Slurp Data Services Platform

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Overview

- A one-stop, code-free solution to quickly develop and deploy extremely fast/agile data services for Windows/Unix/Cloud.
- Operates as an in-memory ETL (Extract Transform Load) platform but is also able to stream data to/from clients and between selected components (easier than ADF). See Data Streaming.
- Uses it's own micro-services framework to ensure maximum performance. If run on Java 21+, it makes use of Virtual Threading for outstanding performance.
- Any service can be configured to be available to an external client, which can access it via Restful or SOAP calls, using basic or token-based authentication.
- Can be deployed as a Windows service, a Unix daemon or by WAR file to a separate Java web server.
- Slurp servers are cluster-ready.
- Has built-in web and OAuth2 servers making it a stand-alone solution.
- Create/test/deploy in mixed Windows/Unix/Cloud environments.
- Requires Java JRE 1.8 or greater. If your Java installation is not recorded in Windows registry, or to choose an alternative JRE, then set the JAVA_HOME environment variable to where it is installed.
- Is a single 16MB binary (slurp.exe) which is used for:

  a) The Service Designer. The user interface to create/update services, and optionally by single click to create a Java web server deployment of the services (WAR file). It will run as a native application under Windows, and for other platforms run it with '*java -jar slurp.exe*'.

  b) To run Slurp as a Windows service or Unix daemon.

  c) The library to add to the build classpath when creating a plugin for Slurp (it is also JAR format).
- The services configuration maintained by a) or read by b) is contained in the file *slurp.xml*, which is in the same directory from which *slurp.exe* is run.
- Other, preference-type properties are kept in the file *slurp.properties*.
- There are existing plugins for:

  a) Secure file transfer (SFTP) and secure remote shell execution (SSH).

  b) LDAP access control checking.

  c) Reading/writing to Windows shares (SMB/CIFS).

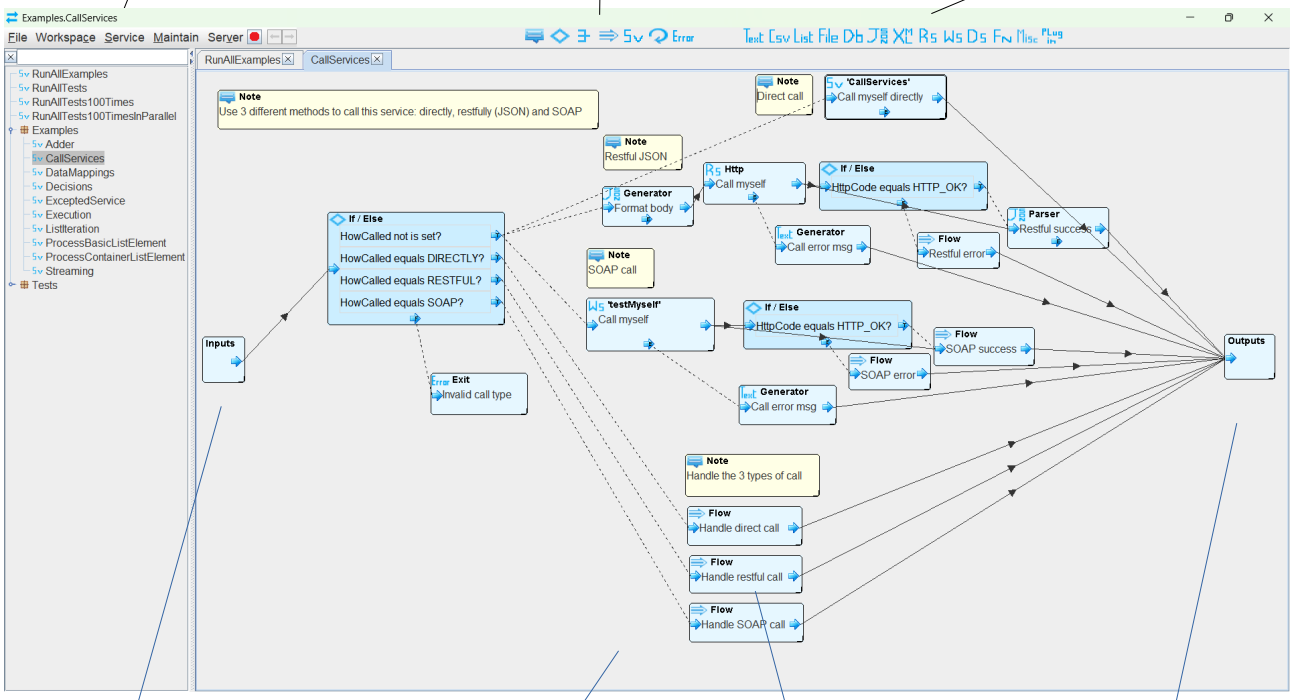
  d) Reading/writing Microsoft documents (only Excel so far but more by request).

The Service Designer

Menu Options: Create, configure, save and deploy services

Programming Pallet: Apply conditions to data flows and other programming components

Operations Pallet: Parse, generate and filter data, call web services and access data stores and plugins



Inputs component: Specify service inputs here

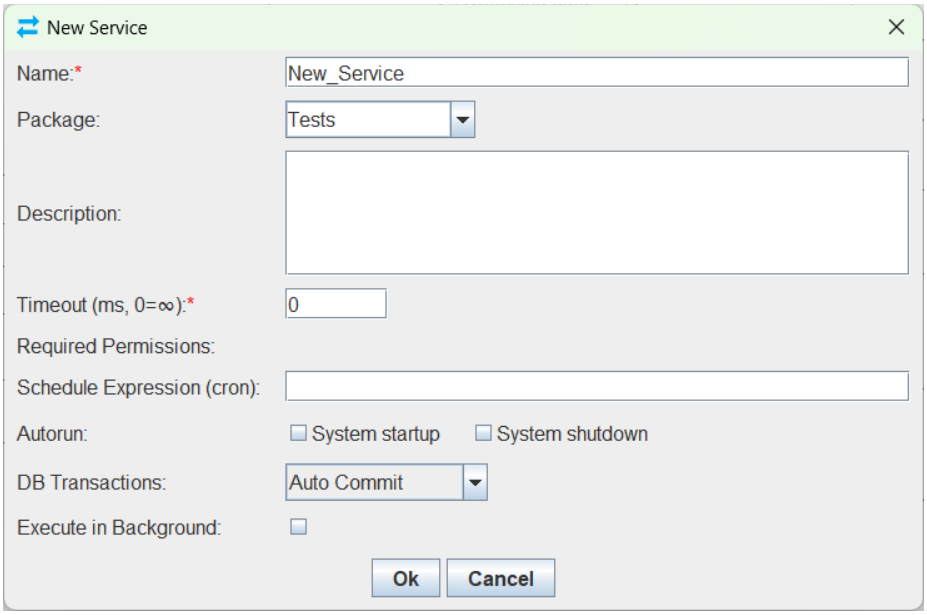
Components: Specify bespoke functionality

Data flows: Connect fields between components

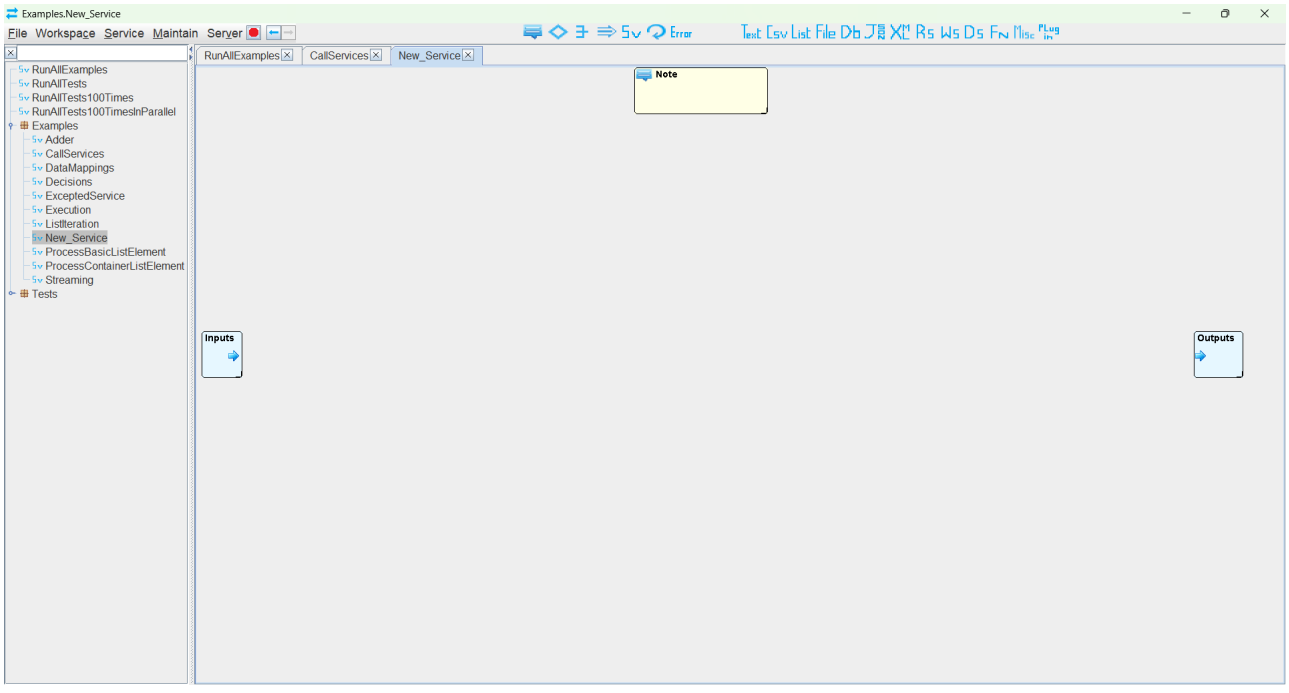
Outputs component: Specify service outputs here

Creating a Service

- Create a service using menu Service>Create (or right-click on the canvas). The following dialogue is displayed:



