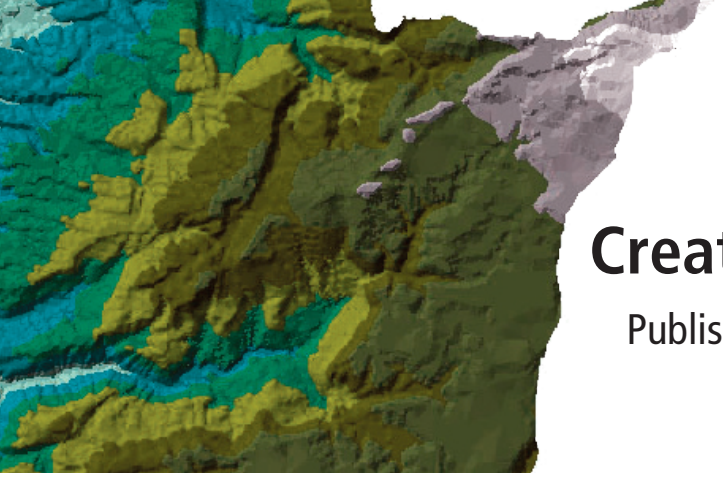
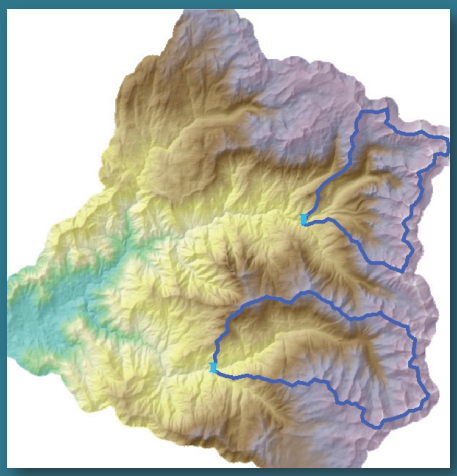


Create a Geoprocessing Service

Publish model and script tools using ArcGIS Server

By Jason Pardy, ESRI Product Engineer



A digital elevation model (DEM)

To access geoprocessing functionality as a service, tools must first be published as part of an ArcGIS Server geoprocessing service.

New with the release of ArcGIS 9.2, users can publish geoprocessing model and script tools to an ArcGIS Server. ArcGIS Server now offers a complete and integrated, server-based GIS with out-of-the-box end-user applications and services for spatial data management, visualization, and geoprocessing.

To access geoprocessing functionality as a service, tools must first be published as part of an ArcGIS Server geoprocessing service. A geoprocessing service is a script or model tool plus its project data. System toolboxes cannot be published directly. Model tools or script tools contain the geoprocessing functionality run by geoprocessing services.

This article tells users how to publish an existing model, created using ModelBuilder, as a geoprocessing service on ArcGIS Server. To run correctly, models run by services must have certain characteristics. Consequently, before being published, existing toolboxes with models or scripts will most likely need to be modified. Considerations when creating or modifying a model for use as a geoprocessing service—such as user input, data management, and optimization—will be addressed. In addition, some issues that must be kept in mind when publishing a model, such as how the model is executed and how the resulting data will be returned to a client (e.g., ArcGIS Desktop, ArcGIS Explorer, and custom Web applications), will also be described.

Getting Started

Download the Watershed Delineation Toolbox from ArcScripts (http://arcscripts.esri.com/details.asp?dbid=15148) and refer to the iWatershed model. Open this model and use the steps in this article to modify and publish the tool successfully. Be sure to use a local digital elevation model (DEM) as part of the testing process and to construct the flow direction and flow accumulation rasters.

The following steps describe the edits required to prepare a model for publishing as a service. The model used in this example delineates a watershed using a DEM. The model tool allows the user to interactively enter pour point locations as point features that will represent the outlet(s) for which the watershed(s) will be determined. This model uses an existing flow direction raster and flow accumulation raster constructed from a DEM.

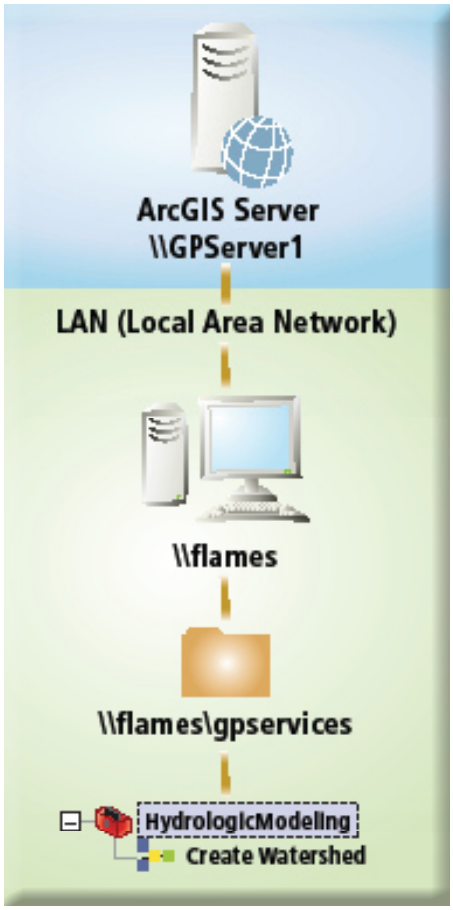


Figure 1: System configuration

Step 1

Give ArcGIS Server Access to Data and Toolbox

This example assumes the system configuration shown in Figure 1. In this illustration, the desktop computer is named flames, and the data, toolbox, and model tool are located on this computer. The ArcGIS Server, named GPServer1, is accessible over the local area network (LAN). In this example, the toolbox and data are not copied to the server; the server will access the toolbox and data on the desktop computer.

This system configuration was chosen specifically because it requires that the server (GPServer1) have access to resources on the desktop computer (flames) via the LAN and demonstrates how to set up account permissions.

SUMMARY

Learn how to publish models and script tools as a geoprocessing service on ArcGIS Server. This article assumes the reader is familiar with the ArcGIS Desktop 9.x environment, ModelBuilder, and how to create and administer basic services on ArcGIS Server.

In a simpler configuration, everything would be put on the server, thus avoiding issues associated with sharing resources across the LAN. However, this simple configuration isn't always possible. More typically, the ArcGIS Server implementation and system configuration will be different and will depend on the design of the network and the policies and procedures established by the system administrator for publishing and accessing ArcGIS services.

Step 2

Optimization through Preprocessing

Preprocessing geoprocessing operations so they can be removed from the model is recommended. For example, the Create Watershed model requires a flow accumulation raster and a flow direction raster as criteria. Since it is not necessary to create these datasets each time the model is executed, the rasters were created ahead of time to reduce execution time and supply optimal performance.

Step 3

Create Parameters and Check the Data Types

Next, identify which variables in the model will become parameters to the model tool. In this example, the pour point will be the input parameter. The snap pour point and watershed rasters will be converted to features and are the output parameters for this model tool. To expose a variable as a parameter in ModelBuilder, right-click the variable and choose Model Parameter from the context menu. The letter P will appear by the variable to indicate that it is now a parameter and will be present on the tool dialog box.

Each variable in a model has a data type. Only certain data types can be used as input and output parameters for published models and tools. For variables that are not parameters, there are no restrictions. Variables with the Feature Class data type are not supported as input parameters. A feature class variable, such as the pour point variable in the example model, should be replaced with a Feature Set data type that is fully supported for input. Right-click the Feature Class variable, choose Properties, and change the data type from Feature Class to Feature Set in the Data Type tab as illustrated in Figure 2.

The Pour Point variable needs to know what type of features to create and how to draw them. This information is set by right-clicking the variable, choosing Properties, and clicking the Data Type tab in the Pour Point Properties dialog box. Under Import schema and symbology from, navigate to any point feature class or layer. If a layer is used, the layer's symbology will be used to draw the input features.

Most data types supported as input data types are also supported as output data types—with some exceptions. A feature class is a supported output data type. When a model is published, the tool is scanned. If an output feature class is found, it is turned into an output feature set and this feature set is transported back to the client. In this example, the toolbox is published to generate the Create Watershed service and the output data is returned to the client as a feature set. Desktop users can access output data using the Results tab in the ArcToolbox window.

The results of this service are feature sets that are managed. A managed output means the output location will be defined by ArcGIS Server when the model is run. It is recommended that all models published on a server have managed outputs, except when working with tool layers. Managed output will be written to the scratch workspace that is automatically created by ArcGIS Server every time the model is run. Right-click on the output variables named Snapped Pour Point and Output Watershed, and choose Managed. The intermediate data used in this model is also set as managed.

