Introduction to GWT

For Developers

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Who am I?

- My name is Robert Hanson
  http://roberthanson.org
- Mgr. of App. Development at QualityTech
  http://qualitytech.com
- Co-Author of GWT in Action from Manning
  http://manning.com/hanson
- Creator of GWT Widget Library
  http://gwt-widget.sourceforge.net
- Proprietor GWT Sandbox
  http://gwtsandbox.com

What this talk is about

- Defining GWT
- Feature tour
- Live Demo
- GWT 2.0 and Beyond

Defining GWT

What is it, and what's in it for me?

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What is GWT?

- “GWiT” vs. “G-W-T”
- Java to JavaScript compiler
- “hosted-mode” browser
- JRE emulation library
- Widgets and tools
- A guide to GWT versions

Why GWT?

- In a word: PRODUCTIVITY
- Java vs. JavaScript?

What’s in it for Java developers?

- Java IDE/Debugger
- Build tools
- OO design patterns
- Testing tools (JUnit)
- JRE

GWT’s “Hello World”

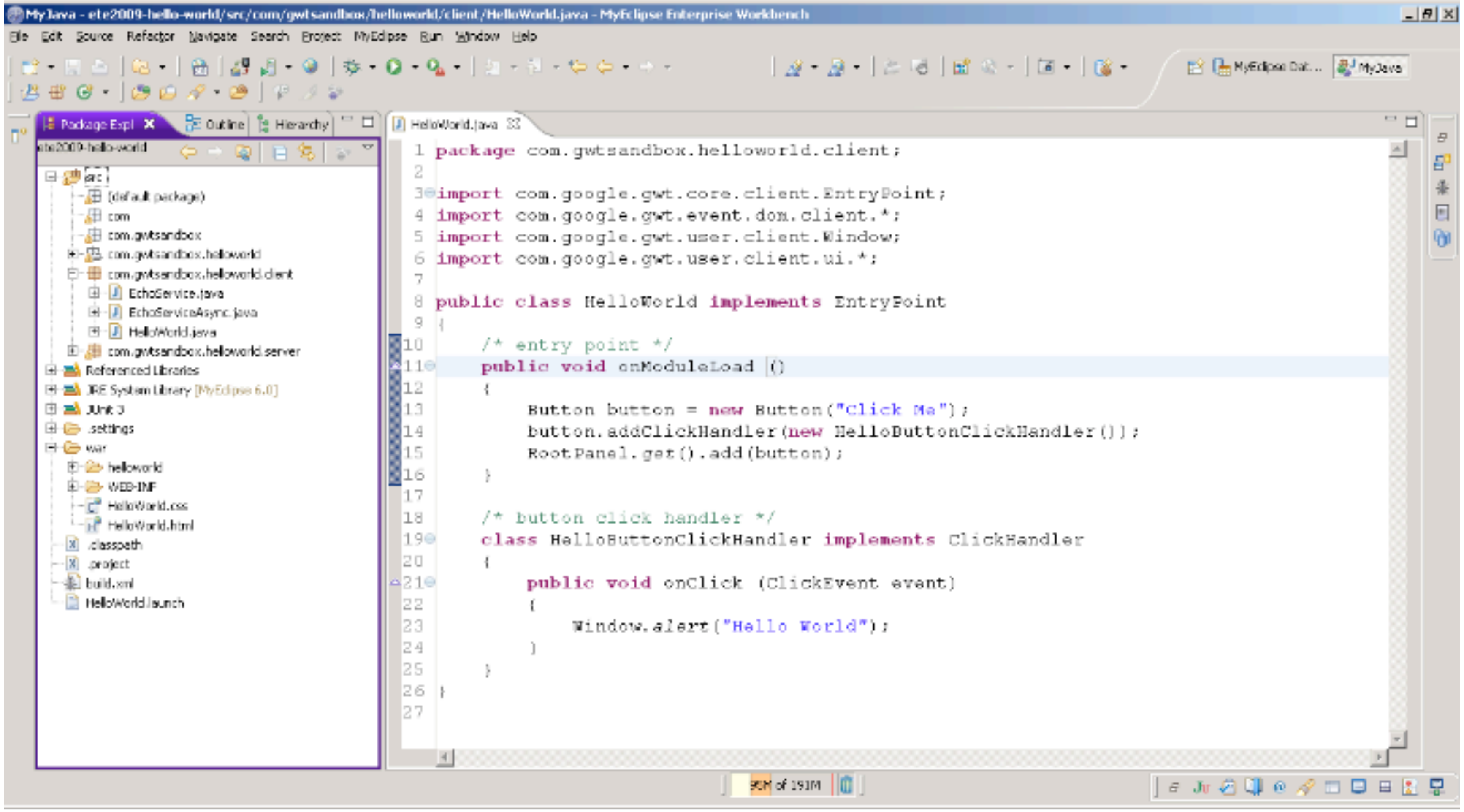
```
public class HelloWorld implements EntryPoint
{
    public void onModuleLoad ()
    {
        Button button = new Button("Click Me");
        button.addClickHandler(new HelloButtonClickHandler());
       RootPanel.get().add(button);
    }

    class HelloButtonClickHandler implements ClickHandler
    {
        public void onClick (ClickEvent event)
        {
            Window.alert("Hello World");
        }
    }
}
```

Developing with GWT

- Code in IDE
- Preview with “hosted-mode” browser
- Debug in IDE
- Compile to JavaScript/Test in “web-mode”
- Deploy to server

