



# Raster Data Management with ArcInfo 8 and ArcSDE 8

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# Raster Data Management Issues

- Format Access
- Size
- Speed
- Seamless
- Quality
- Multi-user Access
- Security



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# ArcInfo 8 Raster

- New *Raster* concept - equal treatment for all raster data regardless of format

“a Raster is a Raster”

- Formats - uses extensible architecture



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# Raster Dataset Extensions

- Any raster format can now have
  - Pyramids for fast display
  - Statistics for display flexibility
  - Map projection information
  - Metadata
  - Stored as raster .aux .rrd .xml



# Auxiliary files .aux

- Stores information the format does not know how to store
  - Statistics
  - Tables
  - Map Projection
  - Pointer to pyramid file
  - Colormap
  - etc



# Supported Formats in 8.1

- GRID and GRID Stack file
- SDE Raster
- Raster Catalogs
- ERDAS Imagine, LAN, GIS, Raw
- TIFF
- MrSID
- JFIF (JPEG)
- BIL, BIP, BSQ
- BMP
- GIF, PNG
- DTED Level 1 and 2, ADRG, CADRG, CIB, NITF
- ER Mapper



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# Raster Catalogs

- Formerly known as Image Catalogs.
- Seamless display of many images as a single unit.
- A table of image names and extents.
- In 8.1
  - Can contain any supported format
  - Not limited to dBase and INFO files
  - Scale dependent drawing



# Catalog or Mosaic?

- Raster Catalog
  - Separate files are better for update of standard mapping units
  - Scale dependent drawing of extents
- Mosaic
  - Seamless
  - Pyramids on a single mosaic will draw faster than multiple rasters
  - Upper size limit of operating system





# MrSID

- Multi-resolution
- Seamless
- Wavelet Compressed (lossy)
- Especially good for large to very large images (100s to 1000s of mb)



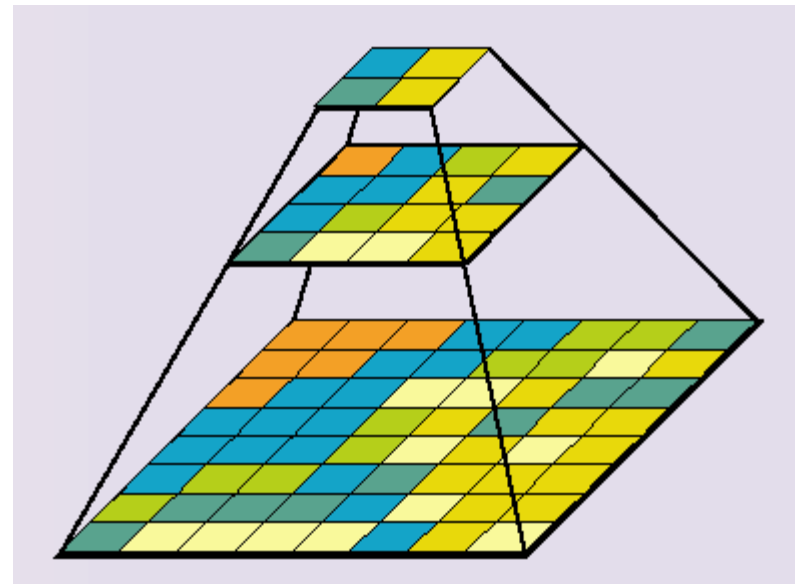
# Add New Raster Formats

- ArcMap won't read ZYZX Format...
- Write your own format dll according to published API, share it with others.
- Your format will have all the power of any other format.



# Pyramids

- Downsampled copies of the raster used to optimize display performance.
- Stored in raster.rrd or .rde file



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# Compression

- Smaller file size
- Performance
  - Pro
    - reduce disk I/O
    - send smaller packets over network
  - Con
    - file must be decompressed before use



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# Lossless Compression

- Cell values do not change, generally low compression ratio (3:1)
  - GRID - adaptive run length encoding, allows random access without decompression.
  - TIFF/GIF - LZW, licensed by Unisys
  - PNG - very similar to LZW, but free



