Summer University
Value Archive Expert

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etm
Professional Control

1 About Vexpert

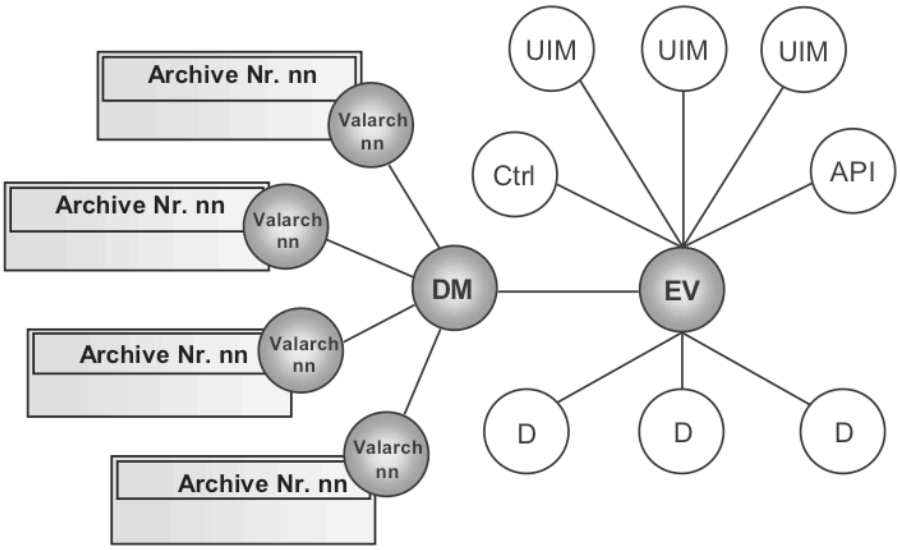
INTRODUCTION

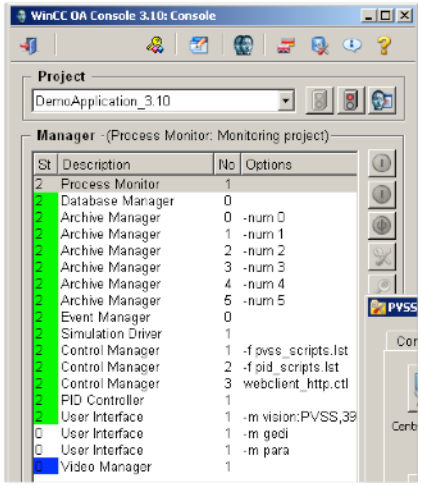
- **Motivation:**

  WinCC OA's archive function stores both fast- and slow-changing values in the same file by default. A file switch is triggered only by time or an overflow of data. Thus, one fast value can create many new files, wasting space allocated to other datapoints until compression is applied.

- **Solution:**

  The Value Archive Expert (Vexpert wizard) compares historical data to guideline parameters set by the user. Datapoints can easily be moved to other archives to optimise their storage in future.





An archive file receives data from an archive manager.

When a DPE changes, the RAIMA database updates the current value, and the archive manager appends the new value to the corresponding file. The appropriate archive manager for a particular DPE is set in the DPE's _archive config (e.g. `nazTemperatureInside._archive.1._class`).

A DPE can be stored in any archive, but no more than one at a time. If a DPE's config is changed, the historical data remains in the original files: past values are not transferred. This means that the list of DPEs in an archive file may change over time.

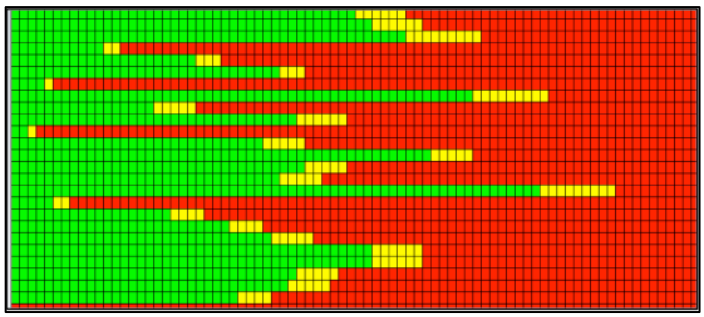
There is also an internal datapoint (e.g. _ValueArchive_1) for each archive, which stores a list of historical files generated by that archive manager. 10 datapoints are provided by default.

Archives may be inactive, if the internal datapoint is present but no archive manager is configured. The manager must have the same number as the corresponding datapoint: e.g. -num 6 for _ValueArchive_6.

