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OpenMap™ Development, Part 2

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Agenda

- Controlling the Map Projection
- Different Projections
- Managing OMGraphics
- Symbols
- Drawing OMGraphics
- OMGrid/OMRaster Issues
- Clipping, Holes in OMGraphics
- PropertyConsumer and GUIs
- Geo (spatial indexing)
- OpenMap 5.0 changes, including time controls

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Controlling the Map Projection

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Controlling the Map Projection

- Projection object in MapBean controls map view
- Change Projection, layers notified
- MapBean API methods
  - `setProjection(Projection proj);`
  - `setCenter(lat, lon);`
  - `setScale(float scale);`

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MapBean Projection API

- Each call to MapBean Projection API causes Projection events to be sent to layers
- For multiple changes, modify Projection object instead and set it on MapBean

Instead of:

```
mapBean.setCenter(lat, lon);
mapBean.setScale(scale);
```

Do:

```
Proj p = (Proj) mapBean.getProjection();
p.setCenter(lat, lon);
p.setScale(scale);
mapBean.setProjection(p);
```

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MapBean as Listener

- MapBean is an event listener
  - PanListener for PanEvents
  - ZoomListener for ZoomEvents
  - CenterListener for CenterEvents

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Find the MapBean

- For API calls, find MapBean as source object of events
  - –ProjectionEvent
  - –MouseEvent
- Components that want the MapBean to listen for events should use the MapHandler.

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Projection and MapBean

- MapBean provides Projection, a read-only interface
- Projections need to be cast to Proj in order to modify parameters
- Call setProjection(Projection) on MapBean after modifications. Layers hold copy and won't pick up changes.

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OpenMap Projection Types

- Mercator
- Equal Arc (CADRG, LLXY)
- Orthographic
- Equal Distance (LambertConformal, UTM)
- Gnomonic

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Projection Line Types

- Great Circle
  - Shortest geocentric line between two points
  - Longitude lines
- Rhumb
  - Line of constant bearing between two points
  - Latitude (and Longitude) lines
- Straight
  - Pixel lines, no geographic significance

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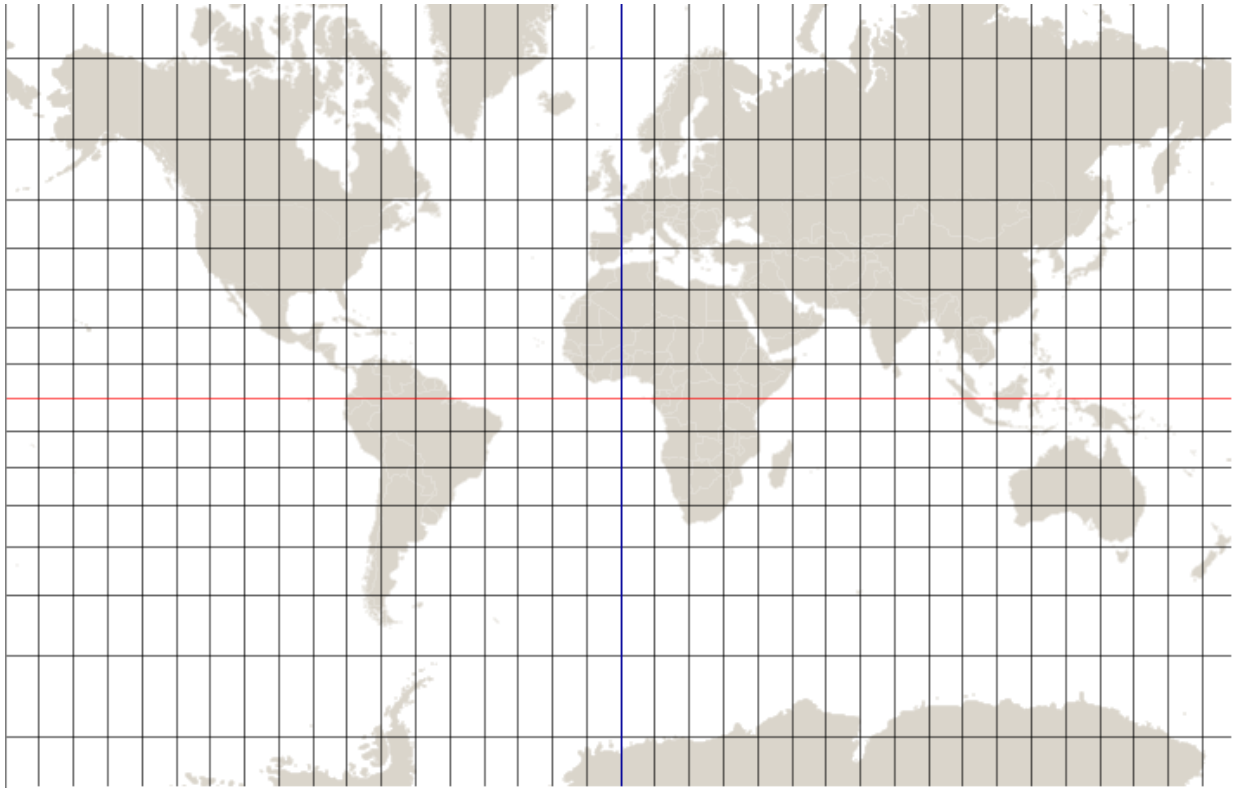
Mercator

