CONNECTED VEHICLE CLOUD
UNDER THE HOOD
Ericsson’s Connected Vehicle Cloud increases the value of car manufacturer’s core business, creates a direct channel to the driver and introduces new actors to take an active part in the value network of the automotive industry.

The rapid development of connected vehicles offers great opportunities! Automotive manufacturers (OEM) will gain a direct channel to customers, strengthening brand relations, driving aftermarket sales, improving quality and building new partner business. The OEM will, using the Ericsson Connected Vehicle Cloud (CVC), create a whole new communication channel to drivers, passengers and vehicles and enabling new business models and revenue streams for the actors in the eco-system of the automotive industry.

The Connected Vehicle Cloud is a connected car solution for telematics services, head unit control and OEM eco system management. CVC is prepared for use cases where the car plays an integral part of the Networked Society building solutions with the home, the city etc.

CVC is built on top of the robust and battle proven Service Enablement platform from the Telecom Industry. It is used cross-industry, leveraging experience, re-using functionality and sharing investment costs between several customers. Ericsson’s Service Enablement provides the essential functionality for building the automotive eco-system, such as Device Management, Identity Management, Commerce and Product Catalogue, Service and Business Management, Service Creation and Exposure. With CVC you have the market’s best designed platform to build an eco-system that connects OEMs with the drivers/owners and the vehicle (Head Units and Telematics Control Unit) but also adding dealers, repair shops and new partners.

The CVC is a fully API based platform that provides integration points for easy connection to both external and internal systems.

In CVC, new actors are given access to existing data, integrated from the car and enhanced with OEM data (CRM etc.) and data from other actors, to fulfill new business needs. The modular approach re-uses integrations and business logic when connecting new actors. This is a key differentiator for time-to-market, creating innovation and being prepared for new use cases.

CVC is proven in the automotive industry and is behind the Volvo Cars Sensus, the world’s first truly global infotainment solution, launched November 2013, and also the cloud system behind AT&T Drive. Volvo Cars Sensus won “Best Infotainment Solution” at Telematics Update in Detroit 2014 and Ericsson was awarded the most prestigious price - “Best Telematics Service Provider”. The judges stated that Ericsson’s “level of innovation” was outstanding and this proves our role in the disruptive world of connected cars.
Vehicle & Device Data Connector

Ericsson Connected Vehicle Cloud provides functionality to connect vehicles and other devices to the cloud without compromising on security.

Vehicles are securely connected through a bi-directional communication link supporting multiple protocols and notification mechanisms such as SMS Shoulder Tap, HTTP, and MQTT.

Status information and data are collected and sent to CVC, where it is normalized, stored, aggregated and combined with data from other systems and sensors. This data is distributed (in part or in full) to the CVC applications and actors that have been granted the relevant access rights. The fine grained access control makes it possible to only expose the precise subset of information needed by the subscribing service, for instance an analytics system. Events are defined for notifications when a particular set of conditions apply.

The firmware update functionality enables the OEM to perform over-the-air updates of software and firmware of onboard units in the vehicle. CVC acts as a cache, delivering software updates to large amounts of vehicles. It also provides business rules and scheduling functionality allowing the OEM to control which software file will be provided to what vehicle and when. A number of industry standard protocols for software and firmware updates are supported out-of-the-box and additional protocols are added using an open SDK.

Screen & Head Unit Management

The Screen & Head Unit Management simplifies the complexity of reaching the user over many screens inside and outside the vehicle. It includes the tools for managing the full life-cycle and version control of both thick and thin clients. It also has a complete Application Store.

CVC features dynamic multi-Screen Management allowing users to interact with their vehicle and access services from any type of device, such as tablets, computers, smartphones and the vehicle head unit. The user experience for each of these devices can be designed through easy-to-use graphical tools. Screen rules can be applied to further control the presentation. Screen rules are validated at each request and control visibility of services based on context. Example of screen rules:

- **Service Availability** – only show for right vehicle model, SW version, market
- **Driver Distraction** – only show services when the car is not moving
- **Segmentation** – for the first two weeks, only show this to drivers with leased cars
- **User Behavior** – show this introductory offer to individuals whom never subscribed to this service before.
- **Time** – only show this information during daytime
- **Location** – show information based on vehicle location

Figure 2: Connected Vehicle Cloud functional overview
Security

The CVC is a complete solution for authenticating and establishing a secure communication channel between CVC’s Cloud Entry Point (CEP) and the vehicles. All communication is encrypted and authenticated using certificates distributed by a Certificate Handler. It provides a Public Key Infrastructure (PKI) with certificate based mutual authentication between devices and cloud. Mutual authentication ensures that both device and cloud (i.e. server side) can verify authenticity of each other. Access can be revoked or suspended through OCSP standards, this puts the OEM in control over which devices have access.

![Certificates handling](image)

Business logic to engage new actors are separated from technical integration to ensure innovation and capturing future business opportunities

Partner Management

Partner Management provides everything needed to support the business processes and workflow for managing the relation with all the different partners that the OEM is working with.

