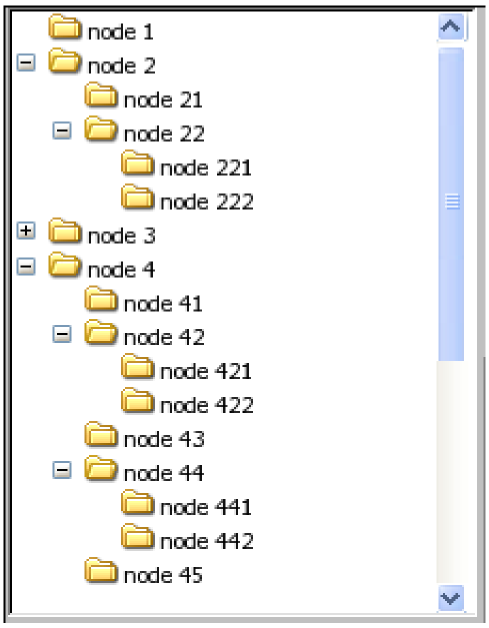
pure4glTv.w

a Treeview Smart Object in pure 4GL

by Sébastien Lacroix, January 2005,

Revision on July 2006



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0 New on July 2006

The new package has been renamed 'pureabltv' to follow some trend, but the main object will remain called pure4gltv.w for backward compatibility. The new package includes a few new tv icons, and a new directory structure to support mulitple skins as documented in the notes bellow.

<Extract from comments in the definition block of pure4gltv.w>

```
slacroix & Nicolas Andricq MAR-2006
1) Support of Royale skin.  Restructuration to support multiple skins

2) Review of the vertical scrollbar to avoid a hole of two pixels on the right.

3) new getSelectedNodeKey() API


slacroix Later in MAR-2006
1) New expandBranch API that is fired on '*' key trigger

2) New enableObject and disableObject API's

3) New expandAll functionality on '*' key

4) Made a new version of Prospy that uses pure4gl tv for greater performance
```

</Extract from comments in the definition block of pure4gltv.w>

1 Why doing a treeview object in pure 4GL?

- This was a great challenge.
- It proves that the 4GL is not only a great language to handle Database Business Logic, but is also very powerful at handling the logic of sophisticated GUI Objects, especially with the use of the powerful 4GL temp-tables. Indeed, in the past, the point of the UI was to manage data in a database. Nowadays, it is almost the other way round with sophisticated UI objects that almost require a database system to manage them. Simply, I was wondering how one can achieve a treeview without using database objects like temp-tables.
- This object provides an alternate solution to using a treeview and an image list OCX. This is a way to avoid potential deployment and license problems.
- Finally, this object works fine on Linux with Wine. Pure 4GL based GUI objects like SmartFolders SmartSelectors or SmartCalendars work fine on this configuration, on the other hand OCX's do not work (or at least make problems). This was preventing the use of a treeview object, which is rather important. Therefore pure4glTv helps to open the door to Linux/Wine. Note that this project has been mainly developed at home on Linux with Wine.

2 The specification was rather short:

- Achieve a Treeview object in pure 4GL, or with a bit of external programming techniques (few calls in few DLL's) so it can work on both MS Windows and Linux with Wine (without any native Microsoft DLL). The idea is to provide an alternate solution to using an ActiveX.
- This treeview has to look and behave like the treeview of the MS Windows XP File Explorer.

3 Achieved Features:

The treeview is a SmartObject^{TM} so it can be used as an object in any smart container (so in a smart window or a smart frame). Please note this is not an attempt to push people to adopt the complete ADM2 framework. One just needs to use smart windows or smart frames so it requires a very little knowledge of ADM2. In other words, SDOs, smart viewers and smart browser are not required. I did not even have the time to prepare a sample code with a few SmartDataObjects and SmartDataViewers, and the example with nodes to display the content of a few database tables directly refers to the database like in pure client server.

3.1 How to use it? (a first drop of pure4glTv on an empty smart window)

With the AppBuilder window, create a new smart window as shown in Illustration 1 (It is actually faster to right click on *New* button then choose the *SmartWindow* popup menu item). Then on the object palette, choose the *SmartObject* button (see Illustration 2), choose the pure4gltv.w object and drop it on the new empty smart window.

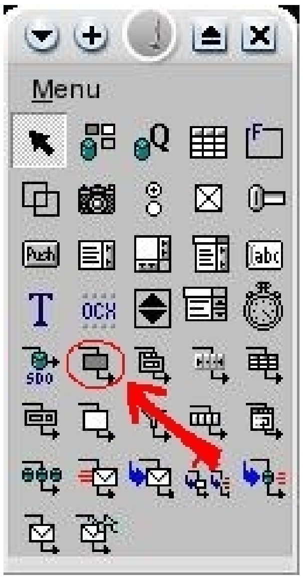
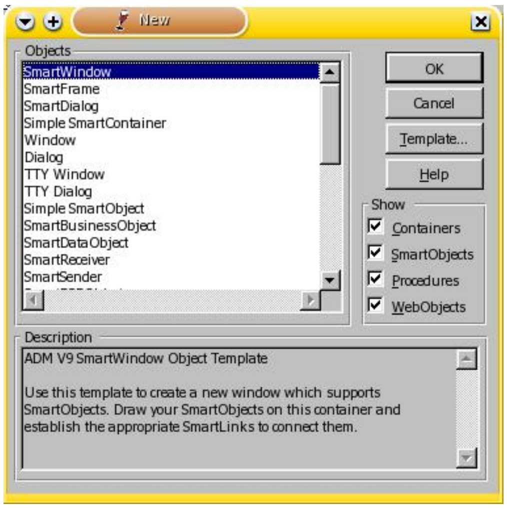


Illustration 1: The simple Smart Object button on the palette



ADM V9 SmartWindow Object Template

Use this template to create a new window which supports SmartObjects. Draw your SmartObjects on this container and establish the appropriate SmartLinks to connect them.

Illustration 2: AppBuilder -> New -> choose 'Smart Window'

You should have a window with a very small treeview looking like Illustration 3.

Then resize the new instance of the pure4gltv to make it a bit bigger so you can see a cute little demo treeview as shown in Illustration 4.

Next, right click on it, choose the SmartLinks menu item then choose the Add button. Select *h_pure4gltv* as Source, *THIS-PROCEDURE* as Target (this one is the smart window) and *New...* as Link type. When you get the New Link Type dialog then type tvNodeeEvent to obtain something like Illustration 5.
With that, the ADM2 will make THIS-PROCEDURE (the window) subscribe to tvNodeEvent. At this point, you have a window that is ready to handle the pure4glTv object, like the given sample testSmart4glTv.w, that is described a bit further in this document.

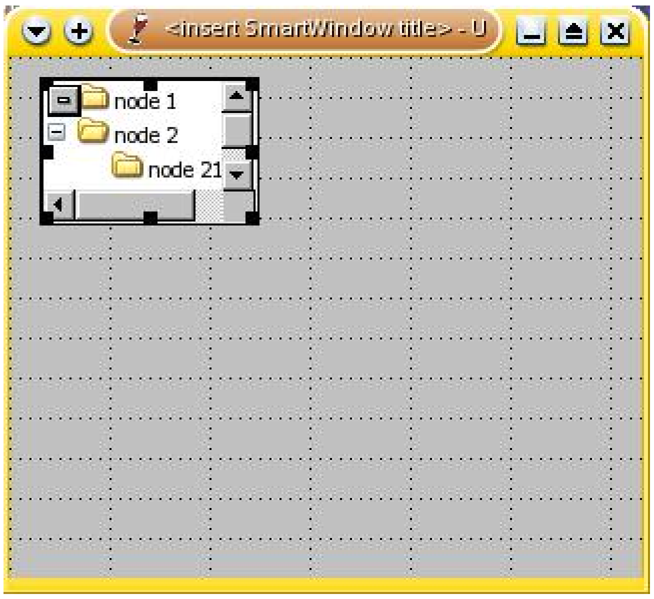


Illustration 3: Pure4glTv was just dropped on a new Smart Window

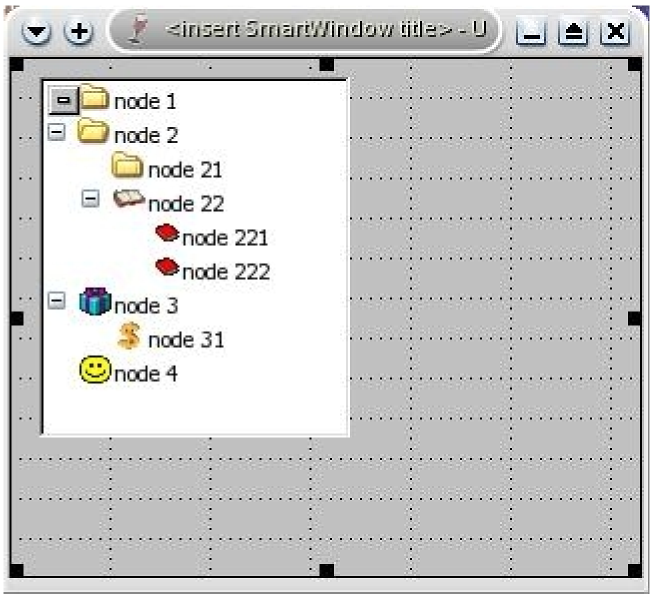
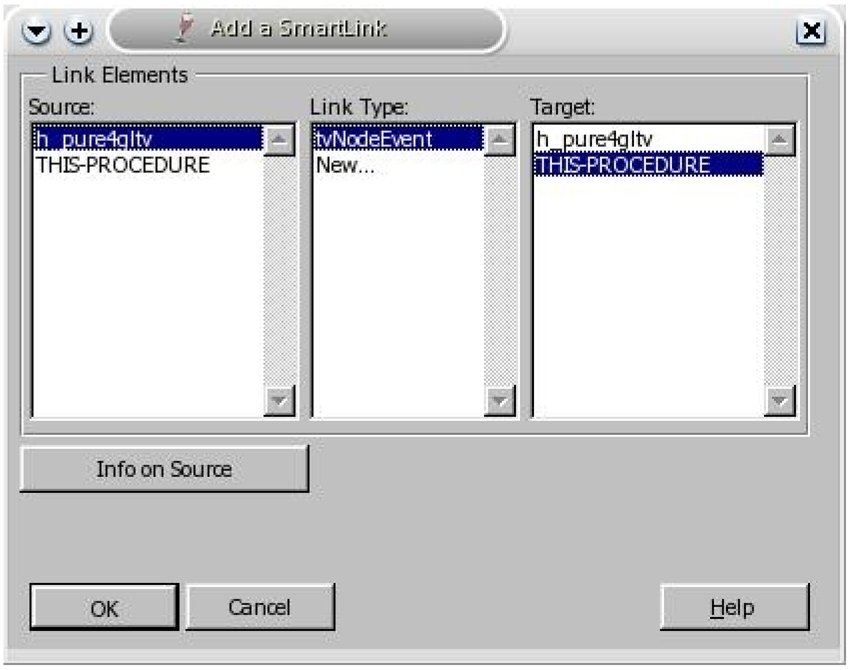


Illustration 4: Pure4glTv has been resized. It shows a cute demo treeview

If one does not want to use smart links, then he can just type the following code in initializeObject of the smart window (after the RUN SUPER. Should be fine):

```
SUBSCRIBE TO “tvNodeEvent” IN  h_pure4gltv.
```


Add a SmartLink

Link Elements

Source:	Link Type:	Target:
h_pure4gltv	tvNodeEvent	h_pure4gltv
THIS-PROCEDURE	New...	THIS-PROCEDURE

Illustration 5: The Add a smart Link dialog. An efficient way to make the window SUBSCRIBE TO tvNodeEvent IN h_pure4glTv

One advantage of using smart links is that there is no need to hard code the name of the treeview instance (here *h_pure4gltv*) as the AppBuilder will take care of it. There are other advantages, but the point of this document is not to be an ADM2 course.

3.2 Look and feel like MS Windows XP File Explorer :

3.2.1. Navigation keys, selection, collapse/expand, click, double click, + and -

3.2.2. Supported Windows skins are *XPStyle* and *Classic*. This might be extended in the future, by adding the popular *Silver*.

3.2.3. Scrollbars:

- Native for horizontal Scrolling
- Fully emulated and controlled for Vertical Scrolling. Again same behavior for all manipulations like grab button, click above/bellow, and the flat down and up buttons.

