

Developing an Editor for Directed Graphs

An Introduction to the Eclipse Graphical Editing Framework

Speaker

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 - JBoss jBPM (<http://labs.jboss.org/jbossjbpm>)
 - JBoss Tools (<http://labs.jboss.org/tools>)
 - => Graphical Process Designer
(<http://labs.jboss.org/jbossjbpm/gpd>)

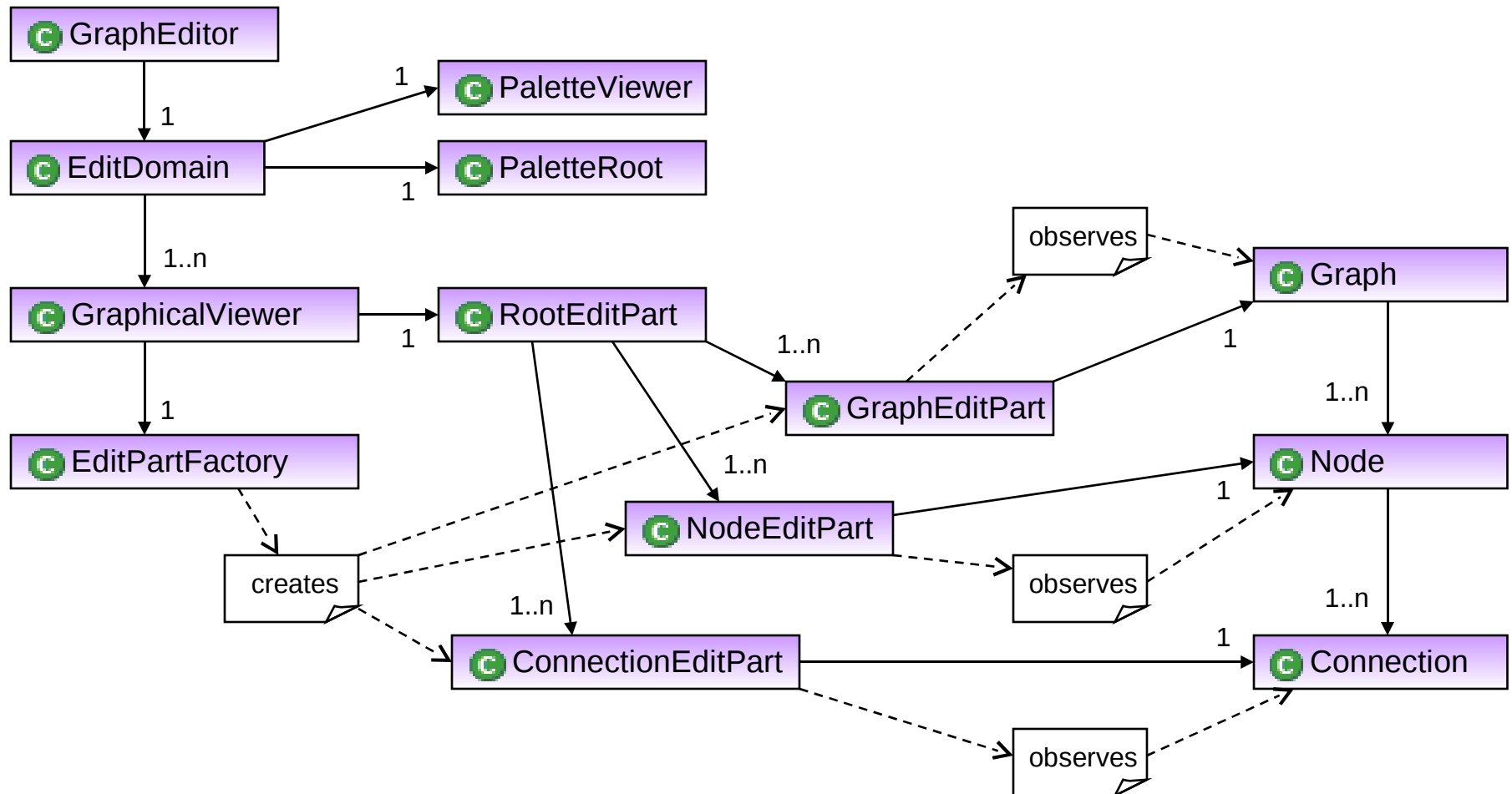
Agenda

- What is GEF?
- GEF Applied : A Graph Editor
 - An Empty Graph Editor
 - Adding the Nodes
 - Doing Things With Nodes
 - Showing Connections
 - Creating New Nodes and Connections
 - Adding Delete Support
- Final Reflections

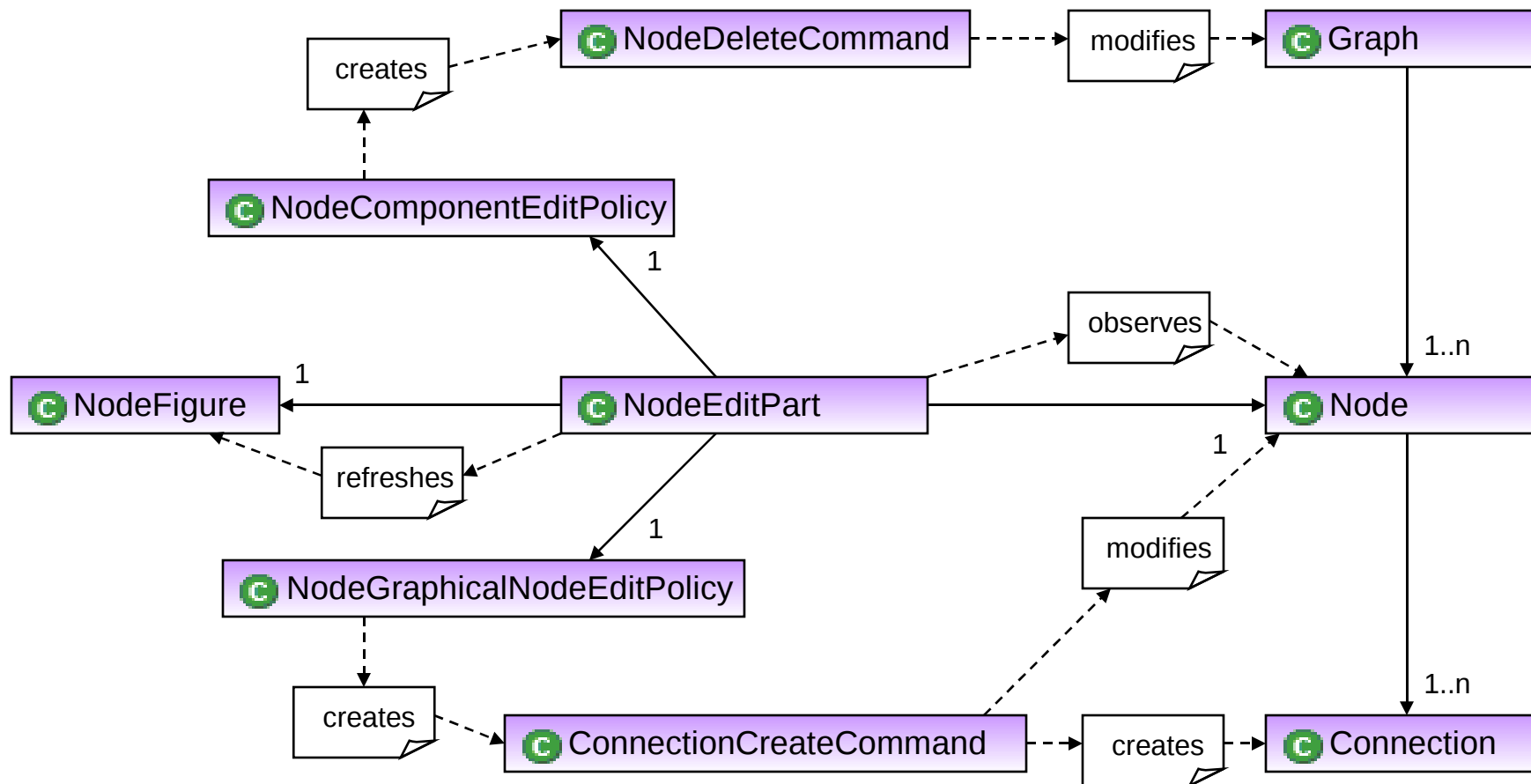
What is GEF?

- Graphical Editing Framework
- Create a Rich Graphical Editor
- Consists of 2 plug-in
 - Draw2D : layout and rendering toolkit for displaying graphics
 - GEF : framework using the old Smalltalk MVC principles
- MVC : Model, Figure, EditPart
 - Input events are translated to requests
 - EditPart has a chain-of-responsibility of so-called EditPolicies
 - EditPolicies translate the requests into GEF Commands when appropriate
 - Commands get executed and result in model changes
 - Model is observed by EditPart
 - When model changes, EditPart refreshes the view

Structure of a Typical GEF Editor



Typical GEF MVC Interactions

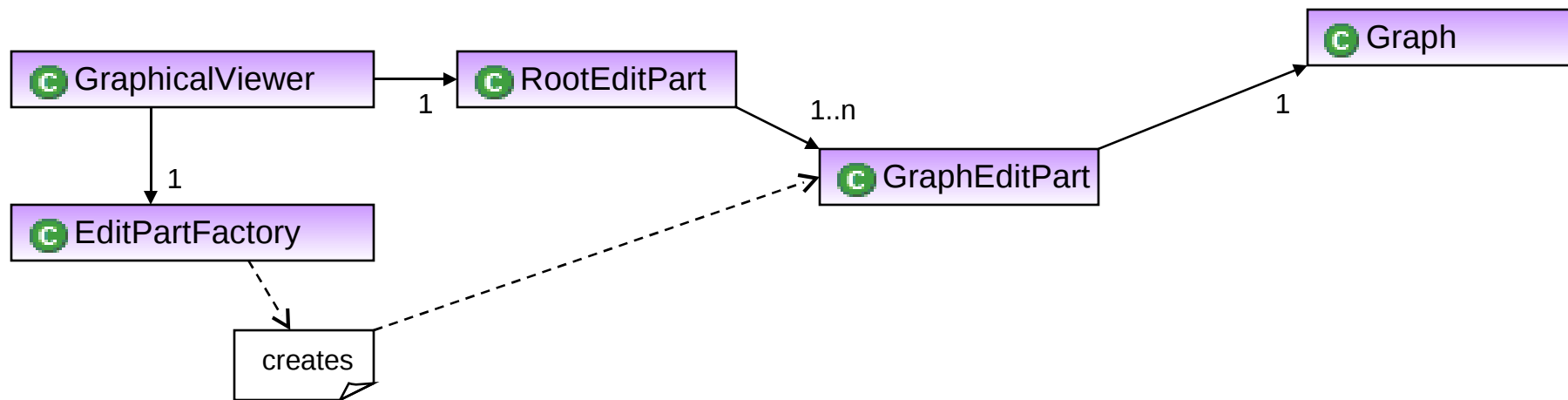


An Empty Graph Editor

- Eclipse Plug-in with Editor
- Add a GraphicalViewer
- Add a RootEditPart
- Define the Graph model
- Define the GraphEditPart
- Define and Add the EditPartFactory