Step 4

Store Symbology in Model Variables

Symbology can be stored in variables of a model for both inputs and outputs. For input Feature Sets, the schema is set for the input features. This schema defines both the type of feature (i.e., point, line, polygon) and the symbology to display each feature added. The newly added feature will be drawn using the client's graphics library, which may only have basic capabilities, not the advanced drawing capabilities found in ArcMap.

For the output Watershed, right-click the variable and choose Properties. In the Output Watershed Properties dialog box, click the Layer Symbology tab and import symbology

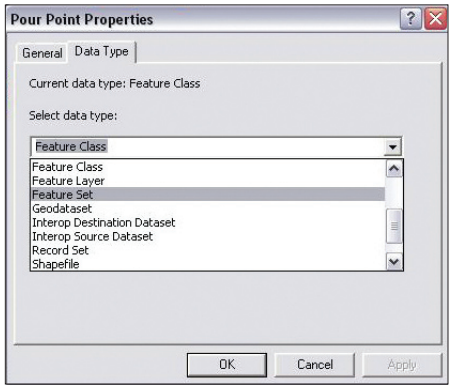


Figure 2: Changing a Feature Class data type to a Feature Set data type

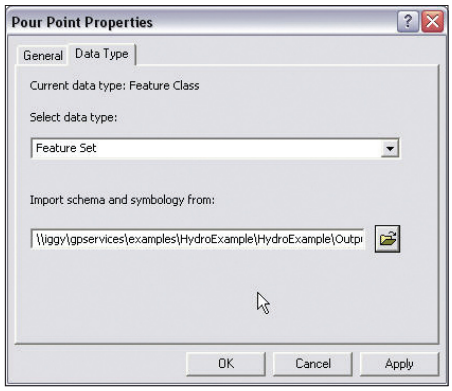


Figure 3: Setting feature type and symbology

that will be applied to the features from an existing layer file.

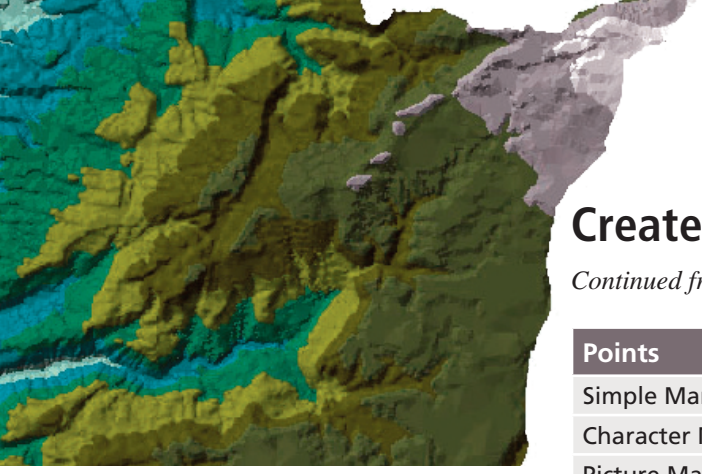
Since there is no associated map service, the output Feature Class will be drawn using the client's graphics library, which may only have basic capabilities. If the clients of the service are custom Web applications with Feature Set input or Feature Class output, symbology must be simple. Use only the symbol types listed in the table on page 46.

Step 5

Publish the Toolbox

Only toolboxes, not individual tools, can be published to ArcGIS Server. In the previous steps, the Create Watershed model existed within the HydrologicModelingTbx toolbox. Because its output is now managed, it is ready

