Esri International User Conference | San Diego, CA
Technical Workshops | 07/13/2011

System Architecture for Large Image Services

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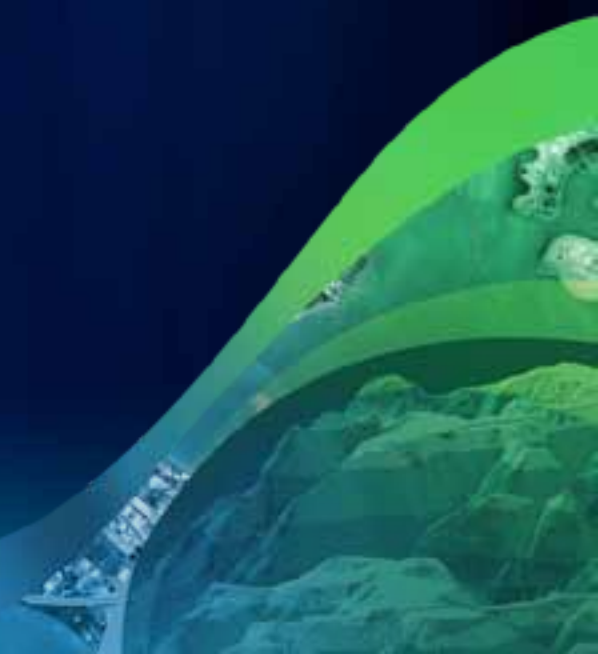
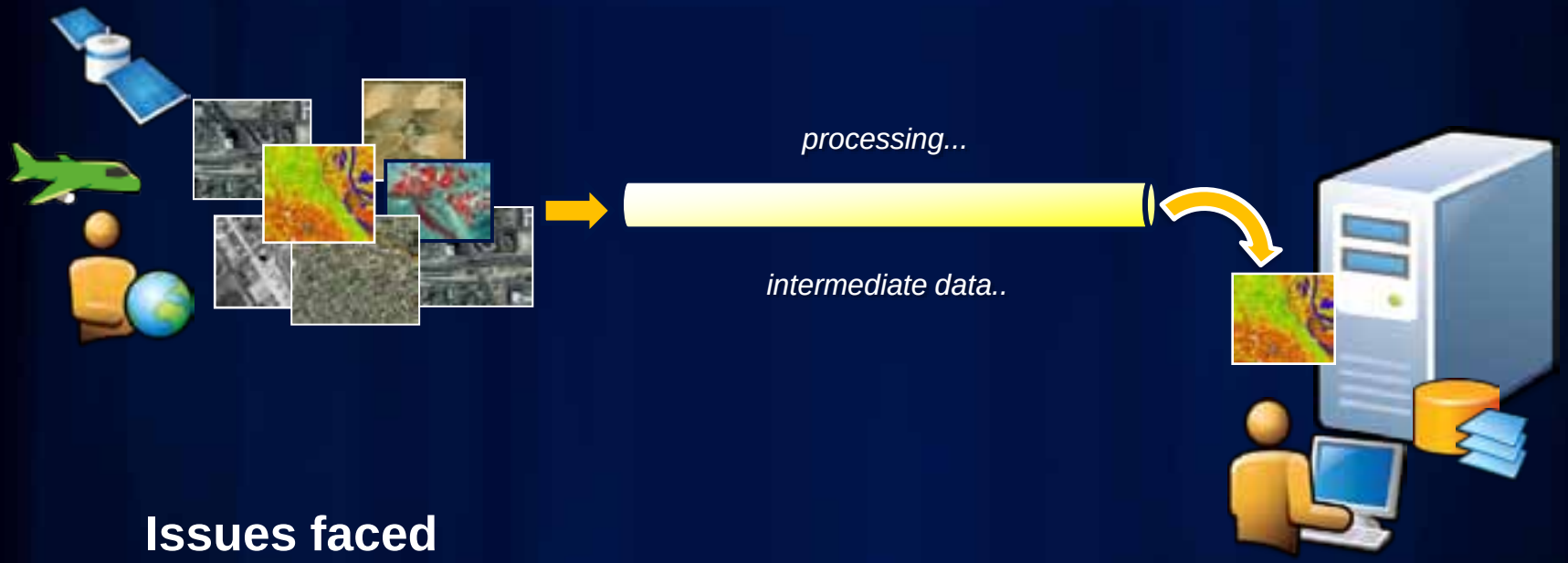


