Raster Layers with single and multiple rows.

Note: In this discussion, the terms “row” and “record” are used synonymously, as are the terms “image” and “raster”.

A raster layer is a Business table (an ordinary table in the RDBMS) with an IMAGE column, and a record in the SDE.RASTER_COLUMNS table. This is analogous to a vector ArcSDE layer (called a FeatureClass in Arc8) which is a Business table with a SHAPE column, and a record in the SDE.LAYERS table.

Just as the SDE.LAYERS table has a unique LAYER_ID for each record, the SDE.RASTER_COLUMNS has a unique RASTERCOLUMN_ID. As an example, here are two rasters loaded into an ArcSDE instance. One raster is called “My_Arc8_Raster_Layer” and the other is called “My_ArcIMS_Raster_Layer”. Shown below are just some of the columns in the SDE.RASTER_COLUMNS table:

SDE.RASTER_COLUMNS

RASTERCOLUMN_ID	OWNER	TABLE_NAME	RASTERCOLUMN_MASK
1	<USER>	MY_ARC8_RASTER_LAYER	256
2	<USER>	MY_ARCIMS_RASTER_LAYER	0

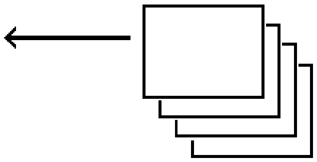
Single-record Raster Layers

A raster layer created and loaded with ArcCatalog has only one record in its Business table. An Arc 8 style single-record raster layer has the following properties:

- The Business table has only one record
- The Business table has two columns: NAME and IMAGE
- The RASTERCOLUMN_MASK column in the SDE.RASTER_COLUMNS table must have a value of 256 (or the 9th bit of the bitmask set [Development reserves the right to utilize more of these bits in the future, so the value may not always be 256]).
- The Business table must have “ESRI_SDERASTERDATASET” in the NAME column

MY_ARC8_RASTER_LAYER

NAME	IMAGE
ESRI_SDERASTERDATASET	1



Single images can be loaded, or multiple images can be mosaic’ed together (see below) into this single record to create large seamless rasters.

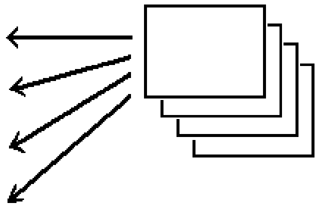
Multi-record Raster Layers

ArcIMS, and the underlying ArcSDE Raster Model (ArcSDE API), support raster layers with Business tables having multiple records, each with its own raster in the image column. Multi-record raster layers have the following properties

- They will not show up in ArcCatalog or ArcMap
- They have a value of 0 in the RASTERCOLUMN_MASK column in the SDE.RASTER_COLUMNS table
- There are no restrictions on the names or number of columns in the Business table. All that is needed is one integer column for the IMAGE column, and it can be named anything.
- If the NAME column is present and you use the **sderaster** loader, the NAME column will get populated with the filename of the image loaded.
- Images in separate rows can have different attributes (pixel-depth, pixel height and width, number of bands
- Images must have the same spatial reference, as this is an attribute on the raster layer, not of individual images.

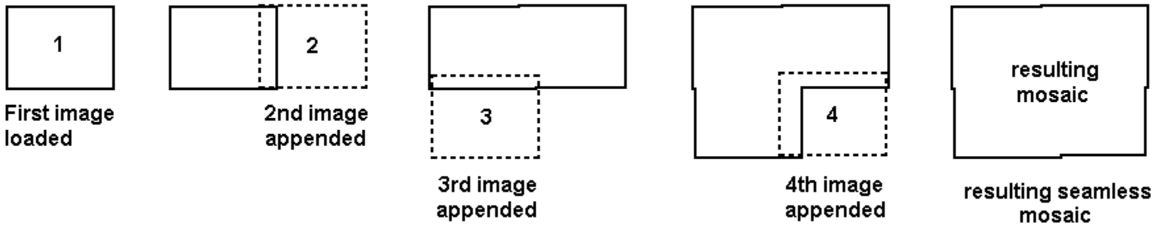
MY_ARCIMS_RASTER_LAYER

NAME	IMAGE
my_image_5.tif	1
my_image_6.tif	2
my_image_7.tif	3
my_image_8.tif	4



What is a Mosaic?