An Empty Editor for Directed Graphs

GraphEditor



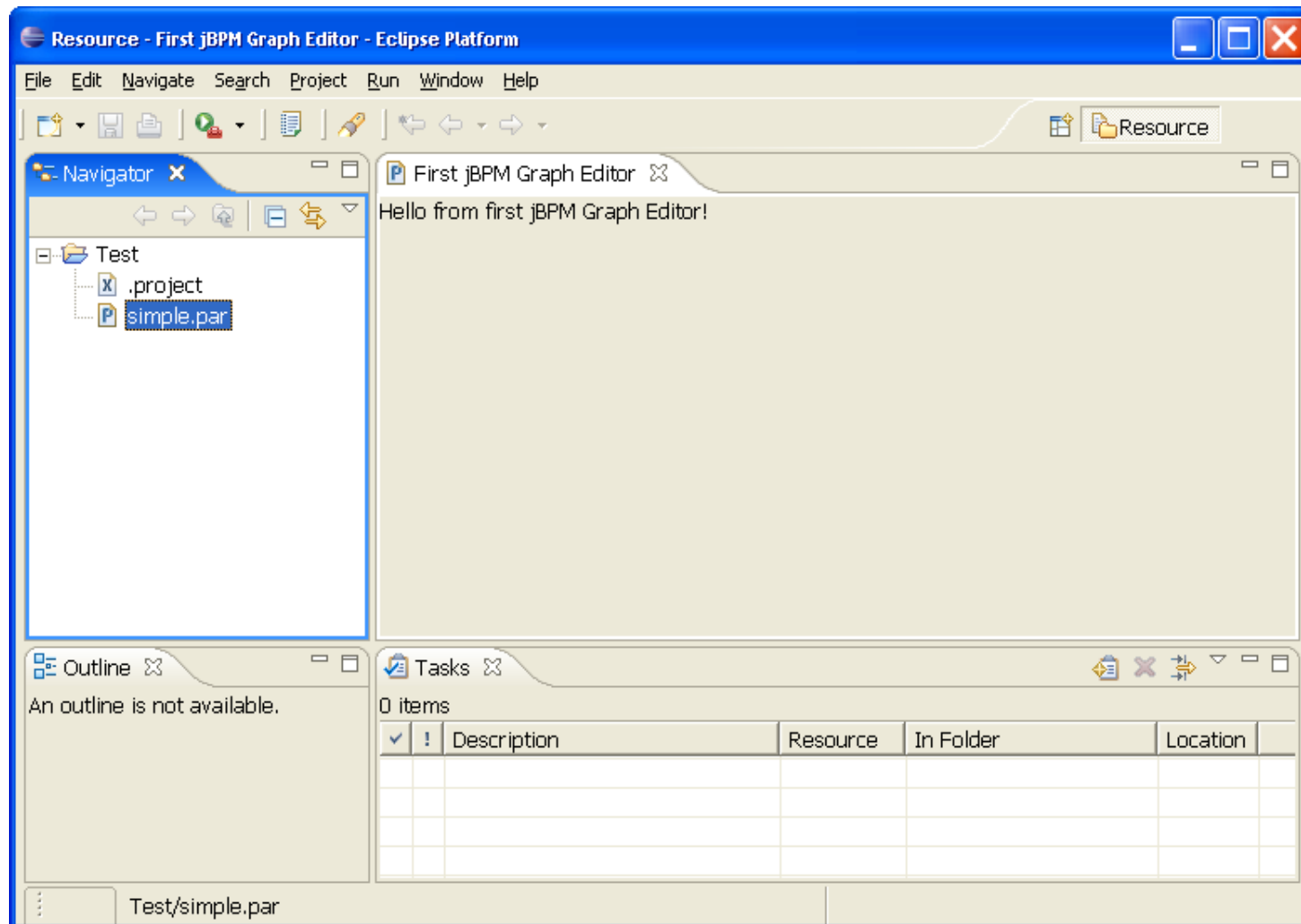
Eclipse Plug-in with Editor

```
<plugin
  id="org.jbpm.graph.ui"
  name="JBoss jBPM Graph Designer"
  version="1.0.0"
  provider-name="JBoss, a Division of Red Hat"
  class="org.jbpm.graph.ui.GraphPlugin">
  ...
  <extension point = "org.eclipse.ui.editors">
    <editor
      id = "org.jbpm.graph.ui.editor.GraphEditor"
      name = "First jBPM Graph Editor"
      icon = "icons/full/obj16/par_obj.gif"
      extensions = "par"
      class = "org.jbpm.graph.ui.editor.GraphEditor" >
    </editor>
  </extension>
</plugin>
```

Eclipse Plug-in with Editor

```
public class GraphEditor extends EditorPart {  
    ...  
    public void init(IEditorSite site, IEditorInput input)  
        throws PartInitException {  
        setSite(site);  
        setInput(input);  
    }  
    ...  
    public void createPartControl(Composite parent) {  
        Label label = new Label(parent, SWT.NONE  
        label.setText("Hello from first jBPM Graph Editor!");  
    }  
    ...  
}
```

Eclipse Plug-in with Editor

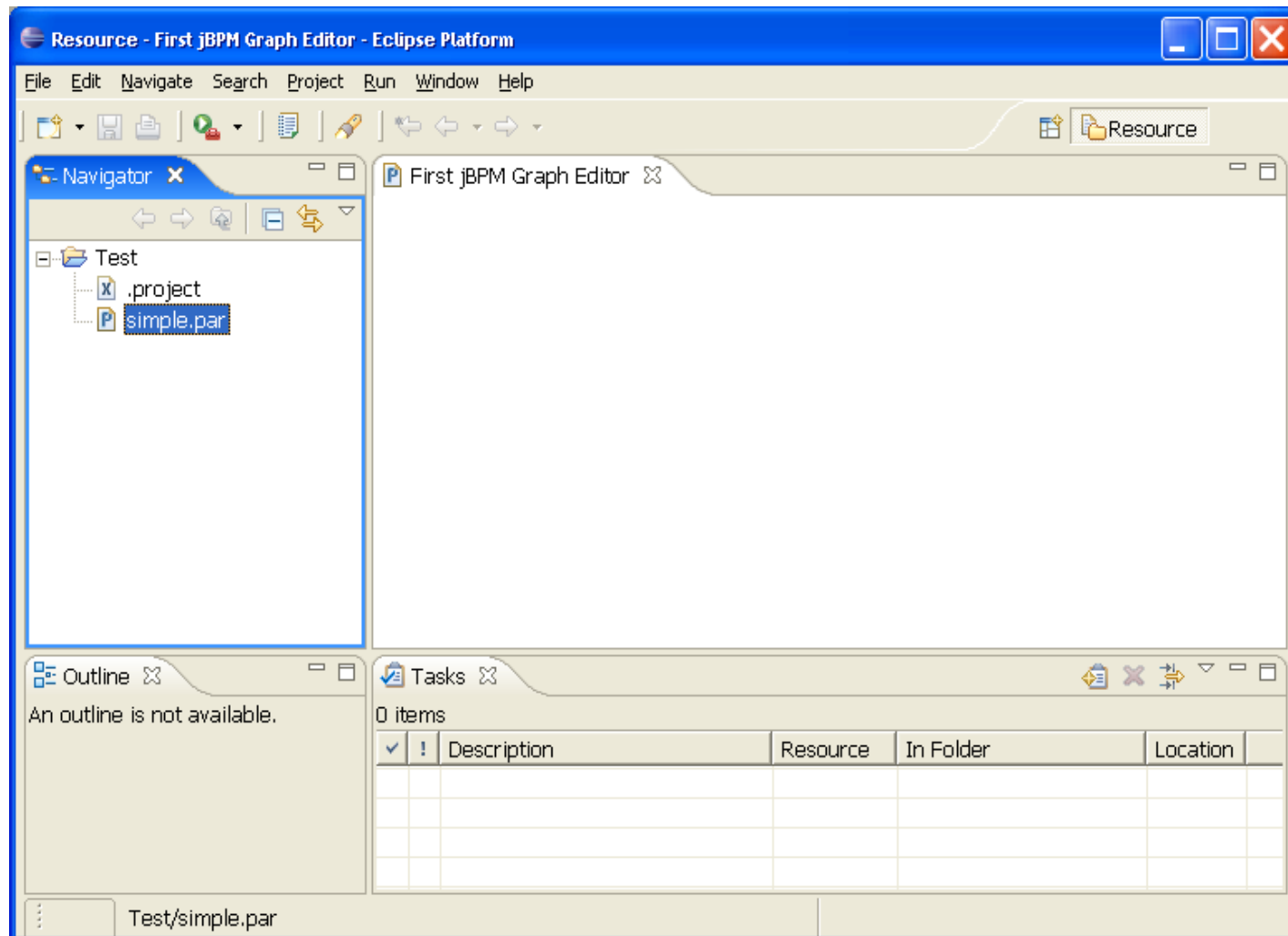


Add an EditPartViewer

- GraphicalViewer is special kind of EditPartViewer
- An adapter on an SWT **Control** that manages the **EditPart**
- Populated by setting its *contents*

```
public void createPartControl(Composite parent) {  
    ScrollingGraphicalViewer viewer =  
        new ScrollingGraphicalViewer();  
    viewer.createControl(parent);  
  
    viewer.getControl().setBackground(ColorConstants.white);  
}
```

Add an EditPartViewer



Add the RootEditPart

- Bridges the gap between the EditPartViewer and its contents
- Can provide for all kinds of services : zooming, freeform figures, etc.

```
public void createPartControl(Composite parent) {  
    ScrollingGraphicalViewer viewer =  
        new ScrollingGraphicalViewer();  
    viewer.createControl(parent);  
    viewer.setRootEditPart(new ScalableFreeformRootEditPart());  
    viewer.getControl().setBackground(ColorConstants.white);  
}
```

Add the EditPartFactory

- A factory for creating new EditParts
- Used when EditPart of EditPartViewer wants to create a new EditPart
- Used when setting contents of EditPartViewer

```
public void createPartControl(Composite parent) {  
    ...  
    viewer.setRootEditPart(new ScalableFreeformRootEditPart());  
    viewer.getControl().setBackground(ColorConstants.white);  
    viewer.setEditPartFactory(new GraphEditPartFactory());  
    viewer.setContents(new Graph());  
}
```

Define the Graph Model

- Initial simplistic model
- Used as the contents of the GraphicalViewer

```
public class Graph {}
```


Define the GraphEditPartFactory

- Only Graph objects are considered
- Return a GraphEditPart instance

```
public class GraphicalEditPartFactory
    implements EditPartFactory {

    public EditPart createEditPart(
        EditPart context, Object model) {
        if (model instanceof Graph) {
            return new GraphEditPart((Graph)model);
        } else {
            return null;
        }
    }
}
```

Define the GraphEditPart

```
public class GraphEditPart
    extends AbstractGraphicalEditPart {

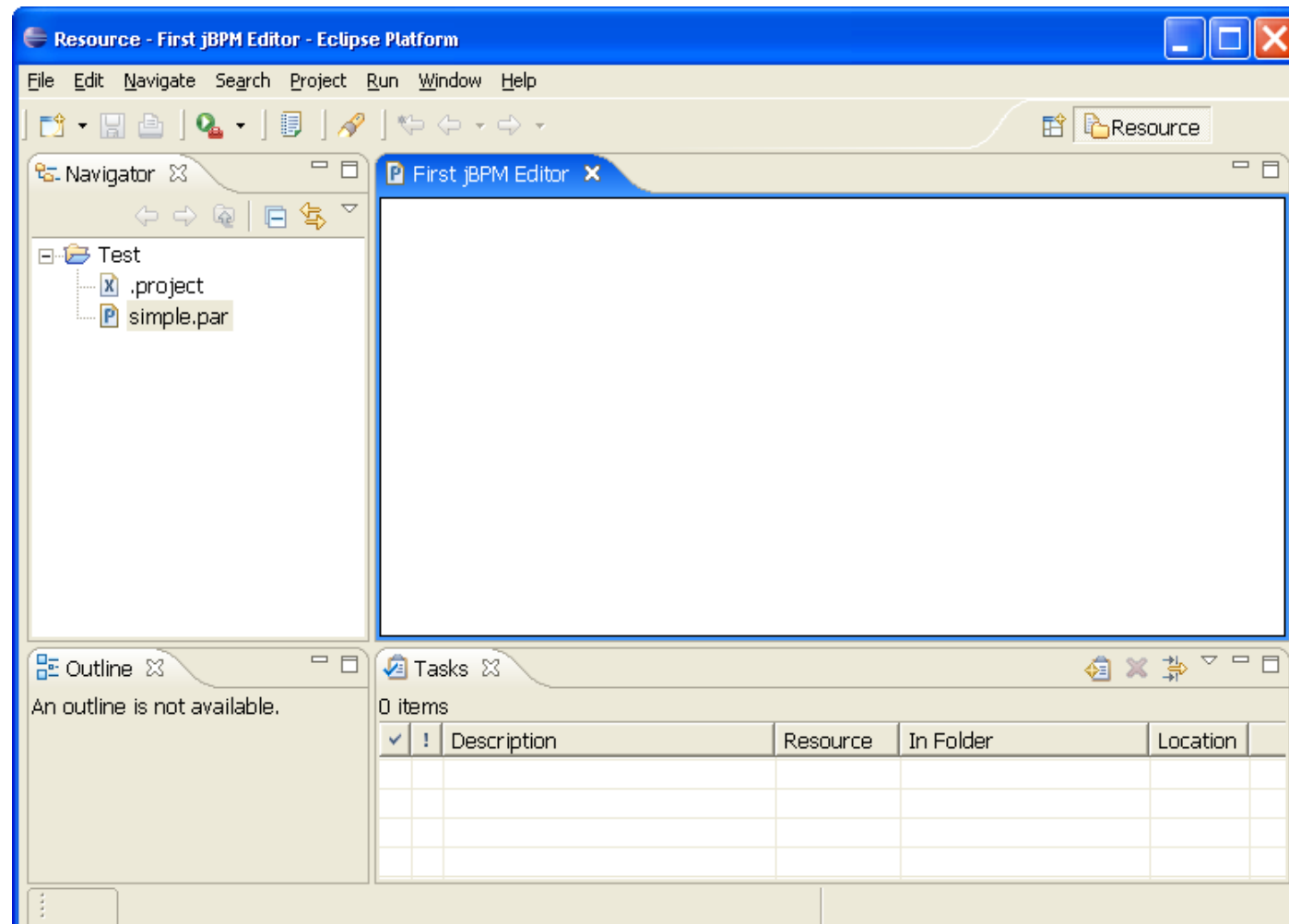
    public GraphEditPart(Graph graph) {
        setModel(graph);
    }

    protected IFigure createFigure() {
        FreeformLayer layer = new FreeformLayer();
        layer.setLayoutManager(new FreeformLayout());
        layer.setBorder(new LineBorder(1));
        return layer;
    }

    protected void createEditPolicies() {}

}
```