Both internal OEM systems and partner systems are integrated through APIs to CVC. The procedure for connecting internal actors and external partners are the same and this design is important to allow use cases to evolve and scale over time.

On top of boundary defenses like encryption, CVC comes with an additional level of security based on a Security Incident and Event Monitoring (SIEM) system that is used to detect suspicious communication patterns and anomalies, sometimes also referred to as an Anomaly Detection system.

Anomaly detection systems help to protect against malicious attempts to hack the vehicles. Events outside of the normal pattern will be detected and the reputation level of the device will change. CVC controls the policy for how a device is using services. For example, if the Anomaly detection system lowers reputation the CVC may enforce read access only.

Additionally the CVC includes a Secure Gateway that filters web surfing traffic when a driver use the Head Unit web browser to browse the Internet. The Secure Gateway filters out virus and malware and ensures that no malicious websites that could damage the Head Unit are accessed.

Partner Management

Partner Management provides everything needed to support the business processes and workflow for managing the relation with all the different partners that the OEM is working with.

Both internal OEM systems and partner systems are integrated through APIs to CVC. The procedure for connecting internal actors and external partners are the same and this design is important to allow use cases to evolve and scale over time.

Business logic to engage new actors are separated from technical integration to ensure innovation and capturing future business opportunities

![Business logic to engage new actors are separated from technical integration to ensure innovation and capturing future business opportunities](image)

Partner Management starts with a financial and technical agreement for accessing vehicle data, user data, provide applications or services. The OEM and the Partner use the Partner Management tool to sign business agreements that control the business terms and Service Level Agreements (SLAs) of both the services that the partner will gain access to through CVC and the application and services that the partner will provide. CVC provides an interface for uploading services (applications) and Editorial Tools for promoting these services.

This whole Partner Management process is controlled with a dynamic configurable business work flow. For application and services, several models of control exist, ranging from full partner control of offers, products, and price to full OEM control.

![Partner workflow](image)

API Management

CVC comes with numerous documented APIs that can be used for easy integration with partners and external systems.

API management is a key component for establishing a developer network. It is used to expose any API or
capability of the CVC and make it available as a business-to-business (B2B) offering by the OEM. A key strength of the platform is the ability to combine APIs from several sources to present a single uniform API to fulfill specific partner needs. API access is throttled (to protect against overload) and validated against the partner SLA.

Here are some examples of the over 50 documented APIs:

- **Service Management** - enables external systems to create, update or query partners, agreements and services.
- **User Profile** - allows adjacent systems to exchange user information with the Cloud, i.e. search for, set, and retrieve information about the drivers/owner/vehicle and associated meta information.
- **Commerce** - allows an external system to exchange commerce information and handle purchases
- **External Activation** - enables the CVC to send notifications to external systems. For example, sending a subscription notification to a partner of Telematics services or car theft service.
- **Customer Care Integration** – the Customer Care tool can be embedded in an external system, enabling users in an external system to access the Customer Care tool directly
- **Content Provider** – enables content providers to upload, offer and sell content
- **Media Asset Event** - allows external systems to consume asset ingestion, edit and deletion events that have occurred in the media repository

---

**Connected Vehicle Cloud is an open platform with API access to all information and services**

**Business Logic**

The business logic in CVC is where you manage and facilitate relationships between different actors and create use cases. The Service Classification manages on the highest level what service is available during which circumstances for whom and how.

The CVC runs and controls two types of external services

- **Proxy Services** – the CVC is in full control of the service. The data stream runs through CVC and the service could be enriched with additional information inside CVC.
- **Redirect Services** – initial access to the service is controlled by CVC and a direct connection managed and set-up between the user and the service.

---

Figure 5: Service Classification

CVC includes a full Identity Management system to keep track of policies and privacy settings for drivers, car owners, vehicles and partners. CVC works in a hierarchy where business logic is managed globally and distributed to different regions.

The Rule Engine executes on policies and context rules in real time. Context is information about date, time, location, vehicle model; explicit and implicit driver/owner information such as preferences, customer segment and purchase behavior, distraction rules and limitations of the device, SW version etc.

The services are priced and charged by the combination of the Product Catalogue and the Commerce Engine. The charge for a service is handled by a payment broker or a credit card provider.

The actual price of a Service is an Offer that could change based on context. Building offerings is very flexible, with multiple charging methods and multiple ways to settle pay outs to partners. The offerings have configurations like:

- **Bundle** – Possible to bundle products
- **Subscription** – with/without automatic renewal
- **Target Consumer Group** – available to a specific consumer target group
- **Time** – an offer in a limited time period
- **Free trial**
- **Usage limit** - number of times it may be used
- **Expiration time** - fixed date/time after purchase
To share revenue between Partners the following Settlement Cases are supported out-of-the-box:

- Sponsoring – a third party acts as sponsor
- Percentage of product price
- Fixed wholesale price

Customer Care is an intuitive and straightforward web-based application. With this application, customer care personnel help drivers/owners solve problems. The main purpose of this tool is to help customer care personnel to keep the driver/owner satisfied. This has been made possible by enabling the following:

- Accessing a service using the same settings as the specific driver/owner. This enables customer care to do a step-by-step guidance.
- Refunding if they are experiencing problems with payment of, access to, or download of premium content.
- Viewing the driver/owner profile which contains more in-depth information.

