

# TIMERULER

## FUNCTIONAL SPECIFICATION

ICGROUP DEUTSCHLAND GMBH

Date	Version	Author	Comment	State
11-Jun-01	0.9	Karsten Koch		For Review
13-Jun-01	1.0	Karsten Koch	Chapter order changed	Released

### Disclaimer

This Specification is almost complete. The component integration requirements are incomplete. If you find other missing descriptions, mail me: [karsten.koch@investconsult.com](mailto:karsten.koch@investconsult.com)

### References

This specification assumes that you are familiar with the following guidelines:

- Java Look & Feel Design Guidelines<sup>1</sup>  
Chapter 3: Design Considerations, Chapter 4: Visual Design
- Windows 2000 UI Design Guidelines<sup>2</sup>  
Chapter 2: Design Principles and Methodology, Chapter 5: Input Basics, Chapter 6: General Interaction Techniques

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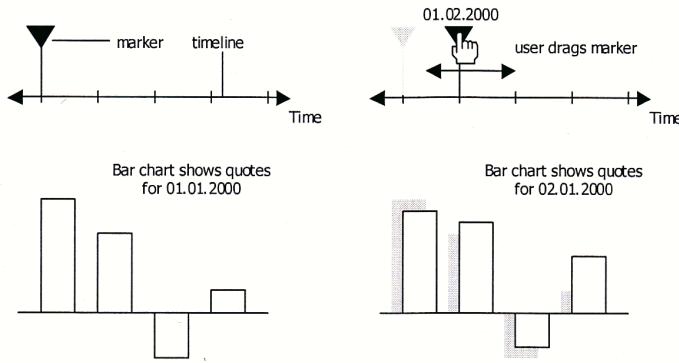
## 1. OVERVIEW AND SCENARIOS

The TimeRuler allows navigation in time. The user can define markers that each refers to a date. From a functional point of view, it is much like a multiple date-picker, which allows choosing multiple dates. The TimeRuler also provides a selecting mechanism that facilitates selecting markers. Moreover, markers can be dragged along the timeline.

To understand the purpose of the TimeRuler, let's consider a scenario (Scenario A). Imagine a bar chart that shows stock quotes depending on a given date. Now, if this date would be linked to a TimeRuler markers date, dragging the marker could update the bar chart with the actual date. The bar chart would show moving bars while you drag the marker right or left. Recall that selecting new dates using a date-picker would require at least 2 clicks: click on the date-picker, click on the day. In this case, dragging a TimeRuler marker with the mouse is much faster and more intuitive.

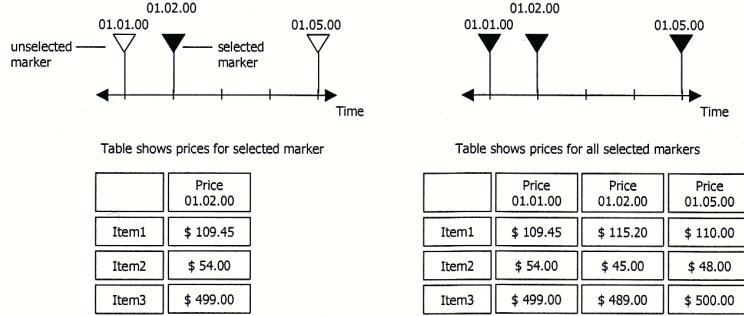
<sup>1</sup> <http://www.aufgang.org/koch/homepage/download.asp?file=resources/JavaLookandFeelDesignGuidelines.zip>

<sup>2</sup> <http://www.aufgang.org/koch/homepage/download.asp?file=resources/Windows2000UIGuidelines.zip>



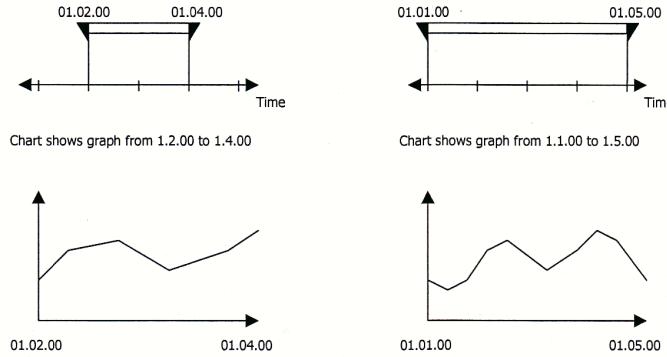
**Figure 1: Marker dragging concept**

In another scenario (Scenario B) there might be a table that uses the selection of multiple markers to identify its number of columns and the corresponding dates. Here, the user selects as many markers as he wants to see in the table as columns. The table designer can rely on the TimeRuler to provide the number of selected markers (number of columns) and does not need to implement add/remove buttons or date-picking functionality.



**Figure 2: Marker selecting concept**

A third common scenario (Scenario C) supported by the TimeRuler is viewing history charts. In this case the user wants to modify the start and end points or directly drag the range along the timeline, which causes the chart to scroll left or right.



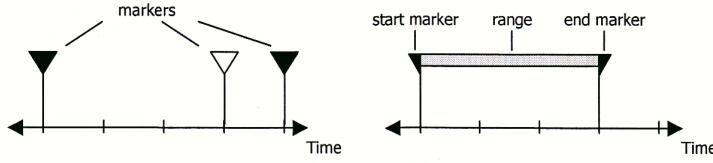
With the TimeRuler, users can intuitively manage markers and visually recognize their position in time. For applications that deal with multiple points in time the TimeRuler is the user interface component of choice.

## 2. MODES AND SELECTION MODELS

There are two modes that must be distinguished: Marker mode and range mode. Modes can be changed programmatically (not explicitly by the user).

The **marker mode** enables the user to manage the position and state of multiple markers. It is appropriate for situations where the program requires the user to define and select points in time, which then may affect the visualization of time-dependent

content. Each marker can be modified independently but only one marker can refer to one date. This means, that defining two markers for the same date is not possible.



**Figure 3: Marker Mode (left) and Range Mode (right)**

The **range mode** shows a time range with a start and an end marker. Both can be modified by the user. This mode is appropriate for views that show time-dependent content for a given time range. Adding new ranges or removing the default range is not allowed.

The modes are exclusive, meaning that if the TimeRuler is in range mode, it does not show independent markers. Conversely, the range disappears when the mode is switched back to marker mode. However, all defined markers are remembered and switching back to the appropriate mode makes them visible again.

The TimeRuler and ButtonTimeRuler support multiple **selection models**. These models strongly affect the behavior of the component and should therefore be used carefully. In most cases the user is not aware of the concepts behind user interface components and gets frustrated when their behavior changes. By default, the selection model multi selection.