3.2.4. Scroll by 3 iterations with the mouse wheel.

Note that this feature does not work on Linux KDE. Sadly, it seems to be due to a smarter way to handle the mouse wheel with KDE: if a scrollable widget is bellow the mouse pointer, then a mouse wheel action immediately gives the focus to its window (without moving it to top, depending on some KDE setting), then it scrolls the scrollable widget. This is very handy to read multiple documents in multiple windows at the same time.

Now, I am relying on a hidden combo-box that keeps the focus until we leave the treeview. This combo catches the mouse wheel scrolls by selecting a next or previous item and firing the VALUE-CHANGED event. The trouble is KDE finds out that this combo is not visible at the top, so it does not fire the action described above. Changing some options in the setting of KDE might solve this problem, but the default handling of the mouse wheel of KDE is so nice for other applications that one may not want to change it (at least me).

3.3 *One central* **tvNodeEvent** *event procedure*

3.3.1 Only one single event is published from pure4gltv.w, with two parameters:

```
        PUBLISH 'tvNodeEvent' (INPUT pcEventName, INPUT pcNodeKey)
```

By having one single event procedure then it is easy to link the Treeview to any object with a custom link (far easier than handling a list of Supported Target events in some custom include files)

One may also just do `SUBSCRIBE TO 'tvNodeEvent' IN h_pure4gltv.` Note that there can be multiple subscribed listeners, however few events rely on a `RETURN-VALUE` (like dragBegin and rightClick)

3.3.2 The complete list of events is:

- select
- deselect
- expand
- collapse
- rightClick Can build popup menus, see the buildAndOpenPopupMenu API
- addOnExpand Fired when a node with option *addOnExpand* is expanded
- DragBegin
- DropEnd See the code of dragNode for details about parameters
- Custom events for the CHOOSE of popup menu-items.

3.4 *A large set of APIs to control the treeview or interact with it:*

All the internal procedures and function that are not supposed to be called from the outside are defined with the PRIVATE option.

Bellow is the complete list of APIs that are available to the developer. More details about each API are given in section *6) API documentation*.

Note that this list does not include the get<Property> and set<Property> functions. These properties are described further.

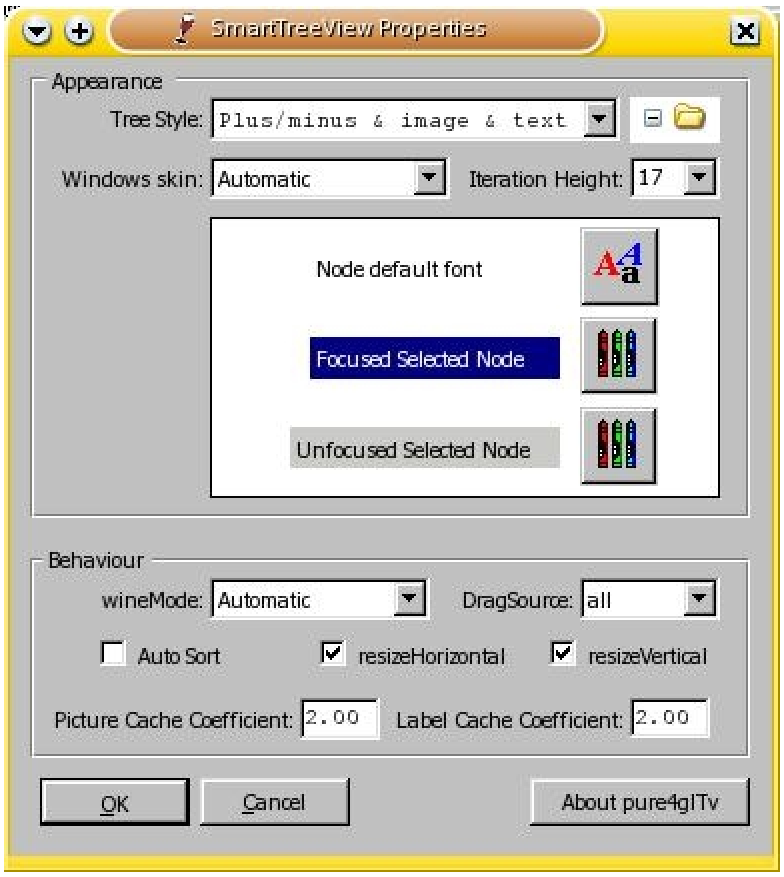
Note also that the APIs marked with two stars (**) were initially designed for internal use but I made them public afterwards because they might be interesting.

- Addnode
- buildAndOpenPopupMenu
- collapseNode()
- deleteNode
- deselectCurrentNode()
- expandNode()
- emptyTree
- findNextNodeToShow

- findPrevtNodeToShow
- fMainKeyEvent **
- getNodeDetails
- getNodeId()
- getNodeKey()
- getNodeLocatedAtXY()
- getNodeParentKey()
- goToNode()
- lastVisibleNode()
- LoadDemoTv
- moveNode
- nodeAtVirtualIter()
- nodeInCollapsedBranch()
- picFileName()
- resizeObject
- selectNode()
- sortChildren
- swapNode
- topNode()
- updateNode
- updateNodeWidth **
- tvRefresh()
- tvScroll()
- widgetsAt **

3.5 A few properties

Illustration 6 shows the instance property sheet of pure4glTv. For non ADM2 users: you obtain it by doing a right-click on a pure4glTv instance and choosing the *Instance properties* menu item.



Appearance

Tree Style: Plus/minus & image & text

Windows skin: Automatic

Iteration Height: 17

Node default font

Focused Selected Node

Unfocused Selected Node

Behaviour

wineMode: Automatic

DragSource: all

☐ Auto Sort

☑ resizeHorizontal

☑ resizeVertical

Picture Cache Coefficient: 2.00

Label Cache Coefficient: 2.00

Illustration 6: Instance Properties sheet of pure4glTv

Bellow is a description of each property:

3.5.1 wineMode (character)

This property should remain set to *Automatic*. Other values are available mainly for testing. The point of this property is only to use the most appropriate optimization procedure for the rendering. There are 2 different optimization procedures because the cost of changing attributes for some GUI widgets is not the same for Wine and for MS Windows. See the optimizeDisplay.xls spreadsheet and the code of optimizeTviterMSWin and optimizeTviterWine for more details.

Internally, the object uses a variable called glWineMode that defaults to NO, so the property can remain set to *Automatic*. When *Automatic*, then glWineMode is switched to YES if we can find a key with name *RunningOnWine* set to *yes* in the *Startup* section of the environment (registry or ini file).

I decided to rely on a key in the Progress environment because I am not aware of any easy way to guess whether we are running on native MS Windows or on Linux with Wine. Apparently, Wine does not provide any possibility to escape from it (i.e. it does not allow the call of a native Linux command through it), which is perhaps not that bad for security…

3.5.2 windowsSkin (character)

This property should remain set to *Automatic*. Other values are there for testing the XP scroll bar when developing on Linux, or the classic scrollbar when developing on Windows XP with the fancy Fisher Price theme.

3.5.3 picCacheCoef (decimal)

Default is 1. Greater value can improve rendering performance (especially on Wine) by enabling a kind of over-caching with a higher number of rendering images than the number of iterations. This way, some widgets are just kept ready and hidden and can quickly be reused by switching their VISIBLE attribute (think of expand and collapse operations).

3.5.4 labCacheCoef (decimal)

Same as picCacheCoef for the label dynamic texts.

3.5.5 tvIterationHeight (integer)

Default is 17. A larger value will result in higher iterations with higher node pictures and labels. Note that currently, the width of pictures is not variable, but it would not be hard to achieve a new property.

3.5.6 treeStyle (integer)

Can have one of the following values: *Image & text*, *Plus/minus & text* and *Plus/minus & image & text*. The value is an integer code that is compatible with the codes used by the usual MS OCX.

3.5.7 FocSelNodeBgColor and FocSelNodeFgColor (integers)

To handle the color of the selected node when the treeview has the focus.

3.5.8 UnfSelNodeBgColor and UnfSelNodeFgColor (integers)

To handle the color of the selected node when the treeview has not the focus.

3.5.9 tvnodeDefaultFont (integer)

For now, the same font is used for all the nodes. We could rather easily handle it as a default font that could be overridden for some given nodes (as an option in the option list param of addNode). To achieve that, we have two possibilities:

a) The hard way: to handle the font info in the tvLab temp-table and perhaps handle that in the rendering optimization procedures, especially if we find out that changing the font dynamically cost a non negligible time compared to changing the X, Y VISIBLE or SCREEN-VALUE attributes of a dynamic TEXT widget.

b) State that changing fonts is rather rare so it would have a rather negligible impact on performance. So we could actually provide a hook to refine a label widget, like a refineLabelProcedure node option in the option list parameter of addNode (a RUN NO-ERROR in a super proc for example).

Anyway, I prefer to anticipate this future need and I therefore call this property tvnodeDefaultFont instead of tvnodeFont.

3.5.10 resizeVertical (logical)

It is up to the container to query this property in order to decide if it may resize pure4glTv vertically with the resizeObject API. Sending an unknown value for the height in resizeObject results in not changing it. See the trigger code of WINDOW-RESIZED of testpure4glTv.w for an example.

Note this property is a standard ADM2 property. In other words, it is not created only for pure4glTv.

3.5.11 resizeHorizontal (logical)

Same as for resizeVertical for the horizontal resize.

Note this property is a standard ADM2 property. In other words, it is not created only for pure4glTv.

3.5.12 dragSource (character)

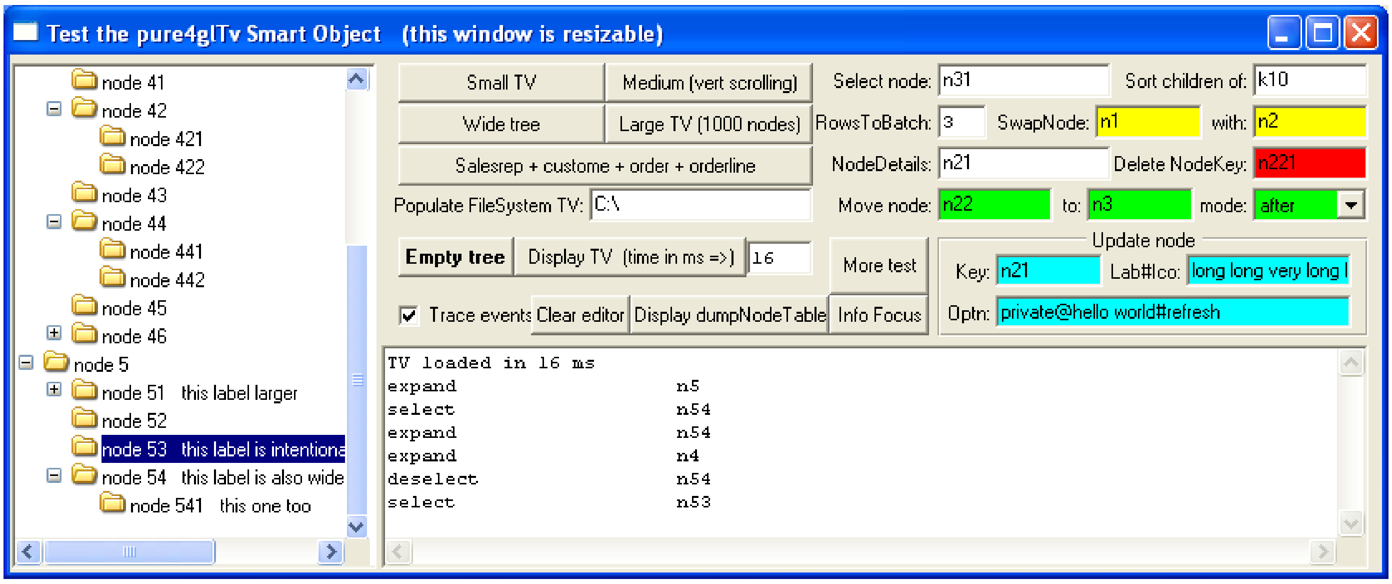
Can be set to *none* or *some* or *all*. When set to *some* or *all* then the two node option *dragSource* and *noDragSource* are taken into account to allow a drag operation. See the source code of addNode for more details about these two node options.

