What's Behind VPVision?

next generation vehicle telemetry

Introduction:

VPVision is a fully cloud based telemetry platform that utilises cutting edge technology and is designed to integrate with vehicles and vehicle systems. This document reviews how our cloud based technology compares against today's leaders in the vehicle telemetry market, a summary of the new capabilities and benefits available in the cloud is provided. An assessment is made of some of the upcoming cloud based technologies and how these will lead the way on emerging trends within the vehicle and mass transit industry.

Typical vehicle telemetry systems:

Traditionally vehicle telemetry systems have been the forte of high-tech software organisations. A typical set up could include some bespoke on-vehicle hardware that can pick up and transmit data generated by the vehicle or by the device itself. For bus systems this data can include values like location, idle times, braking and accelerating behaviours – and from this fuel efficiency and other metrics can be derived.

These organisations would have been constrained by the back-end hardware needed to support their platforms. Constraints might include data storage space, processing power and physically where and how to set up the architecture and servers needed. All the back-end programming required to manage these platforms and govern things like data security and authenticating connections, data management and archiving, database design and indexing, would need to be designed and coded bespoke for the application. As more vehicles were connected, the supporting architecture would need to grow, and this would generate increasingly complex challenges.

On top of this, governments started to impose regulations, such as the EU data protection directive, that added further complexity.

Some companies have been successful in navigating these hurdles over many years and generated a capability that can provide a vehicle telemetry service. However, the complexity of these systems and large amount of maintenance required is prohibitive, the lack of flexibility to integrate, scale up and innovate means that this type of set up can be beaten by new cloud based systems.

VPVision uses Amazon Web Services (AWS):

AWS was borne out of problems experienced by Amazon back in the early 2000's as it grew rapidly into the company it is today. Amazon set their team to developing a platform that would support their growth and huge hunger for data storage and processing, and in doing so they documented the different technologies they created as a series of Application Programming Interfaces (API's).

These API's allowed for a much smoother and more organised development of Amazon's various online shopping platforms. Identifying that other organisations shared the same problems they had experienced, Amazon launched their API's and, importantly, the supporting infrastructure as a service in 2006 calling it AWS. Today AWS accounts for over a third of the market (more than Microsoft, Google & IBM combined) and is the market leader in cloud computing.

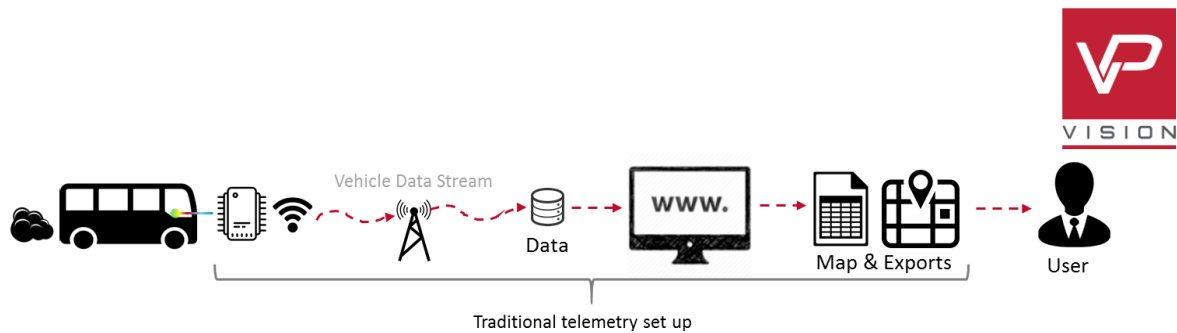The set up of traditional telemetry systems with a comparison to VPVision is shown below.

