SCXML 101
An Introduction to State Chart XML

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Outline

- Introduction to State Chart XML (SCXML)
- Sample use cases for SCXML
- SCXML Extensibility
  - Data model
  - Custom actions
  - External communications module
- Specification Status
- Available implementations and tools

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State Chart XML (SCXML)

- **Generic and environment agnostic markup language for state machine definition**
- **Based on**
  - UML 2.0
  - Harel state transition tables
  - Oriented towards reactive systems
- **Powerful and generic controller with broad application**
  - Dialog flow in Voice applications
  - Interaction Manager for multimodal applications
  - Controller for multi-namespace documents (CDF type of documents)
  - Backend controller for business processes

SCXML features

- States and transitions
  - Composite, Orthogonal and Final
  - Events, guards and target(s)
- Data model
  - Pluggable data representation, expression language
- Executable content
  - On entry, exit or transition
  - Extensible
- External communications module
  - Send, cancel
  - Invoke, finalize
- History

Hello World and a transition

```
<scxml xmlns="http://www.w3.org/2005/07/scxml"
       version="1.0" initial="hello">

  <state id="hello">
    <onentry>
      <log expr="Hello World" />
    </onentry>

    <transition target="done" />
  </state>

  <final id ="done" />
</scxml>
```

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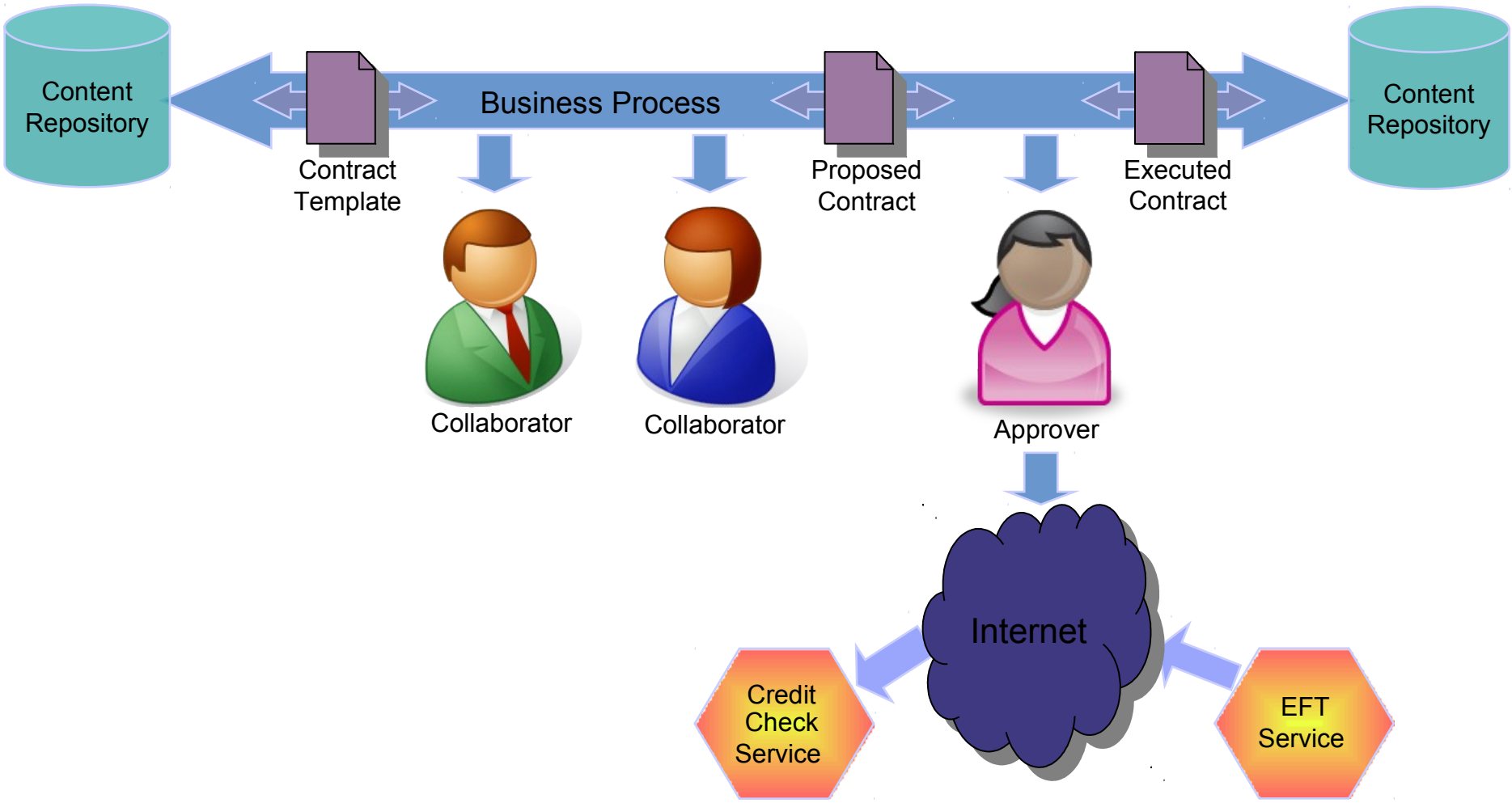
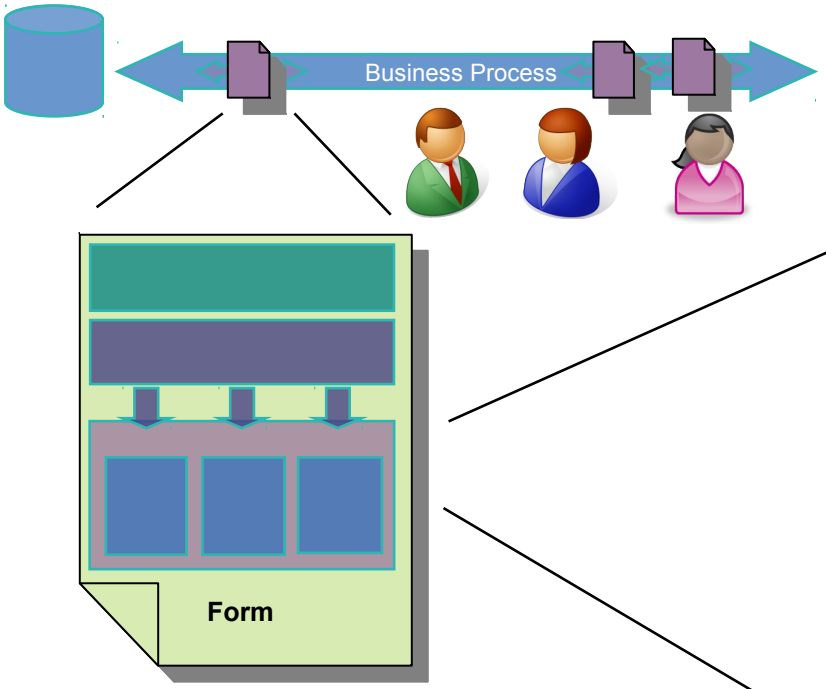
Workflow - Collaborative Business Process Systems