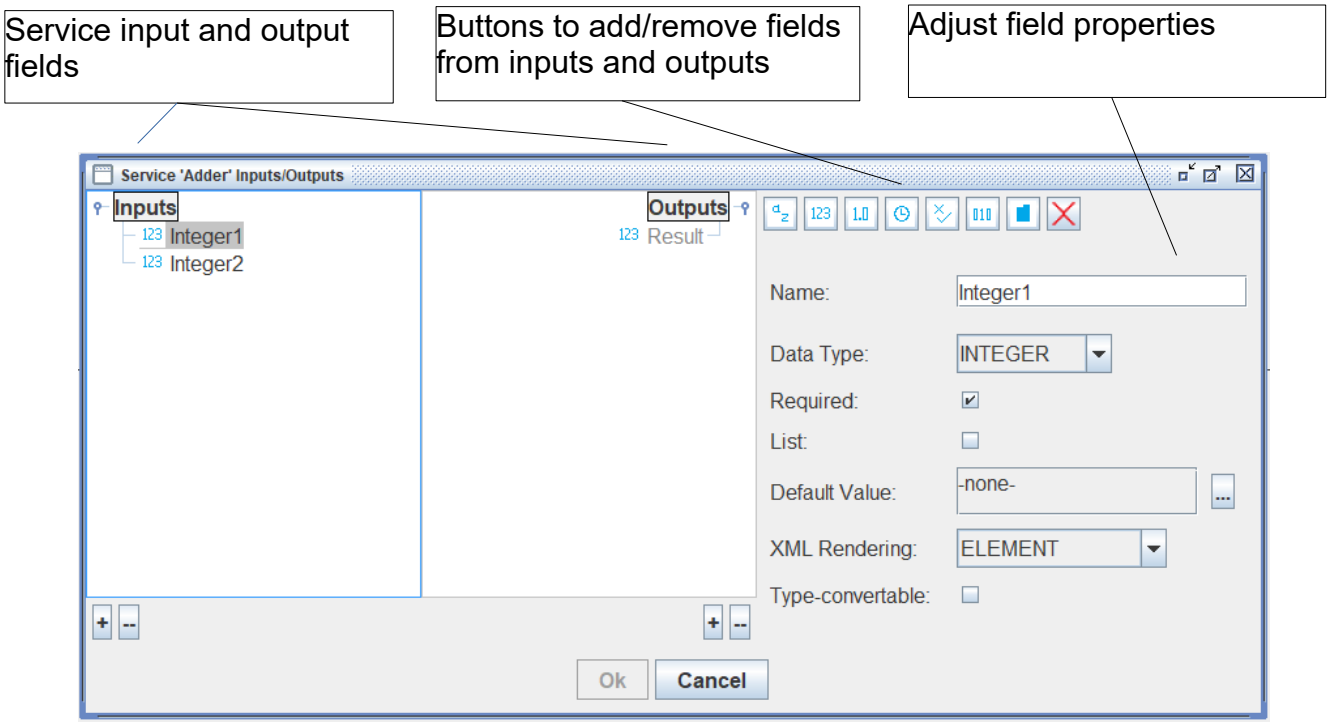
- Assign a ‘Package’ to the service so that related services can be grouped together for the convenience of, eg. importing/exporting them. Packages do not exist on their own right, but only if specified by one or more services. The ‘Timeout’ can be set such that the service will be aborted if its execution takes longer than the specified time. ‘Required Permissions’ are the permissions required to execute the service, which will be derived from an authenticated user, see Security Model. Automatic (in addition to the normal on-demand) invocation of the service can be specified with a Cron expression and/or when the Slurp web serving is started and/or stopped. ‘DB Transactions’ specifies how to handle database transactions (if any) for this service and for other Slurp services called from it. See Miscellaneous Operations for more details. ‘Execute in Background’ will cause the service to run in the background so that the caller does not need to wait for it to complete. A blank service will look like this:



- The service contains 3 components by default: for input, output and a service comment.
- No service inputs or outputs have been specified so far. If this service is run it will not expect any inputs and will return no outputs. It could nonetheless do something useful in between.
- The service can be tested in the GUI by right-click ‘Run Service’ (or control-r). Alternatively, it can be tested from a web client, eg. browser, using the inbuilt Jetty web server (see Testing a Service).
- To switch between different services, either:
  - Double-click on a the service in the navigation panel.
  - Use mouse forward and back buttons (if you have them) to scroll through your service editing history, or the ‘Next’ and ‘Previous’ buttons in the menu.
  - Right-click the canvas and select ‘Go to Service’, then select a service.

Defining Service Inputs and Outputs

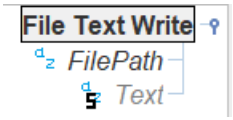
- Right-click on a service and select ‘Properties’. This will invoke the Container Editor on the service input and output components, eg:



- The basic field types are: text, integer, decimal, date/time, boolean, binary and container. For a singular required field these are represented by one of the following icons respectively:

- The date/time type represents a local date/time as would be represented by a calendar date combined with time. More description in FAQs.

- There are variants for each field type, depending on whether it's a list of the type and if its value is mandatory, eg. for text type:
  - List of text
  - Non-mandatory text
  - Non-mandatory list of text
- If a field has had a constant value applied to it (right-click, 'Set Constant') then it will have a yellow background and the constant value can be displayed by hovering the mouse over it, or the constant changed or removed by right-click.
- Streamable fields have a black 's' marked in the icon, eg:

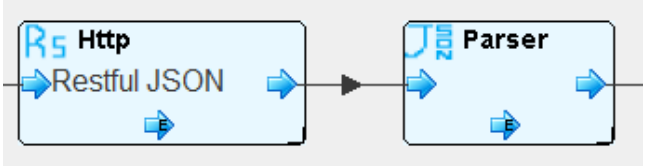


  If a streamable output field is connected to a streamable input field and it is not making use of ETL field mapping functionality (merging, splitting or mapping functions) then data will be streamed between the components, as opposed to being held in memory. This allows for unlimited amounts of data to be transferred between the components. A data flow that is set to stream data between components is depicted with a thick black data flow line. More details about streaming data flows can be found in Data Streaming.
- You can also set the service input or output fields using an XSD (XML Schema Document) or JSON Schema by double-clicking on the input or output component itself.
- Note: avoid modifying the workspace while Slurp is actively web serving or a service is running in the background: this may cause the service to fail, but is permitted.

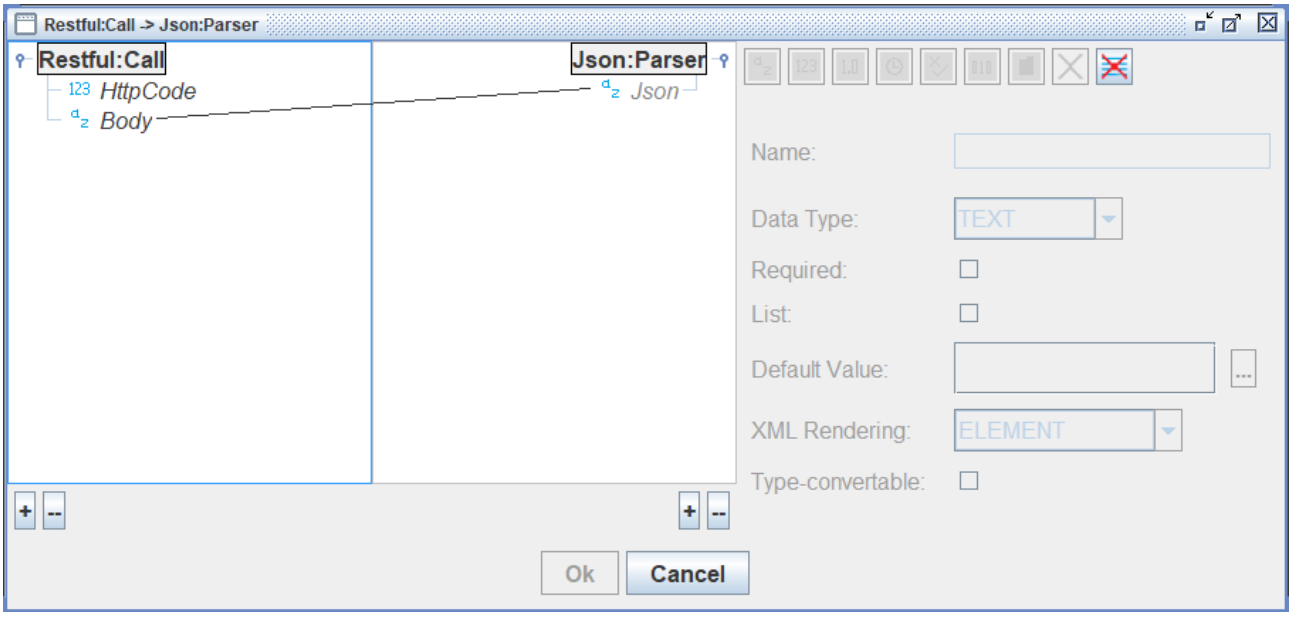
Adding Components to a Service

- This is done by dragging components from the Programming Pallet or Operations Pallet and dropping them on the canvas.
- At the point of drop, most components display a dialogue so that a variant of the component can be chosen and configured. This process will set the component's input and output fields, and usually the default value of input fields (to save you from having to set them using a data flow or constant).
- The arrow on the left is for the component inputs, the arrow on the right is for the component outputs and the arrow at the bottom can be used to handle errors when the component is executed (by connecting it to a component that handles the error).
- Initially, the component's titles and borders are greyed out. This is because it doesn't yet have any input flows to activate it. It is effectively commented out code until at least one input or control flow is passed to it (see Programming Pallet for a description of component activation).

- Once the component is on the canvas, it's conventional to specify where its inputs are coming from (if it has any). This is done by dragging a line (creating a flow) from the output of a previous component to the input of the current component, eg: to parse the output of a Restful service call:



- Components and flow lines can be removed by selecting them with the mouse and then using the delete key. Most components panels can be written into to document their intended purpose.
- Double-click a data flow line to specify the data mappings between the output fields of the previous operation to the input fields of the next operation (at runtime, this will signify that the contents of the output fields are copied to the input fields). This invokes the Field Mapping Editor, as follows:



- Create data mappings by dragging a line from a source field on the left to a destination field on the right. In-line transformations on the data can be specified by right-click and selecting 'Add Function' to wire-in a function call (the same functions can be dropped onto the service canvas by using a Call Function). Illogical mappings, eg. decimal field mapped to binary field or trying to lose the context of a container list element cannot be made or will be highlighted as an error.
- Data mapping lines can be can removed by clicking with the mouse and then using the delete key. Once happy with the mappings, click Save.
- Now that the inputs are available to the component it may require further configuration (which is often dependent on the inputs). To do this, double-click the component to (re)configure it.

