

eSync Adaptive Delta Compression Engine

Introduction

The eSync™ Adaptive Delta Compression Engine (eSync Delta) is used by the eSync OTA Server to optimize OTA (Over-The-Air) updates. The engine uses binary differencing algorithms that have been enhanced by Excelfore’s own patented dynamic compression technology. It is available as separately-licensed software as well as part of the eSync System.

A delta update requires only the download of the difference between an existing software version and the new version. The full new version is then reconstructed locally. When there are millions of vehicles receiving software updates, delivering them as delta updates is an effective mechanism to reduce bandwidth and airtime.

Delivering updates using deltas is a proven concept. Delta updates are commonly deployed for PCs, set-top boxes, smartphones, and other devices.

Automotive Delta Update Challenges

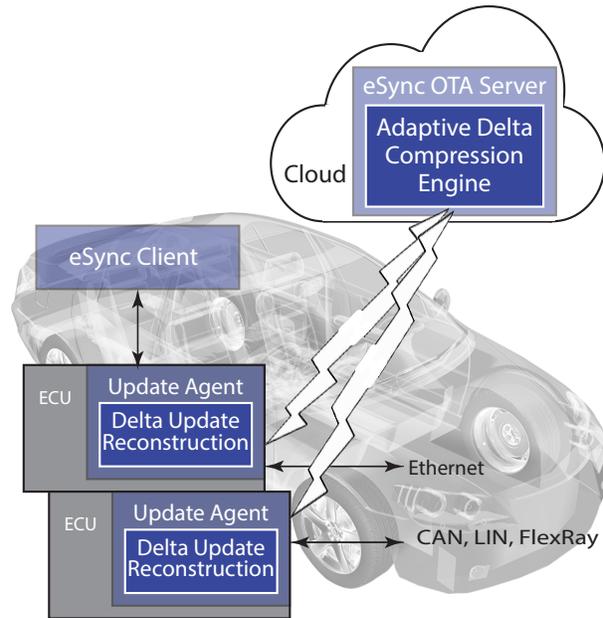
Automotive OTA is more complex than OMA-based (Open Mobile Alliance) OTA used for mobile devices. Within a typical vehicle, there are dozens of processors with different computational capabilities on different kinds of networks.

A compression scheme which optimizes only for file size reduction may have certain shortcomings. It will reduce transmission airtime, but reconstruction may be so complex that it extends downtime while the updating device decompresses, reconstructs and installs the new file(s).



The complexity of delta reconstruction drives OEMs to perform it in the headunit. This has two drawbacks. First, the reconstructed file is substantially larger than the delta, and will extend downtime as it transmits over the vehicle networks. Second, if several ECUs are to be updated at once, the total vehicle downtime will be even longer, as these updates must be reconstructed serially in the headunit.

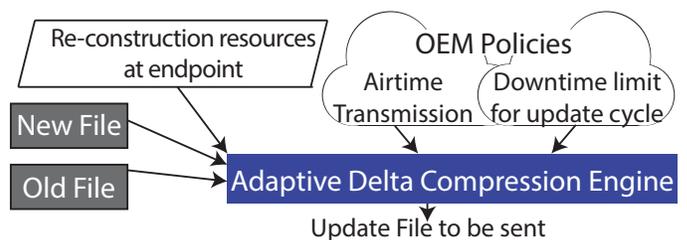
Reconstruction could be done in parallel in the endpoint ECUs; however there may be processing and memory limitations. Current update engines do not take into account endpoint resources when compressing the update file.



eSync Adaptive Delta Compression Engine

Excelfore delta update creation and delivery begins at the OTA server. eSync Delta analyzes the differences between the old file and the new file. eSync Delta then takes this a step further by using an adaptive approach. It selects a differencing and compression strategy to match the specific computational resources of each end device in the vehicle and the specific policies set by the OEM.

eSync Delta uses a variety of differencing algorithms. These algorithms exhibit varied efficiencies based on data content. eSync Delta selects the best approach for creating the delta file based on more priorities than just file size.



There are a variety of compression algorithms which perform well on difference files. eSync Delta uses its patented dynamic compression technology to dynamically choose the technique which produces the smallest file that the endpoint can reconstruct, given the OEM’s airtime and downtime policy inputs. The compressed difference files are then securely encrypted for transmission.

OEM Policies and Decisions

The optimum delta for a target ECU depends on a variety of factors, and the Adaptive Delta Compression Engine considers these factors when determining the best compression scheme for a given file.

- **Re-construction Resources**

eSync Delta will select a compression scheme that works within the target CPU resources.

- **Vehicle Downtime Limits set by the OEM**

eSync Delta can select a compression scheme to minimize downtime.

- **Airtime and Transmission Policies set by the OEM**

eSync Delta will select the compression scheme with minimum downtime when bandwidth costs are low. For example, Wi-Fi delivery is usually faster and less expensive than cellular delivery.

Delta Update File Creation

Delta Updates are specific to the difference between the old version of the software and the new version of the software. OTA campaigns may have multiple Delta Update files; for example, when updating to version 1.2, there will be a file for updating version 1.1 to 1.2, another for updating version 1.0 to 1.2. The update files are managed dynamically during run-time, or can be pre-computed and stored.

Security and Data Integrity

To enhance security and ensure correct delivery of updates, the eSync System uses SHA-256. Original files have an SHA-256 hash value computed and attached in the OTA server.

The eSync Delta reconstruction software at the endpoint can compute an SHA-256 hash value on the reconstructed file and compare it to the original hash it received. A match ensures that the Adaptive Delta Compression Engine has produced an exact copy of the original binary image. The system can then complete the reflashing of the endpoint device.

More information on encryption and SHA can be found in the Excelfore eSync System Guide.

The eSync System and the Adaptive Delta Compression Engine

The Excelfore eSync System uses the Adaptive Delta Compression Engine. Excelfore provides a variety of OEM policy inputs to take full advantage of the capabilities of eSync Delta. OEMs who license eSync Delta software separately can use the full range of features or a subset.

Ease of Integration

eSync Delta provides straightforward integration with the OTA server. APIs integrate with local file systems, security systems, operator inputs, and other system resources.

Sample Delta Update Reconstruction Engines are available. These have APIs to interface to local file systems, security systems, and other resources.

Excelfore offers engineering services, and can assist in configuring the Adaptive Delta Compression Engine for custom environments, or integrate it into the OEM system.

Summary

The eSync Adaptive Delta Compression Engine optimizes compression of software updates for OTA delivery within the constraints that are unique to the automotive industry. It lets OEMs minimize service costs and vehicle downtime, increasing customer satisfaction.



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