Data Centers: Driving Digital Transformation for the Automotive Industry

White Paper

New data center management approaches are key to car makers finding value in the mobility and transport industry revolution.

serverfarm™

Executive Summary

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Digital transformation in the car industry is creating huge waves of disruption in intelligence, collaboration and interaction.

An entire industrial sector is shifting towards alliances and partnerships with groups and technology developers from beyond its traditional ecosystem.

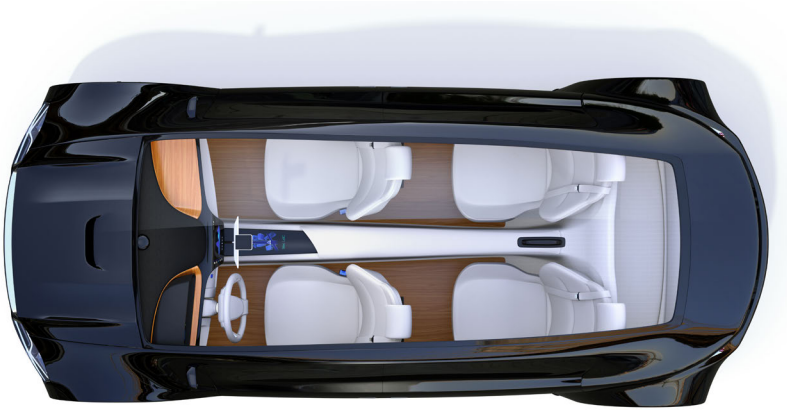
As cars become more automated and autonomous there are huge edge, connectivity and core data center infrastructure implications.

From clean energy to operation, products are rapidly changing in almost every way imaginable.

Digital transformation is also rapidly changing the production methods including smarter supply chains and intelligent manufacturing.

The car business itself is changing as connected cars for connected consumers create digital requirements and new business opportunities. The industry has a new manifesto based around digital and sustainability.

All of this will rely on better management of distributed digital infrastructure deployed as core-to-edge data centers, across multiple sites, that are creating an 'intelligent car industry.'



The skills to execute DCET & DCOT for the car industry.

This is happening in the context of rapidly changing operating environments – think smart motorways and smart cities.

To achieve this, the industry needs to consider the investment, development and management strategies of its digital infrastructure.

New data center management approaches are key to car makers finding value in the new mobility and transport industry.

This paper will explore how digital transformation is putting data centers at the forefront of the car industry in the 21st century, just as the assembly line was in the early 20th.

This Paper will also show how ServerFarm's skills and experience make it uniquely positioned to execute Data Center Economics Transformation (DCET) and Data Center Operations Transformation (DCOT) for the car industry.

Contents

Part 1: Introduction

A data-driven transport revolution.

Few industrial sectors are embracing digital transformation as quickly as car makers.

Hundred-year-old manufacturers who are used to thinking in decades are now looking to meet digital challenges to their supply chains, manufacturing, distribution models, changing consumer expectations and demands for sustainability.

This is fundamentally changing not just their products, but also their businesses. In the digital sphere, car makers will increasingly use core and edge data center infrastructure to extend value through telemetry, capture, data storage, data labeling, and analytics.

This involves collaborating with other industries, leveraging disruptive technologies from outside the vehicle and forming new joint ventures / alliances / partnerships.

"What is going on inside the car of the future? Cars already generate huge amounts of data. Just the biometrics being developed for the car market will generate vast pools of data. In vehicle connected car data will include: iris, face, fingerprint, heart (ECG) and brain (EEG) scanning."

Car makers are examining every aspect of their product from a data perspective. The questions being asked cover:

- What is happening inside the vehicle?
- What can the vehicle see and sense about its surroundings?
- How will the vehicle process, store, analyze and communicate data to the user, to other vehicles, to its maker and to its Smart City operating environment?

The industry is looking to an entirely new digital infrastructure set-up.

The stakes could hardly be much higher. Autonomous vehicles aim to end car related injury and fatalities, plus ensure sustainability through the decarbonization of mobility.

This will lead to lower insurance costs, fewer traffic jams and better environments through lower fuel consumption and cleaner energy sources.

Fully autonomous cars operating in all geographies in any conditions will not be on our roads until well into the 2030s, according to the SMMT (see page 5).

Connected Autonomous Vehicles Levels 1 – 5

In its Connected Report 2019, the Society of Motor Manufacturers and Traders (SMMT) cited the SAE International (formerly the Society of Automotive Engineers) classification of automated driving features into five levels. These range from basic driver assistance (L1) to full automation (L5).

These levels are considered the industry convention for categorizing the driver assistance and automated features provided by Original Equipment Manufacturers (OEMs).

Level 2 automation features such as adaptive cruise control are already available on the market. Technology advances, regulation permitting, will see vehicles with higher levels of automation are set to roll out over the next decade "allowing drivers to disengage safely from dynamic driving tasks such as maneuvering in traffic jams and driving on motorways."

SAE International forecasts that from 2021 onwards, some early generation Level 4 automation features may be introduced. These could include highly automated highway pilot, automated valet parking and automated vehicles such as taxis operating within virtually defined or 'geofenced' zones in urban areas.

"Level 5 automated vehicles should have the capability to be fully self-driving, unconditionally, and with no operating domain or geographic restrictions. This is expected around 2035."