- Longitude and latitude lines perpendicular and straight
- Distortion - moving away from equator increases pixel distances between latitude lines
- Lines of constant direction (bearing) are straight



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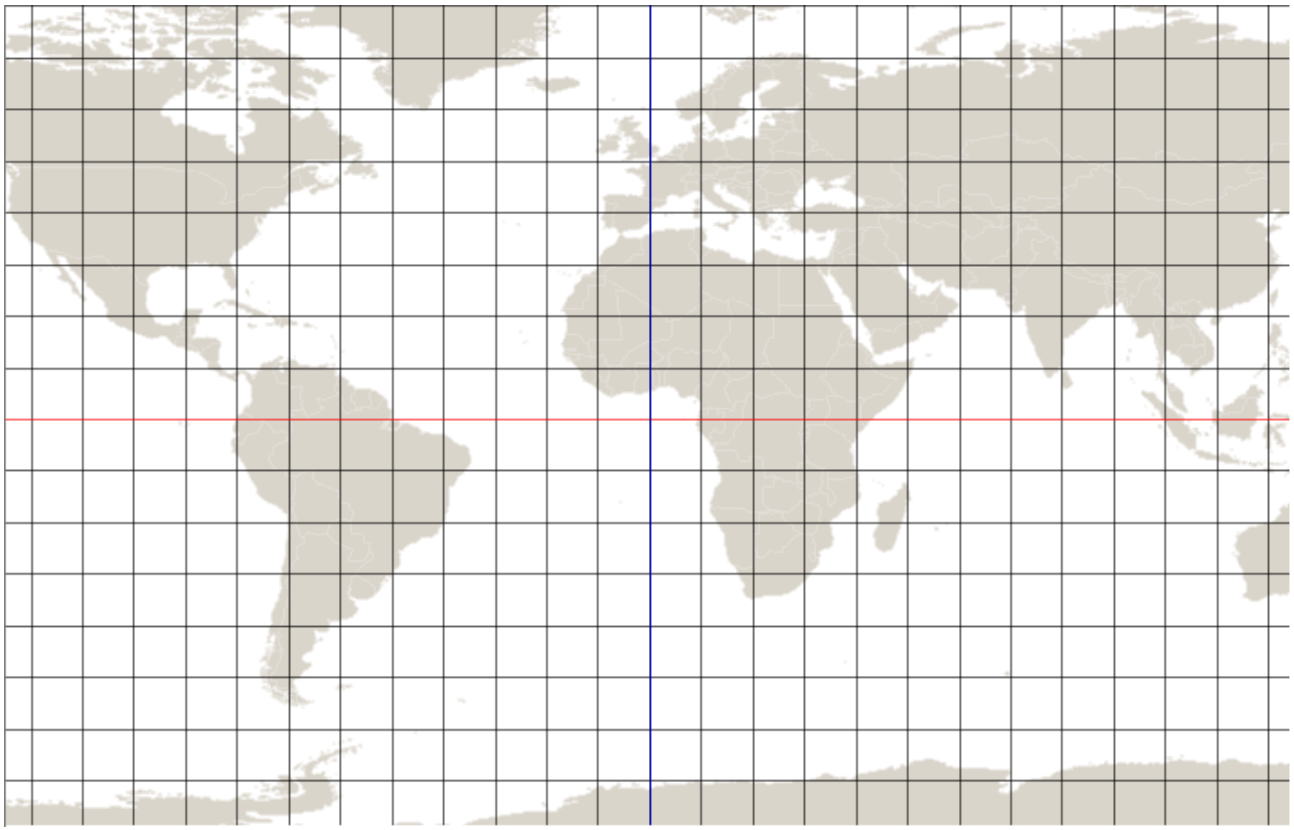
Equal Arc (CADRG, LLXY)