Note also that another way to disable a drag operation is to make *tvNodeEvent dragBegin* return the keyword *cancelDrag*. See the comments in the source code of dragNode in pure4gtv.w for more details about the *dragBegin* and *dropEnd* events, or for any further information.

3.5.13 autoSort (logical)

Taken into account only when adding a node, so during the execution of the addNode API. Once a node has been added, it can be moved anywhere in the tree (although there are a few rules) with the moveNode or swapNode APIs. See the code of these two APIs for more information regarding the move of nodes.

4 Quick demo with the smartWindow testSmart4glTv.w



Select node: n31 Sort children of: k10
RowsToBatch: 3 SwapNode: n1 with: n2
NodeDetails: n21 Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22 to: n3 mode: after
Display TV (time in ms =>) 16
Key: n21 Lab#Ico: long long very long l
Optn: private@hello world#refresh

```
TV loaded in 16 ms
expand                    n5
select                    n54
expand                    n54
expand                    n4
deselect                  n54
select                    n53
```

Illustration 7: testSmart4glTv.w, a single window to demo multiple uses of pure4glTv

4.1 Testing navigation, resizing, and the events fired by pure4glTv

Having a session connected to sports2000**, run testSmart4glTv.w. Choose the *Wide Tree* button to load a tree as shown in Illustration 7. Expand node n5, navigate in the Tree with the keyboard and see that you can go up and down, or expand or collapse. Try also the Page-up/Down or home and end keys, or even the plus and minus keys in the numeric key pad (only on a node that can be collapsed or expanded). Indeed, pure4glTv just behaves like the native treeview of the MS File Explorer.

** If you really do not want to be connected to a sports2000 demo database, then you might comment the code that refers to it. Actually, there is only one sample treeview that uses it (the *Salesrep + custome + order + orderline* button), but it is handled in a few procedures…

Next, testSmart4glTv.w is a resizable window so the height and width of the treeview is always adapted to fit the window. Try to resize it in various ways and have a look at the code in the WINDOW-RESIZED trigger to achieve the same kind of resizing.

See the events that are fired by pure4glTv in the editor widget when navigating in the tree. They consist in an event name and a node key. Notice that the tvnodeEvent procedure in the container is a kind of event broker. The advantage of doing that is that there is only one smart link called *tvnodeevent* to add between the container and pure4glTv (see *smart link* with a right click on a pure4glTv instance in the container) and there is no need to maintain a list of target and source events to subscribe to.

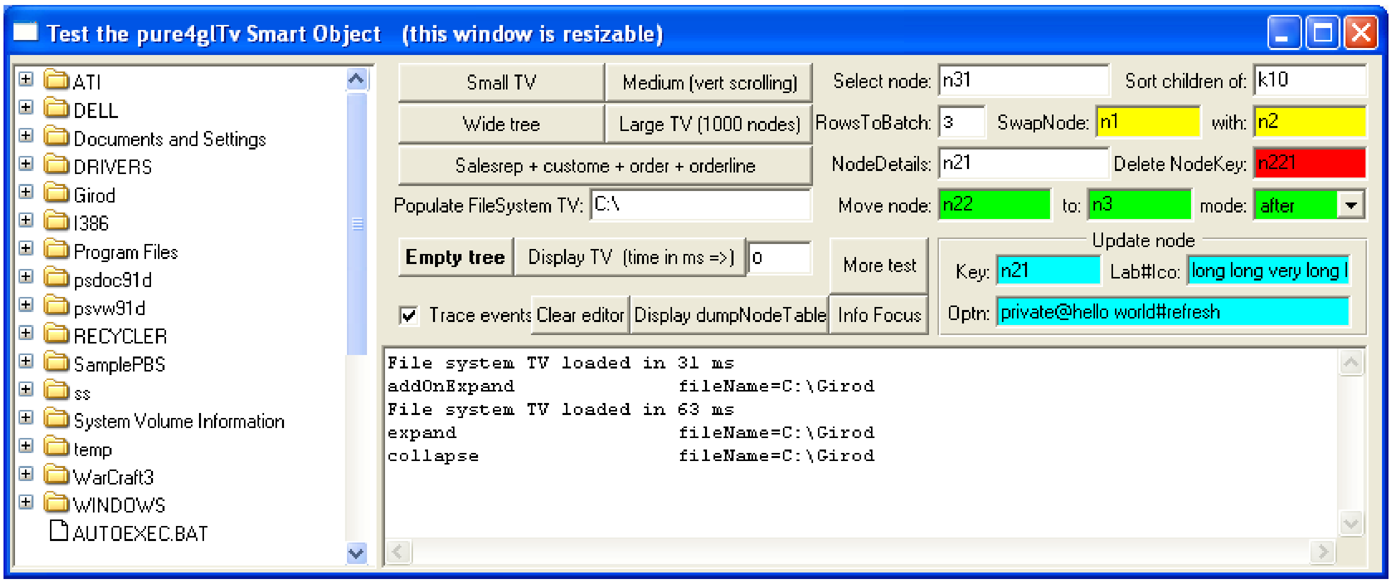
4.2 How is the treeview populated?

4.2.1 Simple static examples

See the code in the choose trigger of the *Medium (vert scrolling)* button and see how the addNode API is called. See also the code for the *Small TV* button and notice that the last parameter is actually a extendable list of options that is CHR(1) separated (see for node *n3*). For more info, see details about the addNode API.

4.2.2 A more practical case with nodes added on the fly

Clear the container again, and press the RETURN key in the *Populate FileSystem TV* fill-in, having 'C:\' in its screen-value to obtain a tree like the one shown in Illustration 8. Indeed, one could easily achieve a file explorer with pure 4GL… Look at the code of loadDirectory and see how short it is.



ATI
DELL
Documents and Settings
DRIVERS
Girod
I386
Program Files
psdoc91d
psvw91d
RECYCLER
SamplePBS
ss
System Volume Information
temp
WarCraft3
WINDOWS
AUTOEXEC.BAT

Select node: n31
Sort children of: k10
RowsToBatch: 3
SwapNode: n1
with: n2
NodeDetails: n21
Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22
to: n3
mode: after
Display TV (time in ms =>) 0
Key: n21
Lab#Ico: long long very long l
Optn: private@hello world#refresh
[✓] Trace events

```
File system TV loaded in 31 ms
addOnExpand                  fileName=C:\Girod
File system TV loaded in 63 ms
expand                       fileName=C:\Girod
collapse                     fileName=C:\Girod
```

Illustration 8: A kind of File Explorer with nodes added on the fly by using the FILE-INFO system handle

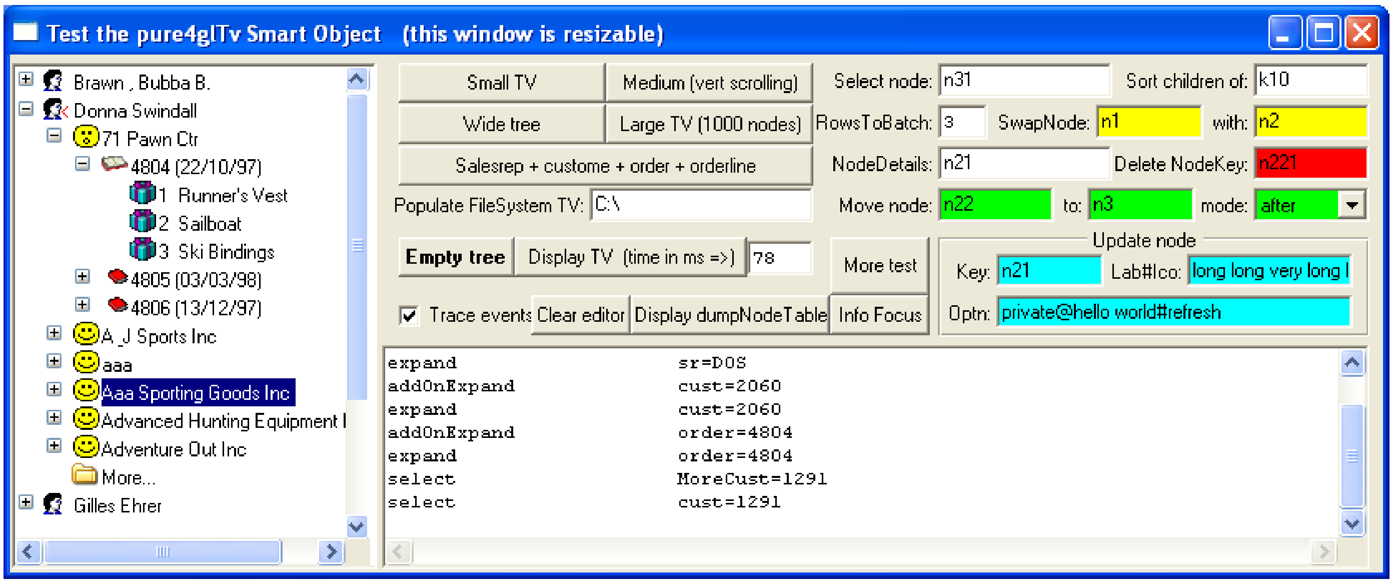
Next, expand the node of some folders. Yes, the situation is handled with sub nodes added on the fly with the following code in tvNodeAddOnExpand of the container testSmart4glTv.w:

```
[…]
IF pcNodeKey BEGINS "fileName=" THEN DO:
    cFullPath = ENTRY(2,pcNodeKey,"=").
    RUN loadDirectory (pcNodeKey, cFullPath).
END.
```

4.2.3 Database nodes added on the fly

This example is certainly the one that will illustrate the biggest need with treeviews.

Clear the container again, and choose the *Salesrep + custome + order + orderline* button. Expand few salesrep, choose the *More...* node to get more customers, expand order and see the order lines. Indeed the nodes are added on the fly. Note that only 3 nodes are added at a time before creating a 'More…' node. This is very small for test purposes but one can well change the value in the RowsToBatch fill-in to something more practical like 50. Note also that the concept of More node belongs to the container, not to pure4glTv itself, which just passes the event *select* to the container (see the tvNodeEvent procedure that calls tvNodeSelect). In other words, pure4glTv was designed to accept the addition of nodes on the fly when selecting a node without any special *More Node* option.



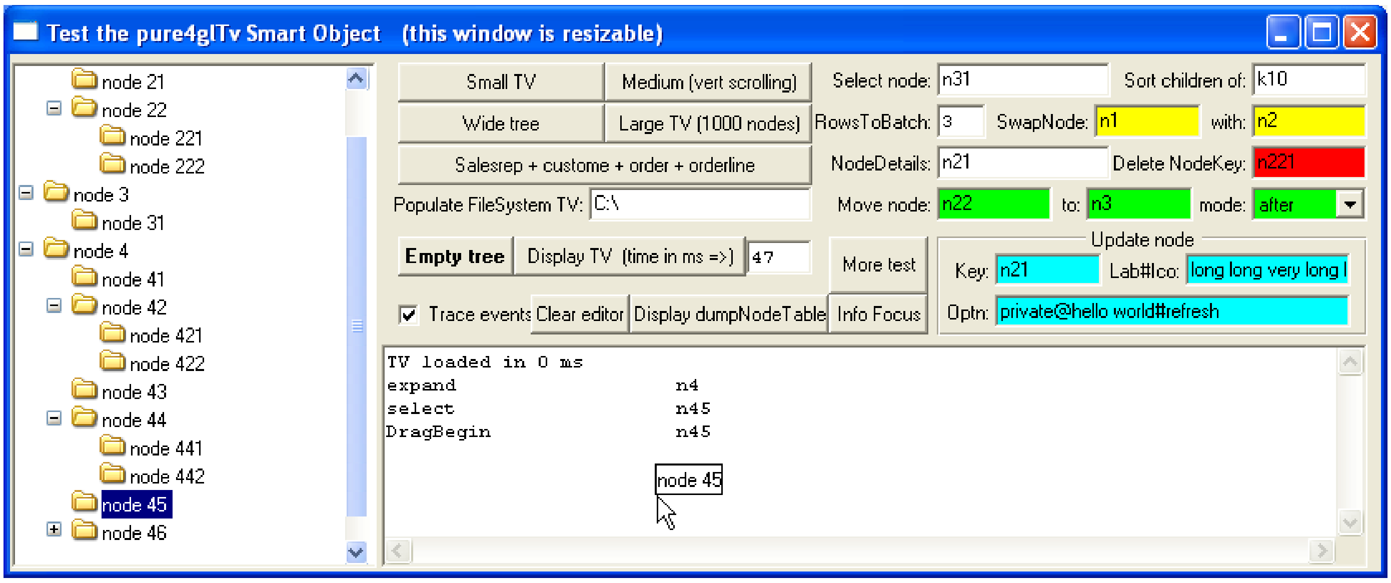
Select node: n31 Sort children of: k10
RowsToBatch: 3 SwapNode: n1 with: n2
NodeDetails: n21 Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22 to: n3 mode: after
Display TV (time in ms =>) 78
Update node
Key: n21 Lab#Ico: long long very long l
Optn: private@hello world#refresh
[✓] Trace events

```
expand                       sr=DOS
addOnExpand                  cust=2060
expand                       cust=2060
addOnExpand                  order=4804
expand                       order=4804
select                       MoreCust=1291
select                       cust=1291
```