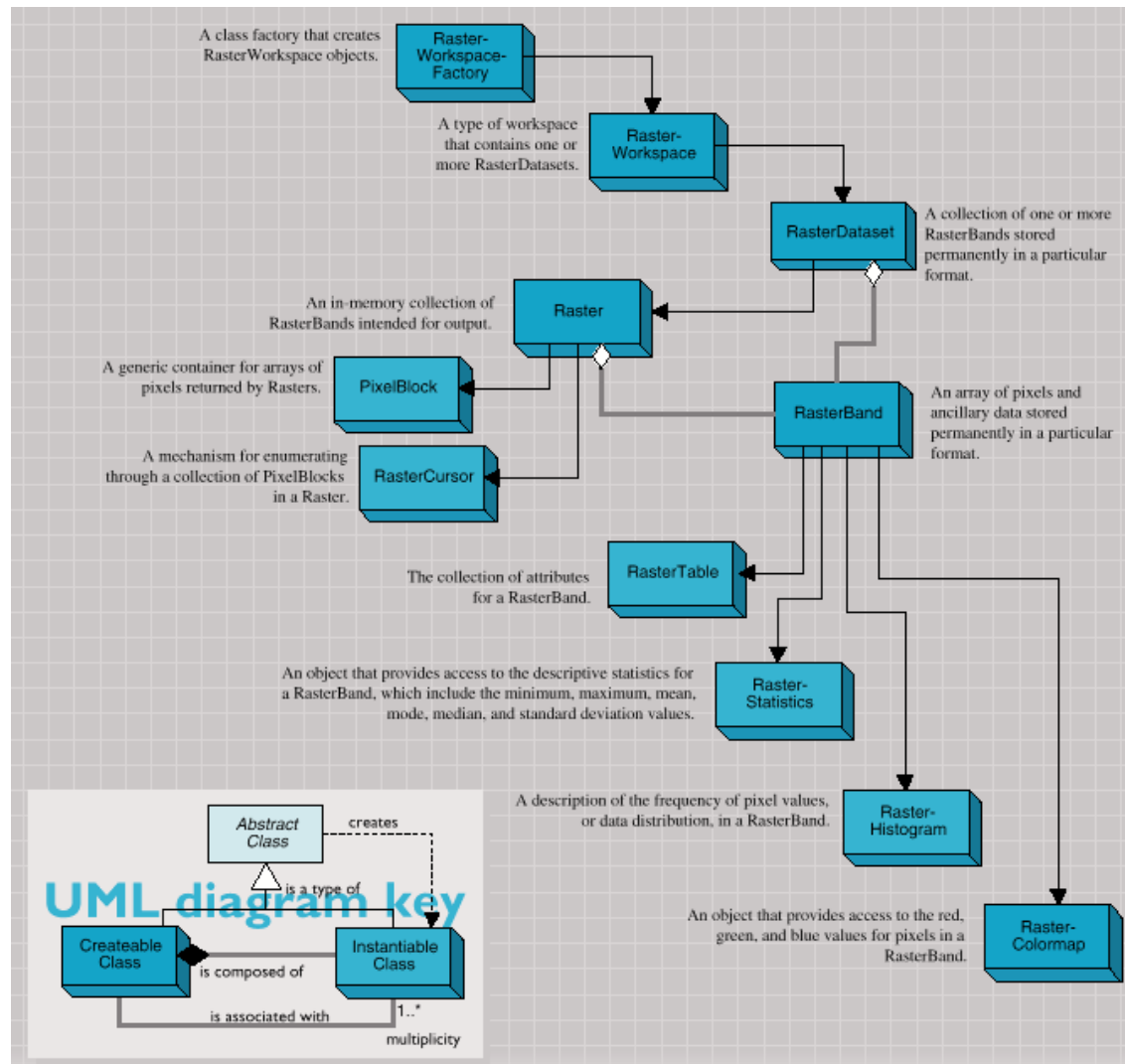
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# Lossy Compression

- Cell values are changes to make image more homogeneous
- Variable compression ratios, can be quite high (50:1)
  - JPEG - JFIF compression
  - MrSID - wavelette compression
- Generally speaking, higher compression ratios mean longer decompression times.



# Raster Data Objects



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# Raster in an RDBMS

- Pyramids
- Compression
- Mosaicing
- Catalogs



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# What is ArcSDE?

- A **gateway** that allows you to store and manage spatial data with other business data in an **RDBMS**.



# ArcSDE Leverages RDBMS

- Multi-user access
- Backup and Security
- Scalable, robust system architecture
- Performance tuning
- Additional RDBMS functionality, i.e. replication, fail-over, etc
- Integrated data model (spatial and tabular data together)



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# RDBMS Benefits

- Single place for all data
- Served via tcp/ip instead of requiring nfs
- Concurrency management (multiuser handling, transactions)
- Backup/recovery tools
- No real limit to the size of data you can store
- DBMS security
- Internet access



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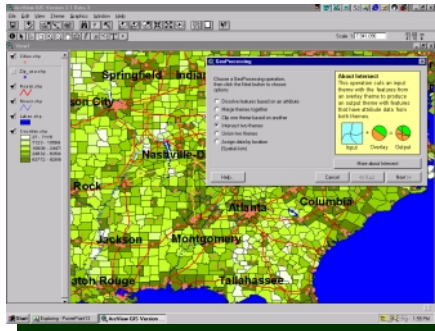
# What does ArcSDE do?

