



Developing Defense Applications using Military Analyst and MOLE

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Schedule

- **75 minute session**
 - 60 – 65 minutes
 - Agenda next slide
 - 10 – 15 minutes Q & A following the lecture
- **We will save and answer your questions at the end**
- **Cell phones and pagers**
- **Don't Forget Session Surveys!**

Please!
Turn **OFF** cell phones
and paging devices



**Please save your
questions for the end
of the presentation**

Agenda

- **Introductions**
- **Defense Solutions Quick Tour**
 - Military Analyst
 - MOLE
- **What's New at 9.3**
 - Code Snippets
- **Integration Scenarios**
 - Demos
- **Resources**
- **Q & A**



Introductions

- Who are we?
 - Defense Solutions
- Who are you?
 - Defense/Intel Developers?
 - Non-Defense Developers?
 - New to Defense Solution Extensions?
 - Desktop?
 - Engine?
 - Server?
 - .NET?
 - Java?
 - Non-Windows (Linux/Unix)?

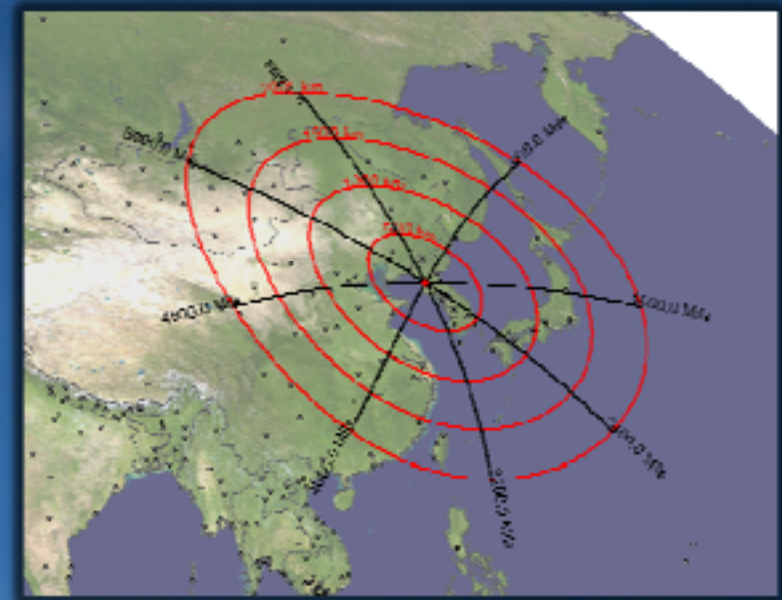
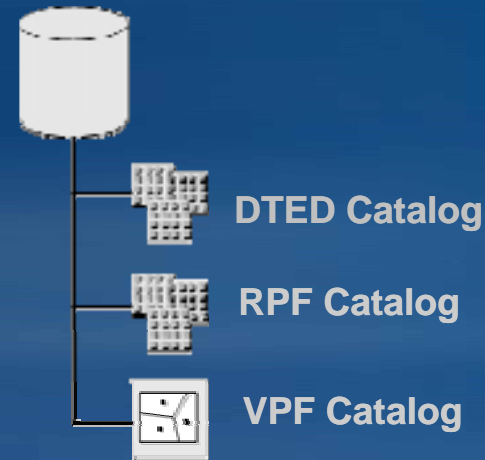


Military Analyst

ArcGIS Military Analyst

Overview

- Extends ArcGIS core functionality
- Data Management
- Military coordinate formats
- Geodetically accurate distances
- Terrain analysis
 - 2D and 3D
- Primary Users
 - Intelligence analysts
 - Geospatial analysts
 - SIGINT analysts
 - CJMTK Developers



Military Analyst Overview

- **Coordinate tool**
 - Enhanced coordinate parsing
- **Geodesy tools**
 - Measure geodetically accurate distances
- **Data management**
 - Loading large MA catalogs
- **Geoprocessing integration**
 - Geometry Importers & Data Loaders
 - Data Converters, Viewsheds, and more!
- **ArcGlobe integration**
 - Interactive tracing for Fly Through
- **API (Application Programming Interface)**

Coordinate Tool

- Convert between DD, DMS, UTM and MGRS
- Draw point on screen and center on coordinates
- Integrated into geodesy and terrain tools
- DMS coordinate parsing with N/S/E/W and +/- hemisphere indicators and coordinate delimiters as space or "/"
- At 9.3, it incorporates a new model based on ArcGIS coordinate systems. (Formerly based on GeoTrans).

The screenshot shows the 'Coordinate Tool' dialog box with the following fields and values:

- Lat: 20.302584
- Lon: -155.714585
- DMS: 201809.30N 1554252.51W
- UTM: 05Q 216506 2247297
- MGRS: 05Q KC 1650647297
- Datum: WGS 1984 (WGS84)
- Ellipsoid: WGS 1984 (WE)

At the bottom, there are two checkboxes: 'Draw point graphic/feature' and 'Center display on coordinates', both of which are unchecked. Below the checkboxes are two buttons: 'Convert' and 'Clear'.

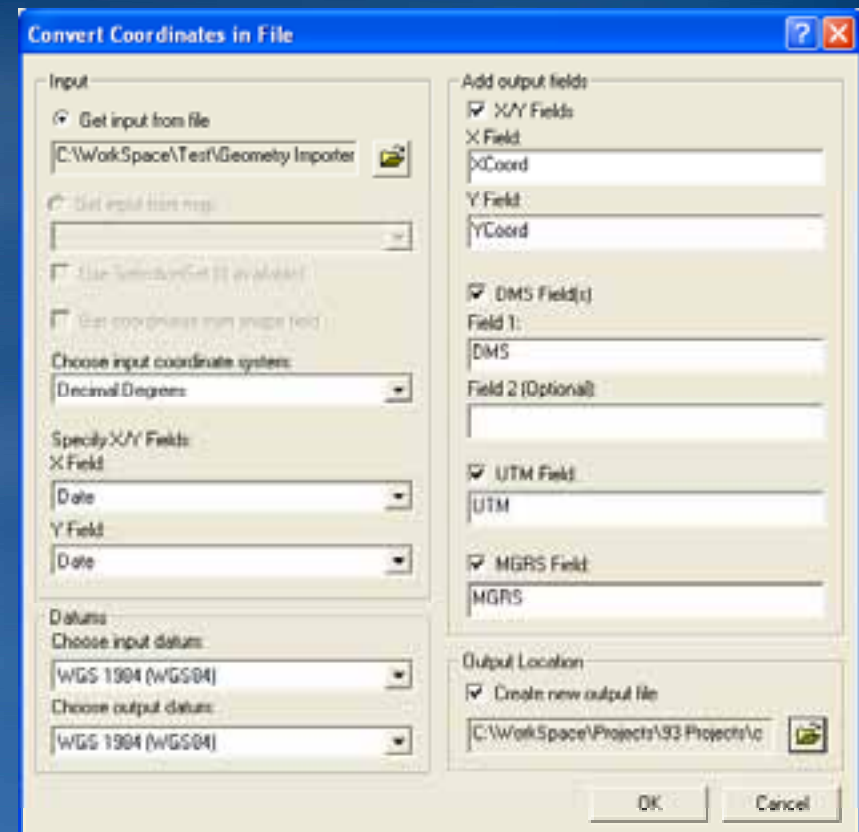
Yellow arrows point to the following fields:

- Lat
- Lon
- DMS
- UTM
- MGRS
- Datum

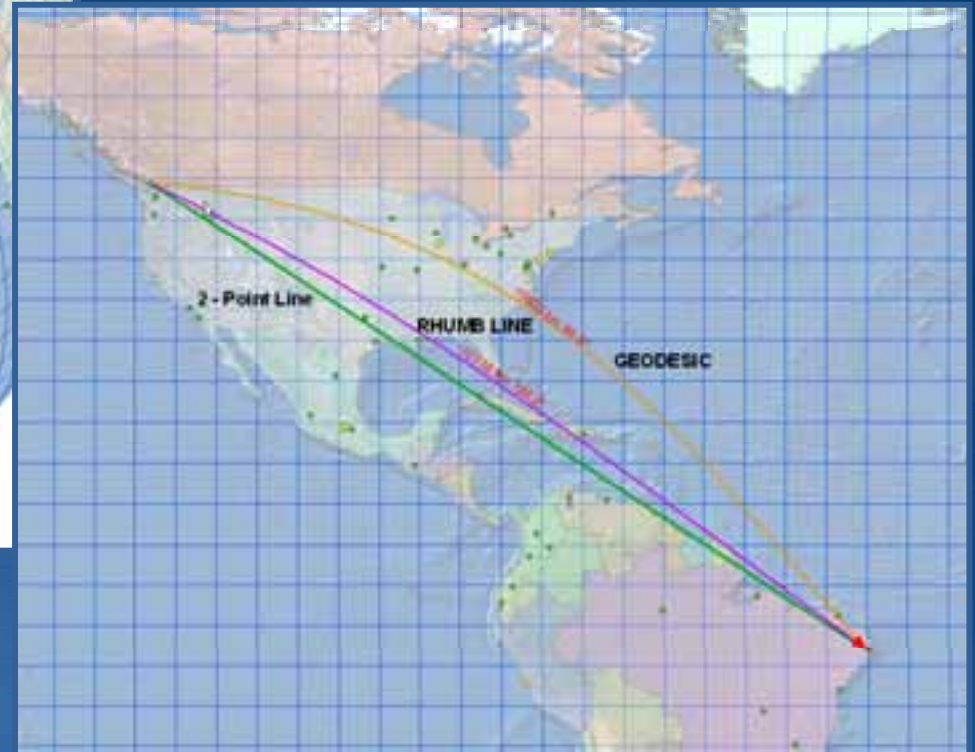
Other Coordinate Tools

Convert Coordinates in File

- Batch coordinate conversion based on Coordinate Tool
- Input can be table or point feature class
 - Support for tables in *.XLS, *.txt, *.csv
- Converts between DD, DMS, UTM and MGRS
- Option to output to *.DBF, Personal, File or ArcSDE Tables
- Convert Coordinates In File for Geoprocessing



What are Geodesy Lines?