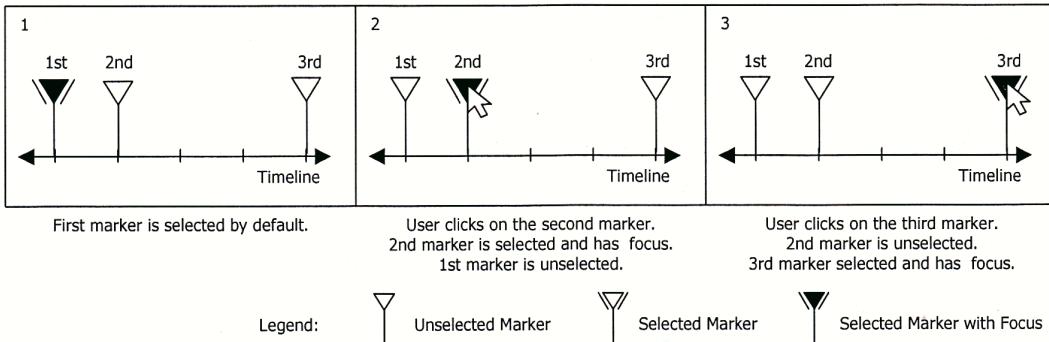
A marker supports 3 states:

- Unselected
- Selected (without focus)
- Selected with focus

The focus exposes the last clicked marker of a selection. The focus is used as the insertion reference point (for new markers) and can be used for similar purposes from other components that refer to the TimeRuler.

## 2.1. SINGLE SELECTION

This model is the easiest to use: Selecting a marker always unselects the previously selected marker and moves the focus to the currently selected marker. This means that the selected marker always has the focus. This behavior is illustrated below.



**Figure 4: Single Selection Model**

## 2.2. MULTI SELECTION

Selecting multiple markers is needed when an action has to be carried out affecting only a subset of markers (or their dates). The TimeRuler for example supports dragging multiple markers. In another scenario, each marker could represent a data series that is shown in a chart if the marker is selected. Clicking on a marker selects it and moves the focus to this marker. All previously selected markers are unselected. Clicking on a marker by simultaneously holding the SHIFT or CTRL key pressed adds it to the selection and moves the focus to this marker. All previously selected markers remain selected.

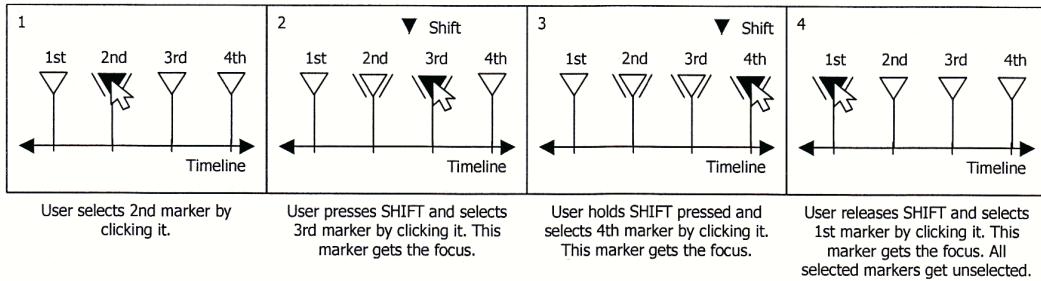


Figure 5: Multi Selection Model

### 2.3. CYCLE SELECTION

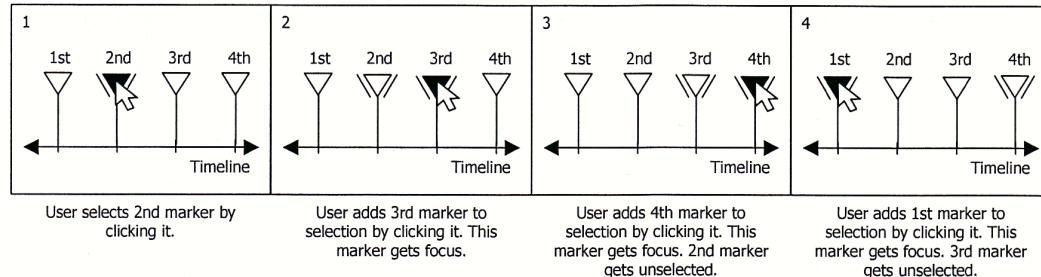
The cycle selection model can be used in scenarios where the number of selected markers has to be limited. If cycle selection is enabled, clicking on a marker adds it to the selection. The maximum of simultaneously selected markers is called the cycle number. If, as an example, the cycle number is set to 4 and 4 markers are already selected, adding a 5<sup>th</sup> marker would unselect the marker that was selected first. This ensures that the user cannot select more markers than the cycle number allows. When the selection mode is switched to cycle selection, the TimeRuler or ButtonTimeRuler should automatically select as many markers as the cycle number demands, leaving the focus on the previously selected marker. If fewer markers than the cycle number are available, all markers remain selected; only the focus can be moved.

#### Technical Note:

Maybe it is possible to handle all selection modes with a single integer property:

```
TimeRuler.SelectionMode = 0; // single selection
TimeRuler.SelectionMode = 1; // multi selection
TimeRuler.SelectionMode = 2; // cycle selection, cycle number = 2
TimeRuler.SelectionMode = 3; // cycle selection, cycle number = 3
```

Cycle count = 2



Cycle count = 3

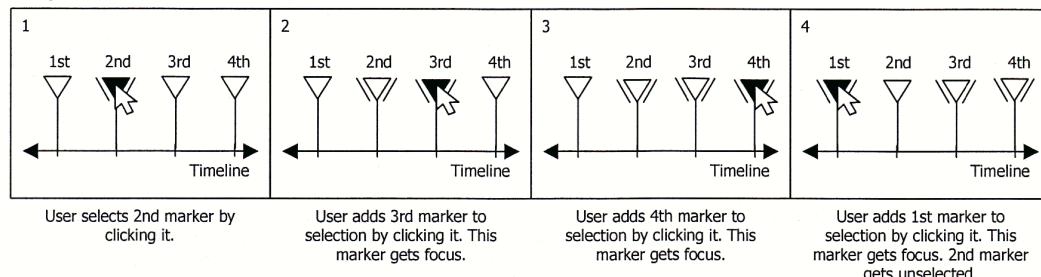


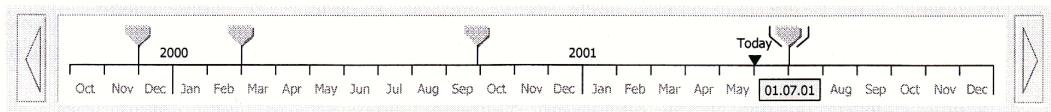
Figure 6: Cycle Selection Model

### 3. LAYOUT

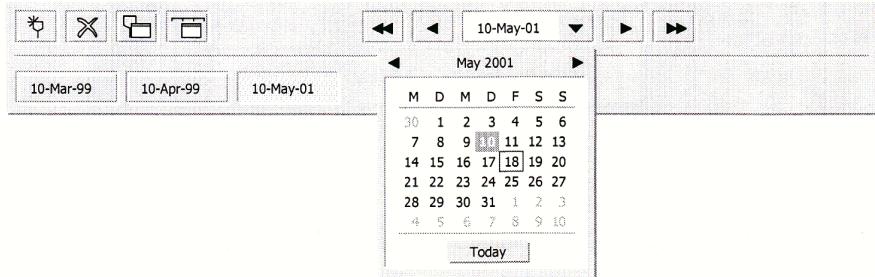
This section describes only the layout of the TimeRuler and ButtonTimeRuler component. A detailed description of the functionality and component behavior can be found in section 5.