Source: https://www.smmt.co.uk/wp-content/uploads/sites/2/SMMT-CONNECTED-REPORT-2019.pdf

"How a connected car senses what is happening beyond its shell is advancing rapidly. AV digital technology stacks include: Processing; Sensing; Mapping; Software; Security/Safety."

However, before fully autonomous cars arrive, the digital technology driven transport revolution will continue to surge as the number of connected cars that are communicating with each other, with their surroundings, with edge data centers and 5G networks grows into the tens of millions.

How the data challenges of the industry being on-boarded through the digital transformation of data centers is a key concern for forward-thinking car manufacturers.

As the industry moves through the different connected, autonomous vehicle levels its reliance on and full integration with digital infrastructure will become more apparent. The challenge and opportunity is to create a modern, forward looking management and operating strategy for the changing distributed data center environment.

The data center infrastructure for global operations, which span manufacturing, distribution and services, are already distributed.

Distributed IT in multiple territories will be transformed to connected, visible, virtual and physical managed infrastructure as it becomes the layer for the new realities of how data, infrastructure, connectivity, 5G, cloud and AI will be the foundation of automotive industry IT.

This is where the data handling, security and transport challenges must be addressed.

Part 2: AV and Connected Car Plans

Technologies and strategies of the key players

Connected Cars

1) Cruise Cars are equipped with the latest machine learning and cloud-based tools. The company uses four main technology domains that ensure safety and efficiency for all its autonomous vehicles:

Webviz: This data visualization analyses all possible obstacles that are experienced on the roads into a singular web-based application.

Cartographer: Semantic maps are created to layout urban landscapes these include boundaries, lanes and traffic control which enables the vehicle to effectively produce an immediate analysis.

Starfleet: Produces codes sent to vehicles to assign maintenance tasks, dispatches and censors vehicle activity on the roads.

2D Testing Scene Edit: Simulation test performed by the vehicles replace the requirement of manual written tests, reduces regression tests by up to 400%.

https://www.getcruise.com/technology

https://www.forbes.com/sites/alanohnsman/2019/07/24/cruise-scaling-up-self-driving-car-tests-as-it-delays-driverless-ride-service-launch/#33d928c4149f

2) Since 2016 Tesla cars have an inbuilt FSD (Full self-driving) technology which consists of sensors and similar hardware systems. According to Tesla CEO Elon Musk new lines of code are being designed by company engineers and estimated to be ready by early 2020.

https://pod-point.com/guides/vehicles/tesla/2019/model-s

https://www.latimes.com/business/story/2019-08-08/tesla-full-self-driving-fsd-technology

3) Zipcar does not intend to build its own brand of autonomous vehicles. Instead it plans to add new features to current cars through the company platform. Manufacturers associated with Zipcar include Ford, Toyota and GM. Each will receive advanced services in the near future.

https://www.zipcar.com

https://www.forbes.com/sites/dougnewcomb/2016/02/29/zipcar-gears-up-for-autonomous-driving/#17db0d703c01

4) Gatik AV company has partnered with Walmart to deliver items B2B. The cars are not designed for commercial deliveries. The installed AI is able to drive 200 miles per day without a driver.

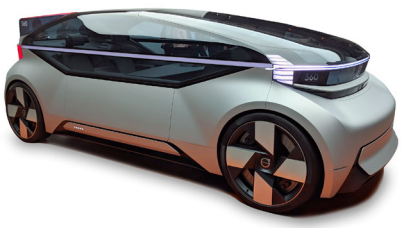
https://techcrunch.com/2019/07/27/gatiks-self-driving-vans-have-started-shuttling-groceries-for-walmart/

5) Concept BMW autonomous cars are designed at SAE level 4 which is defined as a fully automated driverless car only in specific circumstances these include terrain and weather conditions. Assistant cruise control and auto parking are some of the features performed without human interaction. The vehicles generate three distinct types of data: Status which monitors odometer reading; Usage the amount of mileage as required for an automatic service call. Telematics data is transferred from the vehicle directly to BMW Group servers through an installed SIM card.

https://www.bimmerarchive.org/photo/6854-405-bmw-vision-next-100.html

https://techcrunch.com/2019/07/04/bmw-and-daimler-partner-on-autonomous-driving-first-results-of-team-up-in-market-by-2024/

https://www.bmwgroup.com/en/innovation/technologies-and-mobility/cardata.html



6) Volvo 360 c vehicle is designed to have a standardized autonomous communication system which interlinks road users such as pedestrians and other driverless cars. This interoperability enables a safe environment as the vehicle makes its action known before it is commenced.

https://arstechnica.com/cars/2018/09/volvo-gets-optimistic-about-the-future-with-the-360c-driverless-concept/

https://www.volvocars.com/intl/cars/concepts/360c

7) Uber's self driving cars are fitted with 20 cameras, several lasers, GPS, Radar and Lidar which contributes to the functionality of autonomous driving. This enables the vehicle to monitor and interpret the surrounding environment and identify objects both mechanical and organic. However, these features are still deemed inadequate for public safety as multiple accidents have occurred in Arizona and Kansas as reported by the NTSB (National Transport Safety Board).

https://www.uber.com/blog/pittsburgh/pittsburgh-self-driving-uber/

https://www.techradar.com/news/uber-self-driving-cars

8) Waymo and Jaguar partnered to produce a fully operational driverless car in 2018. The integration of AI enables cars to efficiently navigate through traffic and avoid obstacles. Sensor, camera and AI software combination shared between on-road vehicles ensures safe driving through an interconnected cloud system.

https://waymo.com/whats-next/

9) Ford has committed to build a fully autonomous vehicle by 2021. This is a main pillar of Ford Smart Mobility: its plan to be a leader in autonomy, connectivity, mobility, customer experience and analytics. The vehicle will operate without a steering wheel, gas pedal or brake pedal within geo-fenced areas as part of a ride sharing or ride hailing experience. By doing this, the vehicle will be classified as a SAE Level 4 capable-vehicle, or one of High Automation that can complete all aspects of driving without a human driver to intervene.