Agenda

- Mosaic Datasets to Manage data
- GIS Image Architecture
- Image Access Patterns
- Performance factors
- Storing imagery data – storage systems
- Network – Tuning and optimization
- Formats
- Memory recommendations
- Web platform configuration strategies
- Organizing Mosaic Datasets (configurations)
- Open Discussion / Q & A

Data Management



Issues faced

- Multiple sources
- Multiple formats
- Increasing bit depths and bands
- Metadata
- Different kinds of processing requirements
- Redundant intermediate data

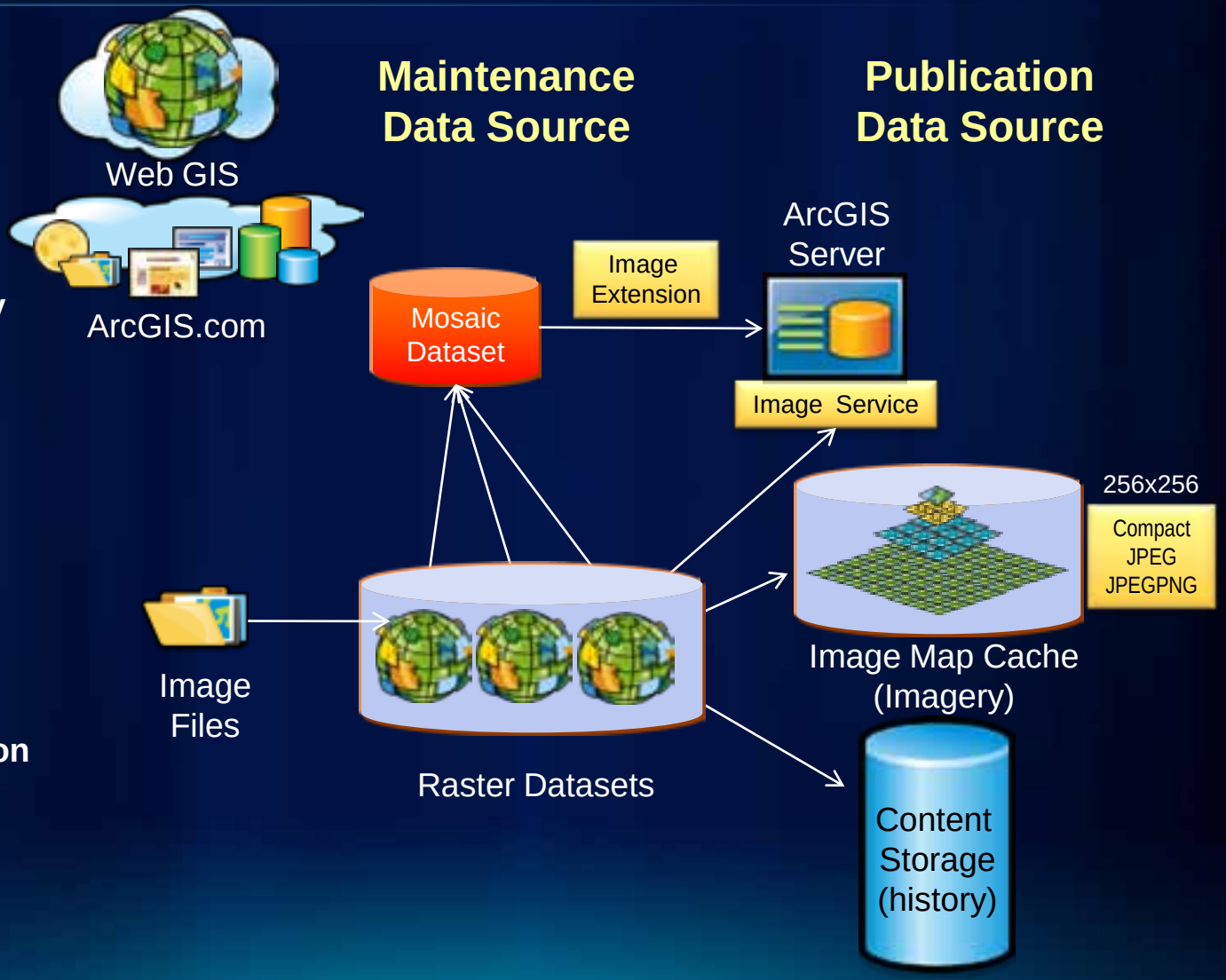
Mosaic Dataset

- Catalog\Library of imagery & associated metadata
- Stored in the Geodatabase
- Massively scalable
- Reference original pixels from file or database
- Apply on-the-fly processing