- Supports spatial and non-spatial queries from clients.
- Interacts with RDBMS server for data storage and retrieval.
- Performs GIS operations on data.
- Carries out Geodatabase operations managed by Geodatabase clients.

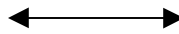


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# What ArcSDE Does



Client



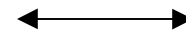
ArcSDE

“Work with my RDBMS to store and retrieve data.”

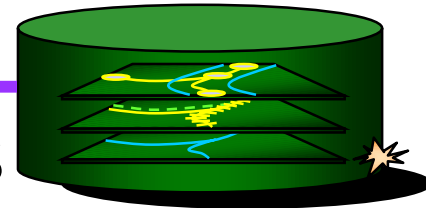
“Fetch data for this map window and use  
this attribute constraint”

“Fetch data and project them on the fly.”

“Carry out this Geodatabase operation.”



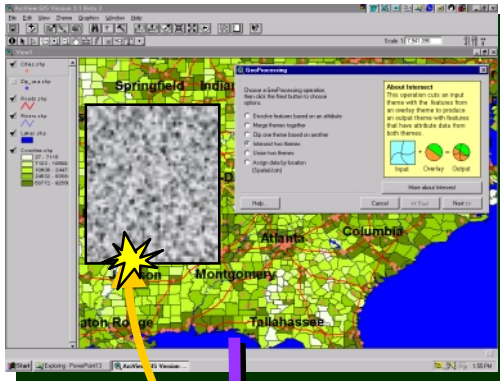
RDBMS



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# ArcSDE Raster Layers

- ... are just like other ArcSDE feature classes
- ... are just like other ArcMap raster layers



Client  
Application

TCP/IP Network

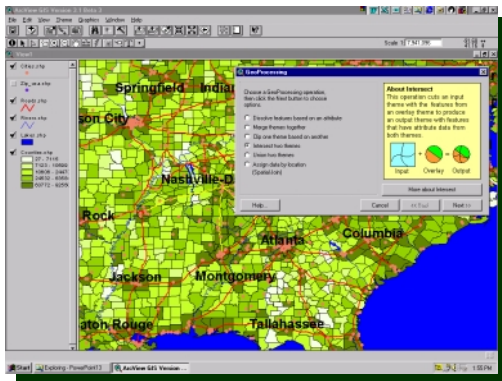


# Architecture Choices

- **3-tier** (ArcSDE Server Process)
  - minimizes network traffic with server-side data filtering
  - best performance
- **2-tier** (Client direct to RDBMS)
  - simple client configuration
  - No need for server management



# ArcSDE 3-tier Client/Server Architecture



Client  
Application

TCP/IP Network

Server Process

ArcSDE

DBMS

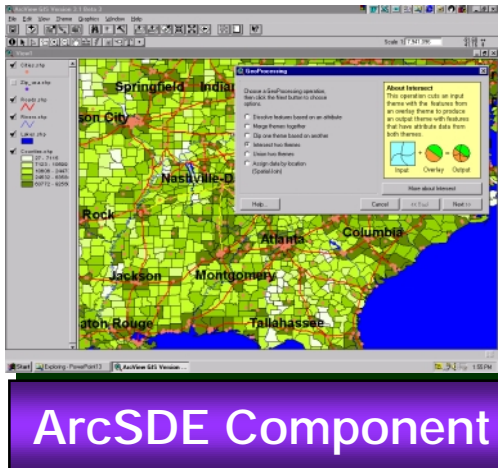
ArcSDE server is an application server for GIS clients.



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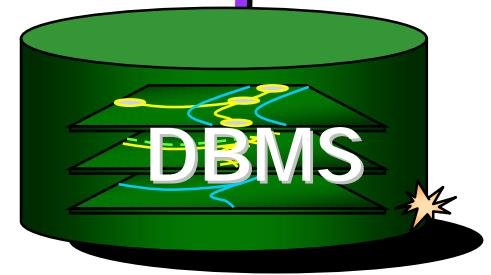
# ArcSDE 2-tier Client/Server Architecture



Client  
Application

TCP/IP Network

Client uses ArcSDE component for direct access to RDBMS.



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# Who could use this?

- Anyone who wants to share their raster data.
- Anyone who wants fast access to very large images.
- Anyone who wants the advantages of a DBMS.