A mosaic is a raster composed of multiple input images. Mosaic'ing can be thought of as merging or appending. A single image is first loaded into ArcSDE. Then subsequent images are mosaic'ed onto the original image, resulting in a new larger image:

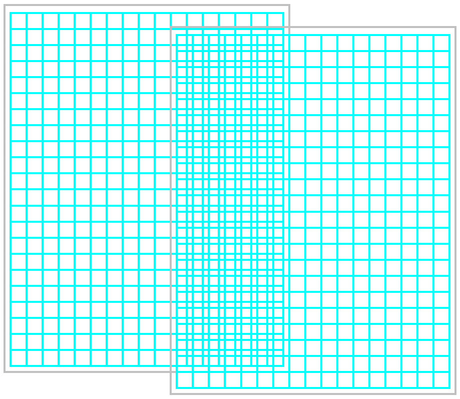


Note that the images being mosaic'ed together may overlap or even have gaps in between them. But they must have exact pixel registration (see below) and have certain attributes in common such as the pixel-depth (1, 8, 16, 32-bit, etc.), pixel height and width, number of bands and spatial reference. For overlapping images, the new image being mosaic'ed in will overwrite the existing image's pixels where they overlap.

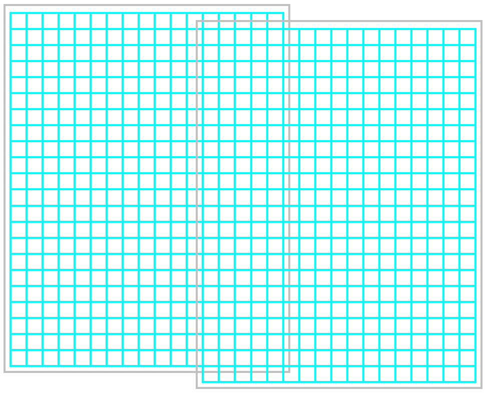
What is Exact Pixel Registration?

Exact pixel registration means that pixels from multiple images line up exactly. This should not be confused with overlap or gaps, which are permitted. But the actually cells have to fall on an even multiple of the cell width and height from one another, and adjacent images cannot have cells starting half-way into the cells of the original image.

Imagine two pieces of ordinary 8.5x11 graph paper as representing two images:



The cells of the second sheet of graph paper (representing pixels) do not line up with the first. The edges of the second sheet's cells fall in the middle of the first sheet's cells. These do not have exact pixel registration.



Here, the second sheet's cells line up with the first. The edges of the second sheet's cells fall precisely on the edges of the first sheet's cells. This is exact pixel registration.

Images with inexact pixel registration can be corrected by adjusting the world files to "shift" the origins slightly (no more than half a pixel up or down, or left or right) so they align properly, allowing them to be mosaic'ed. There is a sample utility called the **world_file_adjuster** which will do this in bulk for many world files.

What is sderaster?

It is an unsupported utility for loading and managing raster data in ArcSDE 8.1 written by the Raster team with executables for NT and Solaris. Other UNIX platforms are planned to be supported in the future. The utility includes a “readme.txt” which is included here. The readme is enhanced with explanations (in bold).

Begin “readme.txt”:

```
Disclaimer:
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THIS SOFTWARE IS NOT SUPPORTED BY ESRI.

This software is provided "as-is" and without warranty of any kind,
express, implied or otherwise, including, but not limited to all implied
warranties of merchantability and fitness for a particular purpose. In no
event shall Environmental Systems Research Institute, Inc. be liable to
you or anyone else for any direct, special, incidental, indirect or
consequential damages of any kind, arising out of or in connection with
the possession, use or performance of this software.


About sderaster
---------------

This is a command-line based raster utility for managing raster data in
ArcSDE 8.1. The supported raster formats include ESRI BSQ and TIFF(*).

TIFF format support requires optional libtiff library and is not included
here. For more information, check out http://www.libtiff.org.

However, if it's on Solaris, chances are the library (libtiff.so)
is already there, in this case, just add /usr/openwin/lib to your
LD_LIBRARY_PATH environment variable.
```