- Pixels and geocentric coordinates change at the same rate
- Good for images from generic sources



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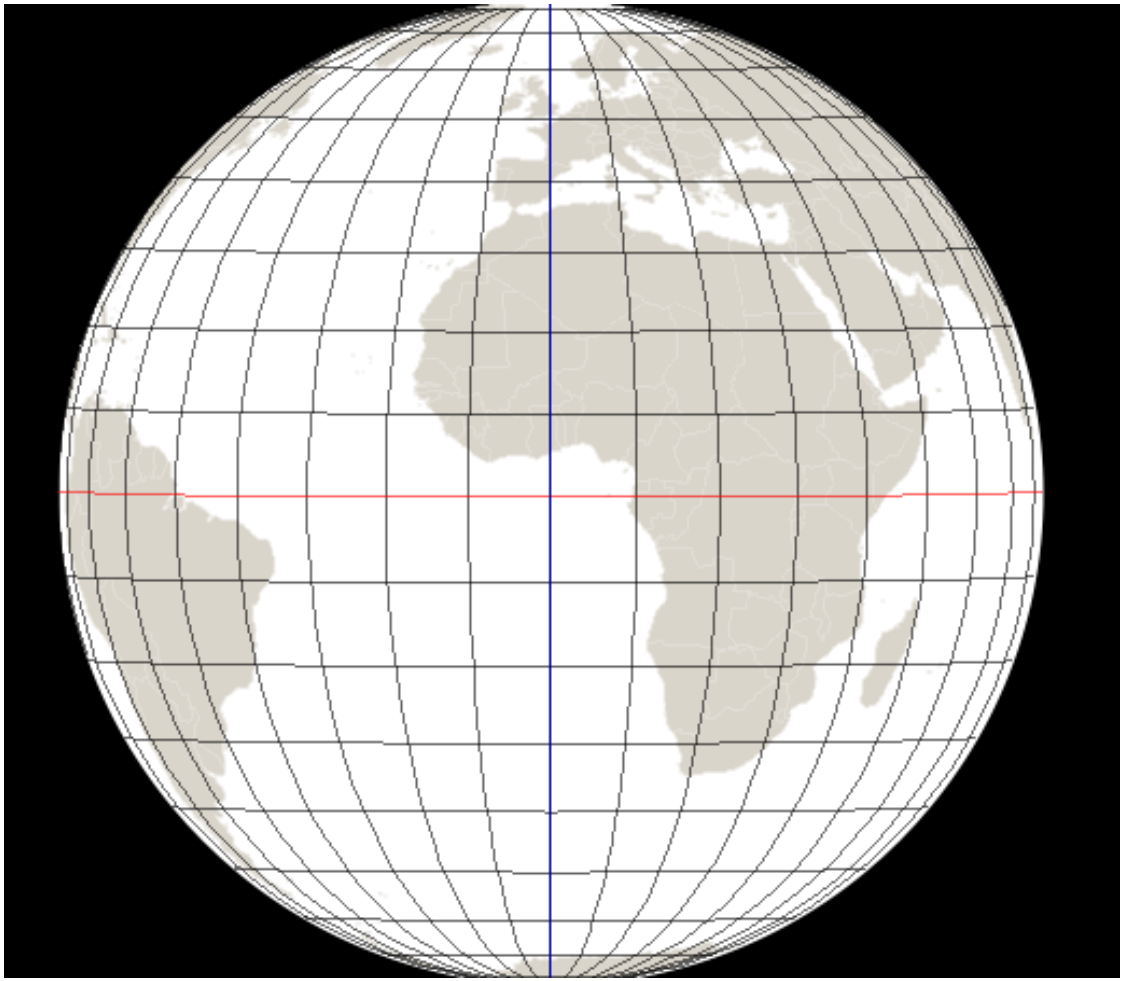
Orthographic

- Great circle lines through center are straight
- Always directed at the center point of map



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Equal Distance (UTM, Conic)

- Pixels and ground distance change at same rate
- Zones based on Longitude, accuracy errors occur when away from Median longitude

