PTOLEMUS
Consulting Group

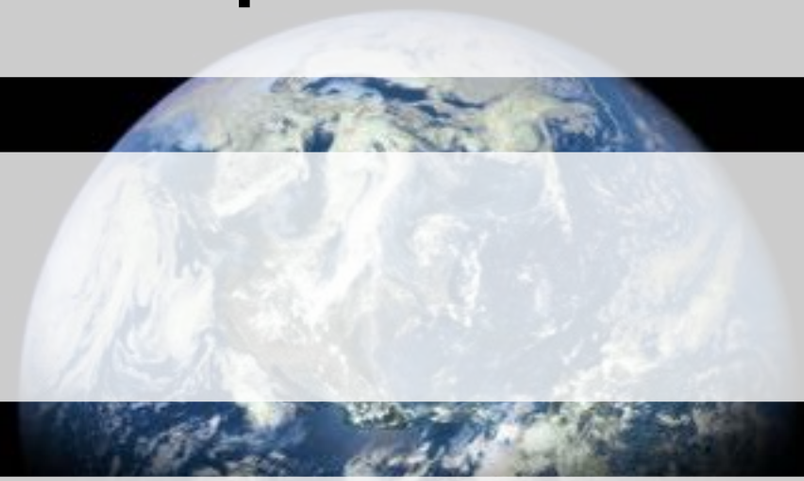
CONNECTED VEHICLE PAYMENTS
Global Study

FREE ABSTRACT

The first investigation of the global v-commerce market

The future of in-vehicle payments for goods & services to 2030

Connected Vehicle Payments Global Study - Free abstract



The first strategy consulting & research firm entirely focused on augmented mobility & automation

Strategy consulting services

- **Strategy definition**
- **Investment assistance**
- **Procurement strategy**
- **Innovation management**
- **Business development**
- **Project management**

Market research services

- **Off-the-shelf reports**
- **Subscription services**
- **Custom market research**

Fields of expertise

Mobility services	Car pooling Car sharing MAAS	Micro-mobility Ride hailing Shared mobility	Smart parking Tax refund
Vehicle services	bCall eCall FMS SVT / SVR	Tracking VRM In-car Wi-Fi Parking	Navigation Speed cameras Traffic information
New energies	BEV EV charging Fuel cards	Fuel cells Hydrogen	PHEV Vehicle-to-grid
Usage-based charging	Car As A Service Electronic Toll Collection	Mobility-as-a-Service Road charging	UBI / PAYD Vehicle rental Vehicle leasing
Vehicle data & analytics	AI CAN-bus Crowd-sourcing Data protection	Driving behaviour OBD Predictive analytics	Remote diagnostics xFCD
Vehicle automation	ADAS Autonomous cars	Autonomous trucks	Robo-taxis Shuttles
Enabling technologies	Positioning (GNSS / WiFi / cellular) M2M / connectivity	Smartphones Sensors	Telematics devices V2X

Our clients are across the mobility ecosystem

Analytics, maps & applications providers

AAADATA · arity · BEMOBILE · CarPay · CCC Information Services Inc · Cognizant · COYOTE · Dynamic Map Platform · Google · here · ESRI · Increment P · RMS · LexisNexis · PASCO · sas · sentiance · tomtom · Towers Watson · TrueMotion · Verisk Analytics · wejo · ZENRIN

Automotive manufacturers & suppliers

AGC · Audi · BOSCH · BRIDGESTONE · Continental · Cox Automotive · DAIMLER · DELPHI · DIRECTED · Ford · GM · HARMAN · HINO · HONDA · intel · ISUZU · MICHELIN · navya · Mitsubishi Motors · NISSAN · Pioneer · Qualcomm · QOROS · RENAULT · SCANIA · Sierra Wireless · SUZUKI · Telit · TOYOTA

Telematics solution providers

Air · Airbiquity · ARKAN · arvento · Danlaw · DigiCore · Cambridge Mobile Telematics · drivefactor · drust · Eliocity · FleetComplete · Fleetmatics · GSGroup · LOJACK · MiX · OCTO · HIMEX · IMS · MiTA Systems · SafeFleet · simobil · SISTEMA · ORION · Quartix · Queclink · Scope Technology · Tantalum · VIASAT · Watchstone

Mobile telecom players

AT&T · ERICSSON · proximus · SFR · SK telecom · Sprint · Telekom Austria Group · Telefónica · verizon · vodafone

Fleet & fuel, ITS & regulators

abertis · ALD Automotive · ARAL · ARVAL · autostrade · AVIS · Axxès · bp · Brisa · CGI · DKV · Edenred · EFFIA · egis · eni · Euromaster · European Commission · ew · FLEETCOR · kapsch · mouchel · OMV · ND Nomad Digital · NORBIT · Q-Free · Reutax · Shell · SICK · SKEDGO · Sofico · TELEPASS · THALES · Toll Collect · Total · Transurban · T-Systems · VR · VITRONIC · wex · zipcar

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Insurers, aggregators & assistance providers

AAA Insurance · ADMIRAL · Agero · Axa Nissay Dowa Insurance · MS&AD Insurance Group · Allianz · Allstate · American Family Insurance · AVIVA · AXA · Baloise · carrot · covea · Crédit Agricole Assurances · Desjardins · europ assistance · Farmers Insurance · FIA · The Hartford · IAG · ICICI Lombard · intact · Inter Mutuelles Assistance · Ингосстрах · HUK · Liberty Mutual · MACIF · Matmut · MENORA · MONDIAL ASSISTANCE · Munich RE · OUT SURANCE · PROMUTUEL · RAC · RSA · smile direct · SOCIETE GENERALE · SOMPO JAPAN · Nationwide · State Farm · Swiss Re · telesure · TOKIO MARINE · youi · ZURICH

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150 consulting assignments to help our clients define their connected vehicle & mobility strategy

Defined strategic positioning in insurance telematics value chain

MICHELIN

Defined strategy & business plan of its telematics business

Aioi Nissay Dowa Insurance
MS&AD INSURANCE GROUP

Helped the insurer evaluate the impact of Autonomous Vehicles on its business

European bank-insurance group

Helped evaluate OEMs' interest for its new vehicle market place

Vehicle data hub

Helped the company define its strategy towards OEMs in North America

Vehicle data hub

Define its 5-year US fleet services strategy & go-to-market plan

Global fuel card company

Built company strategy, value proposition & go-to-market plan in fleet mobility services

Global electronic tolling supplier

Defined market entry strategy & business case of a new fleet Telematics Service Provider

Vehicle data aggregator

Evaluated the European market for fuel, ETC & tax refund services

Fuel card operator

Defined its future vehicle connected services global strategy

Global roadside assistance group

Identified & selected potential M&A targets in European connected car services

Vehicle data hub

Defined connected vehicle data strategy for innovative telematics services provision & monetisation

Vehicle data aggregator

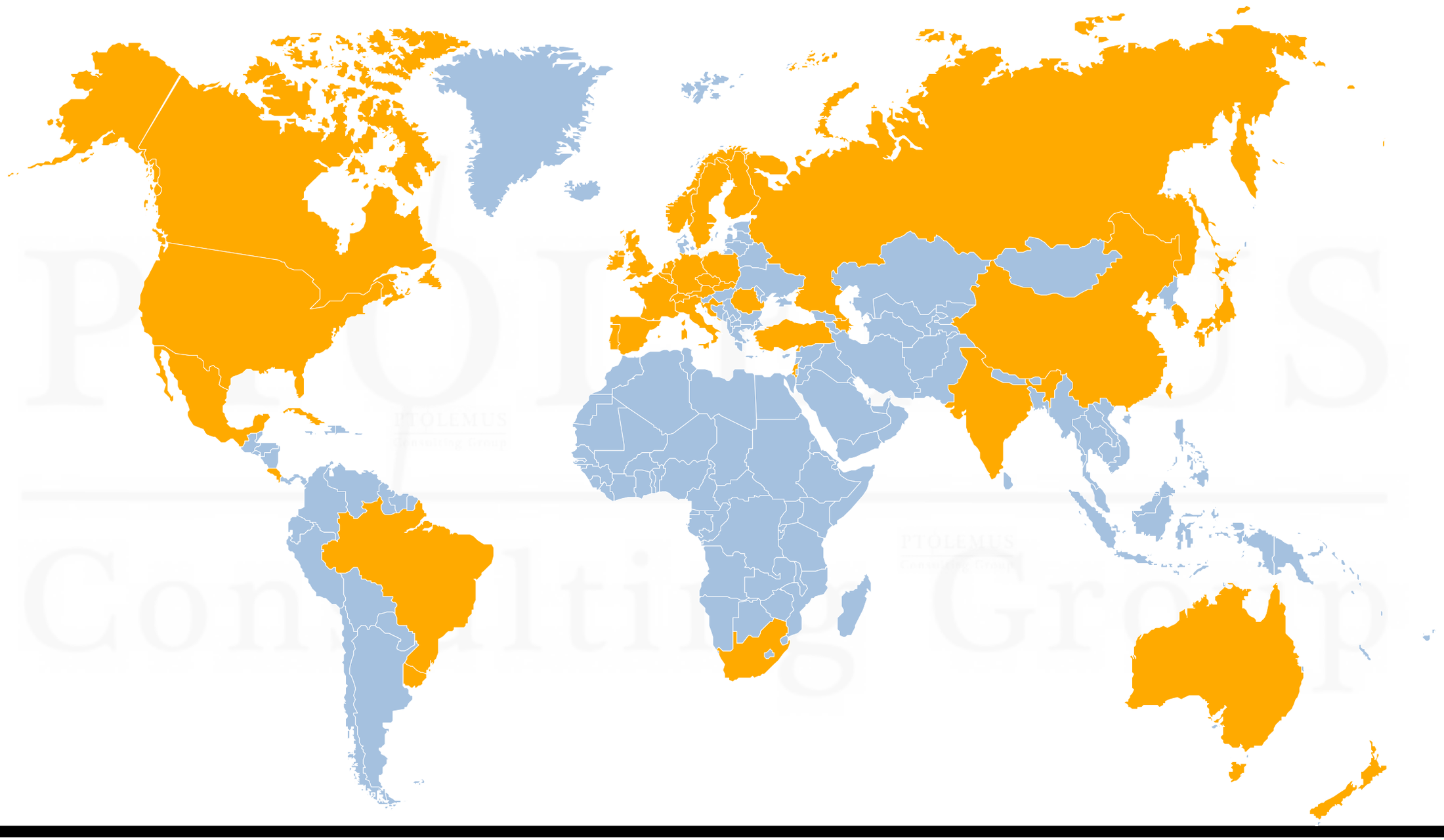
Advised on the optimal structuring of the truck tolling scheme

