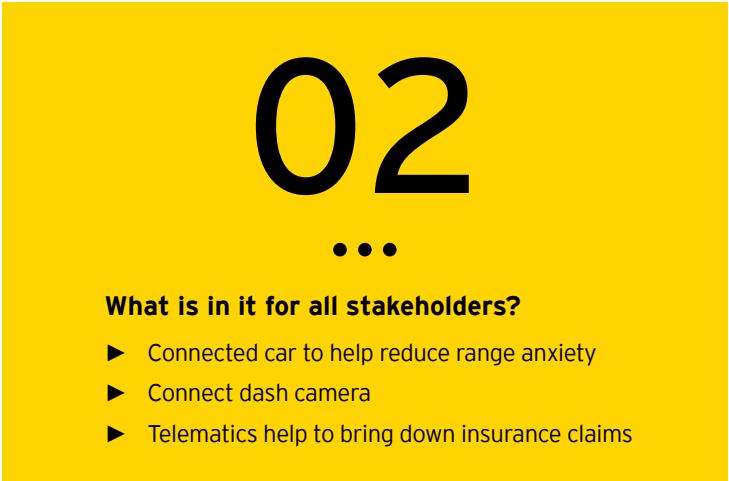


The better the question. The better the answer.
The better the world works.

EY

Building a better
working world

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... Foreword

Modern automobiles have completely changed, they are connected, available on demand and mobility is pervasive. This revolution of automotive connectivity with humans and infrastructure presents the big challenge - cybersecurity! Auto manufacturers and hackers have both demonstrated the value and perils of this connectivity and thus it necessitates a sharp focus from all stakeholders in the ecosystem - OEMs, regulators, component suppliers, insurance companies and even consumers to make the connected world safe.

The EY team is pleased to bring forward thought provoking scenarios and questions we all have to collectively answer. We live in a connected world today and in the foreseeable future, this trend is likely to increase. Historically, our experience in the industry has largely been around the use of information technology, which is now supplemented with operational technology. This combined flood of data is voluminous, instant and can be open to the outside world. This evolution opens all of us to the threats of cybersecurity, if not managed carefully.

As responsible corporate citizens we believe it is the duty of all stakeholders in this ecosystem to not only appreciate the threats of cyber but to also effectively take steps to prevent and mitigate risks. We at EY realize the enormity of the task at hand, the significant costs involved in terms of training of our people, the broader ecosystem, systems and checks and balances to be incorporated to safeguard our business.



Vinay Raghunath

Auto Sector Leader

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... Foreword

A connected car and in-car connectivity have moved from being mere buzzwords to becoming an ubiquitous ask by the Indian consumer. The industry is already focused on multiple aspects of this transformation which include making connectivity a standard feature (as opposed to being an optional add-on), creating new business and pricing models for connectivity solutions and working with regulatory bodies to establish standards to enable a faster roll out.

We believe that the end consumer's continuous demand for seamless in-car technology will continue to fuel innovation and collaboration between organizations spanning multiple sectors like telecom, internet service providers, automakers and component manufacturers.

Most OEMs are gradually expanding their internal organizational teams to work with these new competency areas while also solving challenges related to integrating vehicle platform development cycle time with the speed of development in the entertainment, communication and information technology space.

Alignment and collaboration across stakeholders in this connected ecosystem will be critical to ensuring that consumers continue to experience innovation in connected vehicles while also trusting the safety, seamlessness, relevance and durability of these solutions.



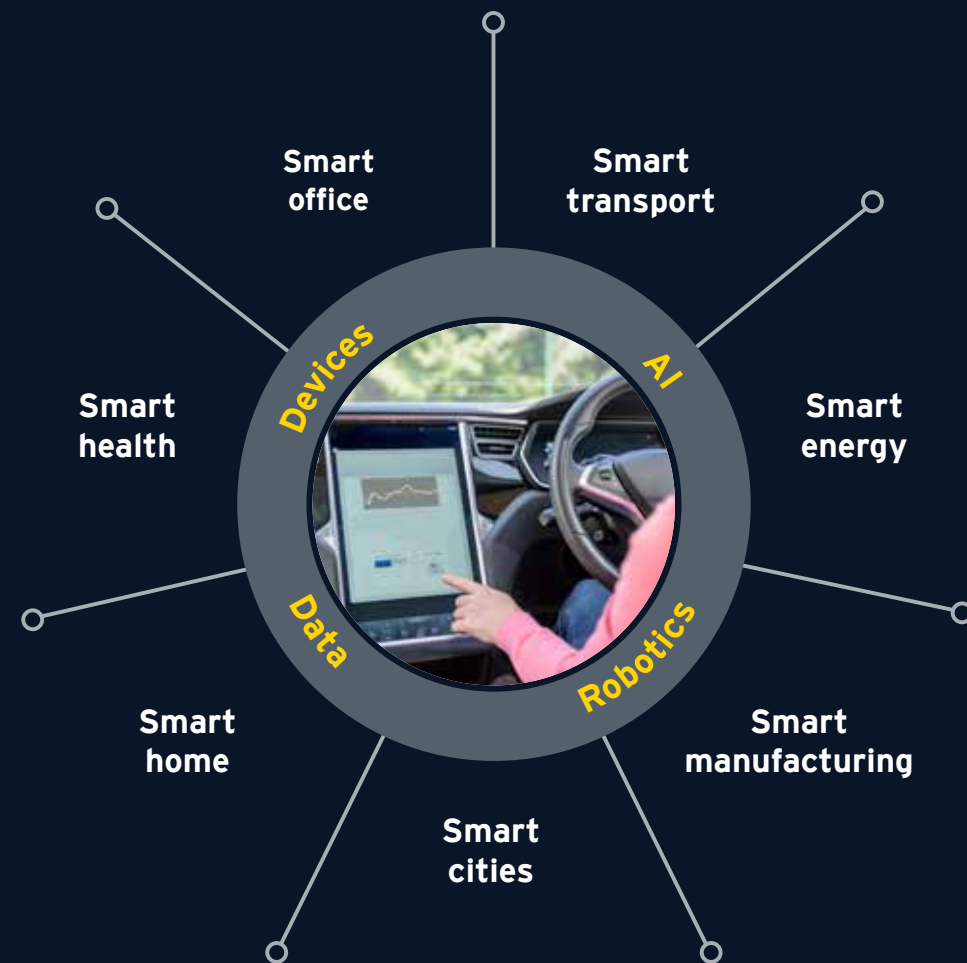
Section 01

.....●

Indian landscape:
connected consumer
and connected car

The changing Indian consumer

At confluence of aspiration and technology...



Paradigm shift in usage patterns

During 2019, it was estimated that

57.16 %
of the global population, or
4.3
billion people, will be using
the internet

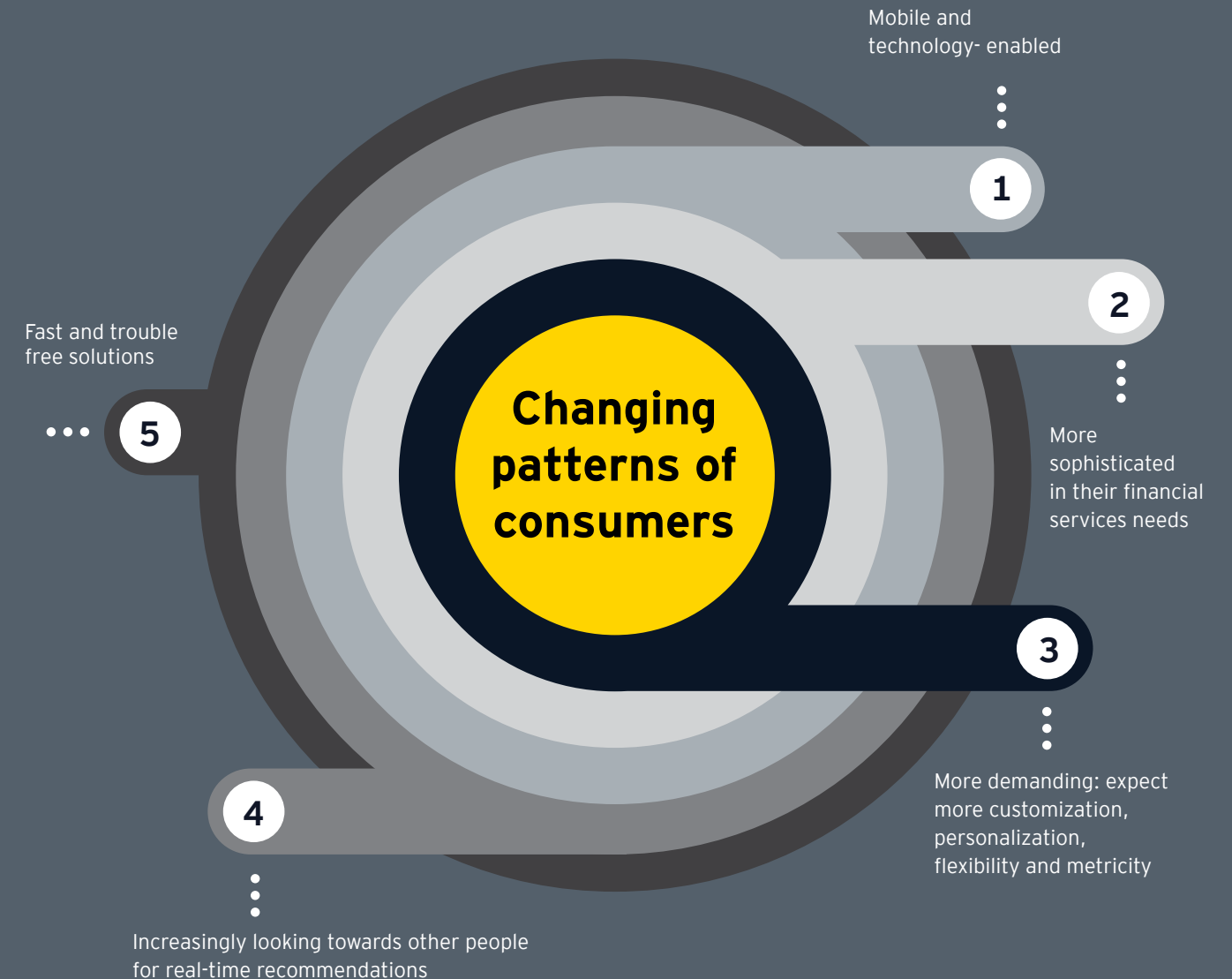
Active mobile-broadband
subscriptions have increased from

268 million
in 2007 to
6.3 billion
in 2019

In 2019, average time spend

144 hours
per day on social networking

Nearly three-quarters of the world will use just their smartphones to access the internet by 2025.



"India to grow faster than China in MBB subscriptions and data traffic"

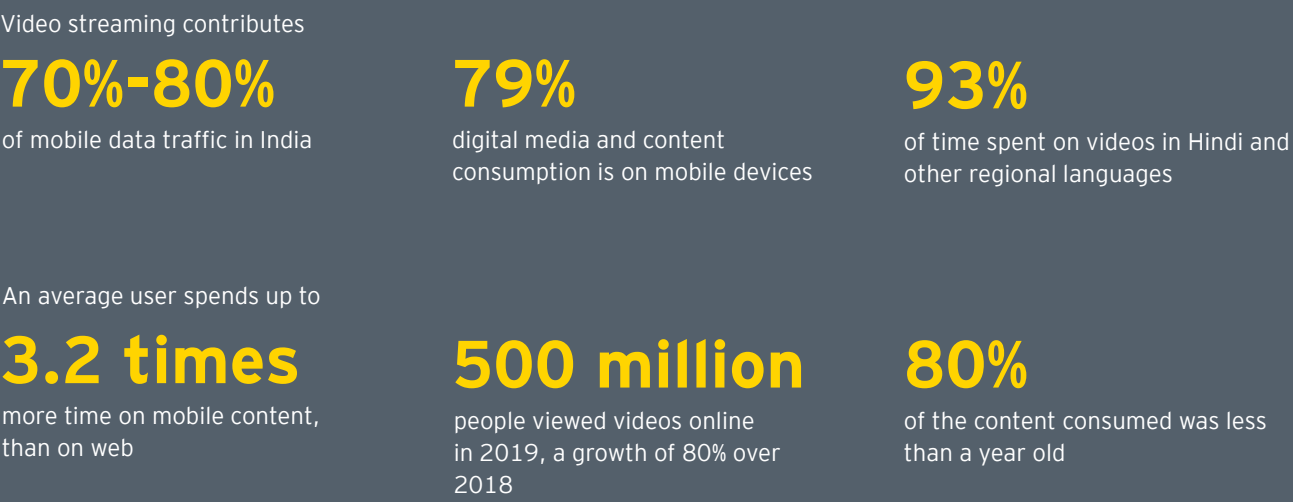
"Focus on content for enhancing customer experience"

"5G to account for 5% of total connections by 2025"

Transforming the lives of 2 billion people

India's digital and social media outlook

Growing digital media consumption, in the form of multi-play offerings, is increasing the data subscriber base for Indian telcos