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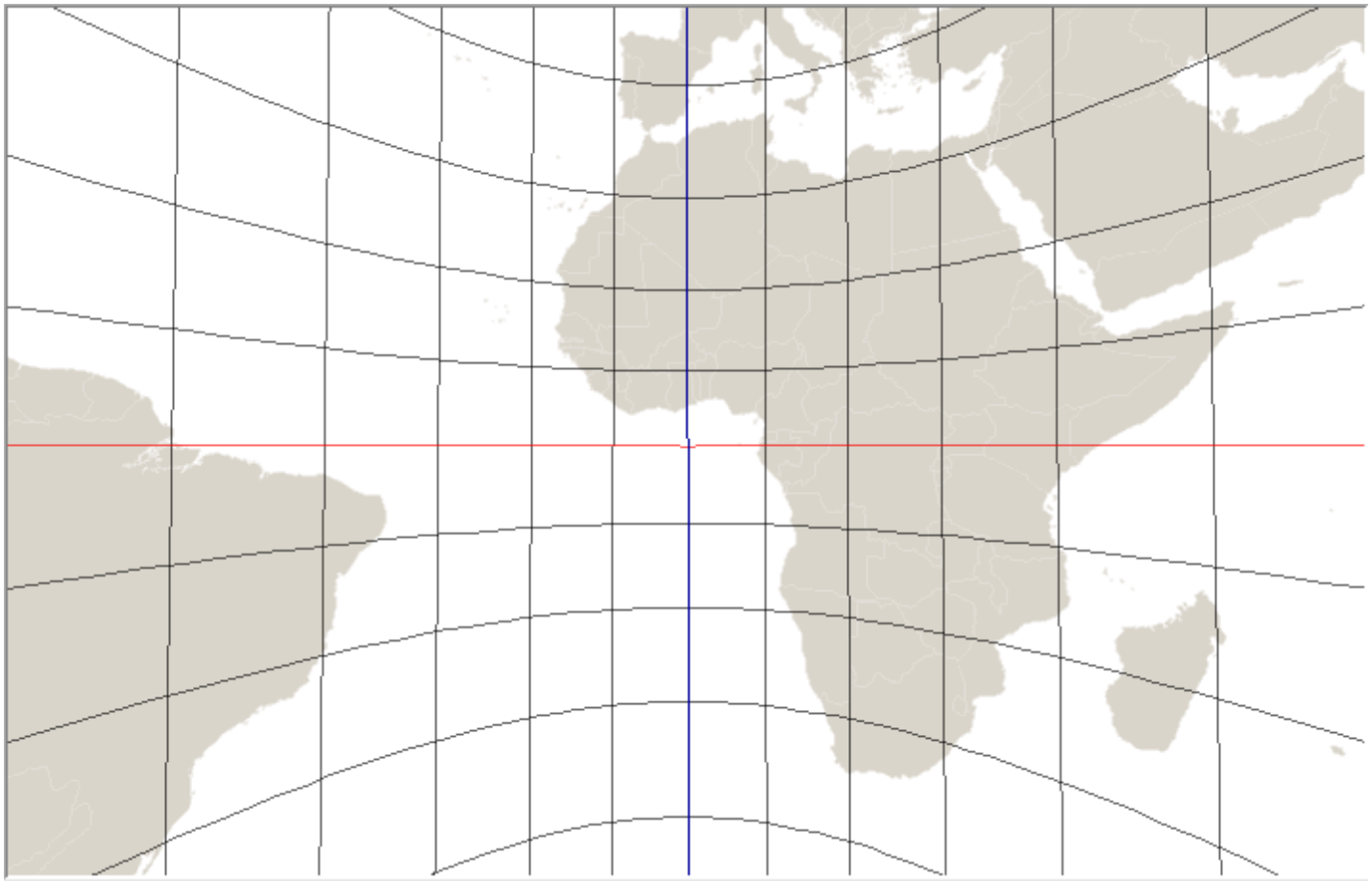
Gnomonic

- Great circle lines are straight



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Managing OMGraphics

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Layer Manages OMGraphics

- Data View, responding to Projection
- Layer is responsible for deciding how OMGraphics are managed and organized
- If more organization is needed, OMGraphicLists to organize OMGraphics into groups

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Responding to Scale Changes

- Change Layers, completely different data source
- Change rendering contents of OMGraphicList for single Layer
- Choice usually depends on:
  - data source for different scales - different source, different layers
  - Complexity of application to present to users

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Switching Layers

- ScaleFilterLayer
  - A parent layer that switches between child layers, depending on the map scale
  - Need to have one less transition scale than layer count
- BufferedLayer
  - A layer that maintains a set of layers within a personal MapBean
  - Renders layers as image

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ScaleFilterLayer

- Configure in API

```
setLayersAndScales(Layer[], float[]);
```

- Configure in Properties

```
scaledRoads.class=com.bbn.openmap.layer.ScaleFilterLayer
scaledRoads.prettyName=Northeast Roads
scaledRoads.layers=neroads neroadsDetailed
scaledRoads.transitionScales=150000

neroads.class=com.bbn.openmap.layer.shape.ShapeLayer
…

neroadsDetailed.class=com.bbn.openmap.layer.shape.ShapeLayer
…
```

