DMT in

Hitachi Entier Database

DMT - Enabling the delivery of relevant and reliable digital map data and content

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Overview

WindSpring is an OEM software development company formed in 2004 to exploit its advanced editable compression product. WindSpring is concentrating its development and support efforts on the OEM navigation market. The technology is called Data Miniaturization Technology or DMT

WindSpring has been awarded three patents in the area of compression, editable compression, and stream compression.

DMT has been tested by Hitachi US on the Hitachi Entier database. This use case describes that implementation and the results from those tests.

DMT is now implemented on over one million vehicles, providing compression and advanced editing capabilities.

WindSpring has support both domestically in the United States and overseas in Japan.

Introduction

WindSpring SDK provides an elegant software-based solution for the data challenges presented by the next generation of mobile device data storage applications. WindSpring SDK utilizes WindSpring's patented Data Miniaturization Technology (DMT) to transform navigation data formats into WindSpring's new Micro Data Format (MDF).

MDF is ideally suited for accessing and editing navigation data used in on-line and off-line GPS navigation. Usually, the large amounts of update data often preclude timely system upgrades resulting in inaccurate navigation and POI data and poor user experience. However, DMT can provide the user with a richer experience by reducing the time to send update information, providing a mechanism to update compressed stored data, and enabling the application of on-line real-time updates to stored datasets.

Typical Embedded Database Issues

Performance

In the area of performance, key issues relate to memory utilization, data size reduction and speed of operation. DMT allows the customer to balance these three competing requirements by selecting different encoding of the dataset.

In this use case, DMT is used for POI searches and updates on a DMT compressed POI dataset. This dataset is attached to a navigation database for separate lookup and search for a spatial route.

Development

During implementation, the user will typically want to be able to tune the dataset. The best outcome is maximum compression with maximum performance and minimum memory utilization. DMT allows the user to achieve a balance that is not achievable with ZIP. The WindSpring development tools provide a flexible method of selecting and testing compression options.

In addition, it is allows the user to tune for update. Normal ZIP compression does not allow update except on a file basis.

DMT allows editing on a block basis and when edits overflow a block it provides a mechanism to append these edits to the end of the dataset.

Database Editing and Updates

The DMT edit process is well suited to database as individual edits can be applied to single blocks.

If the block size does not grow then edits are applied directly to the database block. In tests with the Hitachi Entier database by Hitachi, DMT compressed the database and provided performance increases.

Spatial Search

Description of system

In a typical spatial search, a route is first calculated. The route is then searched for POIs close to the route. These may be along the route or adjacent to the route.

Characteristics of these searches include:

- GEOMPOINT data-type used for spatial search
- Search by points, lines, routes, polygons and circles
- WITHIN and DISTANCE search functions
- RIGHT, LEFT or BOTH along a route

To implement DMT, a Dell PDA was chosen. The original database was analyzed for compression and suitable parameters chosen to balance compression, speed and memory utilization.

DMT Software Integration

DMT Results for Data Compression

KIWI data is usually provided on DVD and as such runs into size limitations based on ISPO file formats. These are usually derived from 32 bit pointers used for file sizes and indices.

DMT does not have this restriction. DMT allows individual files to grow beyond 4GB in compressed format. (Naturally the ISO limitation still applies to the compressed file).

DMTs codec provides enhanced file handling for compressed files in its WindSpring File System. This places multiple files in containers and **overcomes the inherent limitation of 4GB** files on DVDs.

This chart shows the maximum sizes that can be supported on DVDs when DMT compression is applied to typical KIWI datasets.

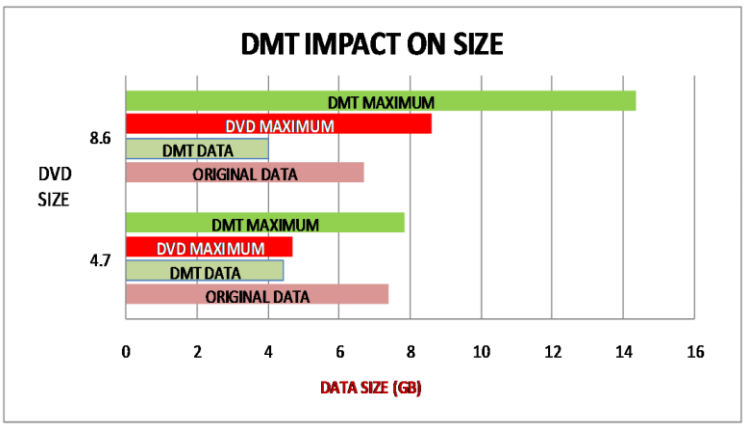

Figure 1 Impact of DMT on DVD Maximum File Sizes

In tests on both 4.7GB (SSSL) and 8.6 GB (SSDL) DVDs, DMT achieved compression ratios of approximately 40%. This increases the effective capacity of a 4.7GB SSSL DVD to approximately 8GB and the capacity of an 8.6GB SSDL DVD to over 14GB.

DMT Software Integration Process

DMT is a software only process that transforms the original navigation data into the Micro Data Format (MDF). This MDF is an exact representation of the original data stored using WindSpring's Data Miniaturization Technology. This format allows high-speed seek, search, edit and access of the encoded data while stored in the compressed state.

The key steps required for this KIWI implementation were:

- Analysis of the navigation data set using the DMT analysis software.
- Optimization for specific speed, file size reduction requirements, and device storage space constraints
- Integration of DMT APIs into the existing application.

Original mapping data was analyzed and then encoded into the MDF format. This analysis, optimization and encoding is done using a range of tools provided by WindSpring.

Edit in Place

Existing Format Limitations

KIWI navigation data updates are usually an updated DVD or a downloaded dataset for HDD systems.

Uncompressed formats compete for in-dash storage space and are slow to update.

Real-time data updates, such as traffic or road works, are provided over the air by carriers on either FM radio or mobile phone networks.

Point of interest information, including real-time pricing is very important for user satisfaction.

In online systems, large data volumes for POIs, traffic and parking information can lead to increased cost and delays.

DMT allows for a different update method.

Normal Online Strategies

Current on-line navigation map update services such as GBOOK are implemented with a mixture of web services, XML, and JavaScript. These technologies can be delivered in real-time to connected in-dash devices, using a data communications module.

Connections are provided using phones (GPRS, HSDPA or other wireless) or Radio (RDS/TMC, Sirius).

A user can customize this service (UCS) but in general the operation is:

1. Download the update or real-time data
2. Expand this compressed data to internal memory
3. Adjust navigation/LBS information based on the downloaded data

It is important to understand the internal resources that are required:

1. Communications buffer memory is required to buffer the compressed information
2. Information is then decompressed into another region of memory

3. **For an update**, the information must then be verified before it is used to replace the existing stored navigation data
4. Finally, the stored information is deleted and replaced with the downloaded dataset.

5. **For an edit**, the changed information must be verified
6. The stored information is then de-compacted, edited and re-compacted before being stored back as navigation data

7. **For real-time data,** such as parking or traffic, the downloaded data must be stored
8. This data must then be scanned whenever it is likely to affect either routing or LBS decision making.

DMT KIWI DVD Update Strategy

DMT is implemented as a block oriented compression strategy. This allows updates to be applied to individual data items in a block or appended at the end of the blocks.

By separating the descriptors for the data blocks, DMT can implement "edit" for DVD or HDD based KIWI map data. Edits and changes can be stored in the navigation controller memory and applied as the data is read from the DVD.

These changes could be delivered as updates to the system or as downloaded packets of information.

The same strategy can be used for dynamic data changes.

DMT Incremental Update Strategy

DMT can deliver updates to KIWI data that are smaller in size than complete updates of the dataset. These updates can be applied directly to the compressed DMT compressed KIWI map data without decompressing that data. Any defragmentation can occur in the background when the system is not being used for navigation.

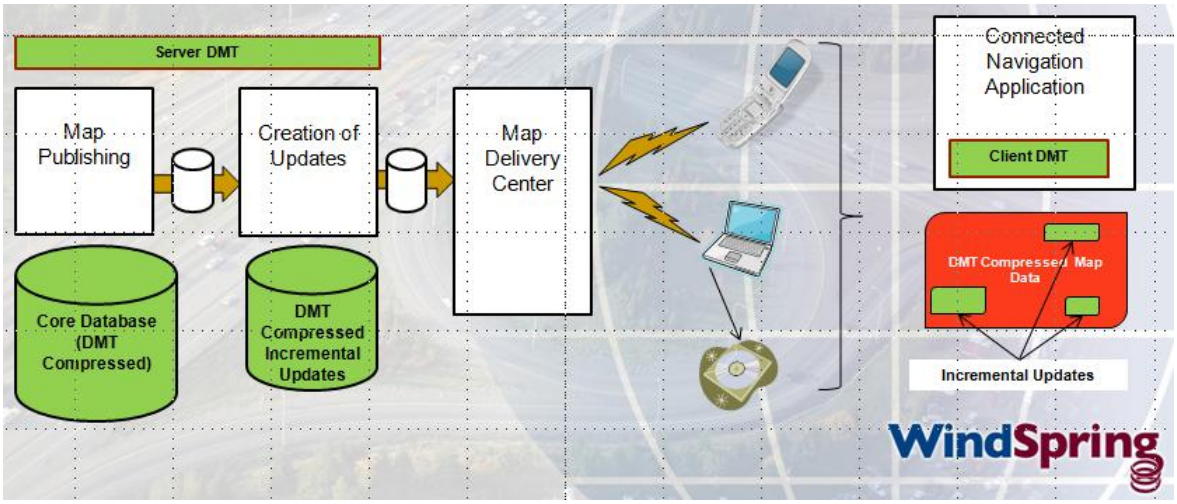

Figure 2 KIWI Map Update Delivery

Summary

DMT delivers relevance

DMT provides advantages for KIWI mapping data in the area of size, performance and updating. In general, compared to original data, DMT will provide a compression of around 40% while delivering speed increases up to 30%. When compared to compressed data (such as LZ data), DMT will provide similar compression performance and speed increases of the order of 5-10%.

More importantly, DMT provides the ability to update that data in the field, whether this is by direct update of the map data or by update of auxiliary database files such as POI.