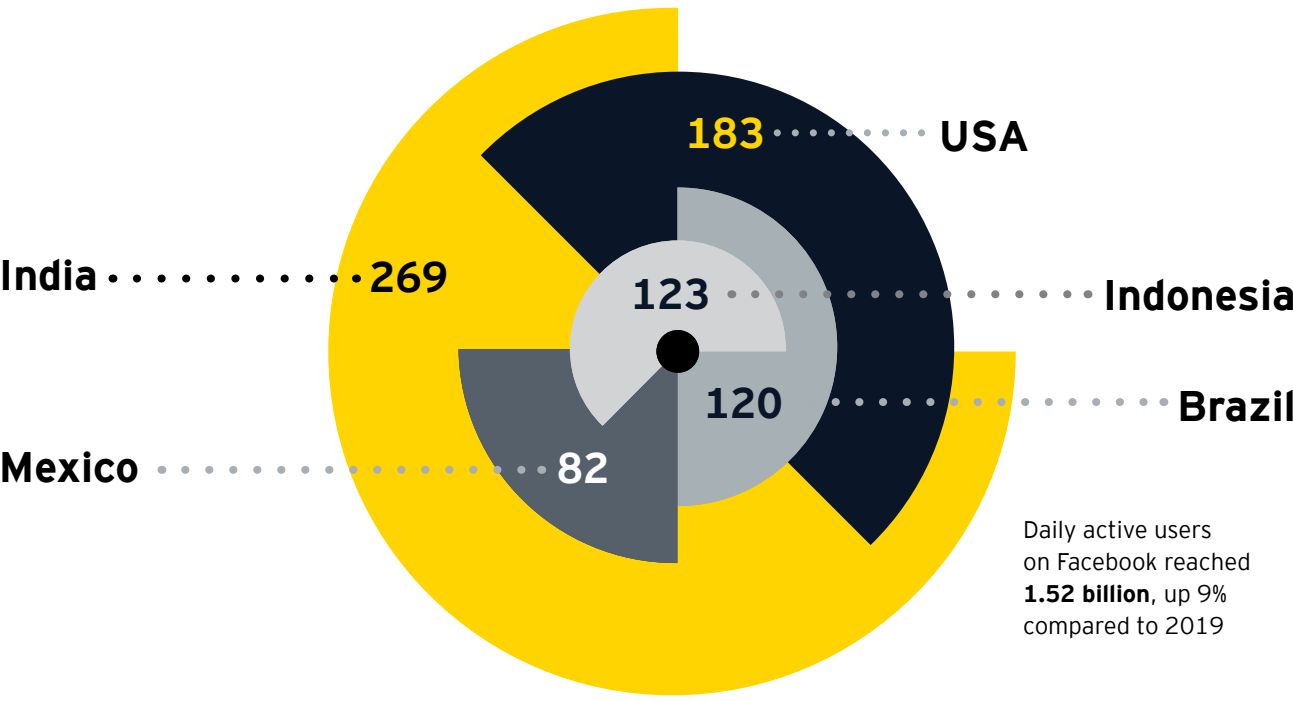
Digital opportunities to drive the next wave of growth in India

Digital opportunities to drive the next wave of growth in India
India to grow faster than China in MBB subscriptions and data traffic



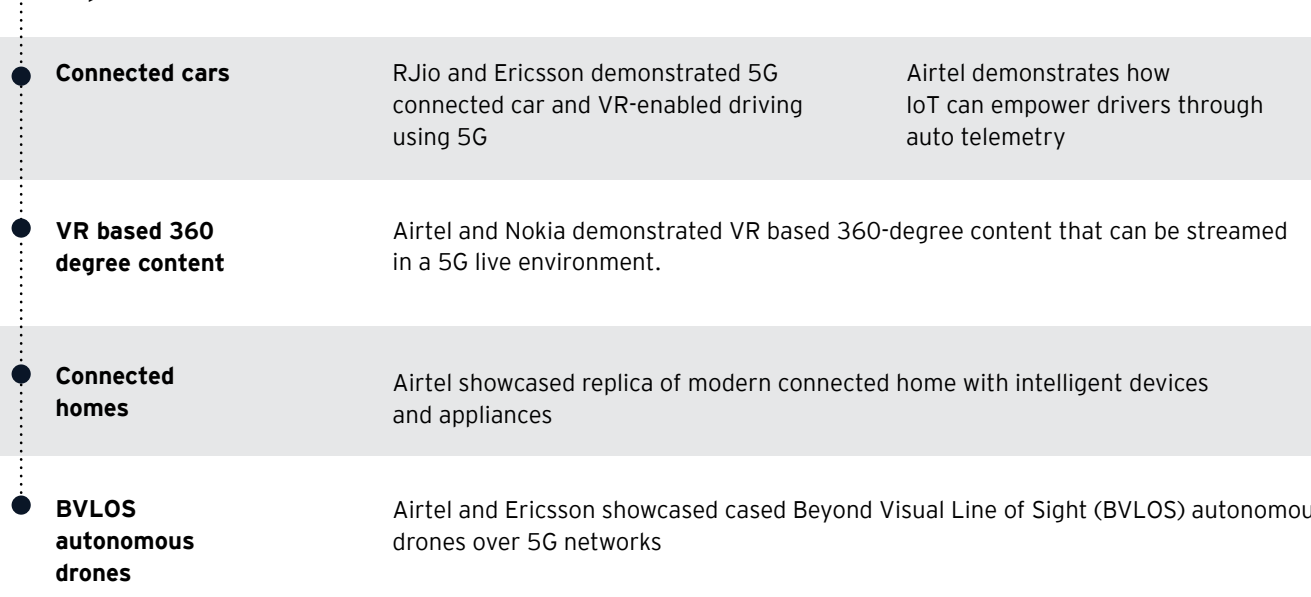
India has the largest number of Facebook users in the world

Million, Oct'19



Source: News articles, Statista 2019 Data, DMR

Operators have showcased a number of 5G use cases



Source: EY knowledge

Connected features for connected consumers

Focus areas: stakeholder's watch



- ▶ Connected car programs are becoming increasingly important for differentiating brands and vehicles from the competition while contributing to consumer engagement, satisfaction and loyalty for the next purchase.
- ▶ Leading automakers need to create connected car experiences that are intuitive, personalized and updatable.
- ▶ Automakers are increasingly developing electric, hybrid and plug-in hybrid vehicles to meet consumer demand and comply with current and future government fuel efficiency mandates.

Source: EY knowledge

What's driving the connected car?

Intelligent mobility paves new roads for marketers

New car technologies are transforming the automotive sector, with major implications for industry players and consumers alike



Continued on next page



Connected cars are poised to become a common phenomenon in India in the near future. And their relevance in the next few years is bound to increase with the expected wide-scale adoption of EVs where connectivity features will help owners locate nearby charging stations and access telematics data among several other things



Connected cars poised to become common phenomenon in India

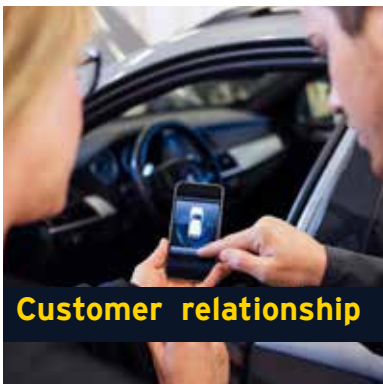
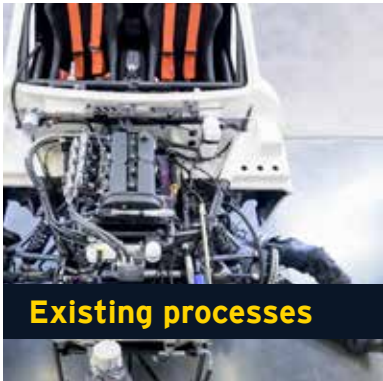
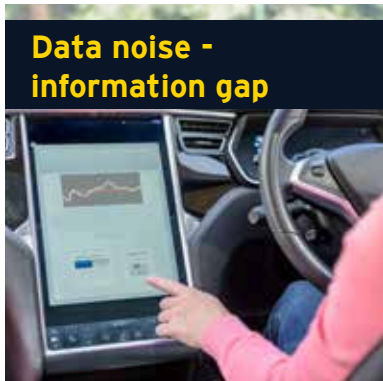
An increase in vehicle legislation and industry compliances regarding convenience features, such as navigation, remote diagnostics, etc. are driving the connected car market

Technologies like telematics, connected and autonomous vehicles will play a vital role in transformation

By connectivity technology: Cellular segment is expected to dominate the India connected car market

Connected consumer puts pressure on all stakeholders for the right strategy

Right business model: stakeholder's watch



Customer value and products portfolios value

Strategy medium/short term plans

strategy discussions amongst shareholder's are essential to overcome frictions in the organization,

because there are a number of key questions and issues to be addressed

Source: EY knowledge



Key questions for all stakeholders

The question...

...and what the answer should be about

What telematics services will be offered (and when)?

Identifying initial target market, with a view on benefits and costs

Are the telematics services technically feasible in my target market?

Understanding the IT landscape, its strength and weaknesses

Are the services commercially viable? What is the end result (top line and bottom line)?

Building up the business plan also to anticipate issues/ concerns and estimate pricing improvement

How are the black boxes / devices installed and maintained and who will bear the cost?

Keeping a flexible approach ready for "device independency"

Who will store and analyze the data (i.e., in-house or outsourced)?

Understanding the path to develop access to adequate technology and skill

What are current consumer attitudes? What would they expect by telematics?

Identifying "differentiating services" to avoid the "commodity pricing trap"

How do I attract new customers without cannibalizing my existing portfolio?

Comparing company's portfolio and clients with market trends and existing threats

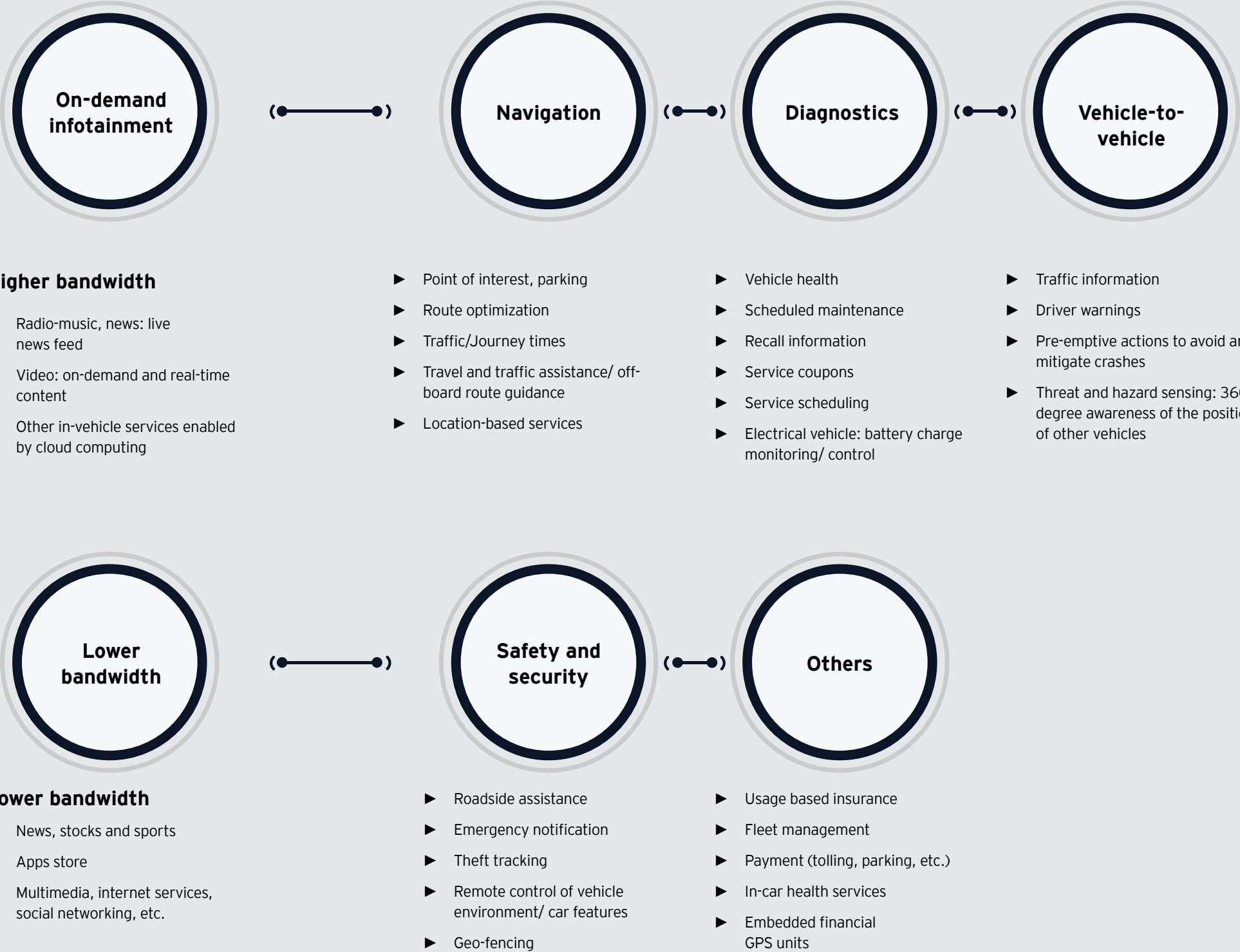
What strategic partnerships would add value to my proposition (e.g., car dealerships, road side assist service providers, technology partners, official bodies)?

Building a vision behind that of a gadget that enhance risk selection, to leverage telematics ecosystem

Source: EY knowledge

Connected car ecosystem

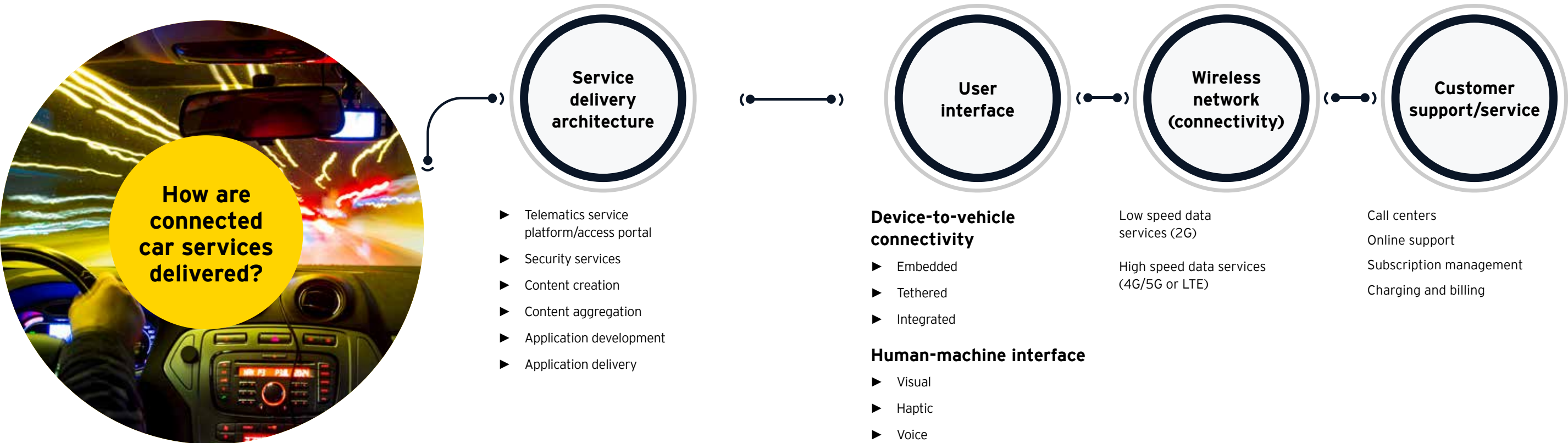
Multiplicity of services and stakeholders



Source: EY knowledge

Connected car ecosystem (continued)

Multiplicity of services and stakeholders...