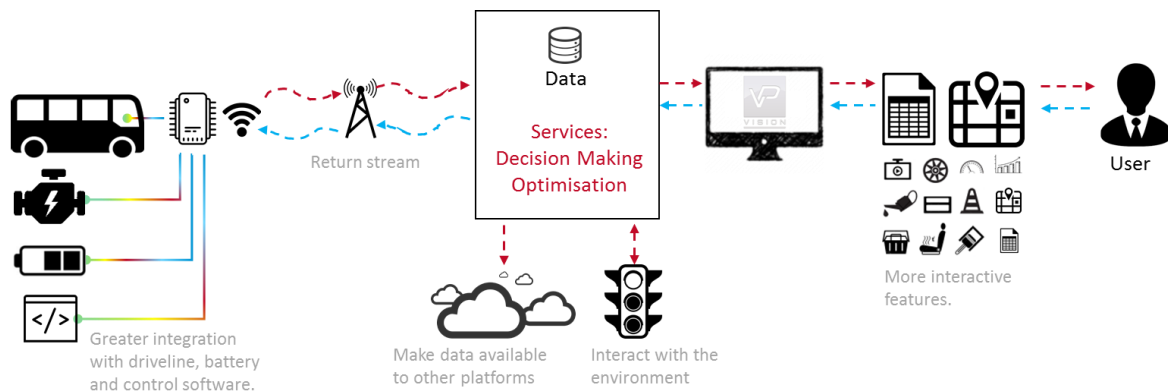Fig1 (above): Traditional telemetry system set up – linear in 1 direction.

Fig2 (above): VPVision is a bi-directional closed loop platform, has greater depth of vehicle integration, can integrate with other devices and has more capable features.

AWS is at the core of VPVision - it is what's typically referred to as the back-end. The means of communicating to and from a vehicle, and all data storage and processing is all provided by AWS.

What does this mean to me and my fleet?

The API's form a toolkit which software developers can utilise as required. These tools are extremely robust and well tested, compliant with regulations, well documented and provide access to a strong support network. This helps reduce development time for new platforms whilst ensuring that benefits and enhancements learnt from other projects are automatically incorporated. Selecting your AWS infrastructure is free, and expanding or changing it is seamless and can be automatic, meaning much less time spent specifying and maintaining back end hardware.

" We focus on what matters – the vehicles! "

Ultimately this means that more investment and engineering resources can be focussed on where it matters most – the vehicles. This allows for a more complete vehicle integration and could mean more data points and higher frequency transmissions providing new insights, more complex and faster data analysis, and access to technologies and services that improve what you and your customers can do with your vehicles.

Example AWS services utilised by VPVision:

Within the AWS environment there are many different services that can be set up and utilised in different ways to create a vehicle telemetry platform. How these services are used will have an impact on things like responsiveness of the website, cost and capability. Below we provide an overview of 2 services utilised by VPVision and provide some insight in to what they offer.

-   **S3 (Simple Storage Service)** – Collect, store and analyse data on a truly massive scale. AWS's S3 service offers 99.999999999% durability, security and is in compliance with the most stringent regulations. It allows for query-in-place functionality, allowing users to run powerful analytics directly on the data without having to extract it to a separate analytics system. The service offers comprehensive data management capabilities and can automate data retention, archiving and deletion.

-   **IoT (Internet of Things)** – IoT forms the secure bi-directional communication platform that allows vehicles to be connected to AWS. It provides all of the necessary tools to allow your vehicles to connect, authenticate and exchange messages to one or to many locations. IoT enables basic rules to be applied to the data as it's ingested, if a connection to a vehicle is momentarily lost it ensures services are not disrupted and all devices will resynchronise when the connection is established.

Before cloud based web services, to get anything close to the two capabilities listed above would have taken years of programming effort and a huge investment in hardware. What would have been created as a result was a series of un-tested and bespoke applications.

Below is an architecture diagram of VPVision. By implemented AWS at its core, this allows VPVision to integrate easily and take maximum benefit from all of the available technologies.
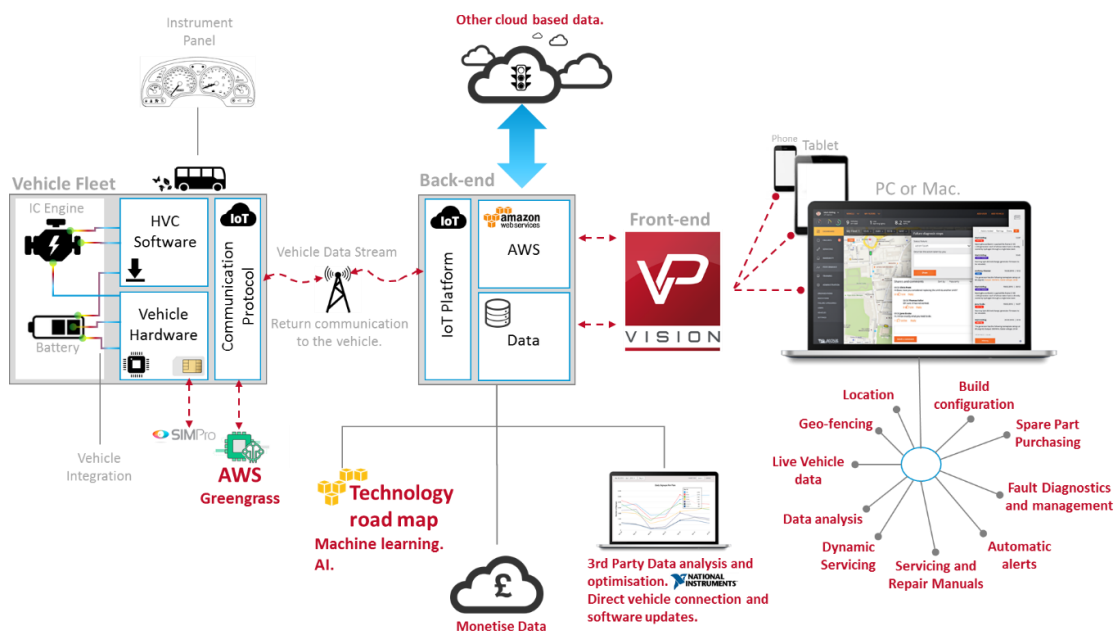