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BufferedLayer

- Configure in API

```
addLayer(Layer);
removeLayer(Layer);
clearLayers();
```

- Configure in Properties

```
bufLayer.class=com.bbn.openmap.layer.BufferedLayer
bufLayer.prettyName=My Layer Group
bufLayer.layers=layer1 layer2 layer3
bufLayer.visibleLayers=layer1 layer3
bufLayer.hasActiveLayers=false…
```

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Modifying Layer Data

- OMGraphicHandlerLayer
  - Filter in the prepare() method
- Initially organize data to quickly evaluate OMGraphics as sets
- Remember to consider data set size
  - Brute force might be just as good as clever organization
  - Run, evaluate, refine

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Organizing OMGraphics

- OMGraphic organization dictated by rendering appearance
  - Rendering related to drawing order
  - Drawing order dependent on OMGraphicList add order
- OMGraphicList doesn't have to be used for rendering
  - Visibility
  - Selection

Symbols

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Using Symbols

- Different sources
  - Images from files
  - Mil-Std-2525B package
  - Icon package
- OMScalingIcon
  - Centers image over location
  - Can change image size for

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Symbol from Image File

- Use ImageIcon class to load

```
ImageIcon ii = new ImageIcon("data/images/earthmap1k.jpg");
Image image = ii.getImage();
```

- Can also use BufferedImageHelper
  - com.bbn.openmap.image package
  - Uses JAI if available

```
URL imageURL = PropUtils.getResourceOrFileOrURL(imagePath);
BufferedImage bi =
  BufferedImageHelper.getBufferedImage(imageURL);
```

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Mil-Std-2525b Symbols

- Use SymbolReferenceLibrary
- com.bbn.openmap.tools.symbology.milStd2525 package
- DISA symbol set, not all possibilities included
- Symbols identified by 15 character key code
- SymbolChooser lets you figure out what's available and get the code

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SymbolReferenceLibrary

- Configure in Properties:

```
srl.class=com.bbn.openmap.tools.symbology.milStd2525.SymbolReferenceLibrary
srl.imageMakerClass=com.bbn.openmap.tools.symbology.milStd2525.PNGSymbolImageMak
    er
srl.path=data/symbols/milStd2525
```

- Configure via API

```
PNGSymbolImageMaker imageMaker = new PNGSymbolImageMaker(pathToPNGs);
SymbolReferenceLibrary srl = new SymbolReferenceLibrary(imageMaker);
```

- PNG, GIF and SVG available

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OMIconFactory

- Creates resizable vector icons
- Defined with IconPart/IconPartList
- Rendered with DrawingAttributes

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Drawing OMGraphics

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OMDrawingTool

- Passes MouseEvents to OMGraphics to change OMGraphic parameters
- EditableOMGraphics wrap OMGraphic
  - Provide grab points
  - Contain state machine that control modification of OMGraphic
- Manages modification, passes result back to DrawingToolListener

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OMDrawingTool and EditToolLoaders

- EditToolLoader tells OMDrawingTool which EditableOMGraphic should be used for OMGraphic
- EditToolLoaders available for circles, range rings, rectangles, polys, rasters, points, lines, splines, text, distance

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EditorLayer

- OMGraphicHandlerLayer with Tool Interface
- Provides controls on ToolPanel
- Provide editing controls for single layer
- Requires EditorTool component that determines what editor does
  - DrawingEditorTool
- Integrated mouse mode directs events to layer

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EditorLayer Examples

- EditorLayer with DrawingEditorTool
- GeoIntersectionLayer

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OMDrawingTool via API

- Ask if DrawingTool can handle OMGraphic

```
omDrawingTool.canEdit(omGraphic.getClass());
```

- Edit OMGraphic

```
omDrawingTool.edit(omGraphic, drawingToolRequestor);
```

- Create OMGraphic

```
omDrawingTool.create(class, drawingAttributes,
  DrawingToolRequestor, ifGUIAllowed);
```

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DrawingToolRequestor

- Component the DrawingTool notifies when it's done
- Usually the layer

```
drawingComplete(OMGraphic, OMAction);
```

- OMAction lets you know if OMGraphic should be added, deleted or moved

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Spatial Filtering

- FilterSupport provides simple spatial filtering in x-y space for an OMGraphicList

```
FilterSupport fSupport = new
   FilterSupport(OMGraphicList);
```

- Filtering based on Shape object, can be retrieved from projected OMGraphic and passed to FilterSupport

```
OMGraphicList filtered =
   fSupport.filter(Shape,insideOrOutside);
```

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OMGrid/OMRaster Issues

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Projection Mismatch

- OMGrid appearance is set of OMGraphics created by OMGridGenerators
- SimpleColorGenerator creates Equal Arc projected image, won't match Mercator
- New ImageWarp/OMWarpingImage classes will take pixels and create warped image

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Crossing the Dateline

- Crossing the Dateline is handled, if the entire image is rendered on map.
- Really a small-world problem - occurs when image needs to be rendered on both sides of map, i.e. if the image wraps around the map area.