Ministerie van Infrastructuur en Waterstaat

Identify opportunities from connected & autonomous vehicles for the space sector

Space agency

Our team of 25 consultants, experts & researchers with 15 nationalities serves our clients worldwide



PTOLEMUS can help your organisation define and achieve its vehicle payments strategy in fast moving times

- **Strategy definition**
  - Shaping of future vision in vehicle payments
  - Strategic plan
  - Impact of connected car payments on the business
  - Go-to-market plan
  - Board coaching
  - Strategy orientation workshops
- **Investment assistance**
  - M&A strategy
  - Commercial due diligence
  - Technology due diligence
  - Feasibility studies
  - Vertical market sizing
  - Business case development
  - Cost benefit analyses
  - Post-merger integration
- **Innovation strategy**
  - Definition of CVP platform
  - Product definition
  - Consent management system definition
  - Data analytics strategy
  - Business model definition
  - Pricing strategy
- **Innovation delivery**
  - Proof of concept design & launch
  - Architecture definition
  - Project management
- **Procurement**
  - VDH sourcing strategy
  - Data sourcing strategy
  - Specifications
  - Supplier selection
  - Assistance to tender definition
- **Partnership strategy**
  - Partnership strategy definition
  - Assistance to tender response

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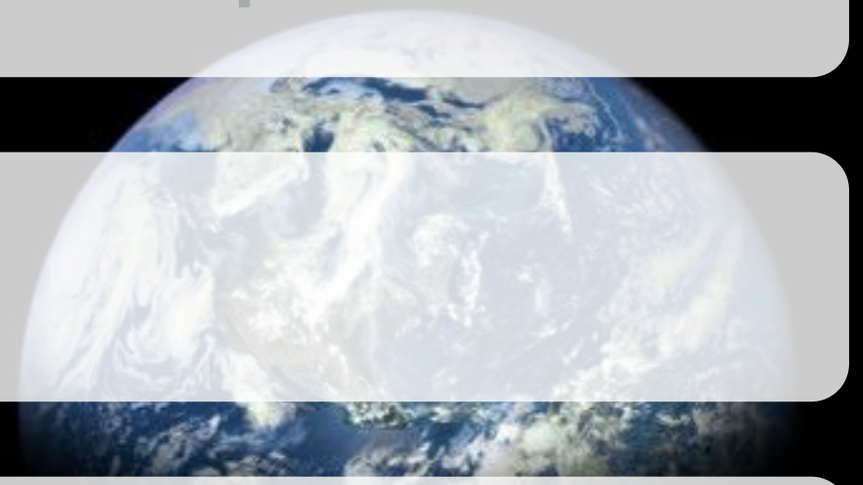

Table of contents

This study is the first in-depth assessment and forecast of the connected vehicle payments market

All the facts, numbers and analysis…

275 pages on the connected car payments market, leveraging:

- The **Vehicle Data Market Global Study**
- The **Global Mobility Roadbook**
- **6 months** of research
- **Over 150 consulting assignments** in mobility and connected car services

The report brings:

- **An in-depth assessment of the connected car payments market today and the benefits it generates**
  - An analysis of **17 OEM** strategies worldwide
  - **32 case studies** of connected vehicle payments pilots & programmes, featuring OEM-led, non-OEM-led and aftermarket programmes
- **An analysis of enabling technologies and user interfaces for car payment programmes**
  - Pros and cons of different consumer-facing **payment interfaces**
  - **Voice assistants**
  - **Connectivity** technology
  - **Payment** technology
  - **Connected vehicle payments architecture**
  - **System integrity and security requirements**
- **An investigation of the tech giants' increasing presence in the sphere, such as with:**
  - **Amazon's Alexa** and **Amazon Pay**
  - **Google's Google Assistant** and **Google Pay**
  - **Alibaba's Tmall Genie (天猫精灵)** and **AliPay (支付宝)**
- **An evaluation of the future direction of connected car payments**
  - Impact of important **trends**
  - **Geographic** and **cultural differences**
  - **Key takeaways**
- **2020 - 2030 market forecasts, integrating the impact of the COVID pandemic**
  - For **18 geographical markets**
  - In **10 vertical markets**
    - ✓ Fuel
    - ✓ Electric vehicle charging
    - ✓ Electronic tolling
    - ✓ Parking
    - ✓ Ferry & bridge access
    - ✓ Food & beverage
    - ✓ Grocery
    - ✓ Entertainment
    - ✓ Roadside assistance
    - ✓ Repair & maintenance

The report tackles numerous strategic questions

What are the different models of connected payment platforms?

What is driving connected car payments?

How can security and integrity be addressed?

What benefits will they bring to customers?

What is the business model for OEMs?

How will user interfaces engage customers?

Who are the most advanced OEMs?

Who will control the data?

What is/will be the market size?

What will be the largest vertical markets'?

What pilots are on the market now?

The report was written by a diverse team of international experts

Frederic Bruneteau

Managing Director, Brussels

The **founder** of PTOLEMUS, Frederic has accumulated **25 years of experience of the mobility and transport domains** and 15 years of strategic and financial advisory.

He has become **one of the world's foremost experts of connected car services & automation** and is interviewed on the subject by publications such as the *Financial Times*, *Forbes*, the *Wall Street Journal* and *The Economist*. He has also spoken at over 40 conferences on the subject.

He has led over 140 consulting projects and helped many world leaders define their strategy and implement it.

Clients he has served include AAA Data, Abertis, AGC Automotive, Allianz, AXA, BP, Bridgestone, Brisa, Cihon, CNH Industrial, Danlaw, DMP, Europ Assistance, the European Commission, Ferrovial, HERE, Kapsch, Michelin, the Netherlands' Ministry of Transport, Octo Telematics, Michelin, OMV, Pioneer, Qualcomm, Scania, Skytoll, Société Générale, Telit, TomTom, Toyota, T-Systems / Satellic, wejo and WEX.

Frederic led the research for over 15 reports including the **Global Mobility Roadbook** and the **Vehicle Data market Global Study**.

Frederic reviewed this report.

Andrew Jackson

Research Director, London

Andrew has 12 years of experience including 8 in the automotive and industrial sectors for companies such as Datamonitor, EurotaxGlass and JATO Dynamics.

He has delivered **advisory services, custom projects, data and insights for some of the biggest names in the automotive OEM and OES sectors**, including: BCA, Continental, CNH Industrial, Delphi, Johnson Controls, Hyundai, LeasePlan, Mannheim, Mercedes Benz, Mobis, Philips Automotive Lighting, PSA, SEAT, Tenneco and Volkswagen.

Over the years, he has been sought to share his opinion via a variety of publications such as the *Financial Times*, the *Wall Street Journal* and *Automotive Industries, AMonline, Fleetworld* and *Fleet News* as well as a variety of national newspapers. He is also interviewed on global automotive events by Bloomberg, CNBC and Reuters.

Andrew is a **Certified Member of the Market Research Society (CMRS).** Andrew is also a qualified Change Management Practitioner, a Certified Scrum Product Owner and Agile Business Analyst.

Andrew directed the research and entirely reviewed and contributed to the writing of this report.

Marissa Burkett

Consultant, Paris

Marissa has more than **4 years of experience** in management consulting for organisations such as Advent International, AGC Automotive, Apax Partners, Axxès, Ferrovial, GSGroup, Nationwide Insurance, the Netherlands' Department of Transport, OMV, Q-Free, Transurban, the United Nations, USAid, the US Federal Acquisition Service.

Marissa's focus at PTOLEMUS is **electronic toll collection, road user charging, and payments.** She also contributed to the update of our **Electronic Toll Collection Global Study**.

Marissa led the research, analysis and writing of this report.

The report was written by a diverse team of international experts

Nina Neubauer

Business Analyst, Brussels

An urban planning and transportation engineering graduate, Nina has developed expertise in **Autonomous Vehicles (AVs), Electronic Toll Collection, Smart Cities and connected cars** by assisting companies such as AXA Partners, Bain Capital, Advent International, Baumarc Project and Vodasun Energie.

She has completed several research projects related to **traffic management** and **automation** for the AVL Motor Test Center AB in Gothenburg and within the TU Munich.

For a global roadside assistance operator, she helped defining a **connected car service strategy** and built a **market forecast of 7 connected car services markets** in Europe.

For a private equity firm she conducted market research on the **European electronic tolling market** regarding global business and regulatory trends.

Nina built the market forecast model for this report.

Nicole Lim

Business Analyst, Singapore

A graduate from the National University of Singapore and the Rotterdam School of Management, Nicole has helped a **leading telematics service provider** monitor and better understand the global insurance telematics market on a quarterly basis, via the **Usage-based Insurance dashboard**.

She has also assisted with research to support the digital transformation of one of the **world's leading road operators**.

Before PTOLEMUS, Nicole gained **marketing** experience in the **motorsports industry** through her double stint at Singapore GP, the race promoter of the Formula 1 Singapore Grand Prix.

She has also worked for IT department of Abbott Laboratories, where she led the project coordination of **regional Asia Pacific tech projects**, including Power BI and workflow builds.

Nicole analysed the enabling technology and user interfaces section and assisted in writing the report.