On my Solaris [2.]7 machine, this library was called /usr/openwin/lib/libtiff.so.3
On NT, you will need a copy of libtiff.dll placed in the same directory as sderaster.

```
Usage
-----

ArcSDE   8.1
Raster   Utility
--------------------------------------------------------------
Usage: sderaster -o command <options>

Available commands are:
        add        Add a raster column/layer to user table.
```

Registers the business table and raster column in the SDE.RASTER_COLUMNS table.

```
        drop       Drop a user table or just a raster column/layer.
```

Unregisters the business table and raster column from the SDE.RASTER_COLUMNS table, leaves the business table intact.

```
        truncate   Truncate a raster layer.
```

Deletes all records in the business table, but raster layer remains registered.

```
        describe   Describe one or all raster layers.
```

Describes metadata about whole raster layer.

```
        list       Describe one or all rasters in a raster layer.
```

Describes metadata about individual rasters (records in the business table).

```
        insert     Insert raster data into user table.
```

Appends an image (adds a new record) to an existing raster layer.

```
        delete     Delete raster data from user table.
```

Deletes an image from an existing raster layer.

```
        update     Update raster data in user table.
```

Updates an image from an existing raster layer.

```
        mosaic     Perform piece-wise update on raster data.
```

Appends an image to an existing image in a raster layer. This differs from insert in that the new image is actually merged with an existing raster to form a new single raster.

```
        pyramid    Update image pyramid.
```

Creates or updates the pyramid levels of an existing raster layer.

```
        stats      Calculate image statistics & histogram.
        import     Import raster data.
```

Creates a new raster layer (business table with raster column). Similar to The shp2sde –o create command.

```
        export     Export raster data.
```

Exports a raster layer to a BSQ file.

```
        grant      Grant privileges.
        revoke     Revoke privileges.
        analyze    Analyze user table.
        rename     Rename user table.

Specify -H followed by a command name for command-specific help.


Examples
--------

1. Importing an image file as an geodatabase raster dataset and enable
   data compression.

     sderaster -o import -l mytable,image -cg -f myraster.bsq -G <projectionID> ...
```

The optional –c flag compresses the raster data with lz77 compression. The raster data is stored uncompressed when this flag is not specified.

The optional –g flag registers the raster layer so it's visible to ArcCatalog and ArcMap. This flag sets RASTERCOLUMNS_MASK in the SDE.RASTERCOLUMNS table to 256 instead of 0, and sets the NAME column of the (single) record in the Business table to "ESRI_SDERASTERDATASET". This flag is only valid with sderaster –o import.

The optional -G <projectionID> flag sets the Spatial Reference information for the image. You provide an integer representing a spatial reference (also called a coordinate system) from the $SDEHOME/include/pedef.h projection engine header file. If you use the -G <projectionID> with the sderaster –o add command, you will also need to use it for insert or mosaic.

```
2. Importing from an existing ArcSDE raster, assume it's in table
   'myothertable' and has a raster ID of 1.

     sderaster -o import -l mytable,image -cg
     -f "-l myothertable,image -v 1 -i 5151 -s server -u user -p passwd" ...

3. Exporting the same raster to BSQ file.

     sderaster -o export -l myothertable,image -v 1 -f mydata.bsq ...

   Note: Exporting to TIFF file is not supported even with the optional
   libtiff library.

4. Mosaic image A and B.

   a) import A
      sderaster -o import -l table,image -f A.bsq -cg -G projectionID ...

   b) mosaic B
      Assume raster ID returned from step (a) is 1.

      sderaster -o mosaic -l table,image -v 1 -f B.bsq ...
```

The –v < rasterID > flag specifies which raster (record) to mosaic the image with. Every record in the raster layer will have a unique integer value in the IMAGE column. For example, when loading a

raster for the first time, the first record will have an ID of 1 in the IMAGE column. To mosaic additional images into this first raster, you would specify –v 1 for rasterID 1. The rasterID is analogous to FeatureID for vector data.

```
   If you have more than two images, repeat step (b).

5. Building image pyramid.

     sderaster -o pyramid -l table,image -v 1 -L -1 -I nearest ...

   If the pyramid level is set to -1 as in this example, server will
   set the actual level for you depending on the image dimension.

   If it's 0, the existing pyramid will be removed.

   Or you may set it to the level you want.
```

You can use –L –1 to build the pyramid levels when the raster layer is imported or inserted. For a raster layer containing multiple rasters (multiple rows), the pyramid levels can be built using the sderaster –o insert command with the –L –1 flag. For a mosaiced raster, the pyramid levels should be built as a separate step using the sderaster –o pyramid command.

(I added number 6.)

```
6. Creating a raster table with multiple records (can only be used with ArcIMS)

   a) import the 1st image
      sderaster -o import -l table,image -f first.tif -cg -G 4269 –L –1
      ...

   b) insert the 2nd through nth
      sderaster -o insert -l table,image -v 1 -f second.tif -G 4269 –L –1 ...
      sderaster -o insert -l table,image -v 1 -f third.tif -G 4269 –L –1 ...
      ...
      sderaster -o insert -l table,image -v 1 -f nth.tif -G 4269 –L –1 ...
```

In this example, -L –1 is used to build pyramids for each image after each image is loaded. The -G 4269 is a projectionID representing Geographic Coordinate System (decimal degrees) based on NAD83.

Note: Case sensitivity on world files

The sderaster utility loads BSQ and TIFF images. While the image extension (.BSQ or .TIF) can be upper or lower case, the world file extension (.bqw or .tfw) must be in lowercase.

EXAMPLES:

Creating a mosaic with sdeloader on Unix

This C-shell script is an example of loading data into a mosaic. Note that pyramids are built at the end of the load after all images have been mosaic’ed. Stats are calculated (this does an ANALYZE TABLE <table> COMPUTE STATISTICS in Oracle) for performance. The compression and GeoDatabase flags (-cg) are only needed for the import (when the raster layer is created), and not for the subsequent images being mosaic’ed.

```
#!/bin/csh -fx

set bustab = MOSAIC_TEST
set image_list = topo_1/quads_1/*.tif
set first_image = $image_list[1]
set raster_id = 1
set auto_level = -1
set connection = ’-s plague –i 5154 -u testuser –p secret’
set proj_id = 4269   #PE_GCS_NAD_1983

sdetable -o delete -t $bustab $connection -N

sderaster -o import -l $bustab,image -f $first_image -cg -G $proj_id $connection
-k RASTER_KEYWORD

shift image_list

foreach next_image ( $image_list )
  sderaster -o mosaic -l $bustab,image -v $raster_id -f $next_image $connection
end

sderaster -o pyramid -l $bustab,image -v $raster_id -L $auto_level $connection
sderaster -o analyze -t $bustab -m COMPUTE $connection

sderaster -o describe -l $bustab,image $connection -V
sderaster -o list -v $raster_id -l $bustab,image $connection -V
```

Creating a multi-row raster layer with sdeloader on Unix

This script is an example of loading data into a multi-row raster layer. Pyramids are built for each image as the images are being loaded.

```
#!/bin/csh -fx

set bustab = MULTIROW_TEST
set image_list = topo_1/quads_1/*.tif
set first_image = $image_list[1]
set raster_id = 1
set auto_level = -1
set connection = '-s plague -i 5154 -u testuser -p secret'
set proj_id = 4269   #PE_GCS_NAD_1983

sdetable -o delete -t $bustab $connection -N

sderaster -o import -l $bustab,image -f $first_image -c -G $proj_id -L
$auto_level $connection -k RASTER_KEYWORD

shift image_list

foreach next_image ( $image_list )
  sderaster -o insert -l $bustab,image -G $proj_id -L $auto_level -f $next_image
$connection
end

sderaster -o analyze -t $bustab -m COMPUTE $connection

sderaster -o describe -l $bustab,image $connection -V
sderaster -o list -v $raster_id -l $bustab,image $connection -V
```