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Small-world Solutions

- OMScalingRaster needs to be extended/ updated to paint image twice, once for each side of map
- Can take code from OMRect to make the projection calls to determine locations

```
ArrayList rects =
   proj.forwardRect(new LatLonPoint(lat1, lon1), // NW
                    new LatLonPoint(lat2, lon2), // SE
                    lineType, nseg, !isClear(fillPaint));
int size = rects.size();
```

- Make smaller OMGrids/OMRasters

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Clipping and OMGraphics

- Setting clip area on java.awt.Graphics limits the render area, specifies the area that gets painted
- java.awt.geom.Area created from Shape, other areas can be subtracted.
- JTS Topology Suite

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Using the PropertyConsumer Interface

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PropertyConsumer

- Interface for component that can be configured by Properties
- Provides methods for setting and getting properties
- Also provides methods for gathering information about what properties are available to be set (editors)

```
void setProperties(String, Properties);
void setProperties(Properties);
void setPropertyPrefix(String);
String getPropertyPrefix();
Properties getProperties(Properties);
Properties getPropertyInfo(Properties);
```

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Defining Properties

- As defined in the class, properties should be unscoped, as if property prefix is undefined

```
public final static ShowLabelsProperty = “showLabels”; // not .
  showLabels
```

- In setProperties, use PropUtils to prepare prefix:

```
String prefix =
  PropUtils.getScopedPropertyPrefix(PropertyConsumer);
String prefix =
  PropUtils.getScopedPropertyPrefix(String);


String property = properties.get(prefix +

                                 ShowLabelsProperty);
```

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Property Output

- getProperties method returns Properties filled with scoped key values as Strings

```
properties.putProperty(prefix + ShowLabelsProperty,
                       Boolean.toString(showLabels));
```

- Should always call super.getProperties() if superclass is PropertyConsumer
- Should always return a Properties object

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Property Metadata

- getPropertyInfo provides Properties that describe PropertyConsumer
- Each property requires 3 properties added
  - Non-scoped property name
  - Property name + ScopedEditorProperty
  - Property name + LabelEditorProperty

```
propInfo.put(ShowLabelsProperty, “Description”);
propInfo.put(ShowLabelsProperty +
  ScopedEditorProperty,
  com.bbn.openmap.util.PropertyEditor.YesNoProperty);
propInfo.put(ShowLabelsProperty + LabelEditorProperty,
  “GUI Label”);
```

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PropertyEditors

- ScopedEditorProperty allows you to define a component that provides a GUI for a property
- PropertyEditors in package com.bbn.openmap.util.propertyEditor
- Inspector class creates GUI from getPropertyInfo properties

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Using the Geo Spatial Package

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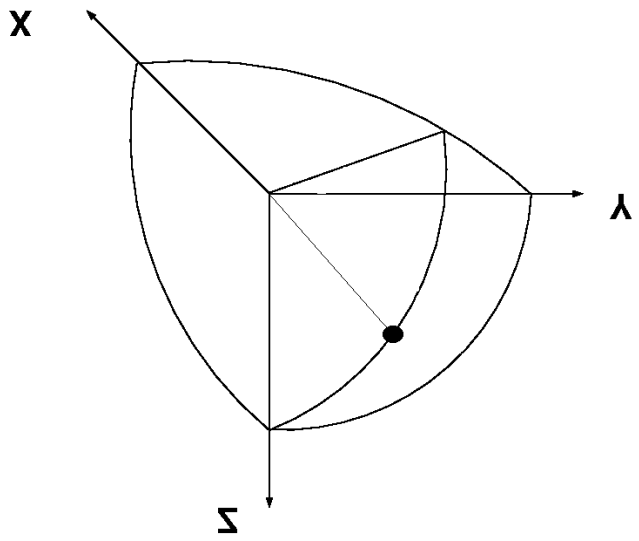
Geo Spatial Index Package

