

Mobility:

The Future of "Point A to Point B"



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What Do We Mean by “Mobility”?

In an era marked by rapid technological change, mobility is frequently cited as an area “ripe for disruption”.¹

However, amidst all the tech jargon and fantastic visions of the future, the meaning of mobility can often become a rather nebulous concept...

Is 2019 The Year That Robot Delivery
Takes Over The Retail World?
Forbes
Jan 23, 2019, 02:53pm

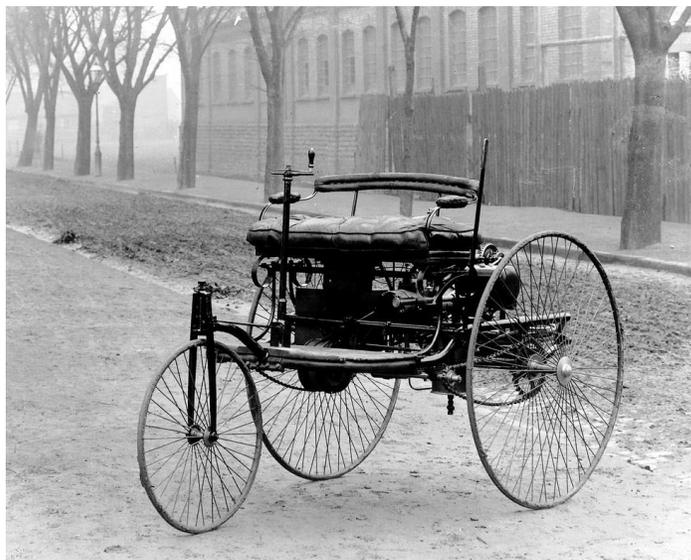
Elon Musk Predicts Tesla
Driverless Taxi Fleet Next Year
The New York Times
April 22, 2019

The End of Car Ownership
Ride sharing and self-driving vehicles will redefine our relationship with cars.
Auto makers and startups are already gearing up for the change.
THE WALL STREET JOURNAL.
June 20, 2017 10:10 pm ET

In our eyes, mobility is about the technologies that allow for the movement of people and goods more conveniently and efficiently.

Mobility: Past and Present

While mobility goes far beyond the automobile, it does a great job of showing how static paradigms in the space have been...



**Benz Patent-Motorwagen
(c. 1885)**

HOW FAR HAVE WE COME SINCE THE WORLD'S FIRST PRODUCTION AUTOMOBILE?

Both of these vehicles:

- **Run on fossil fuels.**
- **Are operated by a human driver.**
- **Cannot engage in any form of two-way communication with their environment.**

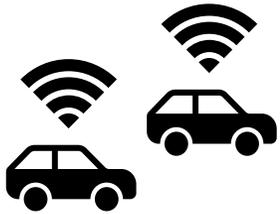


**Mercedes-Benz E-Class
(c. present day)**

While today's cars have far more creature comforts, they have a great deal in common with their earliest iteration. This, however, appears to be changing along with the face of mobility as a whole.

How is Mobility Changing?

While there are many innovations occurring in the mobility space, we feel that there are some trends of particular importance going forward:



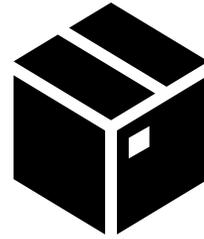
CONNECTED CARS

V2X and related technologies that will allow vehicles to more intelligently interact with their surroundings in real time.



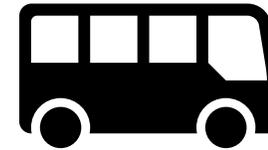
NEW POWERTRAINS

Transition from internal combustion engine (ICE) to various types of electric vehicles (EVs).



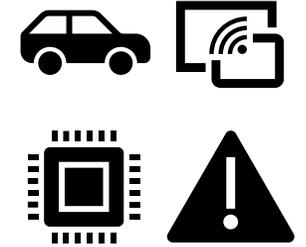
SMART(ER) LOGISTICS

Innovations which help goods move more easily- whether around the block or around the world.



PUBLIC TRANSIT v2.0

Introduction of new technologies to make mass transit smarter, more efficient and convenient.



ROAD TO AUTONOMY

Incremental innovations in driving technology, which ultimately lead to autonomous/driverless cars.