Fig3 (above): VPVision architecture with AWS at the core.

Benefits of choosing a system built on AWS:

The benefits of moving to a newer technology such as AWS are numerous, some of the main benefits for vehicle integrated systems include:

- **Scalability –** AWS has been built from the ground up to ensure applications can be scaled up or down easily and reliably. Amazon has massive infrastructure spread across the globe - going from 1 vehicle to 1,000+ vehicles is what it's designed for. Auto Scaling allows for capacity to be dynamically scaled up and down automatically, based on demand and within a pre-defined set of conditions. So, if your vehicles are not driven at night, or you have a rapidly growing fleet of vehicles, or user behaviour is unpredictable, AWS can accommodate this without taking a breath.

- **Cost Control –** AWS offers an online billing platform that breaks down monthly invoices in detail and by each service utilised. This allows users to understand exactly where costs are coming from, trend cost data and even forecast future costs, enabling accounts to become highly cost effective. In addition to this, AWS also offers many of its services on different tariffs – for example performing complex analysis on huge amounts of vehicle data could be done on-demand, or to save cost, processing can be run when the AWS infrastructure has spare capacity or it can reserved on a scheduled rota.

- **Security and Encryption –** Mutual authentication and encryption at all points of connection mean data is never exchanged without a proven identity. Asymmetric cryptography ensures a message is encrypted on the vehicle before transmission and the only way to decrypt it is using a private key stored securely within AWS.

- **2 Way Communication –** Communication from the vehicle to the cloud and the cloud to the vehicle comes as standard with AWS IoT. Regardless of which direction data is streaming, the same levels of data management, stability and security are applied. This enables data to be manually sent to the vehicles, either for software updates or making modifications to parameters, it also enables automatic updates or instructions to be sent to the vehicle in response to geo-fences and vehicle optimisation routines, and this opens the door to instructions being sent to the vehicle from artificial intelligence.

- **Data Durability –** VPVision makes use of Amazons S3 data storage service. S3 runs on the largest cloud infrastructure in the world and promises 99.999999999% durability with data distributed across a minimum of 3 physical facilities geographically separated. Your data is safe!

- **Connection Stability and Persistence –** As vehicles drive around they'll loose connectivity, transition between cell towers, or maybe move from a cellular network on to a local WiFi, all of which could lead to disruption to the data connection. AWS IoT has a number of tools that enable connections to be established and maintained. If a connection is broken, vehicle data can be buffered and subsequently synchronised when the connection returns, from the cloud side, if other services or devices need to interact with an offline vehicle they will not be disrupted and any commands or instructions to the vehicle can be queued.

