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Positive Impact of AVL on Safety & Security

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Abstract: **An automatic vehicle locator (AVL) is an IoT application widely used in companies and organizations for the safety and security management of their mobile assets, such as vehicles, engines, ships, equipment, etc. AVL is generally used to track and locate assets in real-time as an essential function, using the global positioning system or GPS. The application relies on the extensive mapping that has been done to support GPS-based applications and satellite services. AVL has many benefits, such as assets utilization, optimization, and maintenance of historical data records, among others. The application creates a specific user interface to locate and track a mobile object on a map quickly. The AVL systems (AVLs) provide organizations with a tool to optimize their fleet by giving an overview of how the vehicles are used, and can be relocated within the organization based on the organization's needs. Moreover, AVLs track the assets in real-time, which contribute significantly to the security and safety of the people during emergencies situation. AVL systems have a specific module for the maintenance with alerts for a periodical check-up to keep the assets healthy.**

Keywords**: AVL, global positioning system, fleet management.**

1. INTRODUCTION

The AVL system consists of hardware that is installed in the vehicle, Machine to Machine (M2M) SIM card, communication server, database, and front-end application. The equipment can be GSM, satellite or combined for both GSM and satellite. The GSM device is used where there is a GPRS coverage only; the satellite device is used where no GSM coverage and the connection method is used all the time. When there is no GSM coverage, the AVL will switch directly to the satellite. There are many types of AVL, which vary depending on the size and the need of the organization. The AVL can be hidden inside the vehicle connected to the dashboard to read all engine information. The AVL system uses the M2M SIM cards, designed to live longer in the elevated temperature environment. The communication server is used to receive the encrypted data coming from the AVL devices via the M2M cards and the communication tower, or satellite via listener application. The data will be sent to the database via a parser application running on the communication server. The front-end application is the window where the end user monitors and tracks his vehicles, and produces the desired reports. The primary AVL application includes per minimum map to locate the car, the reports module, and the configuration module to set up the alerts and manage the fleet.

This comprehensive system provides the following features:

Live Location of the Vehicle

This feature is significant when using the AVL systems because it contributes significantly to the safety of the driver and security of the vehicle. Safety is an essential aspect for any organization and ensures that the person given the car can be tracked as they carry on their activities. The vehicle safety can be ascertained through the use of the system and can be used to ensure high accountability.

- Speed monitoring according to the roads speed
- Location history for any vehicle at any time
- Alerts messages via email or SMS for over speed or seat built

- Restricted areas using Geofence to control the movement of the car

Finally, the AVL can help the organizations to optimize their fleet by analyzing vehicle utilization to reduce cost.

2. HOW AVL WORKS

AVL is a system that consists of hardware and software illustrated in the below figure.