Editor Showing Empty Graph

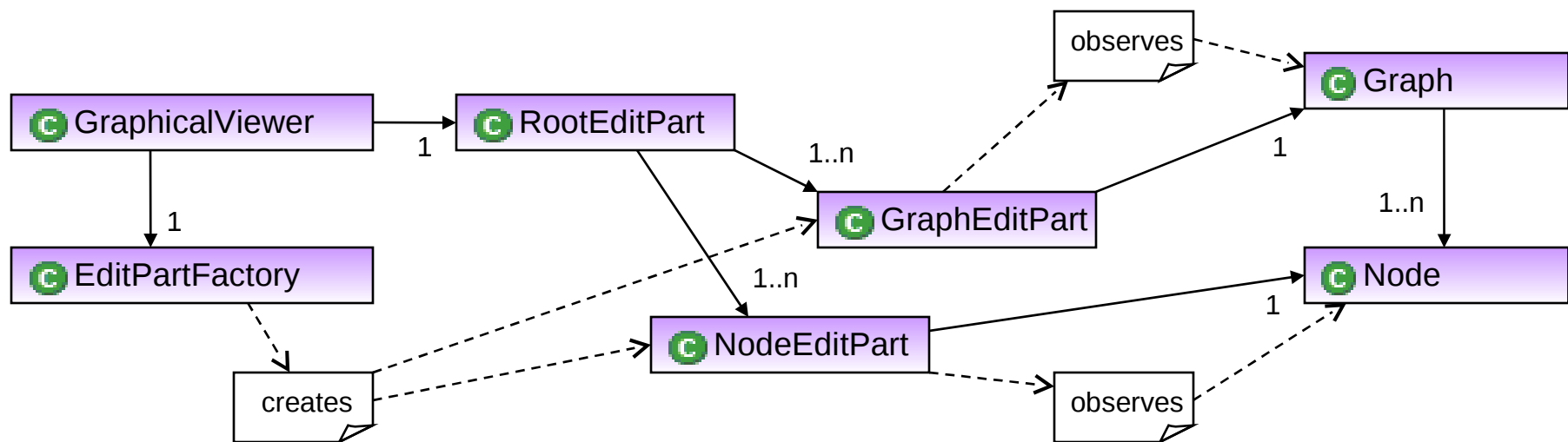


Adding the Nodes

- The Model Class : Node
- Graphical Representation : NodeFigure
- The Controller : NodeEditPart
- Update the GraphEditPartFactory
- Update the GraphEditPart

Adding Nodes to the Editor

GraphEditor



Define the Model : Node

```
public class Node {  
    Rectangle constraint;  
    String name;  
    public Rectangle getConstraint() {  
        return constraint;  
    }  
    public void setConstraint(Rectangle constraint) {  
        this.constraint = constraint;  
    }  
    public String getName() {  
        return name;  
    }  
    public void setName(String name) {  
        this.name = name;  
    }  
}
```

Define the Model : Graph Revisited

- Graphs manage a list of nodes

```
public class Graph {  
    List nodes  
    public List getNodes() {  
        if (nodes == null) nodes = new ArrayList();  
        return nodes;  
    }  
    public void addNode(Node node) {  
        getNodes().add(node);  
    }  
}
```

Define the Model : ContentProvider

```
public void createPartControl(Composite parent) {  
    ...  
    viewer.setContents(  
        ContentProvider.INSTANCE.newSampleGraph());  
}
```


ContentProvider Continued

```
public class ContentProvider {  
    public static final ContentProvider INSTANCE =  
        new ContentProvider();  
    public Graph newSampleGraph() {  
        Graph result = new Graph();  
        result.addNode(newNode(200, 150, 65, 35, "first"));  
        result.addNode(newNode(300, 250, 65, 35, "second"));  
        result.addNode(newNode(100, 300, 65, 35, "third"));  
        return result;  
    }  
    ...  
}
```

ContentProvider Continued

```
public class ContentProvider {  
    public static final ContentProvider INSTANCE =  
        new ContentProvider();  
  
    ...  
    private Node newNode(  
        int x, int y, int width, int height, String name) {  
        Node result = new Node();  
        result.setConstraint  
            new Rectangle(new Point(x, y),  
                new Dimension(width, height));  
        result.setName(name);  
        return result;  
    }  
}
```

Define the View : NodeFigure

- Mostly using the Draw2D framework

```
public class NodeFigure extends Figure {  
    private Label label;  
    private RectangleFigure rectangle;  
    public NodeFigure() {  
        setLayoutManager(new XYLayout());  
        rectangle = new RectangleFigure();  
        add(rectangle);  
        label = new Label();  
        add(label);  
    }  
    public Label getLabel() {  
        return label;  
    }  
    ...  
}
```

Define the View : NodeFigure (ct'd)

```
public class NodeFigure extends Figure {  
    ...  
    public void paintFigure(Graphics g) {  
        Rectangle r = getBounds().getCopy();  
        setConstraint(  
            rectangle, new Rectangle(0, 0, r.width, r.height));  
  
        setConstraint(  
            label, new Rectangle(0, 0, r.width, r.height));  
  
        rectangle.invalidate();  
        label.invalidate();  
    }  
}
```

Define the Controller : NodeEditPart

```
public class NodeEditPart extends AbstractGraphicalEditPart {  
    public NodeEditPart(Node node) { setModel(node); }  
    protected IFigure createFigure() { return new  
NodeFigure(); }  
    protected void createEditPolicies() {}  
    public void refreshVisuals() {  
        NodeFigure figure = (NodeFigure) getFigure();  
        Node node = (Node) getModel();  
        GraphEditPart parent = (GraphEditPart) getParent();  
        figure.getLabel().setText(node.getName());  
        Rectangle r = new Rectangle(node.getConstraint());  
        parent.setLayoutConstraint(this, figure, r);  
    }  
}
```

GraphEditPartFactory Revisited

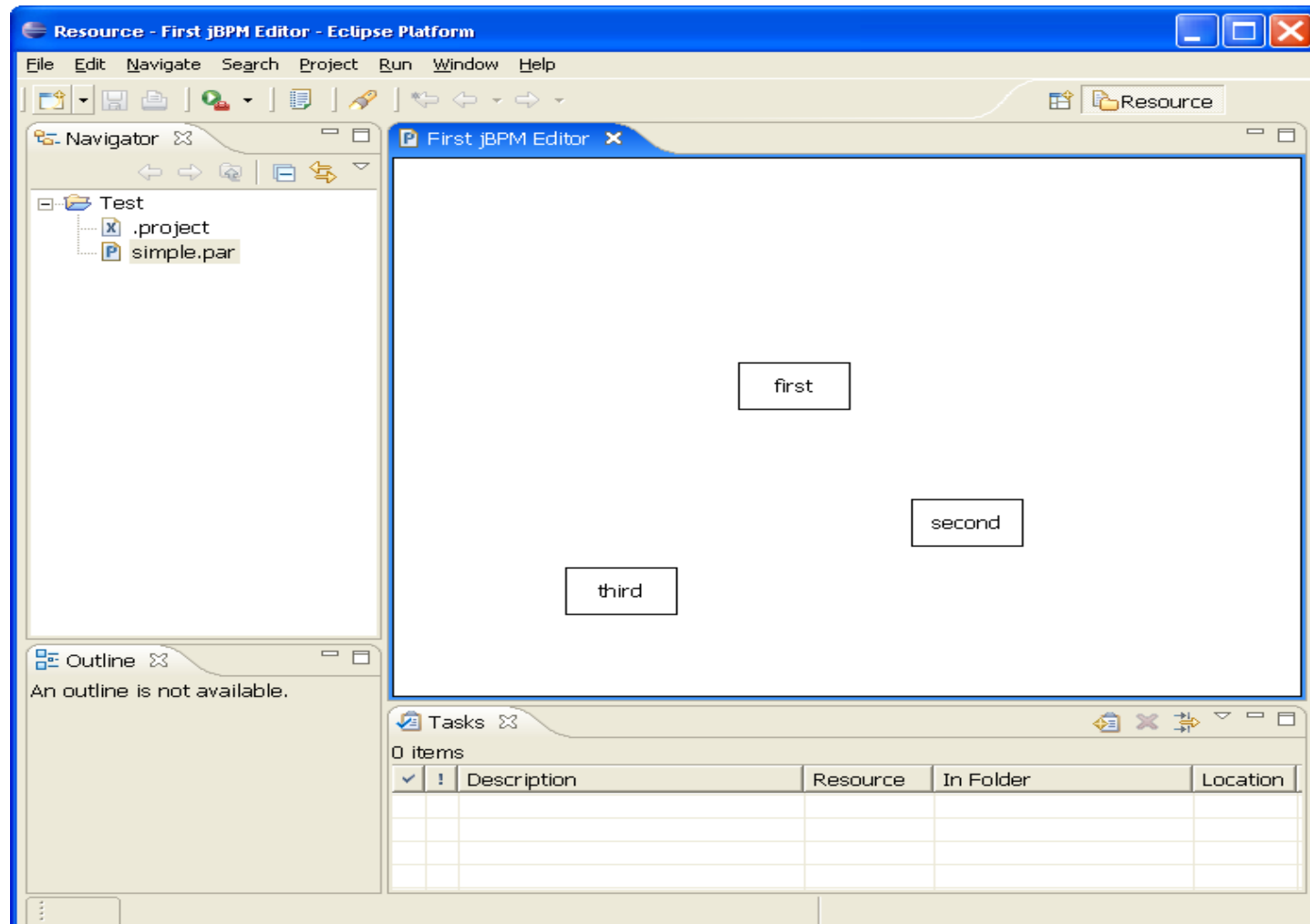
```
public class GraphicalEditPartFactory
    implements EditPartFactory {

    public EditPart createEditPart(
        EditPart context, Object model) {
        if (model instanceof Graph) {
            return new GraphEditPart((Graph)model);
        } else if (model instanceof Node) {
            return new NodeEditPart((Node)model);
        } else {
            return null;
        }
    }
}
```

GraphEditPart Revisited

```
public class GraphEditPart
extends AbstractGraphicalEditPart {
    public GraphEditPart(Graph graph) {
        setModel(graph);
    }
    protected List getModelChildren() {
        return ((Graph)getModel()).getNodes();
    }
    protected IFigure createFigure() {
        FreeformLayer layer = new FreeformLayer();
        layer.setLayoutManager(new FreeformLayout());
        layer.setBorder(new LineBorder(1));
        return layer;
    }
    protected void createEditPolicies() {}
}
```

