The Google Web Toolkit (GWT): The Model-View-Presenter (MVP) Architecture – Official MVP Framework

(GWT 2.5 Version)

Originals of Slides and Source Code for Examples:
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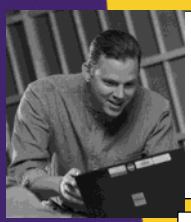

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Topics in This Section

- **Motivation**
  - What's wrong with what we already have?
- **Pros and cons**
- **Main components of MVP framework**
  - Model
  - View
  - ClientFactory
  - Activity
  - Place
  - PlaceHistoryMapper
  - ActivityMapper

Overview

So What's Wrong with What We Already Had?

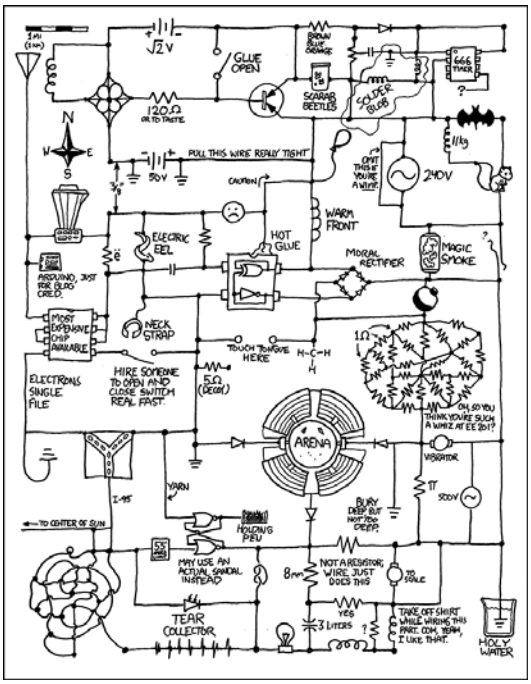
- **History management is all over the app**
  - Presenters hard code and/or know too much about history
- **Defining the Display (i.e., view) interface inside the presenter doesn't allow for bi-directional communication**
  - Impossible to use @UiHandler shortcut with UiBinder
- **View creation means a lot of DOM calls**
  - Expensive and slow!
    - If no state is saved in the view, why create new view every time? Just reuse the same view instance.

So What's Wrong with What We Already Had? (Continued)

- **Recycling view instances is technically not part of MVP but very useful and fits well into MVP**
  - DOM operations are expensive so we try to avoid them
  - Note that this implies that no state should ever be stored in a view
- **Keep the presenters disposable**
  - No DOM code resides there, so they are very lightweight and cheap to recreate every time
    - No need to reset their state
- **GWT MVP elegantly abstracts history handling**
- **All these are advantages of GWT MVP Framework**
  - Besides all the same advantages of MVP in general

Disadvantages of GWT MVP

- **All the same as before, but now a REALLY steep learning curve!**
  - Can feel a bit like this at first:
- **Bottom line:**
  - Give yourself time to get used to all the standard steps



From xkcd.com and Randall Munroe.

Components of MVP Framework

Main Components of GWT MVP Framework

- **Model**
  - Responsible for holding raw data
  - No business logic allowed (just like any model really)
- **Example:**

```
public class Customer { // can be Serializable
  private String firstName, lastName;

  public Customer(String fName, String lName) {...}

  public String getFirstName() { ...}

  public void setFirstName(String firstName) {...}
  ...
}
```


Main Components of GWT MVP Framework (Continued)

- **View**
  - Responsible for displaying data
  - No business logic allowed
  - Based on a custom standalone interface which defines the methods of this view
    - Inside view interface, we define the Presenter interface for the concrete presenter that will be associated with this view
    - Allows UiBinder to pass through UiHandler methods to the presenter
  - View interface extends isWidget interface that defines asWidget method
- **See next slide for example**

Main Components of GWT MVP Framework (Continued)

- **Example View interface:**

```
public interface HelloView extends isWidget {
  void setName(String name);
  void setPresenter(Presenter presenter);

  public interface Presenter {
    String getName();
    ...
  }
}
```