Automotive industry

- ▶ Vehicle manufacturers
- ▶ Auto component suppliers
- ▶ Repairer networks / service centers

Information technology

- ▶ Packaged software vendors
- ▶ IT services companies

City/State regulators

Telecom

- ▶ Telecom operators

Telematics service provider

- ▶ Telematics service platform providers

Device manufacturers

- ▶ Smartphone manufacturers
- ▶ Portable navigation and infotainment device manufacturers

Insurance industry

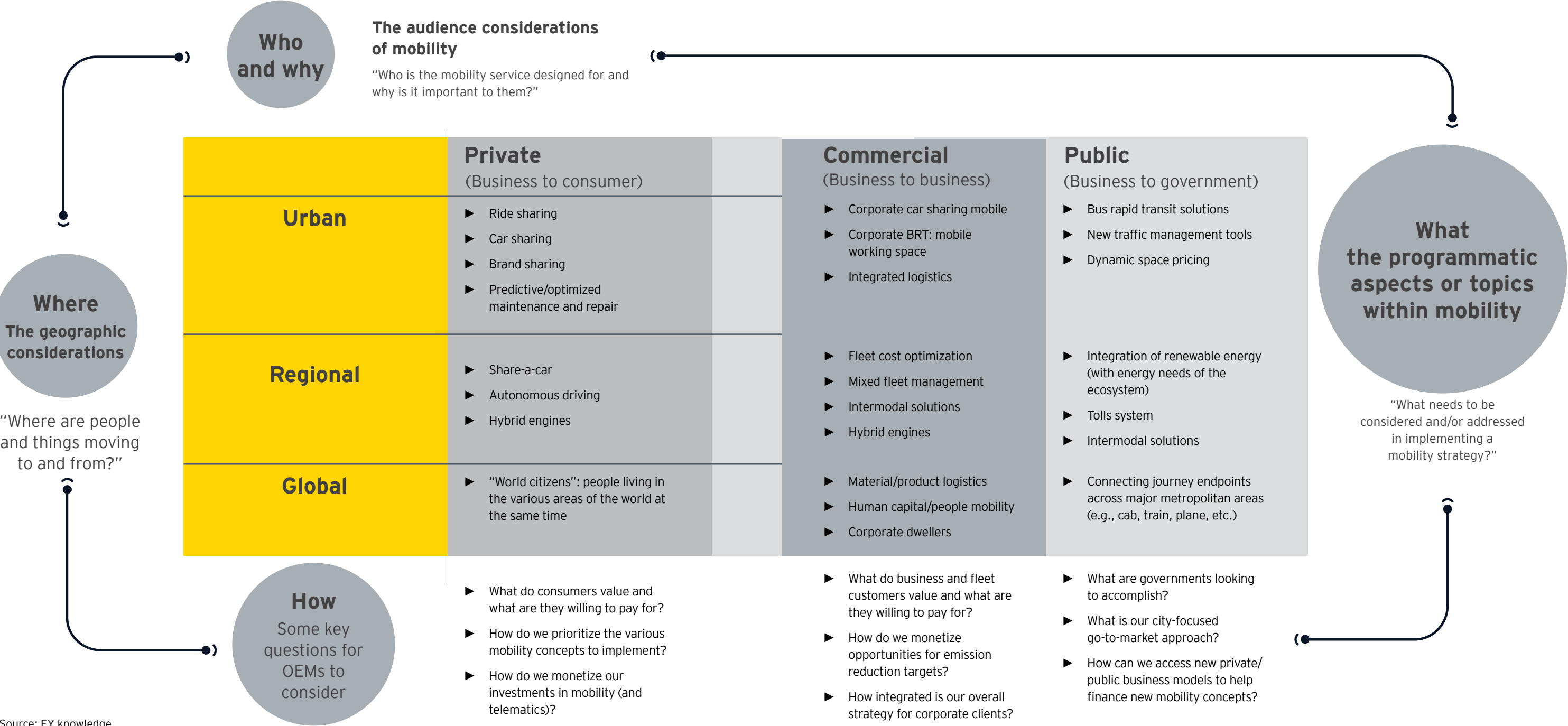
- ▶ Insurance providers
- ▶ Insurance distributors (brokers and aggregators)

Others

- ▶ M2M service providers
- ▶ BPO
- ▶ Roadside assistance providers

We see connected vehicles as a part of the overall mobility solutions landscape

Mobility solutions considerations: who, what, why, where and how...



Source: EY knowledge

India connected car market

Emerging profit pool for the Indian automotive industry

- ▶ The Indian connected car market is estimated to be US\$9.8 billion in 2019 and is projected to reach US\$32.5 billion by 2025, at a CAGR of 22.2%.
- ▶ The key factor driving the growth of the market is the increase in the number of connected features in economy vehicles by OEMs. Additionally, an increase in vehicle legislation and industry compliances regarding convenience features, such as navigation, remote diagnostics and multimedia streaming through various platforms such as Android Auto, CarPlay and MirrorLink are driving the Indian connected car market.
- ▶ New safety norms are encouraging automakers to equip the vehicles with safety and security connected features, which in turn is increasing the demand for connected cars.
- ▶ Various technologies such as heads-up displays, smart infotainment and telematics systems are becoming an integral part of high-end automobiles.

Connected cars: market dynamics

Drivers

- ▶ Economy car manufacturers attempting to provide luxury features
- ▶ Government initiatives for implementing connected car technology

Restraints

- ▶ Lack of supporting infrastructure
- ▶ Unavailability of standard platforms

Opportunities

- ▶ Emerging profit pool for automotive industry
- ▶ Evolution of the new value chain ecosystem of the automotive industry

Challenges

- ▶ Increase in the threat of data breach and cyber security for connected vehicles
- ▶ Increase in the price of the vehicle with connected services





Section 02

What's in it for all the stakeholders:

OEMs, suppliers, insurance companies, service providers

OEMs challenge and opportunity

Technology, commercial and operations: are these the big questions?

“

Connected car mobility is the 21st century's biggest opportunity. OEM challenge will be to find new business model for the connected services and revenue stream will the proof ”

Som Kapoor

Partner, Future of Mobility

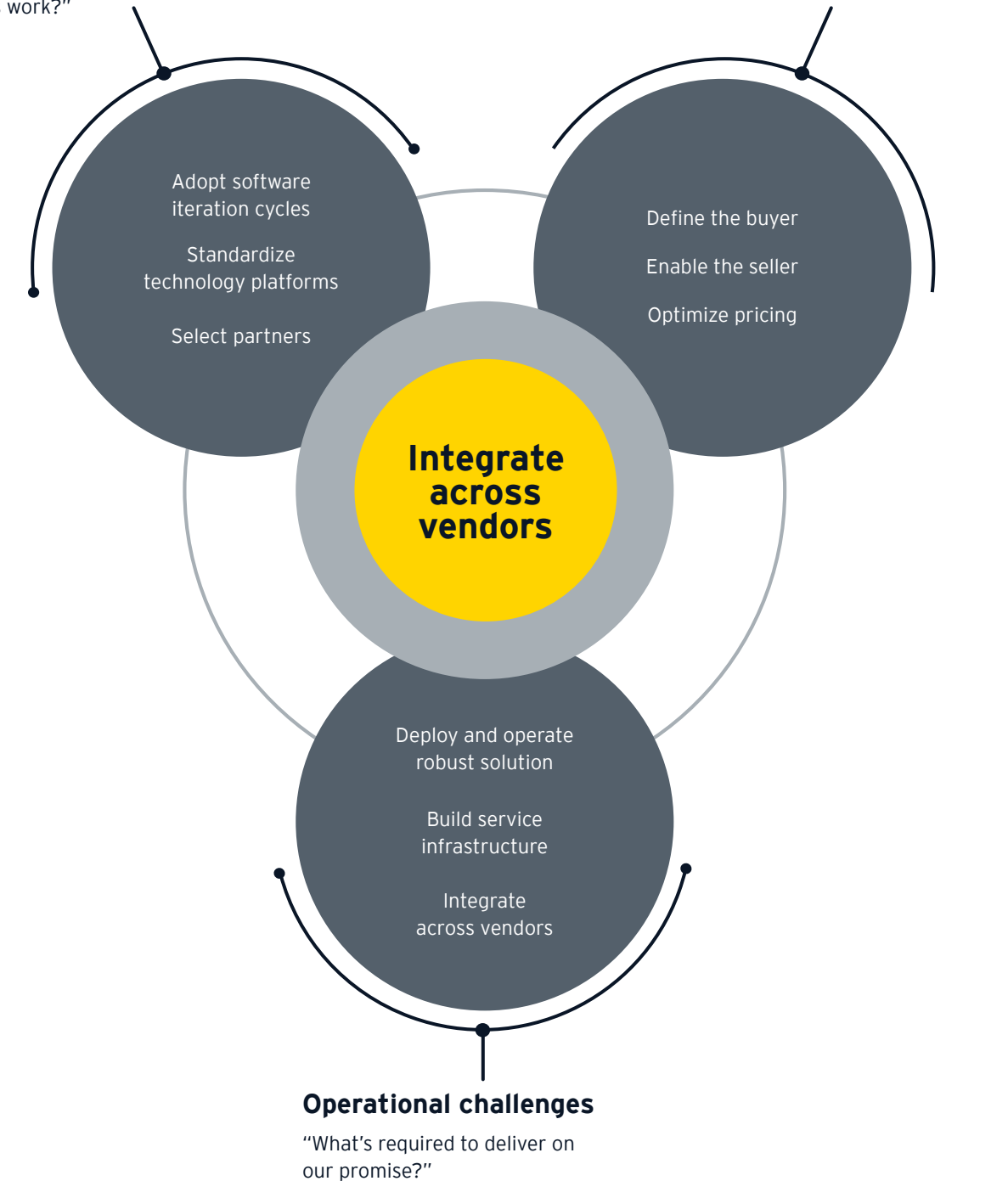
Som works with automotive OEMs across the country

Technical challenges

“How will my connected vehicle solutions work?”

Technical challenges

“How will my connected vehicle solutions work?”



Connected vehicles: opportunities and challenges for vehicle manufacturers

Internet-enabled, telematics

From

- ▶ Managed as feature/ functionality item
- ▶ Owned by product development/engineering
- ▶ VM branded
- ▶ Unclear value proposition
- ▶ Optional item bundled in a package

Many definitions exist - we propose

Mobility - moving people and things from point A to point B

Connected vehicles - internet-enabled, mobile equipment

Telematics - hardware and software to connect vehicles

Challenges

- ▶ Defining value and willingness to pay for dealers and customers
- ▶ KISS: keep it simple for users
- ▶ Organizing for success
- ▶ Operating a services business
- ▶ Managing partnerships vs. vendors
- ▶ Owning and using data

To

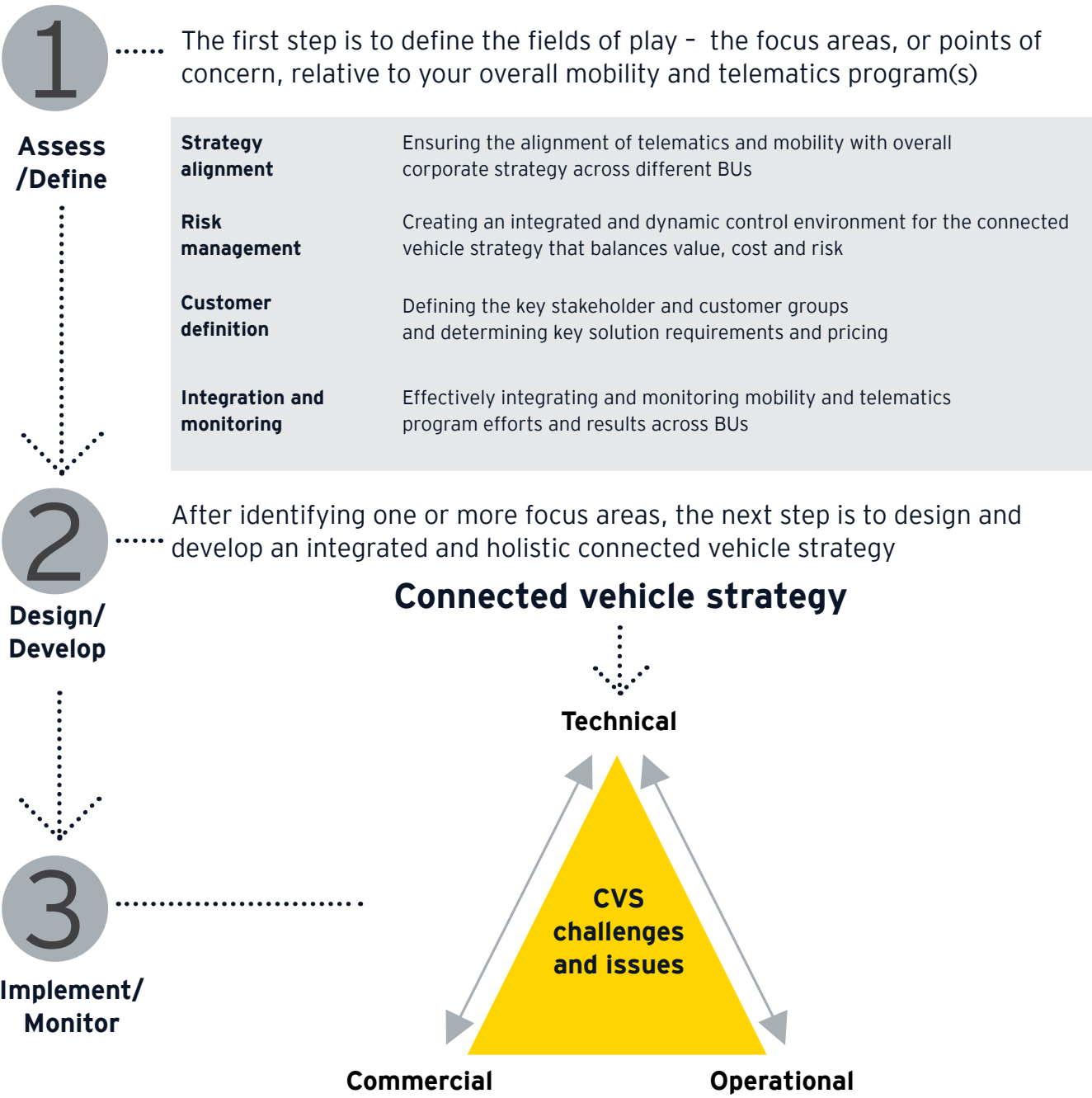
- ▶ Key element of customer engagement
- ▶ Application across ownership lifecycle
- ▶ Services-driven value proposition
- ▶ Multi-vendor, multi-brand solutions
- ▶ Standard item
- ▶ Tight smartphone integration

Opportunities

- ▶ Differentiate through the connected vehicle experience
- ▶ Build direct relationships with customers
- ▶ Use data to improve quality/ reduce warranty expense
- ▶ Increase share of post warranty, customer pay parts and services spend

Success in connected vehicles requires focus and diligence in strategy and execution

Connected vehicle strategy: Define - Develop - Monitor



New revenue streams for all stakeholders

The connected car opportunity: who will provide the infrastructure and who will give the content?