Adding or removing managers is done on the Console panel. Vexpert makes the relationship between internal datapoints and archive managers clear, and allows managers to be added or removed directly from the wizard. To do so manually, use:

Console > Append Manager

Archive Files (3)



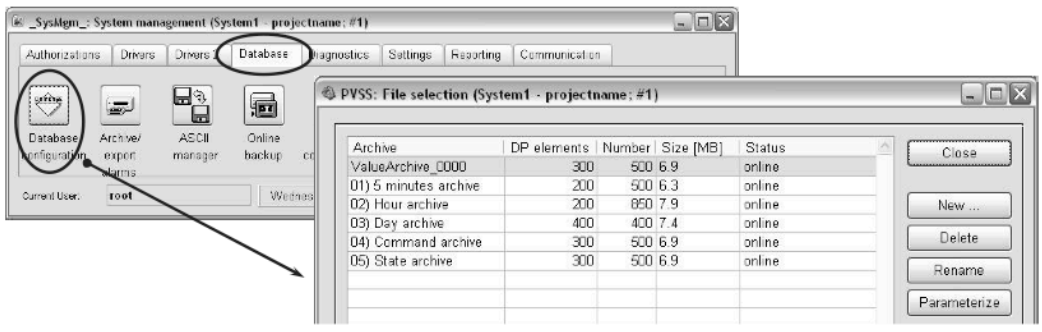
The diagram above shows the structure of an archive file. New archive files may be generated the same day if the heap size is exceeded by any one DPE.

Archives are stored as a memory-mapped flat file, with no indexes and direct access to each historical value. This allows fast access and simple addressing, but results in large files.

File size is related to the number of DPEs in an archive. In the worst case, if one fast-changing DPE shares an archive with many slow DPEs, the fast one causes many large files to be created. These files are filled with blank space, as no new value has been read from the other DPEs.

The statistics available for an archive file are the start time, end time, DPE name, and number of values. From this, it is possible to calculate the rate of change of the DPE. Change rates in Vexpert are represented upside-down: 119 means 119 seconds per value, rather than values per second. This is since guidelines are more intuitive in this format than values/hour or otherwise.

Archive Datapoints (4)



At present, the panel to a new archive's internal datapoint is not easy to access. It is located in:

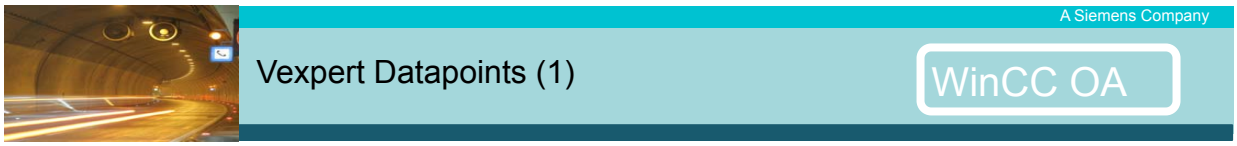
System Management > Database Configuration

When an archive manager with the corresponding number of that datapoint is running, the Status column changes to online. Parameters are set using the Parameterize button. These are much more detailed than those available through the Vexpert wizard, and may be appropriate for experienced clients. For detailed control of compression and backup media, the original panel should be used.

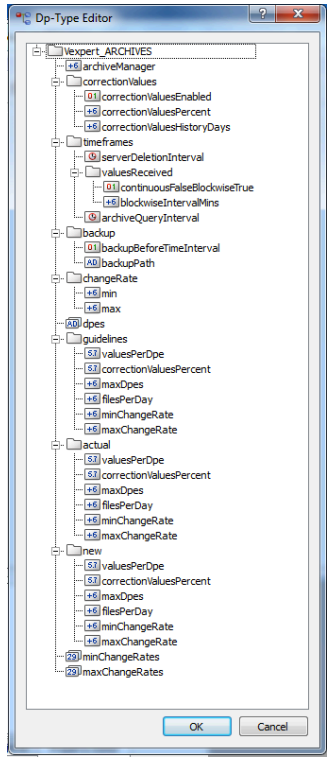
Because archive managers read values from their corresponding internal datapoints, the manager should be deleted before the datapoint.

2 *Vexpert Config Panel*

VEXPERT DATAPOINTS



Archive properties are stored all over the place: an archive manager sitting in the Console, an internal datapoint with settings to govern the manager, and a config on the datapoint to be archived. What can be done to clean this up?



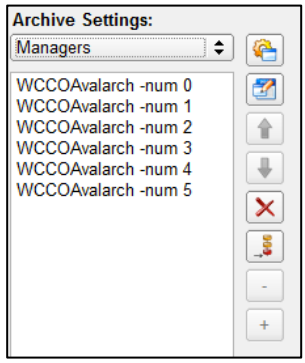
Make a new datapoint! At first, one would assume that making the problem worse is the last thing you want to do. But actually, the Vexpert_ARCHIVES datapoint type is designed to unite the previous properties into a single point of reference. It also means that wizard settings do not directly affect the archives until they are applied, so there is always a Cancel option.