**Application Execution Environment**

CVC can host and monitor applications in the cloud developed by either the OEM or partners. These applications run in a secure environment called Application Execution Environment (AEE) which deploys, configures, monitors and hosts Hosted Web Applications (HWA) built in Java.

The SDK (Software Development Kit) for HWA provides an environment and framework for building and testing. The AEE and its SDK can be used to develop and host both applications that realize complete end-user services as well as applications that combine common functional components to be re-used by many applications.

The Application Execution Environment provides support for:

- Running and centrally monitoring HWAs
- Deployment of HWAs with independent release cycles from a global cluster to one or more regional clusters
- Replication of assets, services, and data from a global cluster to one or more regional clusters
- Possibility for data storage APIs which allow HWAs to utilize the CVC data storage to store application data and share data between applications for mash up.
- Storage of user settings in the cloud allowing user settings to be available in any vehicle.
- Usage of the CVC Rule Engine to control which applications can be accessed by which users and in which context
- Options to control where the application data for each user is physically stored to comply with regulations that prevents transferring data across borders

**Ericsson Hosted Web Application**

In combination with API Composition are used to remove complexity and processing from the Head Unit (HU) of the vehicle to the cloud and thereby enhance user experience. For example, when integrating internet-based service API’s through CVCs proxy service:

- Multiple internet style API requests are aggregated in CVC HWAP server objects to provide a single response to the vehicle HU
- Service Provider APIs may use resource demanding protocols, for example XML. These can be translated into more lightweight protocols that the HU can more easily parse, like JSON.
- Above combined with efficient HU client design utilizing CSS and JavaScript with local browser caching allowing for asynchronous communication to CVC
Cloud Management

The Service Enablement is by design built for being deployed on industry standard cloud infrastructure platforms. Adding new nodes on the fly is a fundamental design structure used for dealing with temporary data peaks but also for fast action on business changes. “Always on-line” is a top priority and to maintain a great customer experience the CVC is ready to be integrated to a operation support system to manage up-time and make sure that operations identify and solves potential issues before drivers are hit.

The CVC built in a hierarchy with a Central Node that connects to the OEM back-end systems and synchronously or asynchronously makes parameters available in the cloud and distributed to regional nodes.

![Central Node diagram](image)

Figure 8: Cloud deployment

The regional nodes are in the cloud but need to be distributed physically in regions (like US, Europe, China). This could be solved by an infrastructure-as-a-Service (IaaS) provider offers the possibility to distribute nodes or you have to connect several IaaS providers in the solution. The reason for the distribution is performance and legal data issues but also for different enhanced technical offerings. For instance, partnership with a mobile operator in one region that enables operator billing. The replication between Central and Regional nodes provides the function to synchronize assets, services, agreements, partners, and other data.

![Synchronous / Asynchronous communication](image)

Figure 9: Synchronous / Asynchronous communication

The platform uses well-defined Version Management concepts for its publishing process. It is a flexible role based environment that makes it easy to perform small and frequent updates to the system such as change discovery, offers, price, content and segmentation and business rules. It is possible to do these changes simultaneously and still deploy them independent for each other. The System Management tools support deployment, rollback and testing, as well as system management and internal and external reporting and settlements handling. Multiple versions of the system configuration can be live simultaneously in the production environment; which is very useful for phased migration when launching new features.

Scaling has been a number one focus when creating the CVC. Cars have a very long life cycle and it is impossible to predict the upcoming services and service usage.

The CVC scales in three ways

- **Adding** Regional Nodes
- **Horizontal scaling** within a Regional Node
- **Shore outing** light versions of a Regional Node for connection

![Deployment and version management](image)

Figure 10: Deployment and version management

Ericsson is your partner

- **Long-term partner** founded 1876
- **Global Company** present in 180 countries
- World’s 5th largest SW company
- Running **Managed Services** for 1 Billion end-users – processes and people in place

Connected Vehicle Cloud – Facts

- **June 2014 – Best Telematics Service Provider** – Telematics Update Detroit
- **Performed more than 15,000 request/s, over 300 payment transactions/s and 2000 Partners connected**
- **Reduce cost of ownership** – CVC built on existing platform, leveraging investments from many customers and industries
**Connected Service Booking** Data collected from the vehicles is shared with repair shop networks to offer regular and proactive maintenance, providing a better user experience and hassle-free car ownership.

**Delivery of goods** Use your car as a delivery space for goods, using existing car integration. With partner integration and API exposure the already existing find car and digital key functions are authorized to be used by delivery companies.

**Car-to-infrastructure communication** Data collected from vehicles, for example road friction, are sent to the cloud and used to warn other cars in the same area. The same data is shared with road authorities. This type of use case will be vital for self-driving cars.