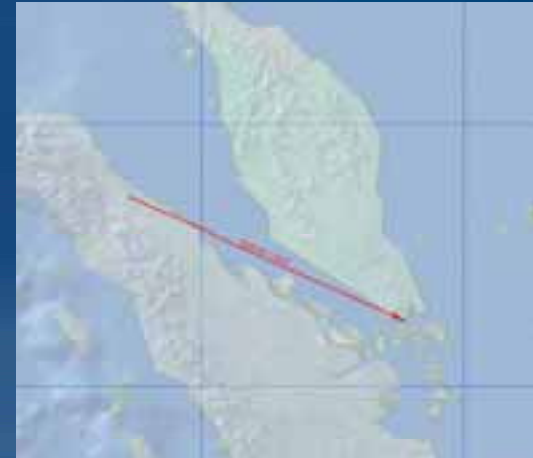


- Spatially accurate and geodetically correct in any projection
- Geodesy Lines
 - Geodesic: shortest distance between 2 points on a spheroid
 - Great Circle: shortest distance between 2 points on a sphere
 - Rhumb Line: line of constant azimuth (straight line in Mercator)

Geodesy Tools

Geodesy Calculator

- Geodesic, Great Circle or Rhumb Line graphic and labels
- Finds bearing and distance between two points
- Finds end point using start point, bearing and distance
- Graphics update as Data Frame coordinate system changes



Geodesy Calculator [?] [X]

Calculations

Calculate distance and azimuth

Calculate end point coordinates

| | X | Y | |
|-----------|------------|------------|-----|
| Start: | -52.496133 | 46.875595 | [P] |
| End: | -7.660125 | 28.424957 | [P] |
| Distance: | | kilometers | [v] |
| Azimuth: | | degrees | [v] |
| Type: | Rhumb Line | | [v] |

Display Options

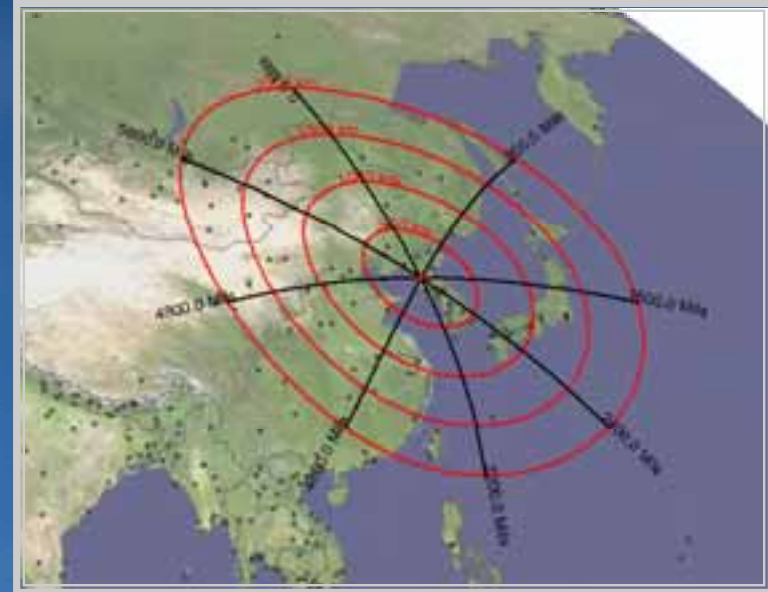
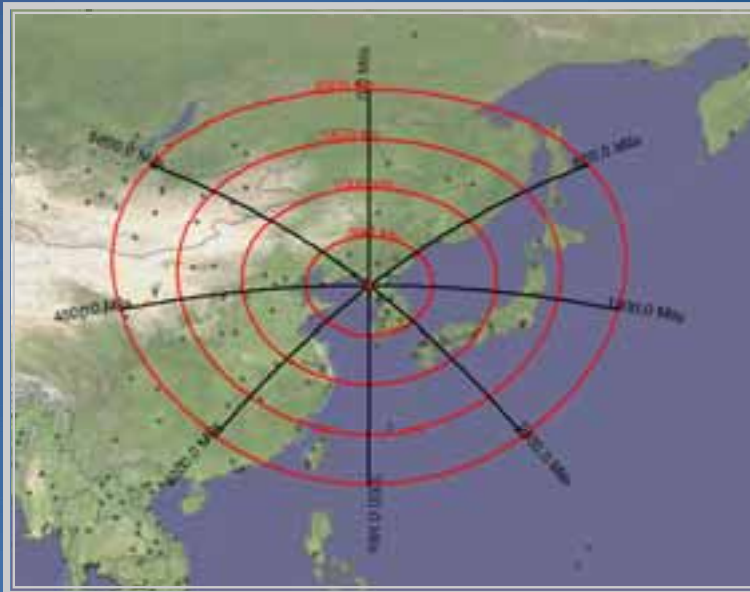
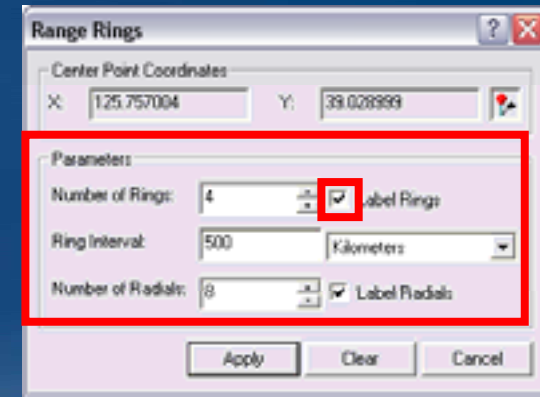
Display graphics Label graphics

Apply Clear Cancel

Geodesy Tools

Range Rings Tool

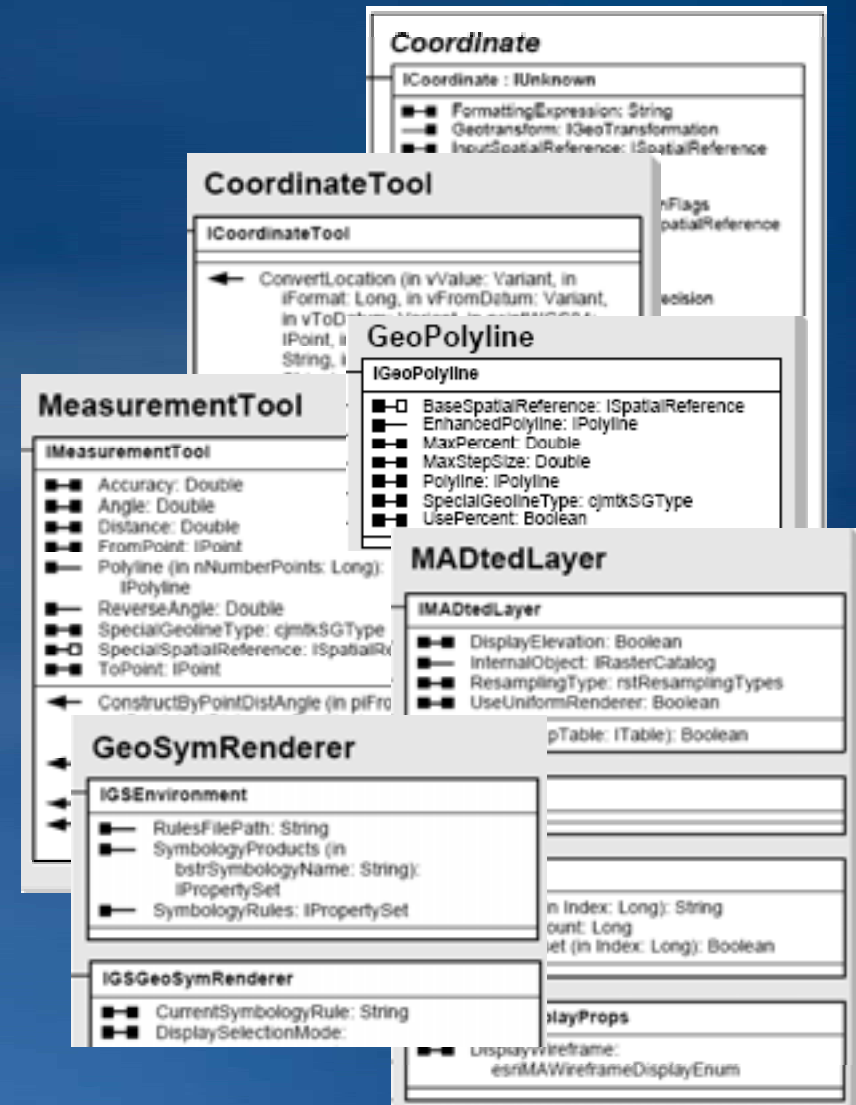
- Projected ellipse Graphics
- Uses: determine aircraft ranges, weapons systems ranges.
- Concentric rings based on a specified distance from a center point
- Enter an observer point (CT), number of rings, distance between the rings, and number of radials
- Graphics update as coordinate system changes for data frame



Military Analyst

Development Overview

- API for Military Analyst
- Military Analyst Library
 - Coordinate tool
 - Geodesy
 - MALayers
 - GeoSym
- Samples available in
 - COM, .Net, Java, and Cross Platform C++
- Geoprocessing Environment