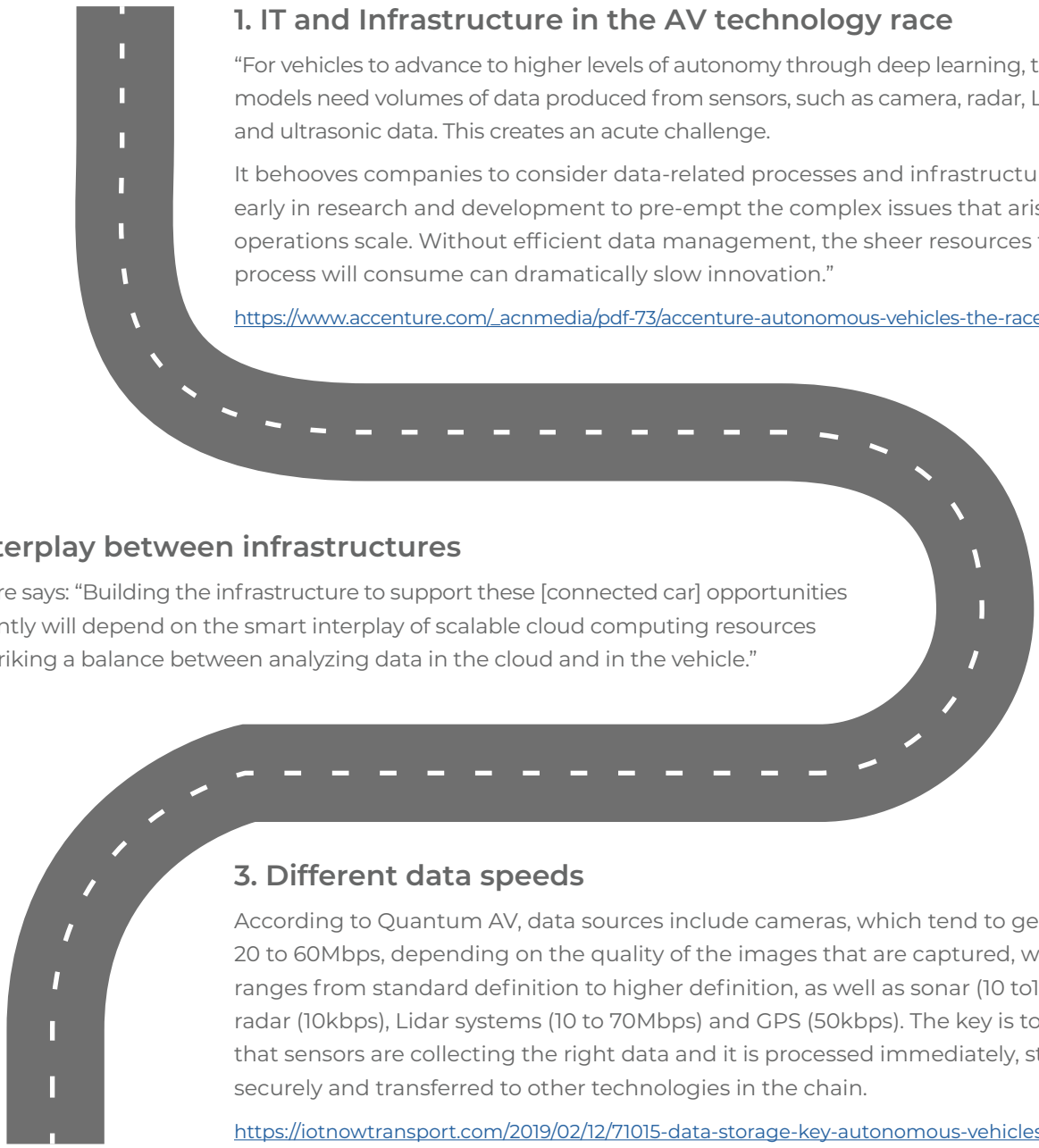
https://corporate.ford.com/articles/products/autonomous-2021.html

Find Me A Parking Space!

One manufacturer started a trial in Berlin to aid drivers with parking, a useful and everyday application. The system parameters and variables were complex. It had to be real time, it had to understand what it was looking for and when. It required 'tons of processing power and bandwidth.' BMW said the volume of data being generated for mapping alone would pose challenges with its cars sending 250 terabytes of mapping data into the cloud. "And the cars themselves are not transmitting raw data," it said. "Transmitting raw data mean tens of petabytes being generated and handed off. It would require fully functioning blanket 5G network coverage densification."