- ▶ Standard onboard function
- ▶ Determines vehicle chassis details, engine number, date of manufacturing and all legal attachments
- ▶ Locates the nearest OEM dealerships and workshops
- ▶ Records and shares the user feedback regarding the dealer with the OEM
- ▶ Onboard engine safety package
- ▶ Warnings include gear shift indication, rev recognition to avoid engine over revving
- ▶ On-board engine safety package
- ▶ Warnings include gear shift indication, rev recognition to avoid engine over revving
- ▶ End-to-end encrypted messaging system allowing users to chat with friends using the chat connect app of the same OEM and also through the vehicles command system.



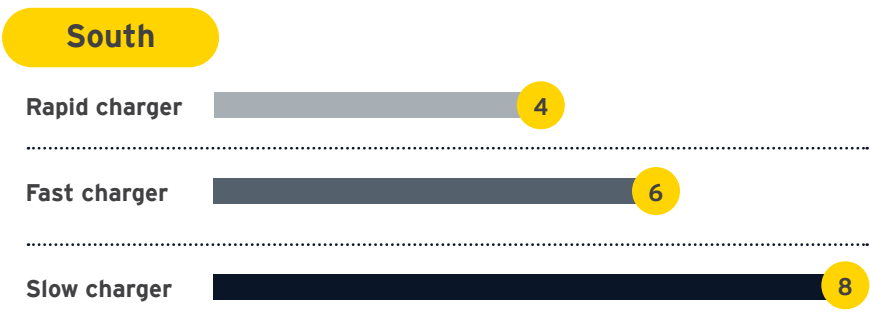
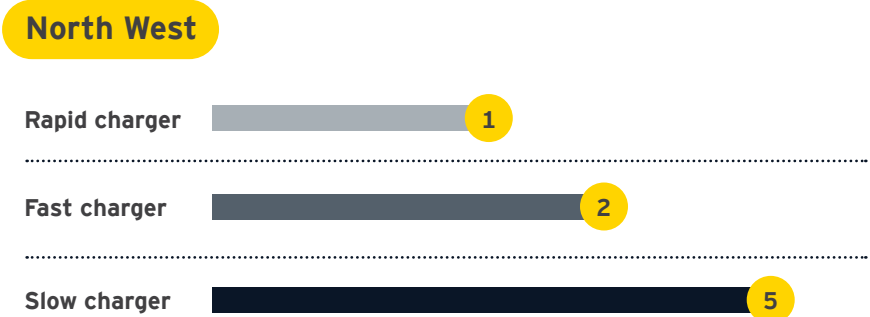
- ▶ Store subscriptions allow unlimited song downloads on-board the vehicle which can be played offline
- ▶ Gives entire summary of engine usage and performance to the user
- ▶ Monitors idling, average speed, clutch usage, brake usage, acceleration, gear selection, etc. and presents in a report format to the user
- ▶ Customizes cabin light colours, instrument cluster lights and button light colours as per the desired ambience
- ▶ Includes vehicle tracking, emergency calling, location sharing and urgent member calling
- ▶ Service track records maintained by vehicle, notifying the user one week prior to the service due date Vehicle books a service appointment with the concerned dealer by itself
- ▶ Sensors installed by default in the vehicle
- ▶ Activation of this package allows user to monitor tyre pressure
- ▶ Provides choice of setting the desired infotainment language for users unfamiliar with the generally accepted Hindi and English

Case study on EVs: how can being connected help reduce range anxiety?

Information at the user's fingertips about charging infrastructure and timely alerts

Nearest charging station and availability for type of charger

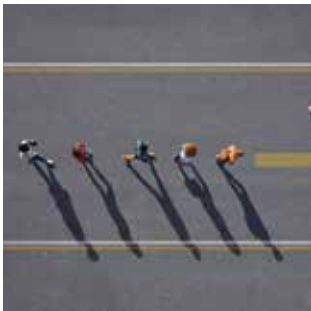
(Case study 1)



To alleviate range anxiety, the electric vehicle battery will need to be safer, cheaper, have faster charging and feature a high energy density for greater range.



Peak and off peak pricing (surge pricing)



Estimated waiting time

Case study: shared mobility connected dashcam

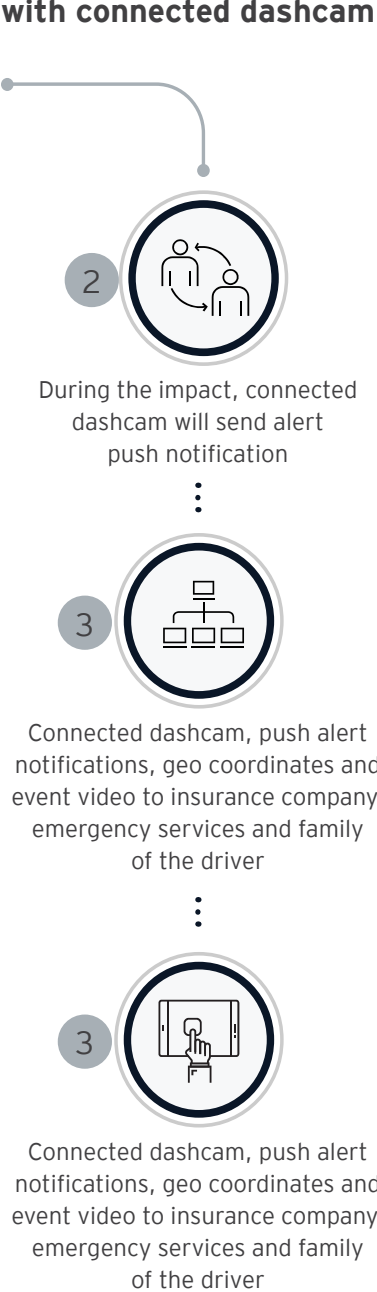
(Case study 2)

Current and future scenario: connected dashcam



- Benefits**
- ▶ Reduction in insurance premium
 - ▶ In case not the driver's fault, no premium increase
 - ▶ Fleet can reward drivers based on the driving performance

Future scenario with connected dashcam



Telematics in claims provide real customer protection and drive down insurance losses

Telematics as survivor!

(Case study 3)



Real time data transmission

- ▶ Location
- ▶ Motion
- ▶ Speed
- ▶ Vin number
- ▶ Acceleration
- ▶ Force of impact
- ▶ Other external environment such weather, traffic and road conditions



Extra information via telematics devices will help manage insurance losses by enabling claims operators to determine the exact circumstance of the claim including nature, type and extent of the damage to the vehicle as well as the early indication of likely bodily injury

- ▶ Reduction in underwriting and claim fraud
- ▶ Reduces the first notice of loss process
- ▶ With two-way communication can help identify individuals involved in the accident
- ▶ Improves the accuracy of case estimation damages reducing the uncertainty in property damage and small injury claims

Telematics enables a superior seamless claims process for a more holistic protection cover for customers

- | | |
|----------------------------------|---|
| ▶ Theft | ▶ Provide vehicle recovery information to customer/police |
| ▶ Theft alarm is activated | ▶ Avoiding total losses |
| ▶ Theft notification to customer | |

Accident

- ▶ Instant crash / emergency notification
- ▶ Send relevant emergency services to the confirmed location
- ▶ Check customer record and contact family
- ▶ Remain in contract with the customer
- ▶ Confirm arrival of emergency service
- ▶ Saving lives

Breakdown

- ▶ Instant notification and location of the vehicle
- ▶ Direct the nearest recovery team directly to the vehicle

Core offering of telematics insurance and connected dashcam

Managing customer needs through core offerings

1

Core UBI offering

- ▶ Design usage-based insurance suited for the business individual insurers business and operation model including product design, IT capacity, analytical function, claim management and capital
- ▶ As the product is still in its early stage of acceptance, lead the UBIs to understand the target market and test different product offerings

2

Risk selection: driving behavior modifier

- ▶ Continuous improvement in risk selection by capturing and analyzing increasingly accurate information about individual driving behavior
- ▶ Actively manage claim costs through real feedback on driving behavior and instant notification of loss events

▶ Reduction of claims cost

3

Product innovation: leverage through value add services, which are highly desired by the customer

- ▶ Provide value-add vehicle services, such as emergency services, breakdown services, theft notifications and early vehicle diagnostic services
- ▶ Additional opportunities exist around integration platforms, content provision and providing access to infotainment and navigation/traffic services
- ▶ Portal functions for new embedded applications, such as tracking of stolen vehicles, parental control, infotainment systems and viewer of journeys
- ▶ Requires support for single point, which is responsible for charging and billing for various services; this is a main reason for the increasing involvement of insurers in the value chain
- ▶ For insurers looking to become more deeply involved in the value chain, strategic alliances in the development of vehicle independent services is an option

- ▶ Increased revenue and profitability from non - insurance product
- ▶ Increased retention for core insurance product

Increasing the product offering with additional services better matches the customer's needs (emotional and logical) with the motor insurance product (traditionally, a begrudged purchase)

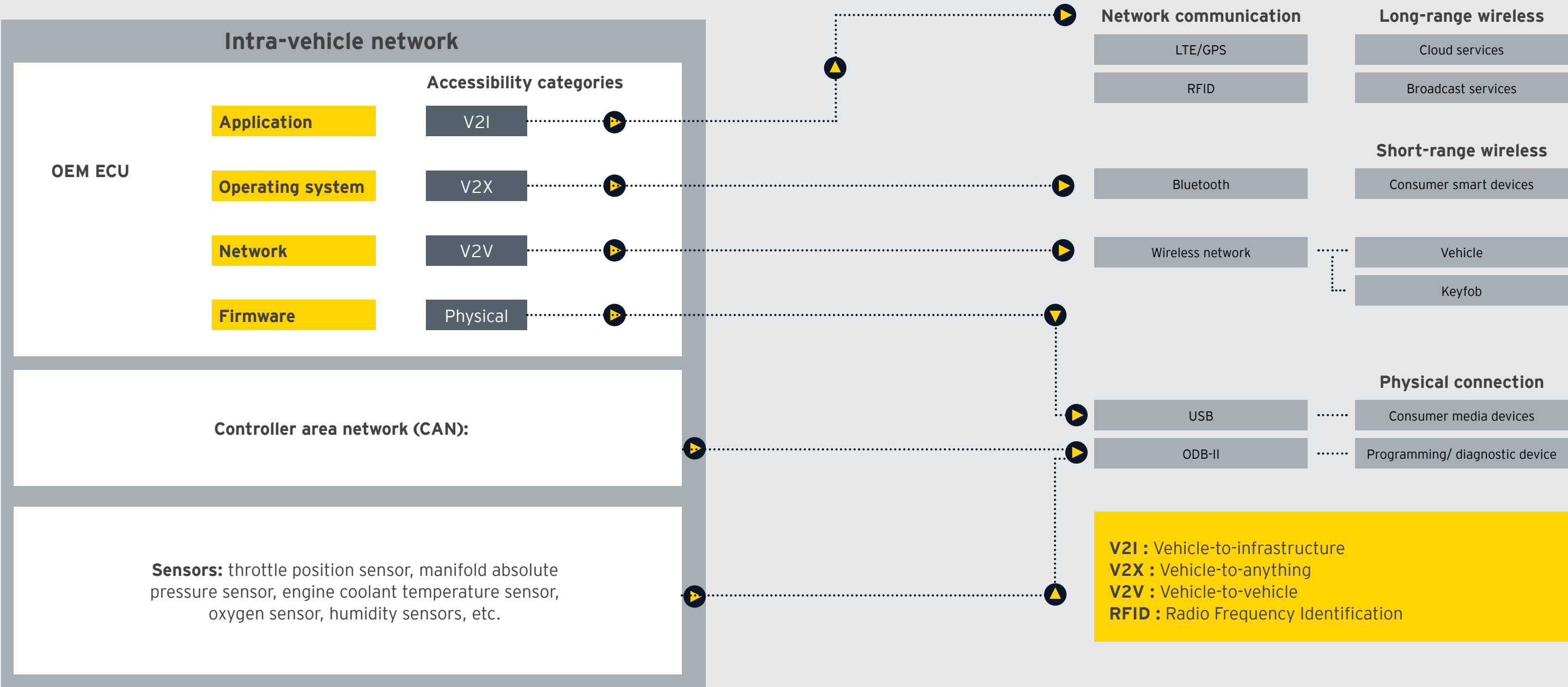


Section 03

Architecture of connected cars and the associated risks

Architecture of a connected car

Overall architecture and implementation view



The connected ecosystem of tomorrow's mobility needs to be robust and looking at dimension of privacy and safety