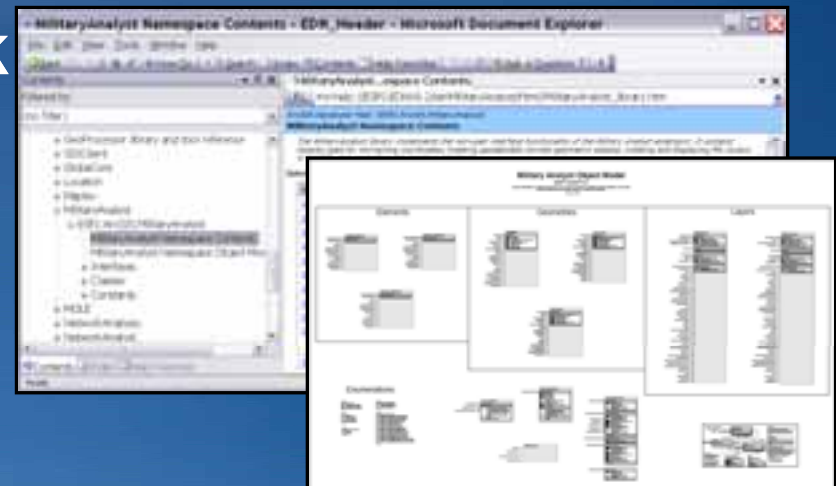
Military Analyst Developer API Components

- **API**

- Coordinate tool, Geodesy, MA Layers
- No UI components (Terrain Analysis, Globe, conversion tools)
- Supported on:
 - Desktop, Engine
 - Windows, Solaris, Linux
 - Java, .NET, VC++, Motif, GTK, VB, VBA

- **SDK**

- Samples Integrate with core SDK
 - Java – Windows and Solaris
 - VB/VBA, .NET, VC++ - Windows
- Component help
- OMD
- EDN



Military Analyst Geodesy API

- **Measurement Tool**
 - Calculate distance and azimuth of GeoPolyline types
 - Geodesic, Great Circle, Rhumb Line
 - Engine behind Geodesy Calculator



MeasurementTool

IMeasurementTool : IUnknown

- Accuracy: Double
- Angle: Double
- Distance: Double
- FromPoint: IPoint
- Polyline (in nNumberPoints: Long): IPolyline
- ReverseAngle: Double
- SpecialGeolineType: cjmtkSGType
- SpecialSpatialReference: ISpatialReference
- ToPoint: IPoint

← ConstructByPointDistAngle (in piFromPoint: IPoint, in dDistance: Double, in dDegreesCWFromNorth: Double)

← ConstructByPoints (in piFromPoint: IPoint, in piToPoint: IPoint)

← GetCoordinate (in dPercent: Double): IPoint

← PathDistance (in piGeometry: IGeometry): Double

Military Analyst Geodesy API

- **Graphic Elements**

- Special graphic element representations of Geo-geometries
- No geodesic geometry type

- **Geometries**

- **GeoPolyline, GeoPolygon, GeoEllipse**
- **Spheroid-aware representations of standard ArcObjects geometry types**

GeoPolyline

IGeoPolyline : IUnknown

- □ BaseSpatialReference: ISpatialReference
- — EnhancedPolyline: IPolyline
- ■ MaxPercent: Double
- ■ MaxStepSize: Double
- ■ Polyline: IPolyline
- ■ SpecialGeolineType: cjmtkSGType
- ■ UsePercent: Boolean

GeoPolygon

IGeoPolygon : IUnknown

- □ BaseSpatialReference: ISpatialReference
- — EnhancedPolygon: IPolygon
- ■ MaxPercent: Double
- ■ MaxStepSize: Double
- ■ Polygon: IPolygon
- ■ SpecialGeolineType: cjmtkSGType
- ■ UsePercent: Boolean

GeoEllipse

IGeoEllipse : IUnknown

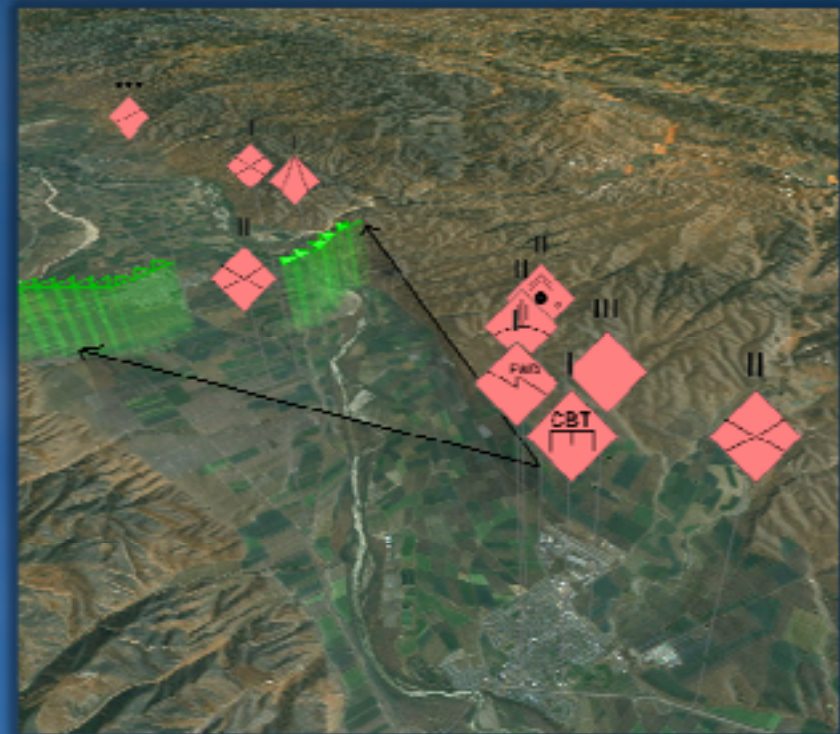
- ■ AxisX: Double
- ■ AxisY: Double
- □ BaseSpatialReference: ISpatialReference
- ■ GeoEllipsePointCount: Long
- — KeyPoints: IPolygon
- ■ Origin: IPoint
- — Polygon: IPolygon
- ■ Rotation: Double

MOLE
(Military Overlay Editor)

Military Overlay Editor (MOLE)

Overview

- Extends ArcGIS core functionality by adding support for creating and managing standard Military Overlays
 - DoD MIL-STD-2525B
 - NATO APP6A
- Military Symbology
 - Force Elements
 - Tactical Graphics
 - 15 Character SID Code
- Primary Users
 - CJMTK Developers
 - SIGINT Analyst
 - Intel Analyst



S P G P U C I Z - - - F U S G

Military Symbolology

MOLE Supported Standards

MIL-STD-2525B w/ CHANGE 2

- DOD standard
- Guidelines for unit, equipment, function
- Criteria for modern battlefield scenario

APP6A

- NATO standard
- Joint manual with 2525B
- Same logic and structure



Military Symbolology

Force Elements and Tactical Graphics

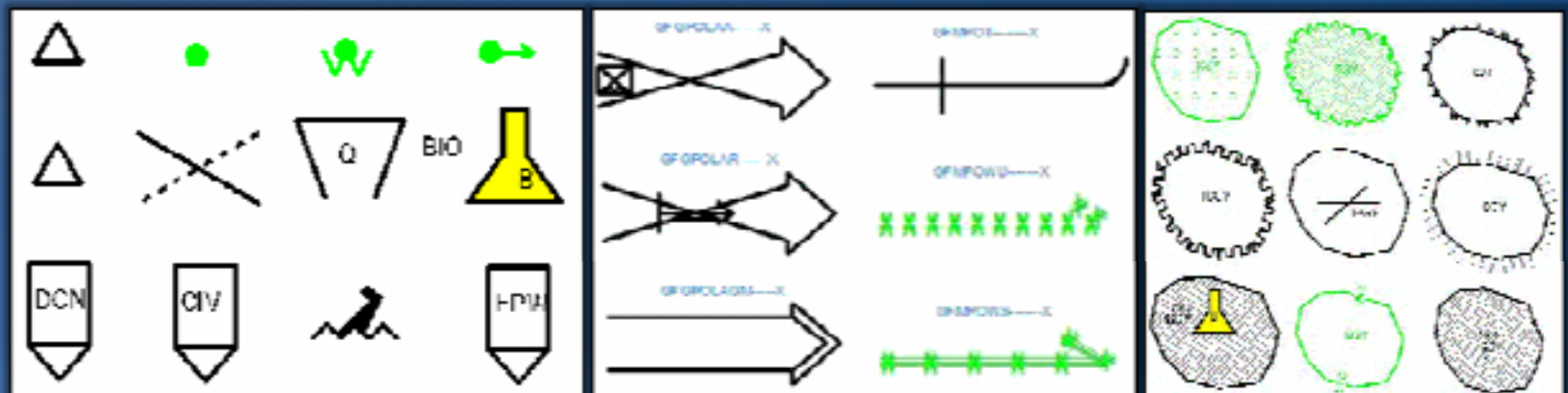
- Force Elements

- Units, Equipment, and Installations
- SIGINT
- MOOTW



- Tactical Graphics

- Military Operations
- METOC

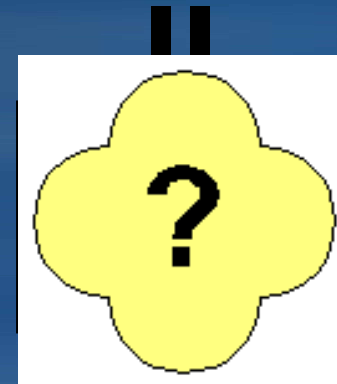


Military Symbology

Symbol ID Code

S
F
G
P
U
C
I
Z
-
-
-
F
U
S
G

- Coding Scheme
- Affiliation
- Battle Dimension
- Status
- Function ID
- Type
- Echelon/Mobility
- Country Code
- Order of Battle