Source: https://iotnowtransport.com/

Digital and IT Infrastructure Roadmap



1. IT and Infrastructure in the AV technology race

"For vehicles to advance to higher levels of autonomy through deep learning, their models need volumes of data produced from sensors, such as camera, radar, Lidar, and ultrasonic data. This creates an acute challenge.

It behooves companies to consider data-related processes and infrastructure needs early in research and development to pre-empt the complex issues that arise as operations scale. Without efficient data management, the sheer resources the process will consume can dramatically slow innovation."

https://www.accenture.com/_acnmedia/pdf-73/accenture-autonomous-vehicles-the-race-is-on.pdf

2. Interplay between infrastructures

VMware says: "Building the infrastructure to support these [connected car] opportunities efficiently will depend on the smart interplay of scalable cloud computing resources and striking a balance between analyzing data in the cloud and in the vehicle."

3. Different data speeds

According to Quantum AV, data sources include cameras, which tend to generate 20 to 60Mbps, depending on the quality of the images that are captured, which ranges from standard definition to higher definition, as well as sonar (10 to100kbps) radar (10kbps), Lidar systems (10 to 70Mbps) and GPS (50kbps). The key is to ensure that sensors are collecting the right data and it is processed immediately, stored securely and transferred to other technologies in the chain.

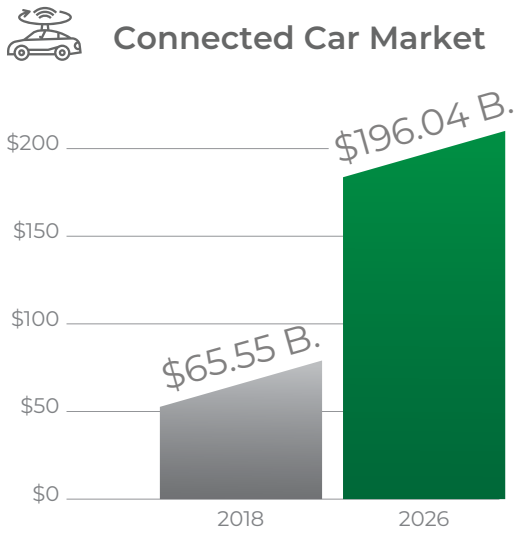
https://iotnowtransport.com/2019/02/12/71015-data-storage-key-autonomous-vehicles-future/

Connected Car Market in Numbers

1. Connected Market Growth

The global connected car market was valued at $65.55 billion in 2018 and is projected to reach $196.04 billion by 2026, growing at a CAGR of 14.7% from 2019 to 2026.

14.7%
from 2019 – 2026



2. 5G Network

"[The Chinese Government]...will spend up to $220 billion on 5G by 2025, according to state media, and plans to install AV infrastructure throughout the 2020s, including telecoms networks to capture data from vehicles and their surroundings, cloud-computing capacity to process these data and map services to guide the cars."

Source: The Economist: https://www.economist.com/business/2019/10/12/chinese-firms-are-taking-a-different-route-to-driverless-cars

67%
increase over today's platform revenue by 2030

3. Platform Revenue

When asked by IBM in a global survey where they saw opportunities emerging, car making executives said: "By 2030, executives in our survey estimate revenue from platforms will be 15 percent of their total. For an industry expected to reach $6.7 trillion in total revenues by 2030, this equates to $1 trillion coming from digital platforms, a 67 percent increase over today's platform revenue.

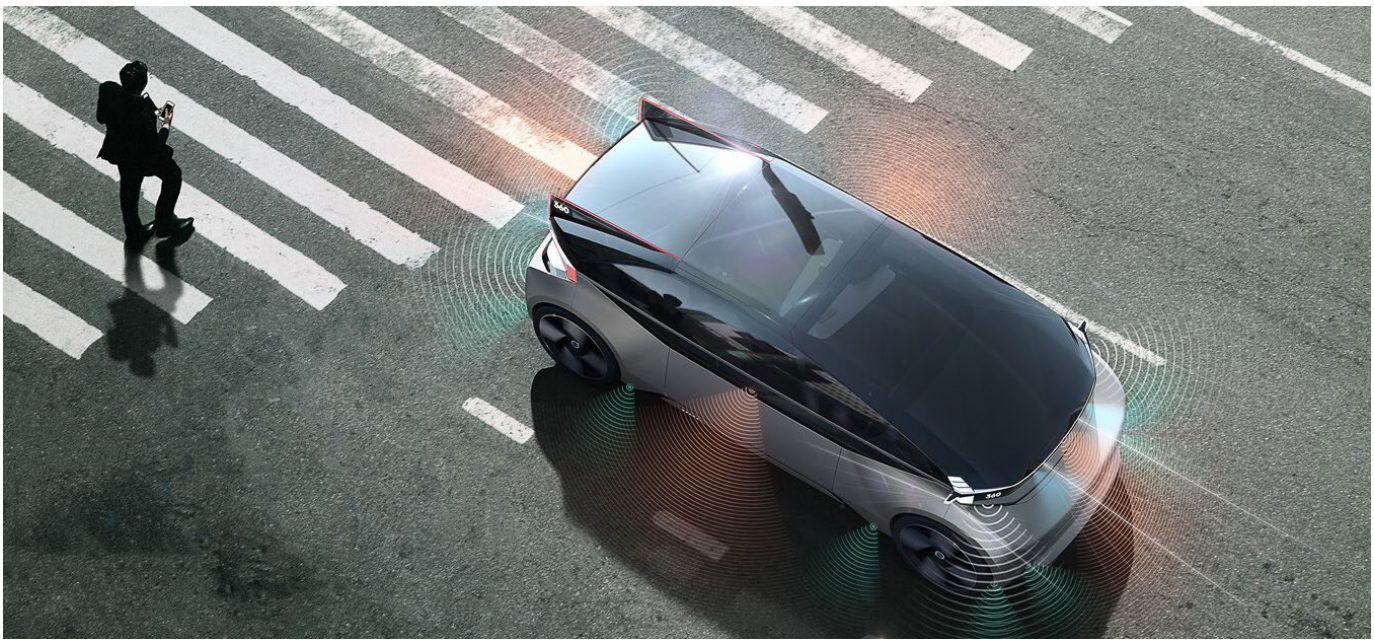
To accomplish this, industry executives expect to have an annual investment budget of over $126 billion by 2030. This is a 38 percent increase in the investment budgets for platforms today.