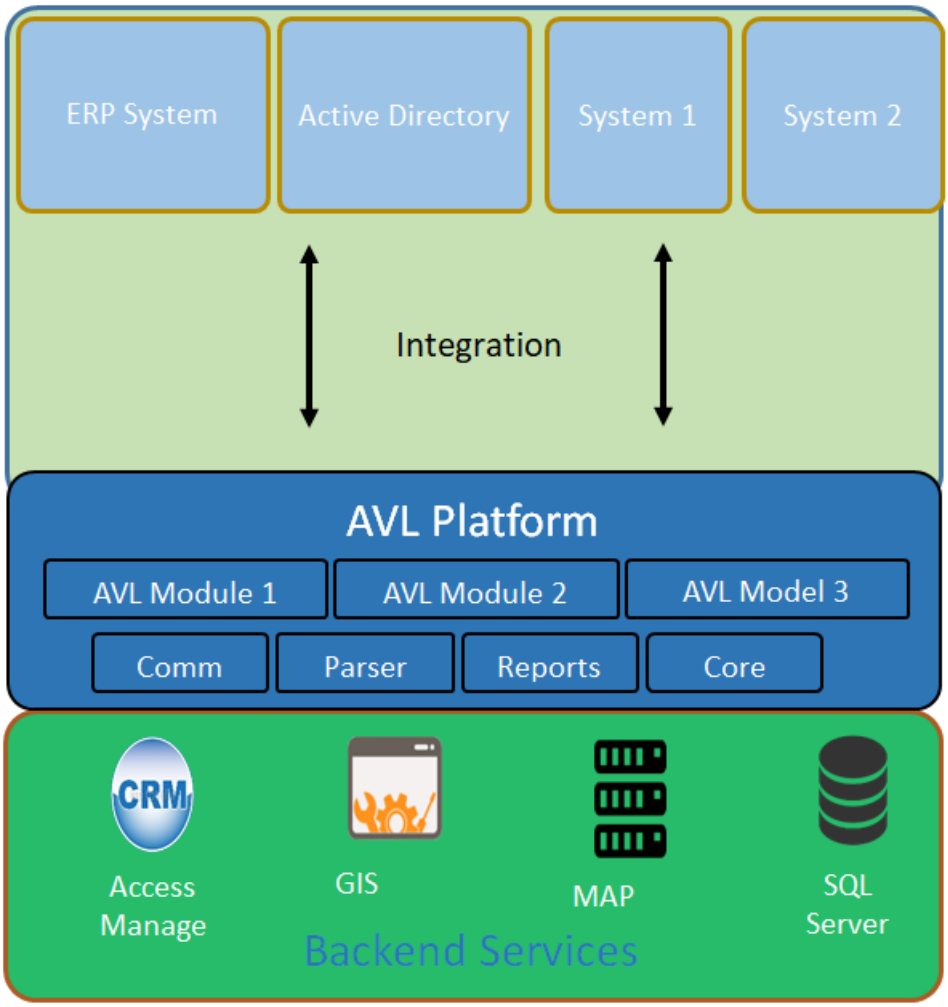

Figure 1: AVL Hardware and Software

The above diagram shows the AVL system integrated with corporate ERP to collect asset information. Also, connected to the backend services for map, access, and database. This comprehensive AVL solution provides the end users with full information about the asset and the real-time location on the map (Furth et al., 2004). Therefore, the AVL program can be used to manage, direct, and control mobile assets, such as vehicles, which makes the AVL an essential tool for transport companies.

3. AVL DEVICE SPECIFICATION

The device is connected via two approaches, the GPRS in the GSM coverage area, and satellite in remote areas where there is poor network coverage. As such, the various connectivity of AVL ensures constant connect and discovery by the owners, even in areas with poor coverage due to the satellite connection (Almadani et al., 2015). The AVL device recommended specifications include:

- Operating Temp should be +70c
- Datum: WGS-84

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- UP to 120,000 data logs
- Firmware upgrade over the air
- Dimension (72mm X 108mm X 31mm)
- Communications: GSM, SMS, GPRS, TC/UDP, FTP, USSD
- Input Ports: three digital inputs (one seatbelt sensor input & two additional), one analog
- Output Ports: two Outputs

The data is sent from the AVL device to the communication server is binary encoded. An example below in Figure #2

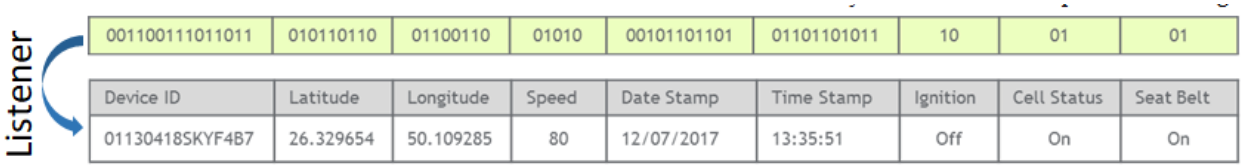

Figure 2: Binary Encoded Data

To protect data from loss during transmission, the AVL application uses Data Distribution Service (DDS) based middleware to ensure data availability and efficiency during transmission. DDS middleware is used today in various applications, such as industrial automation, defense applications, and aerospace operations (Dailey & Cathey, 2003). DDS is used because of different characteristics that support mobile distributed environments and improve the efficiency of the network (Almadani et al., 2015). The following are the unique features of DDS middleware that allow its use in the AVL applications.

4. DATA DISTRIBUTION SERVICE FEATURES

Asynchronous Interaction

The asynchronous interaction is an online-based communication approach that facilitates communication irrespective of the time and location of the communicating parties. As such, DDS makes a perfect middleware for transmission in the AVL devices, because the asset and the owner are mostly in different locations and time regions (Almadani et al., 2015). Unlike the synchronous communication, which is affected by the bandwidth and the connection frequency, the asynchronous interaction is more reliable.

Data Sharing

DDS can offer continuous data even in the absence of the server between the asset and the AVL device, which makes it the most effective and reliable data distribution approach for AVL. Consistent connectivity and access to the database should be provided to the device users, even without the availability of a connection, which has promoted the desirability of DDS in AVL devices (Almadani et al., 2015).

DDS Offers Dynamic and Reflective Reconfiguration

DDS is used in the AVL device due to its ability to allow different connections with available resources (Almadani et al., 2015). The mobile nodes can adapt to the changing environment without the need for optimization to optimize the system.

AVL Application features

The AVL front-end application consists of the following features:

- The tracking functional specifications include: speeding (general, corporate specific speed), seat belt, harsh braking, zooming in/out monitoring, tampering and abnormal acceleration (Almadani et al., 2015).

- Custom reports features include; asset utilization report, seat belt violation reports, daily commuting reports, speed violation tickets report, and speed violation report. These custom reports can be used to increase the control of the AVL device (Almadani et al., 2015).

5. CONCLUSION

AVL systems are globally used by organizations to reduce the fleet maintenance cost, optimize fleet usage, and rescue drivers and passengers in case of accidents or breakdowns. The Return on Investment (ROI) of the system is recognized to support the organization's operations. AVL uses advanced communications technology, the fleet, or any moving objects that can be tracked anytime and anywhere, and the services are charged a competitive price to attract more consumers. Moreover, the AVL system components have high quality and built-in components in all modern vehicles, to enable the owners to efficiently manage and use the AVL system in a very cost-effective manner. The AVL applications use DDS-based middleware, which ensures high data availability during transmission. The use of DDS-based middleware is motivated by its data-centric and asynchronous communication paradigm, along with many sets of Quality of Service (QoS) policies. AVL applications have many reports, based on extensive data collected, that help organizations to establish an AVL dashboard to analyze data and give a clear picture on the driver's behavior, vehicle maintenance records, and offer operations support.

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