There are two different layouts that can be used to implement the TimeRuler:

- **TimeRuler** (graphical): a graphical representation of markers and ranges



- **ButtonTimeRuler:** a button-based nongraphical representation



**Note:**

Recommendation is using TimeRuler or ButtonTimeRuler to name the components.

### 3.1. TIMERULER LAYOUT

The TimeRuler layout closely adopts the original idea using two scroll buttons and a ruler area that includes the timeline and the markers as graphical items (bitmaps). The figure below shows the general layout and the elements of the ruler area.

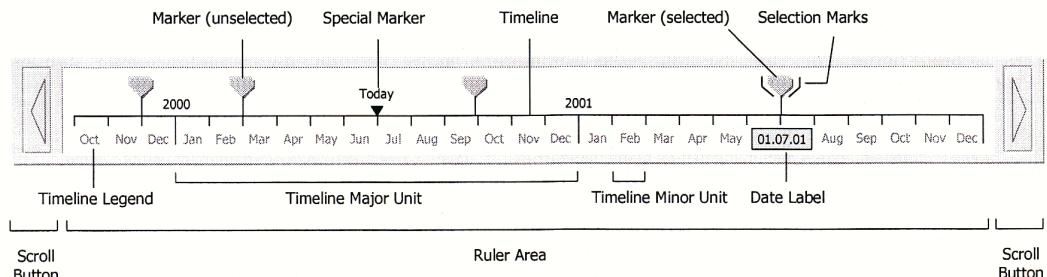


Figure 7: TimeRuler Layout

**Pane, Buttons and Ruler Area** can be implemented using standard components. Thus, they inherit the Look & Feel from these components. The ruler area provides a focus border that appears when the user activates the TimeRuler by clicking into the ruler area or starts manipulating markers. Major unit labels are positioned above the timeline; minor unit labels are positioned below the timeline. The ruler area is resizable. Unit texts are shown within the units (not at tick position) and are left aligned with a defined left spacing to the unit tick. Tab traversal order is from the first left marker to the last right marker and does not include the scroll buttons.

**Technical Note:**

Ruler area resizing demands a rule for width-dependent repainting of the timeline: If the last unit cannot be drawn with at least 8px spacing to the right focus border, it must be clipped (hidden). This feature is called "unit clipping".

**Note:**

The 1px raised style of the pane (shown in figure) is recommended. The embedding style of the TimeRuler should match the applications specific style of embedding components into its user interface.

Colors, Dimensions, Positioning:

- Scroll Button Icons: 7 x 13 px, black (RGB: 0,0,0; HueSatLight: 0,0,0)
- Ruler Area Background: white (RGB: 255, 255, 255; HueSatLight: 255, 255, 255)
- Ruler Area Focus Border: 1px, color = primary Look & Feel color (standard focus border)
- Timeline: 1px height, 6px spacing to focus border (7px to area border), black
- Timeline (dimmed): light gray (RGB: 192, 192, 192; HueSatLight: 0, 0, 192)
- Major Unit Ticks: 1px width, 14 px height (including timeline), black
- Minor Unit Ticks: 1px width, 4 px height (including timeline), black

- Major Unit Text 1px spacing to unit tick, 3px spacing to timeline, black, 10pt SansSerif
- Minor Unit Text 5px spacing to unit tick, 4px spacing to timeline, black, 11pt SansSerif

**Note:**

Gray backgrounds are shown to ease the recognition of graphical object shapes. They are not part of the component.

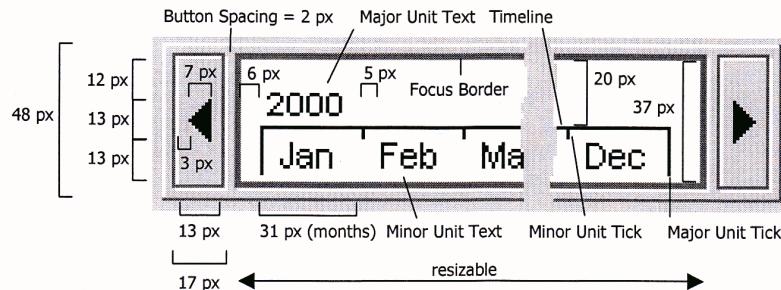


Figure 8: TimeRuler Pane, Buttons, Ruler Area and Timeline

The smallest **timeline** unit dictates the highest possible accuracy for marker positioning. By default, the smallest timeline unit is a day, represented by 1 pixel of the timeline. However, this can change if the user modifies the minor timeline unit. The screenshots in this document show timelines with days as smallest unit (1px) and minor units set to month, which are displayed with 31 pixels width. The last day of months with less than 31 days covers the remaining pixels. The following table shows all possible timeline settings and the corresponding display modes:

Timeline display modes				
No.	Major Unit	Minor Unit	Smallest Unit	Possible Grid Settings
1	Year	Quarter, displayed as "Q1", "Q2", "Q3", "Q4"	Week = 2 pixel	Week, Month, Quarter
2	Year or Quarter	Month, displayed as "Jan", ..., "Dec"	Day = 1 pixel	Week, Month, Quarter
3	Year, Quarter or Month	Week, displayed as "1", ..., "52"	Day = 4 pixel	Week, Month, Quarter

The TimeRuler provides a feature that allows programmers to define lower and upper **enabling boundaries**. That means that markers cannot be dragged beyond a given lower and upper date. The timeline appears dimmed outside of these boundaries. The figure below shows a timeline with an upper boundary set to 17.05.2000.

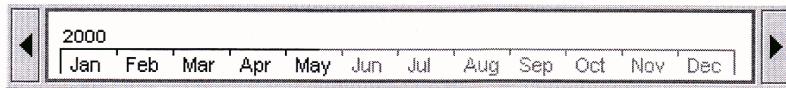


Figure 9: TimeRuler Timeline is dimmed from 17.05.2001

**Markers** are visualized above the timeline using a vertical line that indicates the exact position on the timeline and a triangle-like head (marker line and marker head). If a marker is selected, its head is painted with two surrounding selection marks. Additionally, a selected marker with focus provides a date label, which is positioned below the timeline within the timeline legend. It is centered below the marker and painted over the timeline legend text. Markers, labels and tooltips are painted over the timeline and its legend. For this reason, markers provide white borders for better visibility. The date label text supports multiple date formats (examples: "31.12.00", "31-Dec-00", "12/31/00").

**Technical Note:**

To display marker heads using different colors, you can maintain a public color list that consists of 8 named colors, which are referred to as the "color list". Colors can be set by the application at component instancing time in order to use colors from the application palette.