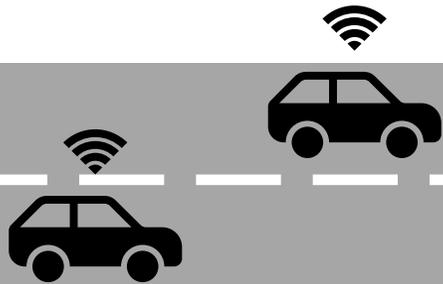
Connected Cars

On the most basic level, connected cars have existed for some time (think OnStar[®], or GPS). However, these were 1-to-1 connections with limited functionality. The connected car of the future interacts with a wider variety of interlinked systems, hence the term “vehicle-to-everything” (V2X).²

V2X Use Cases

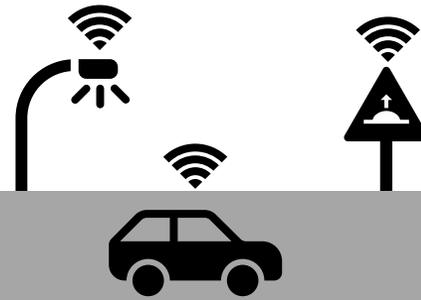
Vehicle-to-vehicle (V2V):

Vehicles can exchange information about their speed, location and heading, helping to avoid crashes, even when unseen (around a corner for example).



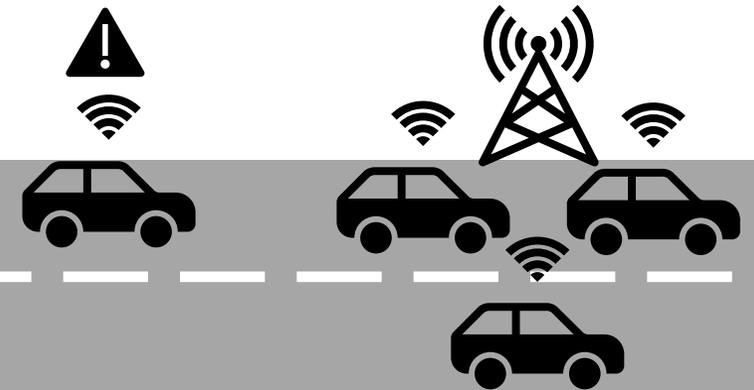
Vehicle-to-infrastructure (V2I):

Vehicles can communicate with infrastructure components such as lane markings, road signs, and traffic lights.



Vehicle-to-network (V2N):

Vehicles can receive alerts regarding accidents ahead or warnings of congestion on their planned route.



What Makes V2X a Reality?

In order for V2X's full potential to be realized, we feel it will require the coordination of telecommunication and transport infrastructure, as well as the involvement of automotive suppliers and chipmakers.

TRANSPORT INFRASTRUCTURE

kapsch >>>

INRIX

NXP



SAVARI®

swarco

Panasonic

LEAR CORPORATION

TELECOMMUNICATION INFRASTRUCTURE

ERICSSON

SKYWORKS®



Cohda Wireless

NOKIA

CHIPMAKERS

Qualcomm

Autotalks

NXP

SIERRA WIRELESS™

ST
life.augmented

AUTOMOTIVE SUPPLIERS



BOSCH

DENSO
Crafting the Core

Continental



LG Innotek

LEAR CORPORATION

TE
connectivity

• APTIV •

FICOSA

Company Profile: Qualcomm Inc.



Qualcomm is a leading provider of semiconductors and telecommunications equipment, probably best known for its role in powering cellular networks and the devices that use them. Less recognized however, is Qualcomm's product suite in the mobility space.³

Role in Connected Cars³:

- Qualcomm's 9150 C-V2X Chipset offers both automotive suppliers and roadside infrastructure providers improved capabilities for making V2X a reality.
- This chipset has been designed to be compatible with the competing standards and systems being used in various V2X trials and rollouts around the world.
- Given this flexibility, Qualcomm has managed to build itself a leading position in the nascent connected cars space.