- Editing data flows and configuring components can be done as many times as necessary.
- Constants can be assigned to input fields instead of using field mapping. Right-click a field to get options. Input fields can also be assigned a default value in case the field is not set by a mapping or constant.
- Components can be moved or copy/pasted using multi-selection: component selection can be done by holding down the left mouse button and dragging across component titles and/or holding the Control key and clicking component titles. Then to move the selection drag a selected component title, or right-click for copy/paste options.
- Right-click on a component to get other component options, including:
  - Edit/View the component inputs or outputs (if it has them). This can also be achieved by double-clicking the component input or output icons.
  - Turn container list iteration on/off for the component. A component with this setting expects to operate on the elements of a top-level container list (see program iteration constructs).
  - Generate XSD or JSON Schema for the component inputs or outputs (if it has them).
  - Log inputs, outputs or both. Requires logging level set to at least 'custom' in menu File>Preferences.
- If the component doesn't have any data inputs it will still require an incoming flow to active it, ie. makes it dependent on the execution of a previous component. This can be either an empty data flow from another component, or the control flow output from a Conditional Flow Control component (see description of the Programming Pallet), or to handle an error from a previous component.
- The different styles of flow lines are:
  - Control flow
  - Data flow with no field mappings 
  - Data flow with field mappings 
  - Data flow set to stream data (see Data Streaming) 
- You can right-click the canvas for other options. If a data flow or component shows any red colouration (indicating an issue) then hover the mouse over it to find the reason.
- Each opened service is contained within it's own tab in the Service Designer. The title of a tab is the service name.
  - A red title indicates that one or more configuration errors exist in the service (hover over your mouse over red components to determine the reasons).

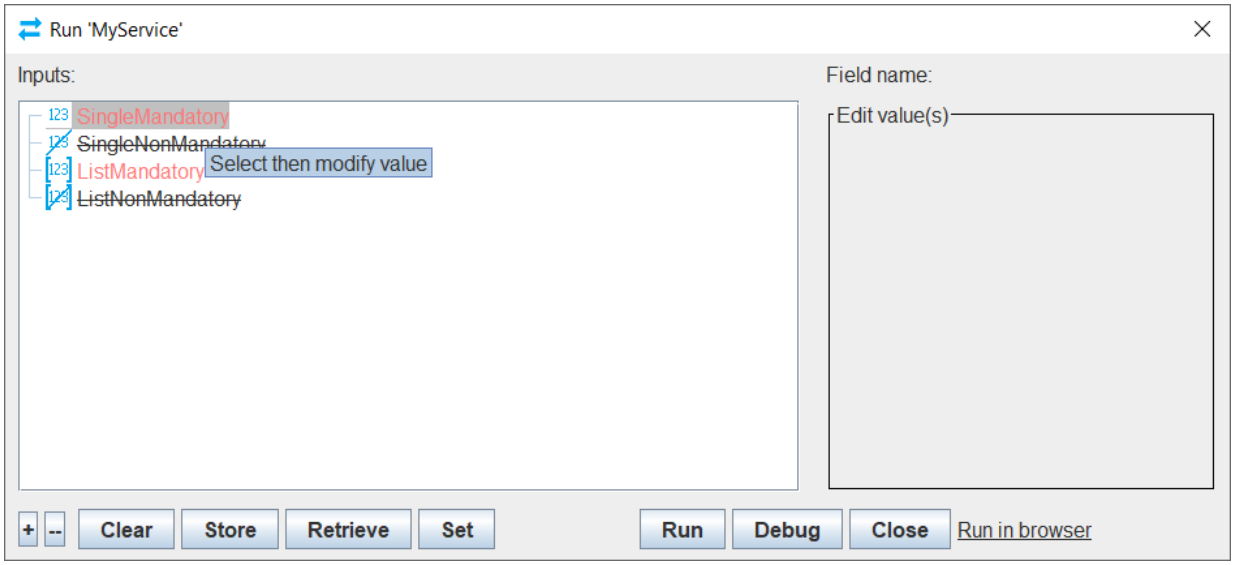
    - If the title is preceded by an asterisk (*) this indicates that the service has been changed since the service tab was opened and right-clicking on the service canvas will have the option to ‘Undo Service Changes’ (since the tab was opened). Service changes that have been undone can be redone with ‘Redo Service Changes’ as long as no other changes to the service have been made since.
    - Once a service tab is closed or you click ‘Save Service Changes’ you lose the option to ‘Undo Service Changes’. However, you always have the option to use menu Workspace>Edit Log and revert to a previously saved snapshot of your services since the Service Designer was started.
    - You don’t have to save changed services between runs of the Service Designer. When you rerun the Service Designer you can carry on where you left off.
    - If the service title is preceded by an exclamation mark (!) this indicates that the service has one or more dialogues open on it, and closing the service may lose their changes.
- During your editing session, periodic snapshots of your work are taken, so that you can revert to them if you decide to undo changes across all edited services, see menu Workspace>Edit Log.

Deleting a Service

- You can either use menu Service>List/Delete to delete services or right-click on services in the navigation bar and select ‘Delete Service(s)’.
- As services can be dependent on other services, it can be helpful to use the former method, as having deleted some services you may decide to not save the result, in which case you can just cancel the dialogue. The dialogue informs you of any missing dependencies as you remove services and allows you to inspect the affected services before dismissing the dialogue.
- Whichever method you choose, if your workspace had unsaved changes before service deletion(s) then a snapshot of the workspace is taken prior any deletions. Prior configuration can be reverted to using menu Workspace>Edit Log.

Testing a Service

- This can be done easily in either of three ways:
  a) Select menu Service>Run (or control-r) to provide input data in the GUI and see the outputs in the GUI.
  b) Use the built-in Jetty web server and call the service from an external client (web browser, Restful or SOAP client).
  c) Create a deployment WAR file for an external Java web server and test the service there.
- For test method a) you will be prompted to enter input data:



- Unset mandatory fields will be marked in red, until set. Unset non-mandatory fields are displayed with strike-through. Select a field and then click in the right-hand box to set its value. If the field is a list then multiple values can be entered. Right-click the field or its value to unset or remove it. A summary of a field's current value is displayed to the right of the field.
- Test data can be created, saved or recovered using the buttons on the left ('Clear', 'Store', 'Retrieve', 'Set').
- You then have 3 options of how to run the service:
    - 'Run': will run the service until it completes normally, or a non-handled error occurs, or a service times out (timeout is a service property).
    - 'Debug': will enable you to debug your services, using breakpoints, single-stepping, etc (see Debugging a Service).
    - 'Run in browser': will call the service from your browser (only enabled for a service with non-container input parameters).
- For test methods b) and c), by default, no services can be called from outside Slurp. To make a service available externally use menu Server>Configure, to assign it a service 'Endpoint' and/or 'Restful Path', and enable it (only 'Endpoint's are used by SOAP requests). For test method b), start the local server using menu Server>Start Local Server, or click the circular server status icon (red=stopped, green=running).
- So, for example, with 'HTTP Port enabled' set to 8080, service "Service XYZ" assigned endpoint name "xyz" and the local server started, then a JSON encoded response from this service can be invoked using *http://localhost:8080/xyz.json*.
- For test method c), the 'Built-in Server' details are not used. Having specified the Endpoints and/or Restful Paths for your services and enabled them, use menu Server>Create Deployment to create the deployment WAR file. This can then be deployed on a separate Java web server like Tomcat.
- There are 3 ways for a request to pass parameters to an invoked service:

    a) As URL parameters, eg. *http://localhost:8080/remote.json?Operation=add&Arg1=3&Arg2=5*, or

    b) As components of the restful path, eg. *http://localhost:8080/remote/add/3/5.json* (where Restful Path for service has been set to *remote/{Operation}/{Arg1}/{Arg2}*), or

    c) As a JSON object or XML content in the request body (if it starts with '{' it is assumed to be a JSON object, if '<' then XML).

    Example JSON request body:

    {"Operation":"add","Arg1":3,"Arg2":5}

    Example XML request body (where input fields are defined as 3 attributes):

    <root Operation="add" Arg1="3" Arg2="5"/>

Example XML request body (where input fields are defined as 3 elements):
<root><Operation>add</Operation><Arg1>3</Arg1><Arg2>5</Arg2></root>

- The format of the response from the service is specified by the extension placed after the endpoint name in the request URL: ".json" for JSON, ".xml" for XML, etc.
- The full set of endpoint extensions are:
  - .json - execute the service and return the results as JSON.

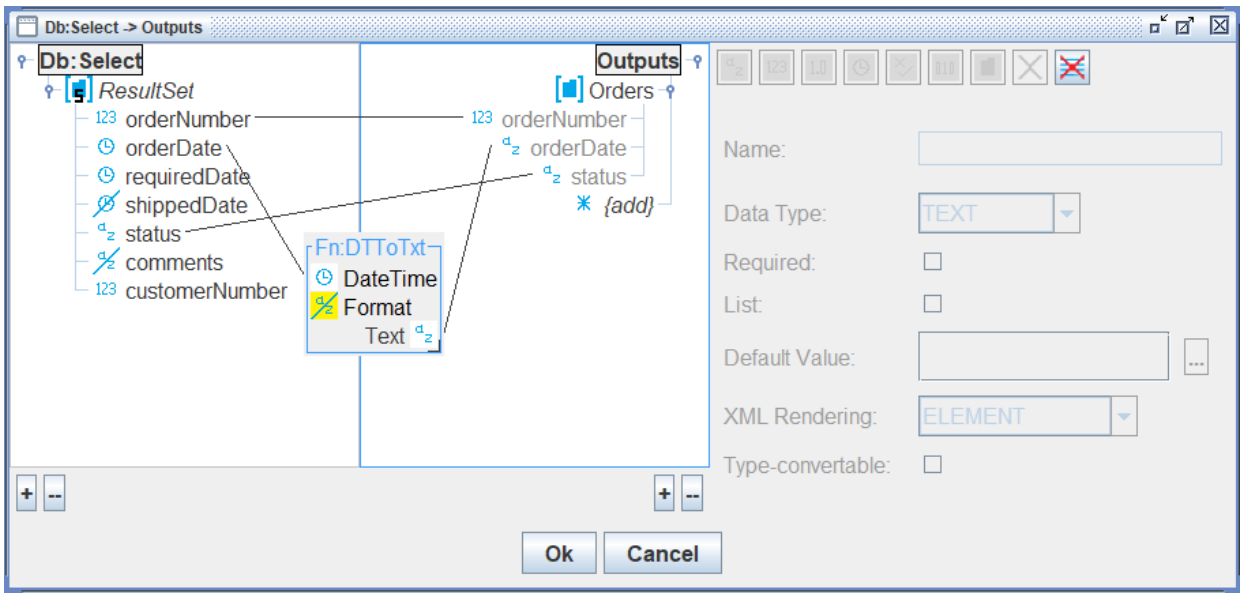
    The returned content type will be 'application/json'.
  - .xml - execute the service and return the results as XML.

    The returned content type will be 'application/xml'.
  - .txt – execute the service and return the results of the single output text field.

    The returned content type will be 'text/plain' unless function setResponseHeader has been called to set 'Content-Type' otherwise.
  - .bin - execute the service and return the results of the single output binary field.