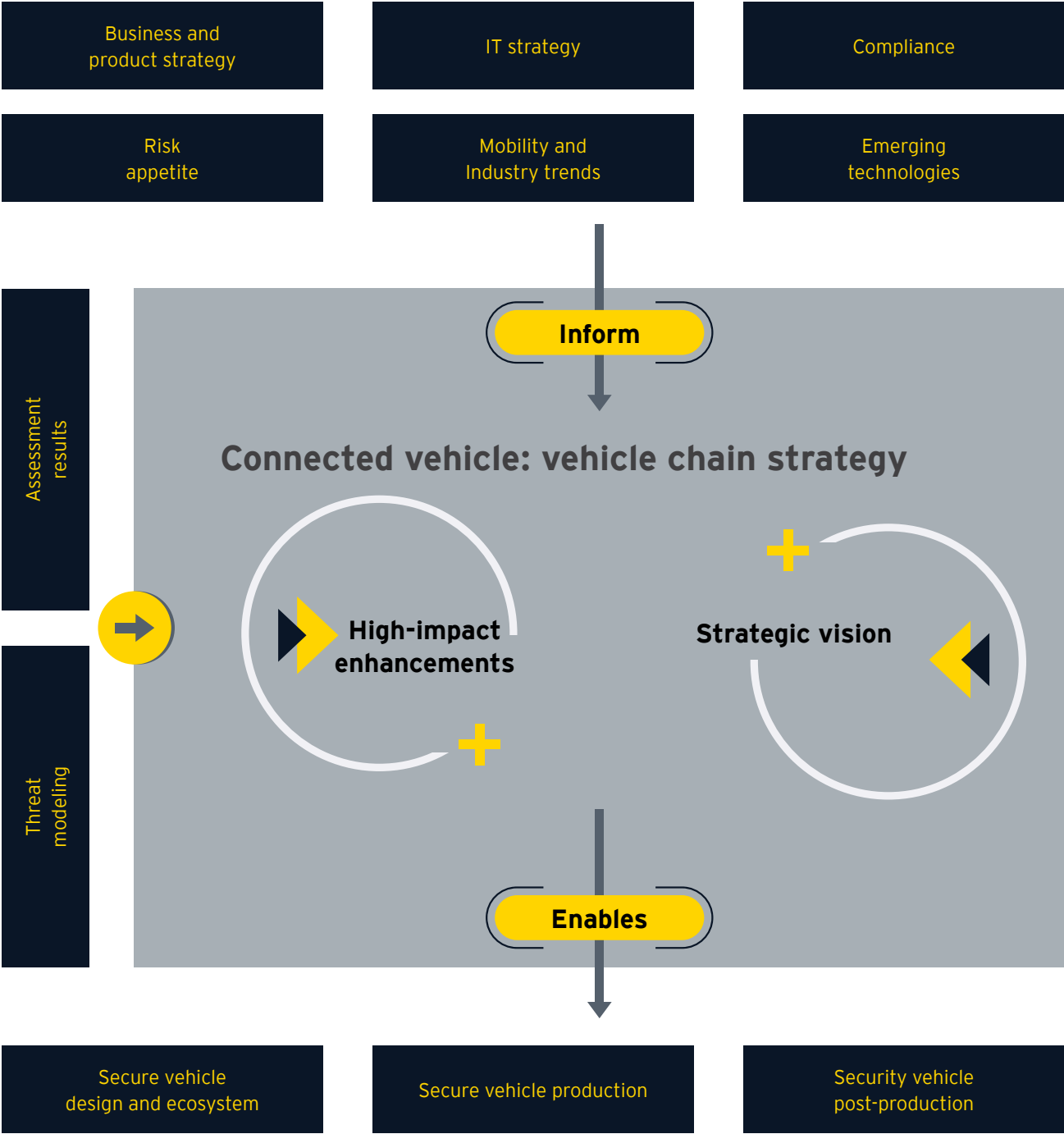


Cybersecurity has risen in importance as the automotive industry undergoes a transformation driven by new personal-mobility concepts autonomous driving, vehicle electrification, and car connectivity. The connected vehicle system will require a common technical framework for the deployment to address security implications and privacy of driver and passengers, as connected environment.

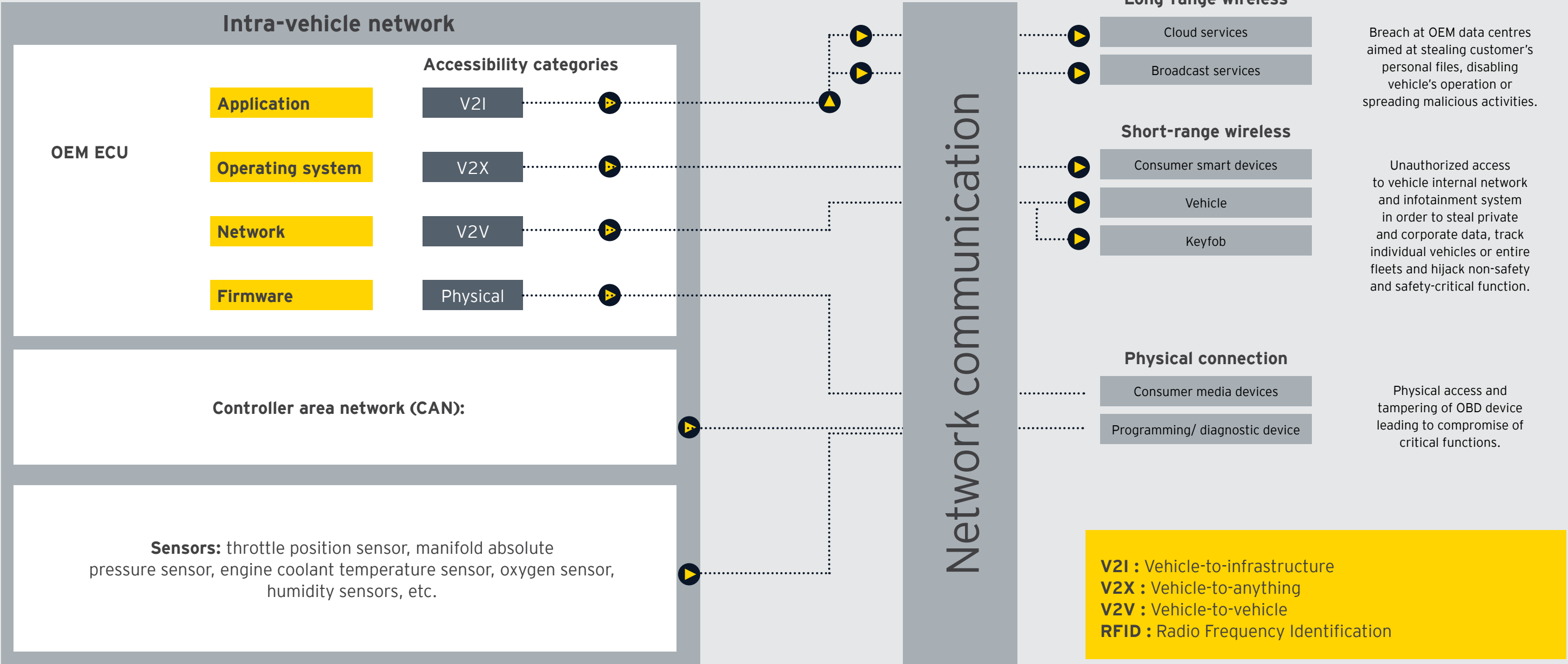
The emerging V2X landscape (V2V, V2I) calls for an approach, which takes care of drivers business use cases and as well as regulatory requirements and in achievement the players have to ensure, consumers interest of privacy at uttermost while maintaining necessary hygiene of cyber security.

R Sundar
Partner, Risk
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Race of cybersecurity: protecting connected cars Cybersecurity and privacy strategy core considerations - Top-down and bottom-up approach

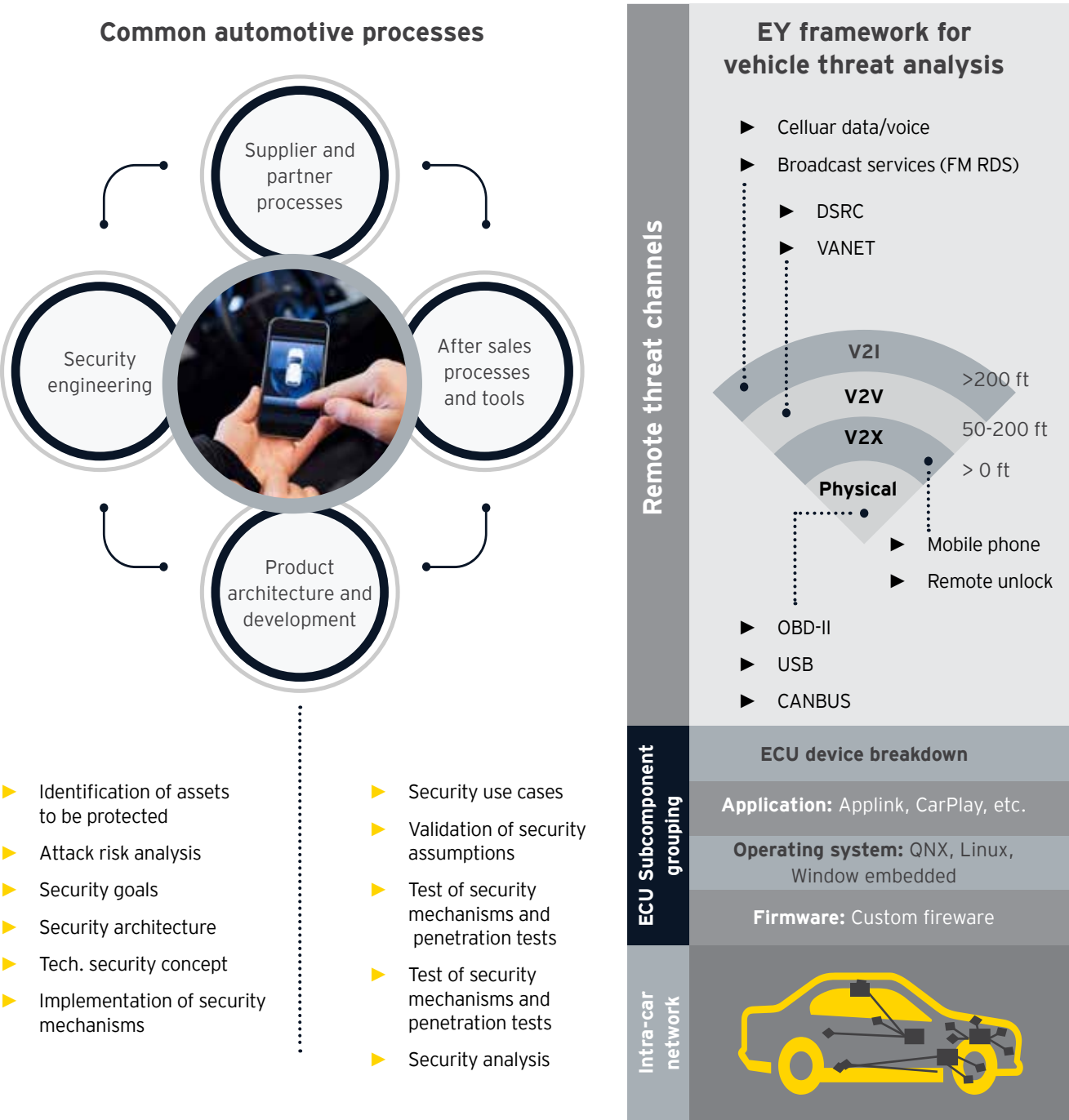


Threats and challenges to connected vehicles



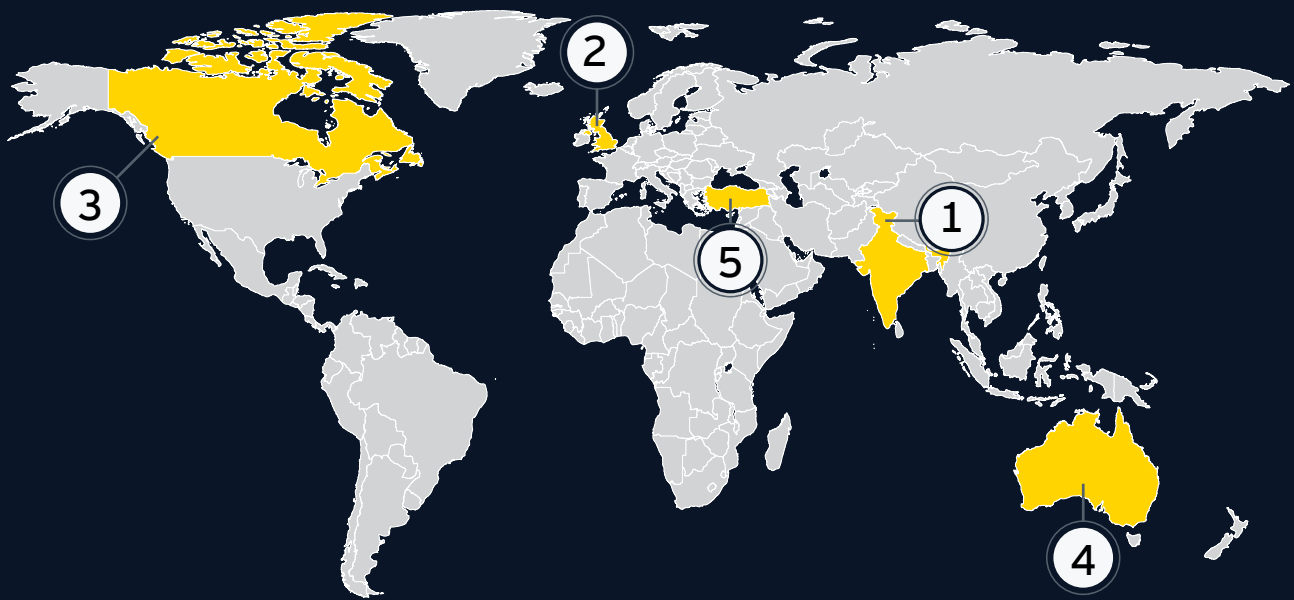
Assessment of security testing in connected car

Security oriented implementation of architecture and functions for connected cars



How big is the problem?

