### ****Overview****

Event handling allows you to specify what actions are to be taken when a particular event occurs in a MiPage. Examples of events include:

* When the value of an input field is changed
* When a button is clicked
* When the mouse hovers over a particular page element.

There are two fundamental ways to handle events in a web application –

* For most simple applications, you will communicate the event back to the server and write APL code to handle it and update the UI, as you would do with a desktop UI. However, since the UI and the server may be separated by a slow link (perhaps the Internet), you may need to think carefully about what information to send to the server from the client.
* If you need a highly responsive UI, you can decide to handle events In the browser – this generally involves writing some JavaScript for your event handler.

MiServer event handling allows you to use either method. MiServer's event handling is based upon jQuery's on() method. For more advanced event handling, it's a good idea to read up on jQuery on().

### Simple Example

The following code implements a simple MiPage that contains a button and a <div> that displays the number of times the button is clicked.

:Class HandlerSample : MiPage

Clicked←0 ⍝ track the number of time the button is clicked

∇ Compose;btn

:Access public

btn←Add \_.button'Click Me' ⍝ add a button to the page

btn.On'click' ⍝ define a 'click' handler on the button

'#output'Add \_.div Clicked ⍝ add a <div> to contain the response from the server

∇

∇ r←APLJax

:Access public

Clicked+←1 ⍝ increment the number of times clicked

r←'#output'Replace Clicked ⍝ and refresh the content of the <div>

∇

:EndClass

This illustrates the basic steps you will generally use to create an event handler:

1. Create some HTML content – in this case a button -  
   **btn←Add \_.button'Click Me'**
2. Create a handler that's bound to the HTML content -  
   **btn.On'click'**

The most important properties of a handler are:

* + The elements that it applies to (the On method of any element sets this automatically)
  + What events handler will react to ('click' in this case)
  + Whether the event will be handled in the client or on the server – by default events are handled on the server by a method named APLJax
  + If the event is to be handled on the server, what data is to be sent to the server. In this example we don't need to send any data to the server.

There are other event handler attributes that you can specify, but we'll cover those later on.

1. Write the callback code for the handler.  
   **∇ r←APLJax  
    :Access public  
    Clicked+←1 ⍝ increment the number of times clicked  
    r←'#output'Replace Clicked ⍝ and refresh the content of the <div>  
   ∇**   
   If the event is handled on the server, the callback code can send a response back to the client to do things like update the web page's content or execute code in the web page. In this case we use the extremely common technique of replacing the contents of a a <div> element (with id=output) which was created for this very purpose.

### Specifying an Event Handler

There are two techniques to specify an event handler:

* Use the “On” method for an element - typically to set up an event on that element.

btn←'b1' Add \_.button 'Click Me'  
btn.On 'click'

* Explicitly add a Handler – typically to handle events on more than one element.

Add \_.Handler '#b1' 'click'

### \_.Handler

All pages, HTML elements, and widgets in MiServer are based on the **HtmlElement** class. The **HtmlElement** class has a public field, Handlers, which is a vector of the event handlers bound to the element. The event handlers are instances of the **\_.Handler** class.

#### \_.Handler Constructor

h←Add \_.Handler [Selectors [Events [Callback [ClientData [Delegates

[JavaScript [Page]]]]]]]

All arguments to the constructor are positional and optional.

#### \_.Handler Public Fields

The table below summarizes the public fields in **\_.Handler**. Fields you're more likely to use are listed higher in the table. Fields listed in "grayed" rows are for more advanced use and not likely to be used in most cases. More detailed discussion follows.

|  |  |  |
| --- | --- | --- |
| **Field** | **Description** | **Default Value** |
| Selector | Either:   * A character vector of the jQuery/CSS selector(s) for the elements * A 2 element vector of character vectors of  [1] the jQuery/CSS selector(s) for the elements [2] the jQuery/CSS selector(s) for delegated elements * A reference to the element to which the event handler is to be bound | '' |
| Events | The event(s) for which handler will respond | '' |
| Callback | One of:   * 1 – handle the event on the server by calling the APLJAX function * 'name' – handle the event on the server by calling the user defined function name * 0 – do not callback to the server, handle the event in the client | 1 |
| ClientData | Specifies the data you want sent to the server from the client | '' |
| Delegates | A character vector of the jQuery/CSS selector(s) for delegated elements (can also be specified as the second element of Selector) |  |
| JavaScript | JavaScript to execute. If making a callback to the server this is executed prior to making the callback. | '' |
| Page | The URL to which the server callback is directed. | current page |
| Hourglass | Boolean which indicates whether to turn the cursor to an hourglass while the server executes the handler. | 1 |
| jQueryWrap | Boolean which indicates whether to wrap the handler definition in code such that it will be defined and bound when the web page is loaded. | 1 |
| ScriptWrap | Boolean which indicates whether to wrap the handler definition in a <script> element. | 1 |
| ForceInternal | Indicates whether to treat the event as an internal event in a widget. One of:   * ¯1 – determine by seeing if the event is an element of the widget's InternalEvents list * 0 – do not treat it as an internal event * 1 – force it to be treated as an internal event | ¯1 |
| WidgetDef | Used to define the syntax for specific types of information for different JavaScript utility libraries. WidgetDef is intended for users who wish to write APIs for JavaScript widget libraries not supplied with MiServer. |  |