The integer archiveManager is the archive manager number (e.g. -num 6) and the number of the internal datapoint (_ValueArchive_6).

The dyn_string dpes stores names of DPEs with this archive number.

The change rate is calculated from the number of values over a time period. This time period is the duration of a historical archive file. Sometimes there are different numbers of values, so the change rate varies for a single DPE. dyn_int minChangeRates and maxChangeRates track the change rate range when several files are examined. changeRate int min and max are the overall range of change rates for all DPEs.

The config panel is used to set the datapoint elements correctionValues, timeframes, and backup parameters. The effect of implementing the changes is summarised in the new values. That allows the modifications to be cancelled before applying them to the real archive. The guidelines are pre-defined, and can only be modified using Para. The actual values, representing the current state of the archive, are written by the VExpert Optimisation Panel.



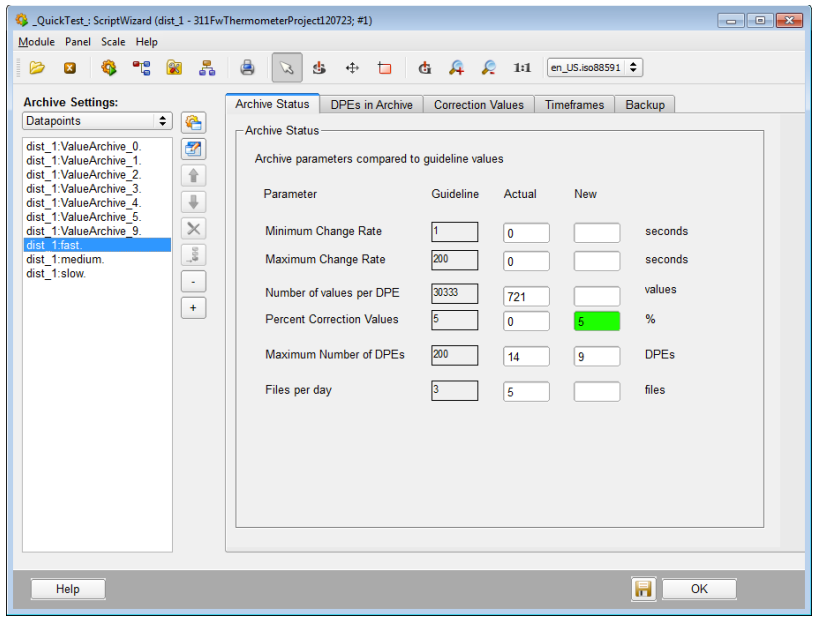
When the config panel opens, a selection list on the top left allows either Datapoints or Managers to be modified. Selecting Managers replaces the list with a corresponding list from the Console of all archive managers.

Two buttons to the right of the list are then enabled, allowing managers to be added or removed directly from the configuration panel. This is much easier than switching to the console and ensuring your new archive number is correct!

When the Datapoints option is selected, the manager add and remove buttons are disabled. Instead, the add and remove buttons for datapoints are enabled! It is also possible to rename datapoints or change the associated archive number using the upper two buttons on the right of the selection list.

The Archive Status tab compares the present archive with guidelines set using para. There is also a New column for showing the effect of changes made in the other tabs, so the user may choose whether to save or not.

A colour scheme of green (OK), yellow (<20% deviation) and red (>20% deviation) is applied to the new fields.

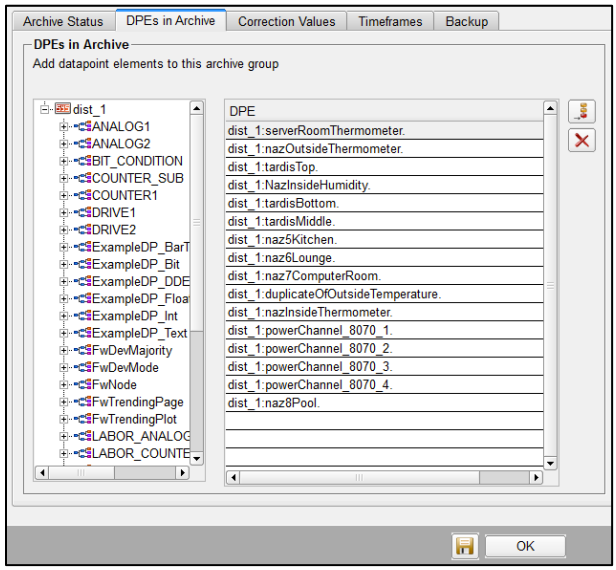


Remaining tabs allow the user to customise archive parameters. The new values for this are stored in the appropriate datapoint of the VExpert_ARCHIVE datapoint type.