- **Regulations –** As of 1st Nov 2017, Amazon AWS recorded compliance with the following, including the EU Data Protection Directive:

Certifications / Attestations	Laws, Regulations, and Privacy	Alignments / Frameworks
C5 [Germany]	CISPE	CIS
Cyber Essentials Plus [UK]	EU Model Clauses	CJIS
DoD SRG	FERPA	CSA
FedRAMP	GLBA	ENS [Spain]
FIPS	HIPAA	EU-US Privacy Shield
IRAP [Australia]	HITECH	FFIEC
ISO 9001	IRS 1075	FISC
ISO 27001	ITAR	FISMA
ISO 27017	My Number Act [Japan]	G-Cloud [UK]
ISO 27018	U.K. DPA - 1988	GxP (FDA CFR 21 Part 11)
MTCS [Singapore]	VPAT / Section 508	ICREA
PCI DSS Level 1	EU Data Protection Directive	IT Grundschutz [Germany]
SEC Rule 17-a-4(f)	Privacy Act [Australia]	MITA 3.0
SOC 1	Privacy Act [New Zealand]	MPAA
SOC 2	PDPA - 2010 [Malaysia]	NIST
SOC 3	PDPA - 2012 [Singapore]	PHR
	PIPEDA [Canada]	Uptime Institute Tiers
	Spanish DPA Authorization	UK Cloud Security Principles

Fig4 (above): List of Assurance Programs offered on AWS.

Amazon AWS provides you with the tools and resources to manage your customers data inline with applicable regulations, and even to prepare for and conduct audits if necessary.

A cutting-edge technology roadmap:

Increasingly, vehicle manufacturers are augmenting their services through the use of software applications. These applications might provide users access to new features within the vehicle, they might improve the driving experience or fuel economy, or they might assist in the servicing, fault diagnostics and repair of a vehicle.

By using AWS, the capability of these software applications are massively enhanced by providing access to greater processing power and data storage, but some of the biggest gains can be made by the level of integration possible. Below is a cut-down list of some of the new opportunities available when using AWS, but this list barely scratching the surface:

Integration with other devices or services – Smart phones & watches, traffic and road works, weather, pedestrian footfall, advertising – more and more organisations are moving their data and in some instances their IT infrastructure in to the cloud. The data your vehicles collect, or have the potential

to collect, might not be that valuable to you but could have huge value to a 3rd party. AWS enables you to securely manage, share and monetise that data.

Alternatively, other data available in the cloud can be used to enhance the services and capabilities your vehicles offer. The "Smart City" evolution has been a long time coming, but more and more devices are being connected and the potential to integrate is increasing with every passing day. By connecting your fleet to AWS your vehicles become an internet connected device, this enables you to participate or take a lead as cities get more connected and more integrated.

Artificial Intelligence – As vehicle drivelines move away from being fuel burning and towards being battery powered or utilising other energy storage systems, more focus is required for energy management and optimisation. Artificial intelligence or machine learning algorithms do not have to be incredibly complex, they can be basic and could deliver benefits to your fleet today. Amazon has spent the past 20 years developing capabilities in this area and part of their toolkit is designed specifically to enable the application of ai on connected devices.

Greengrass – Greengrass is an example of an emerging technology that provides access to a host of new capabilities.

AWS Greengrass allows for the "on the spot" processing and decision making to be moved from the cloud back to the vehicle. This might sound a little counter intuitive given that a greater level of integration is one of the main benefits of AWS, but it's really exciting! Think of Greengrass as an extension of AWS, where processing can now be completed on vehicles as well as in the cloud – the cloud will manage the processing routines and synchronise these with the vehicles, and the vehicles will execute these routines. This enables devices to act locally removing the need to transmit and receive data, which means much faster decision making. It means that if a vehicle has lost or has an intermittent connection, it can operate independently without disruption to services and it also means the amount of raw data needing to be transmitted to and from the cloud can be greatly reduced which in turn reduces costs.

Summary:

As more organisations move their data and IT services in to the cloud, traditional non-cloud based vehicle telemetry systems will struggle to keep pace. The vehicle industry is demanding more data, faster analysis and greater levels of integration. Off-the-shelf services provided by AWS present a massive step change in what's possible with vehicle telemetry and are leading the way on many of these emerging trends.

The benefit of moving to AWS is monumental, with the ability to scale up easily, access more data and use secure bi-directional communication all representing huge advances. This makes services like remote vehicle diagnostics and predictive maintenance achievable across a large fleet through the VPVision platform.

AWS is incredibly flexible so applying this technology to different vehicles or different systems doesn't present a challenge.   Immediate enhancements to your existing services, such as repair and maintenance tasks, can be quickly realised, but these easy-wins don't represent the best reason for moving to AWS. If you look longer term, the technology roadmap and investment is colossal, AWS will

continue to spawn more cutting edge technologies and continue to provide your vehicles and systems with entirely new possibilities, new capabilities and importantly, brand new revenue streams not otherwise possible.