Code in IDE



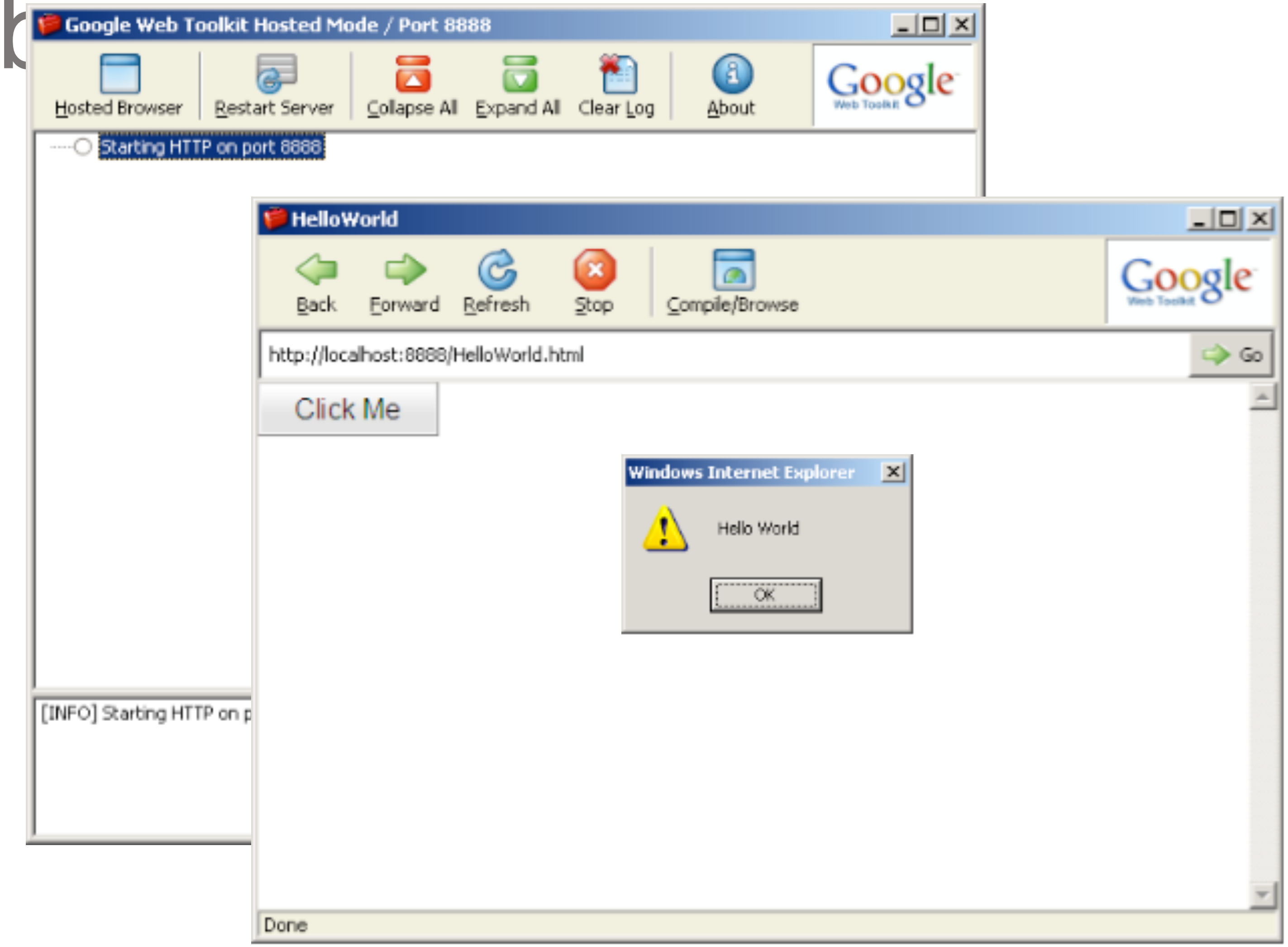
```java
package com.gwtsandbox.helloworld.client;

import com.google.gwt.core.client.EntryPoint;
import com.google.gwt.event.dom.client.*;
import com.google.gwt.user.client.Window;
import com.google.gwt.user.client.ui.*;

public class HelloWorld implements EntryPoint
{
    /* entry point */
    public void onModuleLoad ()
    {
        Button button = new Button("Click Me");
        button.addClickHandler(new HelloButtonClickHandler());
        RootPanel.get().add(button);
    }

    /* button click handler */
    class HelloButtonClickHandler implements ClickHandler
    {
        public void onClick (ClickEvent event)
        {
            Window.alert("Hello World");
        }
    }
}
```

Preview in “hosted-mode: b



```
Starting HTTP on port 8888
```

```
[INFO] Starting HTTP on p
```