    The returned content type will be 'application/octet-stream' unless function setResponseHeader has been called to set 'Content-Type' otherwise.
  - .wsdl - return a WSDL for the service (no service execution).
  - .jsoni - return a JSON Schema of the request body (no service execution).
  - .jsono - return a JSON Schema of the response body (no service execution).
  - .xsdi - return an XSD (XML Schema Definition) for a request body (no service execution).
  - .xsdo - return an XSD (XML Schema Definition) for a response body (no service execution).
- To test a service using a SOAP client you will need to obtain the WSDL (Web Service Description Language) for the service. This can be done in 3 ways:
  - By right-clicking on the service's Input component and selecting menu Generate>WSDL for Service.
  - By invoking the .wsdl URL for the service (see endpoint extension, above).
  - Alternatively, the WSDL for all externally available services can be obtained using, eg. *http://localhost:8080?wsdl*.

Field Mapping Editor



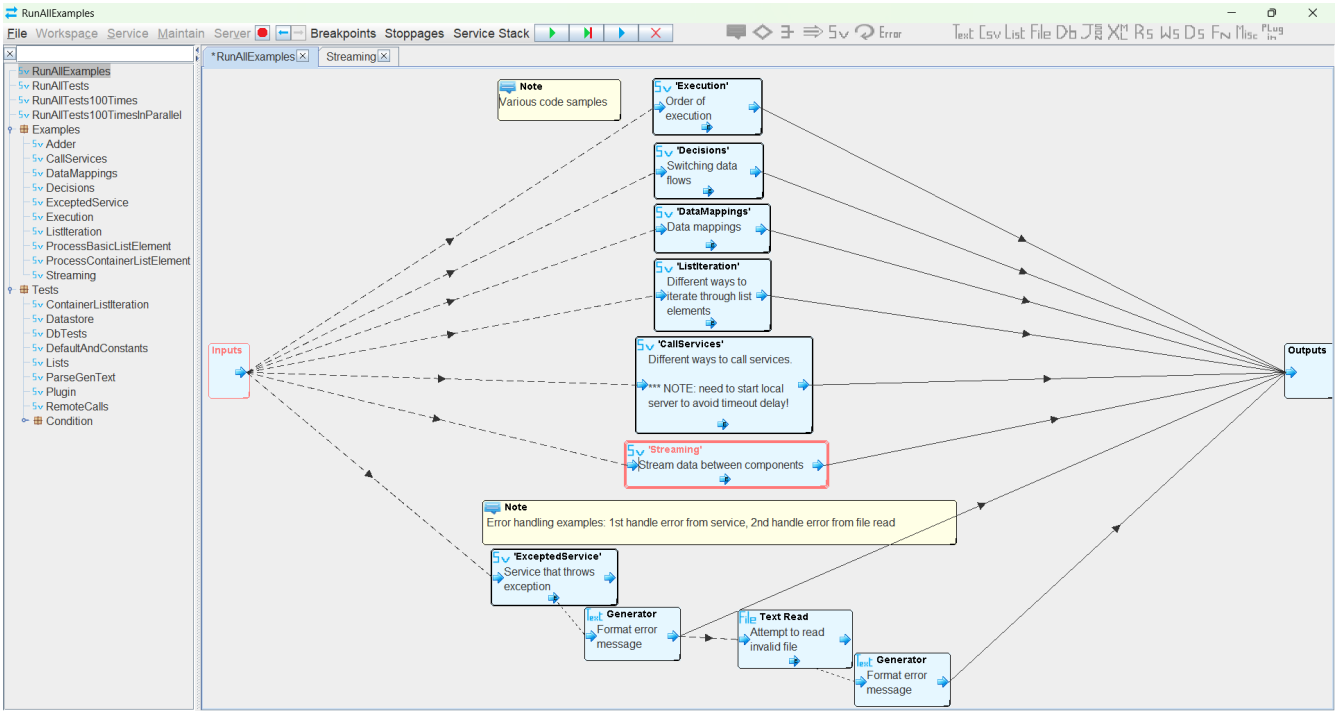
- The Field Mapping Editor is invoked by double-clicking on a data flow that connects the output container of a previous operation to the input container of the next operation.
- It can be used to specify the field mappings between the containers (ie. how the contents of the fields will be copied at runtime) as well as the properties of the fields in the containers.
- Fields can be created and removed using the top-right toolbar or delete key. To specify a field mapping, drag a source field to a destination field using the mouse. Invalid mappings will be not be allowed, or highlighted in red. If the destination container has a pseudo field called '{add}' then dragging a mapping line to it will create a copy of the source field as well as the mappings to it (not for container field in some circumstances). This pseudo field mechanism is used as a prompt to where input (parameter) fields are expected to be created as well as facilitating their creation.
- Click on a field to view its properties, and change them (component-defined fields are generally read-only but their default value can nonetheless be updated).
- Right-click for other functions including copy, paste and for adding an in-line function call.
- A destination field does not have to be mapped to and could, if necessary, be set to a constant value (right-click field, 'Set Constant'), or have a default value set.
- Dragging from a source container to a destination container will attempt to map fields between the two containers. This auto-mapping only applies to fields of the

same name (case-insensitive) and type (as might be created by copy/paste of a field hierarchy). The Auto-map tool performs the same function but at the top level.

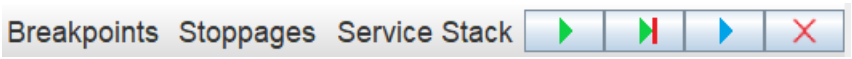
- Slurp has 7 field types, made up of 6 data types (text, integer, decimal, date/time, boolean and binary) plus the container type. It is not possible to map from one type directly to a different type without either using a conversion function  or specifying that the source field permits auto-conversion ie. by default, no automatic type conversions are performed.
- The toolbar elements and field properties may be disabled, depending on field selection and whether the field is read-only (a component-defined field).
- Incorrect mapping lines are red dashed. If a field is in labelled in red then hover the mouse over it to find the reason.
- If the destination field is a container that allows user-added parameters then the pseudo-destination field ‘{add}’ specifies where additional component parameter fields are to be populated. These are usually data fields (ie. not a container), but for some components a container can also be specified.

Debugging a Service

- If you click ‘Debug’ in the run panel, the Service Designer will be displayed with 3 extra menus and 4 extra buttons, and service execution will be stopped on the Inputs component (component title and border coloured red). Service time outs are not honoured in debug mode:



- The additional debug menus and buttons are:



- The ‘Breakpoints’ menu lists breakpoints that have been set on components (by right-clicking them and selecting ‘Set Breakpoint’. You also have the option of clearing all breakpoints. Individual breakpoints can be cleared by right-clicking a component and selecting ‘Clear Breakpoint’. When a component has a breakpoint set on it, it will be displayed with a thick red border.
- The ‘Stoppages’ menu lists service runners where components are waiting to be executed. It may contain different entries for the same service as the same service may be being executed by different service runners at the same time.
- The ‘Service Stack’ menu lists the service runner stack in the context of the currently select stoppage (if you haven’t selected a particular stoppage then it will default to displaying the service runner stack of the first stoppage found for the current service).
- You can select a service runner from the stack to see the inputs and outputs of executed components in the service call chain.

- The  button runs any single ‘awaiting execution’ component in the current stoppage service (select a particular stoppage if the service is currently being run by different service runners). The icon will be greyed out if there are none to execute. To run a specific ‘awaiting execution’ component, right-click and select ‘Execute’ (or ‘Execute Into’ if it’s a service call and you want to step into the service call).
- The  button will resume executing all ‘awaiting execution’ components across all services and stop execution at the first component which is set with a breakpoint. If no breakpoint is hit then execution will continue without stopping. The icon will be greyed out if there are no breakpoints set across all services.
- The  button will resume executing all ‘awaiting execution’ components across all services and continue without stopping (ie. breakpoints will have no effect).
- The  button will terminate the debug session immediately and return you to the run panel. It will spin while all components are executing.
- Additionally, if you have a service with any ‘awaiting execution’ components then you can right-click on any component and select ‘Execute to Here’. This will resume executing all ‘awaiting execution’ components in the current service runner and either stop at the selected component, or if it is not hit, execution will stop on the output component (giving you the opportunity to examine what just happened).
- During debugging, right-clicking a component will display component-related debug options, below the divider in the pop-up menu. These include:
    a) Execute. This option is only available if the component is awaiting execution.
    b) Execute Into. This option is only available if the component is awaiting execution and is a service invoker.
    c) Set/Clear Breakpoint. This option is always available.
    d) Execute to Here. This option is only available if you are in the context of a stopped service.
    a) View/Modify Inputs. The ‘View Inputs’ option is available if the component has already been executed. The ‘View/Modify Inputs’ option is available if the component is awaiting execution.
    a) View Outputs. This option is available if the component has been executed.
- During debugging, if the execution of a component fails and it doesn’t have an error handler (resulting in a failed service), then the component incurs a stoppage so that its inputs and call stack can be examined.

Service Security Model

- Slurp uses a permissions-based security model where the permissions granted to a request can be derive from either basic authentication (HTTP Authorization, type ‘Basic’) or indirectly via an access token (HTTP Authorization, type ‘Bearer’).
- By default:

  a) No system permissions, static access tokens, basic authentication or OAuth2 services are pre-defined (menu Maintain>Security).

  a) The default authentication for service endpoints is ‘None’ (menu Server>Configure).

  a) Services cannot be stipulated to have ‘Required Permissions’, since none are pre-defined (menu Service>Create or when editing service properties).

  A service cannot be called from outside of Slurp unless it has been given either an Endpoint and/or Restful path in menu Server>Configure, and which is ‘enabled’.
- If basic authentication is required for any service then go to menu Maintain>Security and select the ‘--- Create new ---’ option of the ‘Authentication Service’ drop-down. This will create a skeletal authentication service, then edit it to suit your needs. For any endpoint which is specified to use ‘Basic’ authentication, this service will be called to authenticate the value contained in the ‘Authorization’ (type Basic) request header. The authentication service does not need to supply any permissions to an authenticated user, unless the services they are attempting to call require them.
- If token-based authentication is required for any service then go to menu Maintain>Security and either create a static access token or configure the built-in OAuth2 server.
- To obtain a static token create a new row in the ‘Static Access Token’ table and then use the ‘Copy Value’ button to get a copy of the value of the token into the clipboard.
- To configure the built-in OAuth2 server select the ‘--- Create new ---’ option of the ‘Token Service’ drop-down. This will create a datastore-based token service (together with datastore and housekeeping service). You can update the implementation to suit your needs. Then, for each 3rd party service create a ‘Client Registration’ entry.
- To obtain an OAuth2 token, 3rd party clients must login at local server path ‘/token_request’. Successful authentication will redirect the client to the ‘Redirection URI’ with the token.
- For token-based authentication, a service invoker must use either the static token value or, for OAuth2, the token delivered to the ‘Redirection URI’ as the value of the ‘Authorization’ (type Bearer) request header. The access token does not necessarily

need to supply any permissions to the authenticated request, unless the services being called require them.