Company Profile: Kapsch TrafficCom AG



Kapsch is one of the leading providers of electronic toll collection systems, and the only truly global player in the space. With the E-ZPass Group and Transport for London (TfL) among its best-known clients, Kapsch's solutions are used every day by drivers around the world. ⁴

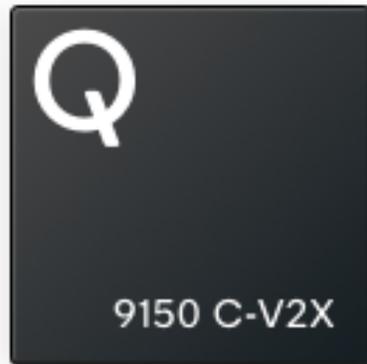
Role in Connected Cars⁴:

- While tolling systems currently represent the majority of Kapsch's business, the company has a clear eye on the future, as evidenced by the growth of its Intelligent Mobility Solutions (IMS) division.
- IMS has a wide variety of offerings, ranging from traffic management systems to smart urban mobility to V2X technology.
- Within V2X, Kapsch can offer end-to-end solutions to implement these systems, from software to hardware, whether it is roadside or in the vehicle.

Case Study: V2X Trials in Colorado

Since 2017, the Colorado Department of Transportation (CDOT), has worked with several companies to test V2X solutions on small portions of its highways. CDOT is now seeking to expand the program to a major portion of the I-70 Mountain Corridor, with the ultimate goal being to launch a statewide V2X system in the coming years.⁵

Qualcomm



Qualcomm's chipsets powers many V2X roadside units (RSUs)...

kapsch >>>



...including those offered by Kapsch TrafficCom.

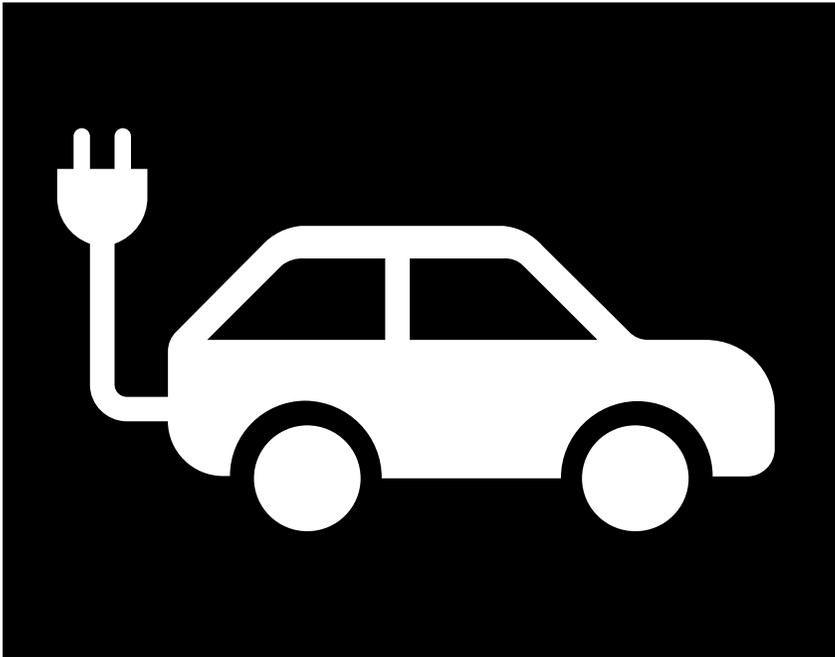


Both Qualcomm and Kapsch count among the partners involved in the CDOT project.

New Powertrains

Though the internal combustion engine has been central to mobility for over a century, it is clearly beginning to cede this dominant position to electric powertrains of various types.⁶

While typically framed in an environmental context, governments, corporations and consumers are beginning to recognize other major benefits of the switch to EVs:



REDUCED COMPLEXITY

On average, ICE vehicles have 2,000+ moving parts, while EVs have 20. This means fewer mechanical failures and lower maintenance costs. No oil changes or belt replacements are necessary.⁷

IMPROVED PERFORMANCE

EVs don't require gear shifts and can accelerate quickly. At the same time, electric batteries tend to be below the floorboard of the vehicle, creating a low center of gravity that results in better handling.⁸