Illustration 9: Nodes added on the fly to display the content of 4 levels of parent child database tables

4.3 Testing the drag and drop feature

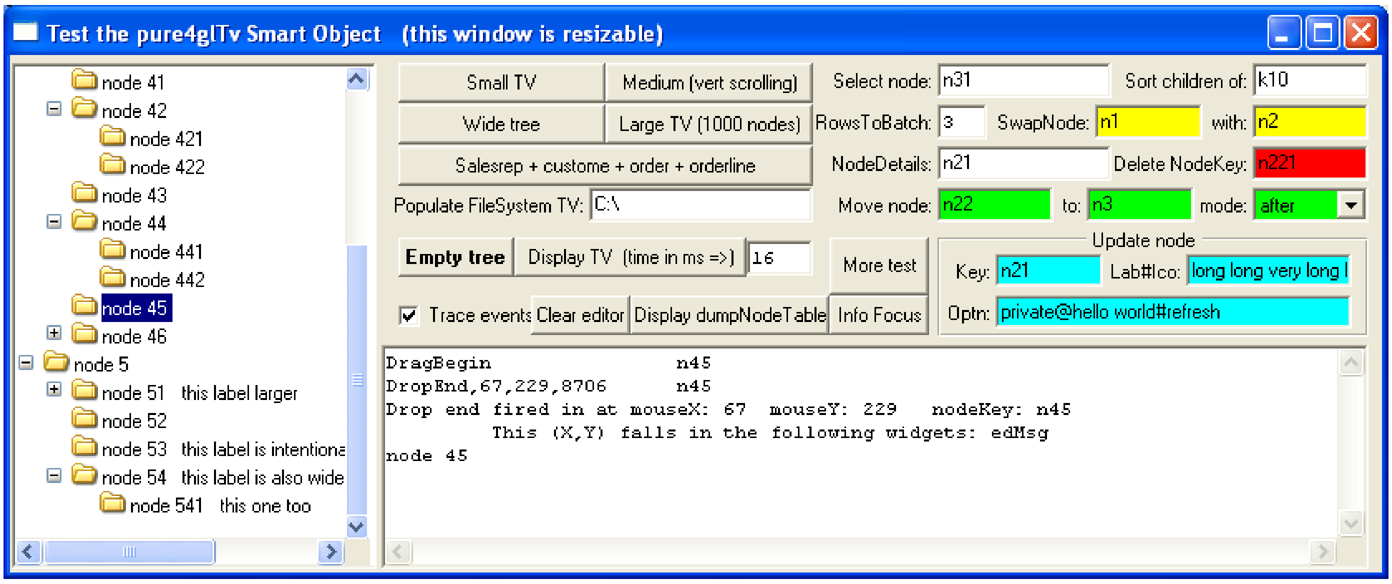
Load a treeview with the *Small TV* or *Medium* button. Drag *node 45* and move the mouse in the window. You see that a DragBegin event has been fired for the node with node key *n45* as shown in Illustration 10.



```
TV loaded in 0 ms
expand                  n4
select                  n45
DragBegin               n45
```

Illustration 10: Drag an drop within the container window (it is also possible to drop in another window)

Then Drop the *node 45* drag-box in the editor. You get a DropEnd event with a few information like the node key of the dropped node, the coordinates of the mouse pointer, and finally the widget handle of the drop target, as shown in Illustration 11.



```
DragBegin               n45
DropEnd,67,229,8706     n45
Drop end fired in at mouseX: 67  mouseY: 229   nodeKey: n45
          This (X,Y) falls in the following widgets: edMsg
node 45
```

Illustration 11: The DropEnd event is actually completely handled by the container

You will also notice that the node label *node 45* has been automatically inserted in the editor.

Actually, the drop end process has been completely handled by the container smart window with the info supplied by pure4glTv, which is sensible enough to not achieve such a drop-node-insert-label by itself.

See the code of the internal procedure tvNodeDropEnd in testSmart4glTv.w. The following code finds out the drop target widget names (or screen-value):

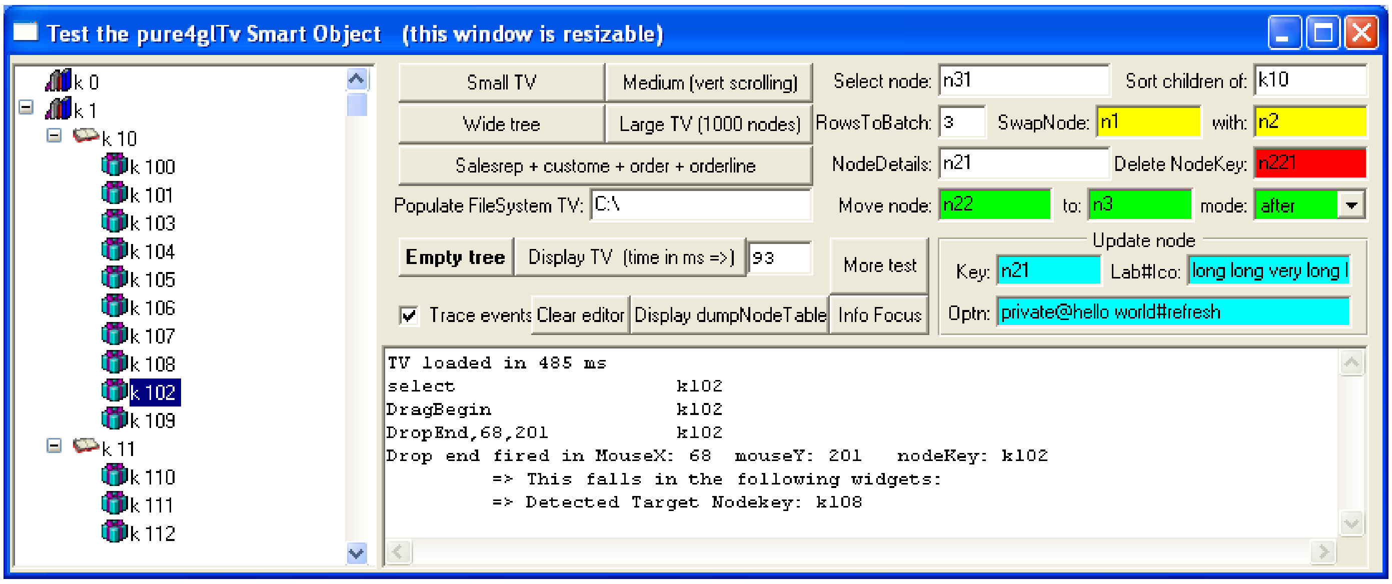
```
/* work out the name of drop target widgets from the handles passed in pcEvent*/
    DO iCount = 4 TO NUM-ENTRIES(pcEvent):
        hWidget = WIDGET-HANDLE(ENTRY(iCount,pcEvent)) NO-ERROR.
        cWidgets = cWidgets + " "
         + IF hWidget:NAME = ?
            THEN (IF CAN-QUERY(hWidget,"SCREEN-VALUE")
                   THEN "SCREEN-VALUE=" + hWidget:SCREEN-VALUE
                   ELSE "?")
            ELSE hWidget:NAME.
    END.
```

And a rather generic code inserts the node label in the drop target widget:

```
/* at last insert the label of the dragged node into the drop target widget */
hWidget = ?.
DO iCount = 4 TO NUM-ENTRIES(pcEvent):
    hWidget = WIDGET-HANDLE(ENTRY(iCount,pcEvent)) NO-ERROR.
    IF NOT CAN-QUERY(hWidget, "SCREEN-VALUE") THEN NEXT.
    IF NOT hWidget:SENSITIVE THEN NEXT. /* otherwise, we give the ability[…]*/

    DEFINE VARIABLE hNodeBuffer AS HANDLE     NO-UNDO.
    RUN getNodeDetails IN h_pure4gltv
     (INPUT  pcnodeKey /* CHARACTER */,
      OUTPUT hNodeBuffer /* HANDLE */).

    IF NOT VALID-HANDLE (hNodeBuffer) THEN LEAVE.

    CASE hWidget:TYPE:
      WHEN "EDITOR" THEN DO:
        hWidget:CURSOR-OFFSET = hWidget:LENGTH + 1.
        hWidget:INSERT-STRING(hNodeBuffer:BUFFER-FIELD("lab"):BUFFER-VALUE + "~n").
      END.
      WHEN "FILL-IN" THEN hWidget:SCREEN-VALUE = hWidget:SCREEN-VALUE +
        hNodeBuffer:BUFFER-FIELD("lab"):BUFFER-VALUE NO-ERROR.
      OTHERWISE hWidget:SCREEN-VALUE = hNodeBuffer:BUFFER-FIELD("lab"):BUFFER-VALUE NO-ERROR.
    END CASE. /* CASE hWidget:TYPE: */
    APPLY 'VALUE-CHANGED'TO hWidget. /*very important if we want the change of the SCREEN-
VALUE
                                          to result in the same as typing */

    DELETE OBJECT hNodeBuffer.

    LEAVE. /* one widget is enough ;) */
END. /* DO iCount = 4 TO NUM-ENTRIES(cWidgets): */
```

Then, choose the *Empty tree* and *Clear editor* buttons in order to get a clear test window again. Then choose the *Large TV (1000 nodes)* button.

Try to drag a node and drop it on another node. You will end up with a situation like Illustration 12.



Select node: n31 Sort children of: k10
RowsToBatch: 3 SwapNode: n1 with: n2
NodeDetails: n21 Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22 to: n3 mode: after
Display TV (time in ms =>) 93
Key: n21 Lab#Ico: long long very long l
Optn: private@hello world#refresh

```
TV loaded in 485 ms
select                      k102
DragBegin                   k102
DropEnd,68,201              k102
Drop end fired in MouseX: 68  mouseY: 201   nodeKey: k102
         => This falls in the following widgets:
         => Detected Target Nodekey: k108
```

Illustration 12: One can use drag and drop on the treeview itself in order to move nodes in the tree

Indeed, the container window has asked the treeview to move the node *k102* after node *k108* with the following short piece of code:

```
/* Example with the large tree (1000 node) and drag-drop used to move
 a node somewhere else (drop in the treeview itself) */
IF pcnodeKey BEGINS "k" THEN DO:
    DEFINE VARIABLE targetKe AS CHARACTER  NO-UNDO.
    targetKe = DYNAMIC-FUNCTION('getNodeLocatedAtXY' IN h_pure4GlTv, mouseX, mouseY).

    [some tracing code here]
    IF targetKe <> "" AND targetKe <> pcnodeKey THEN
     RUN moveNode IN h_pure4gltv (pcnodeKey, targetKe, "after", "refresh") NO-ERROR.
    IF NOT ERROR-STATUS:ERROR THEN DYNAMIC-FUNCTION('selectNode' IN h_pure4gltv , pcnodeKey).
    ELSE MESSAGE "This node cannot be moved here!"
         VIEW-AS ALERT-BOX INFO BUTTONS OK.
END.
```

A last demo with drag and drop: clear the window again, choose the *small TV* button, right-click on the *MoreTests* button and choose the menu-item *Run OtherDropTargetWin.w*. Move this *otherWindow* away. Drag the node *node 1 (drop on another window)* and move the mouse pointer in the container window then in the *otherWindow*. Notice that a new set of dynamic widget is following the mouse pointer in the other window. How is this done? Again, from the container window, with the following code in tvnodeEvent:

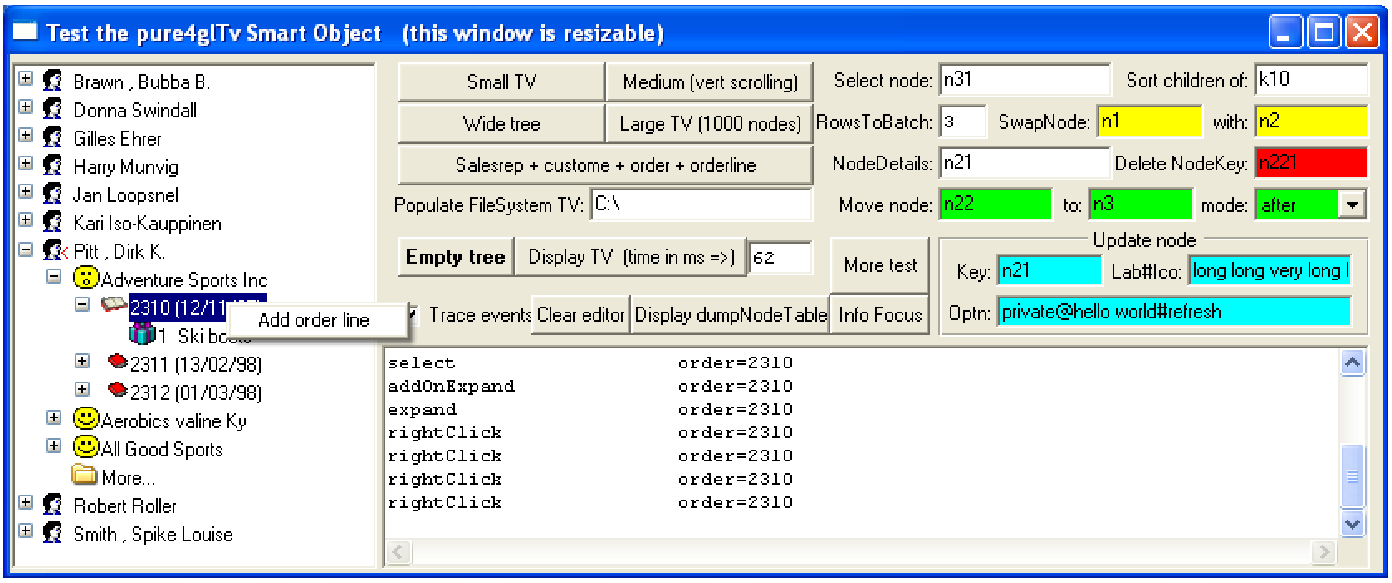
```
    WHEN "DragBegin" THEN DO:
       [...]
       /* drop target frame is in another window */
```

```
IF pcnodeKey = "n1" THEN DO:
    DEFINE VARIABLE hTargetFrame AS HANDLE     NO-UNDO.
    /* that window has a SUBSCRIBE TO "getOtherWinTargetFrame" ANYWHERE  */
    PUBLISH "getOtherWinTargetFrame" (OUTPUT hTargetFrame).
    IF VALID-HANDLE(hTargetFrame) THEN RETURN STRING(hTargetFrame).
END.
```

Of course, here we rely on the node key (which code is up to the developer) to keep the example simple, but one may rather rely on a node property to query with the getNodeDetails API.

4.4 *Testing popup menus*

Clear the treeview and choose the *Salesrep + custome + order + orderline* button. Expand a salesrep and an order then see the order lines. Now right-click on an order node. You get a *Add order line* menu



Select node: n31   Sort children of: k10
RowsToBatch: 3   SwapNode: n1   with: n2
NodeDetails: n21   Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22   to: n3   mode: after
Display TV (time in ms =>) 62
Key: n21   Lab#Ico: long long very long l
Optn: private@hello world#refresh

```
select                         order=2310
addOnExpand                    order=2310
expand                         order=2310
rightClick                     order=2310
rightClick                     order=2310
rightClick                     order=2310
rightClick                     order=2310
```

Illustration 13: Pure4glTv can build custom popup menu on the right-click event

item in a popup menu as show in Illustration 13.

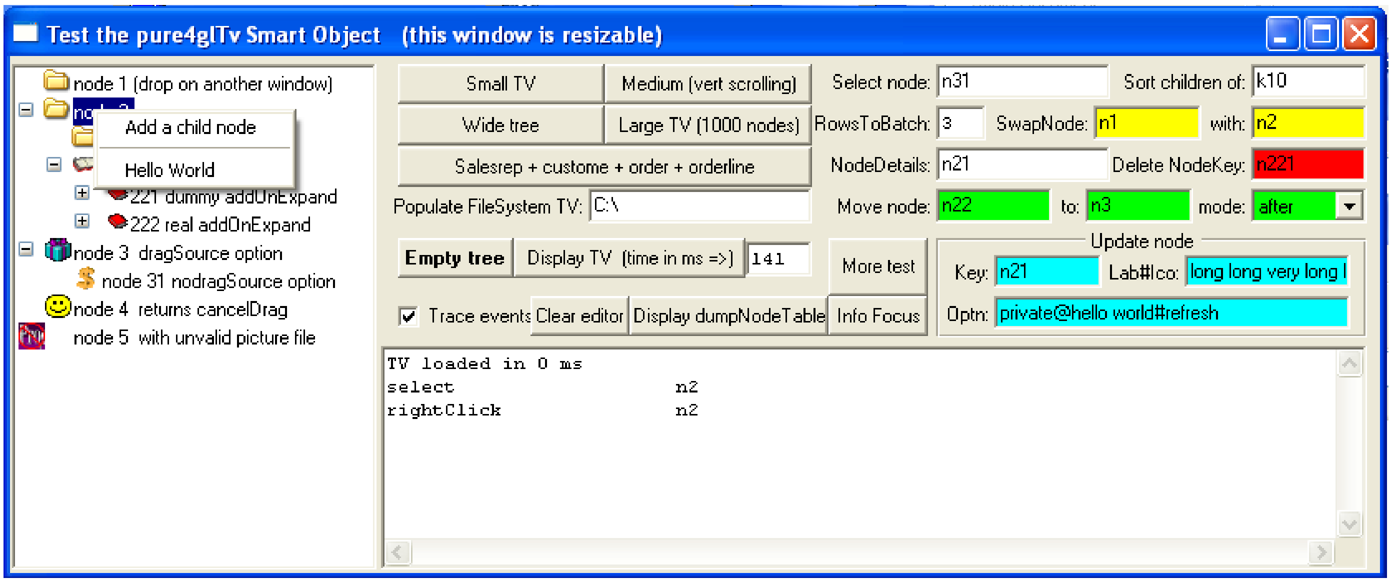
How is this done? See the code in tvnodeEvent, it calls tvNodeCreatePopup that will just return a list of pairs of menu items and events to fire when a menu-item is chosen. Note the returned list will be passed back to the pure4glTv by tvNodeEvent with a `RETURN RETURN-VALUE`. Note that pure4glTv will take care of this `RETURN-VALUE` only if the event was *rightClick*, otherwise it will just ignore it.

The pure4glTv will then build the popup menu dynamically with the `RETURN-VALUE`. It will fire the corresponding event with the parent node key of the popup menu when the menu item is chosen.

Choose the Item. The editor shows that tvNodeEvent is fired with the expected event name of *MenuAddOrderLine* that was supplied in the list mentioned above.

The above example has only one menu-item, and one may wonder how to display a rule item in the popup menu. Then clear the treeview, choose the *Small TV* button and right click on a node. You will then get the popup menu seen in Illustration 14 with two items and a rule in between, thanks to returned string of `"Add a child node,MenuAddChildNode,RULE,,Hello World,MenuHelloWorld"`.

Notice in the list that the item after RULE is blank. Actually, one might well put whatever here, since a


Test the pure4glTv Smart Object   (this window is resizable)
node 1 (drop on another window)
Add a child node
Hello World
221 dummy addOnExpand
222 real addOnExpand
node 3 dragSource option
node 31 nodragSource option
node 4 returns cancelDrag
node 5 with unvalid picture file
Small TV
Medium (vert scrolling)
Wide tree
Large TV (1000 nodes)
Salesrep + custome + order + orderline
Empty tree
Display TV (time in ms =>)
More test
Trace events
Clear editor
Display dumpNodeTable
Info Focus

Select node: n31
Sort children of: k10
RowsToBatch: 3
SwapNode: n1
with: n2
NodeDetails: n21
Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22
to: n3
mode: after
141
Update node
Key: n21
Lab#Ico: long long very long l
Optn: private@hello world#refresh

```
TV loaded in 0 ms
select                   n2
rightClick               n2
```

Illustration 14: A Popup menu with multiple items and a decoration rule

rule item is just a decoration item. Note also that pure4glTv does not support sub-menus in popup menu. For more information, see the buildAndOpenPopupMenu API.

4.5 Testing few APIs (with the colored widgets on the right)

For more informations about the following tests, just see the code of the corresponding widget triggers. Note that the Enter key is the most used trigger in the colored widgets in order to run few common APIs, as a few tooltips say.

Load the *Small TV*, then press ENTER in a yellow *SwapNode* fill-in. This will swap *node n1* with *node n2*.

Press Enter in the *delete NodeKey* red fill-in, this will delete *node n221.*

With the green *move node* fill-in, it is possible to move any node almost anywhere in the tree. As mentioned earlier in this document, it is not possible to move a parent so it would become a child of itself. See how such an error is handled in the code.

The blue widgets give the ability to update the label or the picture or the options of a node. Read the tooltip of these widgets to understand how to use them and see the updateNode API for more information.

The NodeDetails fill-in has an intersting piece of code to get all possible information about a given node, and even obtain a handy buffer handle that will allow someone to walk through the tree with great performance. See the getNodeDetails API for more information.

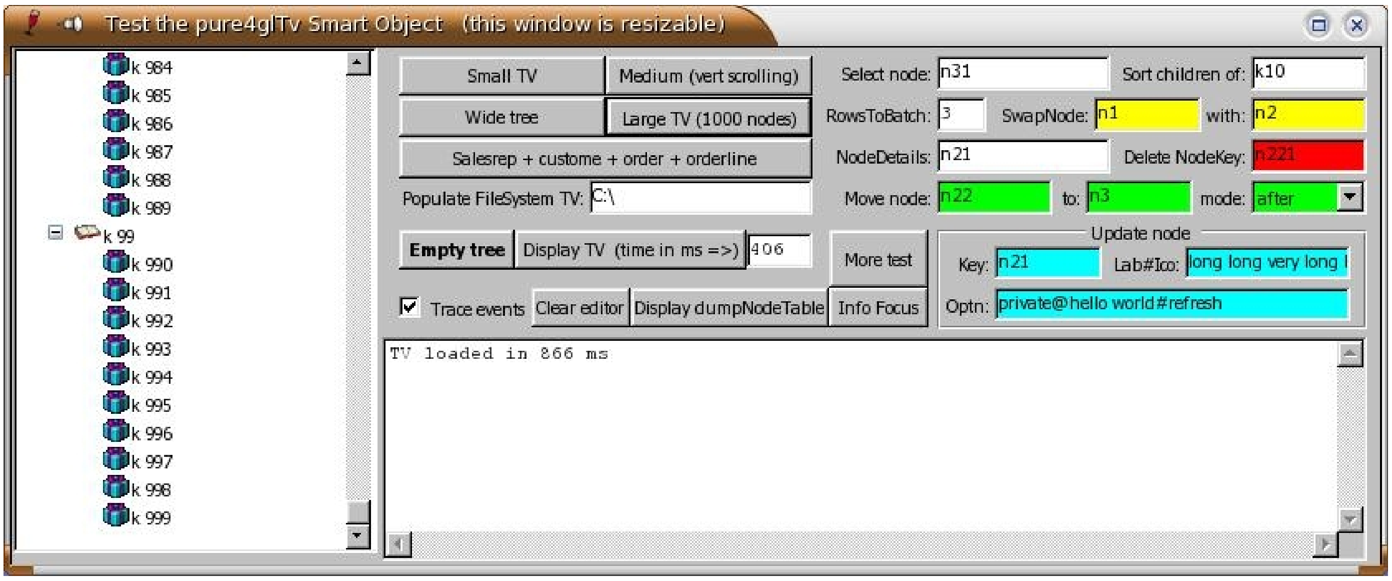
5 A few Performance tests

The following results often show that pure 4GL things run with a very similar speed on both Linux/Wine and MS Windows as long as it does not involve the UI. Pure4gltv caches the key attributes of key widgets in a few temp-tables to avoid costly queries of attributes at the UI level. Note that the size of cached data is rather small, so the involved resources are rather small.