- Automation – GP tools/ArcObjects
- Accessible as:
  - Image – Dynamically mosaiced and processed
  - Catalog – Geometry and metadata

GIS Imagery data Architecture

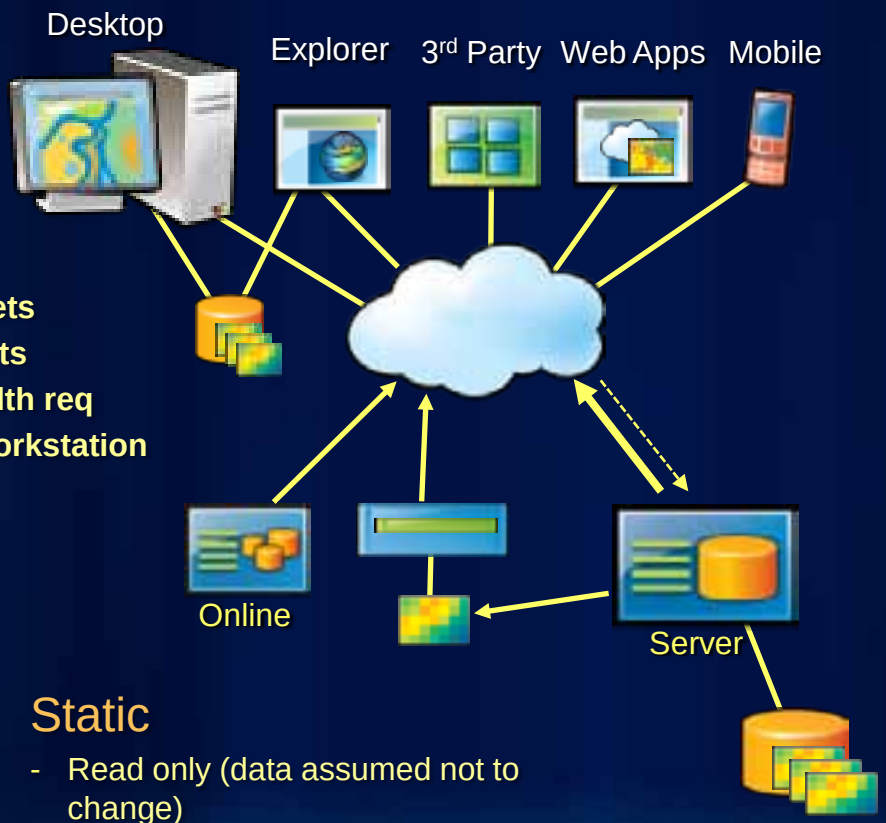
Data Resources

- **Raster Data**
  - **Aerial Photography**
  - **Satellite Imagery**
  - **Storage Formats**
    - **TIFF**
    - **IMG**
    - **MRSID**
    - **JPG2000**
  - **Lidar Point Elevation**
  - **Terrain Data**



ArcGIS Image Access Patterns

Three patterns for Image Access



Direct

- **Raster Datasets**
- **Mosaic Datsets**
- **High bandwidth req**
- **Traditional workstation**
- **Tiff, jp2...**

Static

- Read only (data assumed not to change)
- Preprocessed and tiled for performance
- MapServer layer, Map Cache, world imagery, bing..