India ranked #1 in total number of cyber crime complaints received in 2018



Top five countries by the total number of cyber crime complaints receive

S.no.	Country	Complaint %	Total number of complaints received
1	India	33.07%	4,556
2	United Kingdom	28.8%	3,970
3	Canada	20.90%	2,880
4	Australia	8.90%	1,227
5	Georgia	8.33%	1,144

Cyber crime - major statistics - 2018

US\$2.71 billion victim losses in 2018

Over 900 complaints received per day on an average

Age	Complaint %	Total Loss (US\$m)
Under 20	9,129	12.5
20-29	40,924	134.48
30-39	46,342	305.6
40-49	50,545	405.6
50-59	48,642	494.9
Over 60	62,085	

Source: 2018 Internet Crime Report, FBI I3C



Section 04

.....● Attack scenarios

Quick snapshot: cybersecurity market for cars

- ▶ The cybersecurity market for cars was valued at US\$186.63 million in 2019 and is expected to reach a value of US\$2460.9 million by 2025, registering a CAGR of 52.15%.
- ▶ The cybersecurity market for cars is being primarily driven by the increasing connectivity of vehicles, increasing adoption of telematics services in automobiles and increasing integration of advanced features.
- ▶ The automotive industry across the globe is undergoing a wave of innovation and advancements, with the emergence of ground-breaking technologies, such as the Internet of Things (IoT), enhanced GPS, location and maintenance live recording, reminders, driving assistance and Wi-Fi services, the demand for connected cars has been rapidly increasing, driving the market forward.
- ▶ As all the connected vehicles are fully dependent on the connected software for all aspects of their operation, hence, they are vulnerable to a wide range of cybersecurity attacks, which increases the need for a cybersecurity solution, which is driving the market forward.
- ▶ With automobiles equipped with in-vehicle infotainment systems and improved wireless-network systems, have boosted the sales of the connected cars in this region, thereby, driving the overall Asia-Pacific cybersecurity market for cars.



EY cyberattack scenarios

Attacker levels and test scenarios

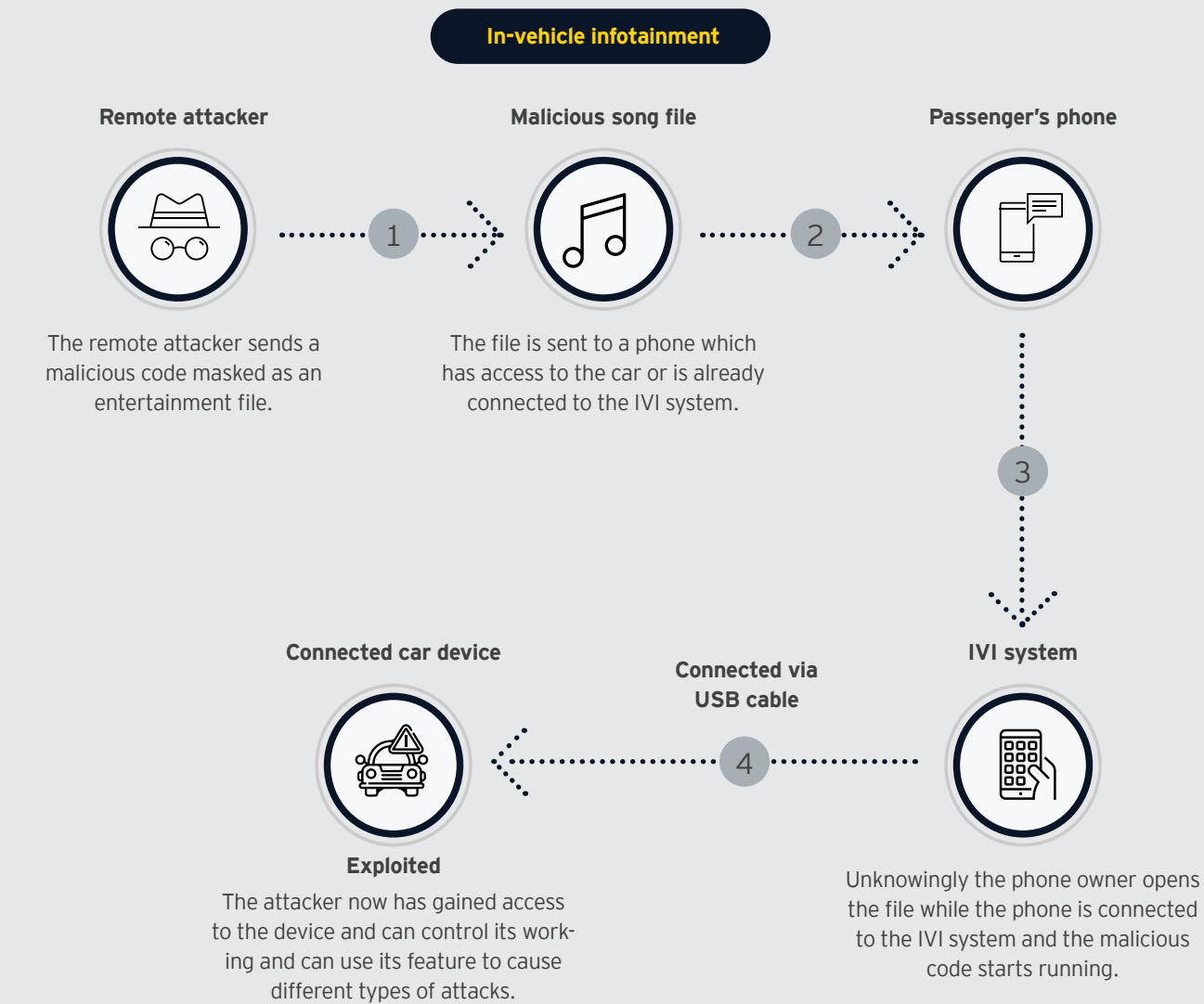
Attackers possess varying levels of skill which we group into four levels as shown in the table below. Against each of the four levels EY has devised a set of test scenarios that we would recommend performing to provide confidence that the component is able to withstand the associated level of attack and associated attack vectors. A process of threat assessment is used to identify the likely attacker, the attack vectors used, their motivations and typical attack targets.



1	2
Attacker level	Attacker level
Beginner (script kiddie)	Professional (experienced attacker)
Capability	Capability
- Has a basic security understanding - Is able to use public exploits or reproduce trivial security findings	- Profound security understanding and experience - Able to adapt existing exploits - Has some basic hardware-level exploitation experience
Example attack vectors	Example attack vectors
- Tries out known attack vectors against the WiFi of the headunit, e.g., breaks the WEP and brute forces easy WPA keys - Port-scans the head unit and looks for commonly known vulnerabilities - Tries to get firmware images of ECUs online and looks through them directly for strings with credentials - Reads car-hacking papers to reproduce findings of the past or is able to reproduce back-doors which are known on internet forums	- Opens embedded devices and tries to read the memory chips - Uses open debug ports to attach debuggers - Reverse engineers K-matrixes - Identifies simple buffer overflows in firmware which can be accessed via debug interfaces - Is able to discover multi-hop attack vectors from the car to the IT infrastructure - Is able to attack RF communication with known flaws in WiFi, GSM and Bluetooth, and well understood busses, e.g., CAN and LIN

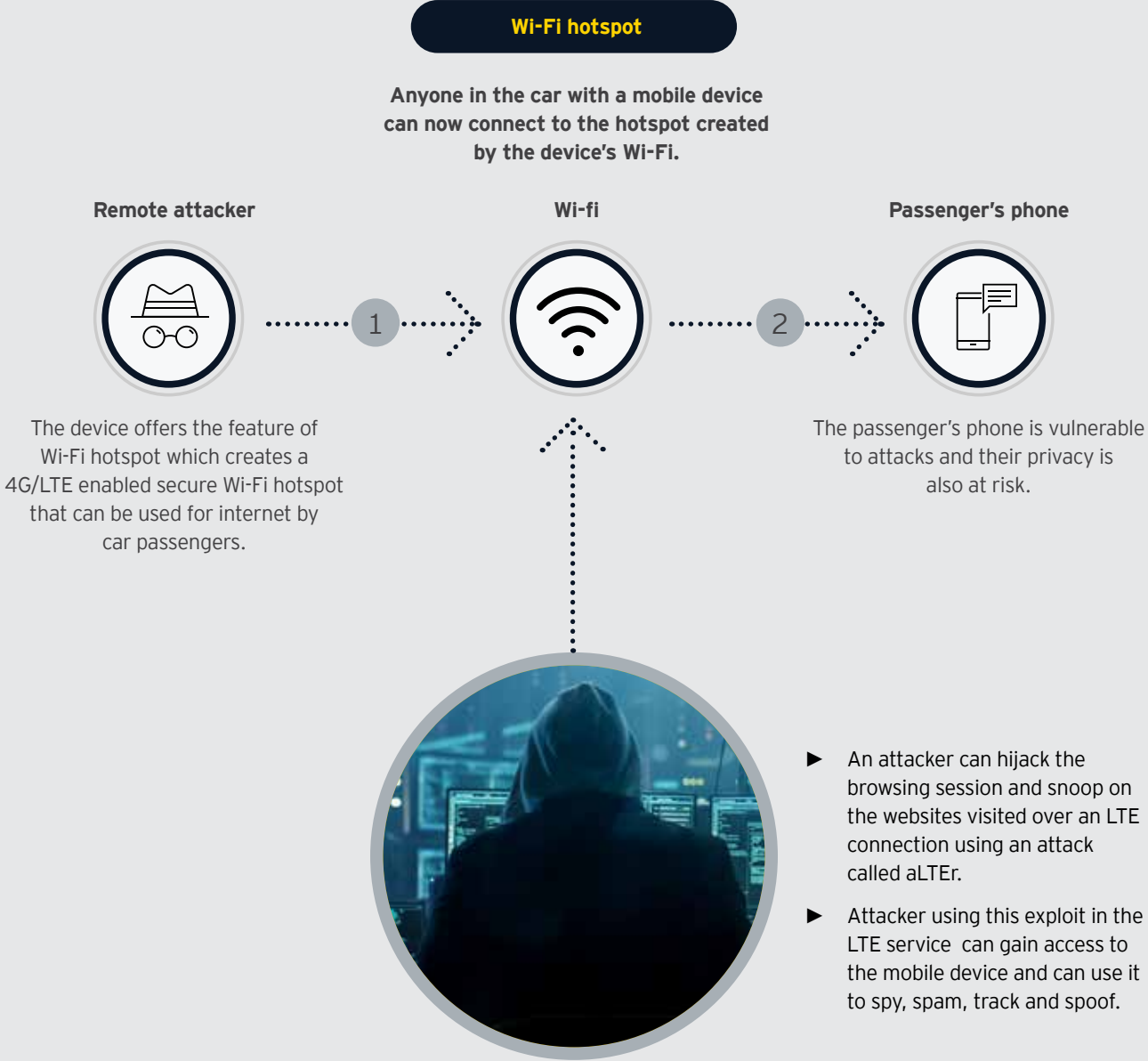
Attack vectors: in-vehicle infotainment (IVI)