When asked where their organizations are today in terms of data usefulness, executives indicate they are using data to create value in how they work. Eighty five percent say their organizations access both structured and unstructured data that come from a variety of sources. These sources could include IoT devices in plants, vehicle sensors, and cameras, or dealer technician reports that include handwritten analysis. Eighty percent of executives report the ability to extract and link data from these and many other sources. Seventy-six percent are creating actionable insights from the data they collect."

Source: IBM

Part 3: Automotive Sector Case Study

A look at how Volvo is using new technology to make its cars safer



https://www.volvocarsramsey.com/blog/2018/september/13/volvo-360c-concept-autonomous-electric-cars.htm

Volvo Cars is taking a human-based approach to autonomous vehicle development where drivers can relax, engage and work during travel times.

Volvo's driver assisted technology trials are already advanced in the Swedish city of Gothenberg. Self-driving technologies being tested today include braking, accelerating and steering. Volvo is using its advances in radar, camera and Lidar tech (see Volvo investments below). The trials include mapping roads and handing off data via a comms link from the vehicle to the Volvo cloud.

In a separate safety focused trial Volvo is using its cloud so cars can warn each other about bad weather conditions. Slippery Road Alert analyses anonymous information from cars connected to the cloud, analyses patterns and trends in road surface conditions. This is then shared with cars farther away on the same road, warning them in advance of what to expect.

This includes Hazard Light Alert detects when the hazard warning lights have been activated, sending a notification to all other connected Volvos in the locale. The aim is to pre-warn drivers of potentially dangerous situations, which otherwise may be hidden from view.

Volvo says commercially available autonomous cars will be ready by 2021.

Volvo and connected cloud

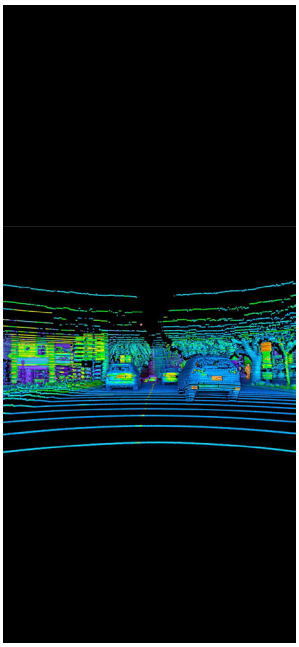
Volvo Cars signed a global deal with Ericsson to provide the industrialized Ericsson Connected Vehicle Cloud (CVC) platform to further enable its digital vehicle services in more than 120 markets worldwide for the next five years.

As Volvo develops new services, connected cars will benefit from increased speed, low latency and capacity for mission critical applications, such as autonomous driving, that commercial 5G networks will enable. Volvo Cars provides car owners and drivers with its latest developments in connected car digital services including automation, fleet management, telematics, navigation and infotainment.

With digital services increasingly becoming a differentiation factor for automotive consumers, the need for a secure and dependable service provision infrastructure is critical to provide quality of service at scale.

The service will be delivered via several geographically distributed centers.

"Volvo's latest concept car doesn't have a steering wheel."