Continued on page 46

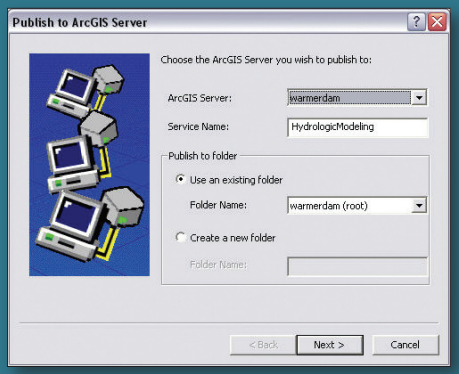


Create a Geoprocessing Service

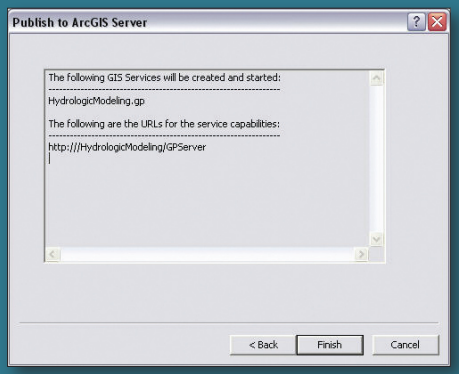
Continued from page 45

Points	Polygon	Line
Simple Marker	Simple Fill	Simple Line
Character Marker	Picture Fill	
Picture Marker		

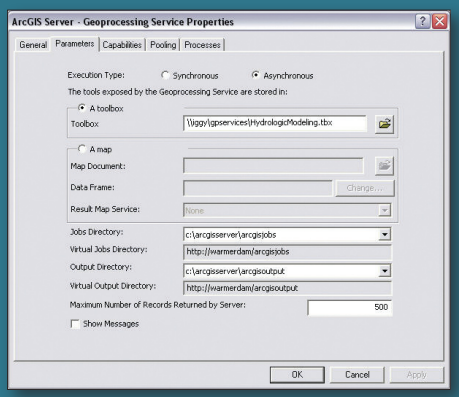
Allowed simple symbol types



Using the publishing wizard



Summary pane of the publishing wizard



Geoprocessing Service Properties page

to publish. A series of steps were performed to give ArcGIS Server access to the local computer. These steps added the Server Object Container (SOC) user account and shared the folder that contains the HydrologicModelingTbx toolbox (GPServices). These steps resulted in a new folder connection in ArcCatalog that is shared using its universal naming convention (UNC) path name (\\flames\GPServices). There are two path names to the HydrologicModelingTbx toolbox:

- C:\GPServices\HydrologicModelingTbx
- \\flames\ GPServices\HydrologicModelingTbx

A toolbox can be published from ArcToolbox or ArcCatalog by right-clicking the toolbox and choosing Publish to ArcGIS Server. When publishing a toolbox, make sure to publish using the UNC path name and not the local name, as described in the next section.

Publishing the Service

In ArcCatalog, browse to and select \\flames\GPServices\. Right-click on the HydrologicModelingTbx and choose Publish to ArcGIS Server to invoke the first panel of the publishing wizard. Choose the ArcGIS Server added in the previous steps. Change the Service Name if necessary. The service name defaults to the label of the toolbox with spaces replaced by underscores. Spaces are not allowed in the service name. Click Next and review the contents of the summary pane. Click Finish. A message box will appear if any issues were encountered during publishing.

How Server Accesses the Toolbox

When a toolbox is published, ArcGIS Server reads the contents of the toolbox and stores information about the location of the toolbox and the individual parameters of its tools. It does not copy the toolbox to the server. When stopping and restarting the service, ArcGIS Server rereads the toolbox and refreshes its information. If a model has changed, the service must be stopped and restarted. In ArcCatalog, browse to the GIS Server, right-click the toolbox and choose Stop. To restart, right-click the toolbox, and choose Start. Once the toolbox is published to the server, the connection to \\flames\GPServices can be removed from the ArcCatalog tree, but the folder must remain shared.

Service Properties Page

The properties of a service can be modified by stopping the service and opening its properties page. Using the service property page, the user can change the execution type, the source toolbox, and the maximum number of returned records.

Step 6

Test the Service

The final step ensures the service works correctly and returns valid results. The easiest test uses ArcGIS Desktop. Open ArcMap and perform the following steps:

1. Add a map service or local data representing the source DEM.
2. Add the published toolbox to the ArcToolbox window.
3. Open the server tool and fill in the parameters by interactively entering a pour point on the source DEM in the map display and run the tool.

Summary

In this example, the resulting datasets are sent back to the client from the server and the client draws the results. The other option for creating geoprocessing services is to publish a map document containing a tool layer. Publishing a map document creates two services, a geoprocessing service and a map service. Publish a map document if

- The results of the service are massive (>1000s of features).
- The resulting datasets will not be sent back to the client.
- Control of the rendering of raster results is desired.
- Map layers will be used in the model.

For more information on how to create geoprocessing services, visit *ArcUser Online* and read the PDF document entitled "For More Information" to find specific Web help topics.