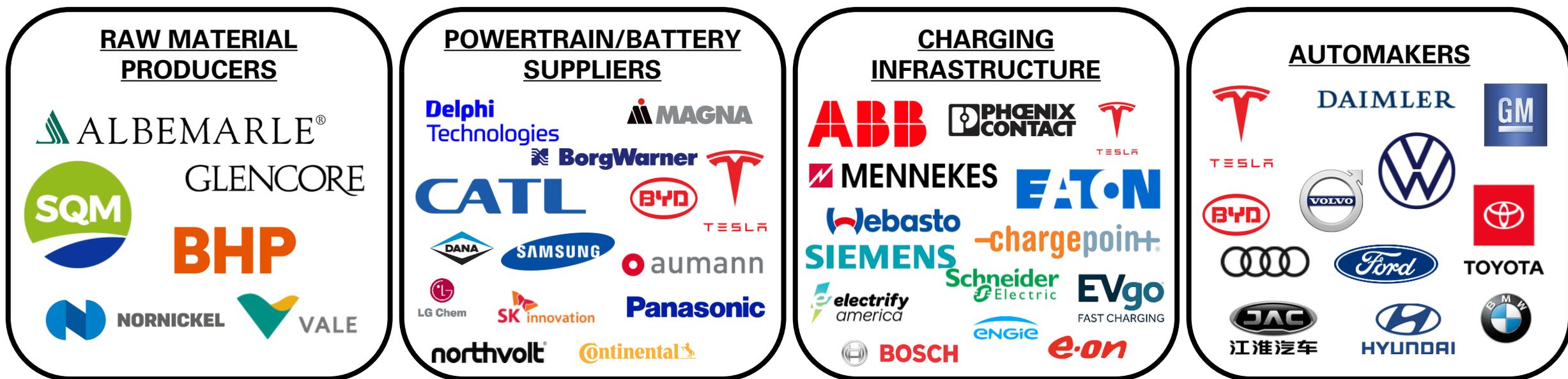
INCREASED COMFORT

EVs produce far less noise, and little to no vibration when running, making for a smoother ride. Their powertrains take up less space in a vehicle, allowing more room for storage space and wider crumple zones.⁷

Who Is Leading the Transition to EVs?

The pace of change from ICEs to electric powertrains seems to be accelerating, with rising adoption in both the developed and emerging world. This appears to be the result of improved vehicle range, proliferation of charging stations and expanded offerings from automakers.⁹

As this trend continues, we expect players throughout the supply chain to benefit, whether from economies of scale, or further development of niche capabilities:



Company Profile: Albemarle



Albemarle is a specialty chemicals producer that has historically focused on bromine and refining catalysts. With the acquisition of Rockwood Holdings in 2015, Albemarle became the world's largest producer of lithium.

Role in New Powertrains¹⁰:

- Lithium is a key input in the production of electric vehicle, given its ability to store and retain energy.
- While many view lithium as a commodity product, the fact is only the highest quality lithium can be used in EV batteries.
- Albemarle's lithium reserves are not only "battery grade", but among the lowest cost in the industry- this likely allows the company to directly benefit from the increased demand for lithium in EV battery production.

Company Profile: BorgWarner



BorgWarner is a global leader in the development, design and manufacture of vehicle propulsion systems and advanced aftermarket solutions. BorgWarner's solutions are used by the world's largest automakers to help optimize performance, emissions and energy consumption.

Role in New Powertrains¹¹:

- Though BorgWarner is generally viewed as a supplier for ICE components, in recent years it has expanded its product suite for hybrid and electric vehicles.
- Today, the company's Electronics portfolio is a significant source of growth, with a broad offering to serve emerging EV architectures, including a state-of-the-art voltage inverter business.
- We believe BorgWarner will continue to benefit from the increased electrification of vehicles and their powertrains.

Smart(er) Logistics

In a world where increasing volumes of goods move from seller to buyer between cities, countries, and continents, it is unsurprising that global logistics networks have become increasingly complex¹²:

LOGISTICS MODELS AND PROVIDERS

First Party Logistics (1PL)

The owner of the cargo, be it a manufacturer or retailer (whoever needs something moved from Point A to Point B), provides their own transportation.



Second Party Logistics (2PL)

A basic mover of cargo, usually by one mode (truck, rail, sea, air). They might bring goods from the manufacturer to the retailer, for example.



Third Party Logistics (3PL)

Often referred to as a freight forwarder, 3PL companies arrange for multimodal transport (cargo might move by sea, then rail, then truck) through different parties, offer warehousing, pick & pack, etc.



Fourth Party Logistics (4PL)

Manages multiple 3PL services, essentially outsourcing the entire supply chain process end to end for the customer.