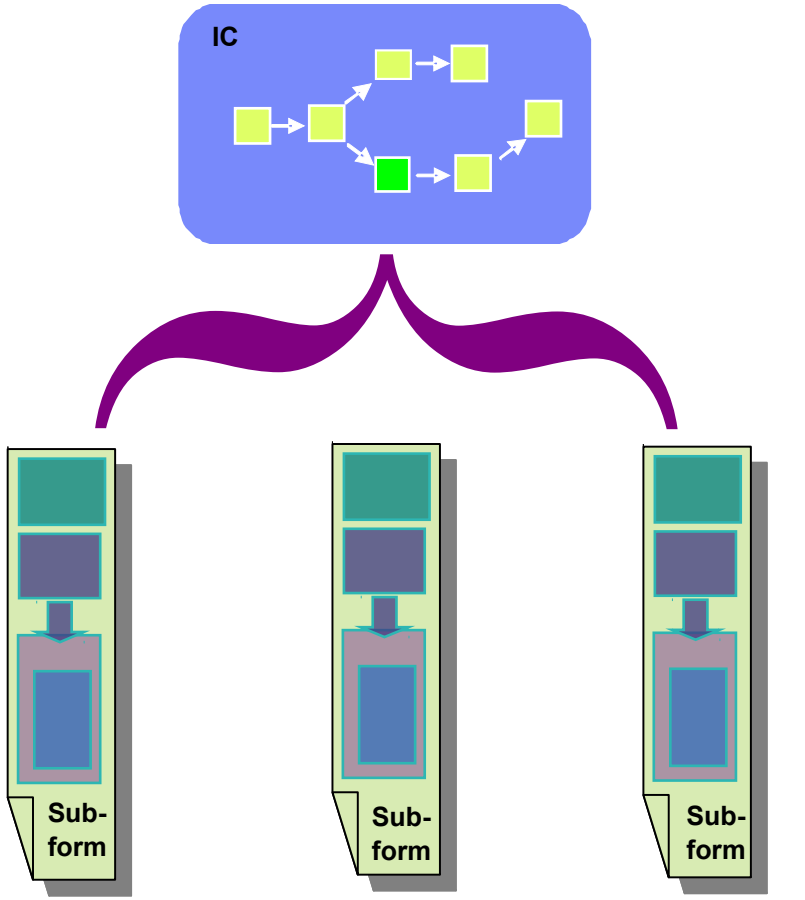


Interactive Web Documents
Interaction Controllers



Multi-page XFDL Form

Interaction Controller (example: State Chart XML)