- Package that represents locations, paths and areas as vectors
- A coordinate is represented by Geo
  - x, y, z tuple instead of lat, lon
- Paths and areas are arrays of Geos



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Geo

- Represents location
- Can perform operations against other Geos
  - Distance
  - Midpoint between
  - Other Geo at azimuth, distance
  - Vector math - add, subtract, dot and cross products
- GeoArray is a Geo[] object

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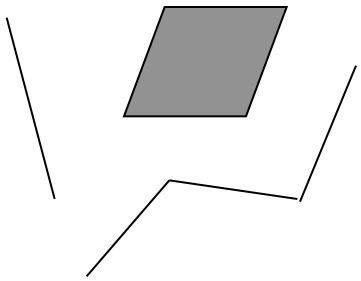
GeoExtent

- Group of Geos that represent an object
  - GeoSegment - two points
  - GeoPath - more than two points
  - GeoRegion - area of points
- All have BoundingCircle (center, radius)



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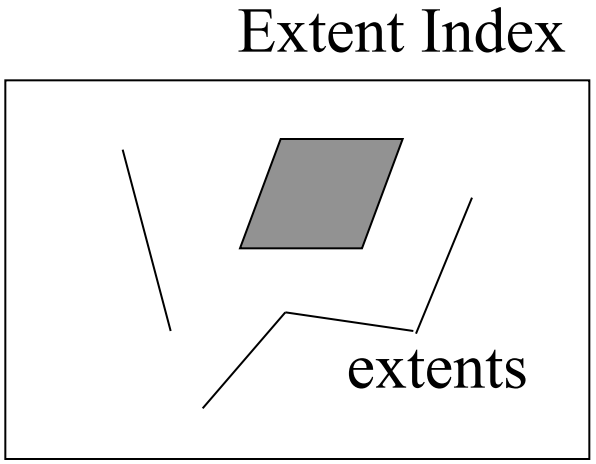
ExtentIndex

- Spatial index that organizes Extents for quick searches
- ExtentIndexImpl organizes by longitude strips



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Intersection

- Class that manages queries on an ExtentIndex
- Also answers direct spatial intersection queries about Extents
- For ExtentIndex queries, uses MatchFilter and MatchCollector
  - MatchFilter specifies distance between objects to be considered a hit
  - MatchCollector is where you get the answers, via iterator

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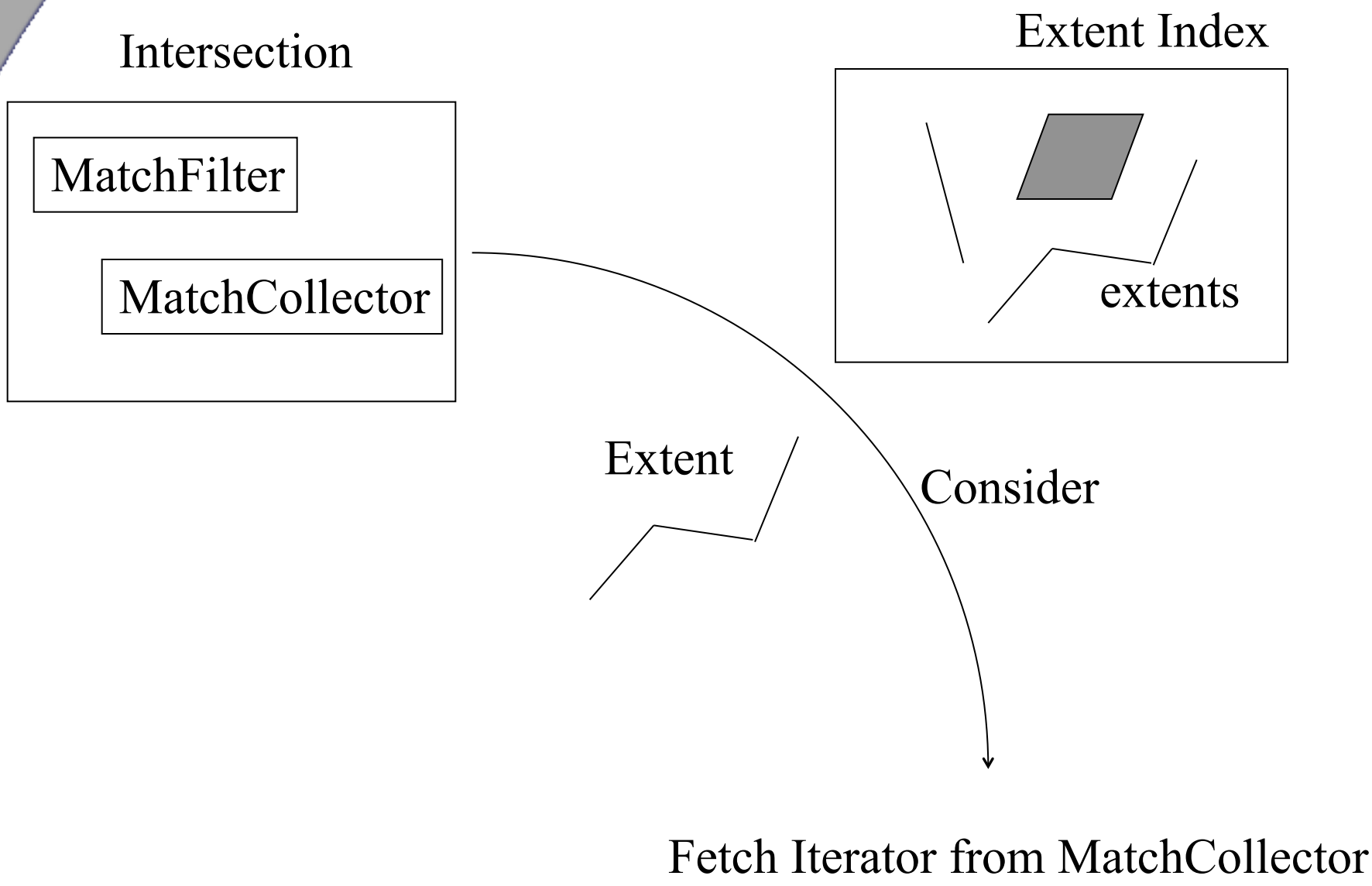
Using Intersection with ExtentIndex