**Selector**

**Selector** specifies what elements the event listener is to be bound to. For instance, assume we've created the following div element.

myDiv←'#myid' '.myclass' Add \_.div 'Click Me'

When using **myDiv.On** to specify the handler, **Selector** is set for you.

myHandler ← myDiv.On 'click'

If you specify Selector yourself it can be:

* A reference to the element

myHandler ← Add \_.Handler myDiv 'click'

* A jQuery/CSS selector (see [jQuery Selectors](http://www.w3schools.com/jquery/jquery_ref_selectors.asp))
  + Bind the listener to the element with id="myid"

myHandler ← Add \_.Handler '#myid' 'click'

* + Bind the listener to all elements with class="myclass"

myHandler ← Add \_.Handler '.myclass' 'click'

* + Bind the listener to all <div> HTML elements

myHandler ← Add \_.Handler 'div' 'click'

* + You can specify multiple selectors

myHandler ← Add \_.Handler '#myid, td' 'click'  
Will bind the listener to the element with id="myid" AND all <td> elements.

* + Id or Class selectors can be combined with element names into a single selector:

myHandler ← Add \_.Handler '.myclass td' 'click'

Will bind the listener to all <td> elements within elements class=”myclass”.

* An empty vector '' or '⍎document' – to bind the handler to the entire document.

myHandler ← Add \_.Handler '' 'click'

**Events**

Events specifies what events the event listener should listen for. It is a space-delimited list of events.

myHandler.Events←'click' ⍝ listen for click  
 myHandler.Events←'click dblclick' ⍝ listen for click and dblclick

The events that you can specify include [jQuery](https://api.jquery.com/category/events/) and [HTML](http://www.w3schools.com/tags/ref_eventattributes.asp) events. Note that the leading “on” in HTML event “attribute names” can be omitted.

You can also define your own events and use jQuery's trigger() method to trigger them in the client – see \_.Timer for an example of this.

**Callback**

Callback specifies where the event is to be handled. Valid values for Callback are:

* 1 (the default) – handle the event on the server by calling a function named APLJax
* 'Name' – handle the event on the server by calling a function named Name
* 0 – handle the event in the client

If you have a simple page with a single handler, using the default behavior and using APLJax. However, if you have several handlers you may want to write separate

**ClientData**

ClientData specifies what information is to be sent from the client to the server.   
See the section on ClientData found later in this document.

**Delegates**

Delegates are used in jQuery's event handling framework primarily to address two circumstances.

* When the same event is to be bound to a large number of elements. For instance, every cell in a large table. Rather than internally bind a handler to every cell, it's more efficient to bind one handler to the table element itself and then specify the cells as delegates.
* When dynamic elements need handlers bound to them. Event handlers are bound when the page is loaded. If, after it's loaded, a page creates new elements that need event handling, then you must use delegates.

Consider the case where:

* your page has a table element with id 'myTable'
* your page can add and delete cells in the table
* you want to be able to handle when a table cell (the td HTML element) is clicked

Without delegates, you wouldn't be able to react to the click event on cells that are created after the page is initially loaded. But with delegates, you can attach a handler to the table itself and specify the td elements as delegates.   
 myHandler.(Selector Events Delegates)←'#myTable' 'click' 'td'

For more on delegates, see <https://learn.jquery.com/events/event-delegation/>..

**Hourglass**

Hourglass is a Boolean which indicates whether to change the cursor to an hourglass when an event is handled by the server. This is intended for event whose server processing time may be lengthy. Most events will be handled so quickly that flipping between the normal cursor/hourglass and back again isn't noticeable. The default value is 1. You might consider setting it to 0 in the case where you use some other mechanism to indicate a lengthy delay, for instance a "Please Wait..." popup.