- Basic and token-based authentication associate an authenticated user name, optional numeric Id and optional permissions to a request. These can be checked by:

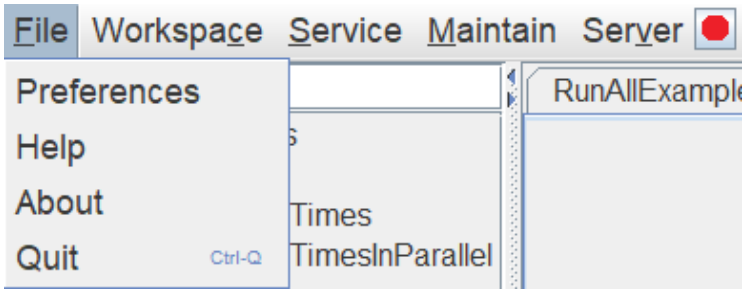
  a) Specifying which permissions are required to execute a particular service by setting the ‘Required Permissions’ property of the service in menu Service>Properties. Or,

  b) A service can programmatically test for the user or their associated permissions by calling Function Fn, either *RequestUserName, RequestUserId or HasUserPermission*.

- An unauthenticated request will have a blank user name, 0 for user id and empty list of permissions.
- Slurp has a built-in login throttle in case of repeated authentication failures, to defeat brute-force attacks.

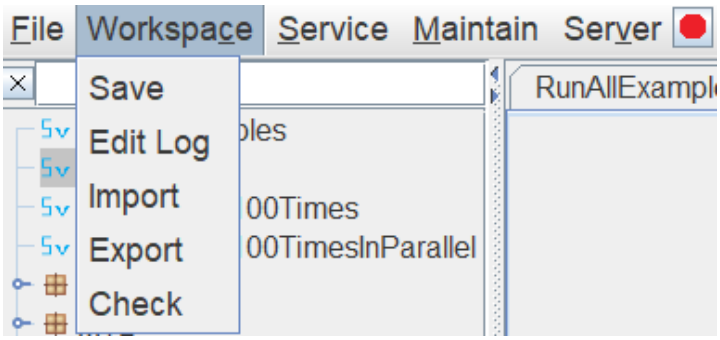
Menu Options

File Menu



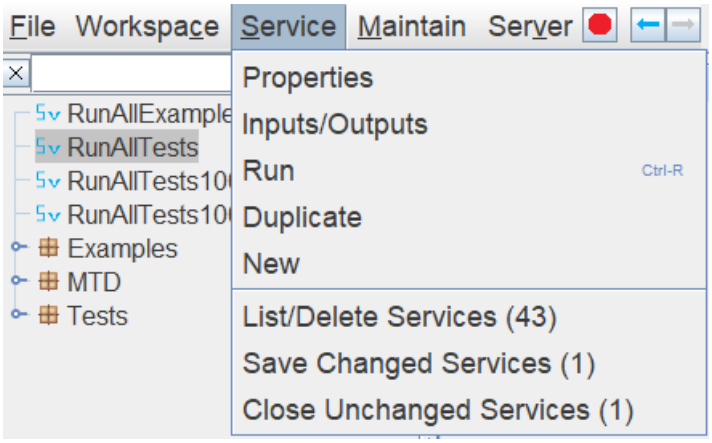
- Preferences. To adjust GUI and runtime preferences.
- Help. Displays this PDF in your browser.
- About. The Slurp version and included software credits.
- Quit. To terminate the GUI (and embedded Jetty server if it is running, indicated by a green spot instead of red).

Workspace Menu



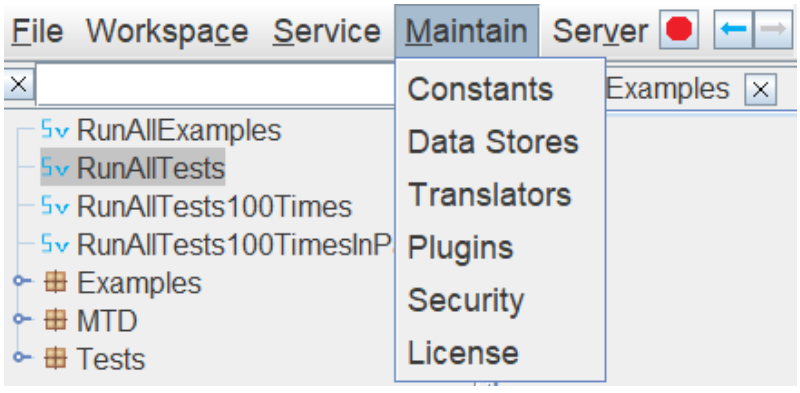
- Save. Writes the current configuration of services to its configuration file (slurp.xml in the current directory). Periodic snapshots are taken automatically every 5 minutes while you are making changes and prior to events such as service deletion.
- Edit Log. Lists snapshots of your edited configuration since the Service Designer was started so that you can switch to a previous instance of your editing.
- Import. Imports service definitions that have been exported from another project into the current project.
- Export. Exports service definitions so that they can be imported into another project.
- Check. Checks for errors/inconsistencies in the current configuration. Most of these checks are performed routinely during editing but this function will also warn you about service invokers that are missing their target services. Generally, missing services are allowed but they will cause a runtime error if you try to invoke them. A warning about them will be issued when you start the Service Designer.

Service Menu



- Properties. View/update the current service properties.
- Inputs/Outputs. View/update just the current service inputs and outputs.
- Run. Run or debug the current service.
- Duplicate. Make a clone of the current service. You can also clone a package using the left-hand service explorer window.
- New. Create a new service (also achieved by right-clicking canvas and selecting Create).
- List/Delete. View details of existing services and perform housekeeping.
- Save Changed Services. Save all changed services (those whose tab titles are preceded with a '*').
- Close Unchanged Services. Close all unchanged service tabs (those whose tab titles are not preceded with a '*').

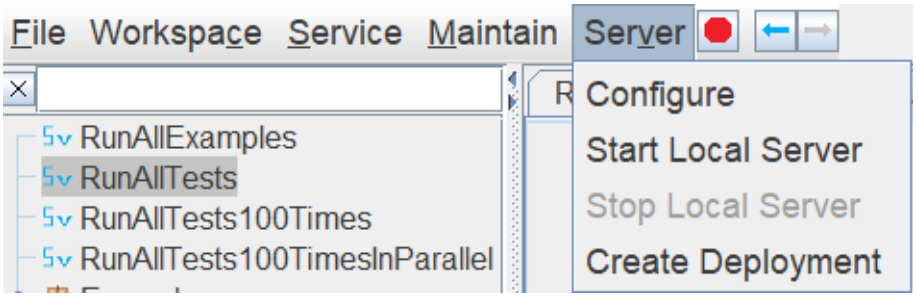
Maintain Menu



- Constants. Are literal values that are used when configuring components, they can be defined and updated here (or while editing components).

- Data Stores. This is where data stores can be created and updated. The structure of the data can be changed and whether it is persisted to file or not. Persistent data stores can be used to synchronise service activities across different JVMs to facilitate clustering. Operations on data stores can be added to a service by using the Access Data Store operation.
- Translators. A translator maps values between one simple type and another simple type. For instance, a number to a name, or a short name to a longer equivalent name. Translators can be defined and updated here. Translators act like functions and can be called from within a data flow (right-click 'Add Function') or on canvas via the Call Function operation.
- Plugins. The plugin architecture allows user-defined Java code to be integrated into a service. Having created a class for a plugin, it can be made known to the Service Designer here. See Writing and Using a Plugin. JDBC drivers must also be added here.
- Security. Here you can define system permissions, static access tokens, basic authentication service or OAuth2 configuration, see Security Model.
- License. A license is only required to run a production data service. Without a license the built-in Jetty server will stop serving after about 1 hour. But you don't need a license to use Slurp as a non-production service for any number of collaborators, or to contact our support. We're only too happy to help.

Server Menu



- Configure. Select which services are available to clients and with what type of authentication (none, basic or token-based), what service (if any) to use for basic authentication, and HTTP and/or HTTPS configuration.
- Start Local Server. To start the internal Jetty server (or use the Start/Stop button).
- Stop Local Server. To stop the internal Jetty server (or use the Start/Stop button).
- Create Deployment. To create a deployment WAR file which can be deployed on any Java web server, eg. Tomcat.
- Local Server Start/Stop button. A shortcut to stop and start the local Jetty web server. It's colour will be red if the server is stopped and green if the server is running.

Programming Pallet

- Drag a component and drop it at the desired location on the canvas. Once on the canvas it can be relocated by dragging its title bar or resized by dragging its bottom right corner. A few components use their panel to describe themselves, but most don't, leaving the panel available for documentation purposes. Generally, double-click a component to (re)configure it or right-click it for other options.
- Initially, the component's titles and borders are greyed out. This is because it doesn't yet have any input flows to activate it. It is effectively commented out code until at least one input flow is passed to it.
- A component with a red background means it's configuration is incomplete or invalid. Hover your mouse over the component to obtain the reason.
- Connect components together in a left to right manner by dragging flow lines from components to dependent components.
- There are two types of flow line, which together control the sequence of component execution. A *control flow* line is drawn finely dashed and used for conditional activation of one or more dependent components. On the other hand, a *data flow* line is used to map the output fields of one component to the input fields of a dependent component and is usually drawn as a continuous line [Note: a data flow line with no mapped fields is slightly dashed because it is only providing dependency control].
- A control flow line can originate from the following icons, and at runtime is considered *activated* if the associated event occurred:

   Conditional test or And/Or evaluates to 'true'.

   Default 'false' result when none of the conditional tests evaluate to 'true'.

   If operation error is to be handled by a dependent component and an error occurred (otherwise unhandled errors result in service error exit).

  Control flow lines do not require configuration, so double-clicking them is of no use.
- A data flow line on the other hand can only originate from the output of a preceding operation component, from icon  At runtime, the data flow is activated if the preceding operation was activated and completed without error. The field mappings in the data flow can be edited by double-clicking on the data flow line. [Note: a data flow line might originate from a component that does not have an output container and is therefore only providing dependency control].
- So, the rules for a component to be activated are as follows:

  a) It has at least 1 input control or data flow.

b) By default, ALL input flows must have been activated. But this can be changed to '1 or more' by right-clicking the component and selecting 'Set Activation by Flows: 1 or more' and the icon will change to  or  .