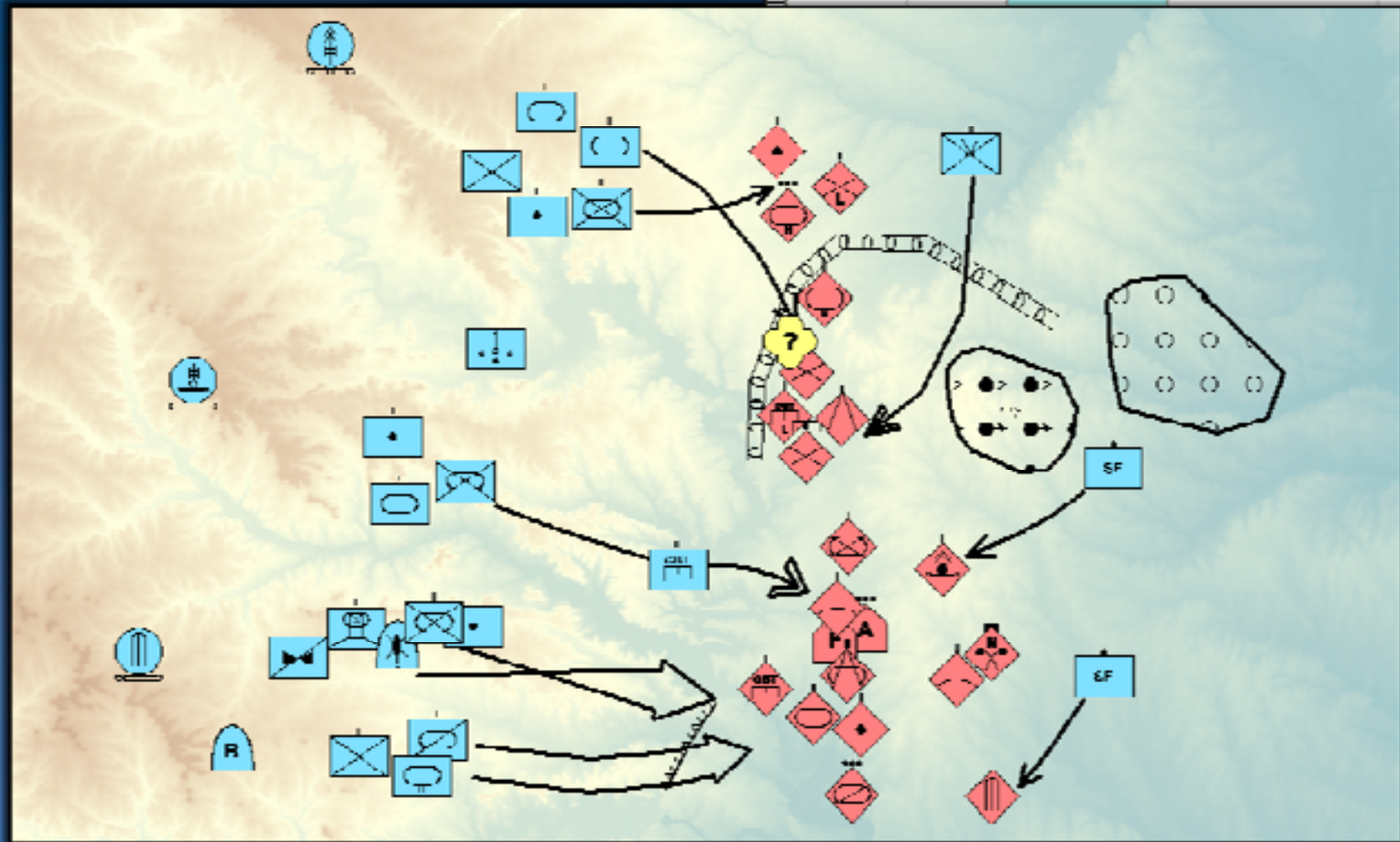


Mechanized Infantry - Battalion

Military Symbolology

MOLE Layer Construction

| OBJECTID * | Shape * | Symbol_ID | Name | |
|------------|---------|-----------------|-------|----|
| 1 | Point Z | CHOPM-----IZ- | 80N | |
| 2 | Point Z | CHVPS----- | AS897 | |
| 3 | Point Z | CHPG-----A--- | 705 | |
| 4 | Point Z | SHGPICA----FIRG | CBP | 15 |
| 5 | Point Z | SHGPIUZ---FIRG | 1 | 3 |
| 6 | Point Z | SHGPIUZ---FIRG | 2 | 3 |

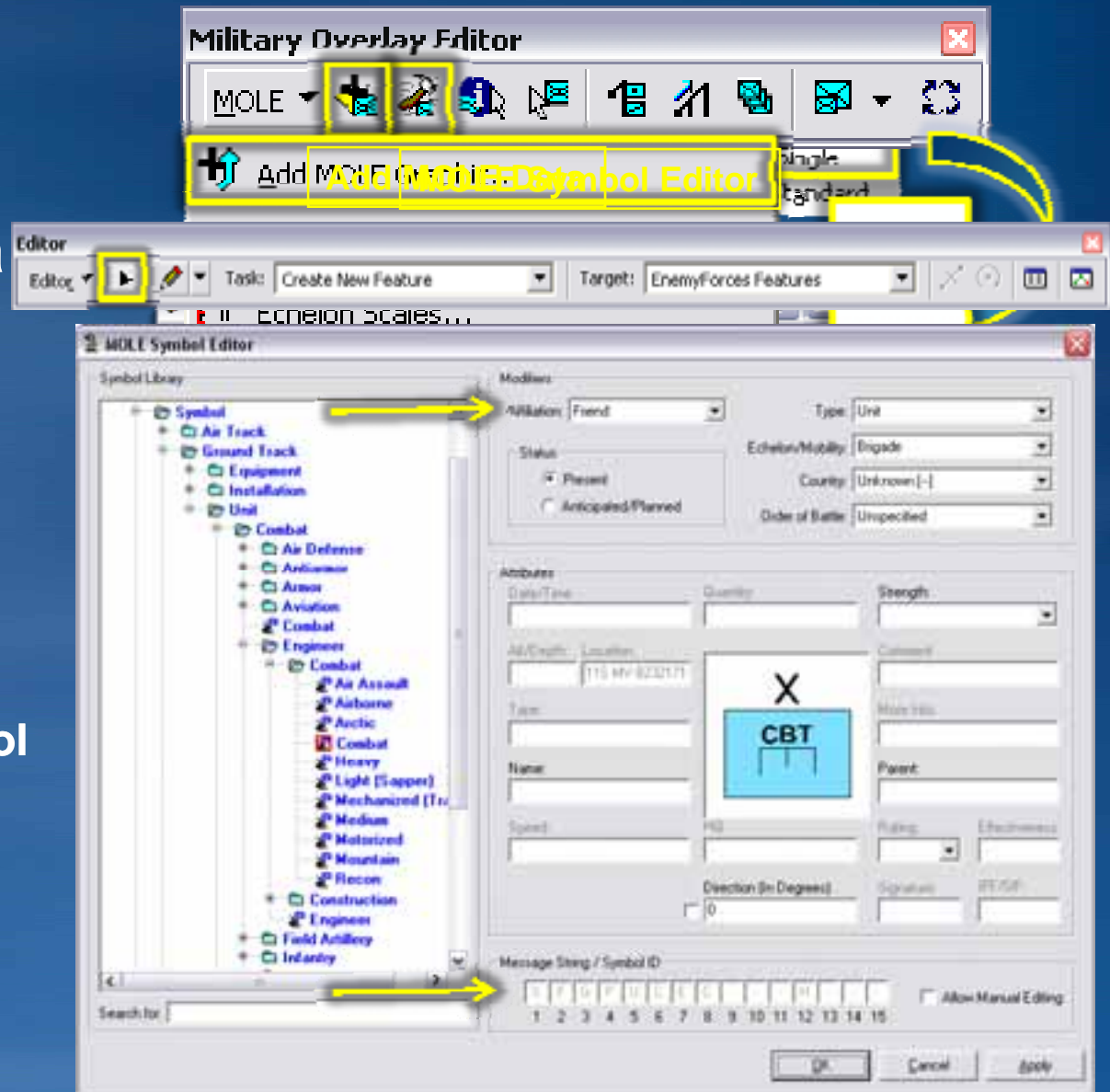


Feature Layer + 15 Char Symbol ID = MOLE Symbol Layer

Military Symbolology

Create and Display MOLE Data in Desktop

- Add MOLE data
- Display MOLE Data
 - Group Layer
 - Feature Layer
 - Graphics Layer
- Create MOLE data
 - MOLE Symbol Editor
 - Add MOLE Graphic tool
- Add MOLE Fields
 - GP tools
 - Attribute table



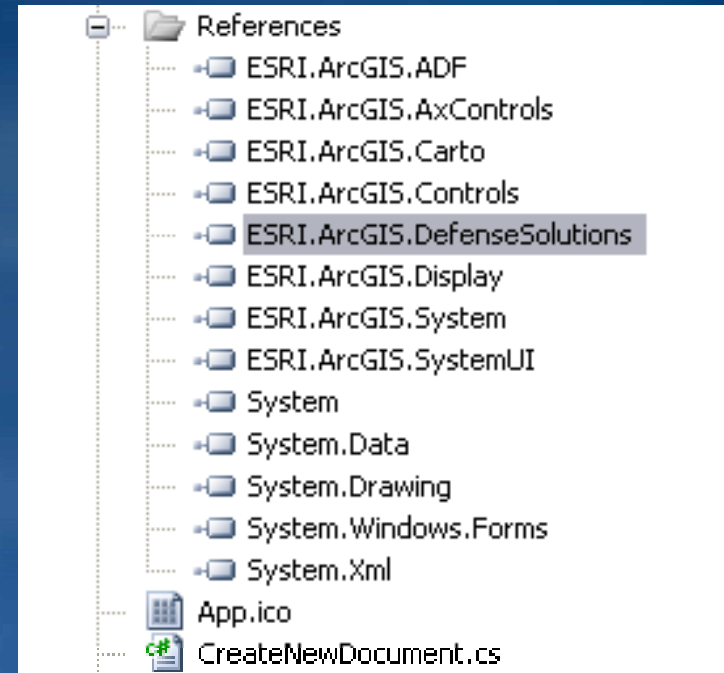
Defense Solutions – What's New at 9.3?