Connected vehicle payments present a €537bn commercial opportunity for OEMs, with data ownership a critical factor

- Four types of mobility payments dominate today - cash, mobile/smartphone payments, physical card payments, and device-based payments. A bulk of these mobility payments involve fuelling, electric vehicle (EV) charging, parking and road-usage charging
- However today's vehicle is at the middle of a vibrant ecosystem, with connectivity becoming a vital part of the OEM operating and business model
  - PTOLEMUS estimates that there will be around **1.7bn connected cars worldwide with connected payments enabled by 2030**
- This will **pave the way for connected vehicle payments** - payments that are **enabled by a dedicated device within the vehicle** or via **systems and software embedded in the vehicle**
- PTOLEMUS has identified **10 payment use cases, amongst which include**:
  - Fuel
  - EV charging, and
  - Road usage charging

Connectivity technology

- Understanding **V2X technology regulation** for each **region** is crucial:
  - **Regulators in the US have all but withdrawn their support for a DSRC-based V2X standard**, with the recent announcement to repurpose portions of the DSRC 5.9 GHz band of for Wi-Fi. The roll-out of C-V2X may now gain more momentum, although the **auto industry is fighting back to gain more time for both DSRC and C-V2X trials**
  - Despite the **European Commission's** (EC) initial choice of DSRC as the V2X standard, **21 EU countries have rejected the EC's plan**. The final decision by the EC will determine the V2X standard in the EU
  - **In China**, connected payment programmes favour **V2X based on cellular connectivity**; A test spectrum became available in 2018 in China and the **5.9GHz band has been allocated for LTE-V2X networks**

User interfaces

- **The customer-interaction models** that have the greatest potential for the future are:
  - In-vehicle
    - ✓ Aftermarket solution:
      - **Non-smartphone devices linked to smartphones**
    - ✓ Line-fitted solution:
      - **Non-smartphone devices linked to in-vehicle infotainment (IVI) systems**
      - **IVI systems only**
  - Out-of-vehicle
    - ✓**Companion smartphone apps complementing the in-vehicle solutions**
- Overall, PTOLEMUS believes that winning customer-interaction models will **favour interactions around the IVI system**
  - Whilst dependent on the how the IVI system is designed (i.e. whether the IVI software marketplace relates directly to tech giants' such as Google or is developed "in-house"), **OEMs have an opportunity to gain ownership of user data** and **control over merchant and customer relationships** and the **user experience**
  - OEMs are hesitant to implement 3rd-party IVI marketplaces where loss of customer data control
- It is thus expected that **OEMs will play a central role in the future connected vehicle payment value chain**

Multiple voice-enabled solutions are being integrated into IVI systems which will sit behind OEM routing technologies

Voice-enabled transactions

- **Tech giants** such as **Amazon, Google and Alibaba** are bringing their voice assistants (**Alexa**, **Google Assistant**, and **Tmall Genie**) to in-vehicle infotainment systems with multiple automotive partnerships
- A hybrid approach that **supports multiple voice assistants** (third-party and native) - will counteract the dominance of a tech giant; players such as **Cerence** offer voice routing technology, selecting the ideal voice assistant for the each task

Payment and security

- Payment technology development strategies are highly-fragmented between manufacturers, with **tokenisation and vaulting, vehicle wallets and e-wallets**, as well as **blockchain** and **cryptocurrency** all considered critical development focus areas
  - Four OEM are developing or have launched their own vehicle wallets
- **System integrity and security** involves **all aspects of the connected vehicle payment architecture**, including:
  - The connected vehicle infrastructure and V2X
  - The connected vehicle architecture
  - The IVI system architecture
  - The actual transactions

Data and regulations

- Managing the **flow**, **ownership** and **usage** of **data points** generated and **keeping abreast of regulations will be of fundamental importance** for OEMs
  - 20 OEMs have pledged to commit to the Consumer Privacy Protection Principles established by the The Alliance of Automobile Manufacturers and the Association of Global Automakers

We forecast OEMs, payment providers and third-parties will battle for control of the connected vehicle payments market

- **We analyse 17 OEMs, 6 platform providers and 6 aftermarket solution providers and their connected vehicle payments programmes and strategies**
  - **Geographic dispersion:**
    - ✓ Out of the 17 OEMs closely studied, **14 OEMs** have launched or are developing programmes in **NORAM**
    - ✓ **8 OEMs** have launched or are developing programmes in **Europe**
    - ✓ **10 OEMs** have launched or are developing programmes in **Asia**
  - **Partnerships:**
    - ✓ **7/17 OEMs** closely studied have **three or more** connected vehicle payment programme **partnerships** (partners that help develop the programmes)
    - ✓ **5/17 OEMs** closely studied are **currently partnered** with connected vehicle payment **platform providers**
  - **Technology giants:**
    - ✓ **The tech giants** are **moving swiftly into the auto market** by **partnering with OEMs** to deliver various competencies
    - ✓ Only **3/17 OEMs are not partnered** with any tech giant **globally** for connected vehicle payment features

The future of in-vehicle payments

- Across the world, several **trends** will accelerate the growth of connected vehicle payments, including:
  - **Roll-out of 5G** for V2X connectivity
  - **Expansion of tolled network** leading to an increasingly crowded market of players
  - Consumer needs surrounding **personalisation and seamless payment experiences**
  - **Voice assistants** will be the next big thing for connected vehicle payments
  - New opportunities for **data exchange and monetisation** emerge, stressing the value of incentivising consumers
- Key takeaways for connected vehicle payments players include:
  - **Geographical idiosyncrasies and cultural norms** drive the success and mode of adoption of connected vehicle payments
  - **Striking up partnerships** is a popular approach among OEMs; however it might result in the loss of control over data
- **PTOLEMUS forecast** shows that the market for **connected car payments** will reach over **€537bn** in 2030
  - The bulk of it will be fuel (€XXbn), parking (€XXbn), food & beverage (€XXbn) and repair & maintenance (€XXbn), which will represent XX% of the global connected vehicle payments markets by 2030
- **By 2030, we forecast the revenues generated for each region as such:**
  - Europe - €XXbn
  - North America - €XXbn
  - Latin America - €XXbn
  - Asia Pacific - €XXbn
  - Africa - €XXbn

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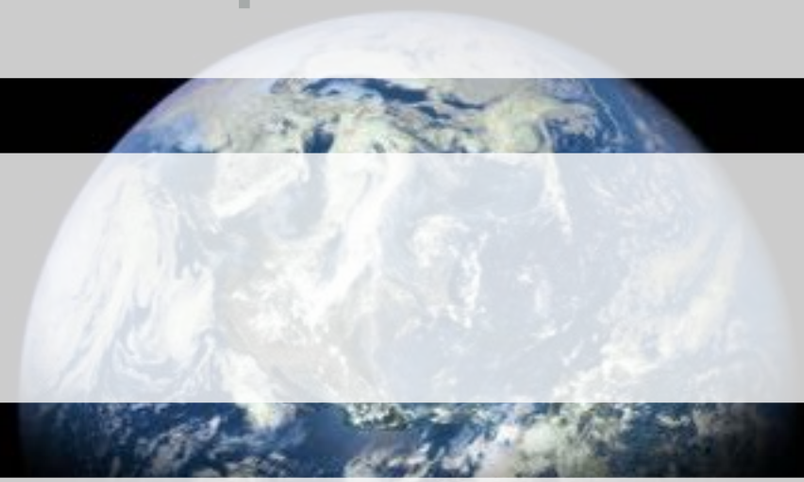
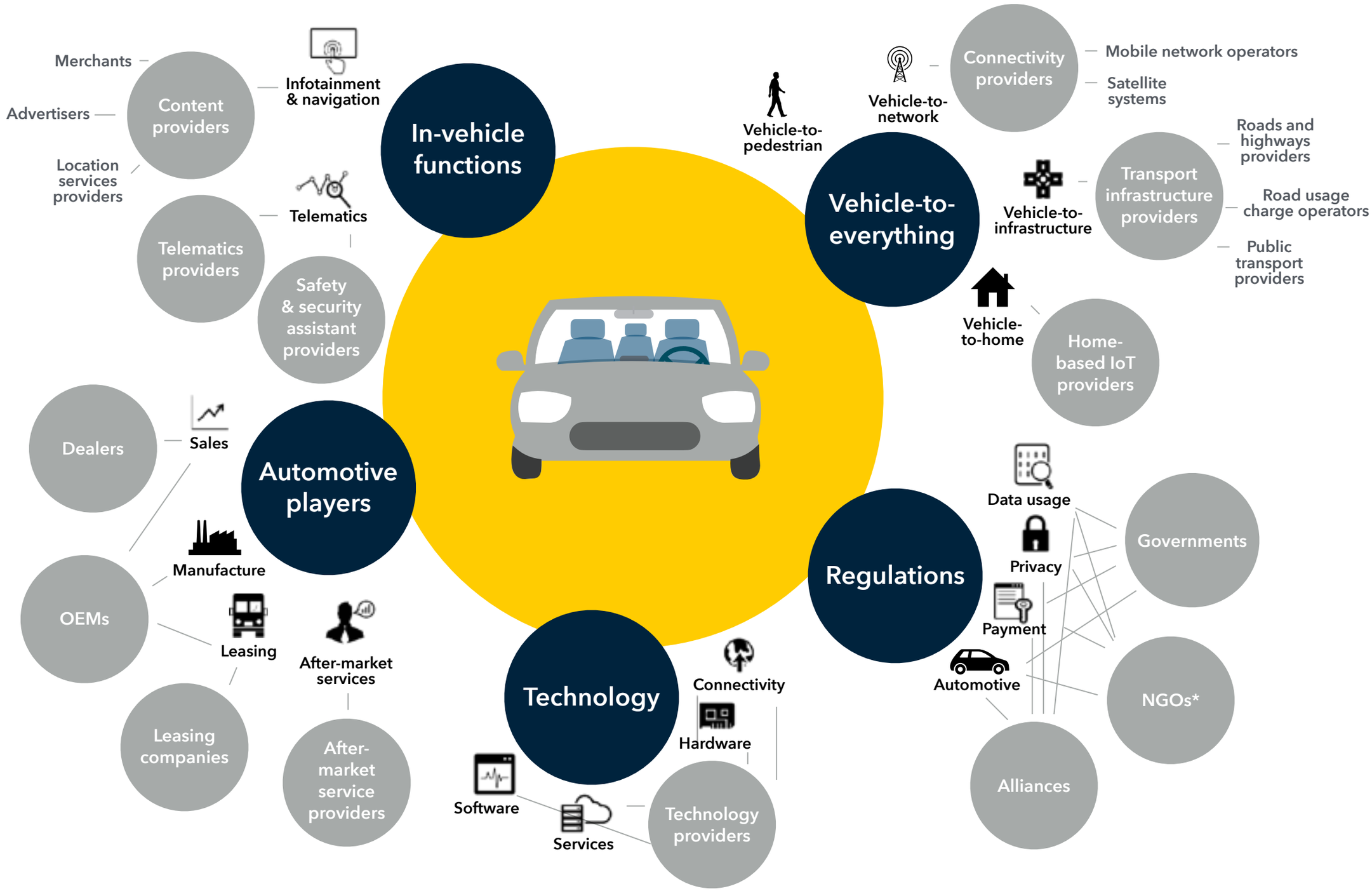
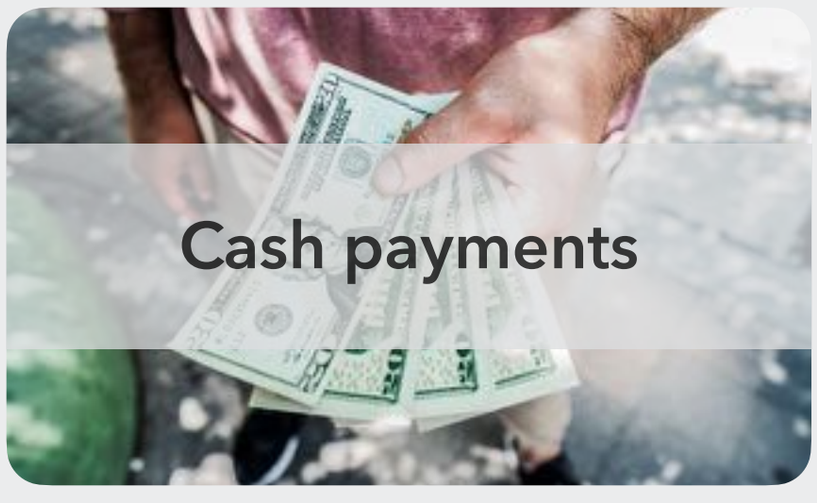


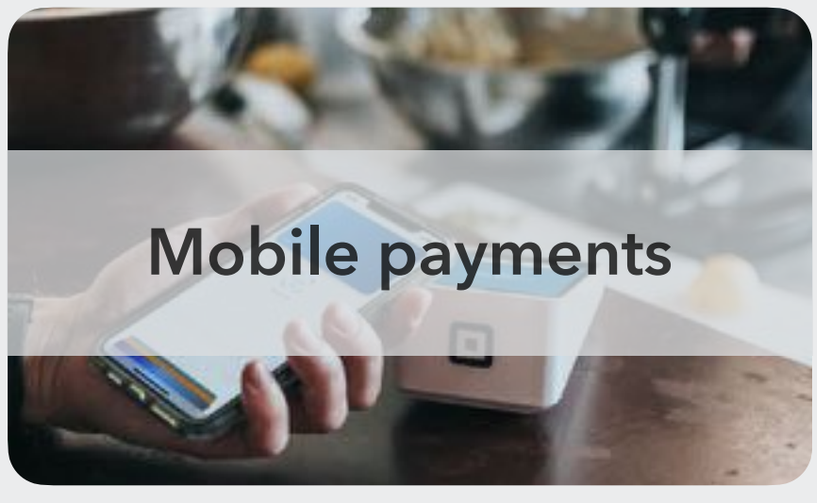
Today's vehicle is in the middle of a vibrant ecosystem

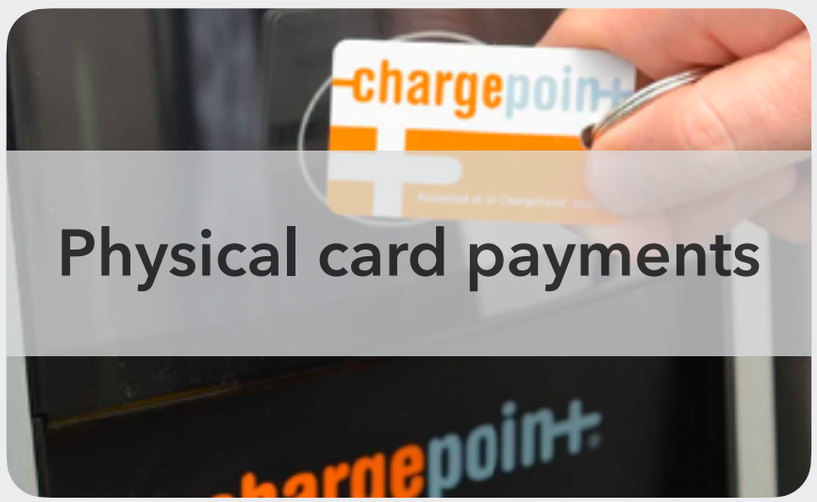


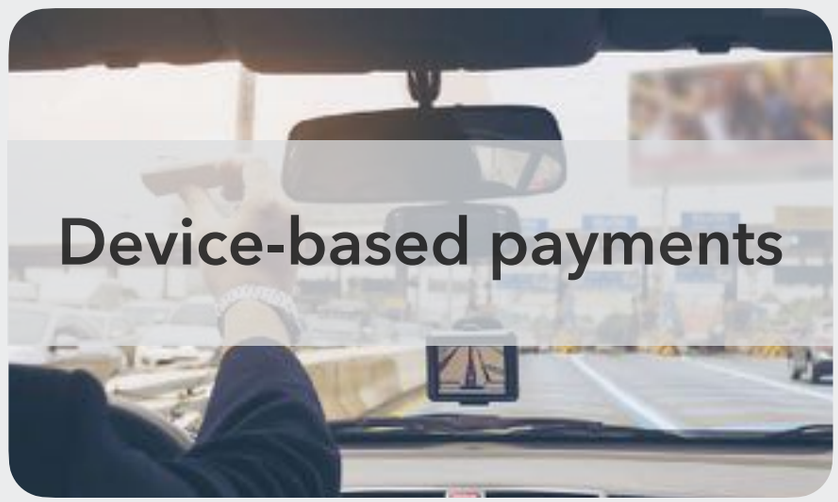
Source: PTOLEMUS; Note (*): NGOs - Non-governmental Organisations

In this ecosystem, four types of payments methods dominate the marketplace, none of which include connected vehicles



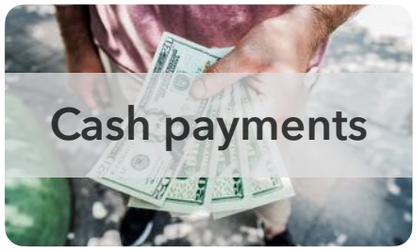
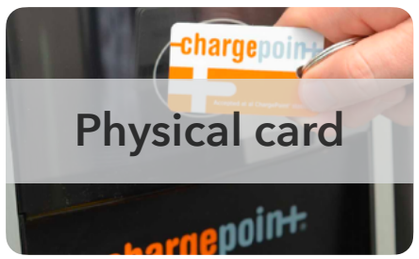
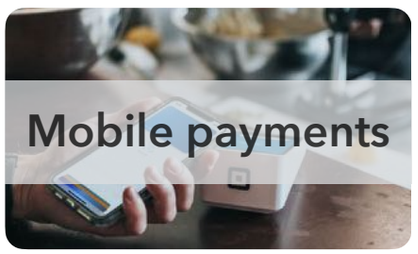
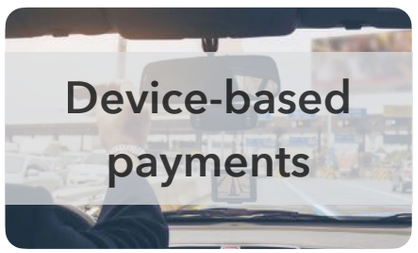






Source: PTOLEMUS

Whilst these solutions are adequate, there is the potential to better meet consumer needs using in-vehicle connectivity

	Pros	Cons
 Cash payments	• Merchants avoid paying transaction fees charged by payment network operators such as Visa and Mastercard • Consumers spend within their means	• ATM* is required for withdrawal of more cash - an added **inconvenience** for consumers in the purchase journey • **Limited amount of goods and services that one can buy using cash from within the vehicle**
 Physical card	• Safer than cash • Increases purchasing power of consumers vs being limited to the cash that they have - e.g. paying for last minute car repairs • Credit and debit cards are widely accepted; allows for multitude of transactions scenarios online	• Fuel and EV charging cards are generally used only for a specific situation • Additional card might be **inconvenient** • **Fraudulent behaviour** targeting people that pay with credit cards at the pump, stealing credit card and PIN information
 Mobile payments	• Convenience of being able to pay and manage payments with a device heavily integrated into consumers' lives • Ability to offer credit/ debit card payments, and integrate e-wallets and mobile wallets • Ability to be used in the vehicle for a wide range transactions	• **Unsafe to use while driving** - e.g. finding a parking spot with app • Could be mitigated with voice assistants but **voice commands must be specific for driving** • **Interaction with consumer is limited to when consumer opens the app for his/her specific needs** • **OEM unable to generate loyalty**
 Device-based payments	• Extremely common in toll, parking and access to tunnels, ferries and bridges • Convenience for drivers in payments already strongly linked to driving	• **Lack of visibility on the payment for the driver -** e.g. in some cases, the charge for a toll payment does not appear on the OBU** • **Lack of OEM visibility** • The OBU is normally **not used interchangeably for other scenarios** • **No over-the-air updates available**; changes require manual effort and consumer inconvenience

Source: PTOLEMUS; Note (*): ATM - Automated teller machine; Note (**): On-board Unit

The industry is now starting to move from these "traditional" payments and aftermarket devices, to embedded systems

Technologies able to deliver payment services

- Until recently, the **majority of payments have been made through traditional and manual methods such as cash or card-based payments**
- However, traditional options **are being phased out** with preferences shifting to smartphone apps and more electronic means
- **Mobile payments with smartphones are becoming common** in general; **other forms of electronic payment are also proliferating** vehicles on the road
- These options are allowing for **several types of in-vehicle payments, both embedded and in the aftermarket**
- In-vehicle apps are being developed to provide the **connected car experience** through cloud-based options

	Manual	Radio	Connected
Aftermarket	Cash  Card 	Tolling/RUC* device  	 PND** Smartphone/ Smartwatch 
Embedded	OEM system  Increasing popularity		Vehicle keys  OEM smartwatch 
	Fixed		**Portable**

Source: PTOLEMUS; Note (*): RUC - Road Usage Charge; Note (**): PND - Personal Navigation Device

The move towards connected payments started 6 years ago, though the momentum of development has recently increased

2014

The first in-vehicle pilot program appears, when Volvo teams up with EasyPark for in-car parking payments

2015

Chinese OEM SAIC Motor launches its first mass market connected car in China in 2016, developed in collaboration with Alibaba

2016

Volkswagen acquires parking space mobile payments provider PayByPhone

Shell and Jaguar launch a programme that allows drivers to pay directly at the pump with the Shell app loaded into the infotainment system

2017

Honda demonstrates its proof-of-concept for parking and fuel payments in January 2018

GM announces its connected Marketplace application in collaboration with Xevo

General Motors (GM) announces that Onstar Go will integrate payments, in partnership with Mastercard and IBM

2018

Telepass announces that all new Jeep models will include a DSRC* device, in partnership with Fiat Chrysler Automobiles (FCA)

Panasonic and Ficosa announce the development of an embedded mirror in the BMW X5 for the Japanese market

Visa and Sirius XM team up in new infotainment pilot

Audi and Gentex launch an integrated RFID** device

Alibaba Group's AutoNavi division announces a partnership with Honda in the development of connected services for drivers

Daimler launches its e-wallet, Mercedes Pay, following its 2017 acquisition of mobile payments company PayCash

2019

FCA releases its in-vehicle commerce platform, Uconnect Market, for its infotainment system, featuring with Shell fuel payments

Daimler announces its TruckWallet platform technology for payments and other applications

Source: PTOLEMUS; Note (*): DSRC - Dedicated Short-range Communications; Note (**): RFID - Radio Frequency Identification

Connected vehicle payments can be made using dedicated in-vehicle hardware and devices, or via embedded apps

Connected vehicle payments are payments made with a device that is inside the vehicle (excluding standalone smartphone apps) **or within an app or functionality that is loaded into the vehicle**.

They can occur while the vehicle is in-motion, such as toll payment, or not-in motion, such as fuel payment.

Connected car payments overview

- **New technology** is driving the switch to electronic payments from manual payments
- **There are several advancements in technology that are spurring the growth and development of connected vehicle payments including:**
  - Connectivity technology
  - Payment technology
  - Interface advancements
  - Security
  - Data and storage
- **We have identified 10 use cases for connected car payments in 4 main categories:**

✳ **Energy**
- Fuel
- EV charging

✳ **Access**
- Road user charge
- Parking
- Ferry & bridge

✳ **Commerce**
- Food & beverage
- Grocery
- Entertainment

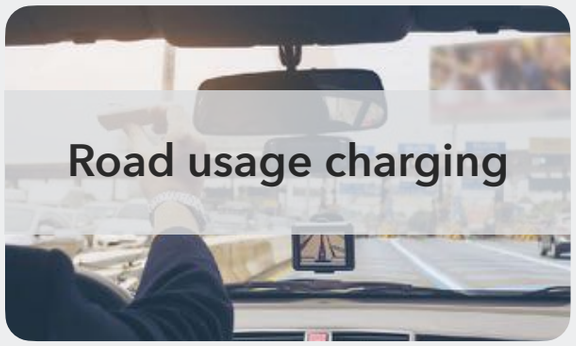
✳ **Maintenance services**
- Roadside assistance
- Repair & maintenance

Source: PTOLEMUS

The report analyses 4 major categories of payment use cases, across 10 business verticals

Energy

Access to infrastructure



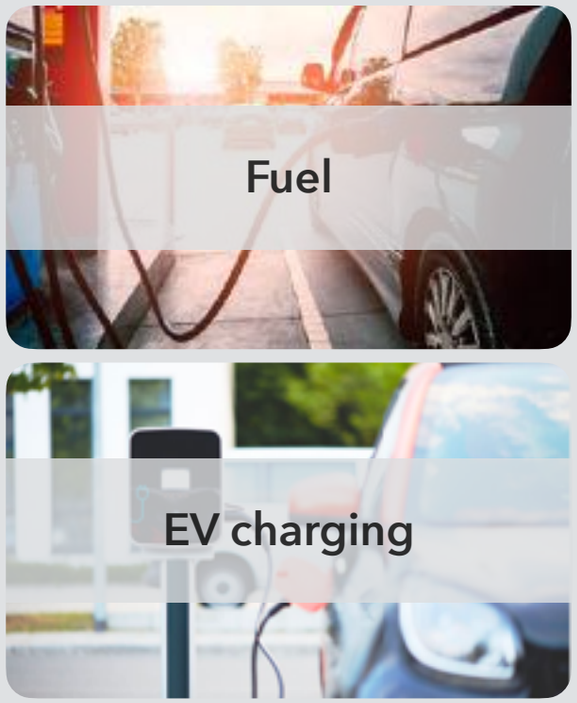
Commerce

Maintenance services

Source: PTOLEMUS

Much of the momentum in the move to connected payments is driven by the energy industry

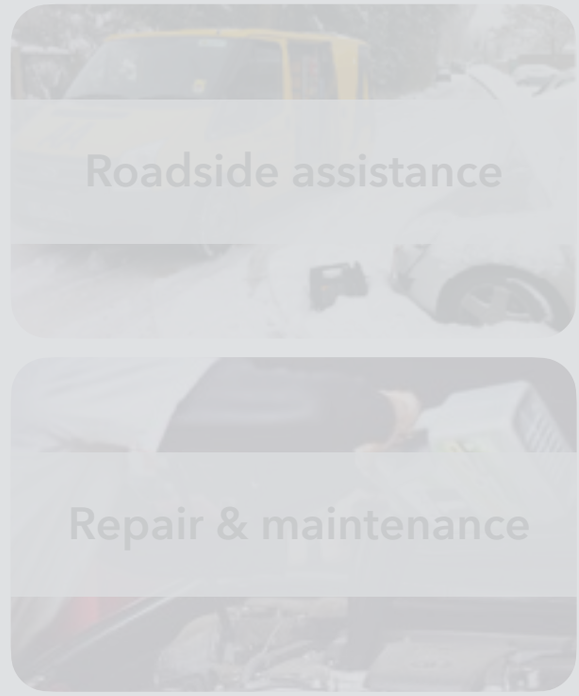
Energy



Energy

- Fuel and EV charging represent one of the largest **recurring payments and customer touch points**
- **Many connected vehicle pilots and payment programmes currently in operation focus on fuel and EV charging**
- Shell is a leading company in the development of connected vehicle payments, having developed phone-based payment apps in 2015, and is a leading figure in the energy industry as it realises the potential of accepting in-vehicle payments across its network of stations
- A key driver for energy companies involvement is the **improvement of user experience** by simplifying and automating payments in order to **gain brand loyalty and customer satisfaction**

Maintenance services



EXAMPLE: EV charging is a complex process, with many data links, the use of in-vehicle payments aims to simplify the process

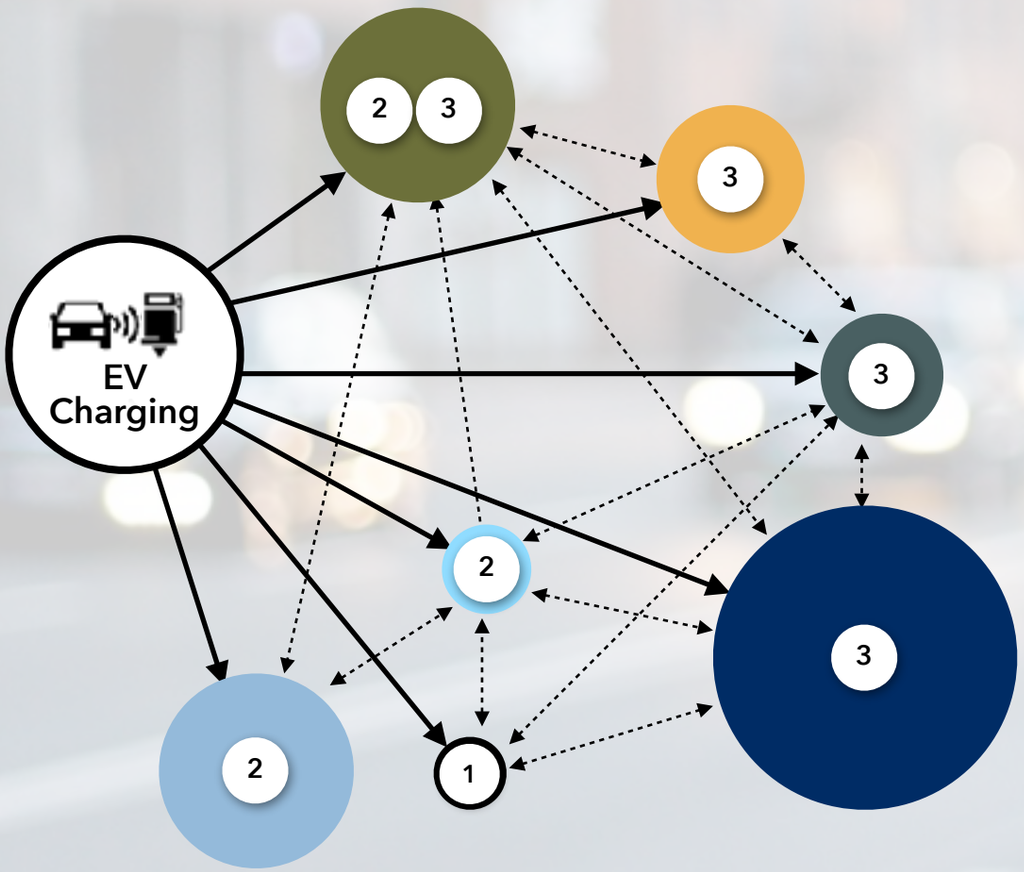
Future model: Electric vehicle charging

Static data
- Driver data
- Vehicle data
- Payment data

Dynamic data
- Contextual data
- Payment transaction data
- Vehicle health data
- Driving data

Data generated by the service →

Data links ⇠⇢



1 Charging station detection

- The **vehicle's health data** such as battery level can potentially communicate with the vehicle's **driving data**, such as destination address and current location. This would allow the vehicle to determine whether an additional charge is required to reach the destination, and which are the charging stations available in the route
- The vehicle's GNSS would navigate the car to the chosen charging station

2 Vehicle detection

- The charging station communicates with the vehicle via enabling technologies such as **DSRC or bluetooth**
- The charging station receives **vehicle data** such as vehicle ID and **vehicle health data**, such as the battery level
- The charging station either receives **driving data** such as destination address, to be able to assist in calculations for the required charge, or the vehicle itself will calculate the required charge without sharing the destination address

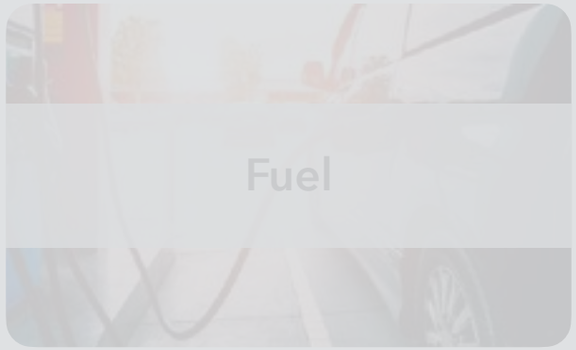
3 Payment

- Payment is made with **payment data** via the vehicle wallet. Authentication can involve **driver data** such as biometric information or **vehicle data** such as vehicle ID. **Payment transaction data** along with **contextual data** is automatically recorded
  - An example is Daimler's successful trial of autonomous payment at electric charging stations - more details on Slide 192

Source: PTOLEMUS, Daimler

As a pioneer of in-vehicle payments, infrastructure providers are involved with connected-vehicle pilot programmes

Energy



Access to infrastructure

Access to infrastructure

- Access to infrastructure refers to all direct charges levied to **gain access to a road, parking garage/spot, ferries, and bridges**
- As with energy, access to infrastructure and making associated payments for the use of infrastructure is a cornerstone in the global transport
- The earliest examples of electronic toll collection date back to 1986 (Bergen, Norway) and have increasingly been implemented across the globe ever since
- Thus many of the **existing alternatives to cash payments have originated from this category** - such as DSRC- and RFID-based aftermarket transponders, installed in vehicles to pay for tolls and pay for the right to enter and park in a designated location
- Yet the **increased visibility and insight into payments for drivers and fleet managers** and **more dynamic charging and pricing for road usage charging (RUC) by road operators and governments** are some benefits of embedded vehicle payments

Entertainment

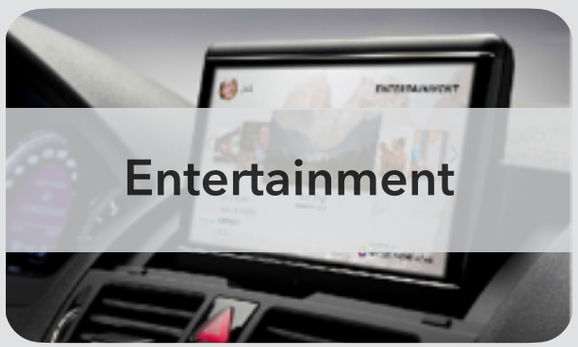
Source: PTOLEMUS

Commerce is seen as a growth sector and is being explored by companies looking for realistic commercial use cases

Commerce

- Commerce includes the purchase of consumer goods, services and content, including but not limited to food and beverage, grocery items, video content, movie tickets and the trunk delivery of goods
- Compared to other situations closely linked to the functioning of a vehicle (fuel, parking), this is **mainly an untapped space for connected vehicle payments****
- As one of the uses of vehicles is to transport people to and from establishments as part of the process of purchasing these goods or enjoying these services - e.g. driving to the grocery store or a movie theatre - there is a **potential to integrate connected payments for these scenarios**
- This **widens the scope of merchants and partners available for OEMs to work with** and **provides players with additional streams of data for better consumer targeting and retention**

Commerce*

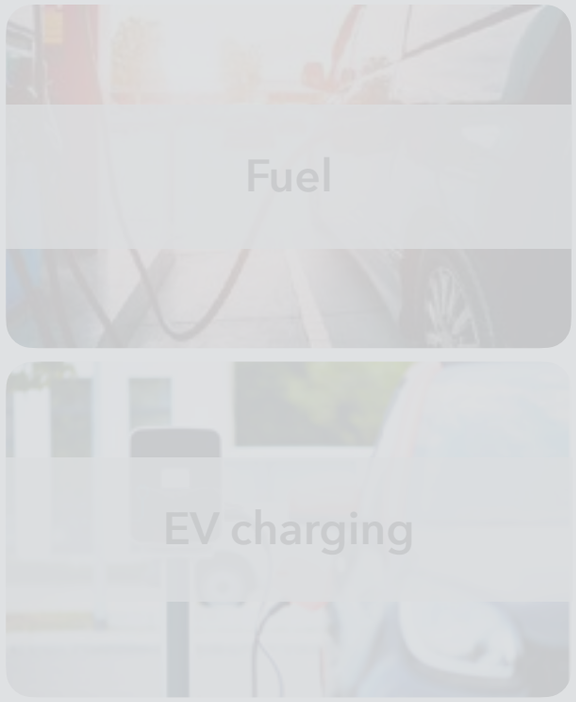


Maintenance services

Source: PTOLEMUS; Note (*): Commerce - Vehicle commerce; Note (**): Vehicles with integrated Alexa skills are expected to enable in-vehicle payment for food and beverage - however we believe that the market size of this is still relatively small

It is expected that maintenance services will be led by OEMs; connecting DTCs* with payments, for swift resolutions

Energy



Maintenance services

- Maintenance services refers to the **payment for services such as roadside assistance, vehicle repair and maintenance work or consumables** (tyres, oil, etc.)
- These services are **indispensable to the automotive industry**, with technology often already in play such as standard breakdown call and emergency call functionality and increasingly, remote diagnostics
- **Regulation is also a related hot topic**, with highly anticipated laws governing the right to repair and the access to telematic and diagnostic data set to roll out - changing the nature of the playing field
- Although almost non-existent at the current moment, there is **plenty of room for connected vehicle payments to flourish in this sphere**, supported by the growing vehicle connectivity and opening of vehicle data access

Maintenance services

Source: PTOLEMUS; Note (*): DTC - Diagnostic Trouble Codes

The report examines 17 OEMs' and 6 platform providers' strategies for the deployment of in-vehicle payments…

AUTOMOTIVE OEM

BMW
RENAULT NISSAN MITSUBISHI
FCA FIAT CHRYSLER AUTOMOBILES
JAGUAR
DAIMLER
VOLVO
GM
Tesla
Audi
VOLKSWAGEN GROUP
TOYOTA
HONDA The Power of Dreams
HYUNDAI
Ford
CHANGAN
SAIC 上汽集团 SAIC MOTOR
RIVIAN

PLATFORM PROVIDER

SiriusXM CONNECTED VEHICLE SERVICES
Xevo
ConnectedTravel
HARMAN A SAMSUNG COMPANY
SK telecom
OWIN

… and finds that OEMs are in various states of readiness, and those open to partnerships are ahead of the pack

OEMs	Use cases*									
	Fuel	EV Charging	Road usage charging	Parking	Ferry & bridge**	Food & beverage	Grocery	Entertain-ment	Roadside assistance	Repair & maintenance
BMW	✓			✓		✓		✓		
Renault Nissan Mitsubishi	✓		✓			✓				
FCA	✓			✓		✓		✓		
Jaguar	✓	✓	✓	✓	✓	✓				
Daimler	✓					✓				
Volvo	✓		✓		✓	✓	✓	✓		
GM			✓	✓	✓	✓	✓	✓		
Tesla						✓	✓	✓		
Audi	✓		✓	✓	✓	✓		✓		
Volkswagen Group	✓	✓	✓	✓	✓	✓				
Toyota	✓	✓	✓	✓	✓	✓	✓	✓		
Honda	✓		✓	✓	✓	✓	✓	✓		
Hyundai	✓	✓	✓	✓	✓	✓				
Ford	✓					✓				
Changan				✓		✓				
SAIC	✓	✓				✓				
Rivian						✓				

✓ Launched
✓ In development/ POC/Pilot

Source: PTOLEMUS; Note (*): Excludes smartphone-only programmes (not considered as connected vehicle payments)

EXAMPLE: Honda has been developing in-vehicle payments since 2016 and with Dream Drive is connecting existing cars

HONDA
The Power of Dreams

ConnectedTravel® VISA

- Honda demonstrated its **in-vehicle payments proof-of-concept for parking and fuel in January 2018**
  - This was part of its ongoing partnership with **Visa** since 2016
- In January 2019, Honda demonstrated its prototype, **Honda Dream Drive, the industry's first in-vehicle integrated driver, passenger infotainment, services and rewards and commerce dashboard**
- Honda Dream Drive expands Honda's in-vehicle payment technology concept.
  - It enables drivers to pay for goods and services such as **parking, fuel, movie tickets, make restaurant reservations and order food**
  - This was developed with connected vehicle platform and application services company, **Connected Travel**
  - **Small bluetooth beacons** at the merchant's premise near the car communicate with the car via **Bluetooth** allowing payments through a **Visa Checkout integration**
  - The system now also integrates **Mastercard** and **PayPal**

Technology

User interface

- Smartphone only
- **Smartphone-IVI system**
- Non-smartphone device - IVI system
- Non-smartphone device - smartphone
- IVI system only

We detail 18 key use-cases that are crucial for any connected vehicle payments service to achieve success

Geographies and cultures

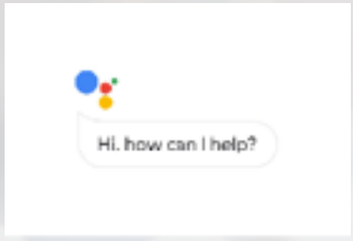


Partnerships



Voice-enabled transactions





Vehicle and e-wallets



Data collection

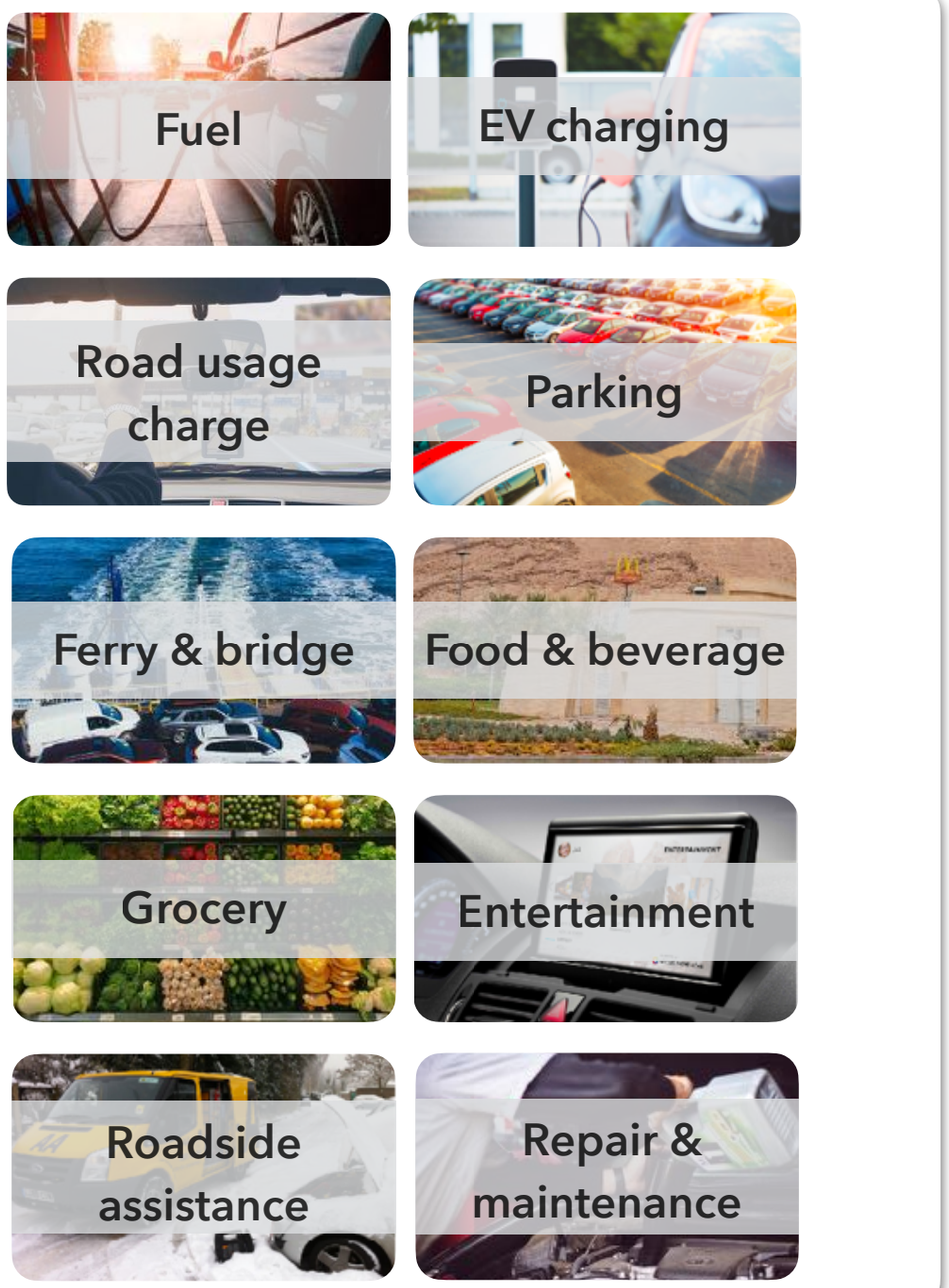


Consumer routines



Plus, we forecast the connected vehicle payments market for 10 verticals, 2 programme categories and 5 regions

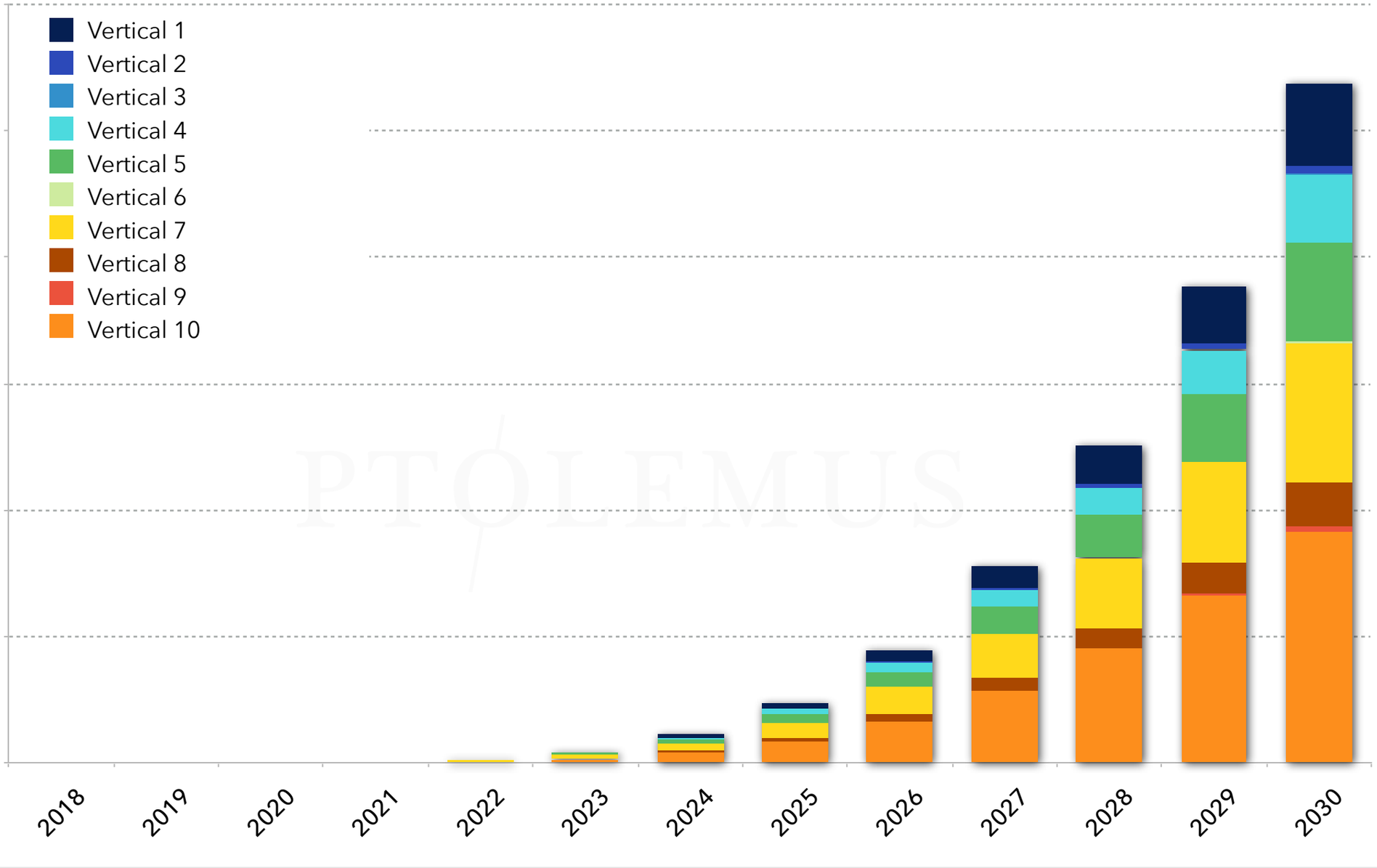
- PTOLEMUS has constructed a **bottom-up estimate and forecast of 10 verticals worldwide**
- We analyse the revenue potential for the two programme categories:
  - **Line-fitted** technology
  - **Aftermarket** devices
- We look at five regions:
  - **Europe**
  - **North America**
  - **Latin America**
  - **Asia Pacific**
  - **Africa**
- We only forecast for **passenger cars** (both personal and company cars included)
- The forecast also takes into account the effect of **COVID-19**:
  - Forecast of new passenger cars sold (registrations at the end of the year)
  - Growth rate of new passenger cars sold



Source: PTOLEMUS

We identify the verticals that will deliver the highest revenues in the €537bn connected vehicle payment market

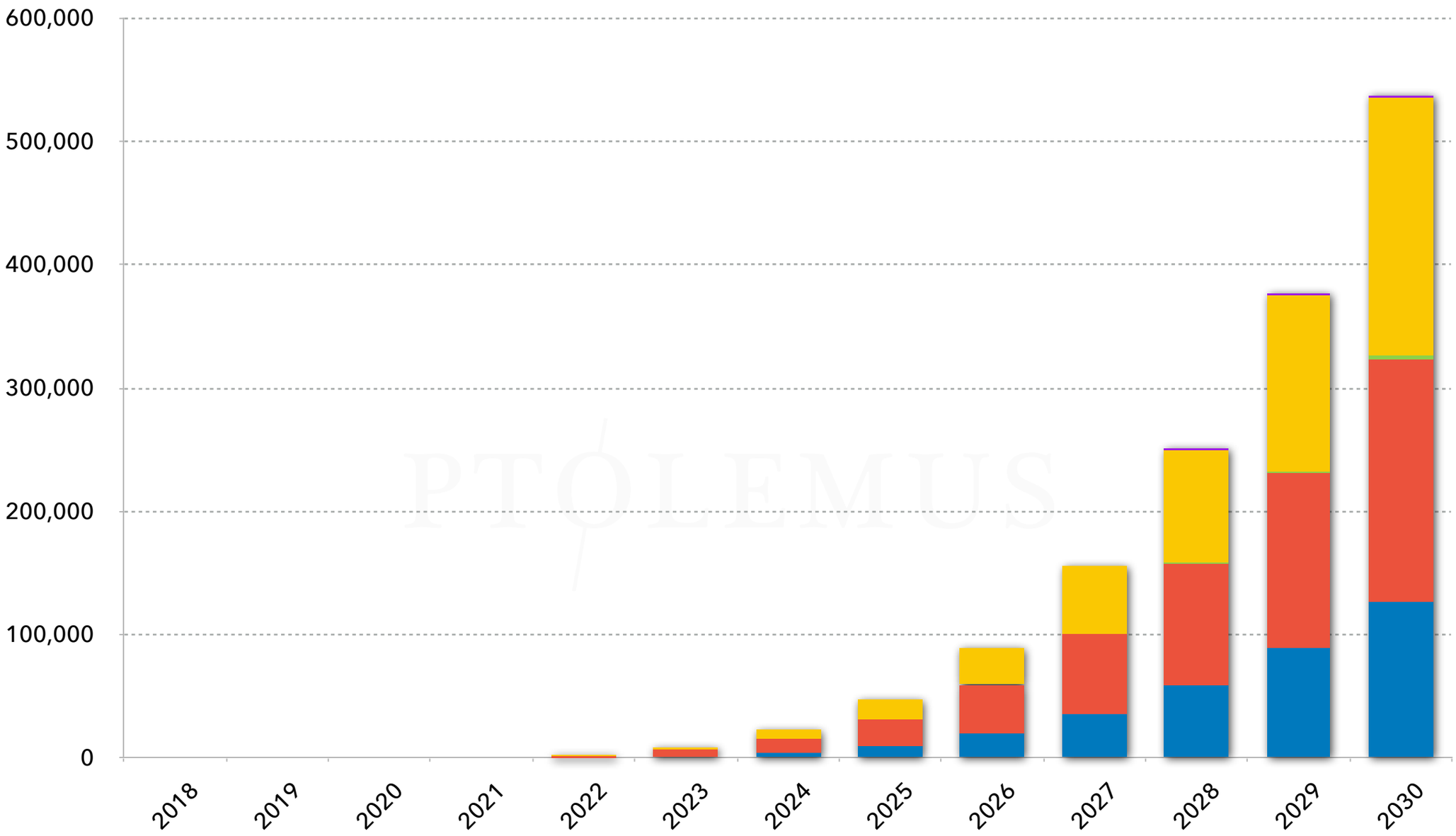
Connected vehicle payments total revenues by vertical (€mn)