Dynamic

- **Server rendered requests**
- **Changeable compression, mosaic method, projection**
- **Image Services**
- **WMS**
- **WCS**

Optimizing Systems Architecture

Factors to consider / Impact

- **CPU / High**
- **RAM / High**
- **WAN uplink / High**
- **LAN /** Medium
- **Disk Speed / Medium**
- **Shared Storage /** Medium
- **Load Balancer /** Medium
- **Web Application Server /** Medium
- **Operating System /** Medium
- **Data Source /** Medium

Storing Imagery Data

- Disk Storage technology
- Disk Storage platform architecture

Disk Storage technology

Attribute	SAS	SATA	Solid State	RAM Disk
Performance	High	Medium	Very High	Very High
Supported disk speeds	15K, 10K, 7.2K RPM	7.2K, 5.4K RPM	No moving parts (no RPM)	No moving parts (no RPM)
Capacities	High, but dependent on disk speeds	High	Low	Very Low
Power consumptions	Consumes more power than the equivalent SATA.	Consumes less power than SAS due to slower RPM speeds	Consumes less power than the magneto-mechanical drives such as SAS and SATA	Based on consumption of system memory
Cost	More expensive than SATA	Lowest dollar per gigabyte	More expensive than SAS and SATA	Highest dollar per gigabyte

Disk Storage platform architecture

- **DAS (Direct Attached Storage)**
  - **Immediately attached to a host system**
- **NAS (Network Attached Storage)**
  - **Shared storage – effective in enterprise (various servers)**
- **SAN (Storage Area Network)**
  - **Provide storage to remote machines (presented as local storage)**

Direct Attached Storage (DAS)

- Single Storage device to single host
- Medium performance and scalability (compared to a SAN)
- SCSI and FC – I/O protocols
- Apt for Small businesses
- Simple and inexpensive
- Easy to install and expand
- Imaging applications, file servers, web servers…..

Network Attached Storage (NAS)

- Multiple hosts connected to shared drives
- Medium performance (limited to bandwidth)
- Apt for Medium to enterprise size organizations (Data Centers)
- Not as scalable as a SAN
- More expensive to implement (than a DAS).
- Easier to implement and manage as opposed to a SAN
- Features Snapshot backup, easy expandibility, data replication..
- Imaging applications, file servers, web servers…..
- Works across all OS’s (heterogeneous OS) simultaneously

Storage Area Network (SAN)

- Single host per Logical UNit (multiple LUN’s to a single processor possible)
- High performance
- ISCSI and FC (HBA’s) – I/O protocols
- Apt for Enterprise Sized businesses
- Highly scalable
- Expensive to deploy\manage
- Variety of failover\fault tolerance features
- High speed fiber channel communication
- Managing multiple disks – single point of control
- High bandwidth video streams, Imaging\transaction processing..

Network – Tuning and Optimizing

- Application types and network load
- Factors affecting Network Load
- LAN Performance
- WAN Performance

Application Types and Network Load

- Rich Client applications – Heavy Load (10 Mb per display)
- RCA via Citrix(image) – Medium (5 Mb)
- RCA via Citrix(Vector) – Light (3 Mb)
- Web Apps (Dynamic) – Medium (2 Mb)
- Web Apps (Cached) – Medium (1 Mb)
- Services (REST) – Medium (2 Mb)
- Services (SOAP) – Medium (3 Mb)
- Mobile Apps – Light (0.05 Mb)

Factors affecting Network Load

- Internet browser caching policy
- Percent of new users
- Image Size
- Image Format
- Blending Location

Recommended throughput capabilities for LAN components:

- Clients - 100 Mbit/sec
- Servers - 1 Gbit/sec

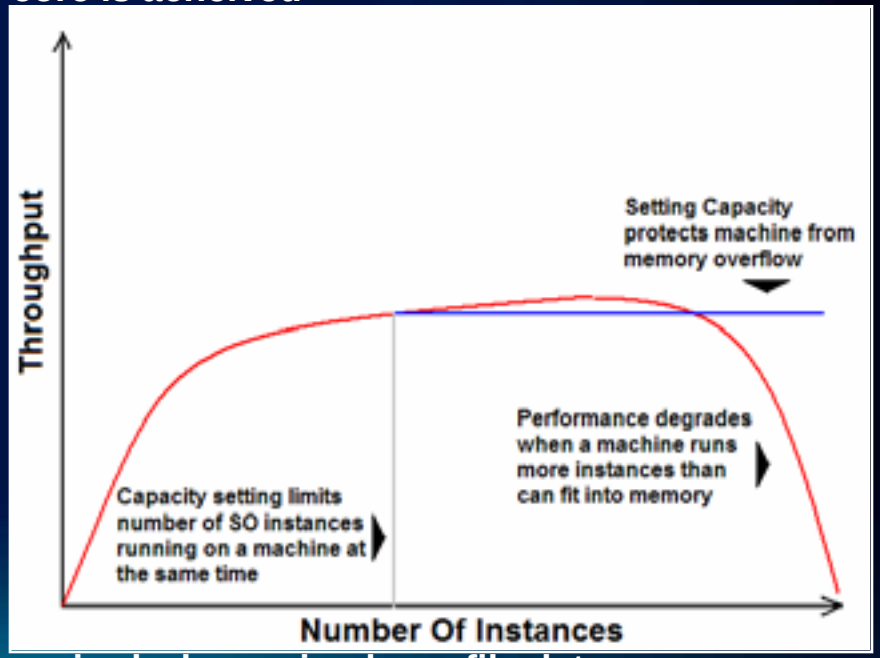
WAN Performance

- Key performance consideration:
  - Bandwidth
  - Latency
  - Network connections (Satellite, ground, ISDN)

- Other components to improve throughput
  - Netscaler
  - Branchrepeater (formerly WANScaler)
  - Acceleration service providers (Akamai)

Memory recommendations

- Too many instances per server can exhaust memory
  - Increased paging when not enough memory
  - Slower processing due to shared compute resources
  - Peak throughput at 3-5 instances per core is acheived
- Too few instances per server
  - Can limit utilization of host hardware
  - Minimum of 3 instances per core recommended
- Provide sufficient memory to support optimum performance
  - Minimum of 3 GB memory per core recommended More memory may berequired when using large file data sources



Formats

- Faster reading
  - Tiff, Raw
- Tiled formats – optimize disk access
  - Tiled Tiff
- Compression formats – less CPU intensive formats
  - Jpeg, LZW
- Define overviews on the mosaic dataset

Formats

- Tiled TIFF with JPEG compression
- TIFF raw - large* files are 20 percent slower.
- MrSID - Approximately 50 percent slower.
- JPEG 2000 - Approximately 75 percent slower.
- IMG with RRD - Approximately 50 percent slower.
- JPEG - large* files are 400 percent slower.

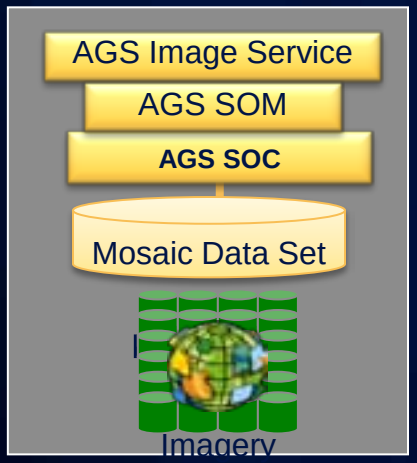
**A large file is approximately 10000 x 10000 pixels, uncompressed; this is approximately a 100 MB panchromatic (one-band) image or a 300 MB color (three-band) image.*