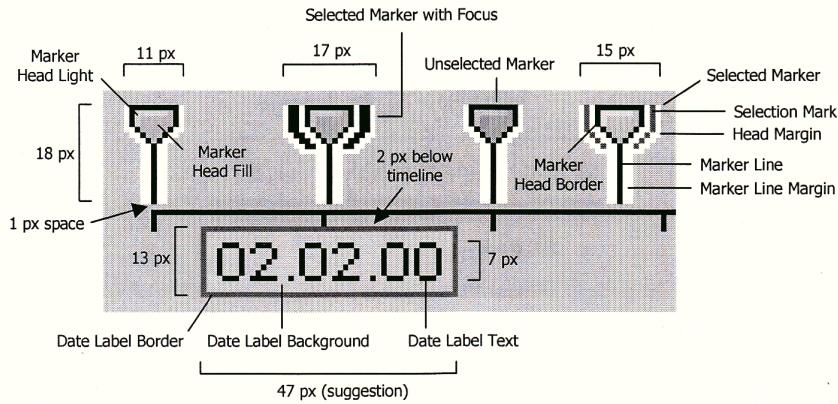
**Technical Note**

Maybe we can use tooltips for the date labels. The appearance of the date label and a usual tooltip is exactly the same except its height and font size.

Colors, Dimensions, Positioning:

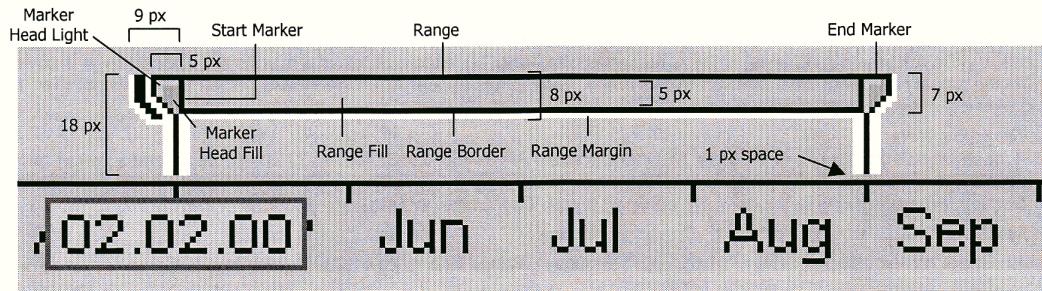
- Marker Head Fill: is automatically assigned from color list, light should be around 179
- Marker Head Light: same as head color, light is increased by 22 (example: 179+22=212)
- Marker Head Border: 1px, black
- Marker Head Margin: 1px, white
- Marker Line: black
- Marker Line Margin: 2px, white

- Selection Mark (focus): black
- Selection Mark (no focus): gray (RGB: 102, 102, 102; HueSatLight: 0, 0, 102)
- Date Label Border: primary color from Look & Feel (same as default tooltip border)
- Date Label Background: secondary color from Look & Feel (same as default tooltip background)
- Date Label Text: black, 10pt SansSerif



**Figure 10: Marker Layout**

**Range markers** have a different appearance than standard markers. A range marker can either be a start or an end marker. Both are draggable but not beyond each other. The minimum range is one week (7 days) for display mode 2, one month (4 weeks) for display mode 1 and 4 days for display mode 3. This ensures that the range can be drawn correctly and provides distinct dragging areas. Start and end markers and the range itself are draggable. The figure below shows the start marker selected. In range mode, either the start marker or the end marker is selected.



**Figure 11: Range Marker Layout**

#### Colors, Dimensions, Positioning:

- Marker Head Fill: first color in color list
- Marker Head Light: same as head color, light is increased by 22 (example: 179+22=212)
- Marker Head Border: 1px, black
- Marker Head Margin: 1px, white
- Marker Line: black
- Marker Line Margin: 2px, white
- Selection Mark (focus): black
- Selection Mark (no focus): not available
- Range Fill: light gray
- Range Margin: 1px, only below range, white
- Range Border: 1px, black
- Date Label Border: primary color from Look & Feel
- Date Label Background: secondary color from Look & Feel
- Date Label Text: black, 10pt SansSerif

**Special markers** are not dragable. They can be used to indicate the position of some important date like "Today". The TimeRuler supports multiple special markers. Special markers appear as a small filled triangle above the timeline. The triangle points to the date of the special marker. Special markers are nonfunctional.

Colors, Dimensions, Positioning:

- Marker color is user-defined (programmable)
- Marker Text same color as marker, spacing to marker top is -1 px (see figure below), 11pt SansSerif, centered over marker

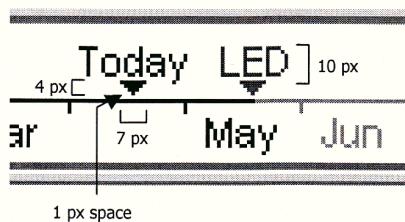


Figure 12: Special Markers

The TimeRuler provides standard **tooltips** for markers, special markers, range markers and the range. Tooltips for markers show the marker's date. Tooltips for special markers show a marker description and the special marker date ("[Description]: [Date]").

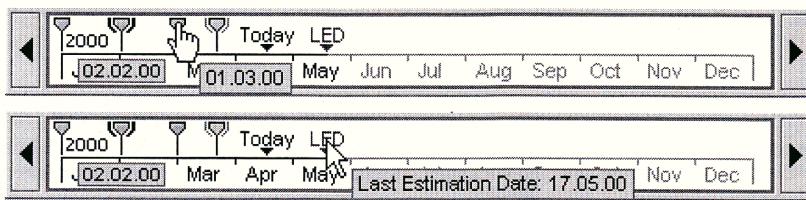


Figure 13: TimeRuler Tooltips

Range markers support tooltips like standard markers. The range itself supports a tooltip showing the following text: "Range: [x] [grid units] ([y] Days)" where [grid units] is the actual grid unit setting, [x] is the number of grid units the current range is covering, and [y] is the actual number of days covered by the range. The tooltips appear when the mouse pointer is held longer than 1 second over a marker or range dragging area.

#### Technical Note:

A month equals 28, 29, 30, or 31 days; two months equal 28+31=59, 29+31=60, or 30+31=61 days, and so on. A quarter equals 4 months. Fractional numbers should always include only 1 decimal place ("1.2", "2.9") using a standard round function. When breaking up months, the equation should be [Number of Months] = [Number of Days] / 30.

Examples:

- Grid = "Week", Range Start = "01.01.2001" (Monday), Range End = "29.01.2001" (Monday)  
Tooltip shows "Range: 4 Weeks (28 Days)"
- Grid = "Week", Range Start = "01.01.2001" (Monday), Range End = "31.01.2001" (Wednesday)  
Tooltip shows "Range: 4.4 Weeks (30 Days)"
- Grid = "Month", Range Start = "01.01.2001" (Monday), Range End = "01.02.2001" (Thursday)  
Tooltip shows "Range: 1 Month (31 Days)"
- Grid = "Month", Range Start = "01.01.2001" (Monday), Range End = "01.03.2001" (Thursday)  
Tooltip shows "Range: 2 Months (59 Days)"
- Grid = "Month", Range Start = "01.01.2001" (Monday), Range End = "23.03.2001" (Friday)  
Tooltip shows "Range: 2.6 Months (81 Days)"

As the tooltip screenshots shows, the **mouse pointer shape** changes to "hand" over a marker indicating that this marker is dragable. A detailed description of the dragging functionality can be found in section 5.3.