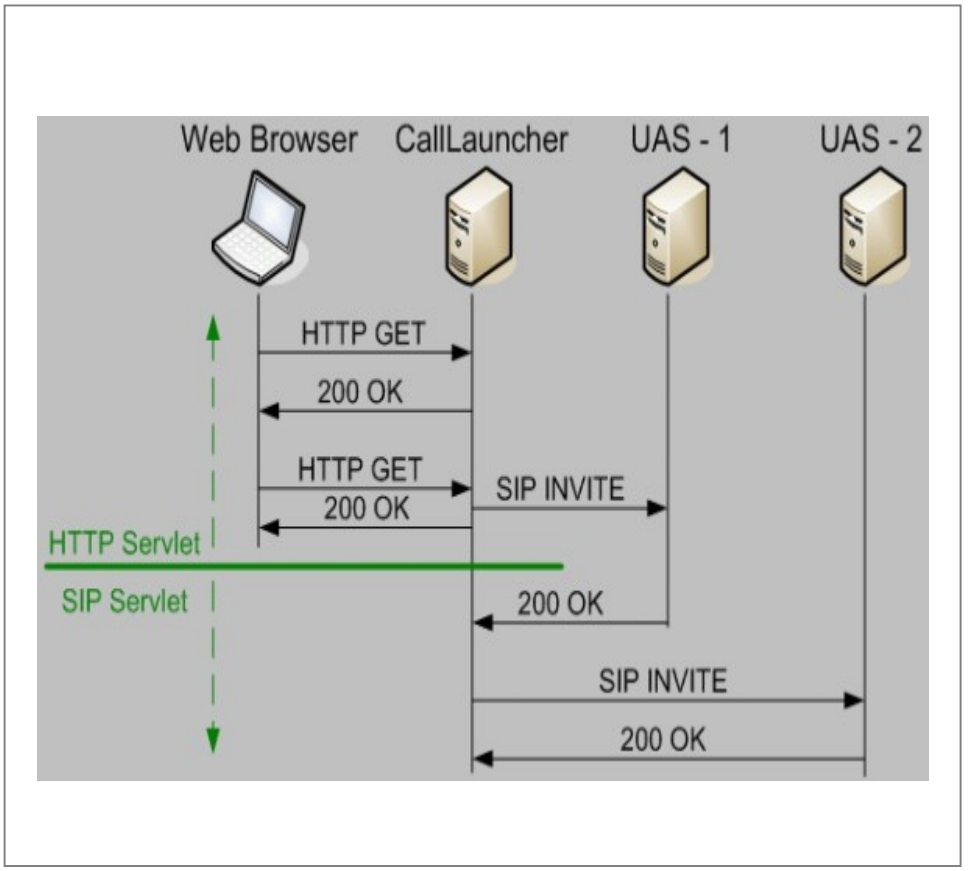


(XHTML + AJAX sub form) * N

Use Case: SCXML as SIP Controller

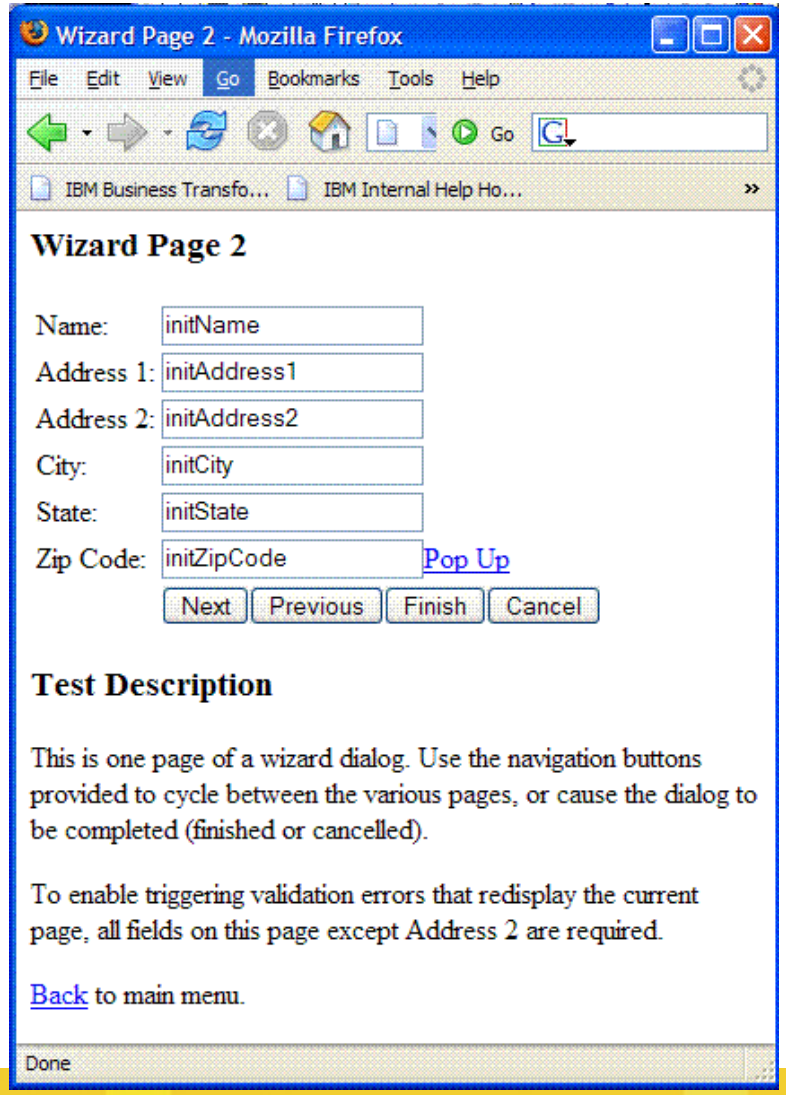
- **Problems with SIP Servlets**
  - **Complex to author – low level Java**
  - **Hard to express common patterns for event-driven, or parallel paths**
  - **Difficult to scale, reuse, compose**
- **Solution using SCXML**
  - **Inherently event-driven semantics**
  - **Direct support for parallelism, hierarchical composition**
  - **Natural replacement for Java-based SIPlet implementations**