New at 9.3

- **9.3 combines the best of classic Defense Solutions along w/ numerous **new** APIs & tools**
- **Military Analyst**
 - Improved NGA data, geodesy & terrain analysis tools
 - Coordinate Tool
 - **Coordinate Conversion API**
- **MOLE**
 - MIL-STD 2525B (Change 2) & NATO APP-6A Symbology
 - **MOLE Symbols API**
- **Defense Solutions**
 - **EDN Samples for using on ArcGIS Server**

Migration from 9.2 to 9.3

- 9.2: MA & MOLE
 - Separate libraries:
 - MilitaryAnalyst
 - MOLE
- 9.3: Defense Solutions
 - **Single** library:
 - DefenseSolutions
- Migration document available in ArcGIS 9.3



DefenseSolutions assembly reference in Visual Studio

New MOLE Approach:

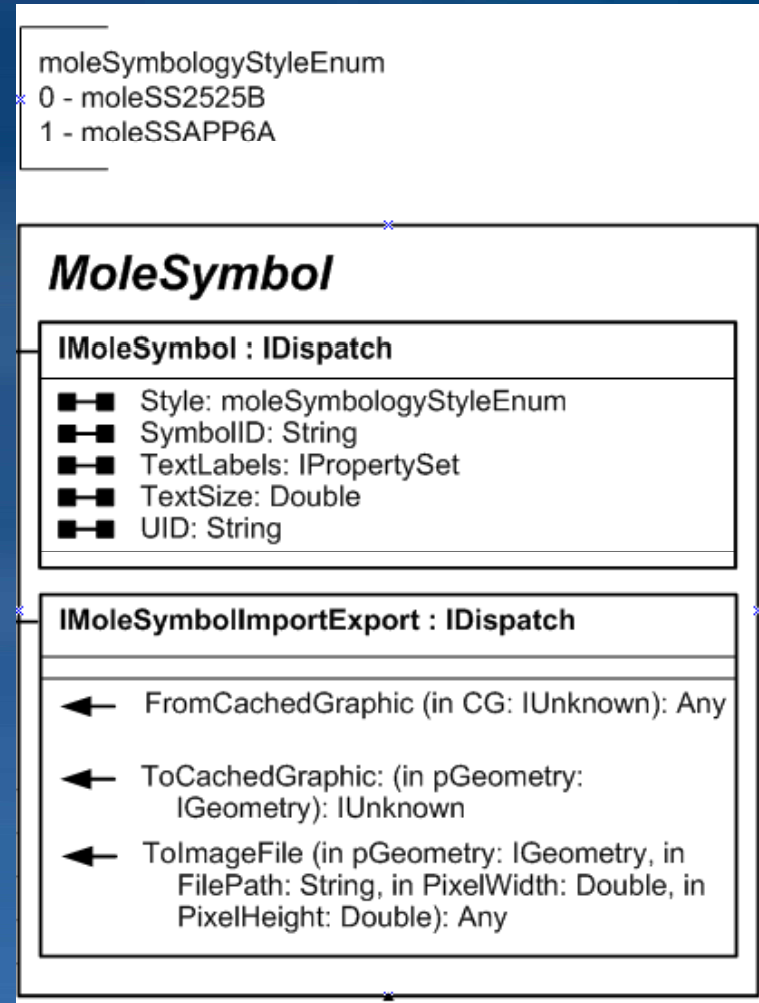
MOLE Marker Symbols - New for 9.3

- **When to use?**

- Don't need the many display customizations of full MOLE API
- Don't want to use feature class
- Only need MOLE functionality

- **Approach**

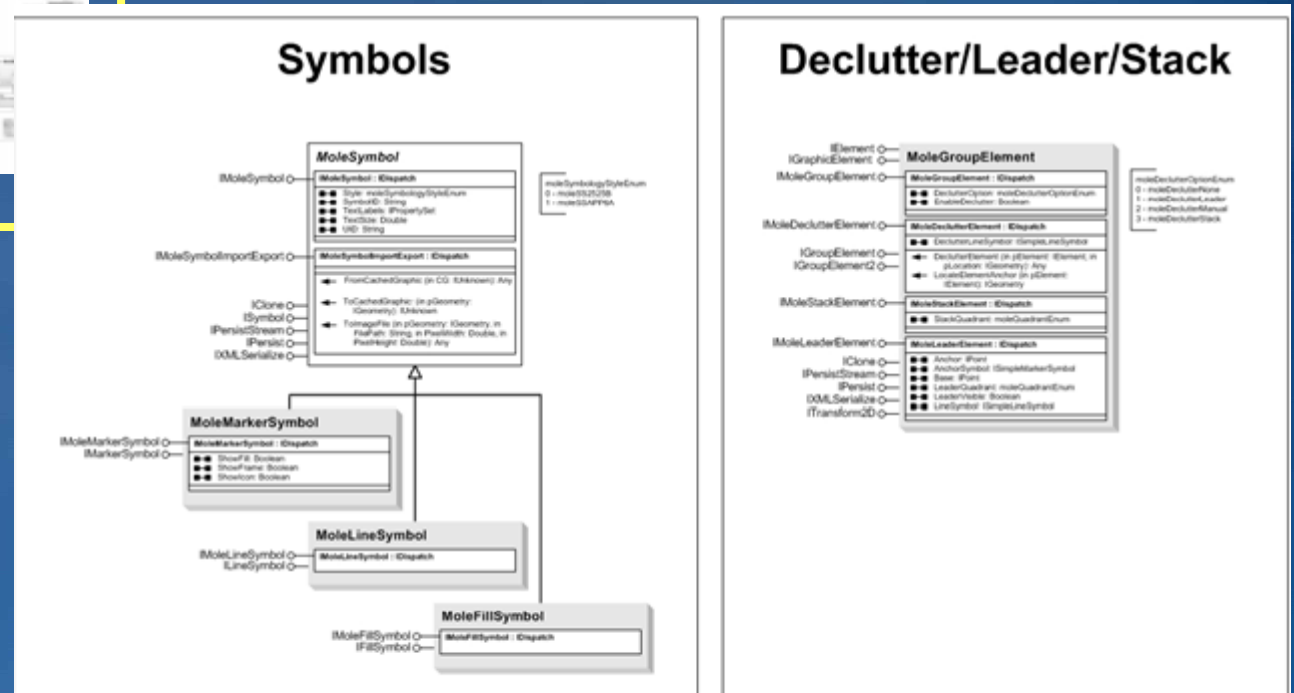
- Carto/Display ISymbol
- Use IMoleSymbol to set MOLE-specific properties
- Use ISymbol to attach to MarkerElements, etc.



New MOLE Approach: Marker Symbols (MOLE ISymbols)



How does it work?



- MoleMarkerSymbol
- MoleLineSymbol
- MoleFillSymbol
- MoleGroupElement

MOLE Marker Symbols Snippet

"MOLE in 6 Lines or Less"

- Use IMoleSymbol to draw MOLE symbology in ArcMap
 - Tools > VB Editor
 - Run macro – specified MOLE symbol is drawn in the display

```
Dim MoleMarker As IMoleSymbol
Set MoleMarker = New MoleMarkerSymbol
MoleMarker.SymbolID = "SUGPUCATL--DUSG"
Dim markerSymbol As IMarkerSymbol
Set markerSymbol = MoleMarker
markerSymbol.size = 64

Dim element As IMarkerElement
Set element = New MarkerElement
element.Symbol = MoleMarker
Set element2.Geometry = point ' point = X, Y

ActiveView.GraphicsContainer.AddElement element, 0
```

Python Tools

Overview

- At 9.3 Defense Solutions exposes numerous Geoprocessing (GP) tools as Python scripts
 - \ArcGIS\ArcToolBox\Scripts
- For example, Terrain Analysis Geoprocessing tools in Military Analyst 9.3
 - Linear Line of Sight, Linear Line of Sight from Features
 - Radial Line of Sight
 - Highest / Lowest Point by Extent, Highest / Lowest Point by Polygon
- Many others
 - Import Coordinates, etc.
- Python scripts can also easily be generated by exporting from ModelBuilder

Python Tools

MA Geoprocessing Tools

- **Sample Geoprocessing Python script**

```
# Process: Highest/Lowest Point by Extent...
gp.HiLoByExtent_ma(Hi_Lo_Input_surface, Hi_Lo_Input_extent,
  Hi_Lo_Output_workspace, Hi_Lo_Output_feature_class_name,
  Highest_point__Lowest_point)

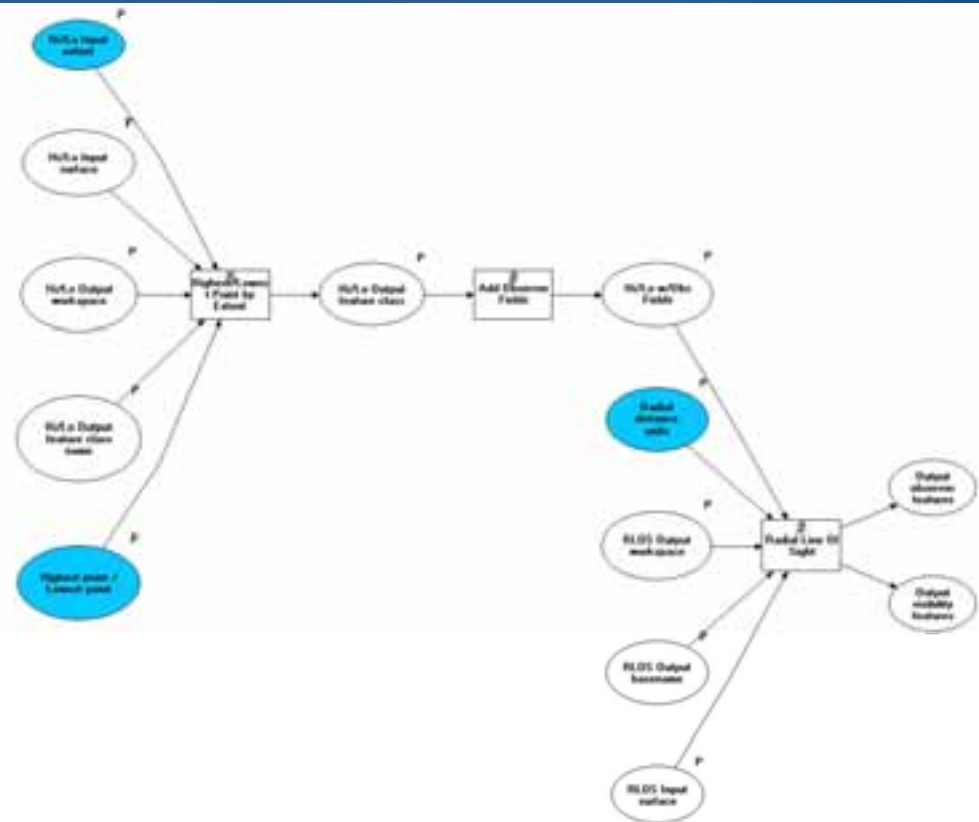
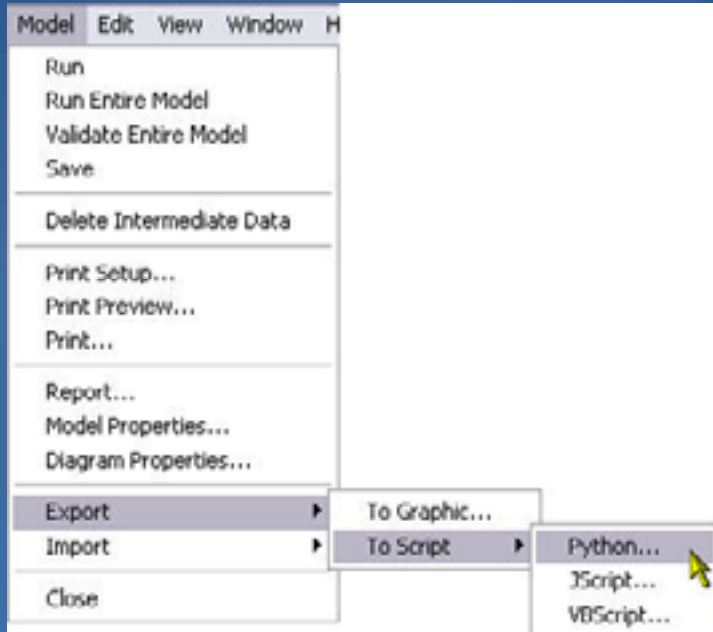
# Process: Add Observer Fields...
gp.AddObserverFields_ma(Hi_Lo_Output_feature_class)

# Process: Radial Line Of Sight...
gp.RadialLineOfSight_ma(Hi_Lo_w_Obs_Fields, RLOS_Input_surface,
  RLOS_Output_workspace, RLOS_Output_basename,
  Radial_distance_units)
```

Python Tools

MA Geoprocessing Tools

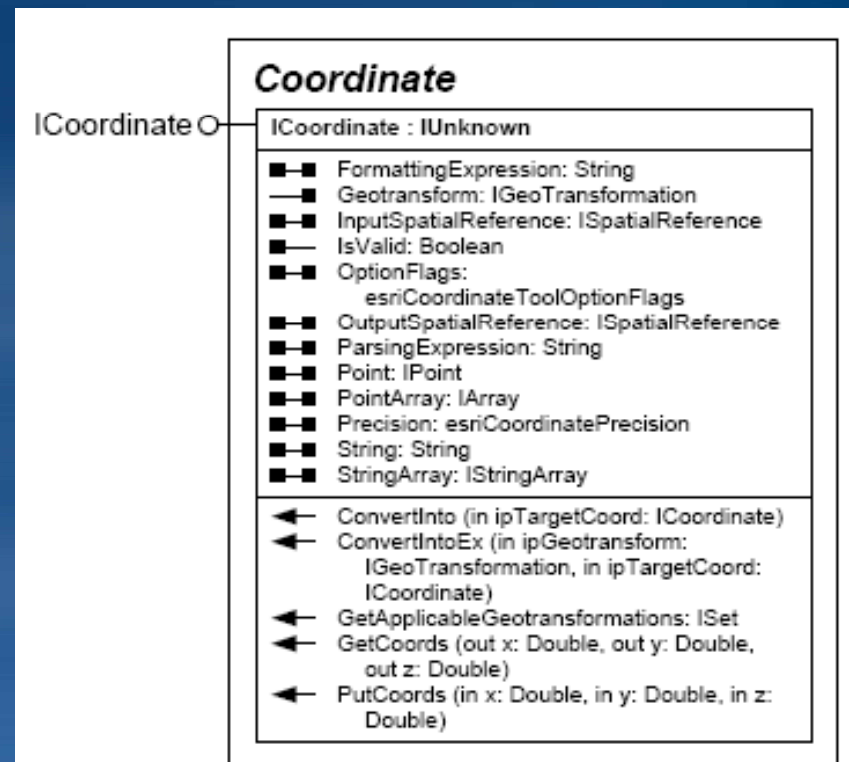
- Use tools directly from ModelBuilder –or–
- Python scripts can easily be generated by exporting from ModelBuilder



Coordinate Conversion API

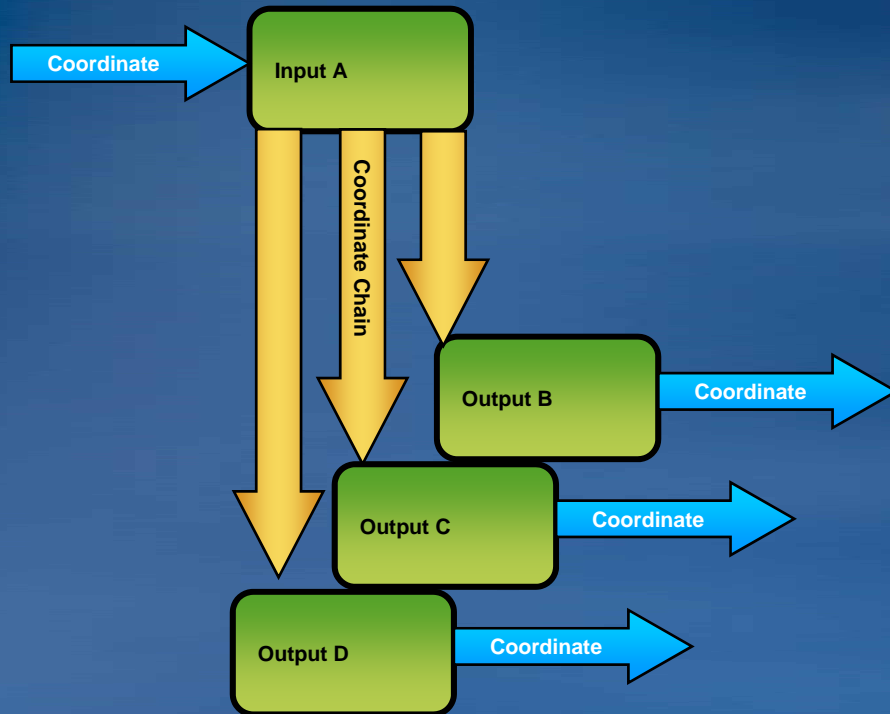
Coordinate Conversion Objects

- Coordinate conversion
 - DMS, DD, UTM, MGRS, USNG
 - Datums and Spatial References from ArcGIS
 - Extensible
 - Parse input and format output
 - Highly configurable
 - Input & Output in Boost regex format (www.boost.org)

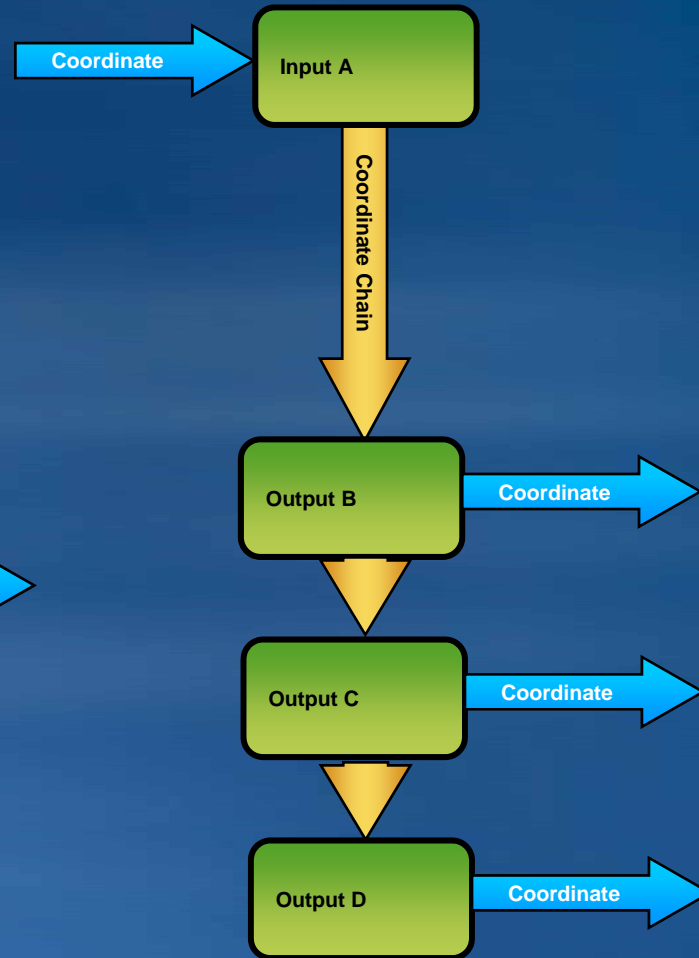


Coordinate Conversion API

Chaining



Parallel Chaining



Series Chaining

Coordinate Conversion API

Coordinate Conversion Objects

- **DD to MGRS Coordinate Conversion**

```
ICoordinate converterDD = new DDCoordinateClass();  
ICoordinate converterMGRS = new MGRSCoordinateClass();  
  
// chain the DD converter to the MGRS converter for output formatting  
converterDD.AddOutputCoordinate(converterMGRS);  
  
// inject the input coordinates (this is where the conversion occurs)  
converterDD.PutCoords(x, y);  
  
return converterMGRS.String;
```