Source: PTOLEMUS

We also identify which regions will grow the quickest and which will be the largest over the next 10 years to 2030

Connected vehicle payments total revenues by region (€mn)



Source: PTOLEMUS

The report mentions more than 150 companies (1/3)

Company	Country	Type
Alibaba	China	Tech giant
Alliance for Automotive Innovation	USA	Association
Allianz	Germany	Insurer
Amazon	USA	Tech giant
Apple	USA	Tech giant
Applebee's	USA	Food & beverage
AppyWay	UK	Parking solutions provider
Aral	Germany	Fuel card issuer
Arval	Italy	Leasing
Astria	Canada	Electric vehicle charging
Atlantia	Italy	Infrastructure operator
Atom Tickets	USA	Movie ticketing provider
Audi	Germany	Automotive OEM
Autonavi	China	Positioning solutions provider
Baidu	China	Tech giant
Berlio	Belarus	Fuel card issuer
BlackBerry QNX	Canada	Security solutions provider
Blink	USA	Electric vehicle charging
BMW	Germany	Automotive OEM
BP	UK	Fuel card issuer

Company	Country	Type
Braintree	USA	Payment provider
BYD Auto	China	Automotive OEM
Carrefour	France	Supermarket
Cerence	USA	Mobility AI solutions provider
Changan	China	Automotive OEM
Chargemap	Europe	Electric vehicle charging
Chargepoint	USA	Electric vehicle charging
Chery	China	Automotive OEM
Chevin	USA	Fleet management software
Chevron	USA	Energy company
Circle K	Ireland	Fuel card issuer
Comdata	USA	Fuel card issuer
Connected Travel	USA	Connected vehicle platform provider
Consumer Financial Protection Bureau	USA	Regulator
Continential	Germany	Tier 1 supplier
Conversable	USA	AI conversational platform provider
Daimler	Germany	Automotive OEM
Delphi	UK	Tier 1 supplier
DFLZ	China	Automotive OEM
Didi Chuxing	China	Mobility services

Company	Country	Type
Diners Club	USA	Payment provider
DKV	Germany	Fuel card issuer
Dunkin Donuts	USA	Food & beverage
E-ZPass	USA	Toll service provider
E.Leclerc	France	Supermarket
E100	Poland	Fuel card issuer
EasyPark	Sweden	Parking solutions provider
Electrify America	USA	Electric vehicle charging
Eni	Italy	Fuel card issuer
Esso	USA	Fuel card issuer
European Commission	Europe	Regulator
European Council	Europe	Regulator
European Diesel Card	UK	Fuel card issuer
Eurowag (EW)	Czech Republic	Fuel card issuer
EVgo	USA	Electric vehicle charging
Exxon Mobile	USA	Energy company
FasTag	USA	Toll service provider
Faurecia	France	Tier 1 supplier
Federal Communication Commission	USA	Regulator
Federal Reserve Bank	USA	Central bank

The report mentions more than 150 companies (2/3)

Company	Country	Type
Fiat Chrysler Automobile (FCA)	Italy	Automotive OEM
Ficosa	Spain	Tier 1 supplier
Fiserv	USA	Payment provider
Fleetcor	USA	Fleet service provider
Fleetio	USA	Fleet management software
FleetPride	USA	Fleet service provider
Ford	USA	Automotive OEM
GAC Group	China	Automotive OEM
GAC Technology	France	Fleet management software
Geely	China	Automotive OEM
General Motors (GM)	USA	Automotive OEM
Gentex	USA	Tier 1 supplier
Geotab	Canada	Telematics service provider
Google	USA	Tech giant
Greenlots	USA	Electric vehicle charging
Groupe PSA	France	Automotive OEM
GrubHub	USA	Food & beverage ordering/delivery platform
GS Caltex	Korea	Energy company
HARMAN	USA	Connected vehicle platform provider
Honda	Japan	Automotive OEM

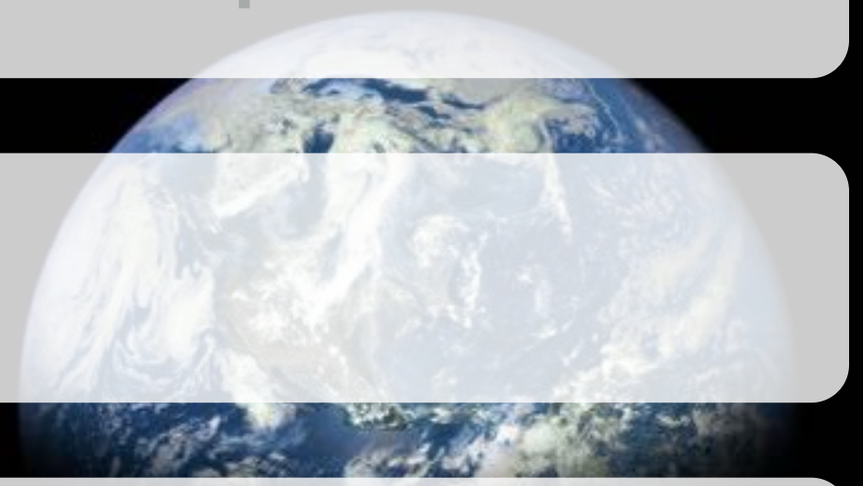
Company	Country	Type
Hubject	Germany	Electric vehicle charging
Hyundai	Korea	Automotive OEM
IBM	USA	Data hub
IHOP	USA	Food & beverage
Indra	Spain	Technology solutions provider
Ingenico	France	Payment provider
IOTA Foundation	Germany	Non-profit foundation
Jaguar	UK	Automotive OEM
Kia	Korea	Automotive OEM
Lear	USA	Tier 1 supplier
LeasePlan	Nethearlnds	Leasing
LG U+	Korea	Telco/payment gateway
Log Pay	Germany	Fuel card issuer
Mack	USA	Automotive OEM
Magneti Marelli	Italy	Tier 1 supplier
Maruti suzuki	India	Automotive OEM
Mastercard	USA	Payment provider
Mcdonald's	USA	Food & beverage
Meituan Dianping	China	Food & beverage ordering/delivery platform
Metropolitan Transportation Commission	USA	Regulator

Company	Country	Type
Microlise	UK	Telematics service provider
Microsoft	USA	Tech giant
Mitsubishi	Japan	Automotive OEM
National Development and Reform Comission	China	Regulator
National Highway Safety Board	USA	Regulator
Navistar	USA	Automotive OEM
Nissan	Japan	Automotive OEM
Olo	USA	Food & beverage ordering/delivery platform
OMV	Austria	Fuel card issuer
OpConnect	USA	Electric vehicle charging
OWiN	Korea	Connected vehicle platform provider
P97	USA	Mobile commerce solutions provider
Panasonic	Japan	Tier 1 supplier
ParkMobile	USA	Parking solutions provider
ParkNow	Germany	Parking solutions provider
PayByCar	USA	Connected vehicle payments solution provider
PayByPhone	Canada	Parking solutions provider
PayPal	USA	Payment provider
Paytollo	USA	Toll service provider
Pimlico Plumbers	UK	Plumbing company

The report mentions more than 150 companies (3/3)

Company	Country	Type
PlugShare	USA	Electric vehicle charging
Renault	France	Automotive OEM
Renault Samsung Motors	Korea	Automotive OEM
RESSA Europa	Spain	Fuel card issuer
Rivian	USA	Automotive OEM
Ryd	Germany	Connected vehicle payments solution provider
SAIC Motor	China	Automotive OEM
Samsung	Korea	Tech giant
Scania	Sweden	Automotive OEM
SemaConnect	USA	Electric vehicle charging
Share Now (car2go/ DriveNow)	Germany	Mobility services
Shell	Netherlands	Fuel card issuer
Shinhan Card	Korea	Payment provider
Siemens	Germany	Tier 1 supplier
Sionic Mobile	USA	Connected commerce technology provider
Sirius XM	USA	Connected vehicle platform provider
Spot Hero	USA	Parking solutions provider
Starbucks	USA	Food & beverage
StateFarm	USA	Insurer
Sun Art Retail Group	China	Hypermarket
T Systems	Germany	Connectivity solutions provider
TATA Motors	India	Automotive OEM
Telenor	Norway	Telco
Telepass	Italy	Toll operator
Telia	Sweden	Telco
Tencent	China	Tech giant
Tesla	USA	Automotive OEM
Tmall	China	E-commerce
Toll4Europe	Germany	Toll service provider
TomTom Telematics	Netherlands	Telematics service provider
Total (AS 24)	France	Fuel card issuer
Toyota	Japan	Automotive OEM
TransCore	USA	Toll service provider
TxTag	USA	Toll operator
US Treasury Department	USA	Regulator
UTA	Germany	Fuel card issuer
Valeo	France	Tier 1 supplier
Verdeva	USA	Connected vehicle payments solution provider
Verisk Analytics	USA	Analytics company
Verizon	USA	Telematics service provider
Visa	USA	Payment provider
Volkswagen	Germany	Automotive OEM
Volta	USA	Electric vehicle charging
Volvo	Sweden	Automotive OEM
Wex	USA	Fleet service provider
Wex	USA	Fuel card issuer
Worldline	France	Payment provider
Xevo	USA	Connected vehicle platform provider

Connected Vehicle Payments Global Study - Free abstract



You have only read 10% of the report and 1% of the forecasts

What you have read

What the report contains

To get your exclusive access to the full study, contact our team at

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The first global analysis of the connected vehicle payment market is now available as a single, worldwide company licence

The facts, figures and analysis… behind the hype

	Global Study	Global market forecasts
Contents	**275 pages** on the connected car payments market, leveraging: - The **Vehicle Data Market Global Study** - The **Global Mobility Roadbook** - **6 months** of research - **Over 150 consulting assignments** in mobility and connected car services • All-in-one searchable and interactive document (PDF, password-protected)	• **2020 - 2030 market forecasts, integrating the impact of the COVID pandemic** - For **18 geographical markets** - In **10 vertical markets** ✓ Fuel ✓ Electric vehicle charging ✓ Electronic tolling ✓ Parking ✓ Ferry & bridge access ✓ Food & beverage ✓ Grocery ✓ Entertainment ✓ Roadside assistance ✓ Repair & maintenance
Company-wide licence	**€ 3,495** *Approx. $4,790*	**€ 1,495** *Approx. $1,795*

To receive more information, contact our research team at CVP@ptolemus.com

Source: PTOLEMUS - Notes: * Indicative budget, to be adjusted based on actual conditions

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