Example Call/Invite SIP event flow



Use Case: SCXML in the J2EE Web Container as JSF Controller

- Problems with current JSF controllers
  - Ad-hoc state-machine like language
  - Difficult to scale, reuse, and compose
- Solution using SCXML
  - Shale “dialog manager” for cross-JSF page navigation in Apache
  - Apache Commons SCXML engine in Shale runtime environment
  - Invokes JSF pages or actions



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Data model extensibility – XML data, XPath

```
<datamodel>
 <data id="cities">
  <list xmlns="">
   <city id="nyc" count="0">New York</city>
   <city id="bos" count="0">Boston</city>
  </list>
 </data>
</datamodel>

<assign
 location="$cities/list/city[@id='nyc']/@count"
 expr="1"/>
```

Data model extensibility – JSON data, ECMAScript

```
<datamodel>
 <data id="cities">
  { "list" : [
    {id : "nyc", count : 0, city : "New York"},
    {id : "bos", count : 0, city : "Boston"}
  ] }
 </data>
</datamodel>

<assign
 location="cities.list[1].count"
 expr="1"/>
```

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Custom actions

- <onentry>, <onexit>, <transition>
  - open content model
  - Implementation or application specific namespaced actions

```
<scxml:onentry>
  <my:email   to="$employee/email"
              cc="$approver/email"
         subject="$message/title"
         content="$message/content"/>
</scxml:onentry>
```

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External communications module - send

- Send target types

```
<scxml:send type="scxml" target="..." />

<scxml:send type="x-foo" target="..." />
```

- I/O processors
  - SCXML
  - HTTP
  - DOM

VoiceXML 3.0 Transition Controllers, e.g. SCXML

```
<v3:form>
  <scxml:scxml initial="...">
    <!--
      Controller
    -->
  </scxml:scxml>
<v3:form>
```

DOM events as glue:

- Initiate execution of a VoiceXML field

```
<scxml:send target="#vfield" type="DOM" event="DOMActivate"/>
```

- Notification on filling fields / slots

```
<scxml:transition event="filled.vfield" cond="vfield == 'foo'"
                  target="statefoo" />
```

External communications module - invoke

- Invoke source types

```
<invoke src="dialog.vxml#welcome" type="vxml3">
 <param name="skinpath" expr="res.paths.skin"/>
 <finalize>
  <script>finalizeAskHit();</script>
 </finalize>
</invoke>
```

- Data transformations
  - param (outbound)
  - finalize (inbound)

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State Chart XML (SCXML)

W3C Working Draft

State Chart XML (SCXML): State Machine Notation for Control Abstraction

W3C Working Draft *13 May 2010*

This version:
http://www.w3.org/TR/2010/WD-scxml-20100513/
Latest version:
http://www.w3.org/TR/scxml/
Previous version:
http://www.w3.org/TR/2009/WD-scxml-20091029/
Editors:
Jim Barnett, Genesys (Editor-in-Chief)
Rahul Akolkar, IBM
RJ Auburn, Voxeo
Michael Bodell, Microsoft
Daniel C. Burnett, Voxeo
Jerry Carter, (until 2008, when at Nuance)
Scott McGlashan, HP
Torbjörn Lager, Invited Expert

W3C Specification Status

- Currently Seventh Working Draft
- Last Call Working Draft expected soon
- Assertions and test suite being produced
- Multiple implementations exist