**Page**

Page specifies the URL to which to direct the event handling. As in the example at the beginning of this document, most events will be handled in the same page that rendered the original web content. However, if you want to separate your event handling code to another page, set Page to the URL of that page.

**JavaScript**

JavaScript is any JavaScript code you would like to be run in the client **before** the event is signaled to the server – or as the handling code when CallBack=0.

**jQueryWrap**

jQueryWrap is a Boolean which specifies whether to wrap the handler in jQuery syntax so that the handler is defined and bound when the web page loads. The default is 1.

This setting is for advanced use when you want to generate and manipulate the handler's code for separate use, such as combining several handlers into within a single jQuery page load invocation

**ScriptWrap**

ScriptWrap is a Boolean which specifies whether to wrap the handler in an HTML <script> element. The default is 1.

This setting is for advanced use and is generally used when you want to combine several pieces of JavaScript into a single <script> element.

**ForceInternal**

ForceInternal indicates whether the event should be handled as a widget's "internal event". This setting applies only to 3rd party widgets (jQuery and Syncfusion).

Widgets in JavaScript libraries like jQueryUI and Syncfusion will often have a list of events – we call these "internal events" because the handler for them is defined within the widget's parameters. Internal events are handled slightly differently and may have different arguments. The MiServer APIs for these JavaScript libraries have a public field, InternalEvents, which lists the events that are internal for the widget at the time the MiServer API was written.

The default setting for ForceInternal is ¯1 which indicates to check InternalEvents for whether to treat the event as an internal event.

A setting of 1 is used to the force the event to be treated as an internal event. You would set this in the (unlikely) case when the widget has an event that is not listed in InternalEvents. This might happen if you install an updated version of a JavaScript library and new events have been introduced.

A setting of 0 means do not treat the event as an internal event even if it's listed in InternalEvents. It's unlikely that you'd ever use this setting, but it's included for completeness.

In general, the nuances of internal events are not important to the MiServer user. But, it is recommended that the user review the source documentation for a widget to be familiar with which events are internal and what features may be of interest.

**WidgetDef**

WidgetDef is intended to be used by people who need to develop handler APIs for JavaScript libraries that aren't included as a part of the "off-the-shelf" MiServer. WidgetDef specifies the syntaxes used by a particular widget library for

* the internal event handler syntax
* the syntax to access the event object
* the syntax to access the widget's object model
* the syntax to access the widget itself

### ****Event Handling** –**ClientData

ClientData **allows you to specify data that is to be sent back to the server. The data can be extracted from any element on the page, not just the element to which the event handler is bound.**

**By default the callback mechanism will return:**

|  |  |
| --- | --- |
| **\_event** | **the name of the event** |
| **\_what** | **the id/name, if one exists, of the element that triggered the event** |
| **\_value** | **the value, if one exists, of the element that triggered the event** |
| **\_selector** | **the selector specified for the handler** |
| **\_target**[[1]](#footnote-1) | **the id, if one exists, of the innermost element that the event fired upon.**  **This will normally be the same as** \_what. |
| **\_currentTarget1** | **the id, if one exists, of the element to which the handler was bound** |

**These fields are directly available in your page when you handle an event in APL.**

**If you do not specify ClientData**, MiServer will also automatically serialize and return any form data found on the page. If you wish to include form data with information selected using ClientData, you will need to use "serialize" as described below.