# Large Seamless Mosaics Served to many people

- 10s to 1000s of rasters, 10s of mb to gigabytes each, managed as one unit.
- National and Local govt. sharing of image data.
- Natural resource managers - forestry, mining, utilities, agriculture.
- Examples currently available on the **Geography Network**



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# Other scenarios

- Feature as attribute of raster
  - spatial extent, footprint of raster
- Raster as attribute of feature
  - pictures of wells



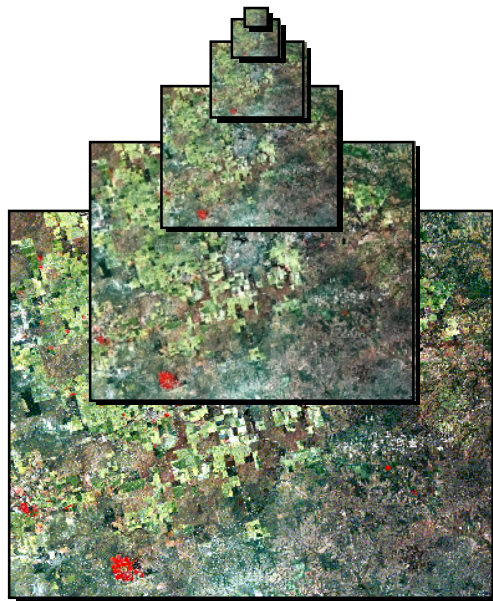
# How we do it

- Pyramids
- Internal tiling
- Spatial indexing
- Compression

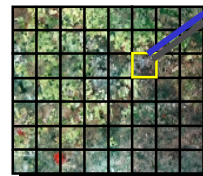


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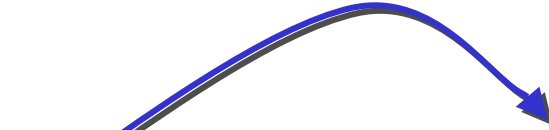
# Putting Raster Data into a Relational Database



Build reduced resolution pyramids



Tile each level



ImgID	PixelValues
R7D4239	48943939548749275967392848697

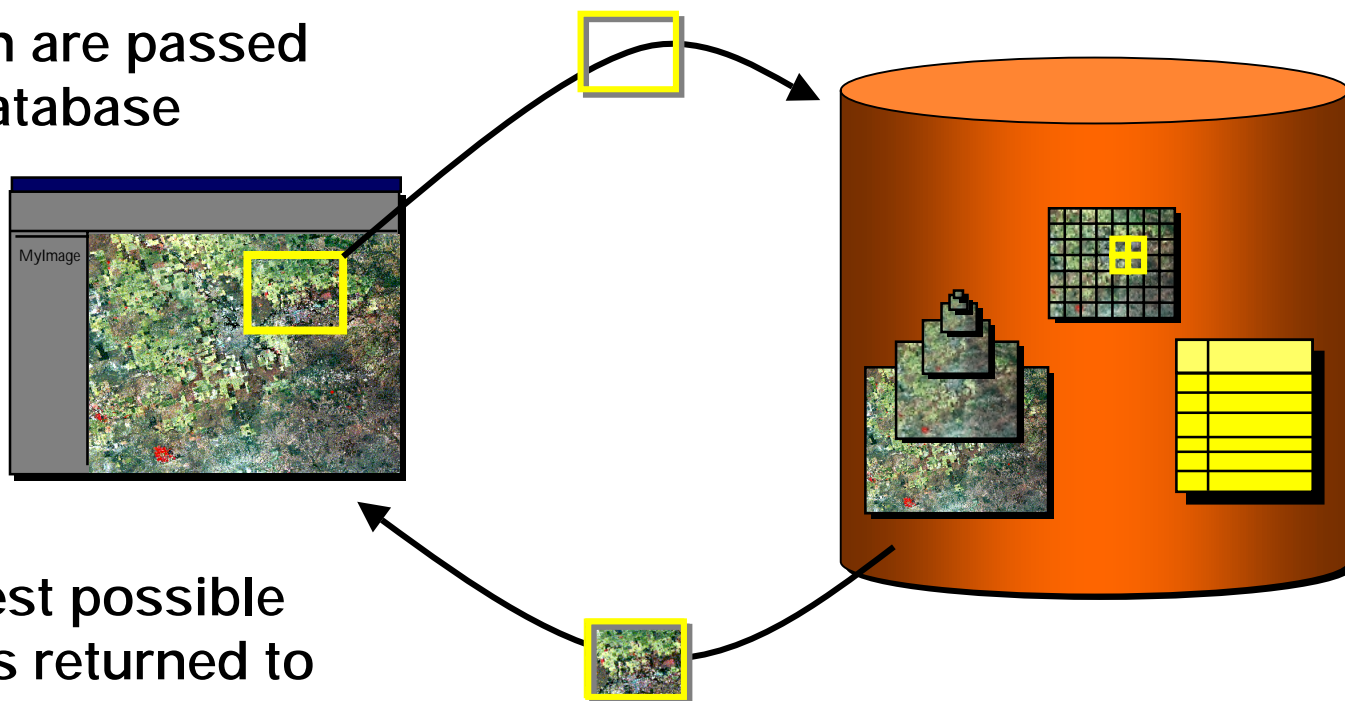
Store as BLOB in database record



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# Getting Data from the Relational Database

Image name, desired extent, and screen resolution are passed to database



Smallest possible image is returned to the client



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# Tile size

- Internally the image is tiled into user defined pieces (e.g. 256x256 pixels)
- The size you choose will depend on your application.