http://localhost:8888/HelloWorld.html

Hello World

Done

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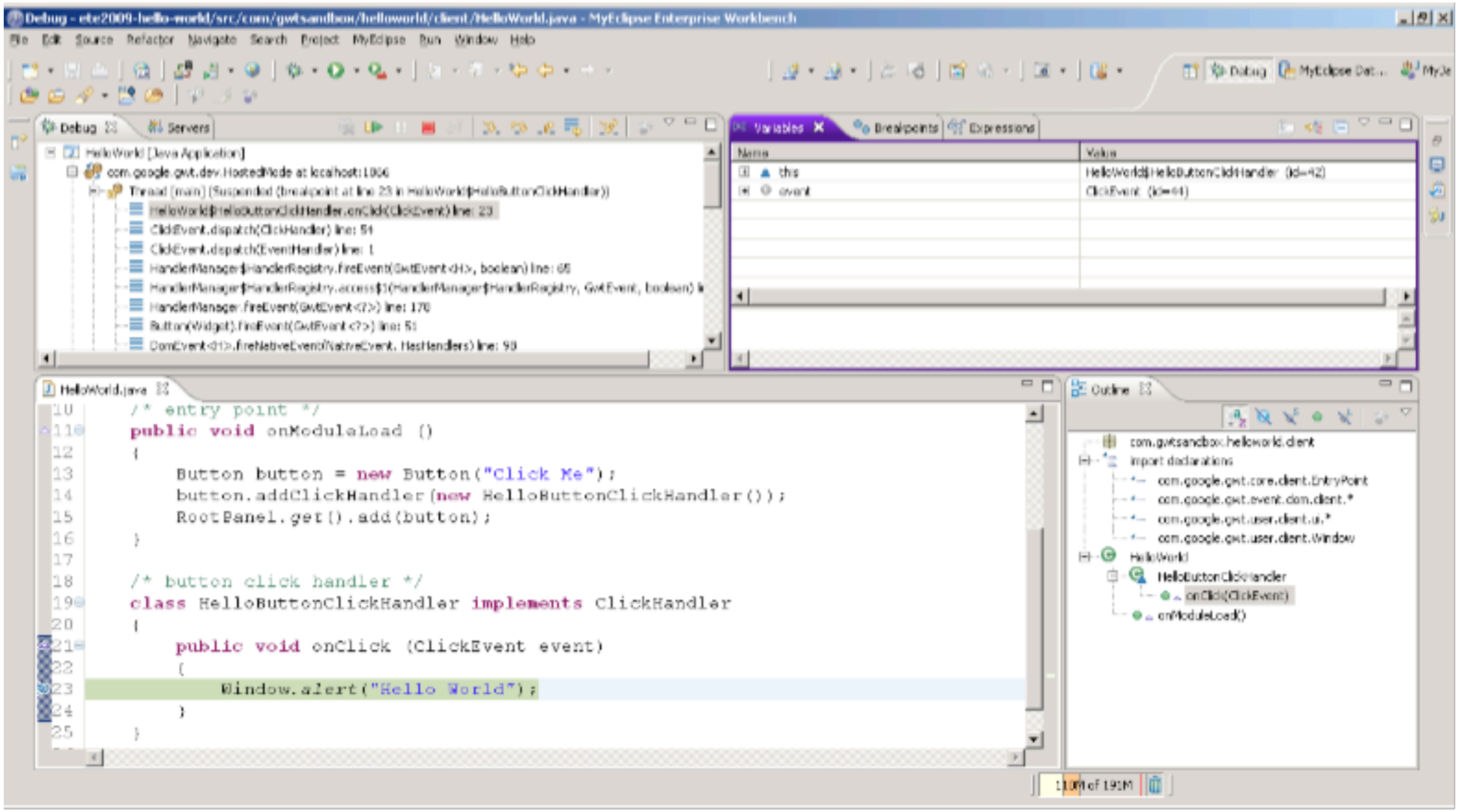
Debug in IDE



Debug - ete2009-hello-world/src/com/gwtsandbox/helloworld/client/HelloWorld.java - MyEclipse Enterprise Workbench
File Edit Source Refactor Navigate Search Project MyEclipse Run Window Help
Debug
MyEclipse Dat...
MyJe
Debug
Servers
Variables
Breakpoints
Expressions
HelloWorld.java
Outline

```
HelloWorld [Java Application]
  com.google.gwt.dev.HostedMode at localhost:1066
    Thread [main] (Suspended (breakpoint at line 23 in HelloWorld$HelloButtonClickHandler))
      HelloWorld$HelloButtonClickHandler.onClick(ClickEvent) line: 23
      ClickEvent.dispatch(ClickHandler) line: 54
      ClickEvent.dispatch(EventHandler) line: 1
      HandlerManager$HandlerRegistry.fireEvent(GwtEvent<H>, boolean) line: 65
      HandlerManager$HandlerRegistry.access$1(HandlerManager$HandlerRegistry, GwtEvent, boolean) li
      HandlerManager.fireEvent(GwtEvent<?>) line: 170
      Button(Widget).fireEvent(GwtEvent<?>) line: 51
      DomEvent<H>.fireNativeEvent(NativeEvent, HasHandlers) line: 98
```

Name	Value
this	HelloWorld$HelloButtonClickHandler (id=42)
event	ClickEvent (id=44)

```java
    /* entry point */
    public void onModuleLoad ()
    {
        Button button = new Button("Click Me");
        button.addClickHandler(new HelloButtonClickHandler());
        RootPanel.get().add(button);
    }

    /* button click handler */
    class HelloButtonClickHandler implements ClickHandler
    {
        public void onClick (ClickEvent event)
        {
            Window.alert("Hello World");
        }
    }
```

```
com.gwtsandbox.helloworld.client
import declarations
  com.google.gwt.core.client.EntryPoint
  com.google.gwt.event.dom.client.*
  com.google.gwt.user.client.ui.*
  com.google.gwt.user.client.Window
HelloWorld
  HelloButtonClickHandler
    onClick(ClickEvent)
  onModuleLoad()
```