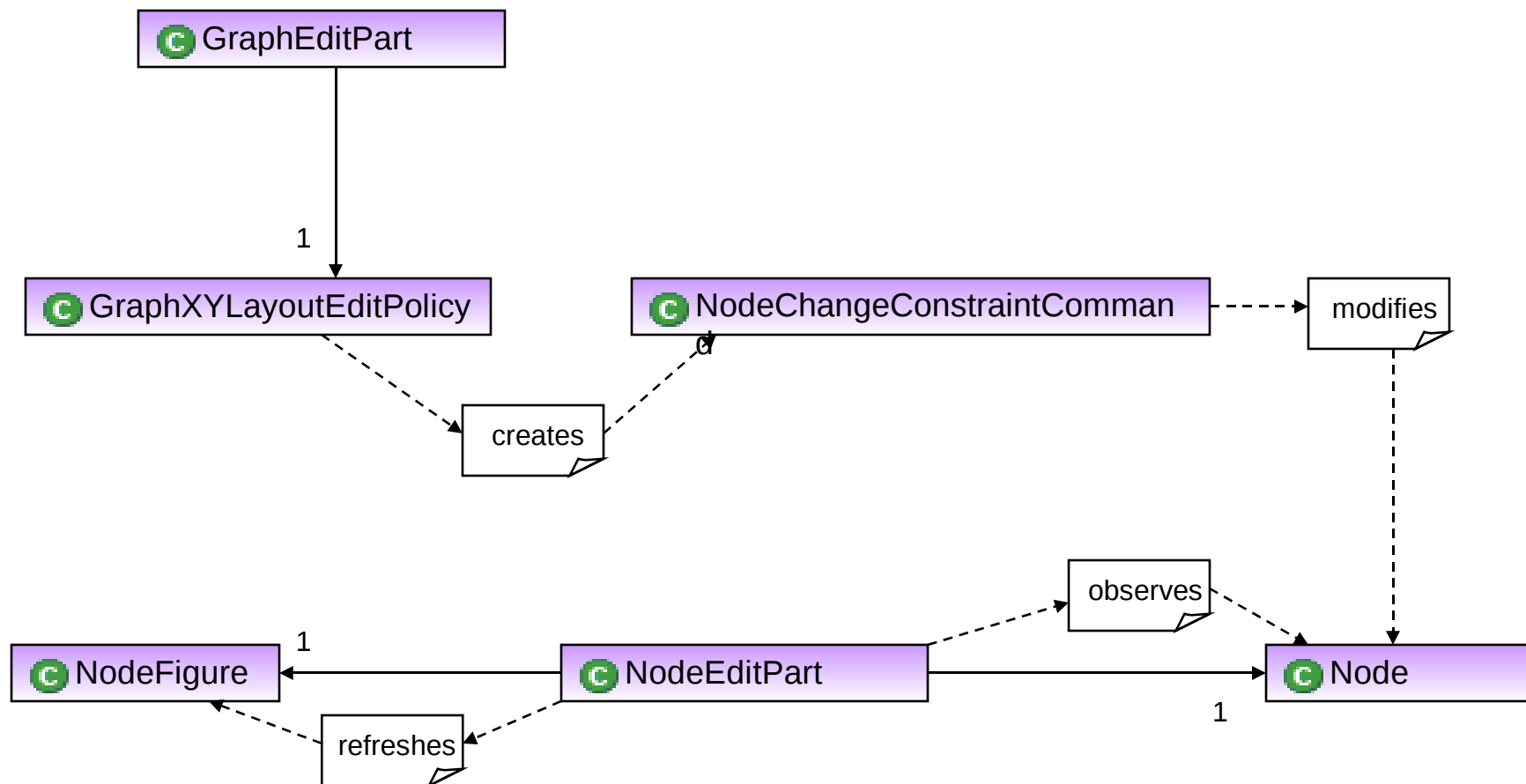
Adding the Nodes : the Result



Doing Things With Nodes

- Adding the Spine : EditDomain
- Transform Requests into Commands : EditPolicy
- Implementing Commands to Modify the Model
- Having the EditParts React to Model Changes : Observer
- Undo and Redo Support: ActionRegistry and ActionBarContributor

The Node Move/Resize Scenario



GEF's Spine : the EditDomain Class

- State of a 'GEF Application'
 - CommandStack
 - One or more EditPartViewers
 - Active Tool
- Tied with an Eclipse IEditorPart

Adding the EditDomain

```
public class GraphEditor extends EditorPart {
    private EditDomain editDomain;

    ...
    public void init(IEditorSite site, IEditorInput input)
        throws PartInitException {
        ...
        initEditDomain()
    }
    private void initEditDomain() {
        editDomain = new DefaultEditDomain(this);
    }
    public void createPartControl(Composite parent) {
        ...
        editDomain.addViewer(viewer);
    }
}
```

NodeChangeConstraintCommand

```
public class NodeChangeConstraintCommand extends Command {  
    private Rectangle newConstraint;  
    private Rectangle oldConstraint  
    private Node node;  
    public void execute() {  
        if (oldConstraint == null)  
            oldConstraint = new Rectangle(node.getConstraint());  
        node.setConstraint(newConstraint);  
    }  
    public void undo() {node.setConstraint(oldConstraint);}  
    public void setNewConstraint(Rectangle newConstraint) {  
        this.newConstraint = newConstraint;  
    }  
    public void setNode(Node node) { this.node = node; }  
}
```

GraphXYLayoutEditPolicy

```
public class GraphXYLayoutEditPolicy
extends XYLayoutEditPolicy {
    protected Command createChangeConstraintCommand(
        EditPart child, Object constraint) {
        NodeChangeConstraintCommand changeConstraintCommand =
            new NodeChangeConstraintCommand();
        changeConstraintCommand.setNode((Node)child.getModel());
        changeConstraintCommand.setNewConstraint(
            (Rectangle)constraint);
        return changeConstraintCommand;
    }
    // We use a stub implementation for the other methods
    ...
}
```

GraphEditPart Revisited Again

- Editparts maintain lists of EditPolicies
- Chain of responsibility enabling certain commands

```
public class GraphEditPart
extends AbstractGraphicalEditPart {
    ...
    protected void createEditPolicies() {
        installEditPolicy(
            EditPolicy.LAYOUT_ROLE,
            new GraphXYLayoutEditPolicy());
    }
}
```

Node/NodeEditPart Revisited

- Nodes notify changes to listeners : Observable

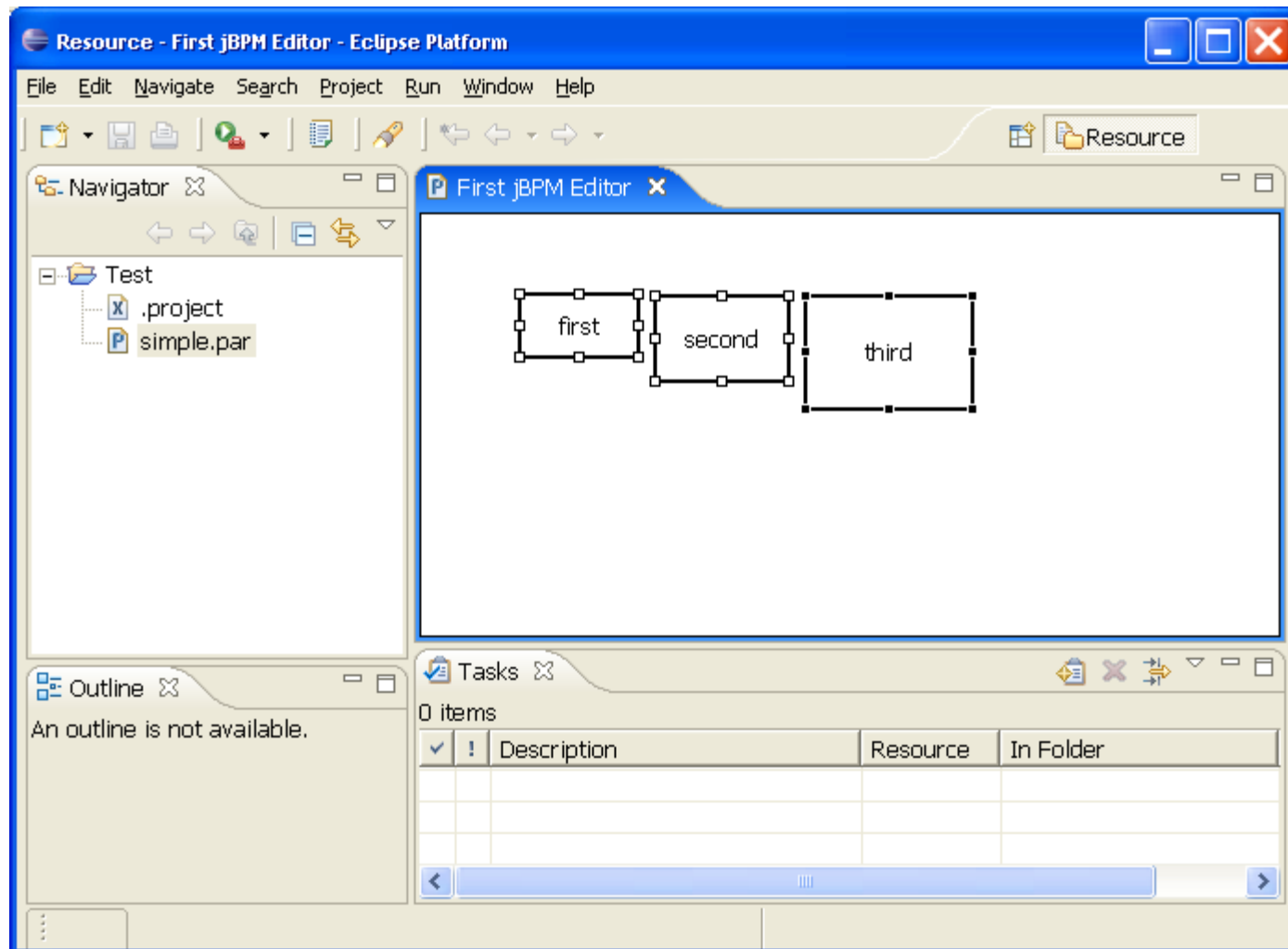
```
public class Node extends Observable {  
    ...  
    public void setConstraint(Rectangle constraint)  
        this.constraint = constraint;  
        setChanged();  
        notifyObservers();  
    }  
    ...  
}
```


Node/NodeEditPart Revisited

- NodeEditParts should respond to the changes of the Node : Observer

```
public class NodeEditPart
extends AbstractGraphicalEditPart implements Observer {
    ...
    public void activate() {
        if (!isActive()) ((Node)getModel()).addObserver(this);
        super.activate();
    }
    public void deactivate() {
        if (isActive()) ((Node)getModel()).deleteObserver(this);
        super.deactivate();
    }
    public void update(Observable arg0, Object arg1) {
        refreshVisuals();
    }
}
```

Selectable, Moveable, Resizable Nodes



Undo and Redo Support

- Add an ActionRegistry : container for Editor Actions
- Implement and register the EditorActionContributor
- Keep track of the Command events : CommandStackListener
- Adapt the Editor to the CommandStack class

Add the ActionRegistry

```
public class GraphEditor extends EditorPart {
    private ActionRegistry actionRegistry;
    ...
    public void init(IEditorSite site, IEditorInput input)
        throws PartInitException {
        ...
        initActionRegistry();
    }
    private void initActionRegistry() {
        actionRegistry = new ActionRegistry();
        actionRegistry.registerAction(new UndoAction(this));
        actionRegistry.registerAction(new RedoAction(this));
    }
    public ActionRegistry getActionRegistry() {
        return actionRegistry;
    }
}
```

Register the ActionBarContributor

- Defines the actions for the editor
- Registered in the plugin.xml

```
<plugin
...
  <extension point = "org.eclipse.ui.editors">
    <editor
      id = "org.jbpm.graph.ui.editor.GraphEditor"
      ...
      class = "org.jbpm.graph.ui.editor.GraphEditor"
      contributorClass=
        "org.jbpm.graph.ui.editor.ActionBarContributor" >
    </editor>
  </extension>
</plugin>
```

Implement the ActionBarContributor

```
public class ActionBarContributor
extends EditorActionBarContributor {
    public void setActiveEditor(IEditorPart targetEditor) {
        IActionBars actionBars = getActionBars();
        if (actionBars == null) return;
        String undoId = ActionFactory.UNDO.getId();
        String redoId = ActionFactory.REDO.getId();
        ActionRegistry actionRegistry =
            ((GraphEditor)targetEditor).getActionRegistry();
        actionBars.setGlobalActionHandler(
            undoId, actionRegistry.getAction(undoId));
        actionBars.setGlobalActionHandler(
            redoId, actionRegistry.getAction(redoId));
        actionBars.updateActionBars();
    }
}
```

Define a CommandStackListener

```
public class GraphEditorListener
implements CommandStackListener {
    private ActionRegistry actionRegistry;
    public GraphEditorListener(
        ActionRegistry registry) {
        this.actionRegistry = registry;
    }
    public void commandStackChanged(EventObject event) {
        Iterator iterator = actionRegistry.getActions();
        while (iterator.hasNext()) {
            Object action = iterator.next();
            if (action instanceof UpdateAction)
                ((UpdateAction)action).update();
        }
    }
}
```