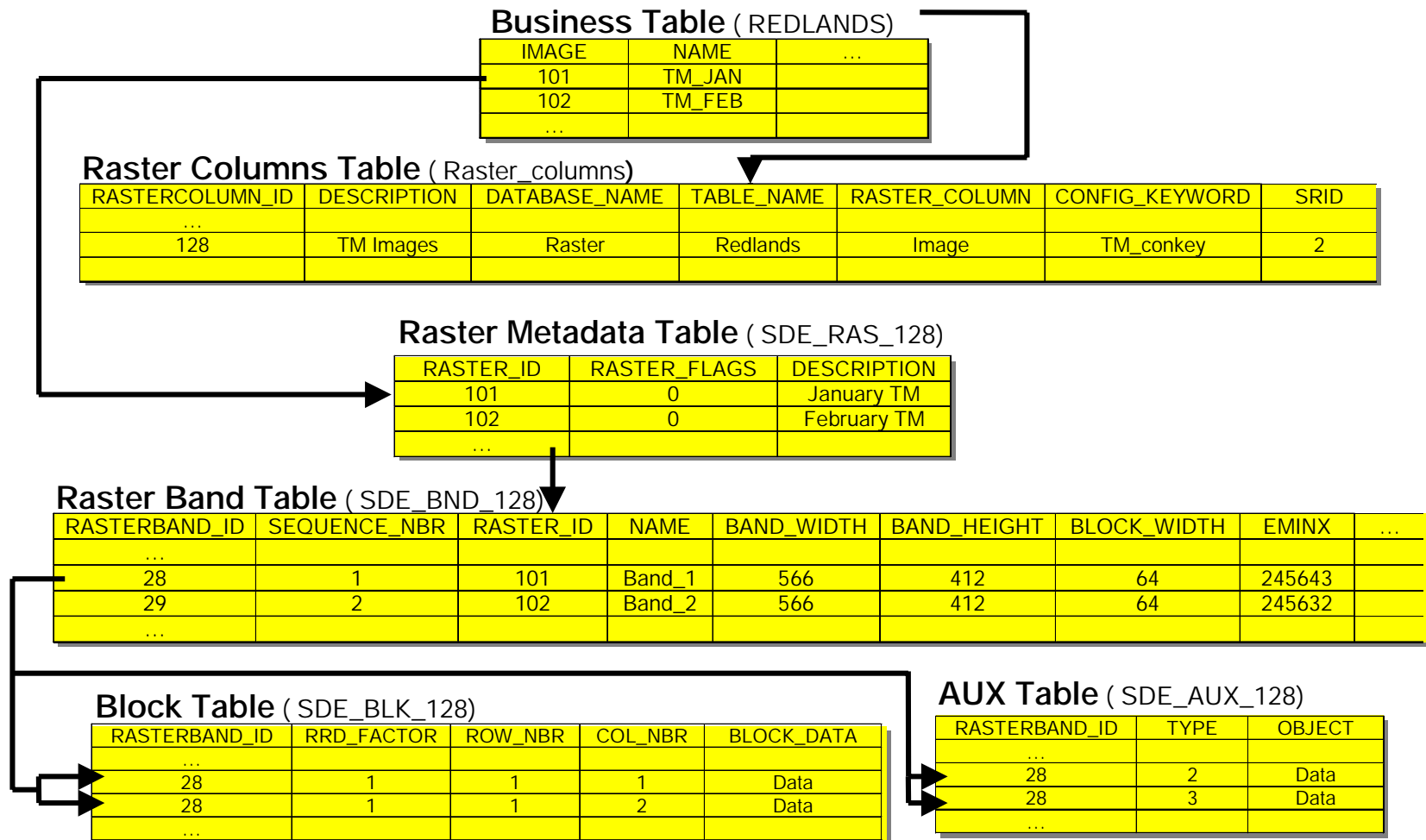


# Spatial Index

- These tiles are spatially indexed to optimize their search and retrieval



# Table Structure



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# Things you can store

- **Single and Multi-band images in all formats supported by Arc8.**
  - Optional mosaic during loading
- **Raster Catalogs**