Scenario 1



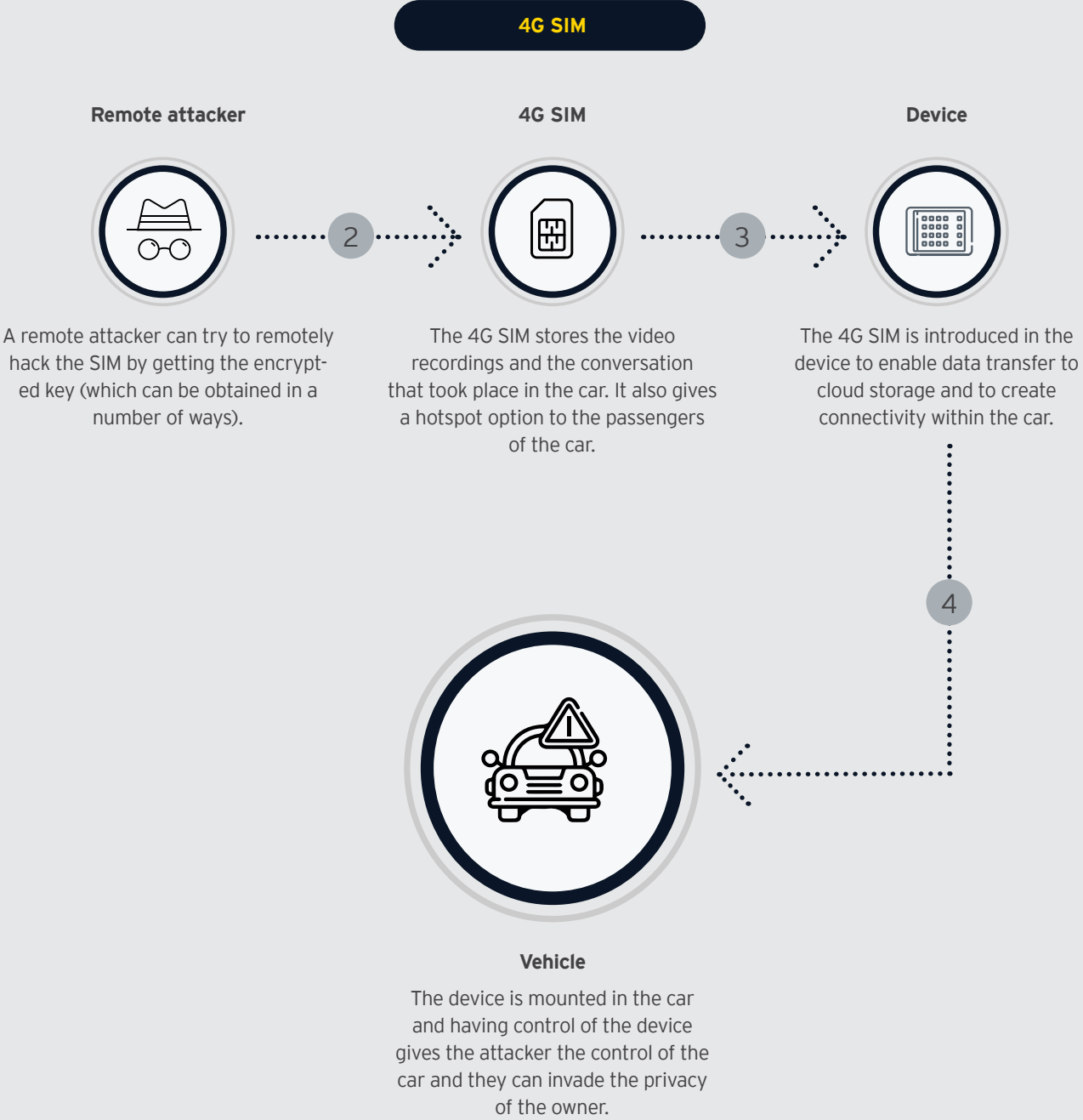
Attack vectors: Wi-Fi hotspot

Scenario 2



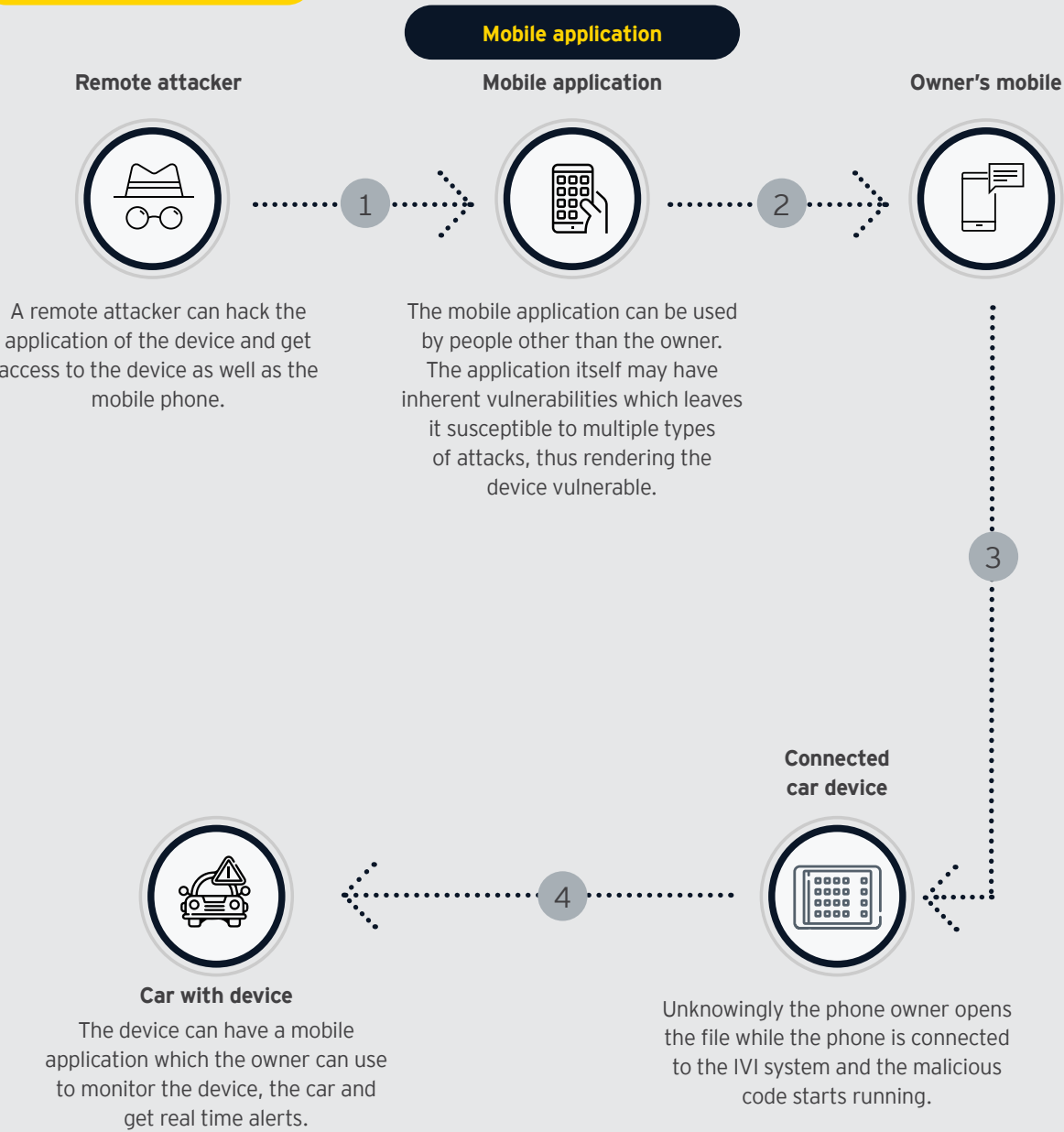
Attack vectors: 4G SIM

Scenario 3



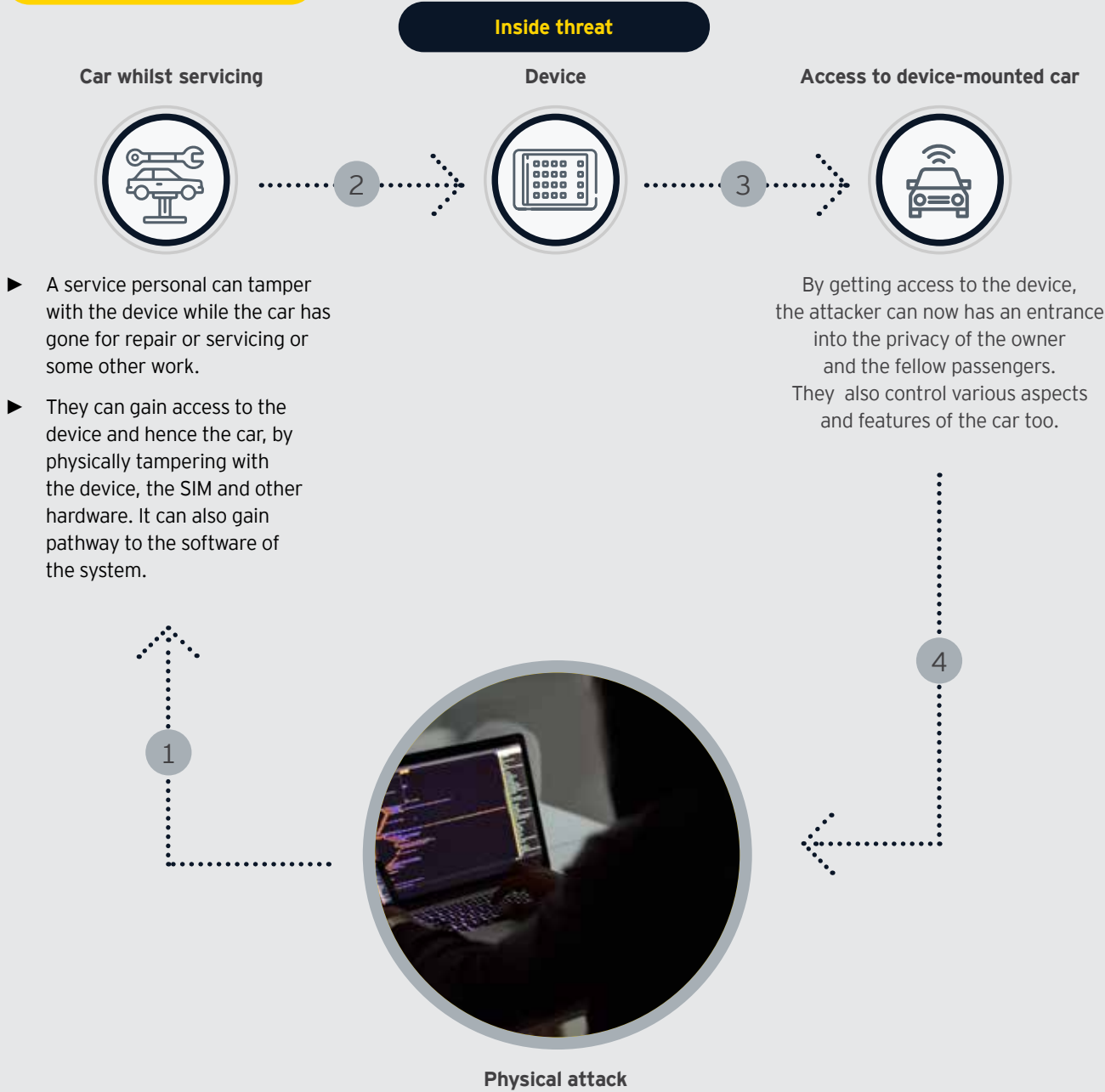
Attack vectors: mobile application

Scenario 4



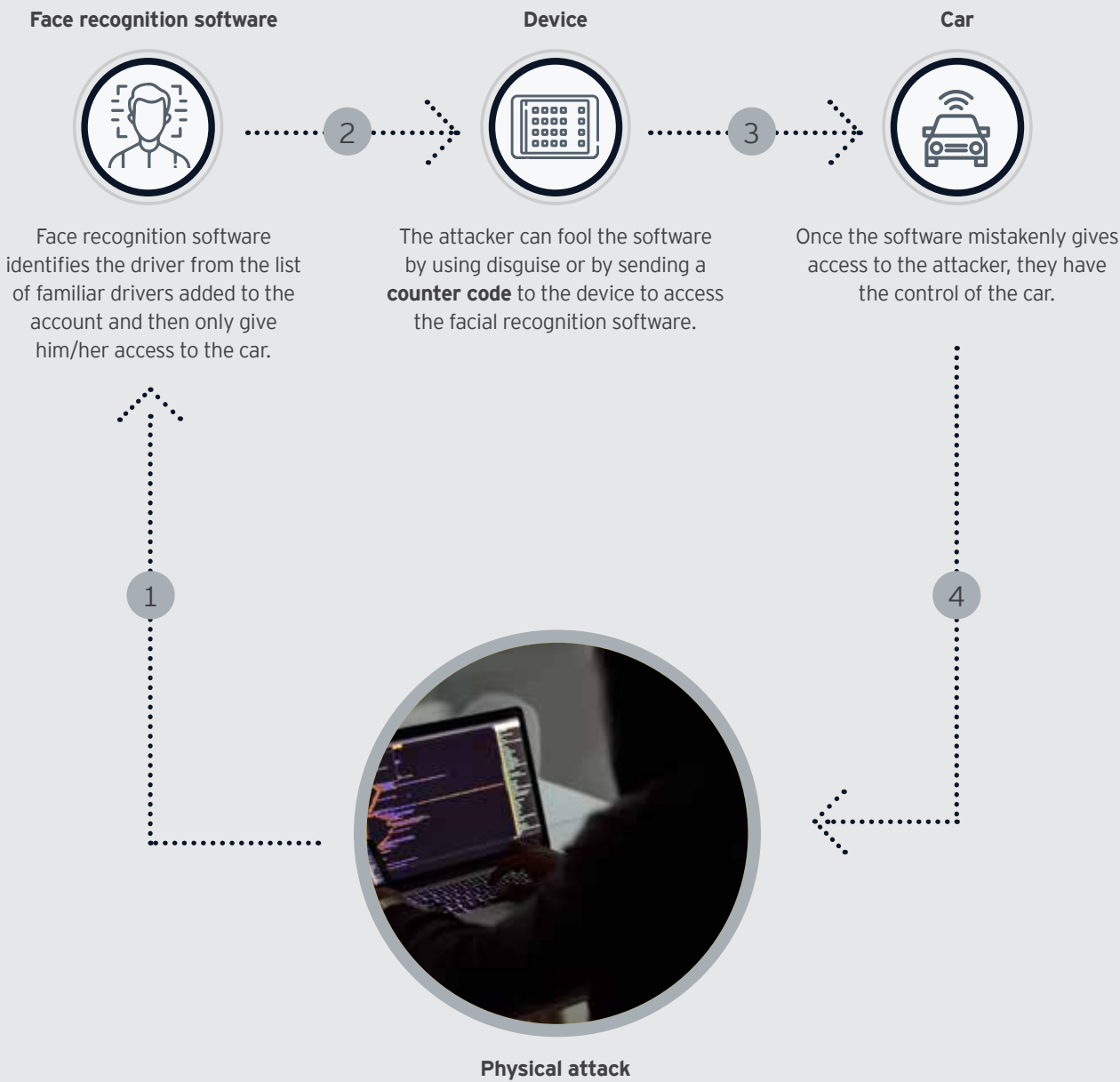
Attack vectors: inside threat (servicing)

Scenario 5



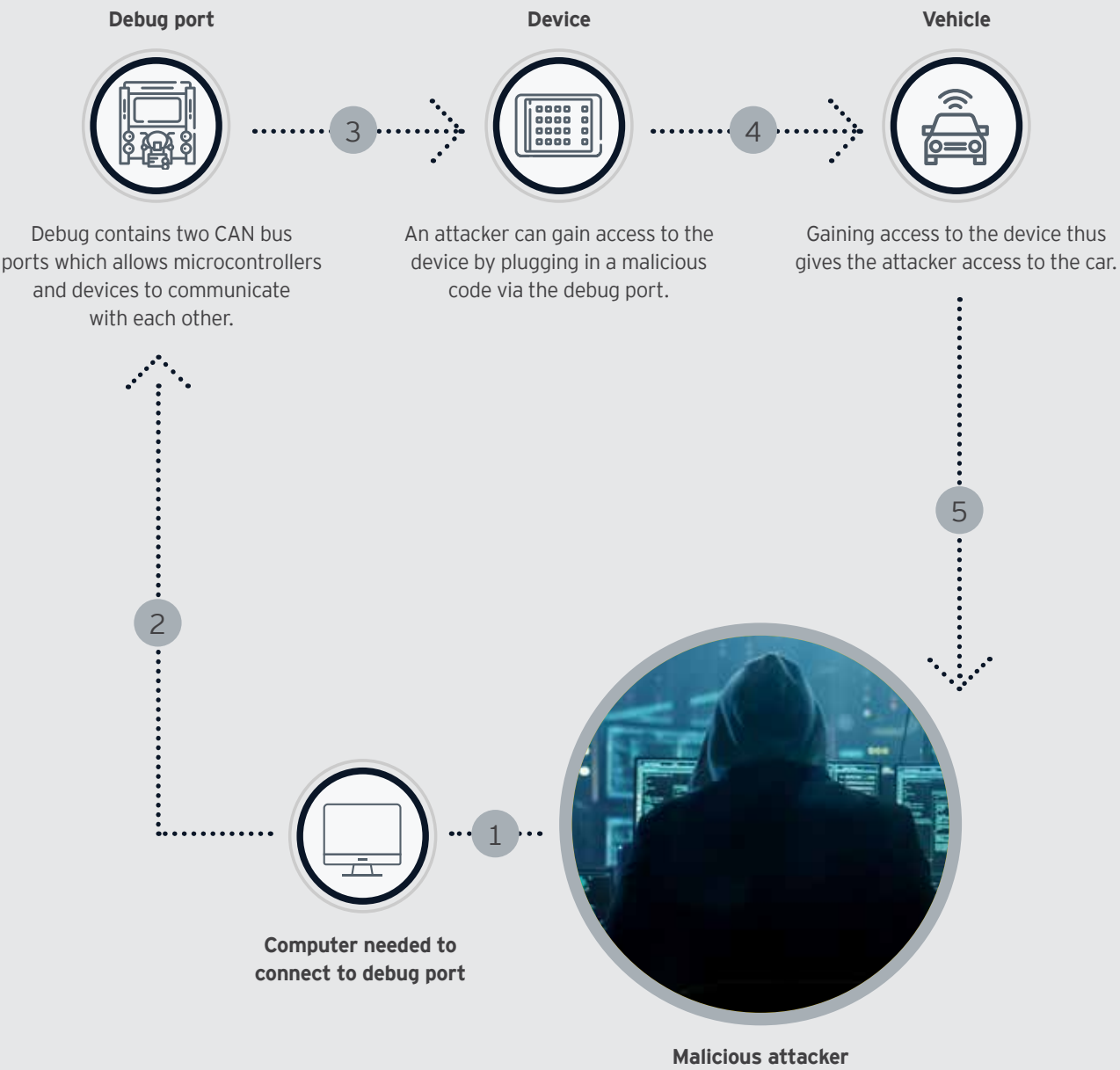
Attack vectors: insider threat

Scenario 6



Attack vectors: insider threat (OBD port)