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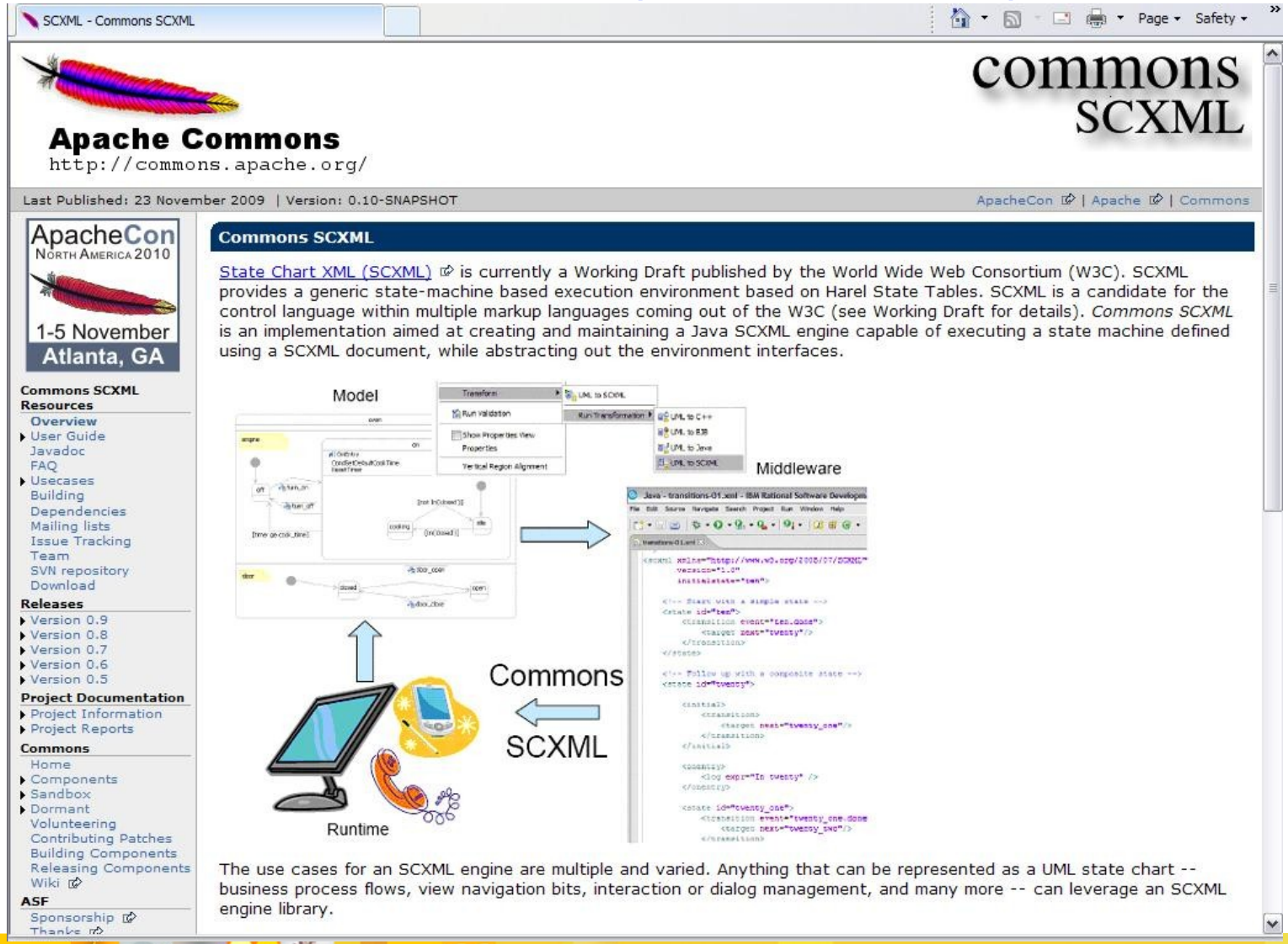
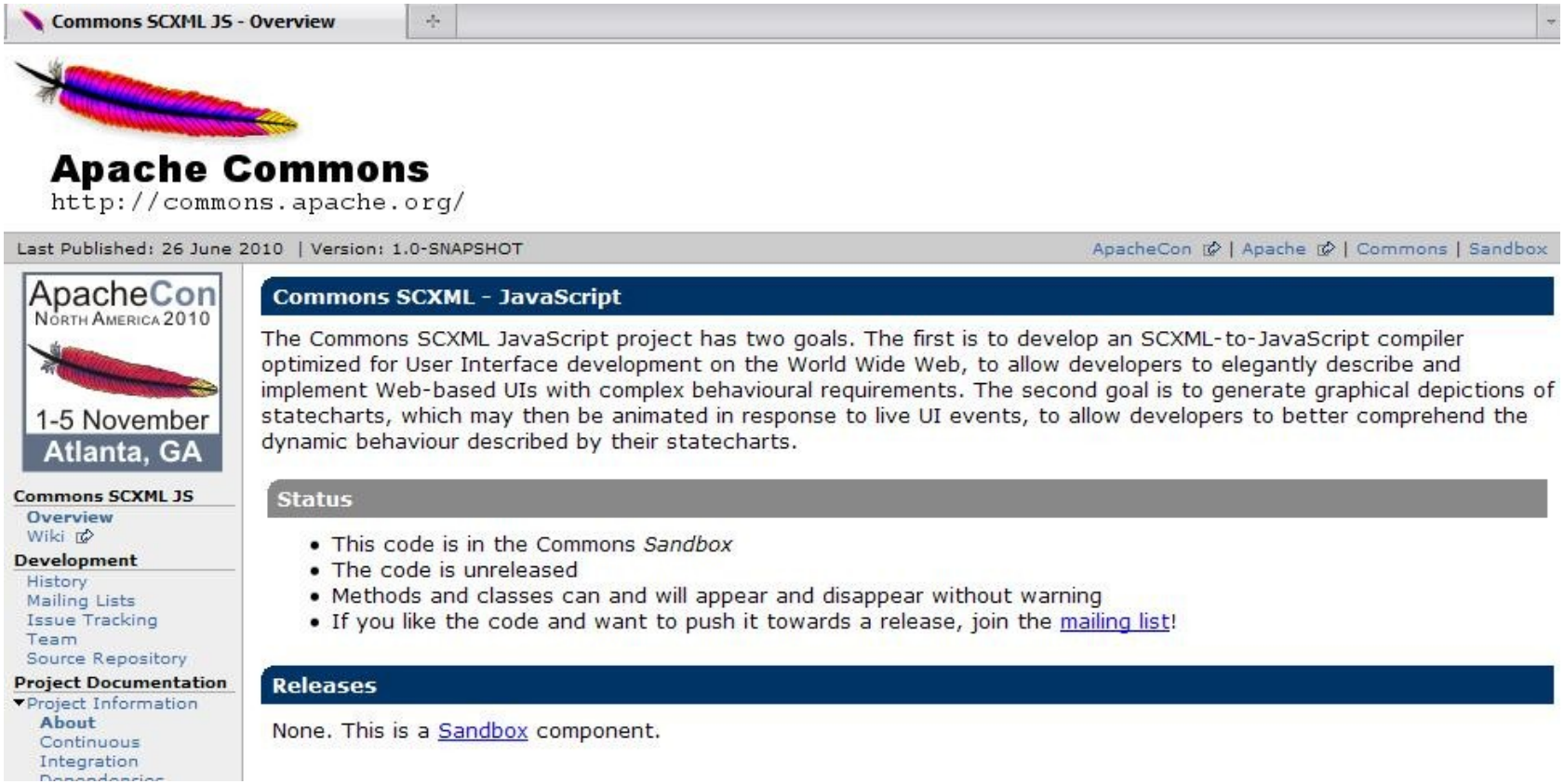
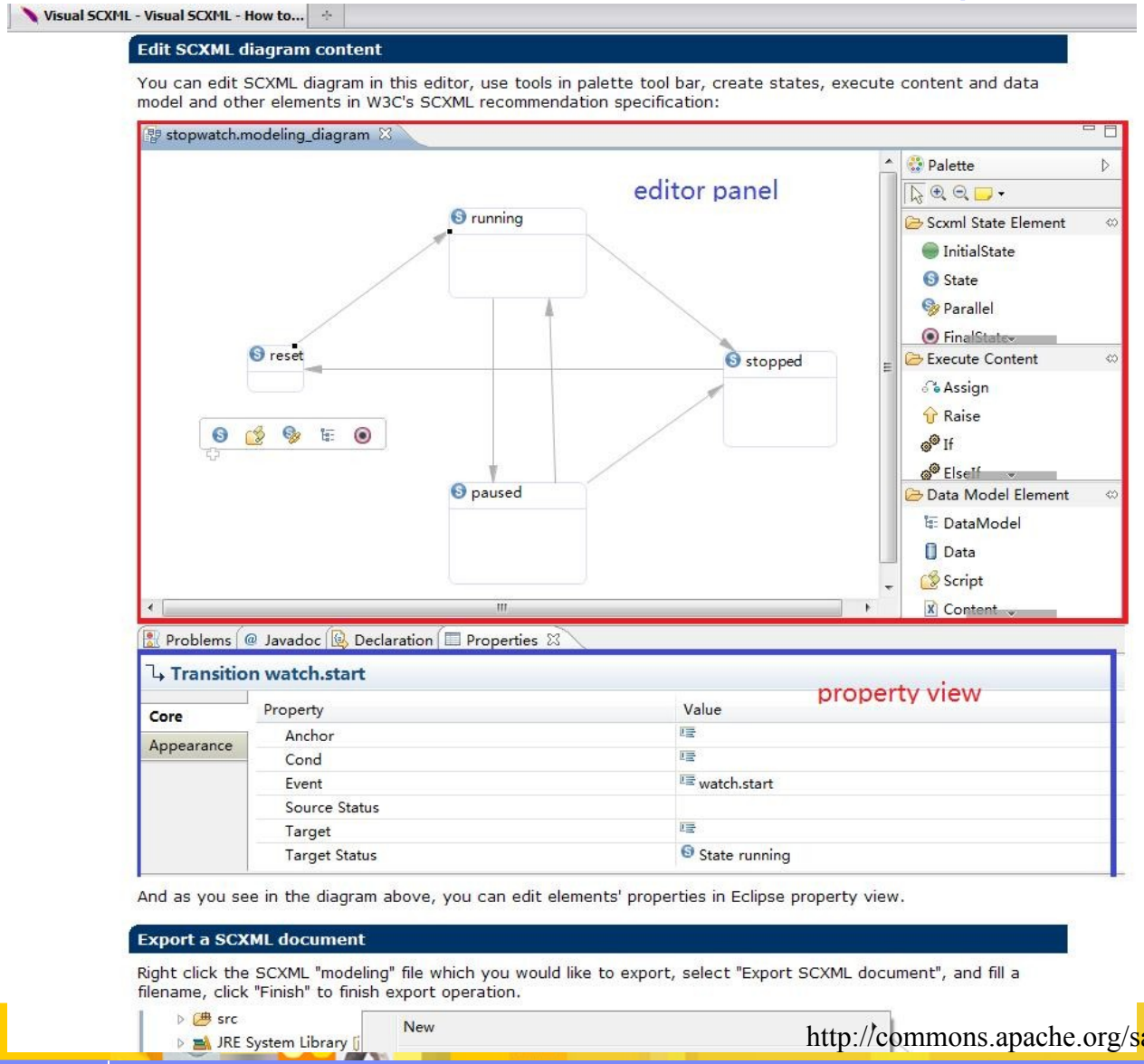
Apache Commons SCXML (Java runtime)