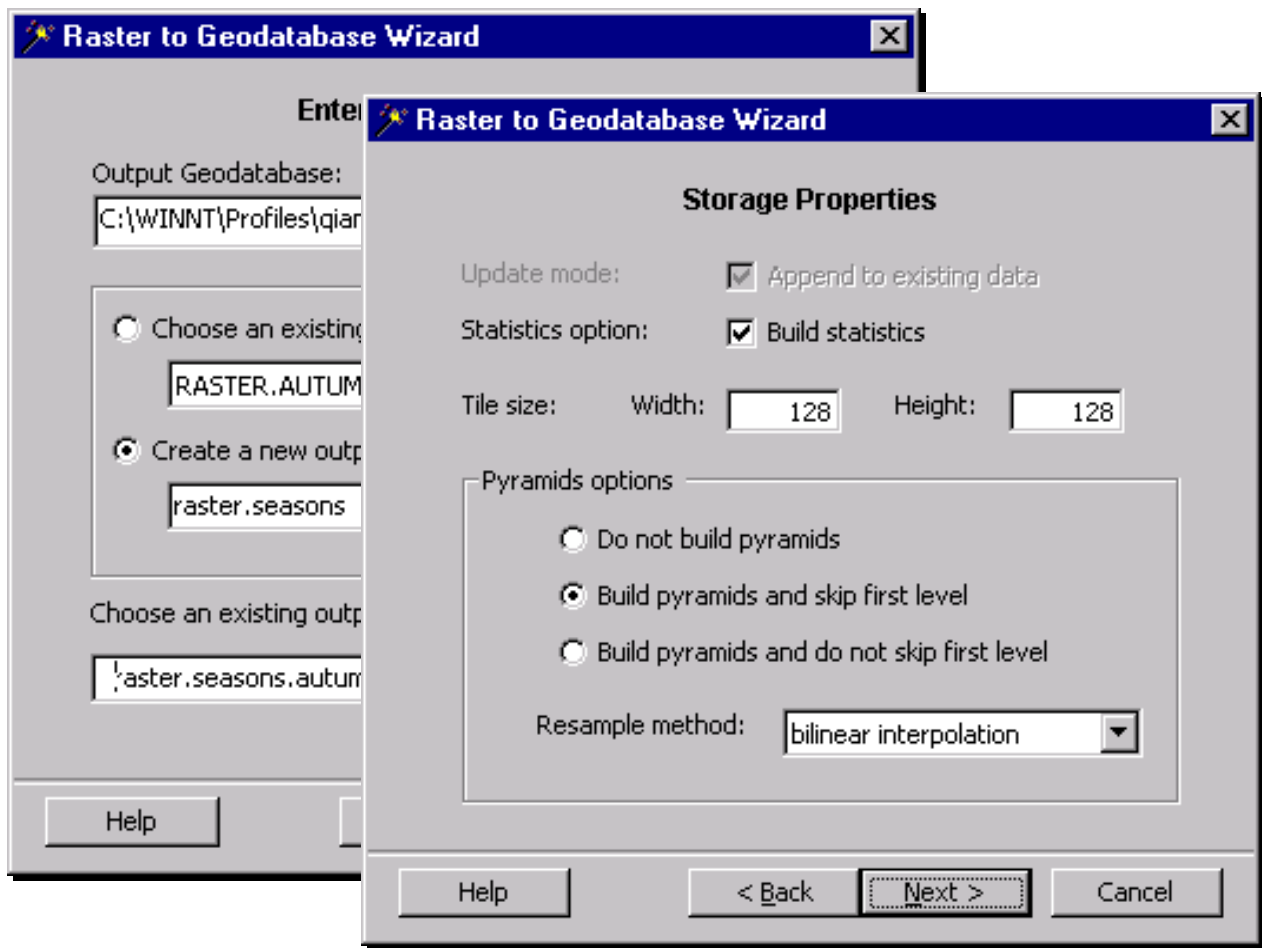


# Loading Options

- ArcToolbox
- COM API to loading
- SDE C API
  - sample loader



# ArcToolbox



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# VB COM API

- **RasterSDELoader CoClass** - three interfaces for loading raster data into SDE, it is implemented upon RDO (Raster Data Object).
  - **IRasterSDEConnection** - defines the connection information.
  - **IRasterSDEStorage** - holds the parameters for storage.
  - **IRasterServerOperation** - defines the operation for the SDE session, such as CreateRaster, Insert, Mosaic, RemoveRasterColumn, and Delete.



# Metadata

- Storage
- Searching



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# Tuning

- Build Pyramids
- Adjust tile size
- Adjust DBMS block size
- Compression
- DB Tune Settings



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# Configuration

- Many small physical drives instead of one big one.
- Separate data and spatial indexes into separate table space, separate physical devices.



# Configuration

- Read Only Acees
- Minimum raster ID
  - ex all DOQs of Utah have similar ID range simplifying mgmt of tables and queries.