Web Platform Configuration Strategies

- Single Tier Architectures
- Two Tier Architectures

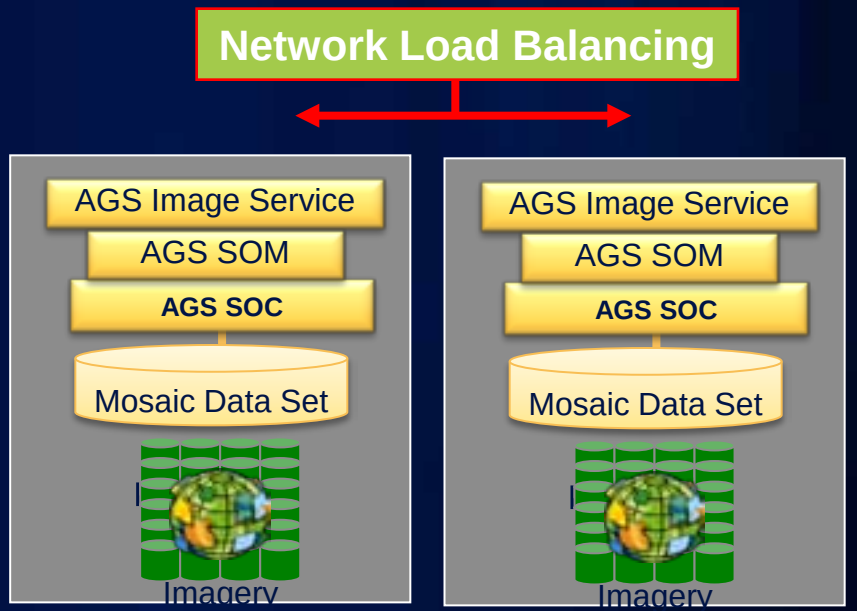
ArcGIS Image Extention – Single Tier Architecture

Traditional Configuration
Single Server



AGS Image Extension Data Source

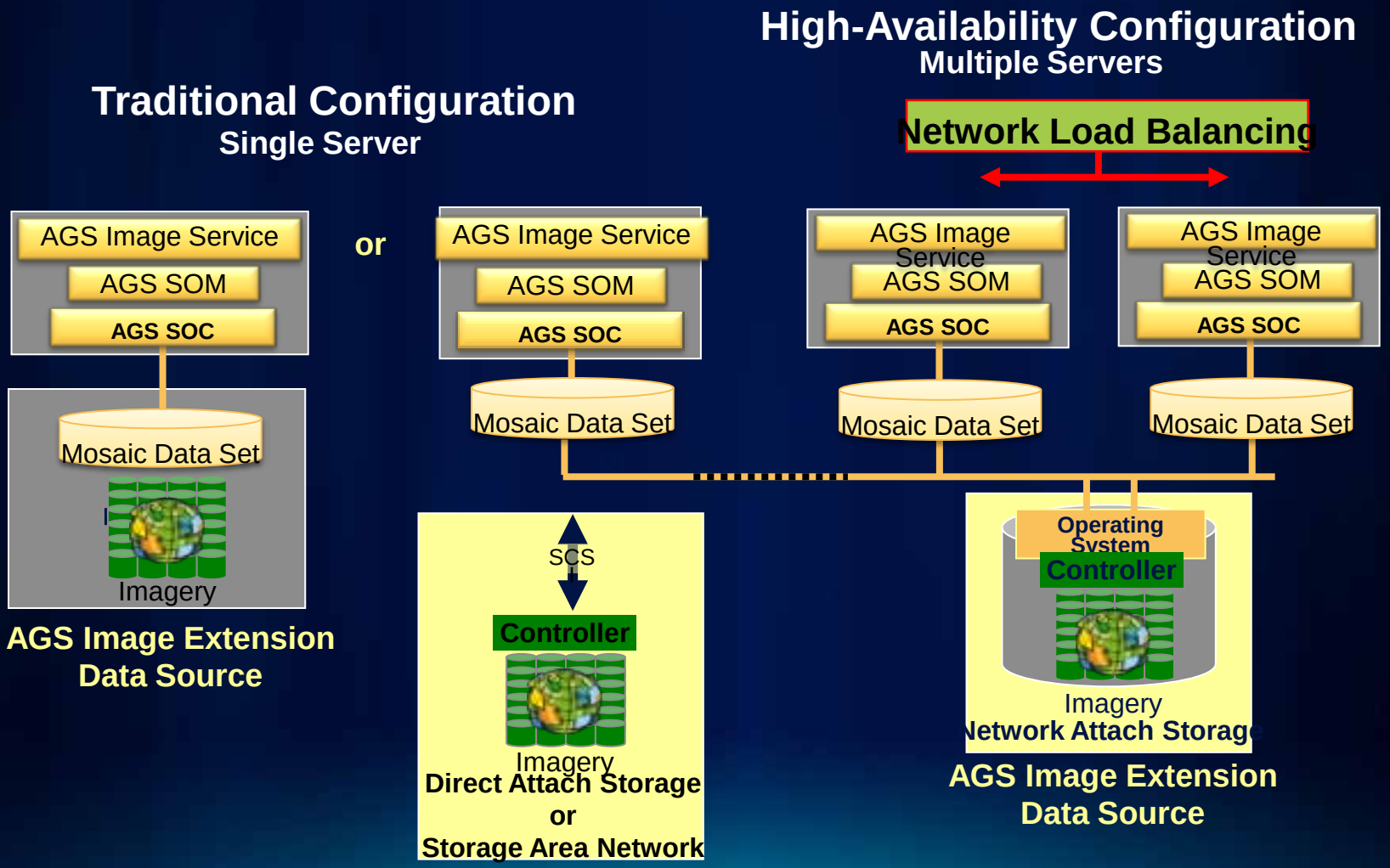
High-Availability Configuration
Multiple Servers