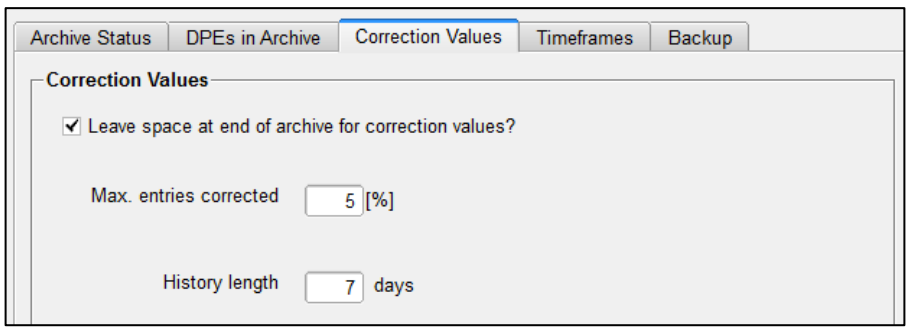
The DPEs in Archive tab allows DPEs to be added to a particular archive. They can be added and removed using the buttons on the right-hand side, or copied from the DP tree with drag and drop.

Before this wizard, editing a datapoint's `_archive` config entry met this need. There was no way to easily display all DPs in an archive on a table, like this.

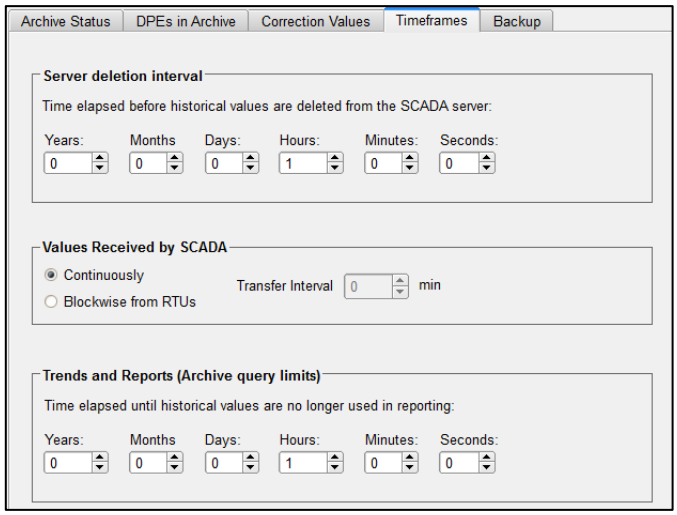
Another important point to remember: it is possible to Cancel your changes. So don't forget to click Save before OK!



The parameters for Correction Values are simple: should the archive file be made larger to account for correction values, and if so, by what percent? Correction values cannot be added after Level 2 compression, so the history length is also entered on this tab.



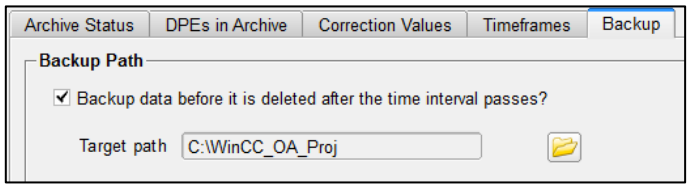
Timeframes include the length of time historical values are kept on the server, before they are automatically deleted. In order not to lose data, is it suggested to have a Backup path enabled later.



Values may be received from RTUs in a continuous stream, or in a blockwise manner with a regular transfer interval. The transfer mode is selected here.

Reports also have their own timeframe, over which historical values are needed. This is also entered here.

Finally, backups ensure that the data is stored safely after it is removed from the SCADA server. The path is entered on the last tab, including a folder browser.



3 *Optimisation Panel*

ARCHIVE TESTING

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Archive Testing (1)