**You can select information to be sent to the server using the following syntax:**

|  |  |
| --- | --- |
| **name type [argument] [selector]**  If the type does not require an argument, then selector can be in the 3rd position.  In other words:  **'data' 'val' '' '#myinput'** and  **'data' 'val' '#myinput'** are equivalent **because val does not require an argument**. | |
| **name** | the name to give the data on the server side |
| **selector** | jQuery/CSS selector of or a reference to the element from which to get the data If selector is omitted, use the element to which the handler is bound if applicable |
| **type** | the type of data to return   |  |  |  | | --- | --- | --- | | **type** | **Returns** | | | **attr** | an HTML element attribute | It's useful to understand the difference between HTML attributes and DOM properties. Attributes are always strings whereas properties can be other data types (Boolean, number, string, etc). In general if an attribute is also available as a property, it's recommended to use the property. For a good discussion on this, see <http://lucybain.com/blog/2014/attribute-vs-property/> | | **prop** | a JavaScript DOM property | | **css** | a CSS setting | | | **is** | specific settings – see jQuery.is() | | | **html** | the HTML content of the element | | | **val** | the value of the element (generally applies only to form elements) | | | **option** | for jQuery and Syncfusion widgets, this will retrieve the value of the option specified in argument | | | **method** | for jQuery and Syncfusion widgets, this will return the result of executing the widget method named in **argument** | | | **event** | for jQuery widgets and HTML elements return a stringified representation of the event object  for Syncfusion widgets, return a stringified representation of the argument passed to the event handler | | | **argument** | same as **event** (deprecated) | | | **this** | return a stringified representation of the element which triggered the event | | | **model** | for jQuery and Syncfusion widgets, this will return either the stringified representation of the entire widget model, or element specified in **argument** | | | **ui** | same as **model** (deprecated) | | | **eval** | the result of the evaluation of a JavaScript string specified in **argument** by using the JavaScript eval() function. | | | **js** | the result of executing the JavaScript specified in **argument** This differs from **eval** in that the JavaScript is executed inline rather than using the JavaScript eval() function. (deprecated, use ⍎ instead) | | | **string** | a constant string | | | **serialize** | the serialization of all input elements in all forms on the page, or the form specified in **selector** | | | **⍎** | the result of executing the 1↓ of **type**. This is a shorthand version of **js** | | |
| **argument** | dependent on **type**   |  |  |  | | --- | --- | --- | | type = | **argument =** | **Example** | | **attr** | the attribute to return | 'attr' 'title' | | **css** | the CSS setting to return | 'css' 'font' | | **html** | '' | 'html' | | **is** | the setting to return – see jQuery.is() | 'is' ':checked' | | **val** | '' | 'val' | | **eval** | the JavaScript string to evaluate | 'eval' '2+2' | | **string** | the string to return | 'string' 'constant' | | **event** | the element of the event object | see jQueryUI document | | **ui** | the element of the ui object | see jQueryUI document | | **model** | the element of the model object | see Syncfusion document | | **argument** | the element of the argument object | see Syncfusion document | | **serialize** | '' | 'serialize' | | **js** | the JavaScript to execute | 'js' 'alert("Hello");' | | **⍎** | '' | '⍎alert("Hello");' | |

**Example:**

**h←Add Handler ⍝ add an event handler  
h.ClientData←('content' 'html' '#div1')**

**('bgcolor' 'css' 'background-color' '#div2')  
  
Returns**

* **a variable named "content" which contains the HTML content of the element with id "div1"**
* **a variable named "bgcolor" with the CSS background color of the element with id "div2"**

### Event Handling - Receiving Client Data in Server-Side Callback Functions

Client data can be receieved in two basic ways:

* Define a public field in your MiPage with the same name as the data you want to retrieve  
  For instance, in the specification used above  
   **h.ClientData←('content' '#div1' 'html')  
   ('color' '#div2' 'css' 'background-color')**  
  You could define two public fields and they would be populated automatically.  
   **:field public content  
   :field public color**  
  There are two caveats when using public fields:
  + if you don't assign them a value when they are declared, if you reference the field and it wasn't set
* The other way is to use the **Get** method to retrieve the data by name. The left argument to **Get** is the default value to use if the data element is not found. Again, using the example from above, the following could be used.  
   **'???' Get 'content'  
   'white' Get 'color'**

## Event Handling – Sending Responses Back to the Client

Server-side callback functions can specify actions to be taken on the client side in response to a callback function. The four functions described below can be used to create client-side actions, and these actions can be catenated together to return a sequence of actions to be performed.

|  |  |
| --- | --- |
| **r ← selector Replace new r ← selector Append new r ← selector Prepend new r ← Execute javascript** | |
| **Replace** | Replaces the HTML content of the element specified by selector with new |
| **Append** | Appends new to the HTML content of the element specified by selector |
| **Prepend** | Prepends new to the HTML content of the element specified by selector |
| **Execute** | Executes javascript string (using JavaScript's eval() function) |
| **selector** | The selector of the elements to update |
| **new** | The new content with which to update |
| **javascript** | A character vector of the JavaScript to execute in the client |

**Example:**

r ← '#result' Replace \_html.h2('Hi')  
 r,← Execute 'alert("Happy Birthday!")'

**Callback functions must return a result, though the result could be '' if no action is to be taken on the client side.**

## Event Handling Recipes

This section shows a variety of examples of handler and callback definition

1. For an example on the use of \_target and \_currentTarget, see the /Examples/Techniques/TargetsExample page in the MS3 MiSite. [↑](#footnote-ref-1)