Defense Solutions: Integration Scenarios Demos

Defense Solutions

Integration Scenarios

- **Defense Solution ArcObjects are available across the ArcGIS platform suite:**
- **ArcGIS Desktop**
 - Important caveat: UI and Command Objects are only supported here
- **ArcGIS Engine**
- **ArcGIS Server**

MOLE Developer Scenarios

The Many Faces of MOLE

- Multiple development scenarios depending on customization and performance requirements
- 9.2 & 9.3
 - Approach 1: **Feature Layers / Feature Classes**
 - Approach 2: **MOLE “Cached Graphics”**
 - Approach 3: **Export Graphics**
- **New for 9.3**
 - Approach 4: **MOLE ISymbols**
- **Note: only MOLE Feature Classes/Layers will work across Map/Globe/Server**

MOLE Approach: MOLE ISymbols

New at 9.3

- **Advantages**

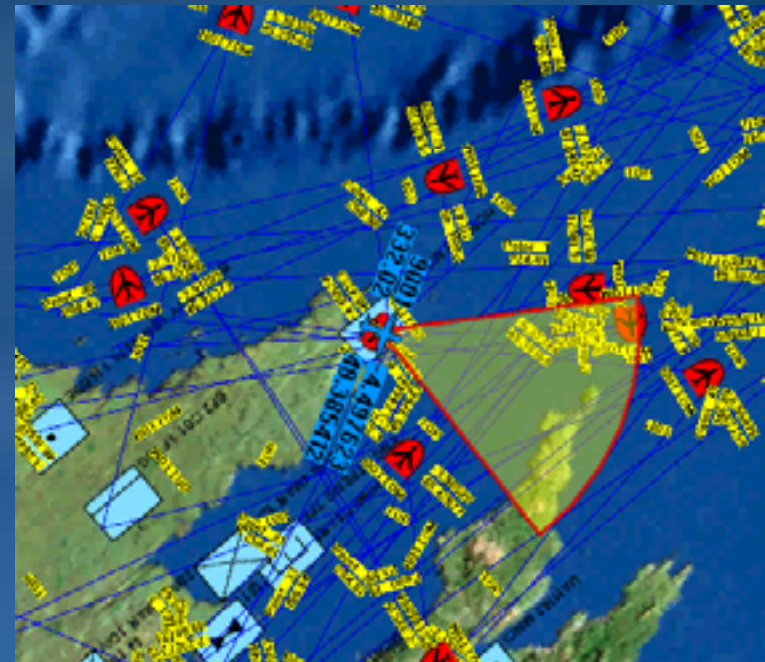
- Easiest to implement
- Works well with ArcObjects cartographic/display framework
- Can generally use anywhere you would use ISymbol
- Good rendering performance

- **Disadvantages**

- Less control over symbols
- Generally only works in 2D

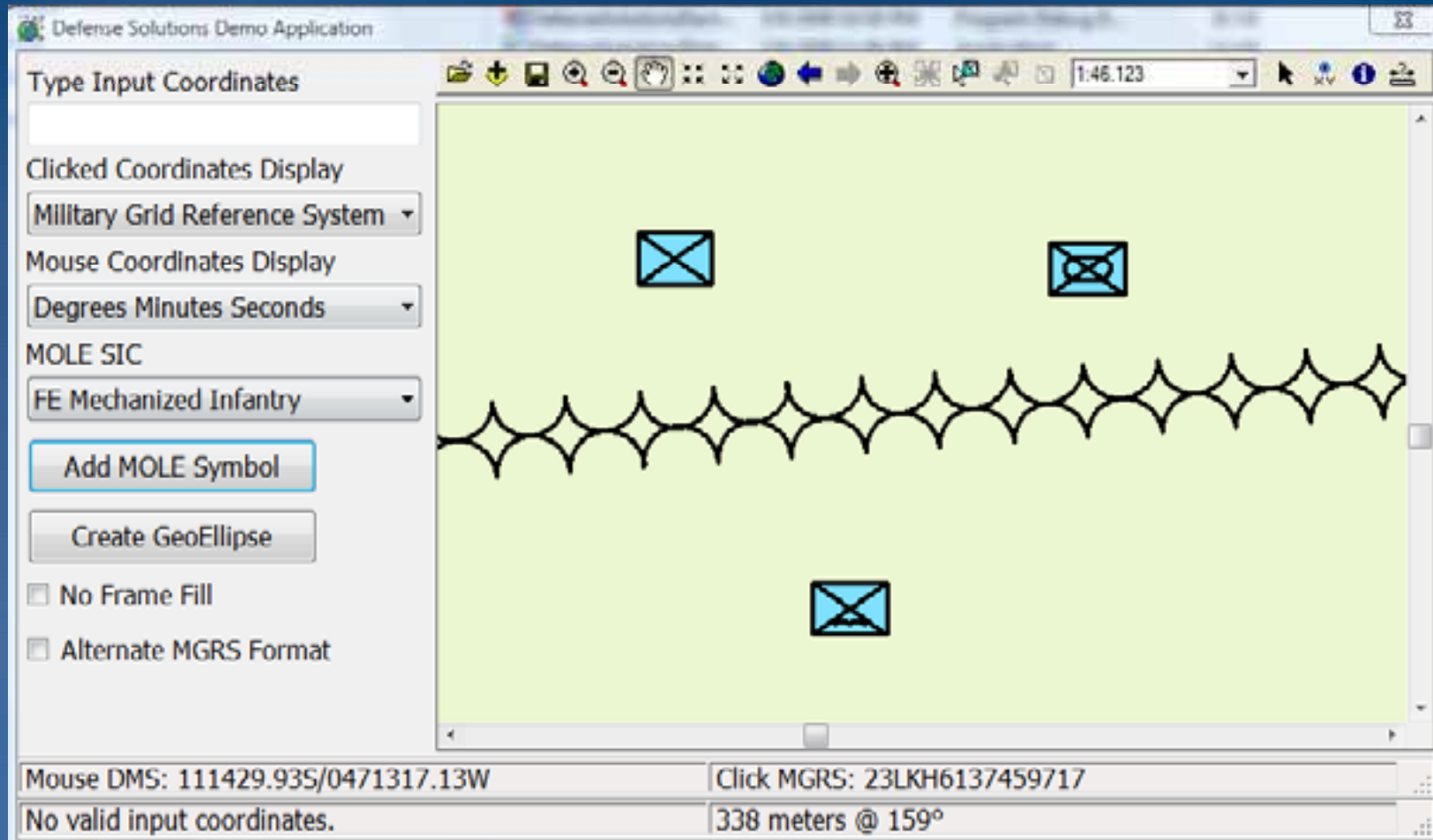
MOLE Approach: **Export Graphics**

- **When to use?**
 - Interoperation w/ external frameworks
 - Dynamic Display
 - OpenGL
- **Approach**
 - MOLE graphics implement ICreateBitmap / IExportGraphic (IMoleSymbolImportExport for MOLE ISymbols)
 - Invoke export methods
 - Use resulting imagery w/ external frameworks



MA / MOLE Demo

Sample Map Control Application



The screenshot displays the "Defense Solutions Demo Application" interface. The main window features a map control application with a light green background. The interface includes a toolbar at the top with various navigation and tool icons, and a status bar at the bottom. The left sidebar contains several control panels:

- Type Input Coordinates:** A text input field.
- Clicked Coordinates Display:** A dropdown menu set to "Military Grid Reference System".
- Mouse Coordinates Display:** A dropdown menu set to "Degrees Minutes Seconds".
- MOLE SIC:** A dropdown menu set to "FE Mechanized Infantry".
- Buttons:** "Add MOLE Symbol" (highlighted in blue), "Create GeoEllipse", "No Frame Fill", and "Alternate MGRS Format".

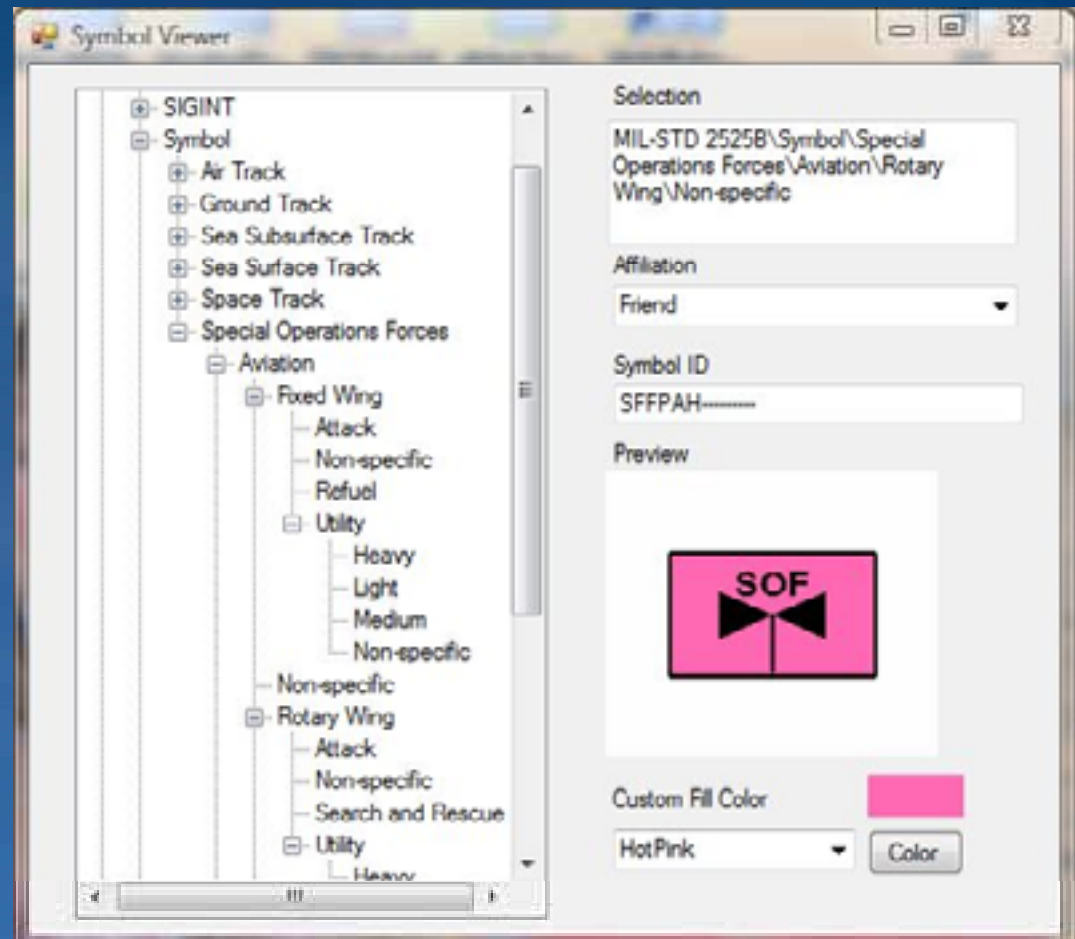
The map display shows three blue envelope icons (MOLE symbols) and a horizontal line of diamond-shaped symbols. The status bar at the bottom provides the following information:

- Mouse DMS: 111429.93S/0471317.13W
- Click MGRS: 23LKH6137459717
- No valid input coordinates.
- 338 meters @ 159°

MOLE Symbol Viewer Demo

Sample Symbol Selector

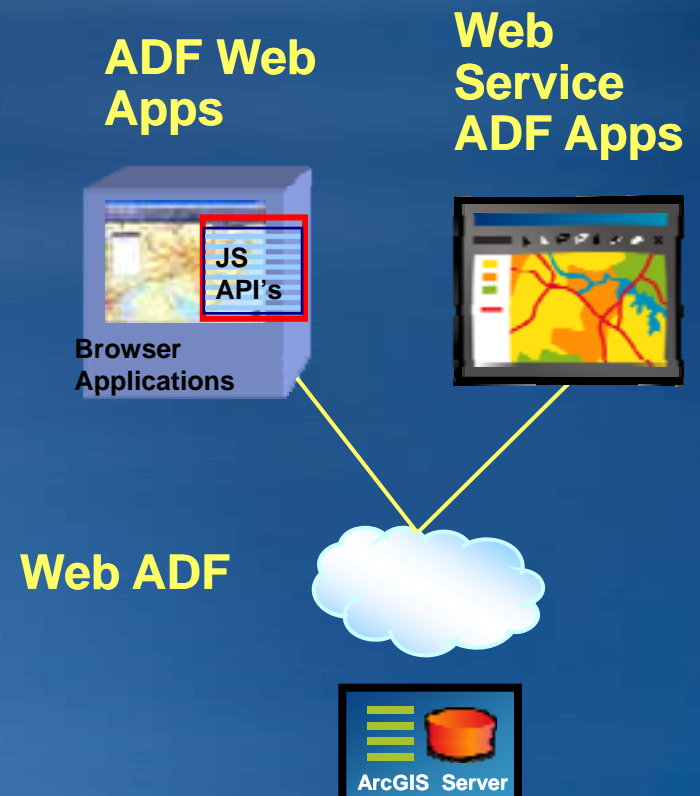
- MOLE ISymbol
- MOLE Export to HBitmap
- Query MOLECore GDB for list of symbols
- Custom Fill Colors



ArcGIS Server ADF SDK Samples

Defense Object in ArcGIS Server

- SDK Samples using Defense Solution Objects in ADF Web Client Map Application
- Show how to consume defense objects in custom ADF Tasks
- Creating DefSol objects in
 - Local Context (“CreateAO”)
 - Server Context (Remote Objects)
- Demo



Common Questions and Developer Resources

Defense Solutions SDK

- **Software Developer Kit**

- **Military Analyst API**

- **Samples & snippets**

- **Fully integrated documentation**

- **Online at**

http://resources.esri.com/help/9.3/ArcGISEngine/ArcObjects/ao_start.htm

ArcGIS Developer Help (ESRI.ArcGIS.MilitaryAnalyst) GeoSymRendererClass Class

Custom renderer for symbolizing data with GeoSym sy

Product Availability

Available with ArcGI

Supported Platforms

Windows

Interfaces

Interfaces

[IFeatureRenderer \(C](#)

[IGSGeoSymRende](#)

[IGSGeoSymRende](#)

[ILegendGroup \(C](#)

[ILegendInfo \(C](#)

[ILevelRenderer \(C](#)



```
// create the IElement to be rendered
// set its geometry to the GeoPolyline
// CreateGeoPolyline subprocedure
m_pLineElement = (IElement) new GeoPolylineElement();
m_pLineElement.Geometry = (IGeometry) m_pMeasureTool.Measure();

// QI to ILineStyle to set the line style
ESRI.ArcGIS.Carto.ILineStyle pLineStyle = (ILineStyle) m_pMeasureTool.Measure();
pLineStyle.Symbol = (ISymbol) m_pMeasureTool.Measure();

// Define the graphics container and draw the GeoPolyline graphic. Display the
// distance and azimuth of the GeoPolyline as calculated by the measurement tool.
SetGraphicsContainer();
m_pGraphicsCont.AddElement((IElement) pLineElement, 0);
m_pActiveView.Refresh();
double dDist = Math.Round(m_pMeasureTool.Distance / 1000, 6);
double dAzim = Math.Round(m_pMeasureTool.Angle, 6);
txtDistance.Text = dDist.ToString();
txtAzimuth.Text = dAzim.ToString();
```

SDK Samples

- **Engine**
 - **Geodesy**
 - **MAGeodesyMapControl**
 - **MALocateCoordinates**
 - **Symbology**
 - **MOLE Symbols**
 - Grouping, etc.
 - **Military Symbology in 3D (MOLE)**
- **Server**
 - **Geodesy**
 - **MOLE Symbols**



Common User Feedback / Questions

How do I do X – Why can't I do Y?

- **Should be in Documentation and KB Docs**
 - If not we need to add them
- **Label visibility**
 - IEnumAttributeLabel – only for ForceElements and ForceElementLayer
 - <http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=34981>
 - Must blank out data field for Tactical Graphics
- **MOLE Crash on Exit in .NET**

```
// Workaround for crash on exit bug.
```

```
// This:
```

```
IMoleCoreHelper mch = new MoleCoreHelperClass();
```

```
mch.ReleaseForceElementRenderer();
```

```
mch.ReleaseTacticalGraphicRenderers();
```

```
// Before This:
```

```
ESRI.ArcGIS.ADF.COMSupport.AOUninitialize.Shutdown();
```

Common User Feedback / Questions

More Common Questions

- **2 Controls for MOLE Tactical Graphic Layer *Text* and *Graphic* Size**

```
// Setting 2 different Layer Size Properties
```

```
TacticalGraphicLayerClass tacticalGraphicsLayerClass = new TacticalGraphicLayerClass();  
tacticalGraphicsLayerClass.FeatureLayer = featureLayer;
```

```
// Text Size:
```

```
tacticalGraphicsLayerClass.TextSize = 0.01;
```

```
// Pattern Size:
```

```
(tacticalGraphicsLayerClass as ICachedGraphicLayer2).Size = 0.05;
```

- **Required Geometry and Point Counts for Tactical Graphics**
 - IGeometryLimits - GeometryType, MinimumPointCount to determine if a graphic requires a specific geometry/point count
 - <http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=35636>

Additional Resources

Questions, answers and information...

- ***Meet the Team***

- *Outside this room right now!*

- ***Other sessions***

- *ArcGIS 9.4—The Road Ahead for Developers*

- Thurs., 10:15am Primrose B*

- *ArcGIS Server Performance and Scalability - Testing Methodologies*

- Thurs., 1:30pm-2:45pm*

- ***ESRI Resource Centers***

- PPTs, code and video



- resources.esri.com

- ***Social Networking***



- www.twitter.com/ESRIDevSummit



- tinyurl.com/ESRIDevSummitFB

Want to Learn More?

ESRI Training and Education Resources

- **Instructor-Led Training**
 - [Introduction to ArcGIS for Geospatial Intelligence and Law Enforcement](#)
 - [Introduction to PLTS Defense Solution](#)
 - [Working with ArcGIS Spatial Analyst for Geospatial Intelligence](#)
- **Free Web Training Seminar**
 - [Introduction to ArcGIS Military Analyst 9.2](#)
- **Free Advice**
 - Know and be comfortable with ArcEngine/ArcObjects before moving to Defense Solutions objects

The Road Ahead

- **SDK**
 - More samples more frequently updated to SDK on web
- **Symbology**
 - **Current Symbology Standard Releases**
 - MIL-STD-2525C released 17 November 2008
 - APP-6(B) released June 2008
 - **Future Releases**
 - MIL-STD-2525D
 - APP-6(C)

Summary

- **Military Analyst**

- NGA data, geodesy & terrain analysis tools
 - Geodetic geometries
 - Measurement tools
 - New Geoprocessing tools & Python scripts
- Coordinate Tool & Coordinate Conversion API

- **MOLE**

- MIL-STD 2525B & NATO APP-6A symbology
- MOLE Basic Symbols API

- **Where to get Samples & Answers**

Questions

Still have questions?



??????

Please Turn In Your Session Survey!

- Please complete the **session survey** – we take your feedback very seriously!



Please Help Me

- Continue to enjoy the conference!

Thank You



Thanks