# Clients and Loaders

- For ArcSDE 8.02
  - Command line loader
  - ArcIMS 3 client
- For ArcSDE 8.1
  - ArcToolbox loader
  - Desktop ArcInfo/ArcView client
  - ArcIMS 3.01 client
- Write your own using C or Java API



# Export and Analysis

- Export via the API to BSQ
- Export to GRID, TIF, IMG from ArcToolbox
- Spatial Analyst works against the full resolution raster.



# Demonstration



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**Twentieth Annual ESRI International User Conference • June 26-30, 2000**



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# Which Database Should I Use

- ArcSDE is an open system -- ESRI doesn't favor any one vendor ArcSDE works with the major RDBMSs
- Some questions to consider:
  - Are they already using an RDBMS?
  - Do they already have hardware/os platforms they must use? May impact decision.
  - Functional requirements (eg: geometry type storage they want to use)
  - Enterprise design (what applications?)
  - Market share (financial investment behind development)
  - Company viability (will they be around when I need them?)



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# Why Use ArcSDE?

- Make use of an integrated spatial and tabular data model
- Support multi-user Geodatabase technology
- Gain powerful benefits from Relational Database Management Systems (RDBMS)
- Maintain an open, enterprise system architecture
- Support modern networking solutions



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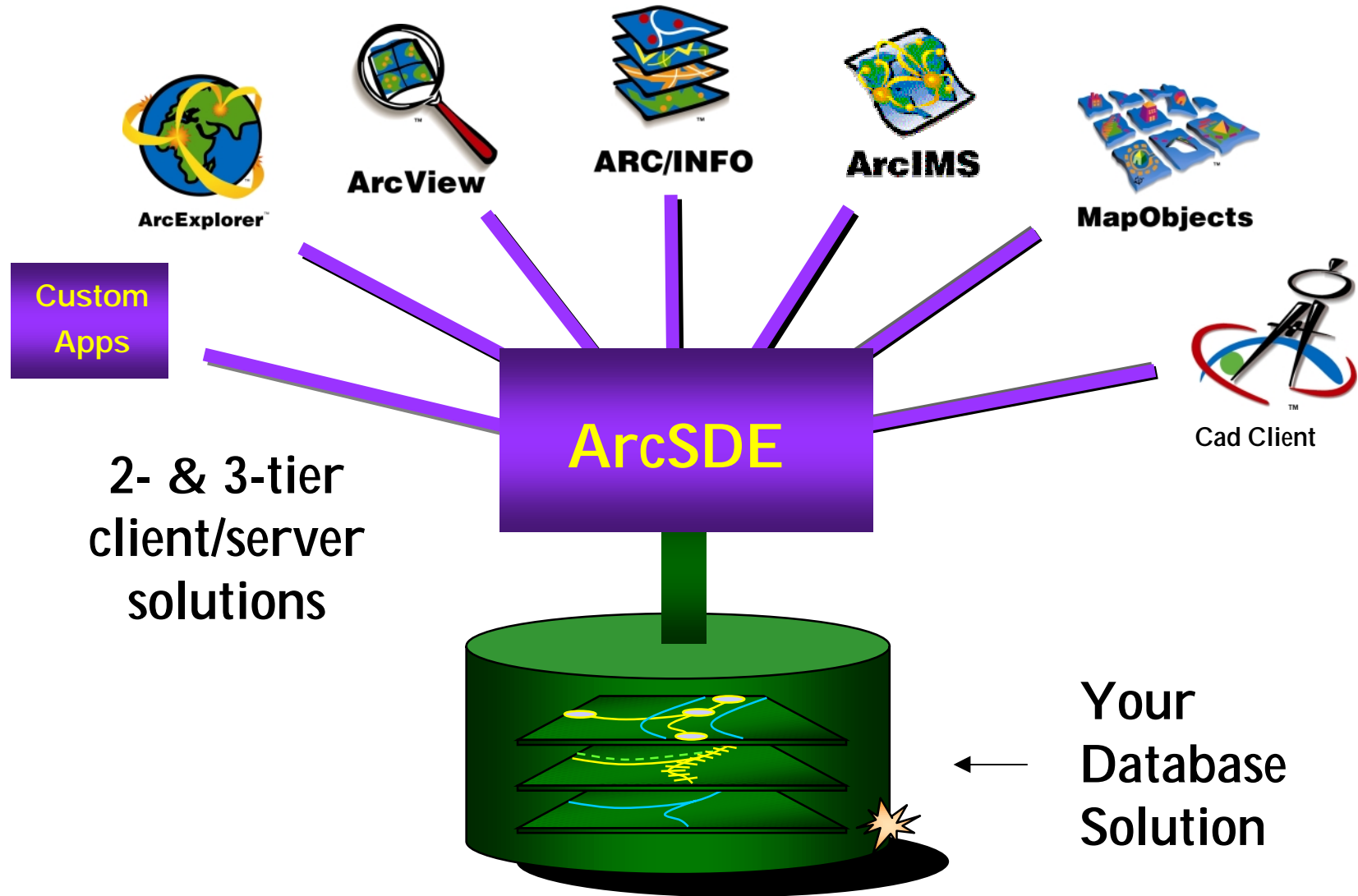