If **cycle selection** is enabled, a small icon indicates the cycle selection behavior. It is located in the bottom right corner of the ruler area and painted over the timeline and timeline legend. The icon supports a tooltip that shows the following text: "Cycle Selection enabled ([x] Markers)" where [x] is the cycle number.

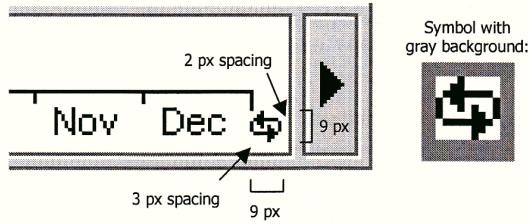


Figure 14: TimeRuler Cycle Selection Symbol

### 3.2. BUTTONTIMERULER LAYOUT

Since a lot of users find it difficult to use components that rely on exact mouse positioning, the ButtonTimeRuler provides an alternative interface using buttons and date-pickers. Its implementation is more straightforward and thus, reduces implementation cost.

**Pane, Toolbar, DatePicker and Markers** can be implemented using standard components. They inherit the Look & Feel from these components. The toolbar area is shown on the top left, followed by the DatePicker area. The DatePicker component itself is not specified. Its style depends on the chosen component. Using freeware or 3<sup>rd</sup> party vendor's components is recommended. The DatePicker component pops up when the user clicks the DatePicker button. Markers are located in the marker area below, which is separated from the upper area by a horizontal inset style line. Clicking into the areas sets the focus to the first component this area. Toolbar icons are displayed in rollover style when getting the focus. All other components provide standard focus behavior.

#### Technical Note:

The 1px outset style of the pane (shown in figure) is just a recommendation. The embedding style of the TimeRuler should match the applications specific style of embedding components into its user interface.

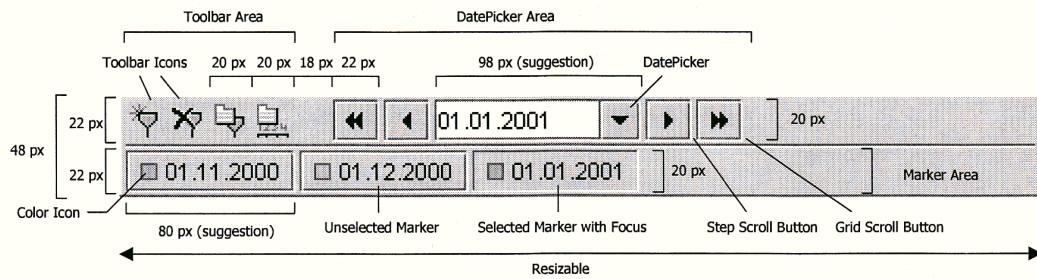


Figure 15: ButtonTimeRuler Toolbar, DatePicker and Markers

#### Colors, Dimensions, Positioning:

- Background: button background color from Look & Feel
- Separation Line: 2px height, gray and white
- Buttons: spacing left and right: 2px, spacing top and bottom: 1px
- Toolbar/DatePicker Spacing: 18px (measured from toolbar icon rollover border)

Tab traversal order is from left to right, from top to bottom across all areas. The ButtonTimeRuler is resizable horizontally. The following figure shows the tab traversal order:

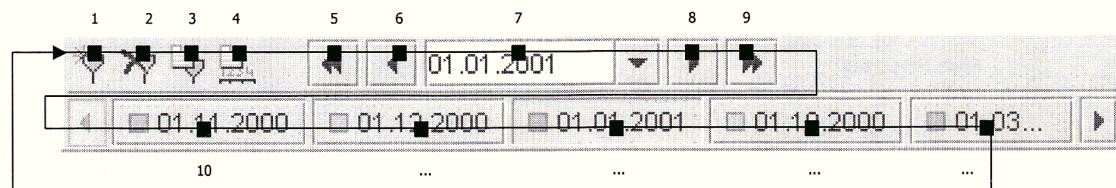


Figure 16: ButtonTimeRuler Tab Traversal Order

The DatePicker area contains 4 scroll buttons and an editable combo box. The step scroll button increase or decrease the selected date by 1 day. The grid scroll buttons do the same but use the actual grid settings to set the date to the next or previous grid point. Like its graphical equivalent, the ButtonTimeRuler also supports enabling boundaries. If a scroll button's action would set the date beyond the enabling boundaries, it is shown disabled.

**Markers** are shown as standard buttons. Selected markers appear pressed. If a selected marker has the focus, its background color changes to the standard selection background color (Look & Feel). Marker texts appear centered. Markers are sorted ascending by their dates from left to right.

**Technical Note:**

The "color list" idea also applies to the ButtonTimeRuler.

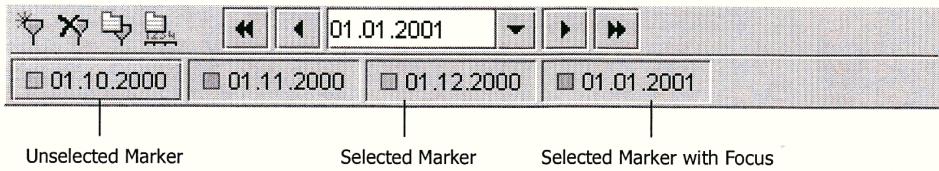


Figure 17: ButtonTimeRuler Marker States

If fitting all markers into the marker area is not possible, marker area scrolling should be enabled. When marker area scrolling is enabled, two scroll buttons appear at the left and right end of the marker area. The last right marker that does not fit into the left space is shown shrunken. It supports tooltips showing the marker date. If the marker text cannot be displayed fully, it has to be abbreviated, followed by ellipses as shown in Figure 18. The first left marker is always shown at full width. Scroll buttons are disabled if the marker area is already scrolled to the maximum left or right. The ButtonTimeRuler does not support special markers.

**Technical Note:**

Scrolling right means skipping the first left button and beginning with the following button.

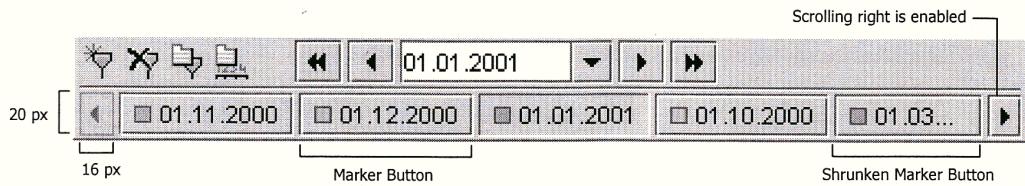


Figure 18: ButtonTimeRuler Marker Area Scrolling

Colors, Dimensions, Positioning:

- Marker: 80px width (recommended), 20px height
- Marker Text: black, 11pt SansSerif, 4px spacing to color icon, min. 5px spacing to right button border
- Color Icon: 8px width, 8px height, 1px gray inner border, color from application palette, min. 5px spacing to left interior flush 3d border (white line)

**Toolbar** icons have a standard size of 16 x 16 pixels. They support rollover borders that are not standard. Rollover borders should be implemented as shown in Figure 19.