Add a CommandStackListener

- Update the actions in the registry whenever the CommandStack's state changes

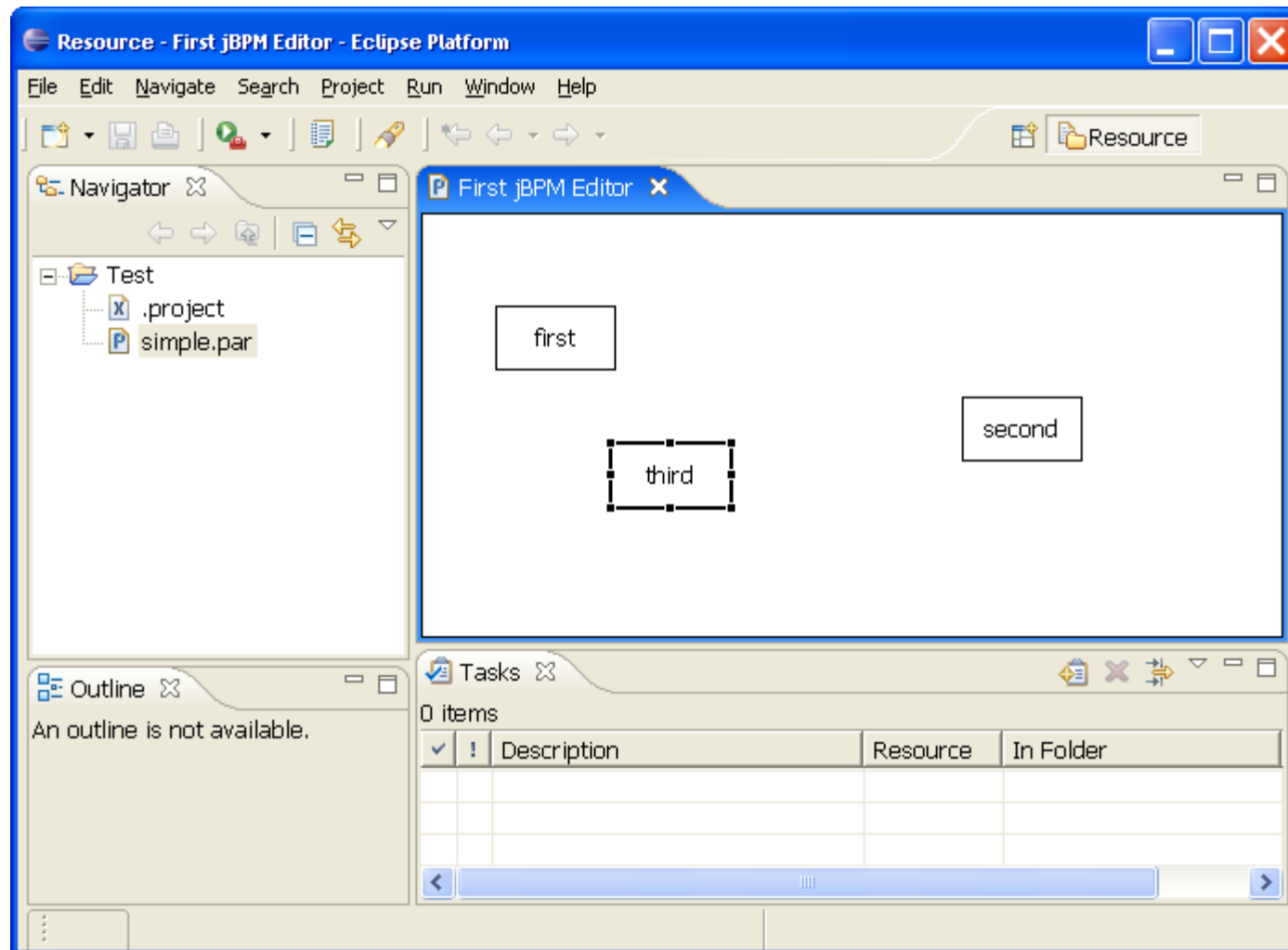
```
public class GraphEditor extends EditorPart {  
    ...  
    public void init(IEditorSite site, IEditorInput input)  
        throws PartInitException {  
        ...  
        initGraphEditorListener();  
    }  
    private void initGraphEditorListener() {  
        editDomain.getCommandStack().addCommandStackListener(  
            new GraphEditorListener(actionRegistry));  
    }  
}
```


Adapt the Editor to CommandStack

- Using the IAdaptable interface extended by IEditorPart

```
public class GraphEditor extends EditorPart {  
    ...  
    public Object getAdapter(Class adapter) {  
        if (adapter == CommandStack.class) {  
            return editDomain.getCommandStack();  
        }  
        return super.getAdapter(adapter);  
    }  
}
```

Undo and Redo Demo



Showing Connections

- The Model Class : Connection
- The Controller and Graphical Representation :
 - ConnectionEditPart
 - PolyLineConnection

Add the Connection Model Class

```
public class Connection {  
    private Node source, target;  
    public Node getSource() { return source; }  
    public void setSource(Node source) {  
        if (this.source != null)  
            source.removeSourceConnection(this);  
        this.source = source;  
        source.addSourceConnection(this);  
    }  
    public Node getTarget() { return target; }  
    public void setTarget(Node target) {  
        if (this.target != null)  
            target.removeTargetConnection(this);  
        this.target = target;  
        target.addTargetConnection(this);  
    }  
}
```

Update the Node Model Class

```
public class Node extends Observable {  
    ...  
    private List sourceConnections, targetConnections;  
    ...  
    public List getSourceConnections() {  
        if (sourceConnections == null)  
            sourceConnections = new ArrayList();  
        return sourceConnections;  
    }  
    public List getTargetConnections() {  
        if (targetConnections == null)  
            targetConnections = new ArrayList();  
        return targetConnections;  
    }  
    ...  
}
```

Update the Node Model Class (ctn'd)

```
public class Node extends Observable {  
    ...  
    public void addSourceConnection(Connection connection) {  
        getSourceConnections().add(connection);  
    }  
    public void addTargetConnection(Connection connection) {  
        getTargetConnections().add(connection);  
    }  
    public void removeSourceConnection(Connection connection) {  
        getSourceConnections().remove(connection);  
    }  
    public void removeTargetConnection(Connection connection) {  
        getTargetConnections().remove(connection);  
    }  
}
```

Update the ContentProvider

```
public class ContentProvider {  
    ...  
    public Graph newSampleGraph() {  
        Graph result = new Graph();  
        ...  
        newConnection(first, second);  
        newConnection(first, third);  
        newConnection(second, third);  
        return result;  
    }  
    private Connection newConnection(Node source, Node target) {  
        Connection result = new Connection();  
        result.setSource(source);  
        result.setTarget(target);  
        return result;  
    }  
}
```

Define the ConnectionEditPart

- Join source and target EditParts
- Figure is typically a line between the two nodes

```
public class ConnectionEditPart
extends AbstractConnectionEditPart {
    public ConnectionEditPart(Connection connection) {
        setModel(connection);
    }
    protected void createEditPolicies() {}
    protected IFigure createFigure() {
        return new PolylineConnection();
    }
}
```


GraphicalEditPartFactory Revisited

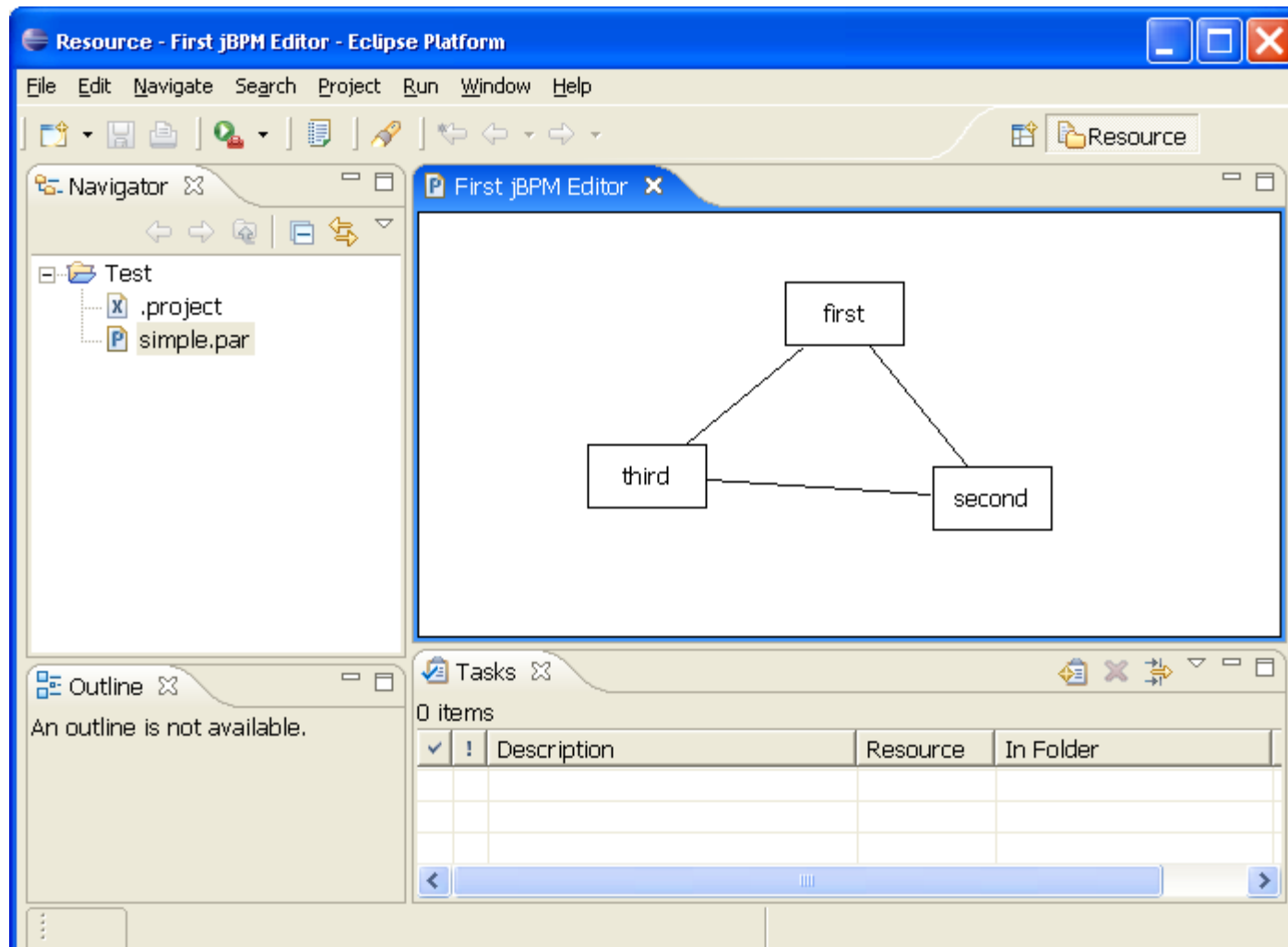
```
public class GraphicalEditPartFactory
implements EditPartFactory {
    public EditPart createEditPart(
        EditPart context, Object model) {
        if (model instanceof Graph) {
            return new GraphEditPart((Graph)model);
        } else if (model instanceof Node) {
            return new NodeEditPart((Node)model);
        } else if (model instanceof Connection){
            return new ConnectionEditPart((Connection)model);
        } else {
            return null;
        }
    }
}
```

NodeEditPart Revisited

- Connections can exist without a model
- Connections cannot exist without a source and a target
- Burden of obtaining the source and target connections is on the NodeEditPart and not on the Node model

```
public class NodeEditPart
extends AbstractGraphicalEditPart implements Observer {
    ...
    protected List getModelSourceConnections() {
        return ((Node)getModel()).getSourceConnections();
    }
    protected List getModelTargetConnections() {
        return ((Node)getModel()).getTargetConnections();
    }
}
```

Nodes and Connections



Creating Nodes and Connections

- Splitting the Canvas : SashForm and PaletteViewer
- Adding the Palette : PaletteRoot and its Tools
- Create Nodes : NodeCreateCommand
- Create Connections :
 - GraphicalNodeEditPolicy
 - ConnectionCreateCommand
 - ConnectionAnchor
 - NodeEditPart interface

GraphEditor Revisited Once More

- Refactor createPartControl
 - Add SashForm to parent
 - Add PaletteViewer and GraphViewer

```
public class GraphEditor extends EditorPart {  
    ...  
    public void createPartControl(Composite parent) {  
        SashForm form = new SashForm(parent, SWT.HORIZONTAL);  
        createPaletteViewer(form);  
        createGraphViewer(form);  
        form.setWeights(new int[] { 15, 85 });  
    }  
    ...  
}
```

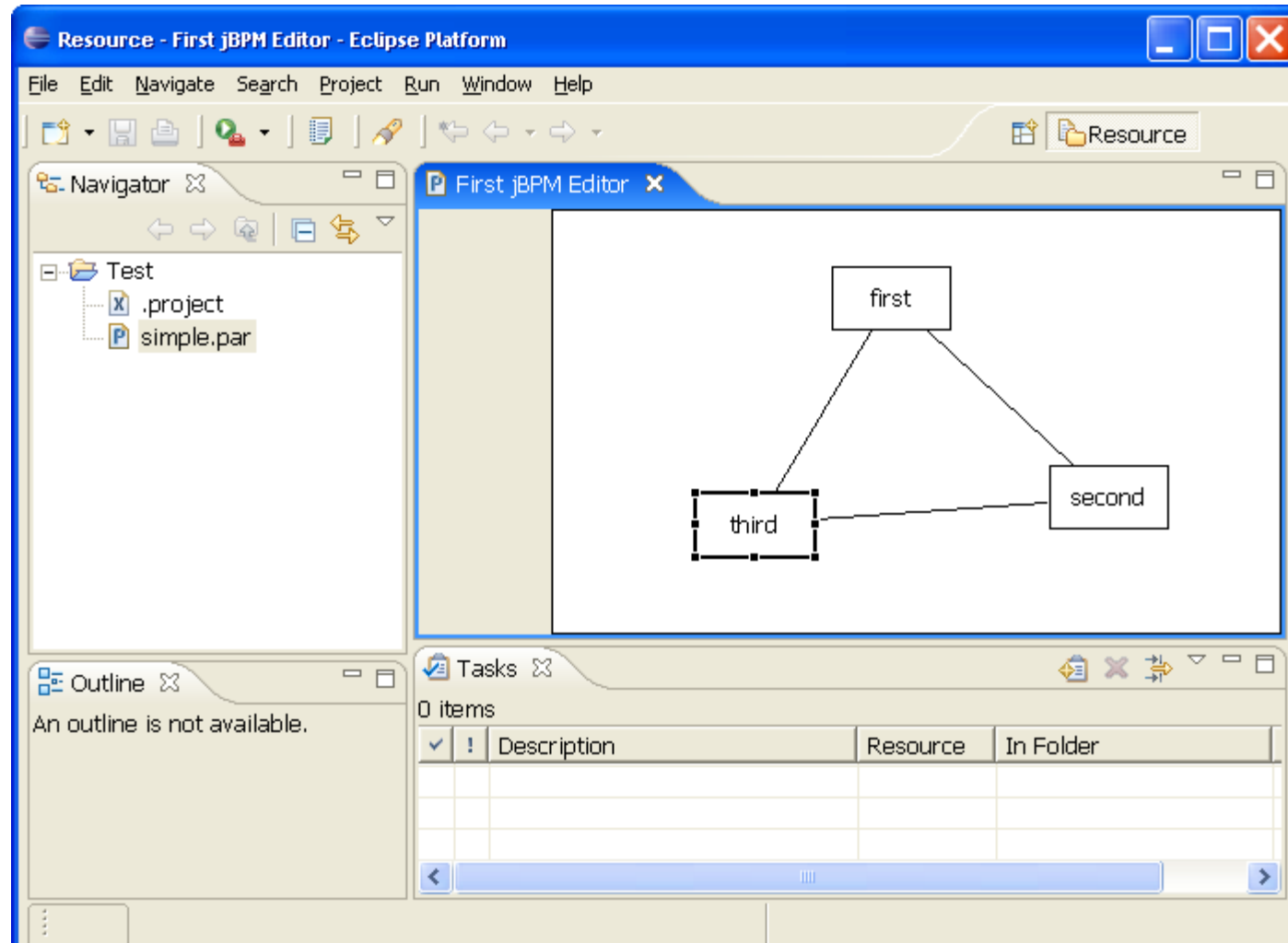
GraphEditor Revisited Once More (ctn'd)

```
public class GraphEditor extends EditorPart {  
    ...  
    private void createPaletteViewer(Composite parent) {  
        PaletteViewer viewer = new PaletteViewer();  
        viewer.createControl(parent);  
        editDomain.setPaletteViewer(viewer);  
        editDomain.setPaletteRoot(new PaletteRoot());  
    }  
    ...  
}
```

GraphEditor Revisited Once More (ctn'd)

```
public class GraphEditor extends EditorPart {  
    ...  
    private void createGraphViewer(Composite parent) {  
        ScrollingGraphicalViewer viewer =  
            new ScrollingGraphicalViewer();  
        viewer.setRootEditPart(new ScalableFreeformRootEditPart());  
        viewer.createControl(parent);  
        viewer.getControl().setBackground(ColorConstants.white);  
        viewer.setEditPartFactory(new GraphicalEditPartFactory());  
        viewer.setContents(  
            ContentProvider.INSTANCE.newSampleGraph());  
        editDomain.addViewer(viewer);  
    }  
}
```

Editor with Empty Palette



Populate the Palette : PaletteRoot

```
public class GraphPalette extends PaletteRoot {  
    public GraphPalette() {  
        PaletteGroup group = new PaletteGroup("Graph Controls");  
        SelectionToolEntry entry = new SelectionToolEntry();  
        group.add(entry);  
        setDefaultEntry(entry);  
        group.add(new PaletteSeparator());  
        group.add(new CreationToolEntry(  
            "Node", "Creates a new node.",  
            new NodeFactory(), null, null));  
        group.add(new ConnectionCreationToolEntry(  
            "Connection", "Creates a new connection.",  
            new ConnectionFactory(), null, null));  
        add(group);  
    }  
}
```

Populate the Palette : CreationFactory

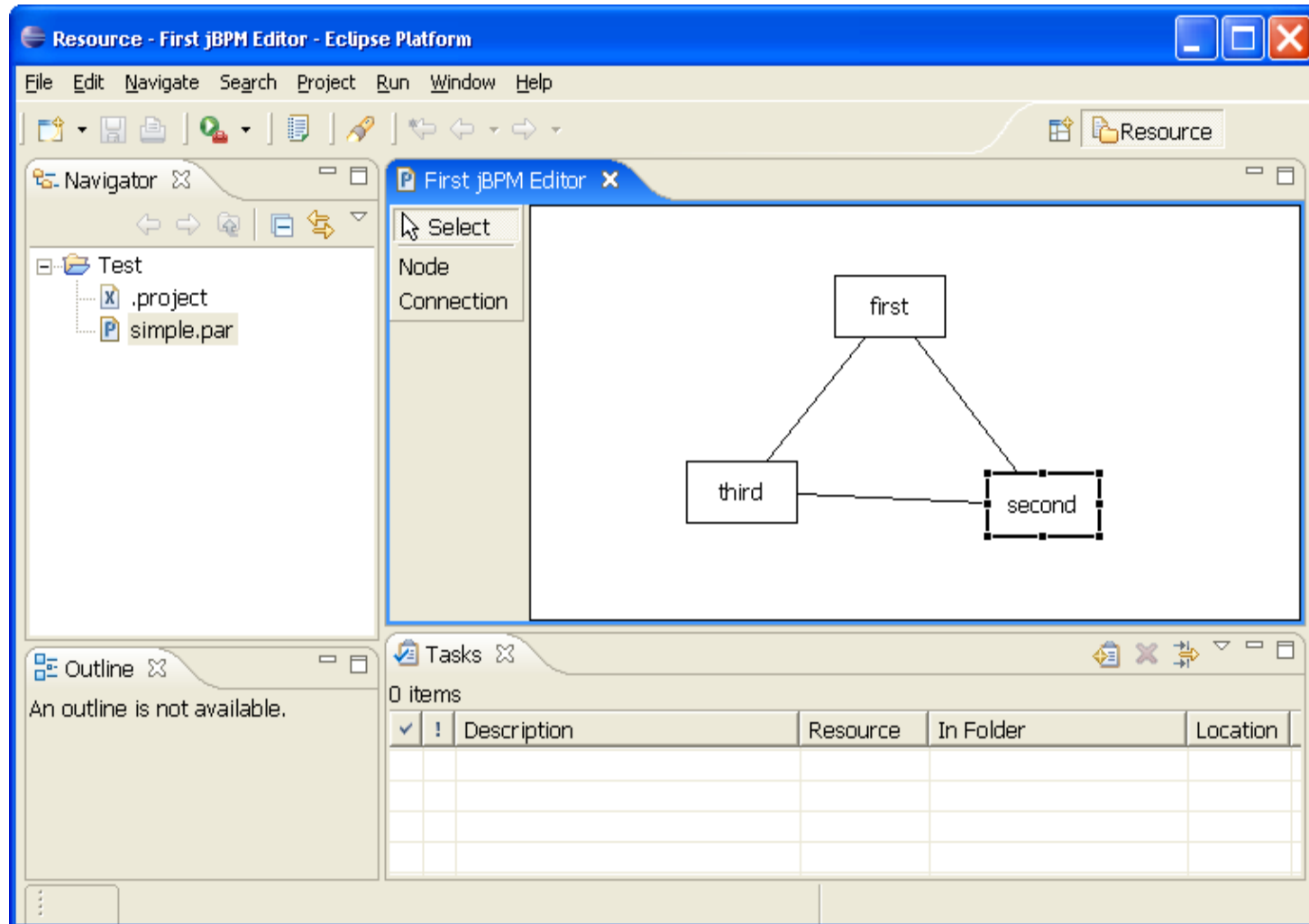
```
public class NodeFactory implements CreationFactor
{
    public Object getNewObject() { return new Node(); }
    public Object getObjectType() { return Node.class; }
}

public class ConnectionFactory implements CreationFactory {
    public Object getNewObject() { return new Connection(); }
    public Object getObjectType() { return Connection.class; }
}
```

Populate the Palette : GraphEditor

```
public class GraphEditor extends EditorPart {  
    ...  
    private void createPaletteViewer(Composite parent)  
    {  
        PaletteViewer viewer = new PaletteViewer();  
        viewer.createControl(parent);  
        editDomain.setPaletteViewer(viewer);  
        editDomain.setPaletteRoot(new GraphPalette());  
    }  
    ...  
}
```

Editor With Populated Palette



Creating New Nodes

- Define NodeCreateCommand
- Implement getCreateCommand
- Make Graph/GraphEditPart Observer/Observable

Define NodeCreateCommand

```
public class NodeCreateCommand extends Command {  
    ...  
    private Node node;  
    private Rectangle constraint;  
    private Graph parent;  
    public void execute() {  
        setNodeConstraint();  
        setNodeName();  
        parent.addNode(node);  
    }  
    private void setNodeName() {  
        node.setName(parent.getNextNodeName());  
    }  
    private void setNodeConstraint() {  
        if (constraint !=  
null) node.setConstraint(constraint);  
    }  
    ...  
}
```

Define NodeCreateCommand (ctn'd)

```
public class NodeCreateCommand extends Command {  
    private static final Dimension INITIAL_NODE_DIMENSION =  
        new Dimension(65, 35);  
    ...  
    public void undo() {parent.removeNode(node);}  
    public void setNode(Node node) {this.node = node;}  
    public void setLocation(Point location) {  
        this.constraint = new Rectangle(  
            location, INITIAL_NODE_DIMENSION);  
    }  
    public void setParent(Graph parent) {  
        this.parent = parent;  
    }  
}
```

Graph Revisited Again

```
public class Graph {  
    ...  
    public String getNextNodeName() {  
        int runner = 1;  
        while (true) {  
            String candidate = "node" + runner;  
            if (getNodeByName(candidate) == null) return candidate;  
            runner ++;  
        }  
    }  
    private Node getNodeByName(String candidate) {  
        for (int i = 0; i < getNodes().size(); i++)  
            if (candidate.equals(((Node) getNodes().get(i)).getName()))  
                return (Node) getNodes().get(i);  
        return null;  
    }  
}
```


GraphXYLayoutPolicy Revisited

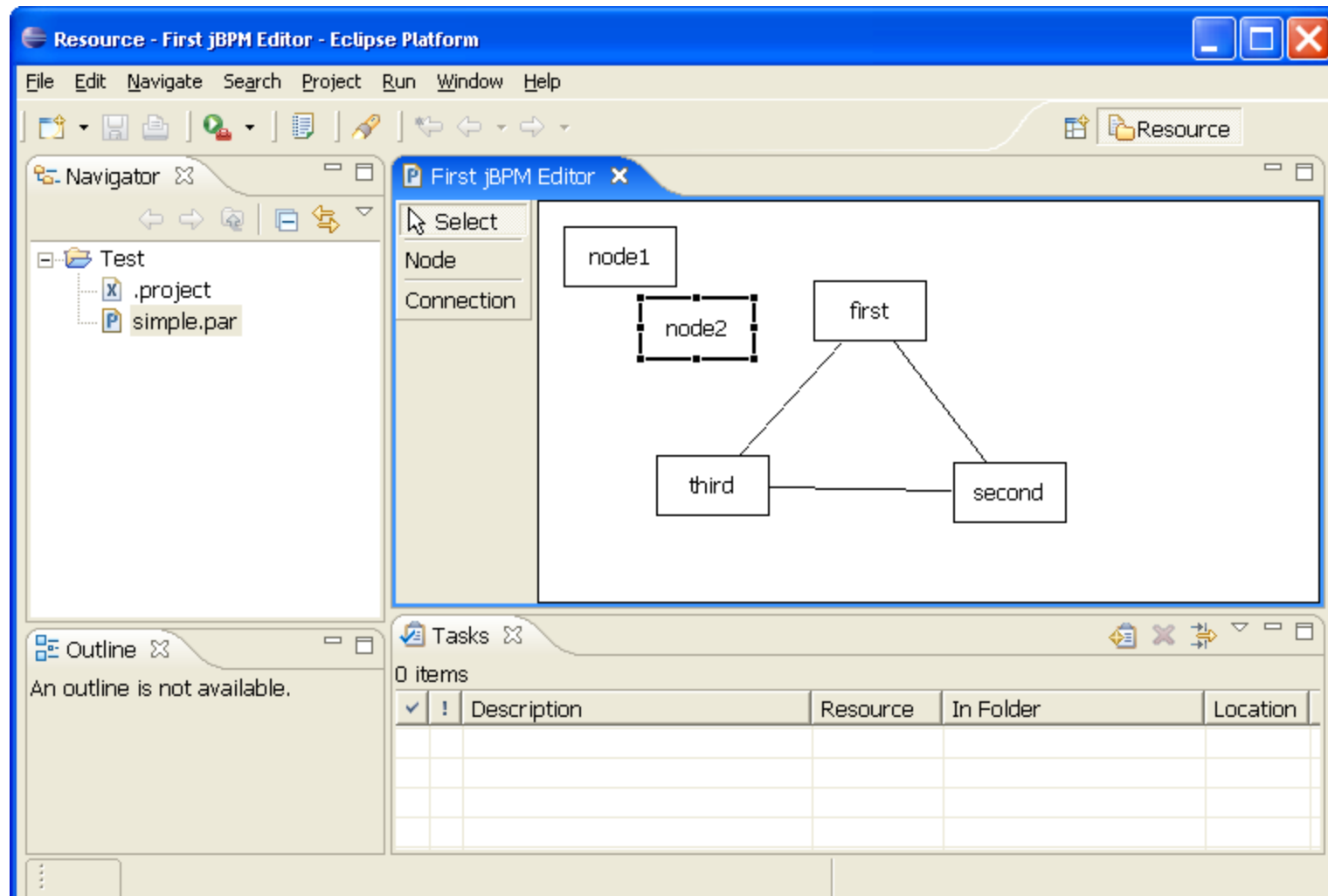
- Implement getCreateCommand
 - Only handle requests to create Nodes

```
public class GraphXYLayoutEditPolicy
extends XYLayoutEditPolicy {
    ...
    protected Command getCreateCommand(CreateRequest request) {
        if (request.getNewObjectType().equals(Node.class)) {
            NodeCreateCommand result = new NodeCreateCommand();
            result.setLocation(request.getLocation());
            result.setNode((Node)request.getNewObject());
            result.setParent((Graph)request.getHost().getModel());
            return result;
        }
        return null;
    }
}
```

Graph Revisited Once More

```
public class Graph extends Observable {  
    ...  
    public void addNode(Node node) {  
        getNodes().add(node);  
        setChanged();  
        notifyObservers();  
    }  
    public void removeNode(Node node) {  
        getNodes().remove(node);  
        setChanged();  
        notifyObservers();  
    }  
    ...  
}
```

Editor With Some Extra Nodes



Creating New Connections

- Define ConnectionCreateCommand
- Define NodeGraphicalNodeEditPolicy
 - Implement getConnectionCreateCommand
 - Implement getConnectionCompleteCommand
- Make connection changes observable
- Install NodeGraphicalNodeEditPolicy
- Make our NodeEditPart implement the `org.eclipse.gef.NodeEditPart` interface
 - Obtaining the ConnectionAnchor
- Observe the connection changes of the model
- Get rid of the ContentProvider

Define ConnectionCreateCommand

```
public class ConnectionCreateCommand extends Command {  
    private Node source;  
    private Node target;  
    private Connection connection  
    public void setSource(Node source) {  
        this.source = source;  
    }  
    public void setTarget(Node target) {  
        this.target = target;  
    }  
    public void setConnection(Connection connection) {  
        this.connection = connection;  
    }  
    ...  
}
```

ConnectionCreateCommand (ctn'd)

```
public class ConnectionCreateCommand extends Command {  
    ...  
    public boolean canExecute() {  
        return source != null && target != null;  
    }  
    public void execute() {  
        connection.setSource(source);  
        connection.setTarget(target);  
    }  
    public void undo() {  
        connection.setSource(null);  
        connection.setTarget(null);  
    }  
}
```

Define NodeGraphicalNodeEditPolicy

```
public class NodeGraphicalNodeEditPolicy
extends GraphicalNodeEditPolicy {
    protected Command getConnectionCreateCommand(
        CreateConnectionRequest request) {
        ConnectionCreateCommand result =
            new ConnectionCreateCommand();
        result.setSource((Node)getHost().getModel());
        result.setConnection((Connection)request.getNewObject());
        request.setStartCommand(result);
        return result;
    }
    ...
}
```

Define NodeGraphicalNodeEditPolicy (ctn'd)

```
public class NodeGraphicalNodeEditPolicy
extends GraphicalNodeEditPolicy {
    ...
    protected Command getConnectionCompleteCommand(
        CreateConnectionRequest request) {
        ConnectionCreateCommand result =
            (ConnectionCreateCommand)request.getStartCommand();
        result.setTarget((Node)request.getHost().getModel());
        return
    }
    //Stubs for the remaining methods
}
```


Node Revisited Again

```
public class Node extends Observable {  
    ...  
    public void addSourceConnection(Connection connection) {  
        getSourceConnections().add(connection);  
        notifyObservers();  
    }  
    public void addTargetConnection(Connection connection) {  
        getTargetConnections().add(connection);  
        notifyObservers();  
    }  
    ...  
}
```

Node Revisited Again (ctn'd)

```
public class Node extends Observable {  
    ...  
    public void removeSourceConnection(Connection connection) {  
        getSourceConnections().remove(connection);  
        notifyObservers();  
    }  
    public void removeTargetConnection(Connection connection) {  
        getTargetConnections().remove(connection);  
        notifyObservers();  
    }  
}
```

NodeEditPart Revisited Again

- Installation of the NodeGraphicalNodeEditPolicy

```
public class NodeEditPart
extends AbstractGraphicalEditPart
implements Observer {
    ...
    protected void createEditPolicies() {
        installEditPolicy(
            EditPolicy.GRAPHICAL_NODE_ROLE,
            new NodeGraphicalNodeEditPolicy());
    }
}
```

NodeEditPart Revisited Again (ctn'd)

- Observing connection model changes

```
public class NodeEditPart
extends AbstractGraphicalEditPart
implements Observer {
    ...
    public void update(Observable observable, Object message) {
        refreshVisuals();
        refreshSourceConnections();
        refreshTargetConnections();
    }
}
```

NodeEditPart Revisited Again (ctn'd)

```
public class NodeEditPart extends AbstractGraphicalEditPart
implements Observer, org.eclipse.gef.NodeEditPart {
    ...
    public ConnectionAnchor getSourceConnectionAnchor(
        ConnectionEditPart connection) {
        return ((NodeFigure)getFigure()).getConnectionAnchor();
    }
    public ConnectionAnchor getTargetConnectionAnchor(
        ConnectionEditPart connection) {
        return ((NodeFigure)getFigure()).getConnectionAnchor();
    }
    ...
}
```

NodeEditPart Revisited Again (ctn'd)

```
public class NodeEditPart extends AbstractGraphicalEditPart
implements Observer, org.eclipse.gef.NodeEditPart {
    ...
    public ConnectionAnchor getSourceConnectionAnchor(
        Request request) {
        return ((NodeFigure)getFigure()).getConnectionAnchor();
    }
    public ConnectionAnchor getTargetConnectionAnchor(
        Request request) {
        return ((NodeFigure)getFigure()).getConnectionAnchor();
    }
}
```

NodeFigure Revisited

- Create the connection anchor lazily

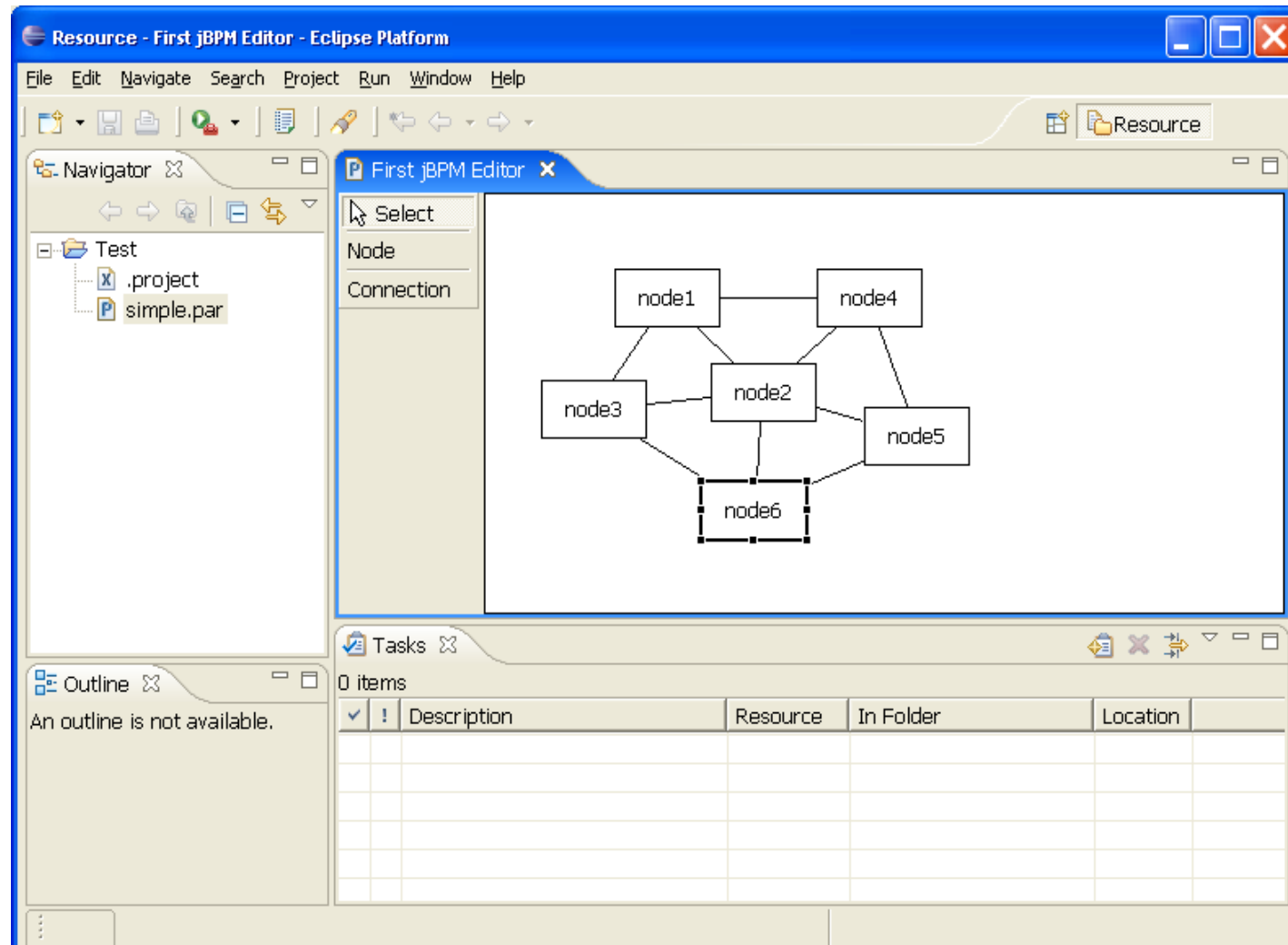
```
public class NodeFigure extends Figure {  
    private ConnectionAnchor connectionAnchor;  
    ...  
    public ConnectionAnchor getConnectionAnchor() {  
        if (connectionAnchor == null) {  
            connectionAnchor = new ChopboxAnchor(this);  
        }  
        return connectionAnchor;  
    }  
}
```

Eliminate ContentProvider

- Delete the ContentProvider class
- Modify the createGraphViewer method in class GraphEditor

```
public class GraphEditor extends EditorPart {  
    ...  
    private void createGraphViewer(Composite parent) {  
        ScrollingGraphicalViewer viewer =  
            new ScrollingGraphicalViewer();  
        viewer.setRootEditPart(new ScalableFreeformRootEditPart());  
        viewer.createControl(parent);  
        viewer.getControl().setBackground(ColorConstants.white);  
        viewer.setEditPartFactory(new GraphicalEditPartFactory());  
        viewer.setContents(new Graph());  
        editDomain.addViewer(viewer);  
    }  
}
```


GraphEditor With Connection Support



Delete Support

- Include DeleteAction in ActionRegistry
- Selection Support :
 - SelectionProvider
 - SelectionListener
- Update ActionBarContributor
- Deleting Nodes :
 - NodeDeleteCommand
 - NodeComponentEditPolicy
- Deleting Connections :
 - ConnectionDeleteCommand
 - ConnectionEditPolicy
 - ConnectionEndpointEditPolicy

ActionRegistry Revisited

```
public class GraphEditor extends EditorPart {  
    private ActionRegistry actionRegistry;  
    ...  
    private void initActionRegistry() {  
        actionRegistry = new ActionRegistry();  
        actionRegistry.registerAction(new UndoAction(this));  
        actionRegistry.registerAction(new RedoAction(this));  
        actionRegistry.registerAction(  
            new DeleteAction((WorkbenchPart)this);  
    }  
    ...  
}
```

GraphViewer Is SelectionProvider

```
public class GraphEditor extends EditorPart {  
    ...  
    private void createGraphViewer(Composite parent) {  
        ScrollingGraphicalViewer viewer =  
            new ScrollingGraphicalViewer();  
        viewer.setRootEditPart(new ScalableFreeformRootEditPart());  
        viewer.createControl(parent);  
        viewer.getControl().setBackground(ColorConstants.white);  
        viewer.setEditPartFactory(new GraphicalEditPartFactory());  
        viewer.setContents(new Graph());  
        editDomain.addViewer(viewer);  
        getSite().setSelectionProvider(viewer);  
    }  
}
```

Define the SelectionListener

```
public class GraphEditorListener
implements CommandStackListener, ISelectionListener
...
    public void commandStackChanged(EventObject event) {
        updateActions();
    }
    public void selectionChanged(
        IWorkbenchPart part, ISelection selection) {
        updateActions();
    }
    ...
}
```

Define the SelectionListener (ctn'd)

```
public class GraphEditorListener
implements CommandStackListener, ISelectionListener
...
private void updateActions() {
    Iterator iterator = actionRegistry.getActions();
    while (iterator.hasNext()) {
        Object action = iterator.next();
        if (action instanceof UpdateAction)
            ((UpdateAction)action).update();
    }
}
```

Add the SelectionListener

```
public class GraphEditor extends EditorPart {  
    ...  
    private void initGraphEditorListener() {  
        GraphEditorListener graphEditorListener =  
            new GraphEditorListener(actionRegistry);  
        ISelectionService selectionService =  
            getSite().getWorkbenchWindow().getSelectionService();  
        editDomain.getCommandStack().addCommandStackListener(  
            graphEditorListener);  
        selectionService.addSelectionListener(  
            graphEditorListener);  
    }  
}
```

Update ActionBarContributor

```
public class ActionBarContributor
extends EditorActionBarContributor {
    public void setActiveEditor(IEditorPart targetEditor) {
        ...
        String deleteId = ActionFactory.DELETE.getId();
        actionBars.setGlobalActionHandler(
            deleteId, actionRegistry.getAction(deleteId));
        actionBars.updateActionBars();
    }
}
```


Define NodeDeleteCommand

```
public class NodeDeleteCommand extends Command {  
    private Node node;  
    private Graph graph;  
    private List connections;  
    private Map connectionSources, connectionTargets;  
    public void setNode(Node node) { this.node = node; }  
    public void setGraph(Graph graph) { this.graph = graph; }  
    public void execute() {  
        detachConnections();  
        graph.removeNode(node);  
    }  
    public void undo() {  
        graph.addNode(node);  
        reattachConnections();  
    }  
    ...  
}
```

Define NodeDeleteCommand (ctn'd)

```
public class NodeDeleteCommand extends Command {  
    ...  
    private void detachConnections() {  
        connections = new ArrayList();  
        connectionSources = new HashMap();  
        connectionTargets = new HashMap();  
        connections.addAll(node.getSourceConnections());  
        connections.addAll(node.getTargetConnections());  
        for (int i = 0; i < connections.size(); i++) {  
            Connection connection = (Connection)connections.get(i);  
            connectionSources.put(connection, connection.getSource());  
            connectionTargets.put(connection, connection.getTarget());  
            connection.setSource(null);  
            connection.setTarget(null);  
        }  
    }  
    ...  
}
```

Define NodeDeleteCommand (ctn'd)

```
public class NodeDeleteCommand extends Command {  
    ...  
    private void reattachConnections() {  
        for (int i = 0; i < connections.size(); i++) {  
            Connection connection = (Connection)connections.get(i);  
            connection.setSource(  
                (Node)connectionSources.get(connection));  
            connection.setTarget(  
                (Node)connectionTargets.get(connection));  
        }  
    }  
}
```

Define NodeComponentEditPolicy

- Override the createDeleteCommand method

```
public class NodeComponentEditPolicy
extends ComponentEditPolicy {
    protected Command createDeleteCommand(GroupRequest request) {
        NodeDeleteCommand deleteCommand = new NodeDeleteCommand();
        deleteCommand.setGraph(
            (Graph)getHost().getParent().getModel());
        deleteCommand.setNode((Node)getHost().getModel());
        return deleteCommand;
    }
}
```

Install NodeComponentEditPolicy

- Responsibility of NodeEditPart

```
public class NodeEditPart extends ... {  
    ...  
    protected void createEditPolicies() {  
        ...  
        installEditPolicy(  
            EditPolicy.COMPONENT_ROLE,  
            new NodeComponentEditPolicy());  
    }  
}
```

Selecting Connections

- Install ConnectionEndpointEditPolicy
 - Primary SelectionEditPolicy for showing focus on connections
 - All ConnectionEditParts need one

```
public class ConnectionEditPart
extends AbstractConnectionEditPart {
    ...
    protected void createEditPolicies() {
        installEditPolicy(
            EditPolicy.CONNECTION_ENDPOINTS_ROLE,
            new ConnectionEndpointEditPolicy());
    }
    ...
}
```

Define ConnectionDeleteCommand

```
public class ConnectionDeleteCommand extends Command {  
    private Node source, target;  
    private Connection connection  
    public void setConnection(Connection  
        this.connection = connection;  
    }  
    public void execute() {  
        if (source == null) source = connection.getSource();  
        if (target == null) target = connection.getTarget();  
        connection.setSource(null);  
        connection.setTarget(null);  
    }  
    public void undo() {  
        connection.setSource(source);  
        connection.setTarget(target);  
    }  
}
```

Define ConnectionEditPolicy

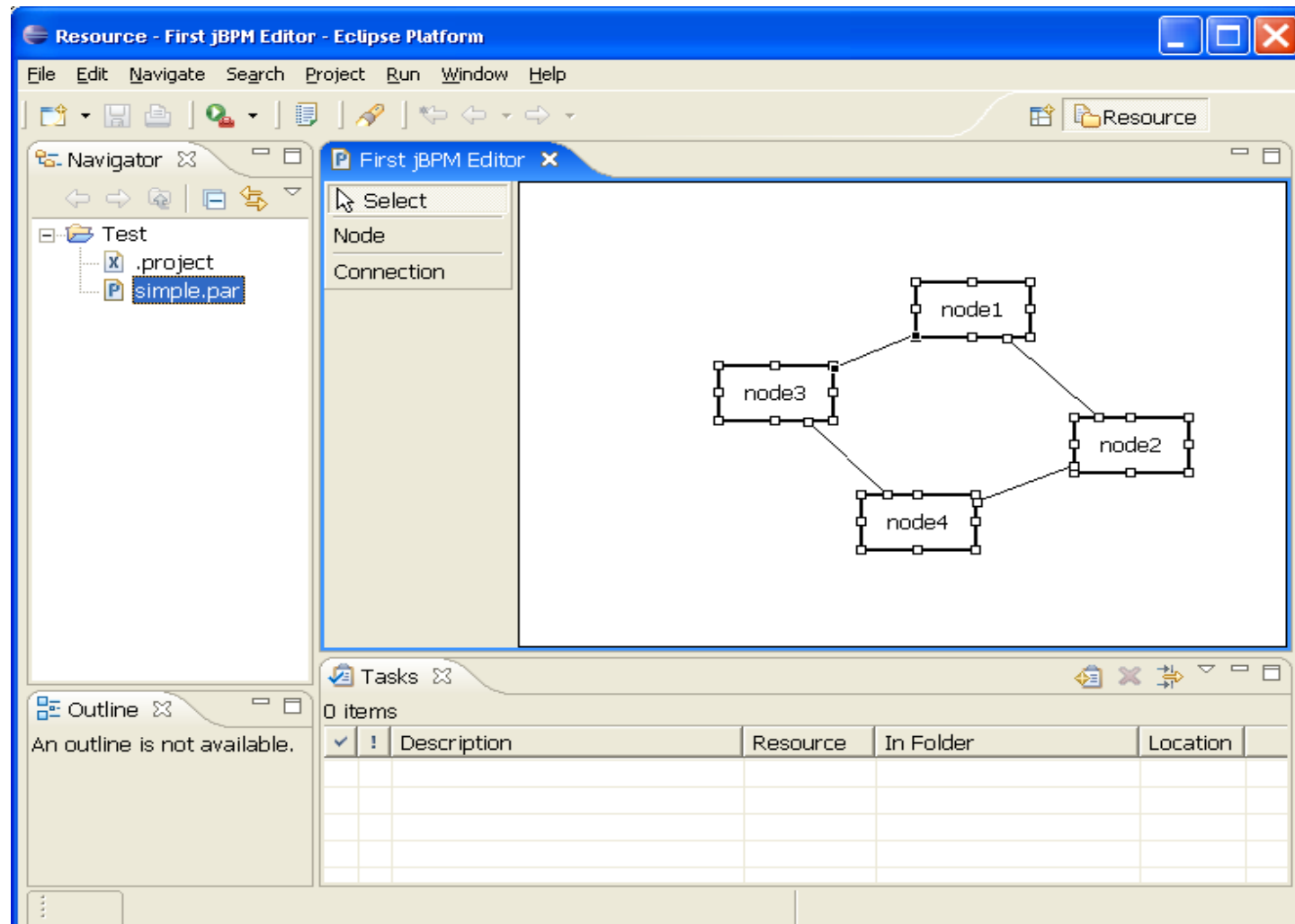
- Default model-based EditPolicy for Connections
- Only knows about the model and its basic operations
 - Single default operation : DELETE

```
public class ConnectionEditPolicy
extends org.eclipse.gef.editpolicies.ConnectionEditPolicy {
    protected Command getDeleteCommand(GroupRequest request) {
        ConnectionDeleteCommand result =
            new ConnectionDeleteCommand();
        result.setConnection((Connection)getHost().getModel());
        return result;
    }
}
```


Install ConnectionEditPolicy

```
public class ConnectionEditPart
extends AbstractConnectionEditPart {
    ...
    protected void createEditPolicies() {
        installEditPolicy(
            EditPolicy.CONNECTION_ROLE,
            new ConnectionEditPolicy());
        installEditPolicy(
            EditPolicy.CONNECTION_ENDPOINTS_ROLE,
            new ConnectionEndpointEditPolicy());
    }
    ...
}
```

Basic Functional Graph Editor



What's Next?

- Saving and loading the model
 - By serialization or with XML representation
- Provide an outline view
- Support for a grid, zooming, guides, ...
- Make actions available through context menu
- Provide an extension point to plug-in custom node types

Final Thoughts

- Steep and long learning curve
 - Starting from scratch is not easy
 - No books available
 - Starting small is mandatory to fully understand
- Very rich framework
 - Lots of predefined functionality
 - Do very complex things with almost no code
- Use code and javadocs to find details
 - Overwhelming for newbie

Questions?