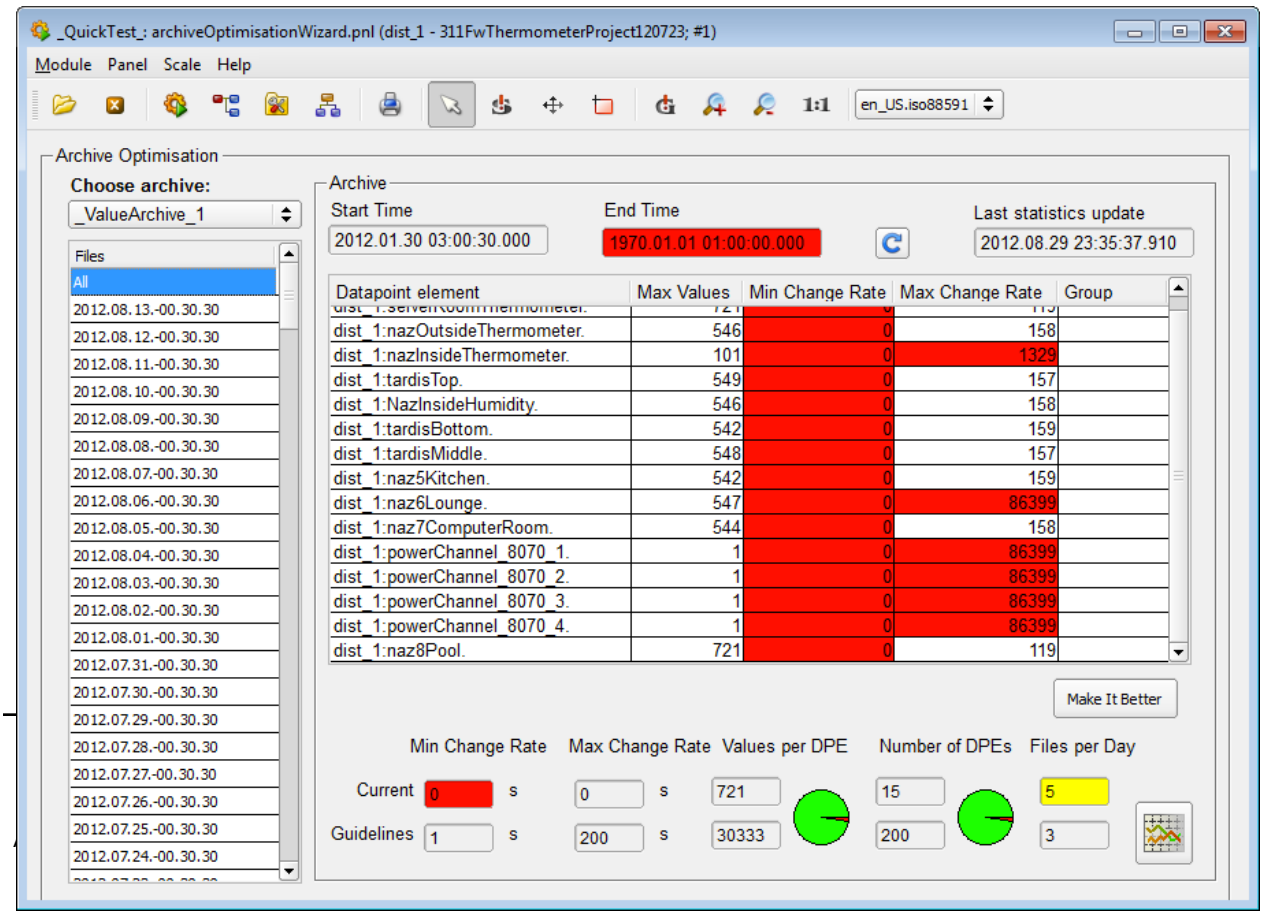
WinCC OA

Opening the Optimisation Panel presents the somewhat intimidating table view below. Why are there so many big red warnings? Actually, this is normal behaviour.

When a whole archive is checked against guidelines, some extreme values wreak havoc with the statistics. In this example, a 5-minute file from configuration had 700 values for some DPs, resulting in a vey fast change rate: one value every 0.x seconds. The end time is obviously out of range, because the archive is still active. The last file has no end time!

The rest of the panel is nevertheless still helpful to understand. The value archive is selected from the selection list. One or more files within that selection may be selected for a partial inspection against the guidelines.