Icons:

Icon	Tooltip Text	Description
	New Marker	Inserts a new marker before the selected marker.
	Remove Marker	Removes the selected marker with focus.
	Marker Properties	Shows marker properties dialog.
	Ruler Properties	Shows ruler properties dialog.

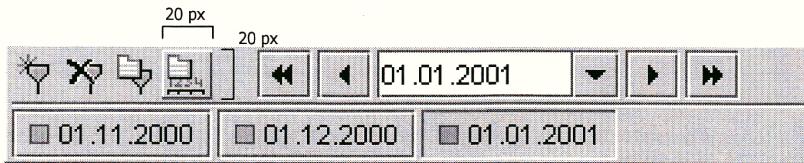


Figure 19: Toolbar Icon Rollover Border

In **range mode**, the marker area shows only the start and end marker of the range. Adding and removing actions are disabled.

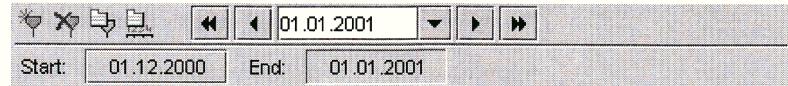


Figure 20: ButtonTimeRuler in range mode

Colors, Dimensions, Positioning:

- Start Label: 6 px spacing to left border, 12 px spacing to button, black, 11pt, SansSerif
- End Label: 11 px spacing to left button, 12 px spacing to right button, black, 11pt, SansSerif
- Marker Text: black, 11pt, SansSerif, centered within marker button

If **cycle selection** is enabled, a small icon indicates the cycling selection behavior. It is located in the top right corner of the DatePicker area and supports the same tooltip like its TimeRuler version.

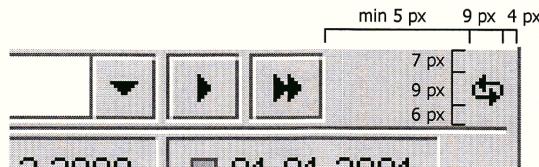


Figure 21: ButtonTimeRuler Cycle Selection Symbol

#### 4. DIALOGS AND CONTEXT MENUS

Dialogs and context menus are mostly the same for the TimeRuler and ButtonTimeRuler. All dialogs should be designed in accordance to the "Java Look & Feel Design Guidelines". This means that they provide mnemonics for all components, use left-right-top-bottom tab traversal and set the "OK" button to the default component. Component spacing is realized using the "multiples of 6 pixels" rule.

The "**Time Ruler Properties**" dialog contains all settings that affect the general behavior of the component:

- Time grid settings can be found in section 5.4
- Minor Units Options: Day, Week, Quarter
- Major Units Options: Week, Quarter, Year
- The content of the "Special Markers" area (TimeRuler only) depends on the special markers that are set programmatically. The default special marker is "Today" and is set to visible. Other special markers are displayed with a checkbox, followed by their name. Unchecking a special marker's checkbox hides it in the ruler area. The checkboxes and labels should be displayed in a row. If insufficient space is left, they should be displayed on a second line below.

The ruler area context menu lists all actions that can be performed with the ruler itself:

- New Marker: Adds a new marker
- Zoom In: Switches timeline display mode to upper value (TimeRuler only)
- Zoom Out: Switches timeline display mode to lower value (TimeRuler only)
- Ruler Properties: Shows "Time Ruler Properties" dialog

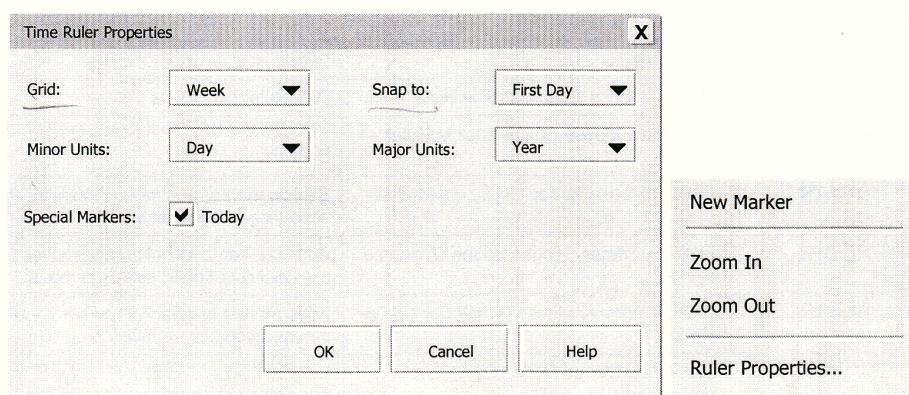


Figure 22: Ruler Properties and Ruler Area Context Menu

There are two marker properties that can be modified by the user:

- Date: The markers date, can be modified using the DatePicker area described in section 3.2.
  - Color: A combo box showing all application palette colors with color icons and names.
- The marker context menu provides the following actions:
- Remove: Removes marker
  - Marker Properties: Shows "Marker Properties" dialog

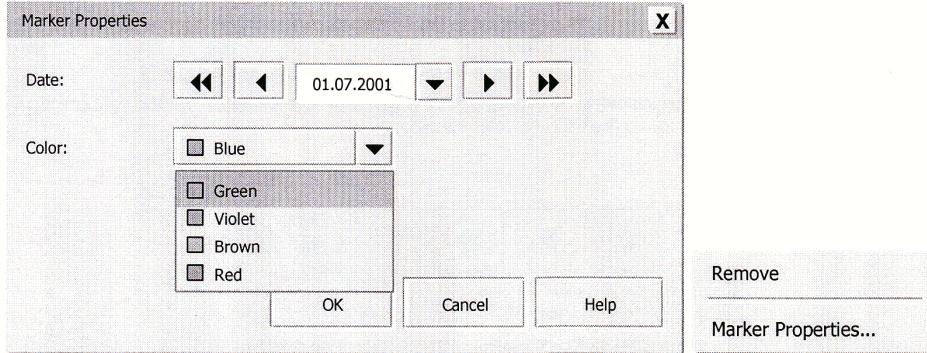


Figure 23: Marker Properties and Marker Context Menu

**Technical Note:**

*The component could expose a collection of 8 colors that can be modified programmatically. When the component is created, the application can set the colors according to its palette.*

## 5. INTERACTION

### 5.1. ADDING AND REMOVING MARKERS

For both layouts the adding and removing concept applies equally. The user can add and remove up to 16 markers. If the maximum number of markers is reached, adding functionality should be disabled. One preferable way to do this is to disable the corresponding toolbar button and menu entry. If only one marker is left, removing functionality should be disabled in the user interface.

**Technical Note:**

*All markers can be removed programmatically. It is only the user interface that doesn't allow removing the last marker.*

An added marker appears automatically selected and gets the focus. The "Remove Marker" action removes only the selected marker with focus. All other selected markers are not removed.