Fifth Party Logistics (5PL)

Seeks to optimize 4PL processes to drive maximum efficiency of the entire system, maximizing resource utilization.

Where Does Logistics Go From Here?

Whether around the world or around the corner, new innovations are helping players throughout the logistics value chain move goods more efficiently:

KEY TREND	MAJOR PLAYERS
 <p><u>Micro-fulfillment:</u> Companies are now looking to build smaller warehouses closer to city centers, allowing for faster and cheaper last mile delivery. These micro-fulfillment centers rely heavily on automated systems from several suppliers.¹³</p>	
 <p><u>Software in the Warehouse:</u> With the increasing complexity of globalized logistics networks, the need for supply chain management (SCM) software has never been greater.¹⁴</p>	
 <p><u>Automatic Identification and Data Capture (AIDC):</u> As supply chains become digitized, tracking the movements of individual assets, cargo or single units becomes far easier than ever before. Companies can leverage this data to search for new efficiencies or ways to reduce costs.¹⁵</p>	

Company Profile: Kion Group AG



The second largest producer of forklifts in the world¹⁶, Kion dramatically expanded its capabilities in the materials handling and logistics space with the 2016 acquisition of Dematic, a global provider of highly automated supply chain systems and equipment.¹⁶

Role in Smart(er) Logistics¹⁶:

- Kion can provide all of the building blocks for any firm's logistics needs, from forklifts and conveyer belts to automated picking and sorting systems.
- The company also offers an impressive suite of companion software that connects warehouse operations, maintenance and analytics for greater data-driven insights.
- With its comprehensive, innovative product portfolio, we believe Kion will continue to retain and grow its position as one of the leaders in the logistics market.

Company Profile: Datalogic SpA



Datalogic is a leader in the AIDC and process automation markets, specializing in barcode and RFID readers, mobile computers, sensors and vision systems. From manufacturing to retail to transportation and logistics, the company serves a diverse, global customer base.¹⁷

Role in Smart(er) Logistics¹⁷:

- Datalogic has been increasingly growing its transportation and logistics business given the growth of e-commerce.
- Whether in-warehouse or out for delivery, Datalogic's products allow logistics organizations to track parcels and shipments the entire way.
- We believe that Datalogic's exposure to several end markets allows it to develop a wide range of solutions that will be in demand in the logistics space going forward.

Public Transit v2.0

Urbanization in both the developed and emerging world has resulted in more cars on the road than ever before, leading to strained infrastructure, unprecedented congestion and deteriorating air quality.¹⁸

In order to deal with the situation, many cities around the world are working to build out and improve upon their mass transit systems, incorporating new technologies to get drivers off the roads and onto trains, buses and trams.

The Route to Modern Mass Transit



Intelligent Transportation Systems

Leveraging new data sources, mass transit can be more dynamic, adding capacity during congestion periods and adapting routes to unexpected disturbances.¹⁹



Multimodality

Various modes of mass transit have traditionally been siloed- even though a single trip may involve walking, a bus and a ride-hail. For both transit authorities and their customers, knowing the best way (or ways) of getting from Point A to Point B is critical.²⁰

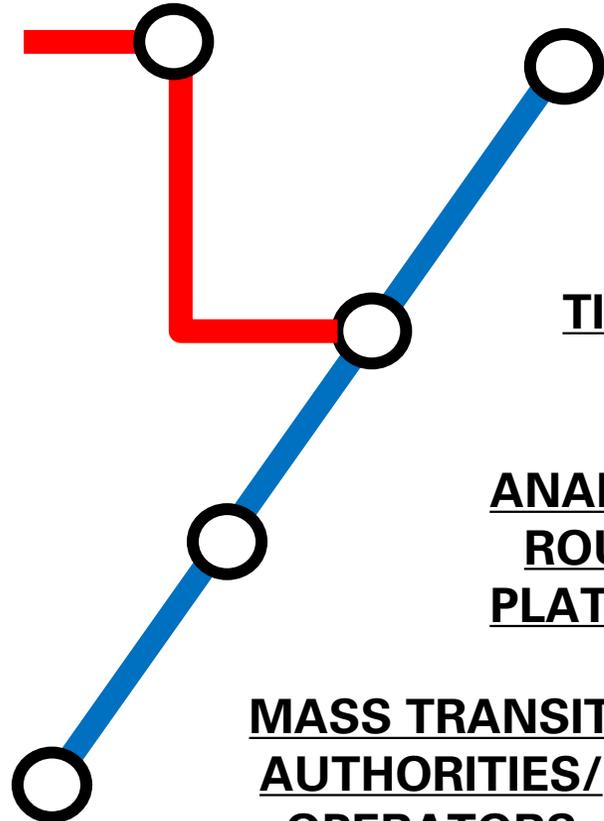


Improving Ease of Use

With an increasing number of journeys using more than one mode of transportation, having a universal fare collection system makes passengers lives easier, and makes them more likely to use mass transit.²¹

Who Makes Mass Transit “Smarter”?