Volvo investments and advances

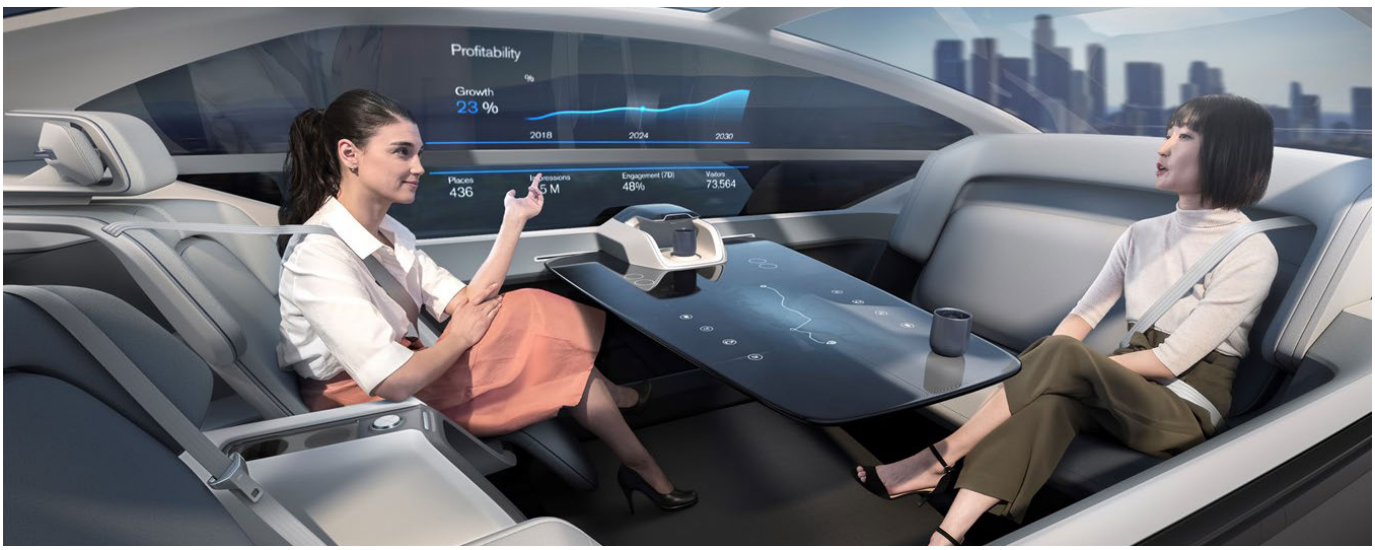
Volvo Cars intelligent autonomous technology strategy began early and included a series of alliances and investments in autonomous technology companies.

The Volvo Cars Tech Fund was launched to invest in high potential technology start-ups around the globe. It focuses its investments on strategic technology trends including artificial intelligence, electrification, autonomous driving and digital mobility services.

Luminar

Volvo Cars made its first strategic investment via a stake in Luminar, a start-up in the development of advanced sensor technology. Palo Alto-based Luminar focuses on. Lidar technology, which uses pulsed laser signals to detect objects and is a crucial element of creating safe autonomous vehicles.

"Lidar is a key technology for enabling autonomous cars to navigate safely in complex traffic environments and at higher speeds," said Henrik Green, Senior Vice President for research and development at Volvo Cars.



https://www.volvocarsramsey.com/blog/2018/september/13/volvo-360c-concept-autonomous-electric-cars.htm

Zenuity

In the market for autonomous driving software systems Zenuity is a joint venture between Volvo Cars and Autoliv (now a standalone division Veoneer). The formation of Zenuity was the first time a premium car maker joined forces with a tier one supplier to develop advanced driver assist systems (ADAS) and autonomous driving (AD) technologies. Zenuity assisted driving and safety software is in Volvo Cars' soon-to-be-revealed fully electric XC40 sports utility vehicle.

Zenuity technology is also in the high performance Polestar 2 announced in 2019.

Varjo

Volvo Cars and Varjo, the Finnish maker of high-end augmented reality headsets, created a mixed reality approach to evaluating automotive prototypes, designs and active safety technologies. Volvo and Varjo have made it possible for the first time to drive a real car while wearing a mixed-reality headset, seamlessly adding virtual elements or complete features that seem real to both the driver and the car's sensors, for development purposes. This is a first in the car industry.

https://www.engineerlive.com/content/volvo-uses-mixed-reality-testing

MDGo

Volvo Cars Tech Fund invested in Tel Aviv-based MDGo, a company specializing in medical artificial intelligence. By using advanced machine learning the company is working to ensure people are treated according to their specific injury following road traffic accidents. Its technology will combine real-time data from the car during an accident with medical knowledge. Data would be transmitted to trauma physicians and emergency personnel via a cloud-based platform to improve treatment of the people involved in an accident. This will be used to inform first responders with the type of trauma they are likely to encounter at the scene of an accident.

Freewire Technologies

On the electrification front, the Volvo Cars Tech Fund invested in Freewire Technologies, a mobile and stationary energy storage start-up located in the San Francisco Bay Area.

Part 4: Smart Cars in Smart Cities

Connected Cars + Connected Consumers – the digital infrastructure needed

Across international bodies, national and municipal governments climate policies have prompted rapid technology shifts from the car industry.

Electrification of transport is already happening meaning connected cars will require smart energy infrastructure.

According to the International Energy Authority electric mobility is expanding at a rapid pace. In 2018, the global electric car fleet exceeded 5.1 million, up 2 million from the previous year and almost doubling the number of new electric car sales. The People's Republic of China remains the world's largest electric car market, followed by Europe and the United States. Norway (46%) is the global leader in terms of electric car market share.

Technology advances are delivering substantial cost cuts. Key enablers are developments in battery chemistry and expansion of production capacity in manufacturing plants. Other solutions include the redesign of vehicle manufacturing platforms using simpler and innovative design architecture, and the application of big data to right size batteries.

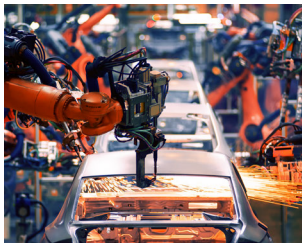
The ACEA, Eurelectric and Transport & Environment (T&E), an NGO, jointly agreed on the need to decarbonize road transport to meet Europe's climate objectives.

This translates into the interdependent and interconnected development of electric vehicles and charging infrastructure markets. The new age of mobility where electrification, connectivity and efficiency are key drivers will require strategic and adequate infrastructure planning.