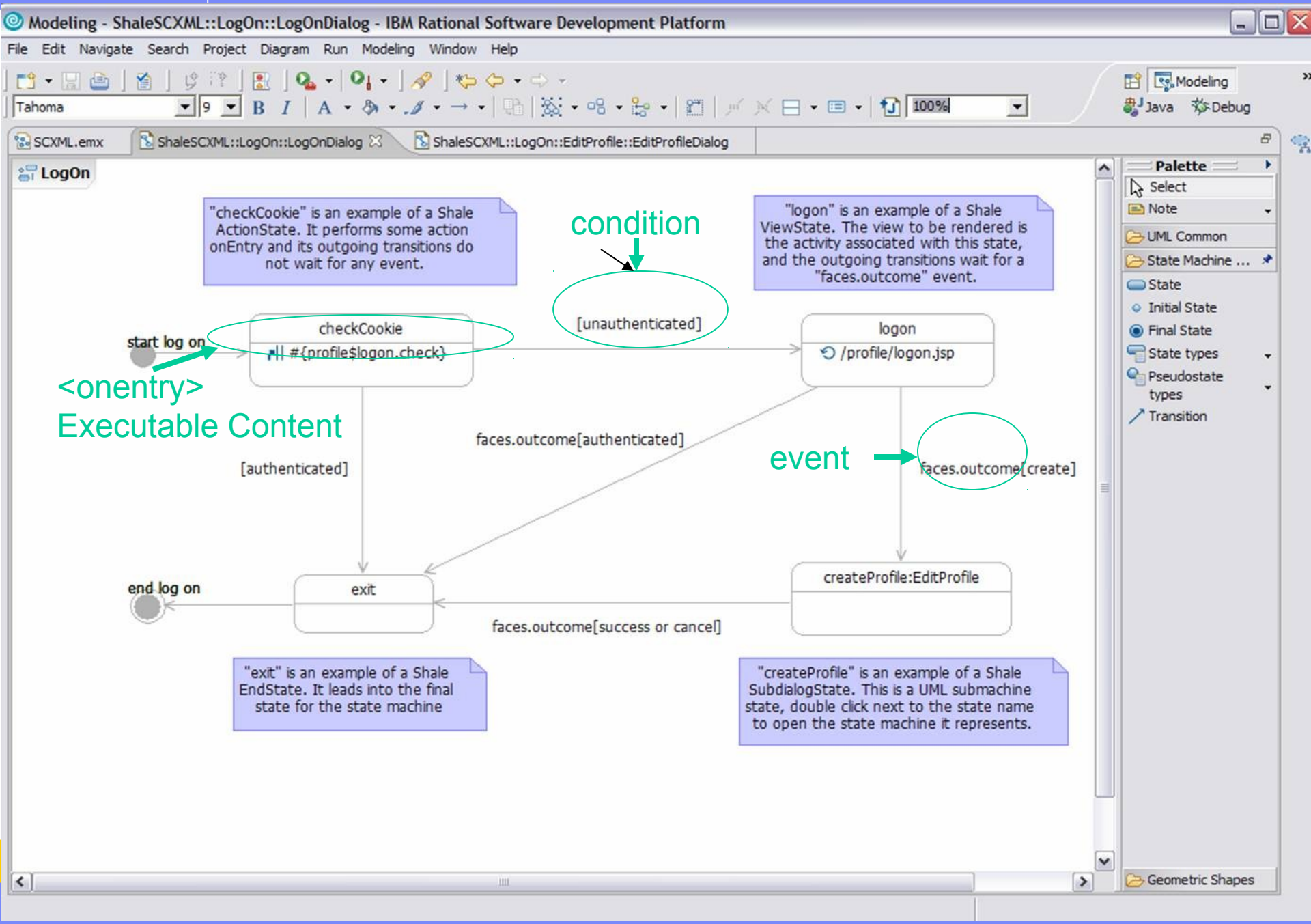
Apache Commons SCXML-JS (JavaScript compiler)