Main Components of GWT MVP Framework (Continued)

- **ClientFactory**
  - Not technically part of MVP, but very useful to facilitate creation of a view once and only once
  - The rest of the app uses ClientFactory to obtain view references
- **Example:**

```
public interface ClientFactory {
  EventBus getEventBus();
  HelloView getHelloView();
  ...
}
```

Main Components of GWT MVP Framework (Continued)

- **Activity**
  - It's a Presenter with "bells and whistles" built in
    - Has lifecycle methods to hook into when:
      - User is trying to navigate away from this activity
      - Activity's widget (i.e., the view it controls) is removed from user's view
      - Etc.
  - Implements the Presenter interface defined in the associated View interface
  - All business logic goes here
    - Responses to events on the view, server calls, etc.
- **See example on next slide**

Main Components of GWT MVP Framework (Continued)

- **Activity example:**

```
public class HelloActivity extends AbstractActivity
                      implements HelloView.Presenter {
  private String name;
  private ClientFactory clientFactory;
  ...
  @Override
  public void start(AcceptsOneWidget container,
                    EventBus eventBus) {
    HelloView view = clientFactory.getHelloView();
    view.setName(name);
    ...
  }
  ...
}
```

Equivalent to the "go" method we had in the Presenter before.

Main Components of GWT MVP Framework (Continued)

- **Place**
  - Encapsulates a navigational state
  - Most Activities have an associated Place
  - Each *Blah*Place extends the Place class
  - Usually has a Tokenizer defined as an inner public class
    - Implements PlaceTokenizer<*Blah*Place>
    - Knows how to take a URL history token and reconstruct a *Blah*Place instance
      - public *Blah*Place getPlace(String token);
    - Knows how to take a *Blah*Place instance and reconstruct a URL history token
      - public String getToken(*Blah*Place place);
  - A place doesn't need a custom Tokenizer if the only URL data it cares about is the name of the place itself

Main Components of GWT MVP Framework (Continued)

- **Place example:**

```
public class HelloPlace extends Place {
  private String name;
  ...

  public HelloPlace(String token) { this.name = token; }
  public String getName() { return name; }

  public static class Tokenizer implements
                                  PlaceTokenizer<HelloPlace> {
    @Override
    public String getToken(HelloPlace place) {...}

    @Override
    public HelloPlace getPlace(String token) {...}
  }
}
```

Main Components of GWT MVP Framework (Continued)

- **PlaceHistoryMapper**
  - A way to let GWT know about your history tokenizers
  - Link between PlaceTokenizers and GWT's history handling mechanism
    - I.e., Link between PlaceTokenizers and PlaceHistoryHandler
- **Example:**

```
@WithTokenizers({HelloPlace.Tokenizer.class, …}
public interface MyPlaceHistoryMapper extends
                                  PlaceHistoryMapper {}
```


Main Components of GWT MVP Framework (Continued)

- **ActivityMapper**
  - A way to map each Place to some Activity
    - Remember that Activity implements Presenter interface
      - I.e., it IS a presenter
  - GWT MVP framework uses it to automatically route the app to an Activity
- **Example:**

```
public class MyActivityMapper implements ActivityMapper {
  ...
  @Override
  public Activity getActivity(Place place) {
    if (place instanceof HelloPlace) {
      return new HelloActivity(...);
    } else if (place instanceof ...) {...}
  }
}
```

Summary: Main Components of GWT MVP Framework

- **Model**
  - Responsible for holding raw data (no business logic)
- **View**
  - Responsible for displaying data (extends isWidget)
  - Defines *Blah*View and an associated Presenter interface
- **ClientFactory**
  - Holds on to instances of views and other reusable system resources
- **Activity**
  - Implements view's Presenter interface and drives all business logic (i.e., it *is* a presenter)
    - Responds to events on the view, makes server calls, etc.

Summary: Main Components of GWT MVP Framework (Cont.)