5.1 Results on Linux / Wine (with a 2GHz Processor)

Illustration 15 and Illustration 16 show that it takes the same time to load 1000 nodes in the tree. However the first rendering of 49 iterations in the view port costs 1.3 seconds whereas it costs only 406 milliseconds to render 17 iterations.

Note that expanding or collapsing nodes or even scrolling will cost less because the rendering widgets will be reused at best by the optimization procedure. Note it is especially interesting to set the

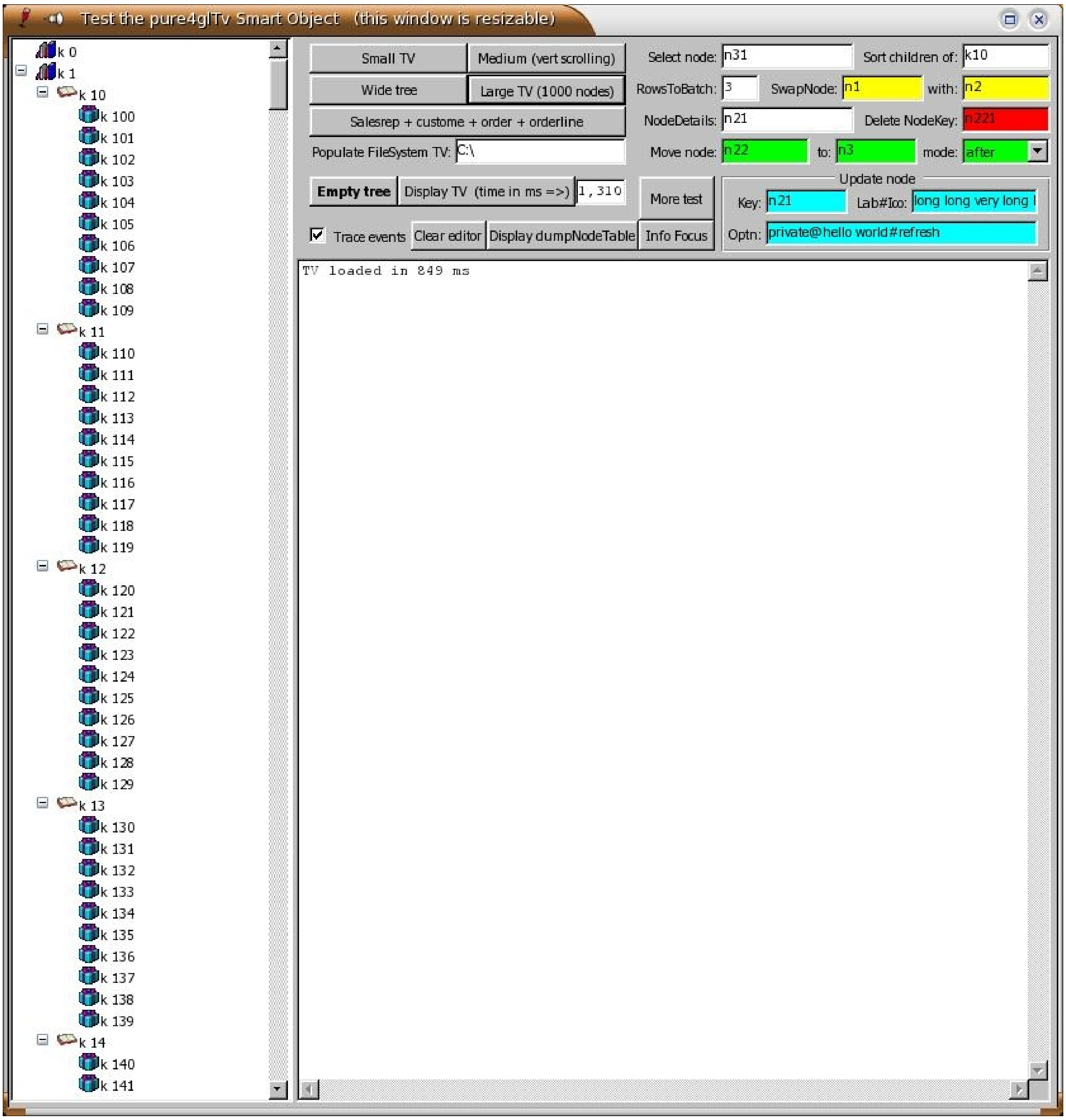


Select node: n31
Sort children of: k10
RowsToBatch: 3
SwapNode: n1
with: n2
NodeDetails: n21
Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22
to: n3
mode: after
Display TV (time in ms =>) 406
Key: n21
Lab#Ico: long long very long l
Optn: private@hello world#refresh
[✓] Trace events

```
TV loaded in 866 ms
```

Illustration 15: On Wine 1000 nodes are added in 866 milliseconds. The rendering of 17 iterations takes 406 milliseconds.

picCacheCoef and labCacheCoef properties to a value greater than 1 (like 2 or 3) for such a large treeview with Wine.

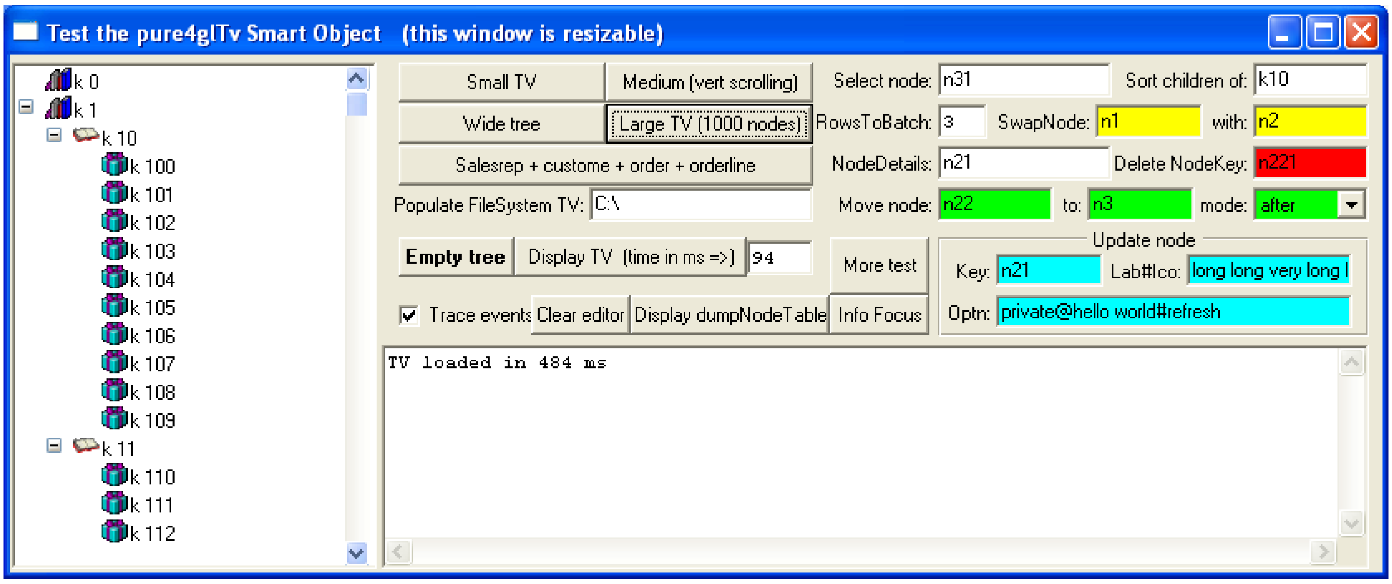


Populate FileSystem TV: C:\
1,310
Select node: n31
Sort children of: k10
RowsToBatch: 3
SwapNode: n1
with: n2
NodeDetails: n21
Delete NodeKey: n221
Move node: n22
to: n3
mode: after
Key: n21
Lab#Ico: long long very long l
Optn: private@hello world#refresh

```
TV loaded in 849 ms
```

Illustration 16: On Wine. 1000 nodes still loaded in 866 milliseconds. But the rendering of 49 iterations now takes 1.3 seconds.

5.2 Results on Native MS Windows (with a 3.2GHz Processor)



Select node: n31
Sort children of: k10
RowsToBatch: 3
SwapNode: n1
with: n2
NodeDetails: n21
Delete NodeKey: n221
Populate FileSystem TV: C:\
Move node: n22
to: n3
mode: after
Display TV (time in ms =>) 94
Key: n21
Lab#Ico: long long very long l
Optn: private@hello world#refresh

```
TV loaded in 484 ms
```

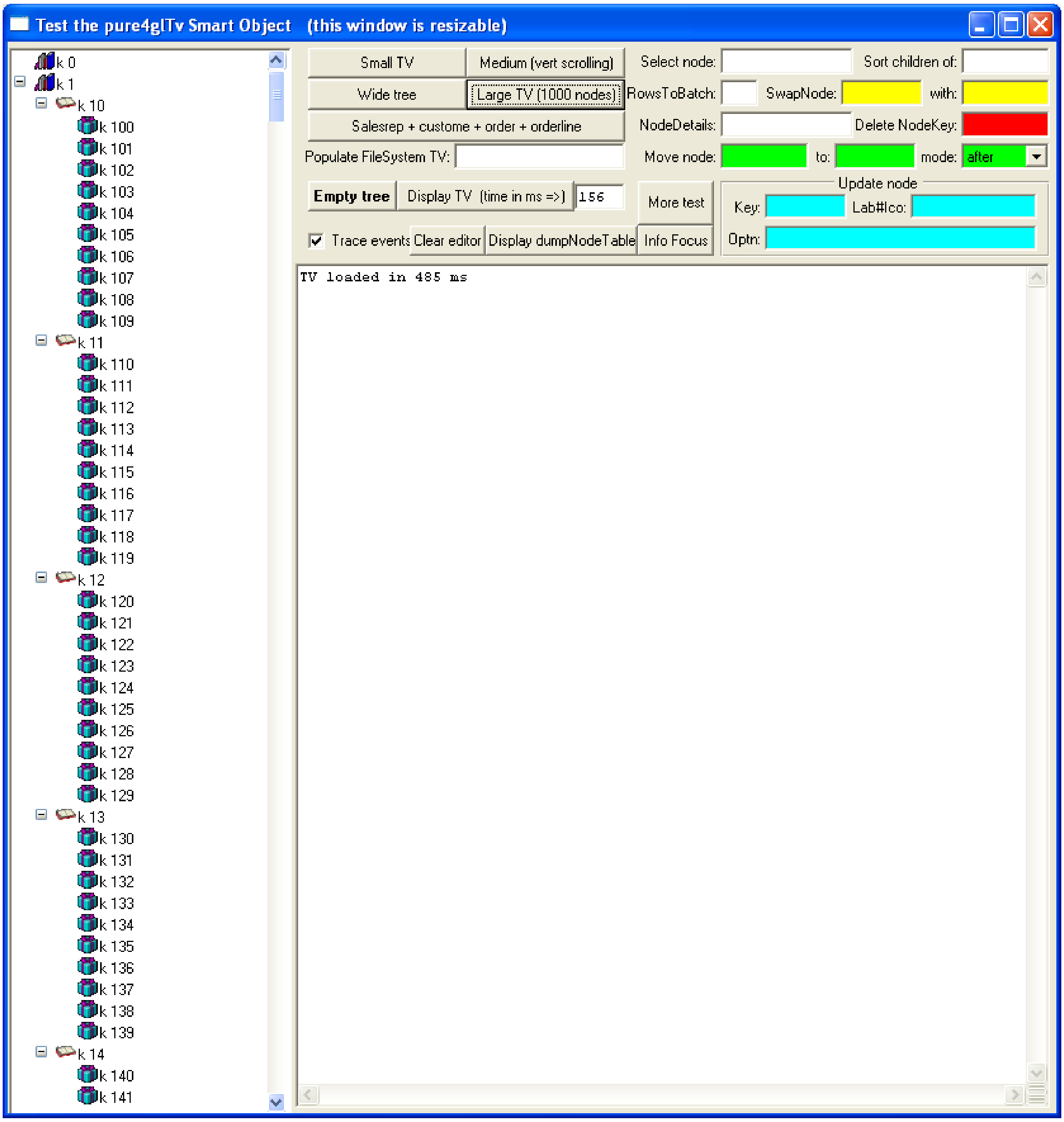
Illustration 17: On native MS Windows, 1000 nodes are added in 453 milliseconds. The rendering of 17 iterations takes 94 ms.

As expected, performances are better on native MS Windows, not because of the addition of 1000 nodes in 453 milliseconds but because the of rendering of 17 iterations that takes 94 milliseconds.

Details to compare the results of the two configurations although the CPU used on the MS machine is much faster:

- 866ms / 3.2GHz * 2GHz = 541 milliseconds that is rather close to 453ms. This shows that the performances on Wine are very close to the one of a native Windows machine for pure 4GL things, i.e. as long as the UI is not involved.
- On the other hand, regarding the rendering of 17 iterations: 406ms / 3.2GHz * 2GHz = 253ms that is quite far from the 94ms obtained on Native Windows. So in short, the display is about 2.5 slower on Wine than on native Windows.

This snapshot shows again that 1000 nodes still take the same time to be loaded. Note that the 49 iterations in the view port costs only 156 ms on MS Windows, which is really fast for a normal production.



```
TV loaded in 485 ms
```

Illustration 18: Pure4glTv is very fast to refresh 49 rendering iterations on Native MS Windows

6 API documentation

The following documentation actually comes from the source code of pure4glTv. It is just a copy of the header comment for each API.

This list of APIs does not include the get<Property> and set<Property> functions. Refer to the property list and their entry in the source code for more information.

Finally, these APIs are procedures unless the name ends with parentheses '()' meaning it is a function.

6.1 addNode

```
/*------------------------------------------------------------------------------
Purpose:    Add a node to the treeview.  A node is added to a parent node as
last child.  We cannot insert t between two children for now
             (easy to implement an option later...)


  Parameters:

  pcKe:  User key used for the node to add
         if blank, then we generate a key with "generatedKey-<bideId>>"

  pcKePar: user key of parent, or "#par=<id of parent node>"

  pcLab: label of the node

  pcIco: icon or set of image.  If blank then classic folder is used.
     => see picFileName() function to see how implement a new set of images


  pcOptn:   An extendable CHR(1) separated list of options, for the node to add,
           or for the addNode API itself (such as "refresh"):
            Actually, options that are not valid for the addNode API itself
           are considered as options for the node record to be added
            Unknown options are taken as custom options and are stored in node.optn

    --- node options considered when adding the node, but not kept in node.optn -------
    expanded       node initially expanded

    selected       Go to that node and select it at the next tvRefresh()


    --- node options stored in node.optn for later use ------------------------
    addOnExpand     Handle it as a collapsed node even when it has no child
                     expanding it will result in publish "tvnodeEvent" with
                     event "addOnExpand" then it will expand the node

    InViewPortIfPossible   In next tvRefresh() will try to make the node
                          visible in the view port by scrolling the treeview
                          if necessary
    dragSource    When the property DragSource is set to "some", then a drag
                  operation is allowed for nodes that have the option
                  "dragSource"


    noDragSource  Disable the drag event even when the property DragSource is set
                  to "all"
                  => Note also that another way to disable a drag operation
                     is to make tvNodeEvent "dragBegin" RETURN "cancelDrag"


    --- option for the addNode API itself (not for the node to add) ------------
    AddMode=after   Instead of adding the node as a child of pcKePar, the
                   node is added as a next sibling of node pcKePar
                    => to do that, we find the parent of pcKePar, add the node
                  to it then run MoveNode to move after the wanted node
           ** if autoSort is set, then this option is used only to retrieve the parent node
              but the new node is added at a place that is compliant with the sort

    AddMode=before  Instead of adding the node as a child of pcKePar, the
                   node is added as a prev sibling of node pcKePar
                    => to do that, we find the parent of pcKePar, add the node
                  to it then run MoveNode to move before the wanted node
           ** if autoSort is set, then this otion is used only to retrieve the parent node
              but the new node is added at a place that is compliant with the sort


    refresh       Calls tvrefresh() at the end of the addNode process
--------------------------------------------------------------------------------*/
```

6.2 buildAndOpenPopupMenu

```
/*------------------------------------------------------------------------------
  Purpose:     build and Open Popup Menu parented by pcKey
               This API is called automatically from labLeftMouseEvent when
               the publish of tvNodeEvent "rightclick" gets a RETURN-VALUE back
               from the linked object

  Parameters:
    pcKey  the key of the node that is going to parent the popup menu

    pcLabelsEvents  Comma separated list of item label and item event to fire
                    when the menu is chosen.

                    Example:
                    "Hello world,MenuHelloWorld,RULE,,Add Customer,MenuAddCust"
                    => Choosing the Item with label "Add Customer" will fire:
                    PUBLISH "tvNodeEvent" ("MenuAddCust" , pcMenuParentNodeKey).

                    Note that if an item label is set to RULE (in *capital* case),
                    then a the item is taken as a RULE subtype menu item



  Notes:       It is a good practice to prefix the events with something like
```

```
               "Menu" or "PopupMenu" so it is easier to handle it in the
               tvNodeEvent target procedure

               I do not handle the case when a pair is missing.  In this
               situation one will hit:
                ERROR Entry <entry#> is outside the range of list <list-string>. (560)

               If a blank or invalid key is passed, then the menu is simply not
               parented to any node (We actually parent it to the frame).

               This API should normally be called from labLeftMouseEvent on
               right mouse click with key of the current selected node (bellow
               the mouse pointer) but nothing prevents you from calling directly
               One little drawback is that it will open the menu at the current
               location of the mouse pointer...
------------------------------------------------------------------------------*/
```

6.3 collapseNode()

```
RETURNS LOGICAL
  (INPUT pcNodeKe AS CHAR
  ,INPUT pcOptn AS CHAR) :
/*------------------------------------------------------------------------------
    Purpose:  Collapse a given node

Parameters: pcNodeKe: key of the node to collapse

              pcOptn: extendable comma separated list of options:
                 refresh       Calls tvrefresh() at the end of the collapse Process

     Notes: This API returns No in the two following cases:
               -there is no node for the passed pcNodeKe
                 => in this case, it also returns an ERROR
               -the node to collapse is already collapsed

            When it is a success, then it does the following:
              PUBLISH "tvNodeEvent" ("collapse", bnode.ke).
              RETURN YES.
------------------------------------------------------------------------------*/
```

6.4 deleteNode

```
/*------------------------------------------------------------------------------
     Purpose:     Delete a given node, and the branch it parents if any
  Parameters:
      pcKe:   User key used for the node to delete

    pcOptn: extendable comma separated list of options:
       refresh       Calls tvrefresh() at the end of the deletion process
      Notes:
------------------------------------------------------------------------------*/
```

6.5 deselectCurrentNode()

```
RETURNS LOG:
/*------------------------------------------------------------------------------
  Purpose:  Deselect the node that is currently selected

    Notes:  This API always returns TRUE and sets the global variable gCurNode to 0

    When there is really a node to deselect, then it does:
     PUBLISH "tvNodeEvent" ("deselect", bnode.ke).
------------------------------------------------------------------------------*/
```

6.6 disableObject (new on Jully 2006)

```
/*------------------------------------------------------------------------------
  Purpose:     Provide a standard ADM2 API to disable pure4gltv
  Parameters:  <none>
  Notes:       Implemented in March 2006
------------------------------------------------------------------------------*/
```

6.7 enableObject (new on Jully 2006)

```
/*------------------------------------------------------------------------------
  Purpose:     Provide a standard ADM2 API to enable pure4gltv
  Parameters:  <none>
  Notes:       Implemented in March 2006
------------------------------------------------------------------------------*/
```

6.8 expandBranch (new on Jully 2006)

```
/*------------------------------------------------------------------------------
  Purpose:     Expand all the nodes of a branch starting from a given node
  Parameters:  pcKe : node key the branch to expand starts from
  Notes:       Typically fired when the '*' key is pressed, but can be called
                directly
------------------------------------------------------------------------------*/
```

6.9 expandNode()

```
RETURNS LOGICAL
  (INPUT pcNodeKe AS CHAR
  ,INPUT pcOptn   AS CHAR  /*list of option like "refresh" */) :
/*------------------------------------------------------------------------------
   Purpose:  Expand a given node

Parameters: pcNodeKe: key of the node to expand

              pcOptn: extendable comma separated list of options:
                 refresh       Calls tvrefresh() at the end of the expand Process
```

```
     Notes: This API returns No in the two following cases:
              -there is no node for the passed pcNodeKe
                 => in this case, it also returns an ERROR
              -the node to expand is already expanded

            When it is a success, then it does the following:
              PUBLISH "tvNodeEvent" ("expand", bnode.ke).
              RETURN YES.
------------------------------------------------------------------------------*/
```

6.10 emptyTree

```
/*------------------------------------------------------------------------------
  Purpose:     delete all node and display an empty tree
  Parameters:  <none>
  Notes:       will call tvRefresh() at the end of the process
------------------------------------------------------------------------------*/
```

6.11 findNextNodeToShow

```
/*------------------------------------------------------------------------------
     Purpose: Find the Next available node of a given node in the treeview
            => can be first child or next sibling, or an uncle ;) (next sibling
             of a parent or grant parent)

  Parameters: INPUT  Node ID we want to find the Next node of

              INPUT  plIgnoreChild  mode
                    YES => Ignore expanded children nodes bellow the given node
                    NO  => This mode is like finding the node in the next visible
                           iteration

              OUTPUT Node id of the wanted Next node.
                  Equals to 0 when no available next node
------------------------------------------------------------------------------*/
```

6.12 findPrevtNodeToShow

```
/*------------------------------------------------------------------------------
     Purpose: Find the Previous available node of a given node
       Similar to the findNextNodeToShow API, but to get a previous node
       (in the iteration above a given node)

        => see comments in findNextNodeToShow

------------------------------------------------------------------------------*/
```

6.13 fMainKeyEvent

```
/*------------------------------------------------------------------------------
  Purpose:
  Parameters:  Key function in the frame.
              Can be a navigation key or "+" or "-"
  Notes:   Was designed to be called internally, but it should work fine to
```

```
          be called from anywhere, so I unchecked the PRIVATE option
------------------------------------------------------------------------------*/
```

6.14 getNodeDetails

```
/*------------------------------------------------------------------------------
  Purpose:  To obtain the details of a given node

  Parameters:  pcKe, node key of the node we want the details
               One can also pass "nodeId=<nodeId>" instead of a node key

  Notes:       This API is rather powerful because it returns the HANDLE of a
               DYNAMIC buffer that we create for the occasion

               Advantages:
                Any field in the node table is available (with dynamic programming)

                The buffer can be reused to walk though the tree with a dynamic
                FIND-FIRST() method or a Dynamic Query, with very high performance

               One disadvantage however:
                IT IS UP TO THE DEVELOPPER TO DELETE the dynamic buffer object
                when it is not needed anymore otherwise, one may get a memory
                leak.
                Note that the dynamic buffer is created in the unnamed widget pool
                so it will be deleted with the pure4glTreeview Object


Example:

    RUN getNodeDetails IN h_pure4gltv
    ( INPUT mynodeKey    /* CHARACTER */,
      OUTPUT hNodeBuffer /* HANDLE */).

    MESSAGE
    "id:"            hNodeBuffer:BUFFER-FIELD("id"):BUFFER-VALUE       SKIP
    "lab:"           hNodeBuffer:BUFFER-FIELD("lab"):BUFFER-VALUE      SKIP
    "ico:"           hNodeBuffer:BUFFER-FIELD("ico"):BUFFER-VALUE      SKIP
    "level:"         hNodeBuffer:BUFFER-FIELD("level"):BUFFER-VALUE    SKIP
    "par:"           hNodeBuffer:BUFFER-FIELD("par"):BUFFER-VALUE      SKIP
    "prev-sibling:"  hNodeBuffer:BUFFER-FIELD("pre"):BUFFER-VALUE      SKIP
    "next-sibling:"  hNodeBuffer:BUFFER-FIELD("nex"):BUFFER-VALUE      SKIP
    "expanded:"      hNodeBuffer:BUFFER-FIELD("expanded"):BUFFER-VALUE SKIP
    "optn:"          hNodeBuffer:BUFFER-FIELD("optn"):BUFFER-VALUE
        VIEW-AS ALERT-BOX INFO BUTTONS OK.

    DELETE OBJECT hNodeBuffer.

------------------------------------------------------------------------------*/
```

