

# GML & JPEG 2000 for Geographic Imagery

# Wavelet Imaging today

- Tested (MrSID is approved COTS for NGA)
- JPEG 2000 – Approved ISO standard
- Ubiquity?
- What about metadata?
  - Geolocation
  - CRS
  - FGDC
  - NITF

# JPEG 2000 – the Reality

- Format Specification
- *NOT* an implementation
- All JP2s are not created equally
  - Complex “dials”
  - Quality
  - Performance
- Lack of metadata standard
- Lack of viewing support

# Now What?

- COTS technology
- Standard “profiles” – NPJE, EPJE
- GML for metadata
- JPIP + WCS/WFS/WRS/WMS (OGC/ISO)

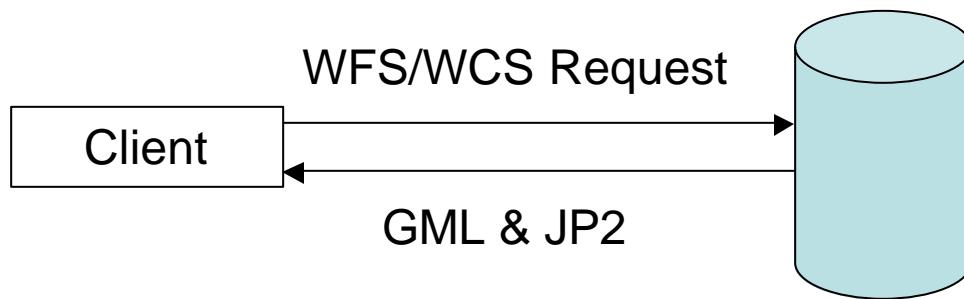
# What is GML ?

- Geography Markup Language is an approved specification of the OpenGIS Consortium an organization of 260+ vendors, government agencies and academic bodies (including NGA!)
- GML en route to being an ISO standard (is CD now) – ISO 19136

# What is GML?

- XML Grammar (XSD) for geography.
  - Features (vector)
  - Coverages (i.e. images)
  - Coordinate Reference Systems,
  - Geometry, Topology.
  - Units of Measure
  - Time
  - Map Styling.

# What is GML ?



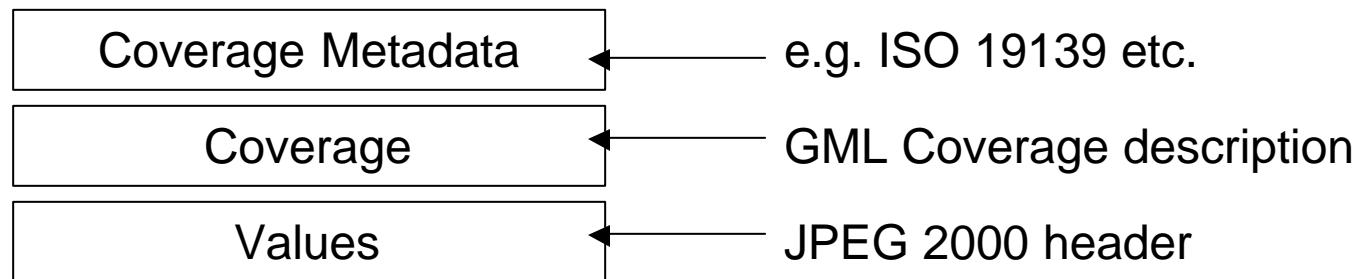
OGC/ISO have developed web service protocols (like JPIP) for update and access to Coverage (WCS) and Feature (WFS) data

# GML in JPEG 2000

- JPEG 2000 allows use of XML for “metadata”.
- GML is XML
- How should GML be used?
- Subject of soon to emerge standard – OGC – ISO.

# Metadata Hierarchy

Think about metadata in a hierarchical manner !



Think of a coverage as a geographic image !!

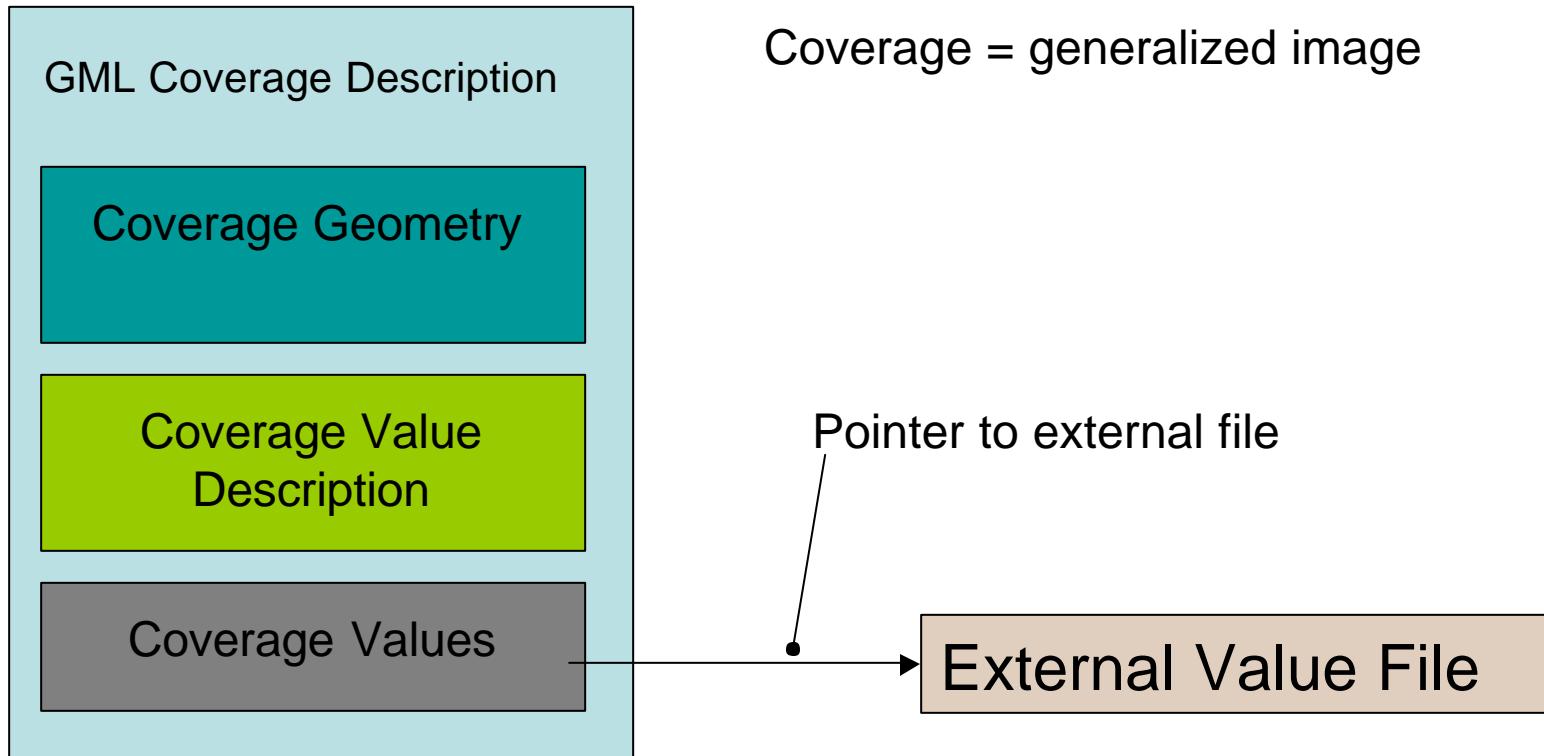
# Why GML & JPEG 2000?

- Flexible, open standard for geographic imagery.
- Enables best of both GML (geography) and JPEG 2000 (imagery) to be brought together.
- Extensible. From a solid base can define extended support for Coordinate Reference Systems, Units, sensor types etc.
- Extensible: Image package can contain the geographic image – extracted features – annotation – metadata – and styling of features & annotation.
- Completely open standard – defined by OGC and ISO (JPEG 2000.)
- Handle standalone (detached) and networked cases

# Use Cases

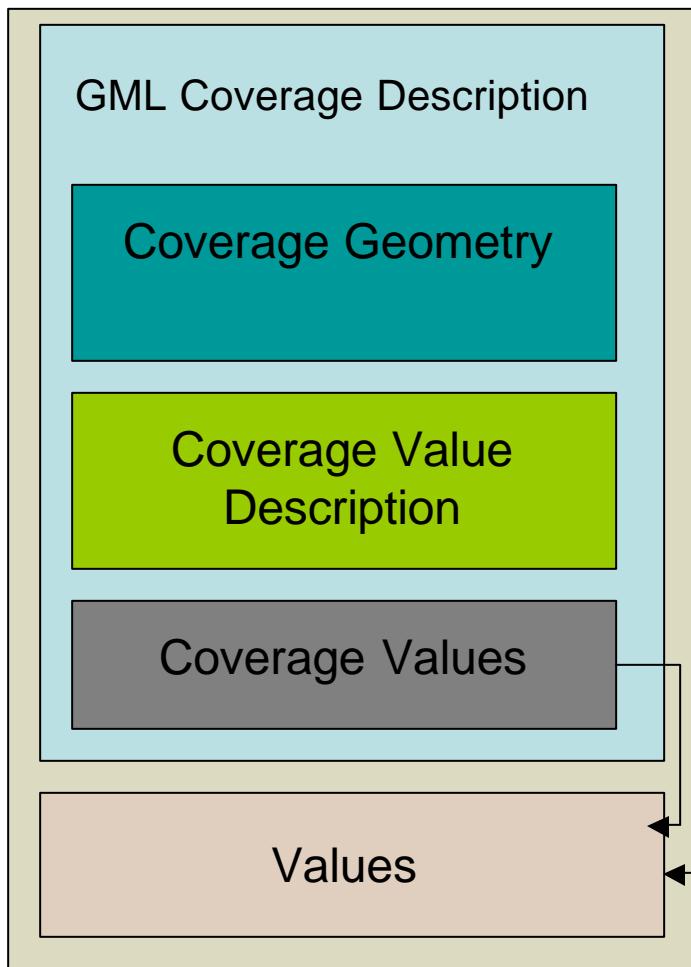
- Image/Coverage Types (Wide Variety)
  - Aerial Photograph
  - Stereo Pair
  - Satellite Image
  - Hyper-spectral Image
  - Triangulation Block
  - Digital Elevation Model
- Image geometry
- Image “radiometry” (coverage value/range)
- Image Annotation
- Feature Extraction/Interpretation
- Coordinate references and units (e.g. radiometry)

# GML & JPEG 2000 - Basics



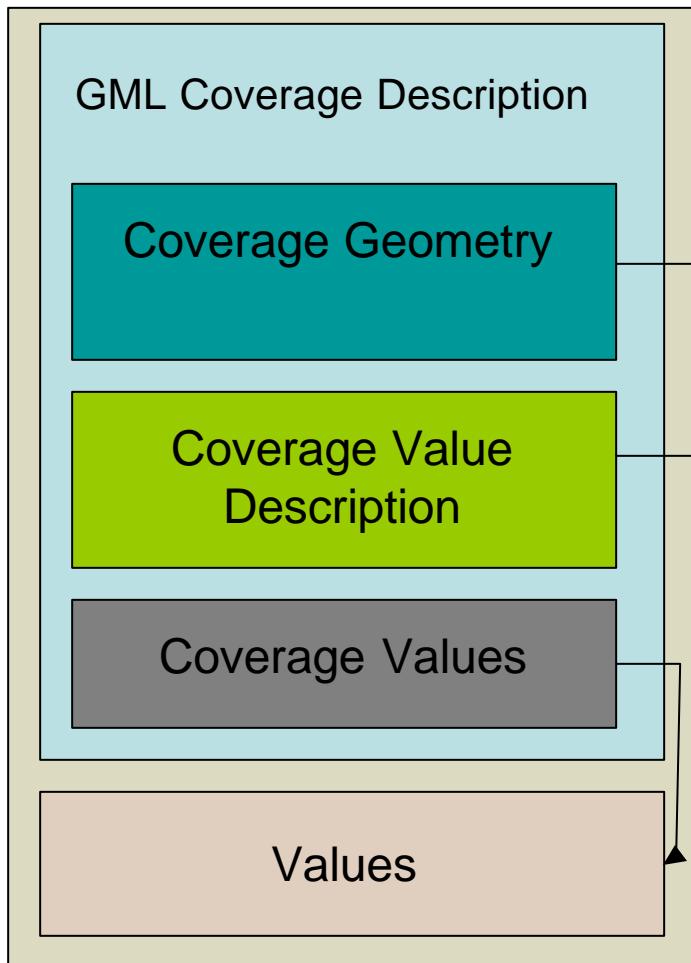
GML can use external files to hold coverage values

# GML & JPEG 2000 - Basics



GML can reference values  
within the containing JPX Pkg.

# GML & JPEG 2000 - Basics

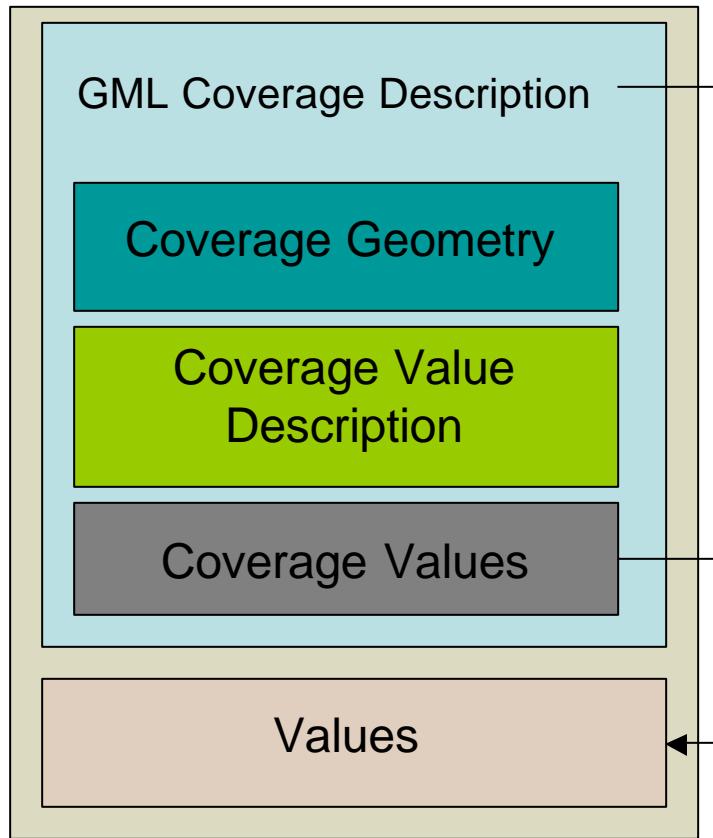


Coordinate Reference  
System Definition

Units of Measure  
Definition

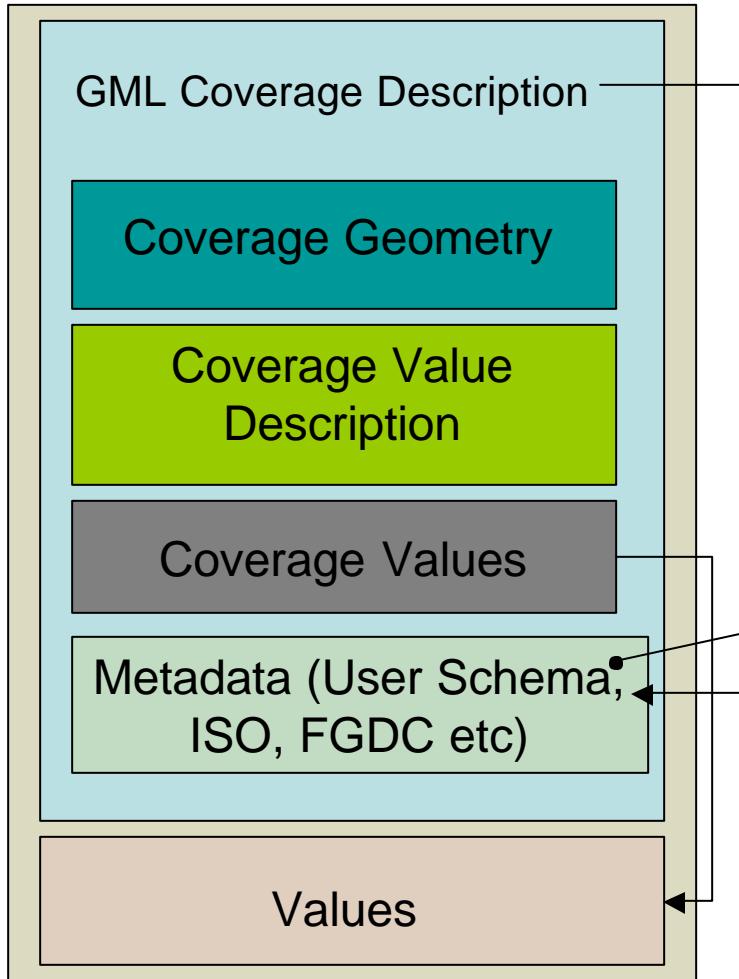
Can reference external definitions of  
CRS and Units of Measure

# Geographic Image Metadata



Supports References to External Metadata Records

# Geographic Image Metadata

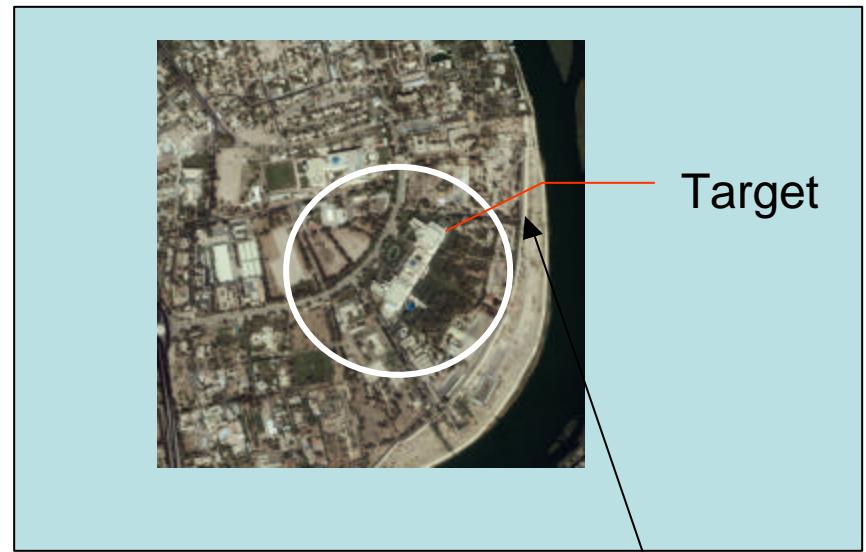
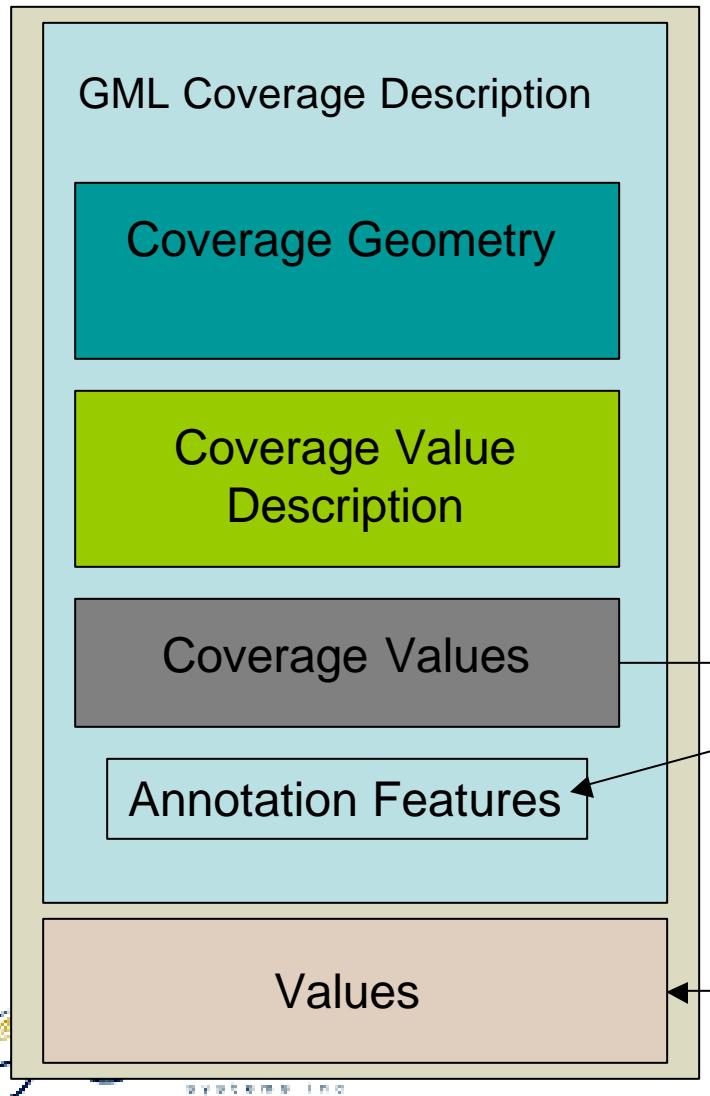


Supports References to Internal Metadata Records

Internal Metadata Description via ISO 19139, ISO 19115, FGDC, User Defined Schema.

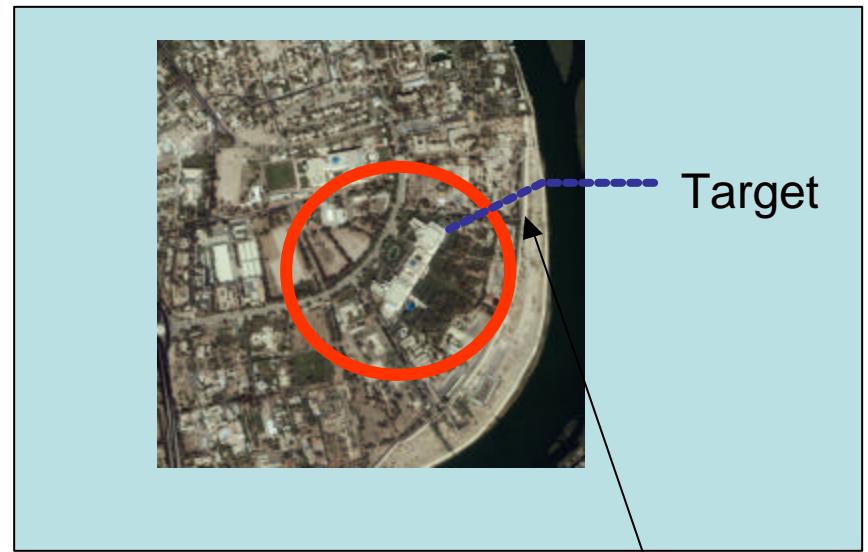
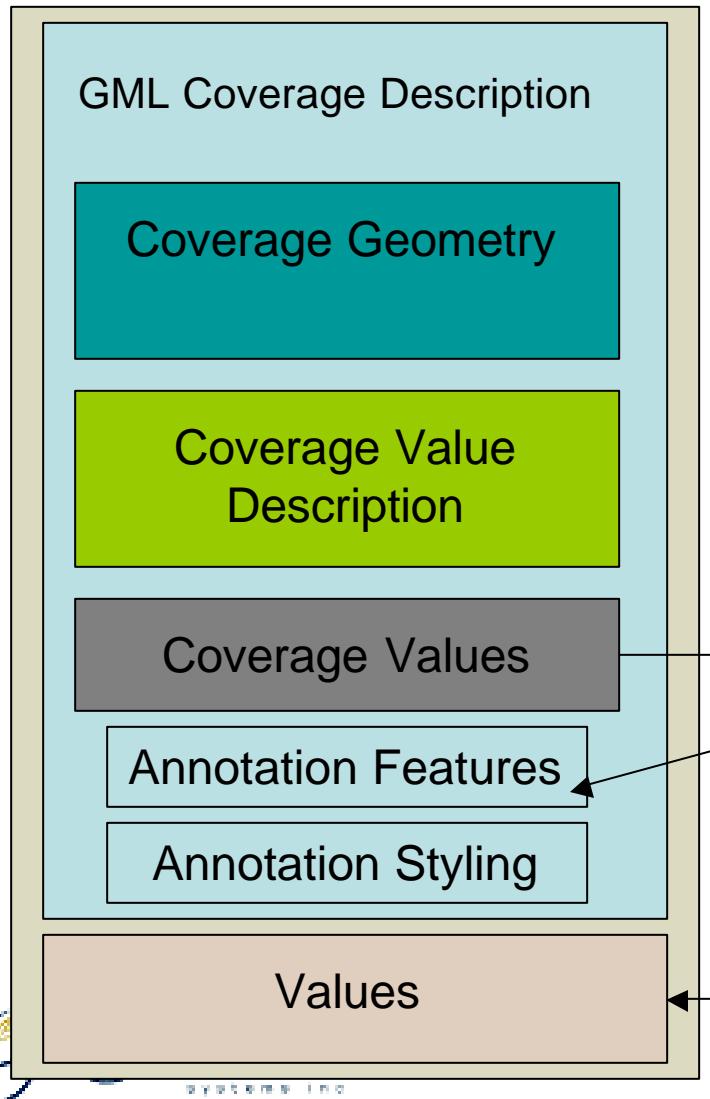
NITF TREs ?

# Annotating Images



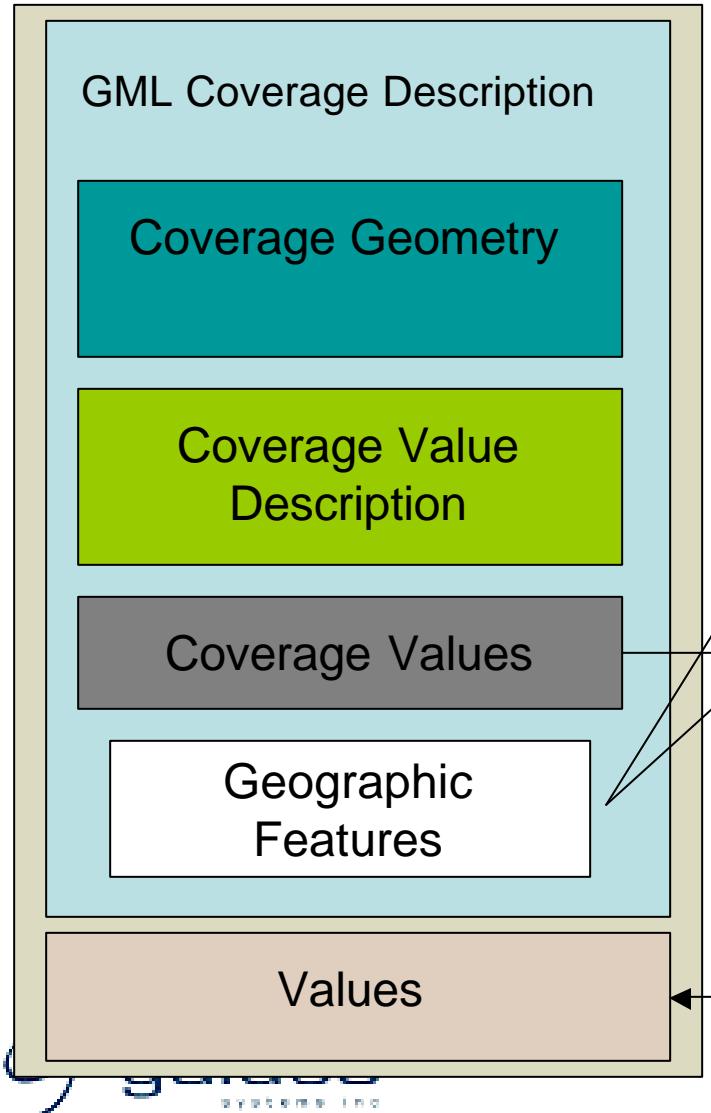
GML can define annotation features in geographic or image coordinate systems.

# Annotating Images



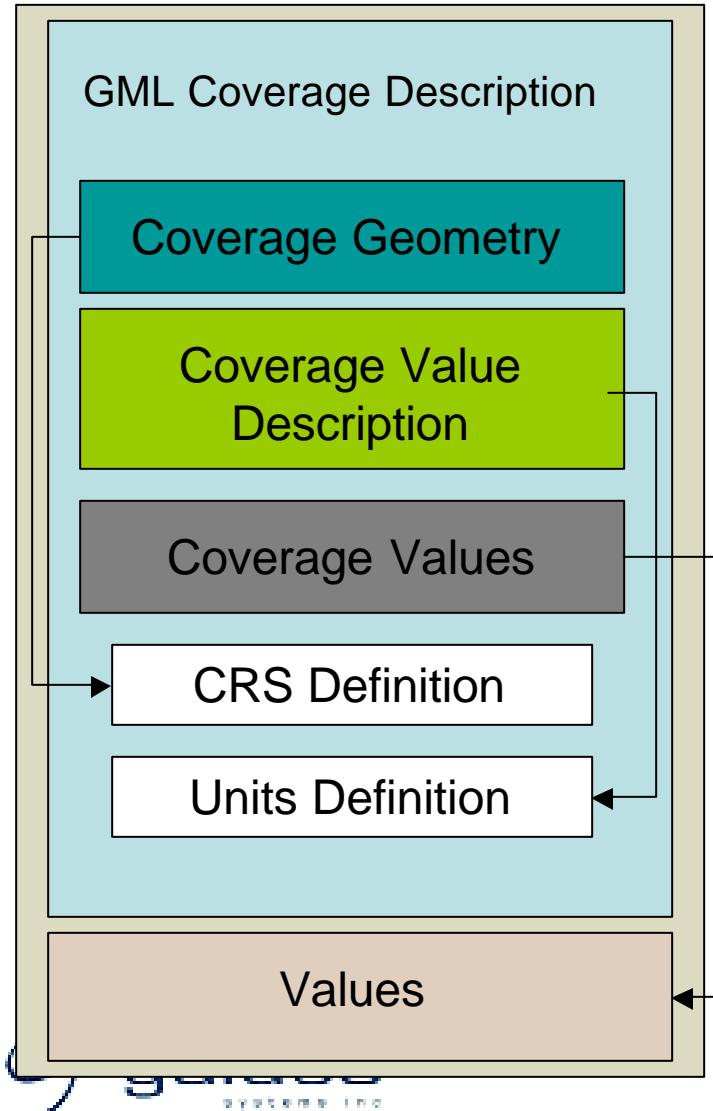
GML can describe styling of the annotation – annotation appearance.

# Bundling Extracted Features



An integrated package bundling  
features & imagery

# Bundling CRS & Unit Definitions

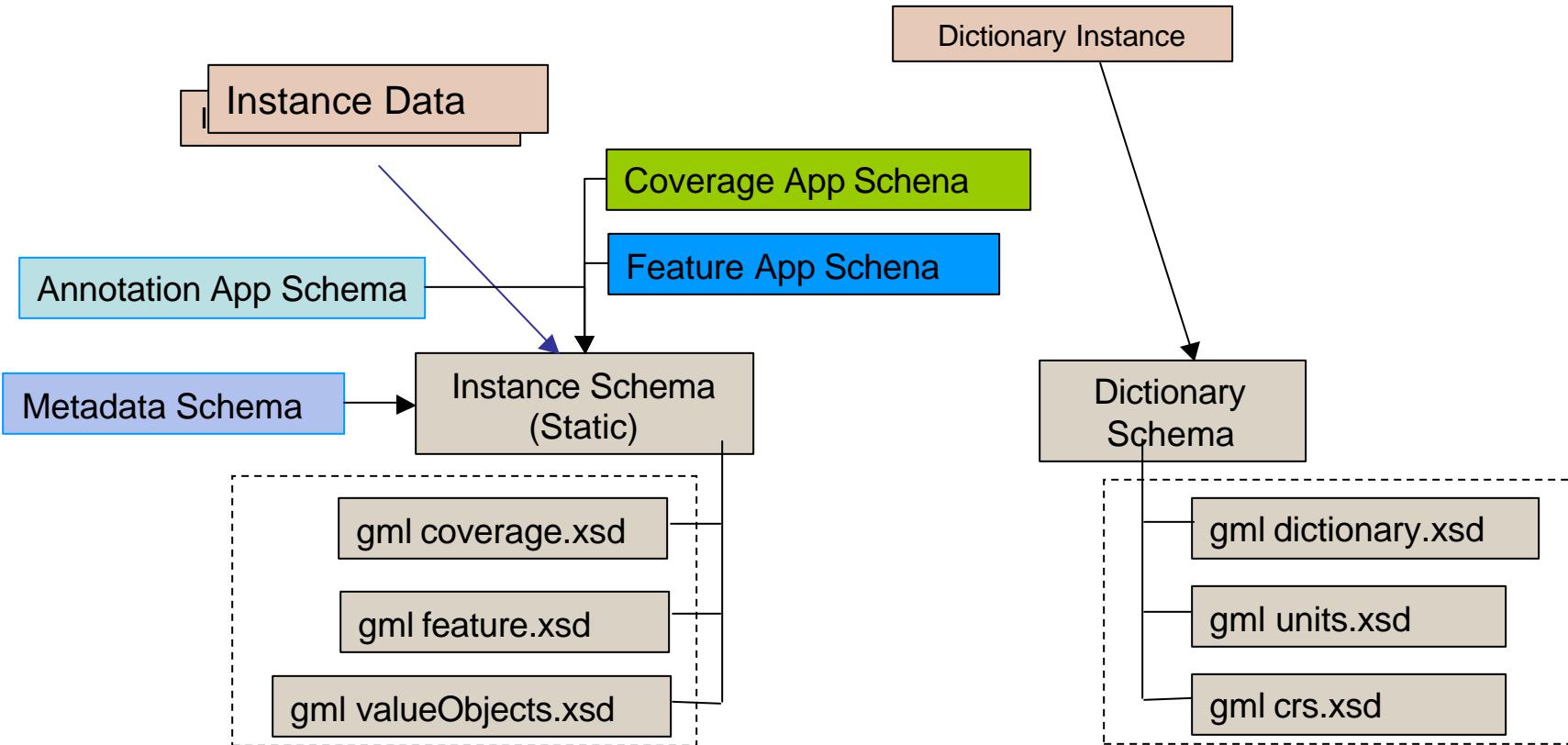


CRS Definitions can be bundled with the image.

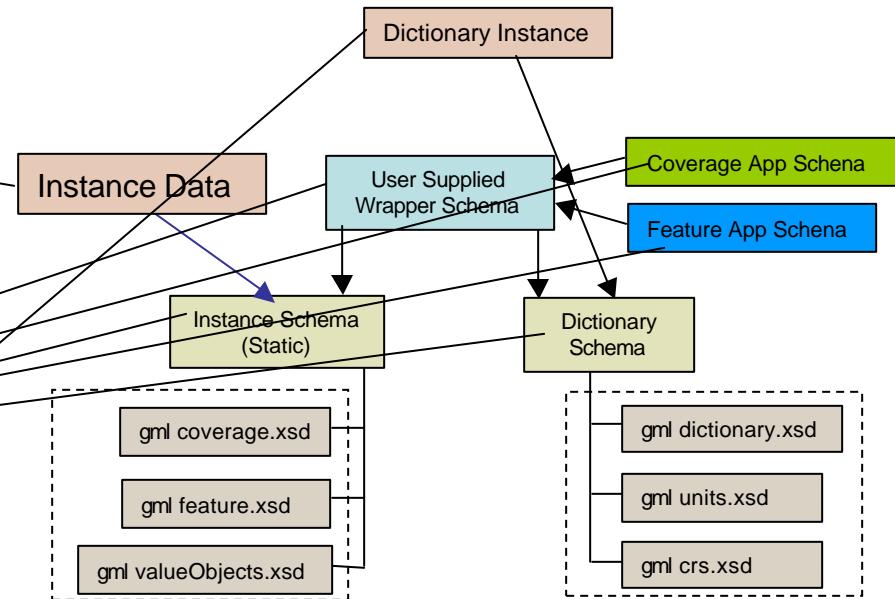
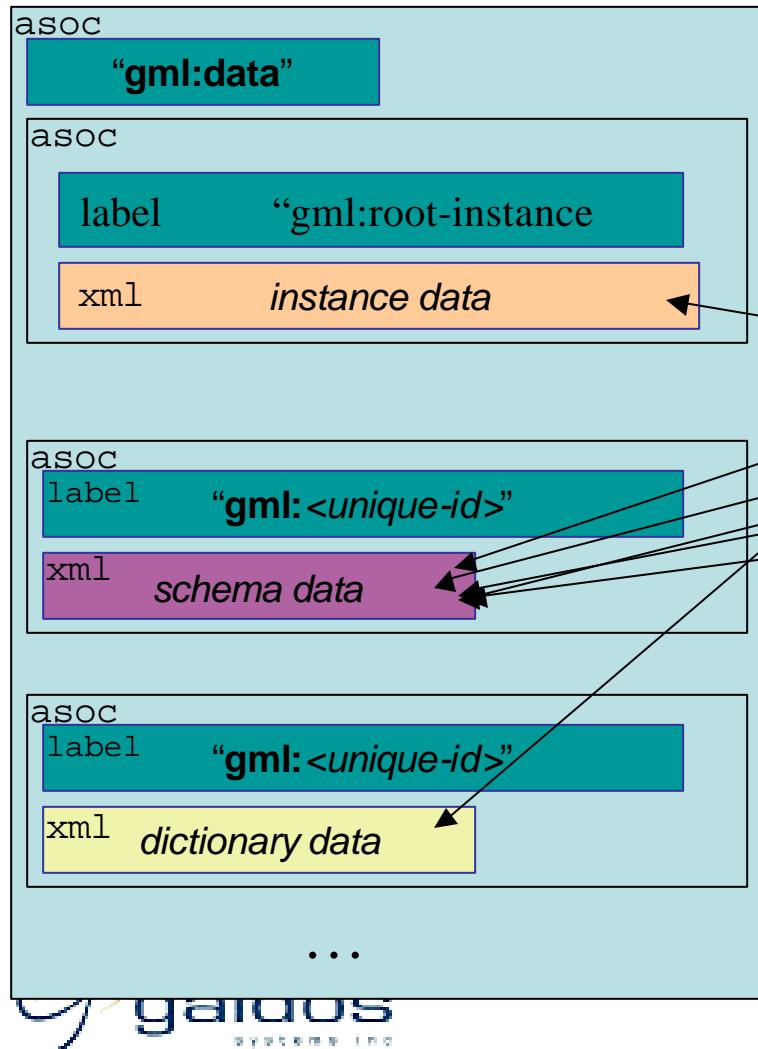
Units of Measure Definitions can be bundled with the image

Can Package and Ship CRS or Units Definitions

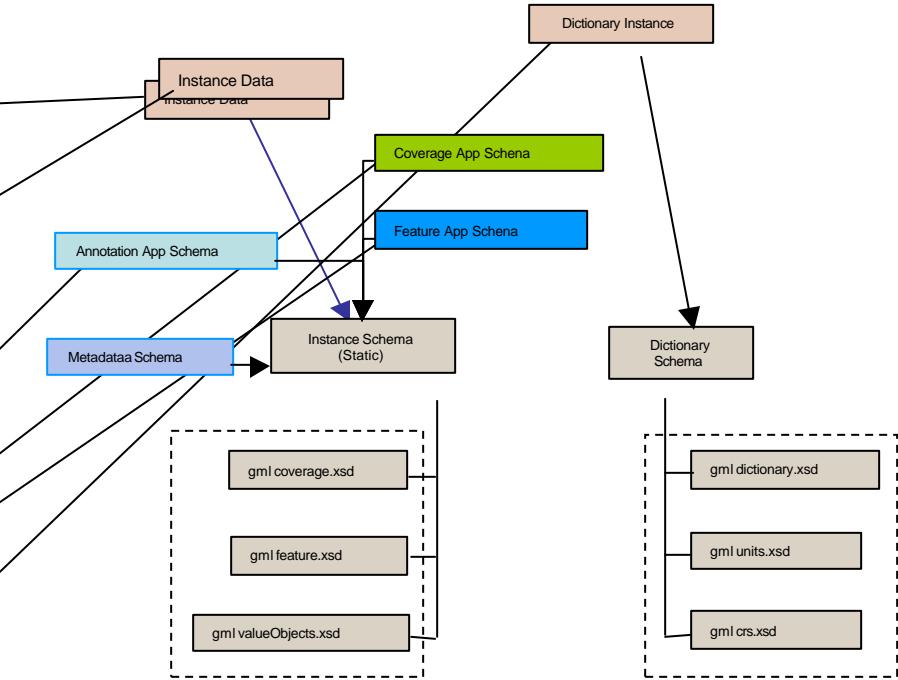
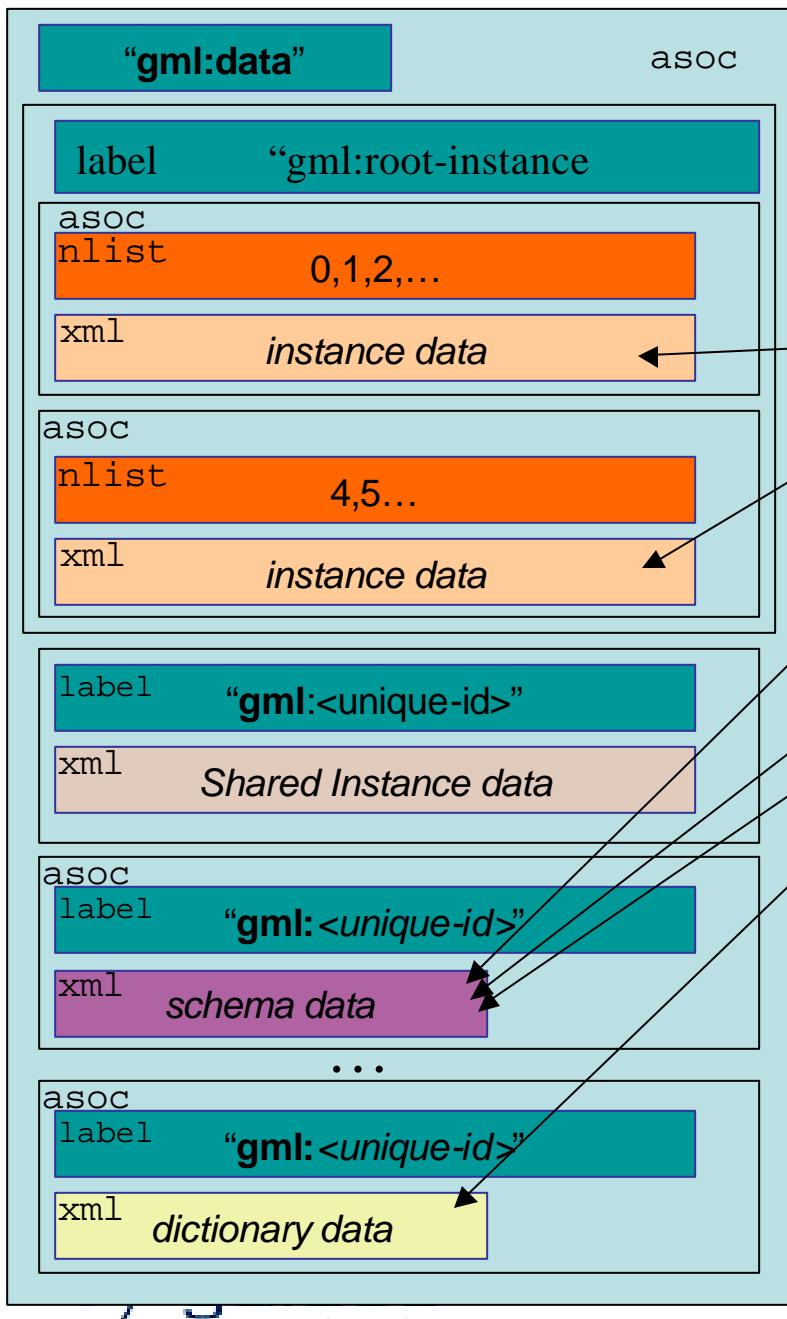
# GML Coverage Description



# Single Image Case



## Encoding the Data

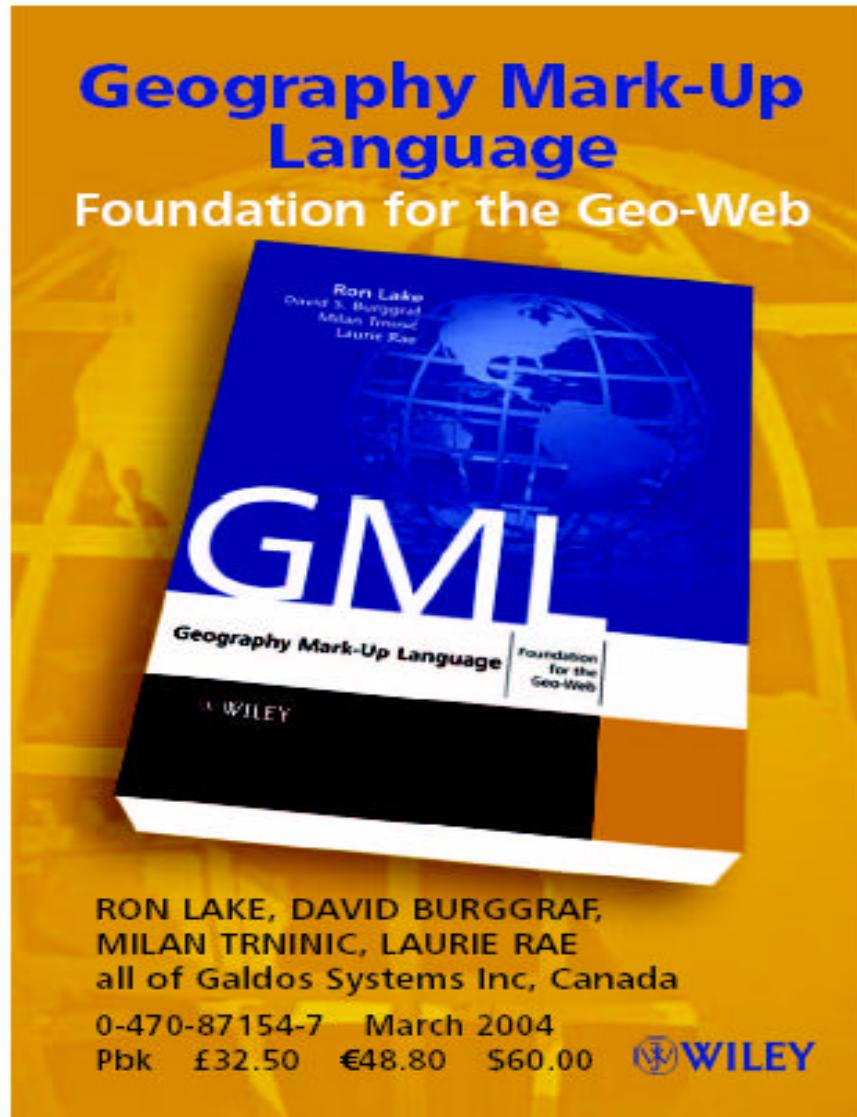


## Multi-Image Case

# Long Range Picture

- Multi-purpose imagery through metadata
- Seamless integration across software
- Powerful vertical applications
- Fully Extensible
- Wavelet = performance!

# The GML Book



# GML Days 2004

- 3<sup>rd</sup> Annual GML & Web Services Conference
- Workshops, Paper Presentations, Exhibits
- GML Technologies & Applications
- Web Services (WFS, WCS etc.)
- Technical exchange – ideas – etc.
- Workshops (GML & JPEG 2000)

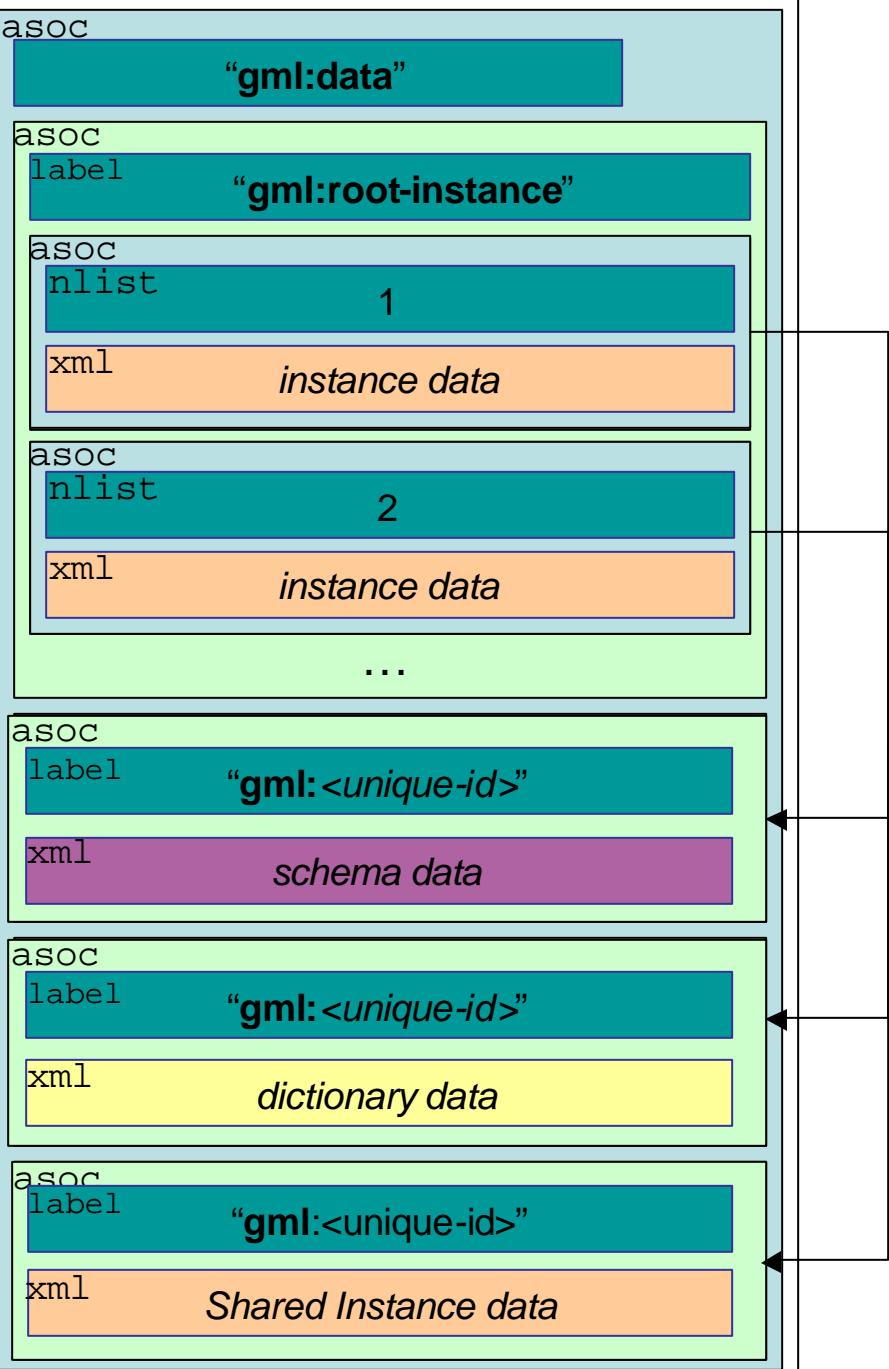
Vancouver, Canada

July 26-29<sup>th</sup>, 2004

# Questions



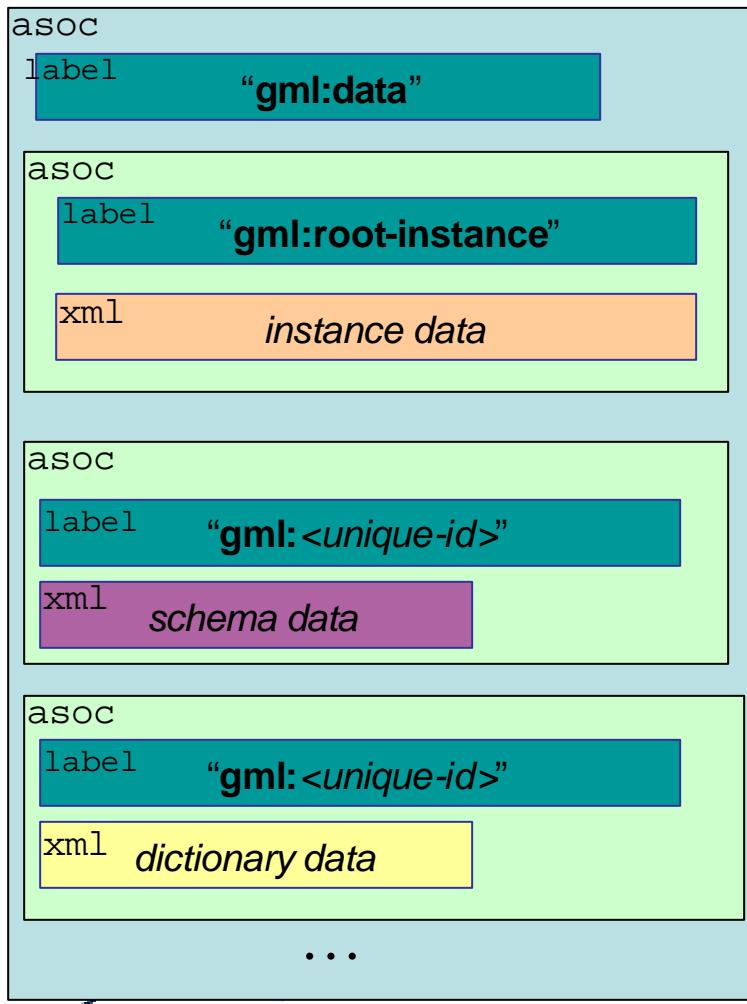
# JPX View



## Multiple Codestreams

- GML Data Box
- Root Instance Box
  - Contains number lists, instance docs
  - GML instances associated with particular codestream(s)
- Schema and dictionary boxes
  - Follow root instance box
  - Unique identifying labels
  - GML data
- Shared instance data
  - Unique identifying labels