# ArcSDE Client/Server Architecture

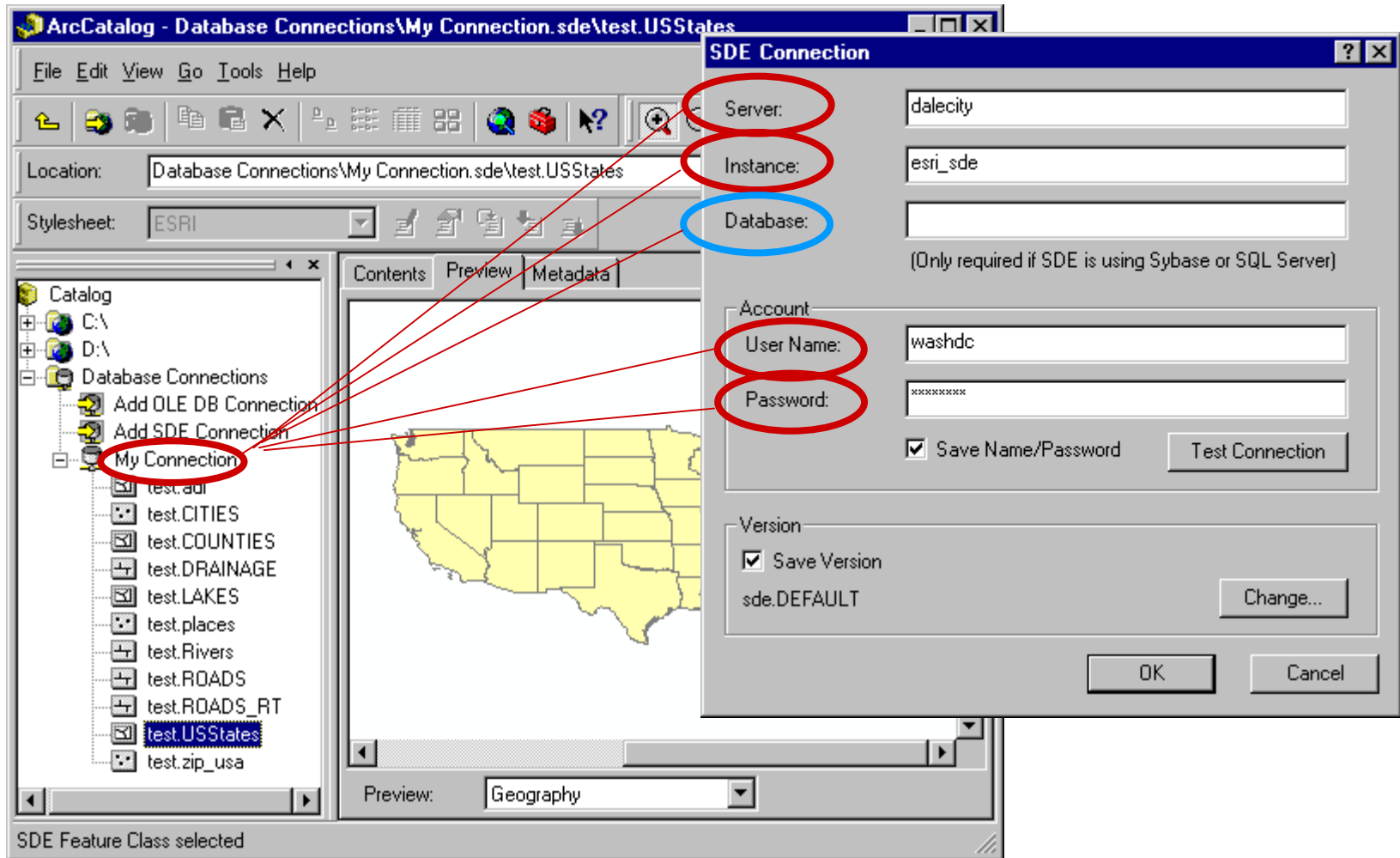
- a server-side application data server in a **3-tier** system architecture
- an application-side software component in a **2-tier** system architecture



# ArcSDE Architecture



# Creating a Connection to ArcSDE



# On the fly Projection

- All raster data can be projected on the fly
- Works best on small geographic areas or between coordinate systems with minimal distortion.
- Don't try to project the entire world



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