Scenario 7



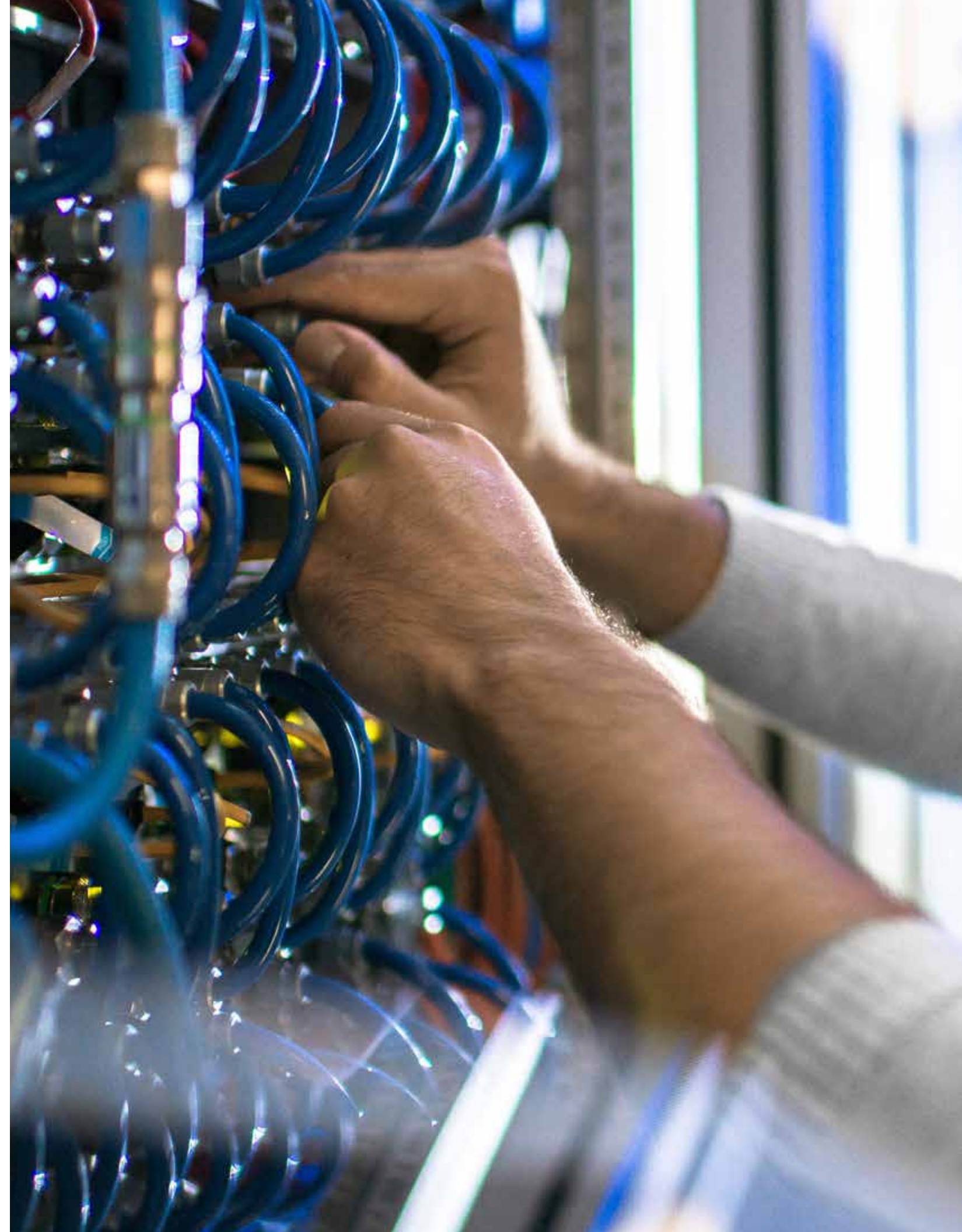
In conclusion...



- ▶ The rapid increasing connectivity, the increasing number of electronic control units and lines of code have increased the complexity of products, thus, the concerns for security solutions are on the rise.
- ▶ The advancement of AI technology can seriously address cyber related issues and help companies in providing solutions.
- ▶ Developments in automobiles, such as the emergence of connected cars (internet-enabled) and predictive maintenance (using telematics), are expanding the cyberthreat surface. Also, mobility as a service (rise of shared cabs) is collecting data about drivers, passengers, destinations and routes, thereby leading to increased concerns on privacy.
- ▶ Underlying opportunities for AI in cybersecurity market include growing need for cloud-based security solutions among SMEs and increased use of social media for business functions.

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Section 05

.....● **How can EY help?**

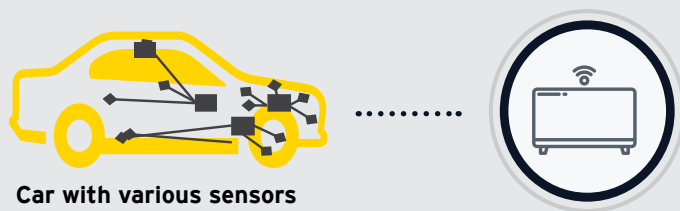
Connected car: how we see it!

EY capabilities

- Connected car strategy formulation
- Implementation support
- Monetization strategy
- Big data analytics
- Predictive maintenance and asset planning
- Digital risk and cybersecurity

Automotive companies can reap sustained benefits by effectively implementing a connected car strategy

OEMs	Third party / others	Customer
▶ Remote diagnostic and prognostic services ▶ Improve after sales and support service ▶ Leverage connected car offering as unique differentiator and improve customer loyalty	▶ Telematics for fleet management ▶ Content creation and management services ▶ Opportunities for telecom companies in machine-to-machine communication in vehicle	▶ Advanced assisted driving capabilities ▶ On demand infotainment ▶ Augmented navigation
▶ OEMs can offer significant value to its customers by combining various elements from online applications, driver assistance, call center services and solutions for the integration of mobile devices ▶ Services provided by the company can include vehicle management, travel and navigation, parking, entertainment, information, emergency call, vision and drive assistance	▶ Companies can use driving usage and car performance data to: ▶ Optimize inventory for spares ▶ Feedback into new product development ▶ Sending maintenance alert to customers and dealership ▶ Over-the-air tuning of the vehicle	▶ Customers can be provided with customized web portals, where they can view diagnostic reports, download directions to the vehicle or even unlock the car's doors ▶ The connected car lives in the network and is open to cyber threats; companies need to have the balance between trust and risk - not just risk level, but trust level - how much assurance do they have ▶ Advanced assisted driving capabilities can be provided by leveraging sensors, analytics, NLP, RPA and cloud computing

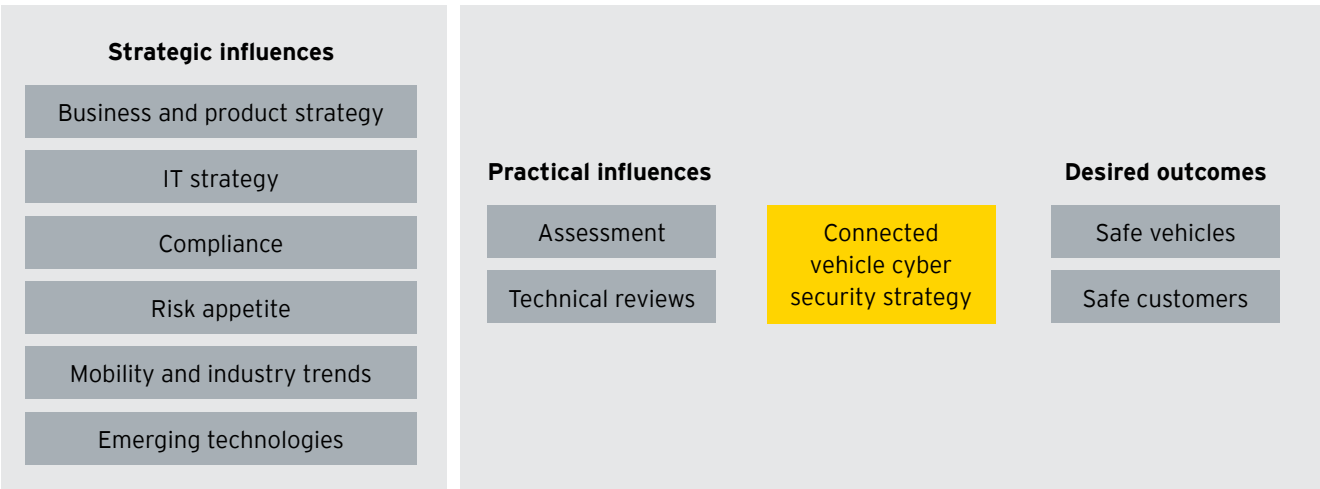


To secure the connected car, cybersecurity needs to be embedded across the entire ecosystem

Our strategic partnering value

- ▶ We use knowledge to build and deploy meaningful solutions consistent with client's objectives and expectations of EY.
- ▶ Our approach is technology and partner agnostic, we leverage the best tools and team with the industry experts to deliver a complete end-to-end service.
- ▶ The depth and breadth of our firm allows us to tap into globally renowned subject matter resources and industry leading methodologies.
- ▶ EY is known and respected for the depth and breadth of our cybersecurity practice.
- ▶ We are the market leaders in building, operating, and sustaining cyber security.
- ▶ Our approach is founded in a firm repeatable process that is capable of flexing with the unique needs of connected vehicle.

A robust connected vehicle cyber security strategy

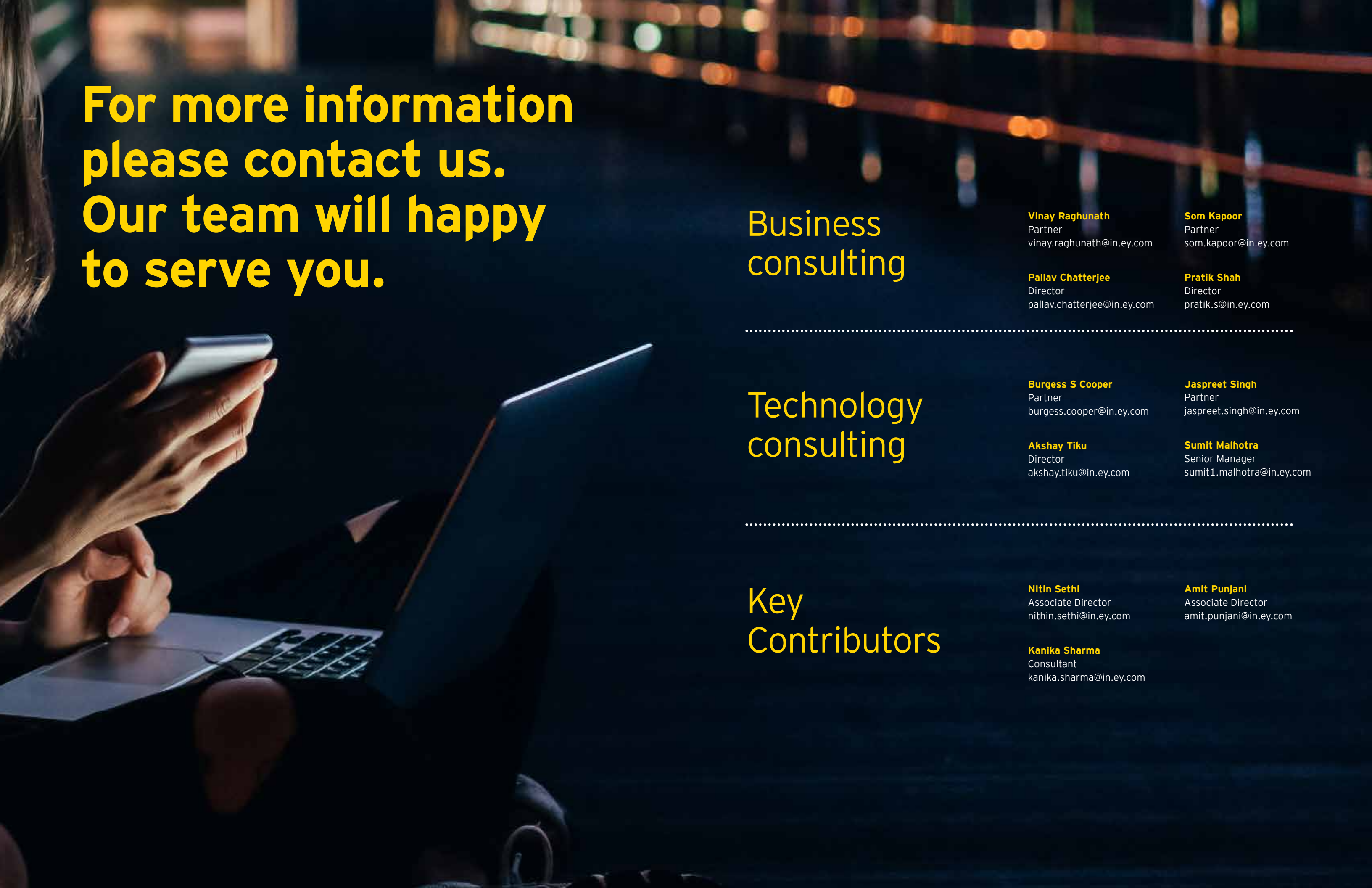


EY's vehicle ecosystems: cyber security and privacy framework

Connected car: how we see it!



EY's vehicle ecosystems: cyber security and privacy framework



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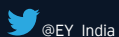
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