In range mode, adding or removing markers is not possible.

### 5.2. MOUSE AND KEYBOARD INTERACTIONS

TR = TimeRuler, BTR = ButtonTimeRuler

Type	Applies to	Interaction	Effect
Mouse	TR, BTR	Primary Mouse Button Click in Ruler Area	TimeRuler gets focus
Mouse	TR, BTR	Secondary Mouse Button Click in Ruler Area	TimeRuler gets focus; ruler area context menu pops up
Mouse	TR, BTR	Primary Mouse Button Click on a Marker	Selects marker and moves focus to marker according to selection mode.
Mouse/Keyb.	TR, BTR	SHIFT + Primary Mouse Button Click on a Marker	Adds marker to selection and moves focus to marker according to selection mode.
Mouse/Keyb.	TR, BTR	CTRL + Primary Mouse Button Click on a Marker	Adds marker to selection and moves focus to marker according to selection mode.
Mouse	TR, BTR	Secondary Mouse Button Click on a Marker	Selects marker and moves focus to marker according to selection mode; marker context menu pops up.
Mouse	TR	Primary Mouse Button Marker Dragging	Drags marker along timeline using the time grid settings.

Mouse/Keyb.	TR	ALT + Primary Mouse Button Marker Dragging; SHIFT + Primary Mouse Button Marker Dragging	Drags marker along timeline using smallest unit steps. Ignores time grid.
Mouse	TR, BTR	Doubleclick with Primary Mouse Button in Ruler Area	Shows time ruler properties dialog
Mouse	TR, BTR	Doubleclick with Primary Mouse Button on a Marker	Shows marker properties dialog
Keyboard	TR, BTR	Tab in Ruler or Marker Area	Selects next marker and moves focus to this marker; ensures that this marker is visible. BTR: moves focus from last marker to first toolbar icon
Keyboard	TR, BTR	SHIFT + Tab in Ruler or Marker Area	Selects previous marker and moves focus to this marker; ensures that this marker is visible. BTR: moves focus from first marker to last DatePicker area button
Keyboard	TR, BTR	Left Arrow	Sets selected, focused marker's date to previous grid point; moves marker to its new position.
Keyboard	TR, BTR	Right Arrow	Sets selected, focused marker's date to next grid point
Keyboard	TR, BTR	CTRL + Left Arrow	Decreases the selected, focused marker's date by one smallest timeline unit; ignores time grid
Keyboard	TR, BTR	CTRL + Right Arrow	Increases the selected, focused marker's date by one smallest timeline unit; ignores grid
Keyboard	TR	PGUP	Scroll 4 minor units left
Keyboard	TR	PGDWN	Scroll 4 minor units right
Keyboard	TR	HOME	Selects marker with lowest (oldest) date and move focus to this marker
Keyboard	TR	END	Selects marker with highest (latest) date and move focus to this marker

### 5.3. DRAGGING BEHAVIOR

**Note:** This refers only to the TimeRuler.

If the mouse pointer's hot spot is within the **dragging area** of a graphical object, it can be dragged by holding the primary button down and pulling the mouse. Dragging areas for markers and ranges are shown below. The red line indicates the dragging area boundaries.

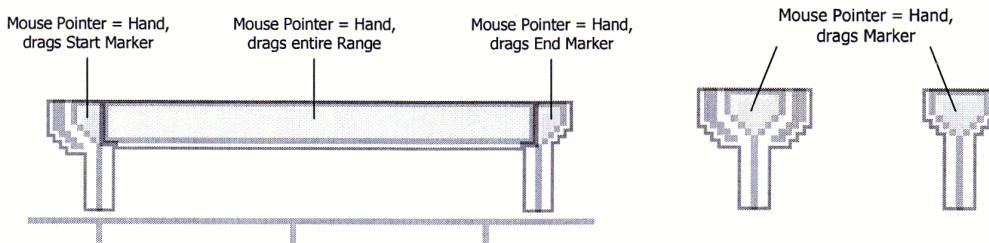
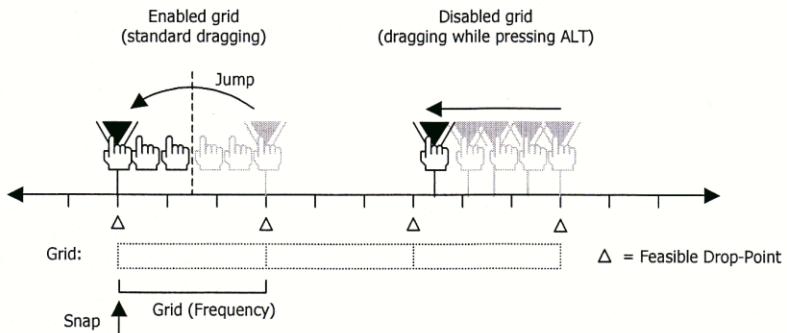


Figure 24: TimeRuler Dragging Areas

Dragging a marker is very easy: The user moves the mouse pointer over a marker's dragging area. As the mouse pointer enters the dragging area it automatically changes to the "Hand" shape indicating that the underlying graphical object can be dragged. The user can now press the primary mouse button, and by keeping it held he can move the marker along the timeline.

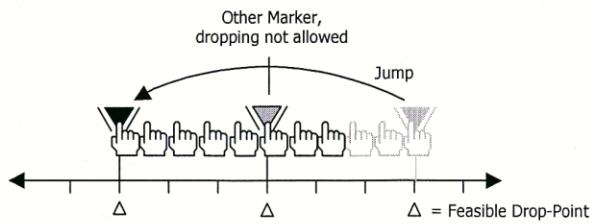
**Standard dragging** lets the marker jump between feasible drop-points while the mouse pointer is freely movable. The current time grid defines these drop-points. The marker jumps to the next feasible drop-point, if the current position of the mouse pointer is closer to this point than to the last marker position. In Figure 25, the gray hand indicated mouse pointer positions where the marker remains on its last position, while the black hand indicates that the marker has jumped to the next feasible drop-point. If the user releases the primary mouse button, the marker remains at its last position, that is, at one of the feasible drop-points. When dragging ranges, this behavior affects only the start marker of a range. The end marker keeps its distance in any case.



**Figure 25: Dragging with Enabled and Disabled Grid**

By pressing the ALT-key, the user can disable this grid jumping behavior. The marker now moves in steps that represent the smallest timeline unit (a day for timeline display mode 2). When timeline display mode is set to 1 (smallest unit = week), markers automatically snap to the day specified by the time grid settings, even if grid jumping is disabled. This is because markers can only refer to a day but not to a week.

Markers cannot be dropped at dates that are already used by other markers. The figure below illustrates this "marker jumping" behavior.