6.15 getNodeId()

```
RETURNS INTEGER
  (pcKe AS CHAR) :
/*------------------------------------------------------------------------------
```

```
  Purpose:  Returns node.id of node record that has node.ke = pcKe
    Notes:  Returns 0 if no such node
------------------------------------------------------------------------------*/
```

6.16 getNodeKey()

```
RETURNS CHAR
  (piId AS INT) :
/*------------------------------------------------------------------------------
  Purpose:  Returns the node key node.ke of node record that has node.id = piId

    Notes:  Returns "" if no such node.
            Note that a node cannot have a blank key, even when a blank node key
            was passed to addNode() to create a node, because addNode then generates
            a key based on the unique id of the node (see code of addNode)
------------------------------------------------------------------------------*/
```

6.17 getNodeLocatedAtXY()

```
RETURNS CHARACTER
  (ipX AS INT
  ,ipY AS INT) :
/*------------------------------------------------------------------------------
  Purpose:  This API returns the node key of the node that is located on a given
           (x,y) in the viewport (FRAME ftv)
           This API is useful to achieve a move node by drag and drop (node dropped
           in the treeview)

    Notes: If there is no node located at the given (x,y) then an empty string is
           returned
------------------------------------------------------------------------------*/
```

6.18 getNodeParentKey()

```
RETURNS CHAR
  (pcKe AS CHAR) :
/*------------------------------------------------------------------------------
  Purpose:  Returns key of parent node
    Notes:  Returns blank if the node has no parent (first level in the tree)

            Returns ERROR if the node does not exist
------------------------------------------------------------------------------*/
```

6.19 getSelectedNodeKey()   (new on Jully 2006)

```
/*------------------------------------------------------------------------------
  Purpose:  returns the node key of the current selected node (or last
            selected node)
    Notes:  If there is no selected node, then we return unknonw value.

------------------------------------------------------------------------------*/
```

6.20 goToNode()

```
RETURNS LOGICAL
  ( ipGoToNode AS INT,
    pcMode AS CHAR ) :
/*------------------------------------------------------------------------------
     Purpose:  Go to a given node.

  Parameters:

      ipGoToNode  node ID we want to go to.

      pcMode:
      - blank (default), will do nothing if the node is already in the viewport.
      - "top" then will force a refresh to put the node a the top of the viewport

    Notes:  We do not test if the node is valid for performance reasons. Up to
            you to call this API for a node that exists
------------------------------------------------------------------------------*/
```

6.21 lastVisibleNode()

```
RETURNS INTEGER
  ( /* parameter-definitions */ ) :
/*------------------------------------------------------------------------------
  Purpose:  Return node.id of last 'visible' node (available in last non collapsed segment)

    Notes:  Returns 0 if tree is empty

    We start from top level and seek last child of last child of last child...
    and stop if we find a non expanded guy on the way
------------------------------------------------------------------------------*/
```

6.22 loadDemoTv

```
/*------------------------------------------------------------------------------
  Purpose:     Guess what...
  Parameters:  <none>
  Notes:       Called internally at design time in order to show a cute little
               treeview
------------------------------------------------------------------------------*/
```

6.23 moveNode

```
/*------------------------------------------------------------------------------
  Purpose:     Move a given node to wherever

  Parameters:  pcNodeKey  Key of node to move

               pcToKe     Key of relative node to move to (after it, before it, last child of
it)

               pcMode     One of the 3 following values
                           "after"
                           "before"
                           "parent"

               pcOtpn    extendable comma separated list of options
                          "refresh"  => calls tvRefresh() at the end of the process

  Notes:       IF pcMode = "parent" and toNode.Ke is blank THEN it means
               'move it so it becomes the last guy at level 0'
                 => In this case, the buffer toNode will hold no record
-------------------------------------------------------------------------------*/
```

6.24 nodeAtVirtualIter()

```
RETURNS INTEGER
  (VIterToGo AS INT) :
/*------------------------------------------------------------------------------
  Purpose:  Returns the node ID of the node located at a given virtual iteration.
            This is quite important to handle scrolling.

            This API returns a node ID and not a node key because it was designed
            to be mainly used internally.  Anyway, it can be used from the outside
            without any problem

            What I call a virtual iteration is the 'line' number of a node if the
            Treeview was big enough to show all the nodes in a very tall viewport
            with first top root node at line number 1.

    Notes: Exceptions:
      Returns 0 when no node in the tree
      Returns -1 when VIterToGo > gExpChildren
      Returns bellow -1 when unexpected error that should never happen since it
       would mean the tree is corrupted (see in the code)
-------------------------------------------------------------------------------*/
```

6.25 nodeInCollapsedBranch()

```
RETURNS LOGICAL
  (ipNode AS INT):
/*------------------------------------------------------------------------------
  Purpose:  Retuns yes if a given node (based on node ID) is in a collapsed
            branch, else no
    Notes:  In the case of an invalid node, it RETURNS ERROR NO
-------------------------------------------------------------------------------*/
```

6.26 picFileName()

```
RETURNS CHARACTER
  (cCode AS CHAR,
   ico   AS CHAR) :
/*------------------------------------------------------------------------------
  Purpose:  Returns a picture file name for a given code and icon/picture file.
    Notes:  Note that ico contains the file name path prefixed by a path, which
            might be relative
    Convention to implement your own set of pictures, called <icoFile> here
    With a Plus/Minus on the left
       noChild   <icoFile>NoSign
       expanded  <icoFile>Minus
       collapsed <icoFile>Plus

    Without Plus/Minus on the left
       noChild   <icoFile>
       expanded  <icoFile>Open
       collapsed <icoFile>
------------------------------------------------------------------------------*/
```

6.27 resizeObject

```
/*------------------------------------------------------------------------------
  Purpose:     standard ADM2 API
  Parameters:  height and width in char units

  Notes:       It is up to the developer to
                1) call this API
                2) query the resizeVertical and resizeHorizontal instance
                  properties to supply the expected values

               If a parameter is ? or 0, then it means that the width or
               height has to remain unchanged

Example in window-resize of a container window:

  {get resizeVertical lresizeVertical h_pure4glTv}.
  IF lresizeVertical = ? THEN lresizeVertical = YES.
  {get resizeHorizontal lresizeHorizontal h_pure4glTv}.
  IF lresizeHorizontal = ? THEN lresizeHorizontal = YES.

  iTvWidth = FRAME fMain:COL - 1.7. /* the treeview is on the left border */

  iVerticalGap = SELF:HEIGHT-CHAR - FRAME fContainer:HEIGHT-CHARS.
  iHorizontalGap = SELF:WIDTH-CHAR - FRAME fContainer:WIDTH-CHARS.

  [...] /* resizing of frame in the smart window */

  RUN resizeObject IN h_pure4glTv
    (IF lresizeVertical THEN SELF:HEIGHT-CHARS - 0.2 ELSE ?
    ,IF lresizeHorizontal THEN iTVWidth + iHorizontalGap ELSE ?).

  [...]
------------------------------------------------------------------------------*/
```

6.28 selectNode()

```
RETURNS LOGICAL
  (pcNodeKe AS CHAR) :
/*------------------------------------------------------------------------------
  Purpose:  Select a the node of a given key

    Notes:  For now, if we select a node that is outside of the view port, then
```

```
            we try to scroll to it
------------------------------------------------------------------------------*/
```

6.29 sortChildren

```
/*------------------------------------------------------------------------------
  Purpose:     Sorts (or resorts) all the children of a parent by their label

  Parameters:  pcKe  key of the parent node

               pcOptn is an extendable comma separated list of option:
                   refresh  => call tvRefresh() at the end of the sorting process
------------------------------------------------------------------------------*/
```

6.30 swapNode

```
/*------------------------------------------------------------------------------
  Purpose: Swap a node with another.

           We do not touch the children nodes, which remain attached to their
           parent, so this API could also have been called swapBranches

  Parameters:  See definition block

  Notes:       It is more efficient to call this API than calling moveNode
               multiple times.
------------------------------------------------------------------------------*/
```

6.31 topNode()

```
RETURNS INTEGER
  ( /* parameter-definitions */ ) :
/*------------------------------------------------------------------------------
  Purpose:  returns node.id of node at the top of the tree
    Notes:  Note this node cannot be in a collapsed branch
------------------------------------------------------------------------------*/
```

6.32 updateNode

```
/*------------------------------------------------------------------------------
   Purpose:  Update the label, or the icon, or a list of option(s) of a given node.

Parameters:          pcKe:  key of the node to update

             pcfieldNames: Comma separated list of fields
                        => for now the complete list is limited to "lab,ico"
                        the idea is to keep it flexible for possible future needs

             pcFieldValues: CHR(1) separated list of values for the fields listed
                           in pcfieldNames.

             pcOptn:  BEWARE, this one is not only about options for the API
                      itself, but especially to update the options of a node
                      in the node.optn field, as explained bellow:
```

```
             pcOptn contains a CHR(1) separated list of option to add, update
             or remove from the node.optn record to update.
               => If the option is not in node.optn yet, then add it

               => If the option is of the form 'name' + CHR(2) + 'value' and there
                is already an option with same 'name' + CHR(2) in node.optn,
                then update the value

               => If the option is in node.optn, but pcOptn has it prefixed with
                "!" (exclamation mark) then it is *removed* from node.optn
                     example "!private" will remove "private<CHR(2)>hello world"

              See the complete list of standard node options in the header
              comments of the addNode API

             If "refresh" is passed in the the option list, then a tvRefresh() is
             called at the end of the update process (I did not want to create yet
             another parameter just for this need...)
              => SO "refresh" IS AN EXCEPTION (don't use it as a custom node option)


    Notes:  Note that this API does not only modify node.lab and node.ico, but
            also takes care of the virtual width of the node to notify the
            treeview if it has to enlarge or shrink its virtual width
------------------------------------------------------------------------------*/
```

6.33 updateNodeWidth

```
/*------------------------------------------------------------------------------
  Purpose: Update the width of a node, by taking care of the virtual width of
   the viewport

  Parameters:  see definition block

  Notes: This procedure was designed to be called internally, but it should work
   OK when called form the outside, so I unchecked the PRIVATE option
------------------------------------------------------------------------------*/
```

6.34 tvRefresh()

```
RETURNS LOGICAL
  (/* char def */) :
/*------------------------------------------------------------------------------
  Purpose:  Refreshes the view port of the treeview.  Used to display the current
            view port

    Notes:  Big change on 01-Nov-2004: we always refresh from iteration 1
            Before, we could refresh starting form the middle of the viewport
            (think of collapsing a node in the middle) for performance sake,
            However it is far simpler and easier to maintain by always refreshing
            the all view port and the impact on performance is ridiculous thanks
            to new optimizeWine/MS procedures that naturally reuse the rendering
            widgets at best.
------------------------------------------------------------------------------*/
```

6.35 tvScroll()

```
RETURNS LOGICAL
  ( ipScrollBy AS INT,
    scrollAsMuchAsPossible AS LOG) :
/*------------------------------------------------------------------------------
  Purpose:  Scroll view port by ipScrollBy
                  positive means scroll up    (going down!!!)
                  negative means scroll down  (going up !!!)

    Notes:  Description of the scrollAsMuchAsPossible parameter:
             Scenario: We ask to scroll 6 up but there are only 5 iterations
             above the top so the maximum we can scroll up is actually 5:
              -if scrollAsMuchAsPossible IS set, then we scroll up by 5
              -if scrollAsMuchAsPossible is NOT set, then we do NOT scroll
               at all and we RETURN NO

   Two little exceptions when we return NO for any value of scrollAsMuchAsPossible:
             1) If we are already at the very bottom and try to scroll up
             2) We are already at the very top and we try to scroll down
------------------------------------------------------------------------------*/
```

6.36 widgetsAt

```
/*------------------------------------------------------------------------------
  Purpose: Return the list of widget handles of the widget(s) that are located
  on a given X and Y

  Parameters:  see definition block

    Notes: This procedure was designed to be called internally, but it should work
   OK when called from the outside, so I unchecked the PRIVATE option
------------------------------------------------------------------------------*/
```

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