110M of 191M

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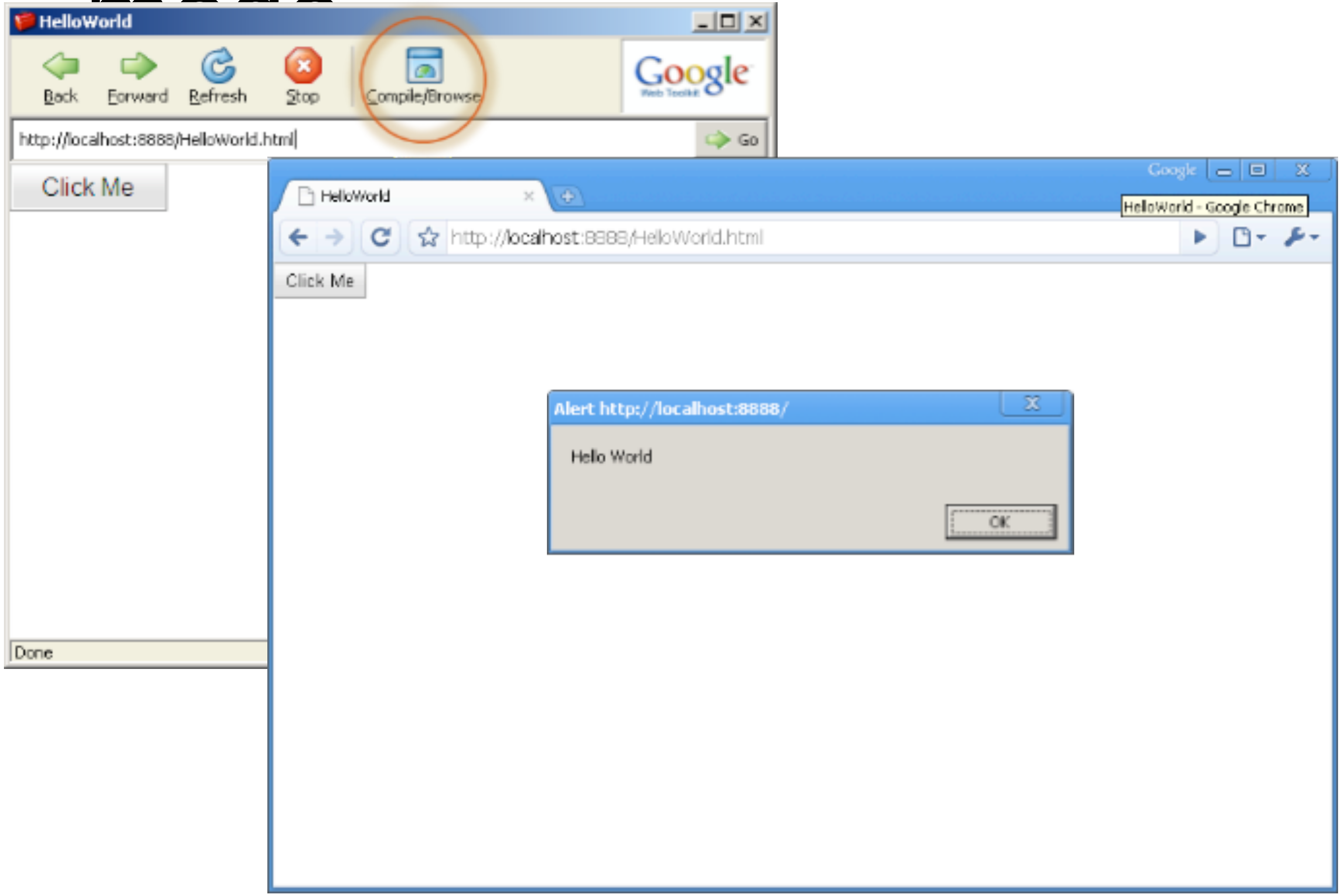
Compile to JS/Test in “web-mode”


HelloWorld
Back
Forward
Refresh
Stop
Compile/Browse
Google Web Toolkit
http://localhost:8888/HelloWorld.html
Go
Click Me
Done
HelloWorld
HelloWorld - Google Chrome
http://localhost:8888/HelloWorld.html
Click Me
Alert http://localhost:8888/
OK

Hello World

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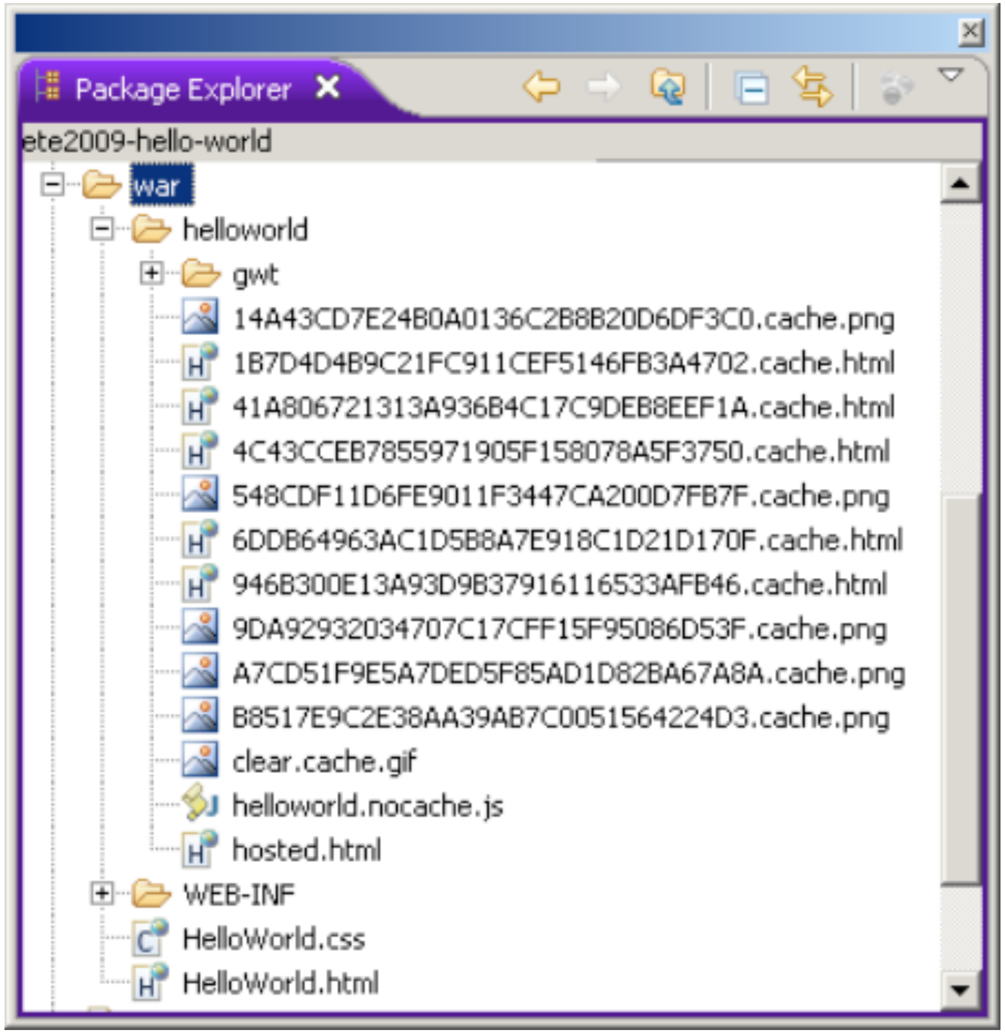
Deploy to server



```
ete2009-hello-world
  war
    helloworld
      gwt
      14A43CD7E24B0A0136C2B8B20D6DF3C0.cache.png
      1B7D4D4B9C21FC911CEF5146FB3A4702.cache.html
      41A806721313A936B4C17C9DEB8EEF1A.cache.html
      4C43CCEB7855971905F158078A5F3750.cache.html
      548CDF11D6FE9011F3447CA200D7FB7F.cache.png
      6DDB64963AC1D5B8A7E918C1D21D170F.cache.html
      946B300E13A93D9B37916116533AFB46.cache.html
      9DA92932034707C17CFF15F95086D53F.cache.png
      A7CD51F9E5A7DED5F85AD1D82BA67A8A.cache.png
      B8517E9C2E38AA39AB7C0051564224D3.cache.png
      clear.cache.gif
      helloworld.nocache.js
      hosted.html
    WEB-INF
    HelloWorld.css
    HelloWorld.html
```

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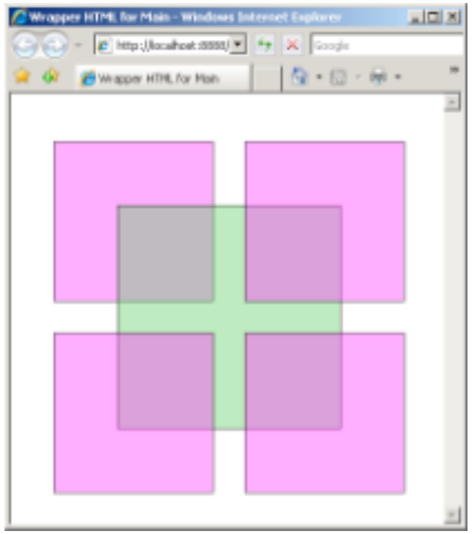
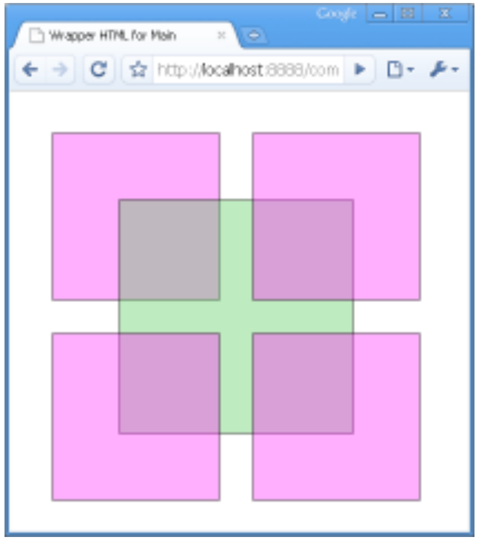
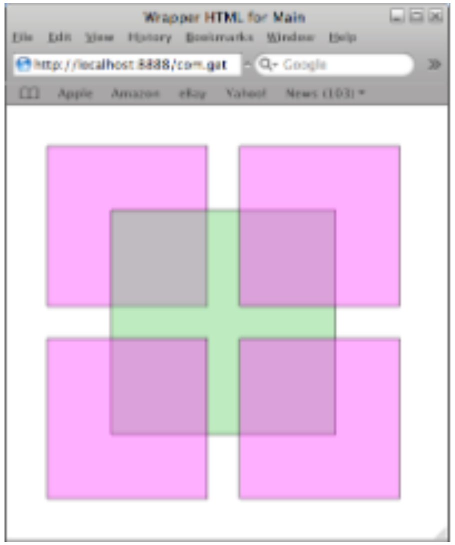
The Many Files of GWT

```
Canvas canvas = Canvas.create(370, 370);
```

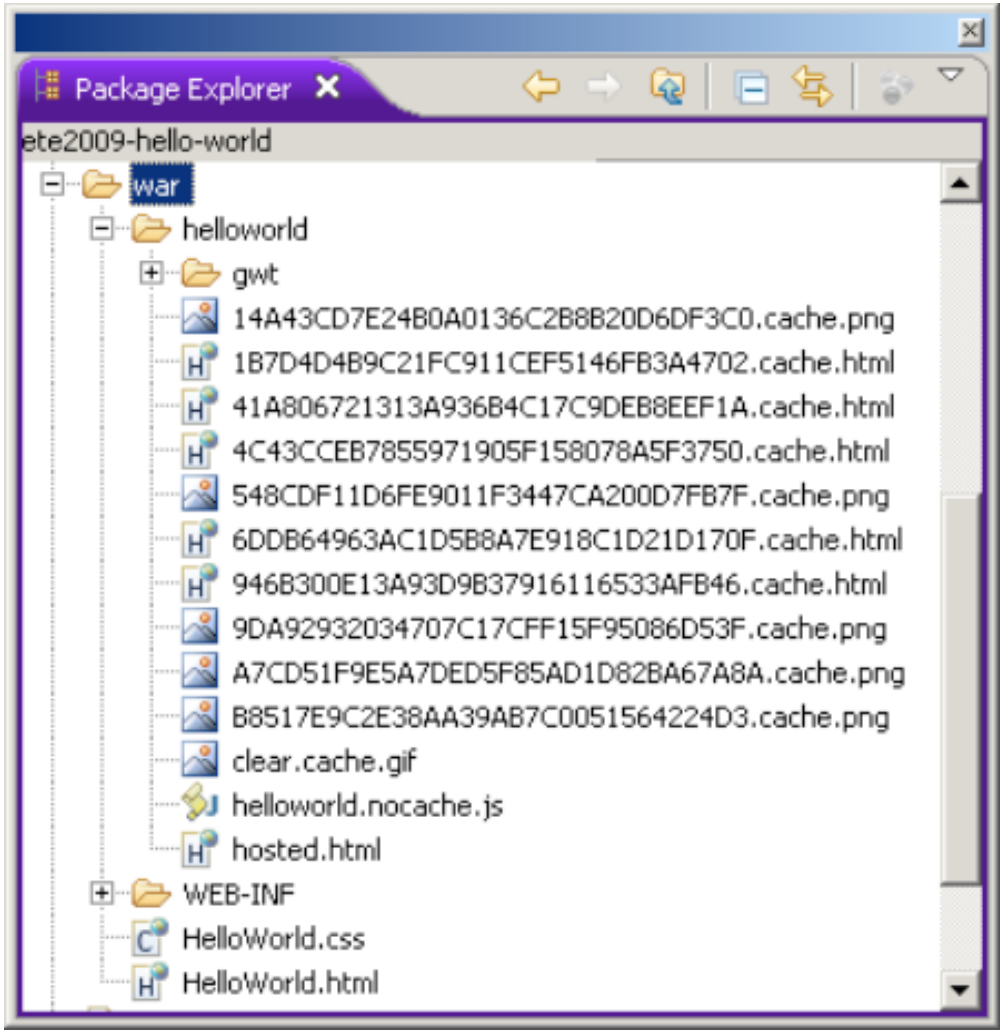
```
public abstract class Canvas extends Widget { … }

public class FFCanvasImpl extends Canvas { … }

public class IECanvasImpl extends Canvas { … }
```






Wrapper HTML for Main
File Edit View History Bookmarks Window Help
http://localhost:8888/com.gwt
Google
Apple Amazon eBay Yahoo! News (103)

Deploy to server



```
ete2009-hello-world
⊟ war
   ⊟ helloworld
      ⊞ gwt
        14A43CD7E24B0A0136C2B8B20D6DF3C0.cache.png
        1B7D4D4B9C21FC911CEF5146FB3A4702.cache.html
        41A806721313A936B4C17C9DEB8EEF1A.cache.html
        4C43CCEB7855971905F158078A5F3750.cache.html
        548CDF11D6FE9011F3447CA200D7FB7F.cache.png
        6DDB64963AC1D5B8A7E918C1D21D170F.cache.html
        946B300E13A93D9B37916116533AFB46.cache.html
        9DA92932034707C17CFF15F95086D53F.cache.png
        A7CD51F9E5A7DED5F85AD1D82BA67A8A.cache.png
        B8517E9C2E38AA39AB7C0051564224D3.cache.png
        clear.cache.gif
        helloworld.nocache.js
        hosted.html
   ⊞ WEB-INF
     HelloWorld.css
     HelloWorld.html
```

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GWT Versions

- 1.4 (August 2007)
    - First non-beta release
- 1.5 (August 2008)
    - Supports Java 1.5 syntax
- 1.6 (March 2009 - RC)
    - New “expanded-war” project structure
    - New event handler system
    - Hosted-Mode uses Jetty (was Tomcat)
    - Ability to trigger native JavaScript events
    - New widgets: DatePicker, LazyPanel

Feature Tour

GWT’s Tools and Widgets

Core Features

- Java to JavaScript compiler
- JRE Emulation Library
- JavaScript bridging
- Widgets and panels
- History sub-system
- Utilities

Advanced Features

- RPC
- Internationalization
- Image bundles
- Deferred binding
- Generators
- Linkers

Java to JavaScript compiler

- Compiles Java source, not bytecode
- Supports Java 5 language features
- Code pruning and optimization (inlining, temp reuse, etc.)
- Reduces memory leaks
- Creates multiple JavaScript files (size optimization)
  - One per browser type and version
  - One per language
- Can optimize loading of images (image bundles)

Java to JavaScript compiler

- Configured using a Module Configuration File

```
<module rename-to='helloworld'>
    <inherits name='com.google.gwt.user.User'/>
    <inherits name='com.google.gwt.user.theme.standard.Standard'/>

    <entry-point class='com.gwtsandbox.helloworld.client.HelloWorld'/>
</module>
```

JRE Emulation Library

- GWT is limited by the capabilities of JavaScript
- Package java.lang (primitive containers, exceptions, System, StringBuffer, Iterable, Comparable, Runnable, etc.)
- Package java.util (Collection, Map, Set, List, Arrays, Enumeration, Iterator, Date, etc. … but no Calendar)
- Package java.lang.annotation (Annotation, Retention, etc.)
- Package java.io (Serializable, OutputStream, PrintStream)
- Package java.sql (Date, Time, Timestamp)

JavaScript bridging

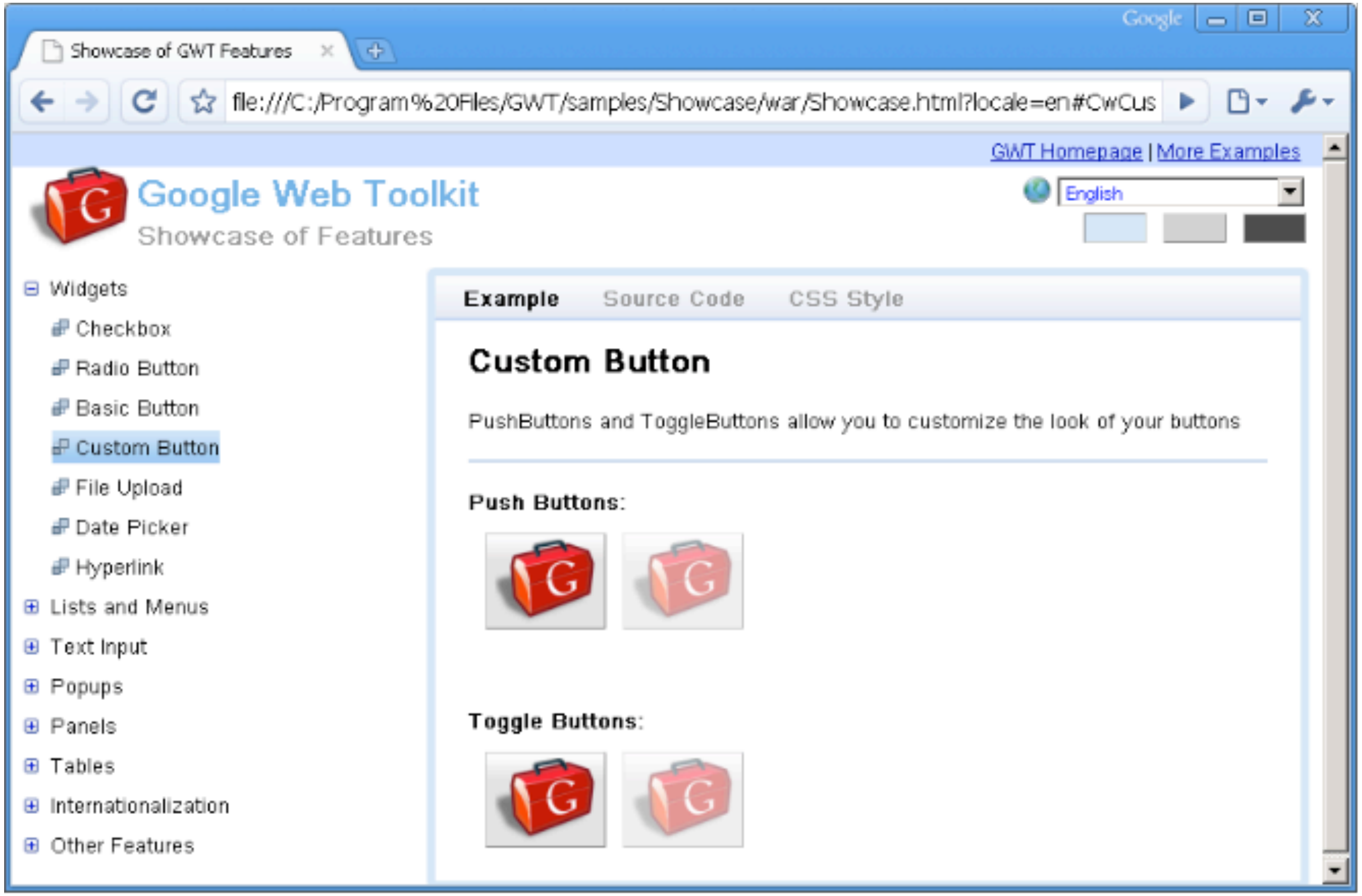
- JavaScript Native Interface (JSNI)
- JavaScript Overlay Types

```
public class BookJs extends JavaScriptObject
{
    protected BookJs () { }

    public final native String getName () /*-{
       return this.name;
    }-*/;

    public final native String getAuthor () /*-{
       return this.author;
    }-*/;
}
```

Widgets and Panels

- Basic layout (HorizontalPanel, VerticalPanel, FlowPanel)
- Table layout (FlexTable, Grid)
- Exact positioning (AbsolutePanel)
- Specialized panels (StackPanel, DisclosurePanel, etc.)
- Forms (HTMLForm, Button, RichTextArea, FileUpload, etc.)
- Menus (MenuBar, Tree)
- Tabs (TabPanel, TabBar)
- Auto completion (SuggestBox)
- And more (Incubator project)

Widgets and Panels



Custom Button

PushButtons and ToggleButtons allow you to customize the look of your buttons

Push Buttons:

Toggle Buttons:

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History Sub-System

- Allows use of browser navigation buttons

```
<iframe src="javascript:''“ id="__gwt_historyFrame"
                style="width:0;height:0;border:0"></iframe>
```

```
History.addHistoryListener(new HistoryListener() {
    public void onHistoryChanged(String historyToken) {
        if (“help-page”.equals(historyToken)) { … }
    }
 });
```

```
http://gwtsandbox.com/gwtapp.html#help-page
```

Utilities

- XML Parser / DOM
- Animation loop
- Benchmark tool
- JUnit TestCase/TestSuite for GWT
- Number formatting
- Cookie handling
- Etc.

Remote Procedure Calls

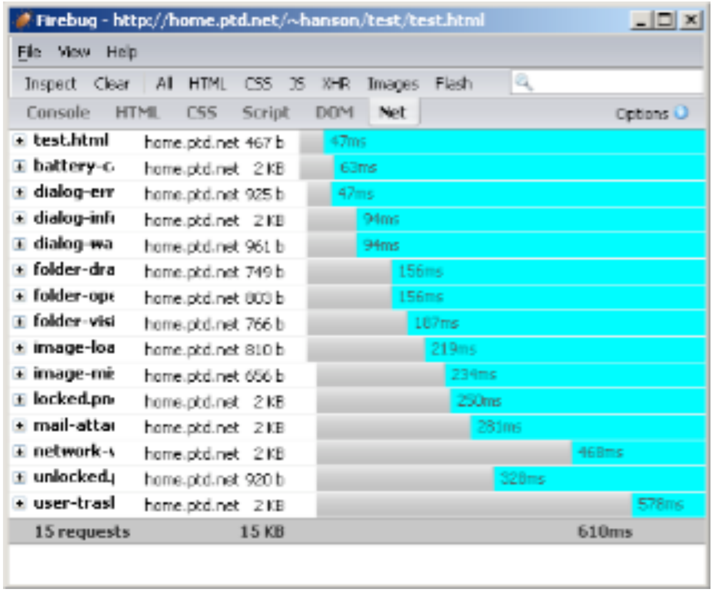
- GWT-RPC
- RequestBuilder
- FormPanel
- JSON support
- XML support
- No SOAP/XML-RPC support

Internationalization

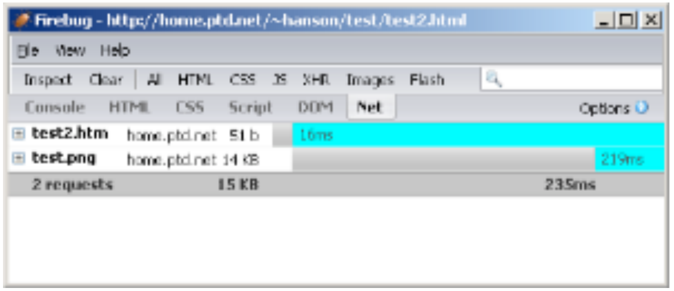
- Static string insertion (compile time)
- Dynamic string insertion (run time)
- Left-to-Right support
- Number/Date formatting

Image Bundles

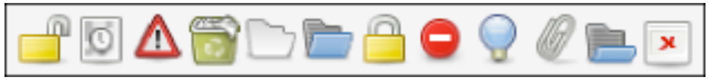
- Bundles images into a single file
- Uses CSS to clip images


Firebug - http://home.ptd.net/~hanson/test/test.html
File View Help
Inspect Clear All HTML CSS JS XHR Images Flash
Console HTML CSS Script DOM Net Options

```
test.html    home.ptd.net 467 b   47ms
battery-c    home.ptd.net   2 KB   63ms
dialog-err   home.ptd.net 925 b   47ms
dialog-inf   home.ptd.net   2 KB   94ms
dialog-wa    home.ptd.net 961 b   94ms
folder-dra   home.ptd.net 749 b   156ms
folder-ope   home.ptd.net 803 b   156ms
folder-visi  home.ptd.net 766 b   187ms
image-loa    home.ptd.net 810 b   219ms
image-mi     home.ptd.net 656 b   234ms
locked.pn    home.ptd.net   2 KB   250ms
mail-atta    home.ptd.net   2 KB   281ms
network-     home.ptd.net   2 KB   468ms
unlocked.    home.ptd.net 920 b   328ms
user-tras    home.ptd.net   2 KB   578ms
15 requests              15 KB                610ms
```


Firebug - http://home.ptd.net/~hanson/test/test2.html
File View Help
Inspect Clear All HTML CSS JS XHR Images Flash
Console HTML CSS Script DOM Net Options

```
test2.htm    home.ptd.net  51 b   16ms
test.png     home.ptd.net 14 KB   219ms
2 requests               15 KB                235ms
```



Deferred Binding

- Allows for browser-dependent class implementations

```
<replace-with class="com.google.gwt.user.client.impl.DOMImplIE6">
<when-type-is class="com.google.gwt.user.client.impl.DOMImpl"/>
<when-property-is name="user.agent" value="ie6"/>
</replace-with>

<replace-with class="com.google.gwt.user.client.impl.DOMImplMozilla">
<when-type-is class="com.google.gwt.user.client.impl.DOMImpl"/>
<when-property-is name="user.agent" value="gecko1_8"/>
</replace-with>
```

```
public class DOM {
   static final DOMImpl impl = GWT.create(DOMImpl.class);
   …
}
```

Compile-time code generation

- Used by GWT-RPC
- Used by internationalization
- Used by image bundles

```
public class ServiceInterfaceProxyGenerator extends Generator
{
    public String generate (
        TreeLogger logger, GeneratorContext context, String typeName)
            throws UnableToCompleteException
    { … }
}
```

Compile-time code generation

- Uses Deferred Binding to generate code

```
<generate-with class="com.google.gwt.user.rebind.rpc.ServiceInterfaceProxyGenerator">
    <when-type-assignable class="com.google.gwt.user.client.rpc.RemoteService"/>
</generate-with>
```

Linkers

- Linker packages the output
- “std” – Iframe linker
- “xs” – Cross-Site linker
- “sso” – Single Script linker

```
<add-linker name=“xs" />
```

Live Demo

When things will likely go wrong

GWT 2.0 and Beyond

The future of GWT

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GWT 2.0 Features

- Release Date (Summer 2010?)
- Out Of Process Hosted Mode (OOPHM)
- Code Splitting

The End

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