AGS Image Extension Data Source

AGS Image Extension Data Source

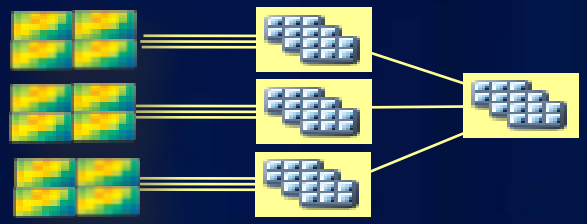
ArcGIS Image Extention – Two Tier Architecture



Patterns to Manage Imagery

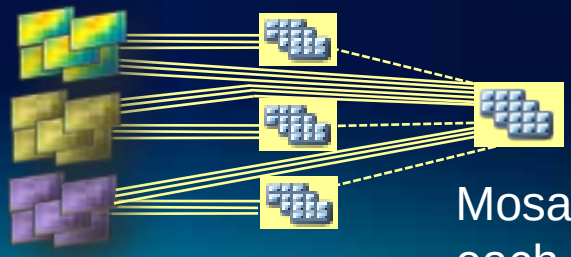
- **Simple Collection**
  - Multiple
    - Files
    - Format
    - Projections

- **Cascaded Mosaic**



- **Multi-Source Collection**

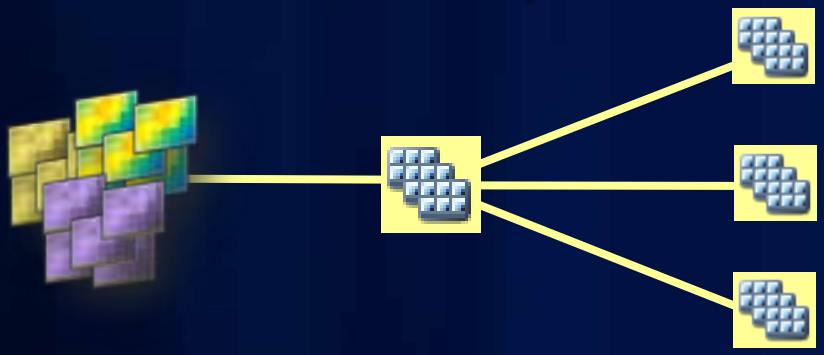
- **Merged Mosaics**



Mosaic of Mosaics,
each managed separately

Reference Mosaics

- **Mosaics derived from Mosaics**
  - **Additional processes**
  - Queries
  - **Properties**
- **Simplify derived product**
- Reduces redundancy



Add NDVI Process

Where Sensor = QuickBird

Where Sensor = Landsat
and Cloud <10%
and Intersect with Spain

Summary

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http://wiki.gis.com/wiki/index.php/System_Design_Strategies

Questions?