In order to fully enable the decarbonized future of mobility for the coming decades, the deployment of strategically located, smart, intelligent and customized charging infrastructure and services is essential.

For smart power infrastructure to be effective requires data, edge data centers and communications.

ACEA European Automobile Manufacturers Association



New Industry Manifesto

2019 saw The European Automobile Manufacturers' Association (ACEA) launch a new manifesto.

Goals include:

- Launch European flagship initiatives focusing on mobility innovation that bring together universities, research centers and players from across the entire automotive value chain.
- Support the development and roll-out of connected and automated driving.
- Remove regulatory obstacles to the deployment of new mobility technologies.
- Enable rapid deployment of the required digital communications infrastructure (V2X) to complement existing transport and road infrastructure.
- Adopt a clear roadmap for the introduction of increasing levels of automation.
- Enable innovation in new data-driven mobility business models, as well as on demand transport solutions and vehicle ownership models.
- Take a 'consumer-focused' approach, by adopting mobility.

Partnership Building

Automotive companies need to build mobility platforms to support emerging business opportunities and monetization models.

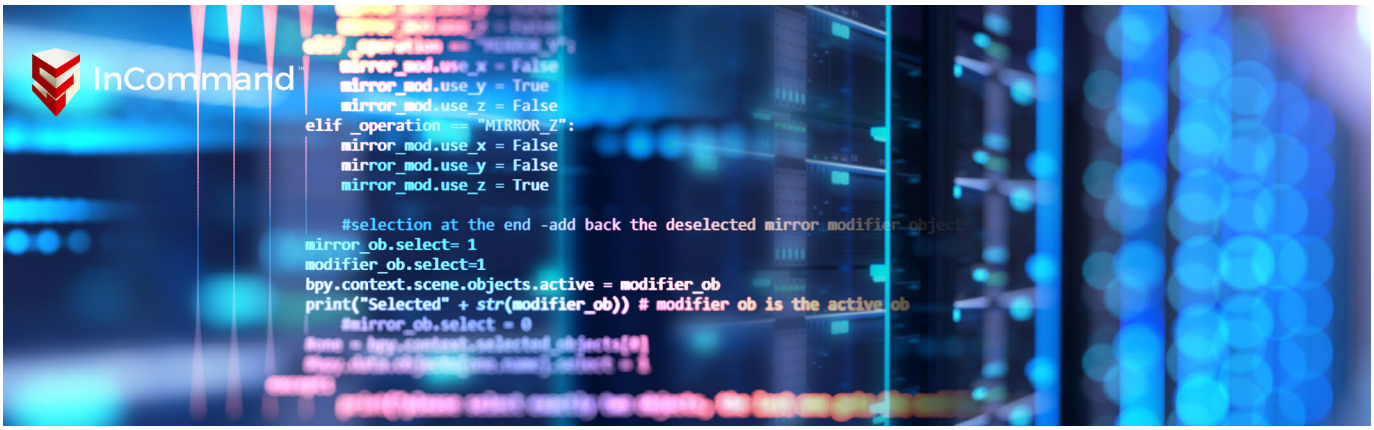
Automotive companies are being compelled to look beyond their own capabilities to build new types of coalitions and partnerships with specialists outside traditional conceptions of the automotive industry. Across industries, loose associations of businesses are coalescing into business ecosystems to provide the comprehensive range of capabilities and customer experiences required.

Part 5: Putting a global car manufacturer InCommand of its data centers

A deeper look at the ServerFarm approach

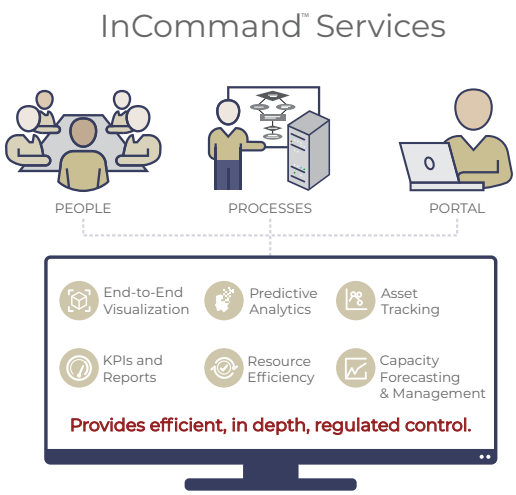
ServerFarm, has a partnership with one of the most recognizable global automotive brands.

The manufacturer is re-architecting its entire data center footprint and will implement InCommand® Services, ServerFarm's integrated platform that brings together people and processes into a portal-based solution, for maximum data center operational efficiency.



Ultimately, the company's goal is to deliver better and more efficient automotive technology, products and services to both customers and employees.

InCommand Services will be employed across dozens of data centers that comprise the auto manufacturer's global IT footprint to deliver asset, capacity and change management.



By combining staff resources, ticketing systems, change control procedures, demand and capacity management into a single 'as-a-service' experience, the automotive company will experience a more dynamic and flexible data center environment.

In addition to an immediate reduction in operational risk, staffing levels and costs, the company will also maximize reliability, overall efficiency and capacity utilization.

InCommand Services will also deliver 24/7 NOC and Service Desk capabilities, as well as coordination, mobilization and validation of all on site resources.