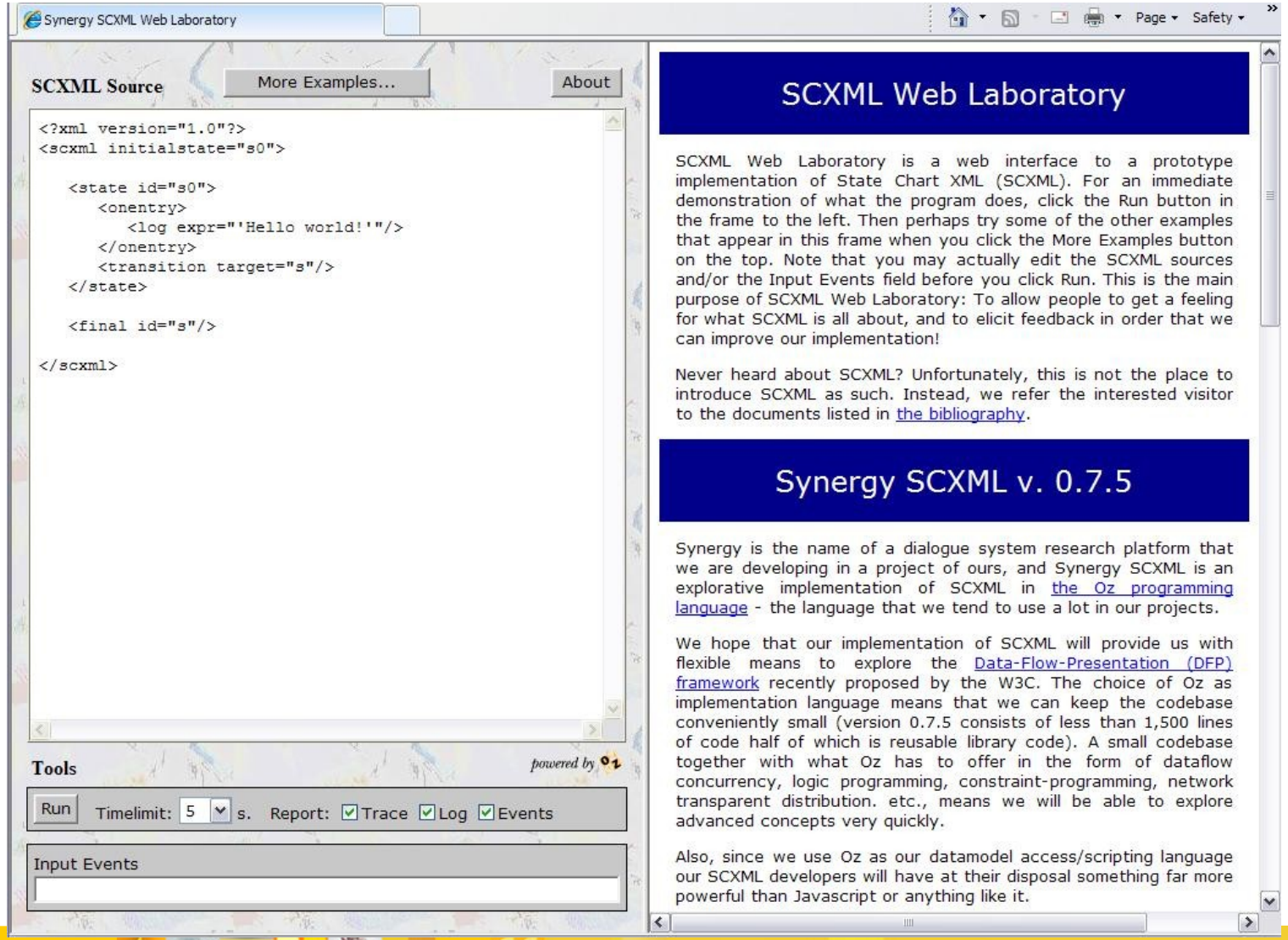
Apache Commons SCXML-Eclipse (Visual Editor)



http://commons.apache.org/sandbox/gsoc/2010/scxml-eclipse/


Modeling - ShaleSCXML::LogOn::LogOnDialog - IBM Rational Software Development Platform
File Edit Navigate Search Project Diagram Run Modeling Window Help
SCXML.emx
ShaleSCXML::LogOn::LogOnDialog
ShaleSCXML::LogOn::EditProfile::EditProfileDialog
LogOn
"checkCookie" is an example of a Shale ActionState. It performs some action onEntry and its outgoing transitions do not wait for any event.
condition
"logon" is an example of a Shale ViewState. The view to be rendered is the activity associated with this state, and the outgoing transitions wait for a "faces.outcome" event.
start log on
checkCookie
#{profile$logon.check}
[unauthenticated]
logon
/profile/logon.jsp
<onentry>
Executable Content
[authenticated]
faces.outcome[authenticated]
event
faces.outcome[create]
end log on
exit
createProfile:EditProfile
faces.outcome[success or cancel]
"exit" is an example of a Shale EndState. It leads into the final state for the state machine
"createProfile" is an example of a Shale SubdialogState. This is a UML submachine state, double click next to the state name to open the state machine it represents.
Palette
Select
Note
UML Common
State Machine ...
State
Initial State
Final State
State types
Pseudostate types
Transition
Geometric Shapes

Synergy SCXML Web Laboratory



http://www.ling.gu.se/~lager/Labs/SCXML-Lab/

Thanks