- The And/Or component is the only exception, where only condition a) applies.
- A component that successfully executes will activate its output flow(s)  . However a component that fails will active its error flow(s)  .
- Hence, sections of programming can effectively be commented out by removing all of it's input flows. However, if the result of this is that required fields in uncommented out components are no longer being set then you may have to make other changes to accommodate the commented out code. Commented out flows lines are ignored by the component activation mechanism.
- A component that incurs an unhandled error (ie. its  not connected to a handler component) will cause service termination with an out-of-band message specifying the error. The format depends on the requested result type (XML, JSON or SOAP fault). To handle component errors (and not have the service terminated prematurely) simply connect one or more control lines from the component's error icon  to activate component(s) that will handle the error.
- A component that is activated but has any missing 'required' inputs will not actually be executed, so it's output will not be set (makes allowance for missing optional elements and is equivalent to a mapping functions not called if one of its 'required' inputs is not set).

Comment 

Can be added anywhere on the canvas for additional documentation.

Conditional Flow Control 

Used to control execution flow as with If/Then/Else/Switch. Input fields contents can be tested to control execution flow. Multiple test conditions can be configured, which will be evaluated in sequence. Each has a 'true' control output and there is a default 'false' control output from the bottom. The first condition that evaluates to 'true' (activated) completes the evaluations, otherwise 'false' is activated.

And/Or Flow Control 

Used to combine activations. Takes data and/or control flows as inputs and outputs a 'true' activation depending on the activation state of it's inputs and the selected logic.

Flow Data 

Copies it's inputs to it's outputs, so a that data flow can be activated by a control flow, or when an extra data merge step is required.

Invoke Service 

Invoke another Slurp service. Once on the canvas, double-click to switch to the service.

Rerun Service

Reruns the current service with new inputs. Allows for repetition (see program iteration constructs).

Service Error

Exit the current service with a formatted error message and optional HTTP status code (defaults to 500 if not set). If this service is called in a hierarchy of Slurp services which do not handle errors then the error is propagated to the ultimate caller of the initial Slurp service. As with any other unhandled service error, this will result in an out-of-band XML, JSON or SOAP fault message to the service caller. A Slurp service can choose to handle any error (including error by this mechanism) that might be generated in a call to another Slurp service.

Operations Pallet

- As for the Programming Pallet: drag an operation and drop it at the desired location on the canvas.
- Connect operations together in a left to right manner by dragging flow lines from operations to dependent operations.
- Double-click data flow lines to specify the mapping of output fields to input fields.
- Double-click an operation to (re)configure it or right-click it for other options. In most cases, (re)configuration just sets the default value of one or more input fields, which if necessary could be overridden by suitable field mappings or setting a constant value.
- The operation panel can be written into, to describe its intended purpose.
- An operation with a red background means it's configuration isn't complete yet. Hover your mouse over the component to obtain the reason.

Text Parser/Generator

Parse or generate formatted text. There are 3 variants of this operation to choose from:

- Generate text from fields: Map input fields to the operation then double-click to configure, ie. format the desired output text. If you have a need for printf-style formatting then use function 'TxtPrintf' (functions can be called from within a data flow (right-click 'Add Function') or on canvas via Call Function).
- Generate text from list: Map a single input list (either simple list or container list) and other input fields to the operation then double-click to configure, ie. format output text for the list.
- Parse text: Map a single input text field to the operation then double-click to configure, ie. specify how output text fields are scraped from the input text. You can parse by specifying a template or a regular expression.

CSV Parser/Generator

Parse or generate CSV (comma separated values) text. There are 2 variants of this operation to choose from:

- Generate CSV: Map a container list to the operation to generate the equivalent CSV output for the list.
- Parse CSV: Map a CSV text to the operation and set the output container list fields as expected.

To generate no column titles use an empty list for input 'Headings'. To optionally choose a specific CSV format set the 'Flavour' input to one listed in CSVFormat.Predefined. A null text field will be formatted as for an empty one. If you want to preserve the significance of null text then you can use Fn:ToNullValue and Fn:FromNullValue to replace null with a representation of null (can also be used for XLS if you want to avoid having blank cells).

List Operations

These are list operations which require a measure of configuration. As opposed to the generic list operations, such as Append Item, which are available via function calls (functions can be called from within a data flow (right-click 'Add Function') or on canvas via Call Function). There are 8 variants of this operation to choose from:

- Sort: map an input list (either simple list or container list) to the operation then double-click to set the sort key(s).
- Filter: configuration as for Sort except other input fields can also be used to set the filter condition(s).
- Convert container list to simple list: map an input container list then double-click to select the simple list(s) required.
- Convert simple list to container list: reverse of the previous variant. Doesn't require any configuration.
- Group by fields: map an input container list then double-click to select the fields to group by.
- Ungroup fields: reverse of the previous variant. Double-click to select the container list that would be common to each group.
- Dedupe: de-duplicate list by selected fields, or return the duplicates.
- Enlist/delist fields. Enlist takes multiple input fields of the same type and puts them into a list of name/value pairs. Delist does the opposite, and can be simply achieved by copy/pasting the enlist operation and reconfiguring it by double-click.
- Compile/decompile basic list. Compile takes multiple input fields of the same type and puts them into a basic list. Decompile does the opposite, and can be simply achieved by copy/pasting the Compile operation and reconfiguring it by double-click.

File Operations 

Read/write binary or text files. Select file path to file and operation type (text/binary, read/write/append). Operation on directories are available via Call Function  .

Database Operations 

Execute an SQL statement or call a stored procedure. The JDBC driver (Java Database Connectivity) must be known to Slurp (add JAR file(s) using menu Maintain>Plugins). Query substitution parameters can be inserted from fields mapped to the 'Parameters' input container. They will be replaced with '?' positional parameters for efficiency and so the format of the query must allow for this, eg. *concat('%',$f{SearchTerm},'%')* might be valid but *'%$f{SearchTerm}%'* is not because it would evaluate to *'%?%'* which is not a valid use of a positional parameter in JDBC. You can also manually specifying any '?' positional parameters in the query but these must represent the first items in the 'Parameters' input. For a non-select query, eg. insert/update/delete, 'Parameters' is a list so that eg. multiple rows can be processed per operation (preferably within a single transaction for efficiency). For select queries and stored procedure calls, the operation can optionally self-determine input/output fields and result set(s), or you can set them yourself.

By Default, database modification operations are auto-committed. To enable database transactions, modify the 'DB Transactions' setting in the service properties. Then, for subsequent database operations, the same transaction will be used to update the database, even if the operation is invoked by a called Slurp service (assuming it uses the same transaction isolation level). Then to commit or rollback all outstanding transactions, a service can invoke the corresponding operation in Miscellaneous Operations. Note1: some databases do not support all transaction isolation levels and some also do not give a warning that a selected isolation level is not supported. Note2: 'select fetch size' and 'commit batch size' can be overridden by using 'Override Component Property' of Miscellaneous Operations.

JSON Parser/Generator 

Parse or generate JSON text. There are 2 variants of this operation to choose from:

- Generate JSON: Map arbitrary input containers/fields to JSON text.
- Parse JSON: Map a single input text field to the operation and set the output containers/fields as expected for the JSON text.

XML Parser/Generator 

Parse or generate XML text. There are 2 variants of this operation to choose from:

- Generate XML: Generate XML text from input containers/fields.
- Parse XML: Parse XML text into output containers/fields.

The following methods can be used to specify the containers/fields (form of the XML):

a) You can manually specify the form of the XML by setting the container/fields.

b) Or, you can provide a sample of XML to automatically set the form of the XML.

c) Or, specify an XSD (local file path or a URL starting with 'http') to automatically set the form of the XML. Note, that this requires a Java compiler to analyse the XSD (see this answer). Normally, Slurp should be able to determine the compiler if you are using a Java JDK, but if not then consult that answer. A description of how Slurp maps XML to and from its fields/containers can be found in this answer. Only this method of setting the form of the XML will properly apply XML namespaces.

Originally, Slurp used the DOM (Document Object Model) approach to parsing and generating XML. But by default this has now been replaced by StAX (Streaming API for XML) for efficiency and to support Slurp's XML Streaming. If necessary, you can switch back to using DOM parsing/generating by setting the property 'xmlImpl' to 'dom' in *slurp.properties*.

Call Restful Service 

Call a Restful web service, using either an Open API specification for a service (in YAML or JSON) or by specifying the URL and manually formatting the request.

Call Webservice 

Call a web service. Limited to web services that are document literal. First, specify the WSDL for the service, which can be a local file path or a URL starting with 'http'. Then select the web service operation to be called. The input and output fields will be set automatically. A Java compiler is needed to analyse a WSDL (see this answer). Normally, Slurp should be able to determine the compiler if you have a Java JDK installation, but if not then consult that answer. If you want to use a custom SOAP header it should be wrapped in elements `<soap:Header xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"></soap:Header>`.

Access Data Store 

Perform an operation a data store (datastores can be defined via menu Maintain>Datastores). Select a datastore and the operation to be performed upon it. The input and output fields will be set automatically. A data store can be defined to be persisted, to have it's contents saved to file in a directory specified by a Slurp property (menu>Preferences). For a persisted data store:

- Locking it includes a lock on the store file itself. This can be used to synchronize activities between services or across multiple Slurp server instances.
- If you change the definition of the data store then you should remove or edit the store file to match your changes.

Call Function 

Call one of a number of predefined functions or translators. A function library. These functions are also available in a data flow (double-click a data flow then right-click to 'Add Function'). They include generic list functions and lots more.

Miscellaneous

Other operations that do not fall into the main operation categories, including:

- Sleep. Suspend execution for the specified number of milliseconds, using the output to (potentially) activate another component when done.
- Send Mail. Send email to one or more recipients.
- Log Message. Log a formatted message to the logging system.
- Run Program. Run an ad-hoc program and potentially collect the results.
- DB Commit. Commits all outstanding database transactions, where connections were opened by a service (or one of its parent services) having transaction isolation level ('DB Transactions') set to anything but 'Auto Commit' when the connection was first used. This operation does not have to be called for a service with 'DB Transactions' set to 'Auto Commit' as each data base operation is committed automatically.
- DB Rollback. As for 'DB Commit' but performs a transaction rollback for all outstanding database transactions.
- Parse Properties. From properties text to a list of name/value pairs.
- Format Properties. From a list of name/value pairs to properties text.
- Calculate. Evaluate an arithmetic expression using field values, literal numbers or constants.
- Override Component Property. Override a property in the next component of the data flow. The properties that can be overridden are:
    - Connection Timeout (milliseconds). Applicable to web service and Restful/HTTP calls (0 = no timeout).
    - Select Fetch Size. Applicable to obtaining result sets from a select list query or call to stored procedure (default = 5000).
    - Commit Batch Size. Applicable non-auto-commit database operations involving a list of parameters (default = 5000, 0 = don't perform automatic commits).

Invoke Java Plugin

Call a defined plugin operation. To build and add a plugin to the Service Designer, follow the steps described in Writing and Using a Plugin. Once the plugin has been dropped on the canvas, it is treated like any other operation: configuration and execution are the same.

Data Streaming

Slurp is primarily an ETL platform (Extract, Transform and Load), which necessitates holding data flow data in memory between component invocations. This is so that field mappings/manipulations can be performed efficiently. But this becomes an issue in some scenarios where the volume of data is too large for the available memory, such as:

- A Restful client wants to call a service with vast amounts of data.
- A Restful client wants to call a service to retrieve vast amounts of data.
- A Slurp service wants to move vast amounts of data between database tables.

Fortunately, Slurp is unique in having a streaming mechanism to enable these operations without affecting memory footprint. The way it works is:

- The main input or output field on particular components either has a field that is marked as streamable (with an ‘s’ in the icon) or can have a field set to be streamable by right-click.
- The field can be either text, binary or a container list.
- If a streamable output field is connected to a streamable input field and it is not making use of ETL functionality (merging, splitting or mapping functions) then data will be streamed between the components. This is indicated by fatter data flow lines.
- There is no particular limit to the number of components that can be connected to each other this way, and all such components will be run together so that streaming of data can occur from the first to the last.
- This table lists the components that can take part in streaming:

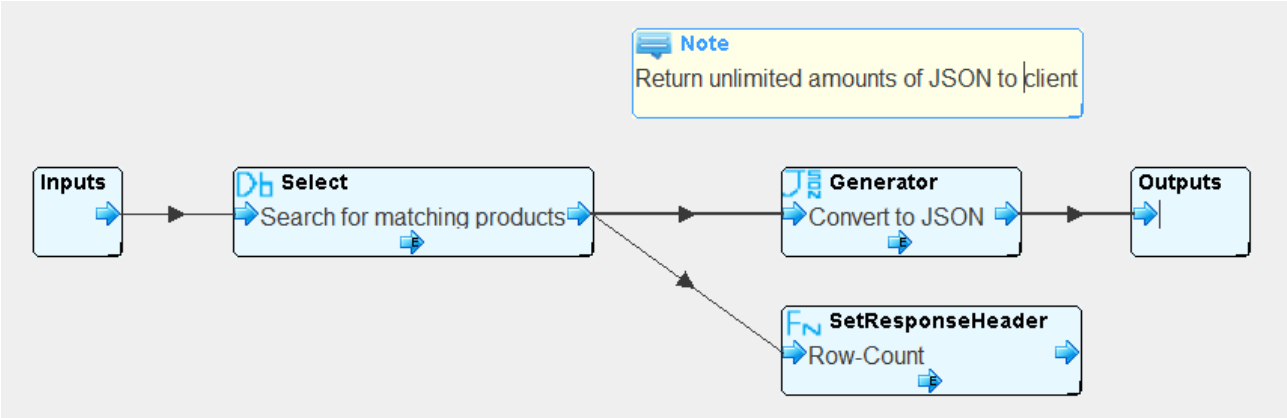
Component	**Data Type**	**What Can Be Streamed**
Service Inputs	Text or binary	Specify a single text or binary field
Service Outputs	Text or binary	Specify a single text or binary field
CSV Gen Input	Container list	Input ‘Inputs’
CSV Gen Output	Text	Generated CSV
File Write Input	Text or binary	Contents to be written to file
File Read Output	Text or binary	Contents of file read
DB Select List Query	Container List	Output result set
DB Non-Select Statement	Container List	Input ‘Parameters’
JSON or XML Gen Input	Container list	Specify a single container list field
JSON or XML Gen Output	Text	Generated JSON or XML
Restful Request/Response	Text or binary	Request and response bodies

[Note: ‘Specify’ is done by right-clicking on a field and selecting ‘Set Streaming ON’]

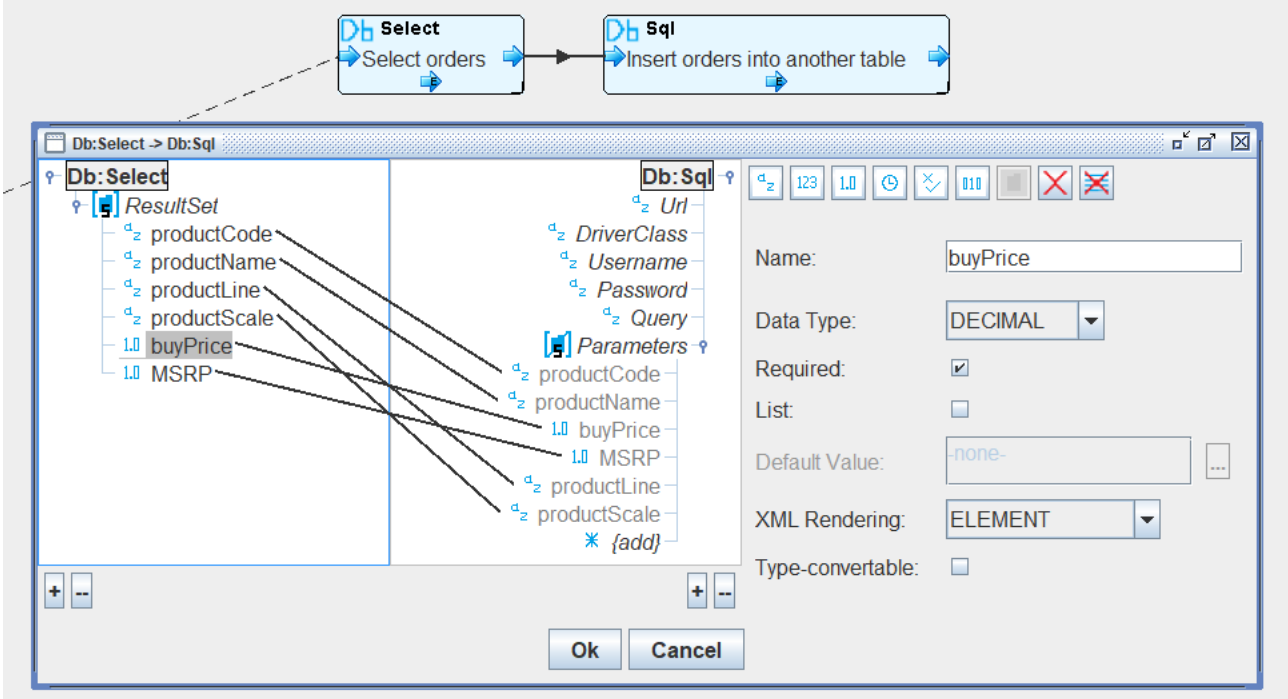
These are some of the data streaming scenarios that can be supported by connecting these components together:

- Restful client can call a service with a huge request body for insertion into a file or database.
- Restful client can call a service and receive huge amounts of CSV, JSON or XML from a file or database query.
- A service can copy huge amounts of data between database tables.

Example 1: Streaming Unlimited JSON Results to Restful Client



Example 2: Copying Unlimited Data Between Database Tables



More examples of these streaming scenarios can be found in the examples services that can be downloaded from https://www.slurpdata.com/downloads.

Running Slurp as a Stand-alone Data Service

Windows (Service)

- Download the version of prunsrv.exe for your platform from Apache Commons Daemon.
- Place prunsrv.exe with slurp.exe (and slurp.xml, slurp.properties), in their own directory.
- Determine the full path to the JVM DLL to be used to run Slurp. The DLL is normally contained in the bin\server directory of the JRE installation.
- From a command prompt in the same directory as prunsrv.exe execute the following command (having substituted the texts in {}'s with your values and making sure the double-quote characters are the correct characters):

  *prunsrv install {service name} --StartClass=com.slurp.Slurp --StopClass=com.slurp.Slurp --Classpath=slurp.exe --StopMethod=stop --StartMethod=start --Jvm="{*full path to jvm.dll*}" --StartMode=jvm –StopMode=jvm --StdOutput=stdout.log --StdError=stderr.log*

- In the Windows Services list, right-click on the new Slurp service and select Properties. Set LogOn as Local System Account and, if required, set StartUp Type to Automatic.
- Start and stop the service as normal.
- The service can be removed as follows. From a command prompt in the same directory execute the command:

  prunsrv delete {service name}

- To set particular JVM properties for the service add the option to the *prunsrv install* command when installing the service. Eg. to set maximum heap size to 1024Mb append " *--JvmMx=1024"* (lookup description of prunsrv).
- While the service is running it will be working from an in-memory version of slurp.xml and slurp.properties. During this time you can still run Slurp's GUI to make changes to your Slurp services, but the new configuration will not be used until you restart the Slurp service.

Windows (Command Line)

- Run a Slurp server from a command shell with the command *java -jar slurp.exe start.* The command remains in the foreground so can be terminated with control-c, or when the user session is logged out [Note: DO NOT use the command *slurp start* as this will confuse the executable wrapper].
- To set particular JVM properties, eg. to set maximum heap size to 1024Mb start server with *java -Xmx1024m -jar slurp.exe start.*

Unix (Daemon)

- Slurp.exe is also in JAR (Java Archive) format so the Unix daemon can be run with:

  nohup java -jar slurp.exe start&
- Slurp still expects to find slurp.xml and slurp.properties in the same directory as itself.
- To stop the daemon gracefully:

  java -jar slurp.exe stop
- To set particular JVM properties, eg. to set maximum heap size to 1024Mb start server with *nohup java -Xmx1024m -jar slurp.exe start&.*
- While the service is running it will be working from an in-memory version of slurp.xml and slurp.properties. During this time you can still run Slurp's GUI to make changes to your Slurp services, but the new configuration will not be used until you restart the Slurp daemon.

Unix (Command Line)

- You can run a Slurp server in the foreground from a command shell with command line: *java -jar slurp.exe start*. To terminate the server use command line: *java -jar slurp.exe stop*, or control-c.
- To set particular JVM properties, eg. to set maximum heap size to 1024Mb start server with *java -Xmx1024m -jar slurp.exe start.*

Writing and Using a Plugin

1) The plugin class must implement the com.slurp.PluginAPI interface. The 4 methods to implement are:
   a) getName(). Should return a non-null string, preferably formatted as *<plugin package name>:<plugin operation name>*, eg. *sftp:put*
   b) getDescription(). A brief description of the operation. Full documentation should be provided elsewhere.
   c) configure(). Called to configure the input/output fields when the component is dropped onto the canvas.
   d) execute(). Called when the component is executed.
2) The plugin can make use of the com.slurp.schema.interFace classes to define fields for configure() and the com.slurp.runtime.service.data classes to obtain and set data for execute().
3) An exception thrown during execute() will invoke the standard error handling for a component. Ie. if the error output of the component is used then the error can be handled by another component. Otherwise, the service will be prematurely terminated with a corresponding out-of-band error return.
4) References to Slurp classes will be satisfied by putting slurp.exe itself on the build path (it is also in JAR format).

5) Package one or more plugins into a JAR file.
6) Configure the plugins into the Service Designer by using menu Maintain>Plugins. First, specify the JAR files containing the plugins, then add the plugins themselves using the Add... button.
7) To use the plugin, drag the Invoke Java Plugin operation  onto the canvas and select the plugin. Then treat it as any other operation with regard to connecting to its inputs/outputs and conditions for activation.

Example Plugin

```
package my.plugins.maths;

import com.slurp.PluginAPI;
import com.slurp.runtime.service.data.RunData;
import com.slurp.runtime.service.data.RunInteger;
import com.slurp.schema.interFace.SlpDataField;
import com.slurp.schema.interFace.SlpFieldContainer;
import com.slurp.schemagen.interFace.FieldType;

public class Add implements PluginAPI {
   private static final String ARG1 = "Arg1";
   private static final String ARG2 = "Arg2";
   private static final String RESULT = "Result";

   @Override
   public String getName() { return "Maths:Add"; }

   @Override
   public String getDescription() { return "My add plugin"; }

   @Override
   public void configureIO(SlpFieldContainer input, SlpFieldContainer output) {
      input.getFields().add(SlpDataField.newInstanceRO(ARG1, FieldType.INTEGER, true, false));
      input.getFields().add(SlpDataField.newInstanceRO(ARG2, FieldType.INTEGER, true, false));
      output.getFields().add(SlpDataField.newInstanceRO(RESULT, FieldType.INTEGER, true, false));
   }

   @Override
   public void execute(RunData input, RunData output) throws Exception {
      RunInteger int1 = (RunInteger)input.getElement(ARG1);
      RunInteger int2 = (RunInteger)input.getElement(ARG2);
      long sum = int1.getValue()+int2.getValue();
      output.setElement(RESULT, new RunInteger(sum));
   }
}
```

Server Clustering

- Multiple instance of Slurp can be run at the same time, either as Unix daemons or Windows services. For each instance, follow the previous instructions for running Slurp as a stand-alone data service for your platform.
- For each instance, the install directory can have symbolic links to a single version of slurp.exe and slurp.xml, but each install requires it’s own copy of slurp.properties, to

contain it’s own values for ‘localServerHttpPort’ and/or ‘localServerHttpsPort’. You may also want to adjust other properties for each instance.

- Sharing of data between instances can be achieved by sharing persistent datastores. Synchronization of activities between instances can be achieved by using the Lock/Unlock operations on a shared persistent datastore.

Frequently Asked Questions

- **Running slurp.exe on Windows does not find Java JRE, why not?**

  There are 2 possible reasons for this. Either a Java JRE has not been installed at all, or it has NOT been installed as a stand-alone product (as part of another installation). The first issue requires you to download and install a Java JRE (version 1.8+). The second issue is because Windows Registry keys have not been set up because the Java installation program was not used. To compensate for this issue you either have to set your JAVA_HOME environment to the directory of your Java JRE or add the path to the java.exe to your PATH environment variable.

- **How to run Slurp Designer when I only have Putty access to my server?**

  a) Firstly, download an X Server for your desktop. For Windows you can download Xming from https://sourceforge.net/projects/xming. It will only show a window once you run Slurp from a Putty session.

  b) Secondly, set X11 forwarding in Putty. In Putty settings tab Connection/SSH/X11, check 'Enable X11 forwarding' and set 'X Display location' to 'localhost:0'. Then open a Putty session to your server. The Putty session should have the DISPLAY environment variable set.

  Run Slurp with 'java -jar slurp.exe' and the forwarded GUI output will be displayed by an Xming window.

- **There are some input/output fields that I can't modify/delete, why?**

  These are fields (in italic font) that the component has configured for itself and that it depends on. Normally, such fields and their default values are set when the component is (re)configured. For an input field that is read-only, you can nonetheless change its default value.

- **How are date/time values treated?**

  The date/time type represents a local date/time as would be represented by a calendar date combined with a time, and normally input/displayed as 'yyyy-MM-ddThh:mm:ss'. On input, only the date part is required, which will assume a time of '00:00:00'. The precision of a date/time is actually to the nearest nanosecond, so if a date/time requires fractions of a second then it can be input/displayed with a dot and up to 9 digits after the seconds part. There are Fn functions to convert the date/time type between time zones. These use zone ids instead of plain time zones so that daylight savings time can be taken into account (java.time package).

- **How to format/parse dates/times?**

  The pattern codes for formatting or parsing dates/times are described at DateTimeFormatter. Example: to format a date/time value as 'day/month/year' use the format string 'dd/MM/yyyy'.

- **How do I control program flow?**

  This is achieved by using control flows:

  a) Control flows can only emanate from Conditional Flow Control outputs  and the error output  of operations (the And/Or Flow Control can be used to amalgamate them if necessary). None of these control flows have to be used but they can be used to activate dependent components.

  b) By default a dependent component is only activated if ALL input control and data flows have been activated (this can be changed to 1 or more by right-clicking the component and selecting 'Set Activation by Flows: 1 or more').

- **Where are the program iteration constructs?**
  - Service flow should not be looped. It will be stuck forever or until service timeout.
  - Field mappings can be used to apply transformations to fields in a field hierarchy. These mappings apply iteratively to the fields of a container list.
  - However, if more sophisticated transformations are required then to iterate over the containers in a top-level container list, right-click a sequence of one or more operations and 'Turn Container List Iteration ON'. If the container list is not at the top-level then make it the top-level by iterating the container list(s) above it. [To iterate over a basic data list, use a List Operation to convert it to a container list, iterate the container list, then use another List Operation to convert it back to a basic data list].
  - Re-run the same service with different inputs by activating the Rerun Service component  . [Note: container list iteration works on each container separately. If you want to accumulate information during iteration then use this method]
  - Set 'Schedule Expression (cron)' in the service properties to have the service automatically re-run at specified times.

- **Input fields: what's the relationship between a field with a mapping, setting a field with a constant value and setting the default value for the field?**

  Applying a mapping to an input field is mutually exclusive with setting a constant on the input field. You cannot have both at the same time, and you can have neither. The default value of the field comes into play if neither a field mapping nor constant have been specified or if a mapping to the field has been specified but it didn't result in the field being set (because the data flow wasn't activated). Setting a field with a constant value will always override its default value if both have been specified.

- **What are the supported XML Renderings?**

  If you don't use XML anywhere then you can ignore the 'XML Rendering' field property. For XML, you have the option of ELEMENT, ATTRIBUTE, CDATA_SECTION or SIMPLE_TYPE. The first two are the most commonly used.

- ELEMENT will render its value within <element> tags.
- ATTRIBUTE will render its value as an attribute of the enclosing container.
- CDATA_SECTION will render its value within <element> tags but between “<[CDATA[“ and “]]>” delimiters.
- SIMPLE_TYPE will render its value directly in the output.

The special field name ‘SimpleContent’ (reserved field name) can be used to represent the value contained in an xsd:simpleContent (which is allowed to contain attributes and a value but no sub-elements). This field can have rendering SIMPLE_TYPE or CDATA_SECTION, and only one of these should be present in a container that can have attributes but no sub-elements.

- **Why does a Slurp generated XSD sometimes have a top-level element named ‘root’?**

  An XML document is required to have a root element, having xs:minoccurs=1 and xs:maxoccurs=1. For a Slurp input or output container to satisfy this constraint, it must have a single top-level field (container or data field with ‘XML Rendering’ set to ‘ELEMENT’) with attributes ‘Required’ and not ‘List’: If such a data or container field is the sole top-level field in the input or output container then the generated XSD will NOT have a ‘root’ element added. For all other cases a ‘root’ element will be inserted at the top-level. Whether a ‘root’ element is inserted or not, the XSD is the correct schema for the XML that can be used to populate the input container or that would be generated for an output container.

- **How are XML namespaces specified?**

  The Web Service Component will use the *targetNamespaces* specified in the WSDL that was used to configure it. The XML Parser/Generator Component will use the *targetNamespaces* (if any) specified via the XSD used to configure it: if no XSD was used to configure it, and in all other cases, the namespace applied will be *https://slurpdata.com/io*.

  If you happen to want to generate XML without namespace then configure the XML Generator with an XSD that doesn’t specify a *targetNamespace*. This can be achieved as follows: having set the input fields for the XML Generator as you desire, then right-click on the actual input fields (not the operation inputs) and select ‘Generate XSD for Field(s)’. Edit the XSD to remove *targetNamespace="https://slurpdata.com/io"* then use it to finally set the XML Generator.

- **Can I have a service-local variable?**

  This can be achieved by defining an optional service input field, where its default value is effectively the initial value of the ‘variable’. If you don’t want to expose the field then wrap the service with another service that doesn’t expose the ‘variable’ field. This caters for any type or shape of variables.

- **Why does Service Designer need a compiler to parse XSDs and WSDLs?**

  The Service Designer uses the Jakarta JAXB and JAXWS tools to parse these file types, avoiding bespoke parsing and ensuring more accurate results. But these tools only create the equivalent Java classes that then need to be compiled so that they can be introspected. It's not a runtime requirement, and is the only dependency on the JDK (Java Development Kit). The Service Designer will use the compiler in the version of Java being used to run it. However, if you are only using a JRE (Java Runtime Environment) to run the Service Designer then you will have to tell it where to find the compiler in an installation of the JDK. You can use the Java compiler provided by OpenJDK without having to pay a license fee. The JDK version used should be the same or less than that used to run the Service Designer (which itself requires Java 1.8 or greater). Then specify the path for 'Java Compiler' in menu File>Preferences. Only a JRE is required to run Slurp services, not a JDK.

- **How to headlessly generate a license request string?**

  From a command shell run: *java -jar slurp.exe license*

- **What to do if I can't or don't know how to implement some logic?**

  You don't need a license to get help from support, we're only too happy to help. In particular, if the function you need isn't currently built into Slurp when it should be then we'll build it into the next version (either natively or as a plugin), which will be available for download within hours (depending on your timezone). We envisage that larger/niche functionality will be provided as a plugin so as not to bloat the standard binary. There are currently plugins for SSH/SFTP, LDAP, SMB/CIFS and reading/writing Excel files.