- **Place**
  - Encapsulates a navigational state
  - Defines Tokenizer that knows how to make a Place out of history token and make a URL history token out of Place
- **PlaceHistoryMapper**
  - Maps places and their tokenizers in GWT MVP framework's history handling mechanism
- **ActivityMapper**
  - Maps each Place to some Activity
    - GWT MVP framework uses it to automatically route to the app to that Activity

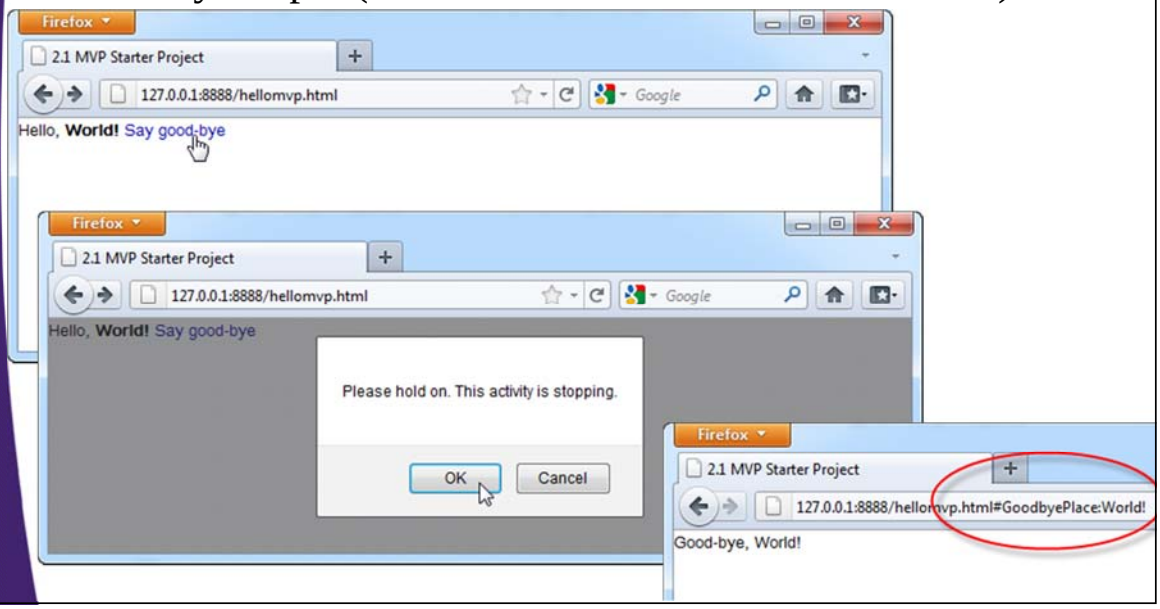
Some Other GWT MVP Components (Provided by GWT MVP Framework)

- **PlaceController**
  - Provided by GWT to programmatically go to a Place, etc.
- **ActivityManager**
  - Keeps track of all Activities within the context of one container widget
  - Listens for PlaceChangeRequestEvents and calls the lifecycle methods of Activity to proceed
    - Activity can let the user reject the request by returning a non-null value (a message to the user) in Activity.onMayStop()

Simple MVP Framework Example

Example Setup

- **Using Google's GWT MVP example app**
  - Very simple (easier to understand the architecture)



EntryPoint: HelloMVP.java

```
...
public class HelloMVP implements EntryPoint {
  private Place defaultPlace = new HelloPlace("World!");
  private SimplePanel appWidget = new SimplePanel();

  public void onModuleLoad() {
    ClientFactory clientFactory =
                  GWT.create(ClientFactory.class);
    EventBus eventBus = clientFactory.getEventBus();
    PlaceController placeController =
                   clientFactory.getPlaceController();

    ActivityMapper activityMapper =
                   new AppActivityMapper(clientFactory);
    ActivityManager activityManager =
                    new ActivityManager(activityMapper,
                                        eventBus);
    activityManager.setDisplay(appWidget);
```

Create ClientFactory using differed binding.

Start ActivityManager for the main widget with our ActivityMapper.

EntryPoint: HelloMVP.java (continued)

```
    AppPlaceHistoryMapper historyMapper =
                          GWT.create(AppPlaceHistoryMapper.class);
    PlaceHistoryHandler historyHandler =
                         new PlaceHistoryHandler(historyMapper);
    historyHandler.register(placeController,
                            eventBus,
                            defaultPlace);

    RootPanel.get().add(appWidget);
    historyHandler.handleCurrentHistory();
  }
}
```

Start PlaceHistoryHandler with our PlaceHistoryMapper

Register GWT MVP PlaceController and the default place (in case no tokens are on the URL or invalid token)

This is equivalent to History.fireCurrentHistoryState() in GWT MVP framework's API. I.e., it tells the app to start trying to interpret the URL tokens.

HelloView.java

```
...
public interface HelloView extends IsWidget
{
      void setName(String helloName);
      void setPresenter(Presenter listener);

      public interface Presenter {
            void goTo(Place place);
      }
}
```

HelloViewImpl.java

```
public class HelloViewImpl extends Composite implements HelloView
{
  ...
  public void setName(String name) {
    this.name = name;
    nameSpan.setInnerText(name);
  }

  @UiHandler("goodbyeLink")
  void onClickGoodbye(ClickEvent e) {
    presenter.goTo(new GoodbyePlace(name));
  }

  @Override
  public void setPresenter(Presenter presenter) {
    this.presenter = presenter;
  }
}
```

This view is using UiBinder.

HelloPlace.java

```
public class HelloPlace extends Place {
  private String helloName;
  public HelloPlace(String token) {
    this.helloName = token;
  }

  public String getHelloName() {
    return helloName;
  }

  public static class Tokenizer
                              implements PlaceTokenizer<HelloPlace> {
    public String getToken(HelloPlace place) {
      return place.getHelloName();
    }

    public HelloPlace getPlace(String token) {
      return new HelloPlace(token);
    }
  }
}
```

AppPlaceHistoryMapper.java

```
...
@WithTokenizers( { HelloPlace.Tokenizer.class,
                   GoodbyePlace.Tokenizer.class })
public interface AppPlaceHistoryMapper extends PlaceHistoryMapper {
}
```

Let's GWT know about our Places and Tokenizers.

HelloActivity.java

```
public class HelloActivity extends AbstractActivity
                           implements HelloView.Presenter {
  private ClientFactory clientFactory;
  private String name;

  public HelloActivity(HelloPlace place,
                       ClientFactory clientFactory) {
    this.name = place.getHelloName();
    this.clientFactory = clientFactory;
  }

  public void start(AcceptsOneWidget containerWidget,
                    EventBus eventBus) {
    HelloView helloView = clientFactory.getHelloView();
    helloView.setName(name);
    helloView.setPresenter(this);
    containerWidget.setWidget(helloView.asWidget());
  }
```

Contains views, eventBus, placeController.

Retrieve *navigational* state so the view can be recreated with it.

ActivityManager calls start to start this activity's processing.

HelloActivity.java (continued)

```
  public String mayStop() {
    return "Please hold on. This activity is stopping.";
  }

  public void goTo(Place place) {
    clientFactory.getPlaceController().goTo(place);
  }
}
```

Asks user before stopping activity

Method from HelloView interface.

AppActivityMapper.java

```
public class AppActivityMapper implements ActivityMapper {
  private ClientFactory clientFactory;

  public AppActivityMapper(ClientFactory clientFactory) {
    this.clientFactory = clientFactory;
  }

  public Activity getActivity(Place place) {
    if (place instanceof HelloPlace) {
      return new HelloActivity((HelloPlace) place,
                               clientFactory);
    } else if (place instanceof GoodbyePlace) {
      return new GoodbyeActivity((GoodbyePlace) place,
                                 clientFactory);
    }
    return null;
  }
}
```

If Place can't be mapped to an Activity, stays on the same Activity as before, i.e., does nothing.

GoodbyeActivity.java

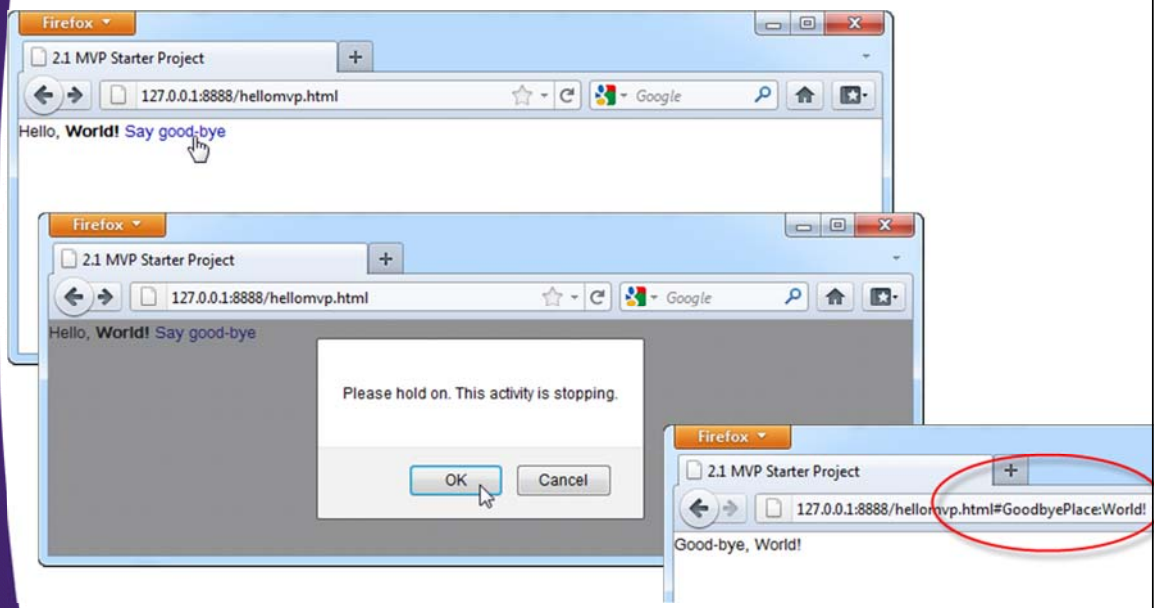
```
public class GoodbyeActivity extends AbstractActivity {
  private ClientFactory clientFactory;
  private String name;

  public GoodbyeActivity(GoodbyePlace place,
                         ClientFactory clientFactory) {
    this.name = place.getGoodbyeName();
    this.clientFactory = clientFactory;
  }

  public void start(AcceptsOneWidget containerWidget,
                    EventBus eventBus) {
    GoodbyeView goodbyeView = clientFactory.getGoodbyeView();
    goodbyeView.setName(name);
    containerWidget.setWidget(goodbyeView.asWidget());
  }
}
```

No need to implement GoodbyeView interface as GoodbyeView does not need any communication with its associated Activity.

Navigational state is passed through the Place instance.

This Activities sole purpose is to set a string on the view.

Tested in Production Mode



Deferred Binding

Deferred Binding For ClientFactory

- **Very similar to IoC (Inversion of Control)**
- **When you call GWT.create(ClientFactory.class), GWT looks up the implementing class in its app.gwt.xml**
- **Example:**

```
<!-- Use ClientFactoryImpl by default -->
<replace-with class="com.hellomvp.client.ClientFactoryImpl">
  <when-type-is class="com.hellomvp.client.ClientFactory"/>
</replace-with>
```

- **Can use <when-property-is>, specifying user agent (type of browser), i.e. mobile, desktop, etc.**
  - Allows to give different view impl for mobile vs desktop

Wrap-Up

Summary

- **REALLY big learning curve, but very flexible and customizable**
  - Still worth it for large scale apps
- **Views define their interface as well as Activities interface (its presenter)**
- **Places handle navigational state**
  - Place-defined Tokenizer allows conversion from token to Place instance and back
- **Use ClientFactory approach to cache reusable resources in your app**
  - Using appName.gwt.xml, use deferred binding to create different views for different browsers, devices, etc.

Questions?