“InCommand offers cloud-like experiences to IT organizations across all data center environments, whether on-premise, or in the cloud,” comments Avner Papouchado, Founder and CEO of ServerFarm. “Our customers trust us to manage their IT environments so they can focus on innovation and developing new products and services. InCommand remains unique in its capability to deliver end-to-end managed services in data centers, and we’re honored to manage infrastructure for this household name.”

“InCommand offers cloud-like experiences to IT organizations across all data center environments.”

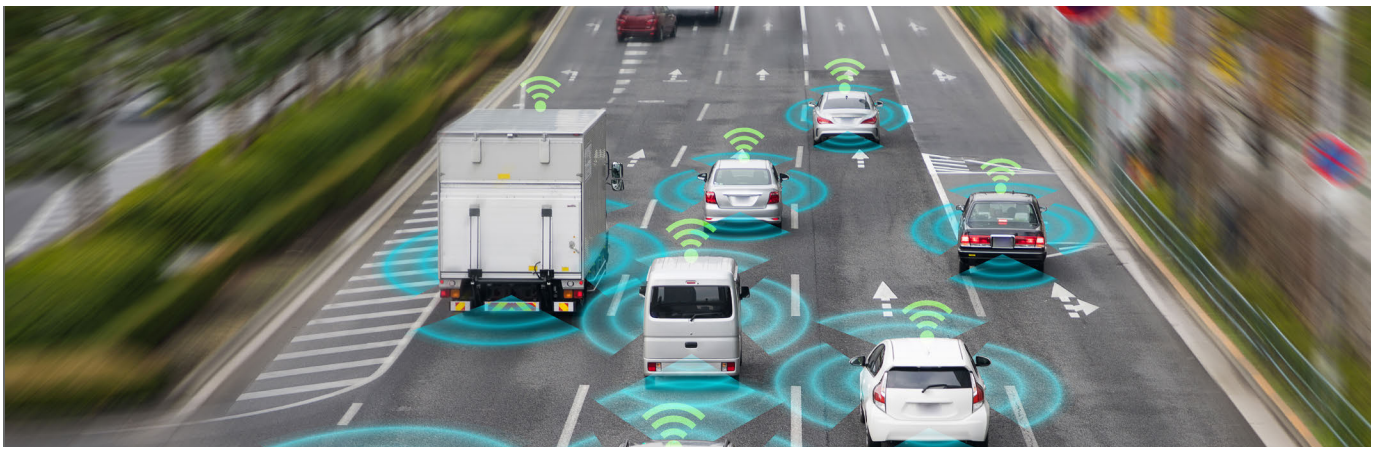
InCommand provides a collaborative service approach that adopts and automates to customer practices. IT teams focused on delivering Apps and services no longer have to track asset inventories and understand the ecosystem of the data center. IT can let go of the physical management of data centers and infrastructure and instead focus on App development, delivery and management.

It gives IT teams a set of tools to do what they do best with new capabilities and processes. With InCommand, an IT group gains the confidence to have management of the ecosystem of all data center infrastructure provided as a service from asset databases to the switching gear to the devices, right up to the server level. Data center management extends from owned and operated physical and distributed facilities to infrastructure on separate cloud platforms. Infrastructure management is fully integrated allowing IT to focus on its core competency of application delivery.

The car industry is changing at an unprecedented rate.

Digital transformation, electrification and sustainability are reshaping a global industry in a manner comparable to and probably exceeding the mass production inflection point brought about roll out of the production line in the early 20th century.

Any manufacturer that is serious about digital must be serious about modernizing the management of its data center fleet. Digital pioneers are engaging ServerFarm about how to use InCommand to make their physical and IT infrastructure ready to service the data driven mobility revolution.



What is InCommand?

Open source-based and created with agile development methodology InCommand is a cloud service combining people, processes and software for the physical management of data centers and infrastructure. InCommand provides unrivaled insight, metrics and analytics into current and predicted behavior of the data center. As a single seamless platform that virtualizes the entire data center InCommand uniquely turns data center management into a cloud service which can push infrastructure capacity utilization rates from 30% to 80%.

InCommand's constantly evolving features include:

- Environmental and power monitoring.
- IT asset change and configuration management.
- IT asset life cycle management, including maintenance records.
- Predictive scenario planning.
- Capacity forecasting for space, power and cooling.

Open APIs to third-party ITSM systems (BMC's Remedy and ServiceNow) and virtual machine management software (VMware and Citrix), enable mapping of virtual workloads to physical machines. This drives up server utilization.

InCommand spans the data center physical infrastructure from the shell to power, cooling and the environment. On the IT side, features support efficient server refreshes, and enable higher IT and space utilization providing cost savings. Preemptive corrective actions can be implemented based on failure scenarios which lower risk. InCommand conducts root-cause analysis of IT issues providing "what-if?" scenario planning. Metrics and KPI reporting as well as recommended actions are standard.

serverfarm™

About ServerFarm

ServerFarm is a global expert in data center real estate and operations. Our mission is to maximize data center and IT infrastructure efficiencies by providing a holistic approach to building, integrating and managing data center environment and IT deployments. Through our innovative InCommand Services, we provide customers with staffing, training, workflows and a data center portal that provide unprecedented process consistency, knowledge management, and KPIs to regulate IT infrastructure.

With more than 17 years in the industry, ServerFarm delivers complete data center oversight from facility to IT infrastructure management, which enables our customers to concentrate on growing their businesses.

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