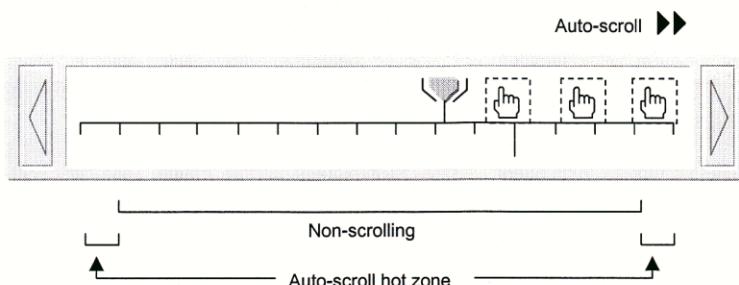


**Figure 26: Marker Jumping Behavior**

When the user drags a marker to a location not currently in view, it is convenient to scroll the area automatically. This feature is called **auto-scrolling**. It is activated when the dragged marker enters the auto-scroll hot zone, which has a width of one minor timeline unit.

**Technical Note:**

*To support this technique during the drag operation, you sample the pointer's position at the beginning of the drag each time the mouse moves. Store each value in an array large enough to hold at least three samples, replacing existing samples with later ones. Then calculate the pointer's velocity based on at least the last two locations of the pointer. Now, if the velocity is 0 to 12 pixels per second, scroll the ruler area one minor unit in the direction associated with the hot zone the marker is in. Values above 12 cause the area to scroll 4 minor units.*



**Figure 27: TimeRuler Auto-scroll Behavior**

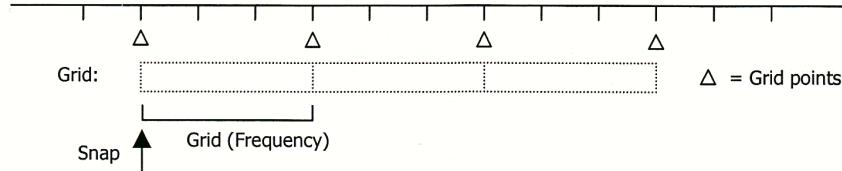
#### 5.4. TIME GRID

Both TimeRuler variant support a time grid. It is defined through two parameters:

- Grid (frequency) Week, Month, Quarter
- Snap First Day, Last Day, First Workday, Last Workday

These parameters are global and valid for all markers including range start and end markers. The time grid can be used to navigate through time-dependent data that is sampled with a defined frequency. By default, the grid is set to:

- Grid = "Week"
  - Snap = "Last Workday" (which in this case means Friday)



**Figure 28: Dragging a Marker using the Time Grid**

## 5.5. USER ACTIONS

An action can be performed in a number of different ways:

- Choosing a drop-down menu entry
  - Clicking a toolbar icon
  - Right-clicking on a graphical object and choosing a context menu entry

The following table lists all actions:

Action	Description	Remarks
New Marker	Inserts a new marker at the next available grid-position before the selected marker with focus. Is disabled when number of markers reaches 16.	The new markers color is assigned using a list of 8 colors (cycling through the list). The visibility of this marker is ensured.
Remove Marker	Removes the selected marker with focus. Is disabled when only 1 marker is left.	The next (later date) marker is automatically selected and gets focus. The visibility of this marker is ensured.
Marker Properties	Shows marker properties dialog.	
Ruler Properties	Shows ruler properties dialog.	
Zoom In	Switches timeline display mode to upper value (1 to 2, 2 to 3). Is disabled when display mode is 3.	Not supported by ButtonTimeRuler.
Zoom Out	Switches timeline display mode to lower value (3 to 2, 2 to 1). Is disabled when display mode is 1.	Not supported by ButtonTimeRuler.

## 6. INTEGRATING THE TIMERULER INTO AN APPLICATION

The following actions should be accessible through the application menu and through toolbar buttons:

- 1. New Marker Adds a new marker
  - 2. Remove Marker Removes all selected markers
  - 3. Marker Properties... Shows marker properties dialog
  - 4. Ruler Properties... Shows ruler properties dialog

Menu entries should ideally appear under the application's "Edit" drop-down menu within a submenu called "Time Ruler". They should disappear if the user decides not to use the TimeRuler.

Toolbar integration is only needed for the TimeRuler. Since the ButtonTimeRuler already provides these buttons, no additional toolbar buttons are required in this case.

## 7. INTERACTION WITH OTHER COMPONENTS

The following table is not complete. It shows a list of properties, functions and events that are needed to enable interaction with other components. The programmer is free to decide implementation issues and final naming.

Property Name (Suggestion)	Description
MarkerColors.Color1 ... Color8 (Read, Write)	Up to 8 colors with names can be set

Marker.Color (Read, Write)	The Marker colors can be accessed
Timeline.RangeStart (Read, Write)	Lower enabling boundary.
Timeline.RangeEnd (Read, Write)	Upper enabling boundary.
Marker.Selected (Read, Write)	Indicates selection state of marker.
Marker.SetFocus (Read, Write)	Indicates selection state of marker.
SpecialMarker.Color	Color of special marker.
SpecialMarker.Text	Special marker text.
SpecialMarker.Description	Special marker description.
Function Name (Suggestion)	Description
GetMarkerForDate()	Returns marker for a given date; returns nothing if no marker exists for this date.
AddMarker(), RemoveMarker()	Adds, removes a marker.
Marker.SetFocus (Read, Write)	Sets marker focus. Marker gets selected.
AddSpecialMarker()	Adds, removes a special marker.
Event	Description
Mouse button down over Marker	User pressed mouse button over a marker
Marker date changed	Marker was dragged or marker date was otherwise modified.

## 8. FEATURE LISTS

TimeRuler		
No.	Feature	Description
1	Resizable pane	Includes scroll buttons, ruler area and focus border.
2	Resizable and scrollable timeline	Includes exposed function that ensures that selected marker with focus is visible.
3	Timeline legend, display mode 2	1 <sup>st</sup> stage: major units: year, minor units: day
4	Timeline legend with major/minor units, all display modes	2 <sup>nd</sup> stage: customizable major and minor units, Zoom In and Zoom Out
5	Enabling boundaries	Markers cannot be dragged beyond boundaries; timeline beyond boundaries is shown dimmed.
6	Unit clipping	Last timeline unit is clipped when insufficient space is left.
7	Markers, range markers and range	
8	Dialogs and context menus	
9	Draggable markers (no grid)	Markers can be dragged using smallest timeline unit.
10	Draggable range	Range can be dragged using smallest timeline unit.
11	Draggable multi selection	Multiple selected markers can be dragged
12	Jumping markers	Marker cannot be dropped over markers.
13	Time grid	Lets the dragged marker or range jump within grid positions
14	Special markers	
15	Auto-scroll	Scrolls ruler area while marker is being dragged
16	Single selection model	
17	Multi selection model	
18	Cycle selection model	

19	Tooltips	
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ButtonTimeRuler		
No.	Feature	Description
1	Resizable pane	Includes toolbar, DatePicker and marker area.
2	DatePicker	
3	Markers, range markers	Interactive buttons displaying a color icon and the marker's date
4	DIALOGS and context menus	
5	Toolbar	
6	Scollable markers	Shows scroll buttons if markers don't fit into the marker area.
7	Time grid	Lets the dragged marker or range jump within grid positions
8	Single selection model	
9	Multi selection model	
10	Cycle selection model	
11	Tooltips	