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Intersection Functions

- Region intersects region?
- Path intersect region?
- Point in region?
- Intersection point between GC arcs?
- Polys intersect?
- Point on segment?
- GC arc within distance of point?

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OpenMap 5.0 Changes

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OpenMap 5.0

- Changes will be required to move from OM4.6.5 to OM5.0
- Projection API changed
- Increased precision
- OMGeo, OMShape

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Starts with LatLonPoint

- LatLonPoint drastically changed
  com.bbn.openmap.proj.coords.LatLonPoint

- Extends Point2D, behaves like it
  - LatLonPoint abstract
  - Create LatLonPoint.Float, LatLonPoint.Double

- 'get' methods return different values
  - getX(), getY() returns double decimal degrees
  - getRadLat(), getRadLon() returns radians
  - getLatitude(), getLongitude() returns float decimal degrees

- setLocation(X, Y) !!! Just like Point2D

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Projection API Changes

- Projections are now based on Point2D objects
  - Old:

```
Point forward(LatLonPoint);
LatLonPoint inverse(Point);
```

  - New:

```
Point2D forward(Point2D);
Point2D inverse(Point2D);
```

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Projection Hierarchy

- Proj/Projection still the top class
- Cartesian projection (x, y)
- GeoProj, new class
  - Generics allow LatLonPoint returns
  - All old projections are GeoProj objects

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ProjectionFactory

- ProjectionFactory no longer singleton
- Created like any other Component, should be added to MapHandler
- Available via MapBean

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Precision Upgrade

- Projection library calculations all based on doubles
- OMGraphics based on doubles, signatures changed
- Old floats only accurate to 7ft, doubles accurate to centimeters.

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OMGeo

- OMGraphic class that internally uses Geo and Extents to represent shapes
- OMGeo abstract, instantiate inner classes
  - OMGeo.Pt
  - OMGeo.Line
  - OMGeo.Polyline
  - OMGeo.Region
- Can be used in ExtentIndex

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OMShape

- New OMGraphic that takes java.awt.Shape objects as source geometry
- Intended for use with Cartesian projection, will work with GeoProj projections if coordinate range fits

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OMEvents and Time Controls

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OMEvent Handling

- OMEvents represent something that happens at a time and place
- Time Conrols display events in
  - List form
  - Timeline form
  - On the map for a given time
- Manage Clock's current time

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OMEvent

- Provides text description of event
- Timestamp
- Optional location
- Can contain attributes

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OMEventHandler

- Creates OMEvents from data source
- Added to MapHandler
- Can provide filtering

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Event List Presenter

- Provides a chronological list of events
- Events are selectable
  - Timeline adjusts
  - Map adjusts of events have location

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Timeline

- Provides view to events on time scale
- Selectable
  - Event list responds
  - Map responds if events have location

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OpenMap Contact Information: