Surfing on Big Data

Vector Measurement Data Management
### Connecting Measurement Results

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<th>Clutch</th>
<th>Team</th>
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<tr>
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<td>System A</td>
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<td>System B</td>
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<td>C</td>
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<tr>
<td>Hybrid</td>
<td>System C</td>
<td>System A</td>
<td>D</td>
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- Each team does own measurements and data analysis
- Team B notices an issue with the transmission
- Team C not aware of any transmission related issues → no effort spend analyzing transmission data
- Team B does not know about the measurements of team C

**Question:**
- how to see correlation between measurements of different teams?
- how to share analysis results with other teams?
- how to prevent to redo measurements by different teams
What are Metadata?

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- Meta data set measurements into perspective
- Meta data are every additional information to a measurement
- Meta data are at least as valuable as measurement data

“... Being forced to see life’s metadata is good training for looking for interesting angles on a topic”

Chris Hardwick
vMDM is Vector’s solution to **manage and analyze** measurement data

**Data management:**
- Store vast amount of measurement data on a vMDM server
- Data are organized into data catalogues, so called collections
- Manage access rights for users and groups
- Search and filter files based on flexible, user defined criteria
- Download files to use in desktop tools

**Data analysis:**
- Pre-process uploaded data following user defined specification
- Automatically analyze signal- and/or meta data
- Share analysis results and reports with your team
vMDM Solution Overview

vMDM Product Variants

vMDM Local

- Part of standard feature set of CANape / vSignalizer / vMeasure exp
- Automatic indexing of MDF files on user's PC
- Meta data based searching & browsing like for server-based vMDM

vMDM Cloud

- Software as a Service (SaaS) in the Vector Cloud
- Data centers in Frankfurt (DE), Tokyo (JP) and Buffalo (US)
- Data stored in highly scalable, redundant object store

vMDM Enterprise

- Installation in customer's data center
- Operation & maintenance by customer IT staff
- Storage subsystem to be provided and managed by customer IT
Local vMDM in Vector Tools

Local vMDM Included in Standard Feature Set

- Direct access from Vector tools
- Local file storage
- Organize, filter, and search measurement files by meta-data attributes
- Save and recall queries
- Inspect file:
  - Meta data
  - Signals
  - Attachments
  - Events
Data Searching and Filtering

- **Full text search**
  > Explore measurement data in the most intuitive way using full text search

- **Property-based filters**
  > If you need more control over your search vMDM allows to filter search result based on property values:

  "all files from last 24 hours where max. oil pressure was larger than 3.4 bar"

  > An easy to use graphical user interface helps to create powerful filters with few mouse clicks

- **Queries**
  > Although working with filters is easy in vMDM, you want to avoid to do repetitive work
  > Therefore vMDM allows to store search & filter conditions for later re-use as so called queries
  > Queries can be private, shared with the project team or even global for all vMDM users
vMDM Solution Overview

vMDM Product Variants

**vMDM Local**
- Part of standard feature set of CANape / vSignalizer / vMeasure exp
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**vMDM Cloud**
- Software as a Service (SaaS) in the Vector Cloud
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**vMDM Enterprise**
- Installation in customer's data center
- Operation & maintenance by customer IT staff
- Storage subsystem to be provided and managed by customer IT
Software-as-a-Service

- Usage-based business model
- Service includes
  - Installation
  - Operation and maintenance
  - End user support

Vector Cloud

- Operated by certified partners
- Worldwide data center locations
  - Buffalo, Frankfurt, Tokyo
- Customer-specific data location policy
  - e.g. Europe only
Administration Roles

- **System Administrator**
The system admin manages system wide vMDM aspects such as administration role assignment or recovery of deleted files and collections.

- **Collection Administrator**
A user who manages a collection.
vMDM indexes your measurement data based on a collection-specific **indexing scheme**

- The collection admin can define the indexing scheme using an easy to use tool with graphical user interface
- No adaptation of the software or the layout of an SQL database scheme required like for other tools

The result is a set of **meta data properties** which describe each measurement file, for example:

- Measurement start time
- Comment
- File name
- Measurement module serial number
- ECU SW & data revision
- Vehicle identification number
- Component variant codes
- ...

Properties are used to **search and filter** measurement files in vMDM

- Measurements are solely organized in terms of collections and properties
- This allows to create flexible data views, not limited by a static directory hierarchy
vMDM Concepts

Upload Data to vMDM

- vMDM offers several ways to initiate an upload of one or several measurement files
  - Once an upload is initiated vMDM will manage the upload task in the background
  - If an upload is interrupted due to network disconnection or restart of the computer it will be resumed automatically when vMDM is online again
  - Ongoing and completed uploads can be viewed from the vMDM icon in the Windows taskbar

- From the **Windows File Explorer**
  - Right click on some MDF files and select a target collection from the vMDM submenu

- From **CANape / vMeasure**
  - Simply configure the recorder(s) of your measurement configuration to upload to a vMDM collection

- Using the vMDM **command line tool**
  - Upload files from batch scripts
  - For integration of tools which do not yet support direct connection with vMDM
vMDM Concepts

vMDM Pre- and Post-Processing

Pre-Processing

\[ \text{sig} = f(a,b) \]
Offline Measurement

\[ T_{\text{max}} = 98^\circ \]
Metrics Calculation

\[ \text{max}(y) > 8 \]
Detect Signal Patterns

VIN : a30z
Meta Data Generation

Post-Processing

Pre-processing: executed once for every file
Post-processing: executed for each analysis, results are stored in vMDM
vMDM Concepts

Collections

- Measurement files are organized in so called collections:
  - Users may have read and/or write access to one or more collections
  - Collection access is managed by the collection admin

Measurement data is organized in collections

Manage collection permissions in the vMDM Admin Tool
Statistical Reports

- Statistical reports on numerous datafiles
- Measured values/signals
- Meta-data
- Share PDF report templates
- Tabular report export, e.g. csv, xlsx,... file format
vMDM Solution Overview

The Vector Measurement Toolchain

- Server-based measurement data management and analysis
- Multi-user
- Vector tools as frontend
- Dedicated admin tool

<table>
<thead>
<tr>
<th>MDM Use Case</th>
<th>CANape</th>
<th>vSignalizer</th>
<th>vMeasure</th>
<th>vMDM Admin Tool</th>
<th>Other Vector Tools</th>
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<tbody>
<tr>
<td>Measurement data acquisition</td>
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<td>●</td>
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<tr>
<td>Interactive analysis</td>
<td>●</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>Automated analysis and reports</td>
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## vMDM Summary

### vMDM Benefits for efficient measurement data management

- **vMDM is made for automotive engineers**
  - vMDM leverages the power of existing Vector tools like CANape and vSignalyzer
  - Access data directly in the tools, no need to learn new concepts or GUIs

- **vMDM takes care of your data**
  - Your data is secured and protected against data loss and unauthorized access

- **vMDM gives you insight into your data**
  - With powerful search and filters your data is never lost in a huge data lake
  - Analyze large amounts of data on the server
  - Visualize and document analysis results with meaningful graphs and diagrams

- **vMDM empowers teams**
  - vMDM is a multi-user system, deployed either in a private cloud or in the Vector Cloud
  - Measured data can be made accessible to all project members
  - Team members can share queries, analysis algorithms and reports
Data Mining

- **Analyze signal and meta data** of a large set of files
  - Selection of files is based on a vMDM search query
  - Query can yield a different set of files for each Data Mining execution

- Data Mining **execution**
  - Based on schedule (e.g. every day at 02:00)
  - On demand

- Same set of **analysis features** as in pre-processing
  - Standard function library or user defined functions
  - MATLAB/Simulink models
  - Own C-DLLs

- Individual analysis results for each measurement file are **aggregated into a report**
  - Classifications, min/max/avg values
  - Individual signal diagrams
  - List of detected signal patterns / events
Use Cases

Use Case – Endurance Testing

▶ Data Management:
- Manage continuous streams of incoming data from a logger fleet
- Collect meta data from customer's fleet management database
- Combine multiple measurement files to single measurement

▶ Data Quality Assurance:
- Detect corrupt / incomplete data

▶ Data Enhancement:
- Add meta data from diagnostic log files
- Extract metrics to compute KPIs for the test campaign

▶ Automated Analysis:
- Detect and count gear shift events, calculate drivability ratings
- Find anomalies in historical data

▶ Reporting:
- Various reports to assess long and short term behavior of individual test vehicles, a selected subset or even the complete test fleet
- Manual analysis of individual driving situations (e.g. low quality gear shift events)
For more information about Vector and our products please visit

www.vector.com

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