Creating a mosaic with sdeloader on WinNT

This .BAT file is an example of loading data into a mosaic. Unlike the Unix example where we used –o import to create the business table and load the first image, here the business table is created manually, and the IMAGE column added with sderaster –o add (analogous to sdelayer –o add). This is just to illustrate an alternative way of creating a raster layer.

```
@echo off
set bustab=MOSAIC_TEST_WINNT
set image_list=topo_1\quads_1\*.tif
set first_image=%image_list%
set raster_id=1
set auto_level=-1
set connection=-s plague -i 5154 -u testuser -p secret
set proj_id=4269

sdetable -o delete -t %bustab% %connection% -N

sdetable -o create -t %bustab% -d "NAME string(65), IMAGE integer" %connection%
-N -k RASTER_DEFAULTS

sderaster -o add -l %bustab%,image -G %proj_id% %connection% -k RASTER_DEFAULTS

set first_one_loaded=false

for %%f in (%image_list%) do call :block %%f
goto endblock
:block
    if %first_one_loaded%==false  (
        sderaster -o insert -l %bustab%,image -G %proj_id% -f %1 %connection%
    ) else (
        sderaster -o mosaic -l %bustab%,image -v %raster_id% -f %1 %connection%
    )
    set first_one_loaded=true
    goto :eof
:endblock

sderaster -o pyramid -l %bustab%,image -v %raster_id% -L %auto_level% -f %1
%connection%
sderaster -o analyze -t %bustab% -m COMPUTE %connection%
sderaster -o describe -l %bustab%,image %connection% -V
sderaster -o list -v %raster_id% -l %bustab%,image %connection% -V
```

Creating a multi-row raster layer with sdeloader on WinNT

This .BAT file is an example of loading data into a multi-row raster layer.

```
@echo off
set bustab=MULTIROW_TEST_WINNT
set image_list=topo_1\quads_1\*.tif
set first_image=%image_list%
set raster_id=1
set auto_level=-1
set connection=-s plague -i 5154 -u testuser -p secret
set proj_id=4269

sdetable -o delete -t %bustab% %connection% -N

sdetable -o create -t %bustab% -d "NAME string(65), IMAGE integer" %connection%
-N -k RASTER_DEFAULTS

sderaster -o add -l %bustab%,image -G %proj_id% %connection% -k RASTER_DEFAULTS

for %%f in (%image_list%) do sderaster -o insert -l %bustab%,image -G %proj_id%
-L %auto_level% -f %%f

%connection%

sderaster -o analyze -t %bustab% -m COMPUTE %connection%
sderaster -o describe -l %bustab%,image %connection% -V
sderaster -o list -v %raster_id% -l %bustab%,image %connection% -V
```

Recommended Additional reading:

SDE 8.1 Docs included on the CD:

- “RASTER DATA IN A GEODATABASE, Pages 17-19 (pdf pages 21-23), Understanding_ArcSDE.pdf
- “RASTER DATA STORAGE, Page 35 (pdf page 39), Understanding_ArcSDE.pdf
- “APPENDIX A, Estimating the size of your tables and indexes: The raster data tables”, pages 114-117 (pdf pages 119-122), config_tuning_guide_oracle.pdf
- “APPENDIX B, Storing raster data”, pages 119-129 (pdf pages 124-134, config_tuning_guide_oracle.pdf
- “Raster parameters”, Page 35 (pdf page 41), Managing_ArcSDE_Services.pdf
- “Raster tables”, Pages 110-111 (pdf pages 116-117), Managing_ArcSDE_Services.pdf

ArcSDE Administration for Oracle Training Class

“ArcSDE raster datasets", Lecture 4, Pages 27-36
“Raster storage layout”, Lecture 6, Pages 19-29
“Raster dataset query”, Lecture 7, Page 10
“Raster catalog overview”, Lecture 8, Pages 36-40