We believe there are several key groups that each play a unique role in driving the future of public transit:



TRAFFIC FLOW MONITORING

Alphabet INRIX TagMaster CISCO

TICKETING/FARE COLLECTION

init moovel THALES SCHEIDT&BACHMANN SB CUBIC indra SIEMENS masabi

ANALYTICS/ROUTING PLATFORMS

kapsch >>> Fluidtime SIEMENS PTV GROUP IBM
A Kapsch Group Company >>> STREETLIGHT DATA the mind of movement

MASS TRANSIT AUTHORITIES/ OPERATORS

keolis FLixmobility MTA GVB Nobina First transdev arriva RATP
Transport for London

Case Study: Managing Traffic in Paris

In 2015, the Île-de-France Road Directorate (DiRIF) selected PTV Group, in collaboration with INRIX, to monitor traffic and congestion in real-time across the Greater Paris metropolitan area. Ultimately, this program will allow DiRIF to better optimize road and transit networks in the Paris region in real time.²²

PORSCHE SE

Though best known for its significant stake in Volkswagen Group, Porsche SE owns 10% of INRIX and 100% of PTV Group.²³ Overall, we believe Porsche SE allows shareholders exposure to a number of key trends in mobility.

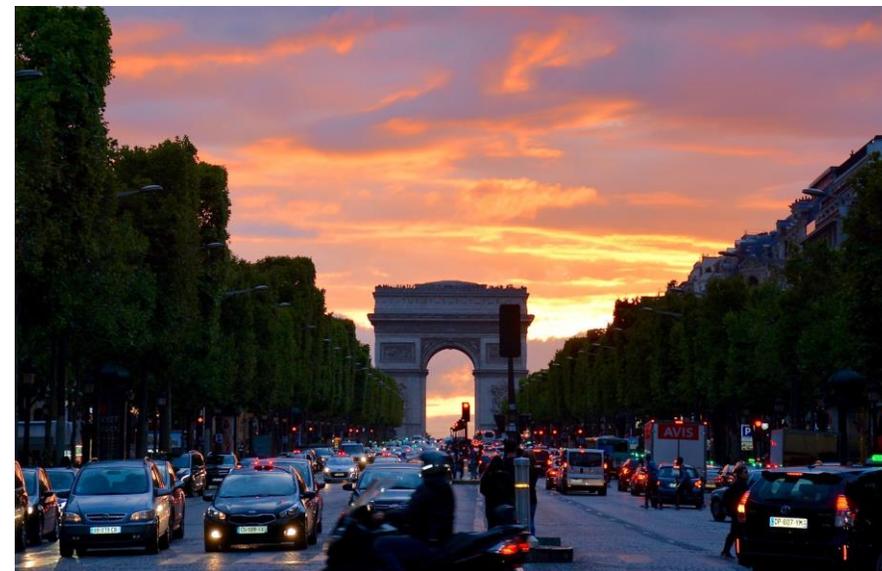


Using both roadside sensors and in-vehicle communication, INRIX is one of the world leaders in traffic data and analytics today, providing this information not only to cities and transit authorities, but also navigation apps like Waze.



the mind of movement

PTV Group produces software and analytics tools for both the public and private sector to make the best use of their traffic data. Whether its optimizing routes for mass transit or logistics firms, predicting city traffic patterns or even getting traffic lights to adapt to real-time conditions, PTV Group offers a solution.



Road to Autonomy

Undoubtedly, the rise of autonomous vehicles is among the most discussed trends in the mobility space today. However, many unrealistically characterize the arrival of “self-driving” cars as imminent. In reality, this will be a gradual transition taking years (if not decades).