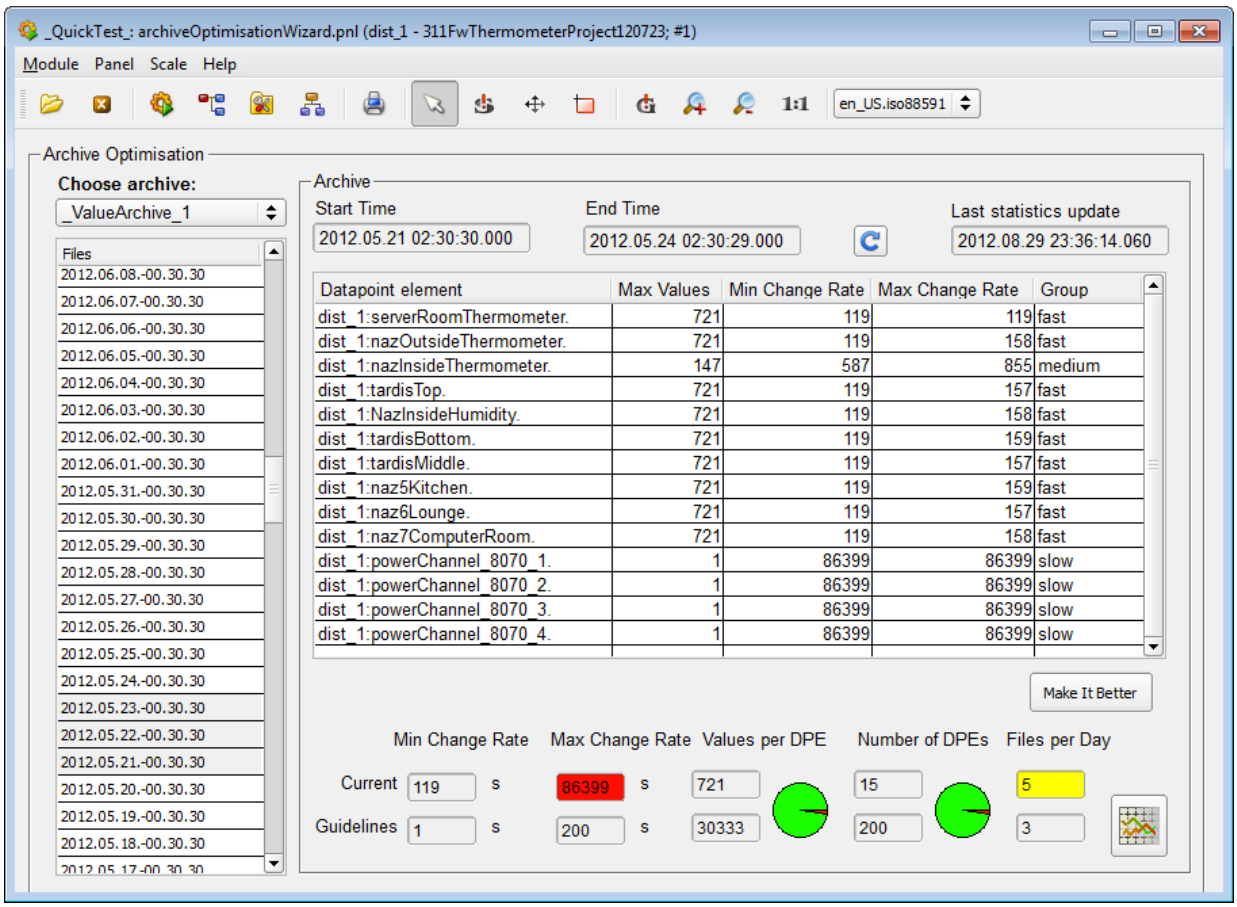
Guidelines and current values are the same as those on the Configuration Panel. Displaying them here at the bottom of the optimisation panel allows the user to select a range of historical archive files in the left-hand column, and see how they compare to the guidelines.



The view may be refreshed if necessary. Because of the statistical errors described earlier, selecting a range of files is the recommended use of this panel.

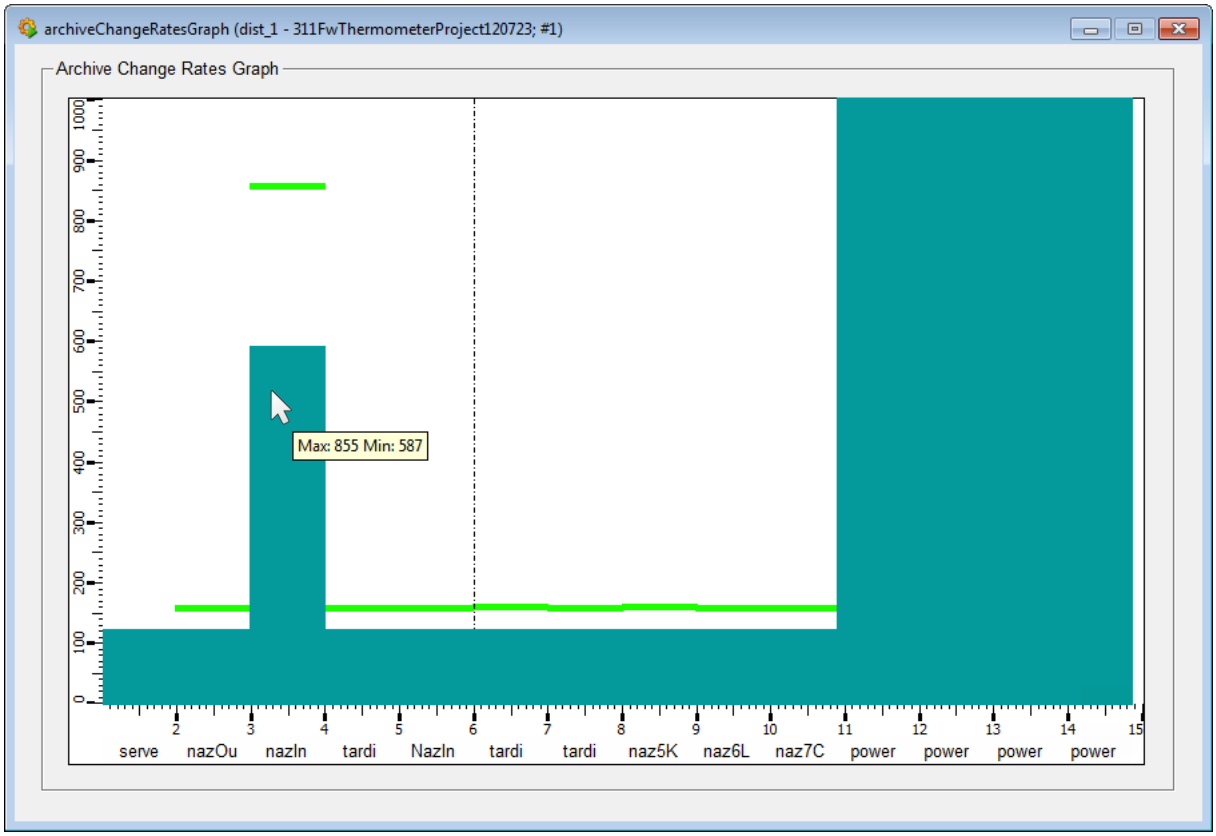
The table shows the names of DPEs in the selected archive file. Max Values should the maximum number of values per DPE per file, which is summarised in the guideline below. This is also used to calculate the minimum change rate: more values means fewer seconds per value. The min and max change rates are the same when a single file is selected, but sometimes differ if several files are inspected.

Group is the magic of the VExpert project. Based on compliance to the guidelines, a recommendation of the most appropriate guideline for a DPE is presented in this column. This is not always the present archive shown in the selection list on the top left; DPEs may fit the guidelines of another archive better. They are not moved yet, but only after the user clicks the Make It Better button below.

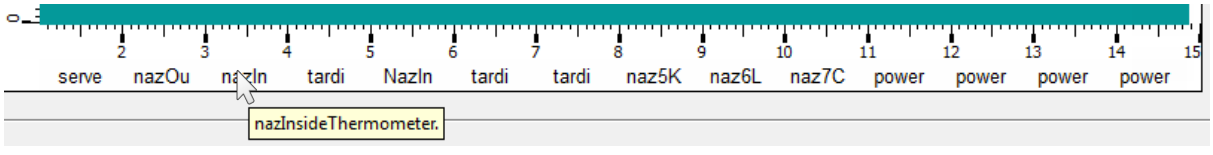


The table view is very powerful. But if there are many DPEs to inspect, it could become difficult to read. Therefore, VExpert implements a bar trend displaying the same data. The turquoise bars display the change rate data, with the solid bar showing the minimum change rate, and the green unfilled bar showing the minimum.

Change rate values for the bar are also displayed in a tooltip. Hovering the mouse cursor over one of the solid bars displays the maximum and minimum values.

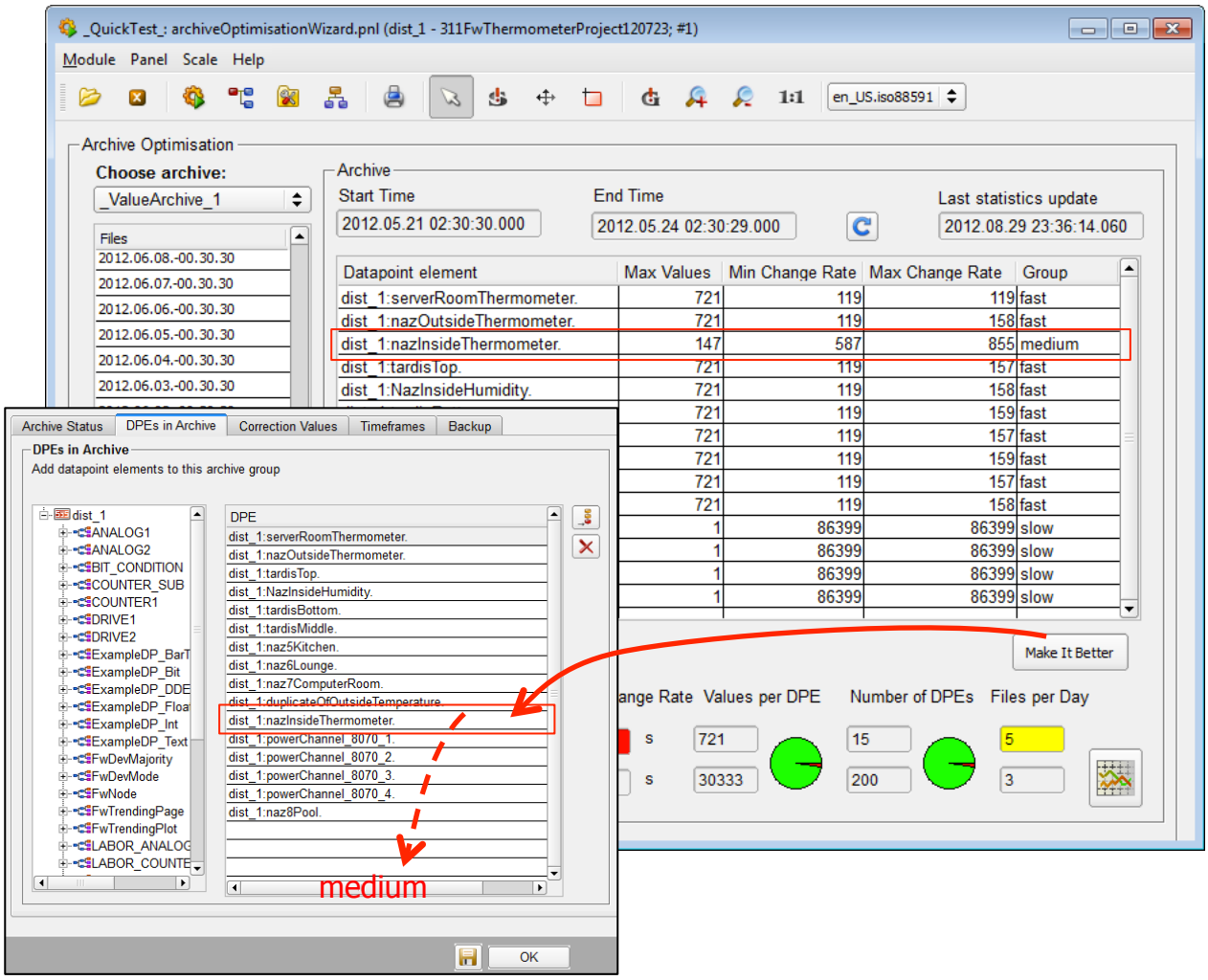


The same tooltip feature also applies on the x-axis, where DPE names are displayed. Only the first few characters are shown at first, but hovering over reveals the full name. The y-axis is the change rate in seconds per value. Auto-scaling this causes very slow change rates (e.g. one value per day = 86399 seconds) to make the rest of the chart appear flat in comparison.



So, the user interface looks good. Rob Jellinghaus, part of the ill-fated Xanadu hypertext project, told Wired magazine: "The front end is the most important thing". But did that distract from the purpose of this project: intelligently moving datapoints to the most appropriate archive?

Not at all: the Make It Better button brings this whole project together. Pressing it moves the DPEs to the most appropriate archive according to their change rates. This can be confirmed in the Config Wizard, if both windows are open at the same time. As well as adding the DPE to the new archive, it is removed from the previous, so that duplicate values are not stored in two different archives.



4 *Future work*

IMPROVEMENTS

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Improvements (1)

WinCC OA

VExpert successfully makes archive management a pleasure to the user, rather than a complex chore. However, it can continue to be developed.

The Make It Better algorithm is currently based on the change rates of values. Including the maximum archive file size (500 MB) in this calculation may be necessary for larger examples. Checks should also be included to ensure that new archives update at a different time, to reduce load on the data manager.

Import and export presents new challenges. Moving the panels and library file was all that was necessary to show how this project can be included in an implementation case. However, the change from ISO to Unicode encoding meant that the whole user interface needed to be re-written when adding a UTF-8 panel into an ISO project. Similar problems could arise.

A smoothing wizard with access to the driver and archive manager would allow the user to modify the change rate. Showing the user the effect of their modifications in real-time using trends would provide excellent usability. However, this is not yet implemented in VExpert.

Compression settings are read and written with the Config panel, and are compared to guidelines. Specifying new intervals than the default is possible by adding and removing datapoints on the Config panel. Compression parameters have not yet been integrated into the Make It Better button, however. Checks for those settings would be a helpful addition.