Levels of Automation ²⁴					
Level 0 No Automation	Level 1 Driver Assistance	Level 2 Partial Automation	Level 3 Conditional Automation	Level 4 High Automation	Level 5 Full Automation
c. 1950	c. 1975	c. Present Day		c. 20??	
Manual control, human performs all the driving tasks (steering, breaking, acceleration, etc.).	The vehicle has a single automated system, like cruise control, to aid the driver.	Vehicle can perform steering/acceleration, and braking function, but human monitors all tasks and can take over at any time.	Vehicle not only performs central driving functions but can alert driver when they must take over.	While driver can take over, generally is only required to do so under a narrow set of circumstances.	No steering wheel, everyone is a passenger. Vehicle can operate in all environments without any human intervention.
 Human Monitors the Driving Environment			 Vehicle Monitors the Driving Environment		

Driving Incremental Change

As this long-term evolution takes place, we believe there are several key areas to focus on, especially as the intermediate stages of automation become a reality:

SENSORS



PROCESSORS



CONNECTIVITY



Company Profile: NXP Semiconductors NV



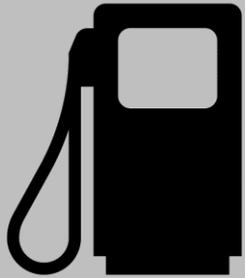
NXP is a global semiconductor company, and one of the leading producers of mixed-signal processors and microcontrollers, which are used across a broad range of applications in mobility, communications, IoT and beyond.²⁵

Role in Autonomy²⁵:

- NXP has a leading position in the automotive semiconductors market, supplying the world's top automakers and OEMs.
- NXP's automotive portfolio is not only among the largest, but also the most advanced, with its products powering some of the most cutting-edge in vehicle systems.
- Whether it is V2X, increased vehicle autonomy, or advances in advanced driver-assistance systems (ADAS), we believe NXP is among the companies best positioned to benefit from changes in the mobility space.

Mobility Pitfalls & Opportunities

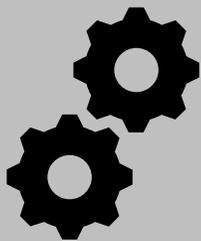
We feel there are several other areas in the mobility space where consensus expectations may be disconnected from reality, due to significantly overstated headwinds or tailwinds.



Fossil Fuel Industry: The transition to EVs will impact companies throughout the fossil fuel space, especially those companies which have a strong downstream retail presence. With that said, these companies may be able to leverage their brand equity and extensive real estate footprints to morph gas stations into EV-charging stations.²⁶



Auto Insurers: While the number of accidents is likely to fall in the coming decades due to new vehicle features, increased complexity of vehicles will result in higher repair costs. This creates a mixed outlook for risk underwriting, but insurance companies who seek to stay ahead of the curve may benefit (as will those who provide them the tools to do so).²⁷



ICE-Centric Automotive Suppliers: OEMs whose businesses rely heavily on producing internal combustion engine components will likely face issues as the transition to EVs accelerates. Those who can leverage their portfolios to adapt to the “New Powertrain” paradigm may stand to benefit.²⁹



Ridesharing: Many have suggested that the ridesharing industry can achieve consistent profitability with the rise of autonomous vehicles. Given our belief that this may be a longer way off than expected, we feel investors may be better served taking a “wait and see” approach to the space.²⁸

Overview

Mobility is a vast space, and it is our view that the changes within it are likely to create a wide array of opportunities for public markets investors for many years to come.

- In particular, we feel there are several key trends particularly worth paying attention to:
 - **Connected Cars:** Vehicles (and their drivers) interact with and understand their surroundings better.
 - **New Powertrains:** The transition from internal combustion engines (ICE) to electric vehicles (EV).
 - **Logistics:** Technologies which move goods to their destinations more quickly and efficiently.
 - **Public Transit v2.0:** “Smart” mass transit networks to meet the demands of the modern urban environment.
 - **Road to Autonomy:** The gradual adoption of technologies which ultimately replace human drivers with vehicles which can drive themselves.
- This list, while not definitive, reflects our views on those trends are likely to play out more expediently, or may be currently misunderstood or undervalued by public equity markets.
- Overall, we believe that amidst these transitions, there are sectors/industries that are on the verge of rapid transformation. While some are more obvious than others, the companies in these spaces which can adroitly navigate these changes may stand to benefit immensely.

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