## JPX File

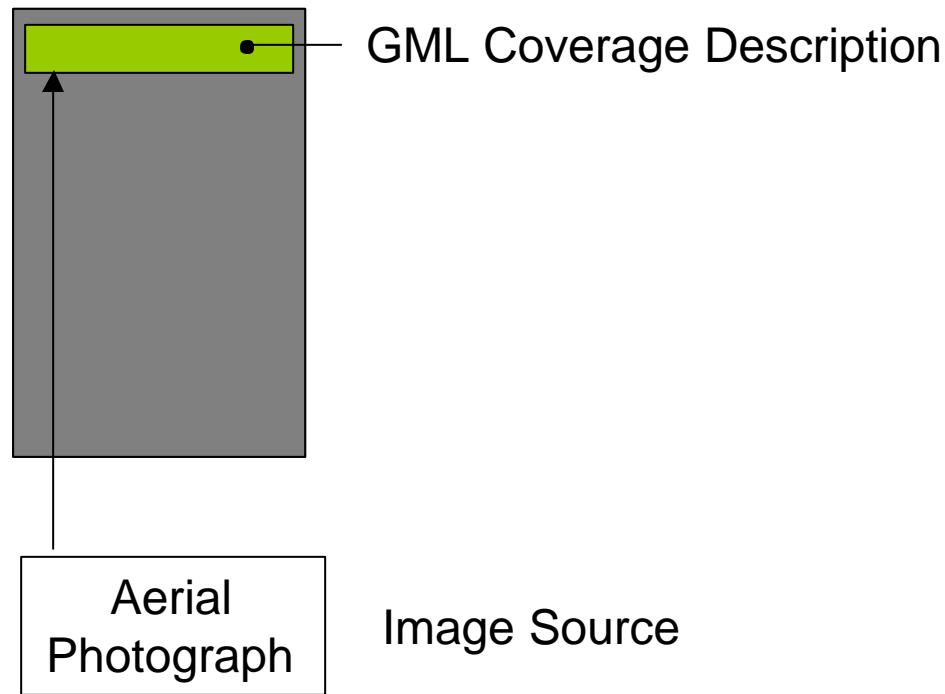


# Hierarchical View

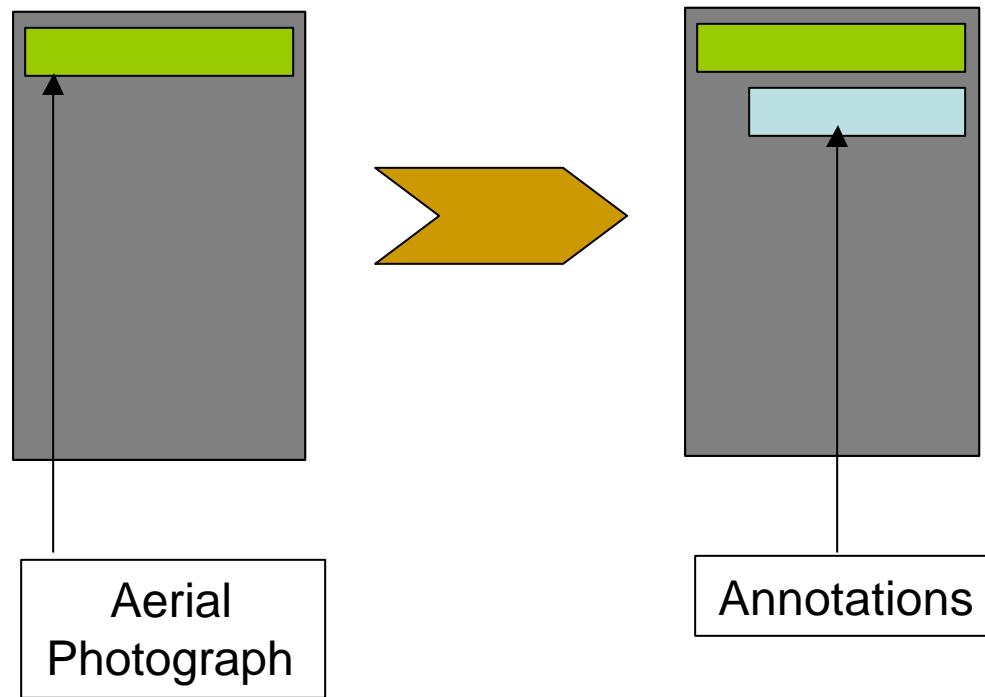
## Single Codestream

- **JPX File**
  - JP2/JPX Boxes
  - ...
  - Asoc
    - Label: “**gml:data**”
    - Asoc
      - Label: “**gml:root-instance**”
      - XML: *gml instance*
    - Asoc
      - Label: *unique id*
      - XML: *schema data*
    - Asoc
      - Label: *unique id*
      - XML: *dictionary data*

# Use Case Review

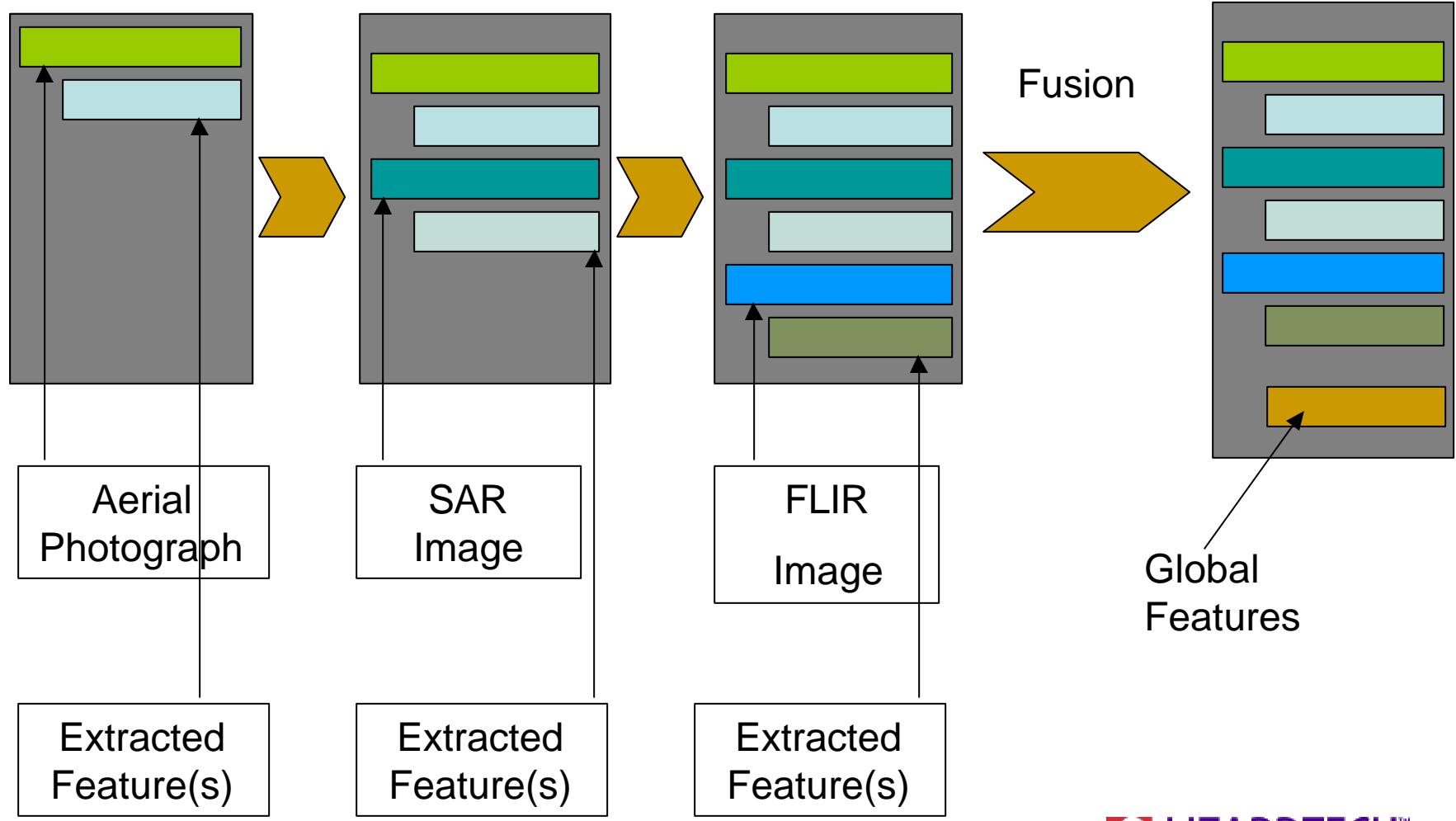


# Use Case Review



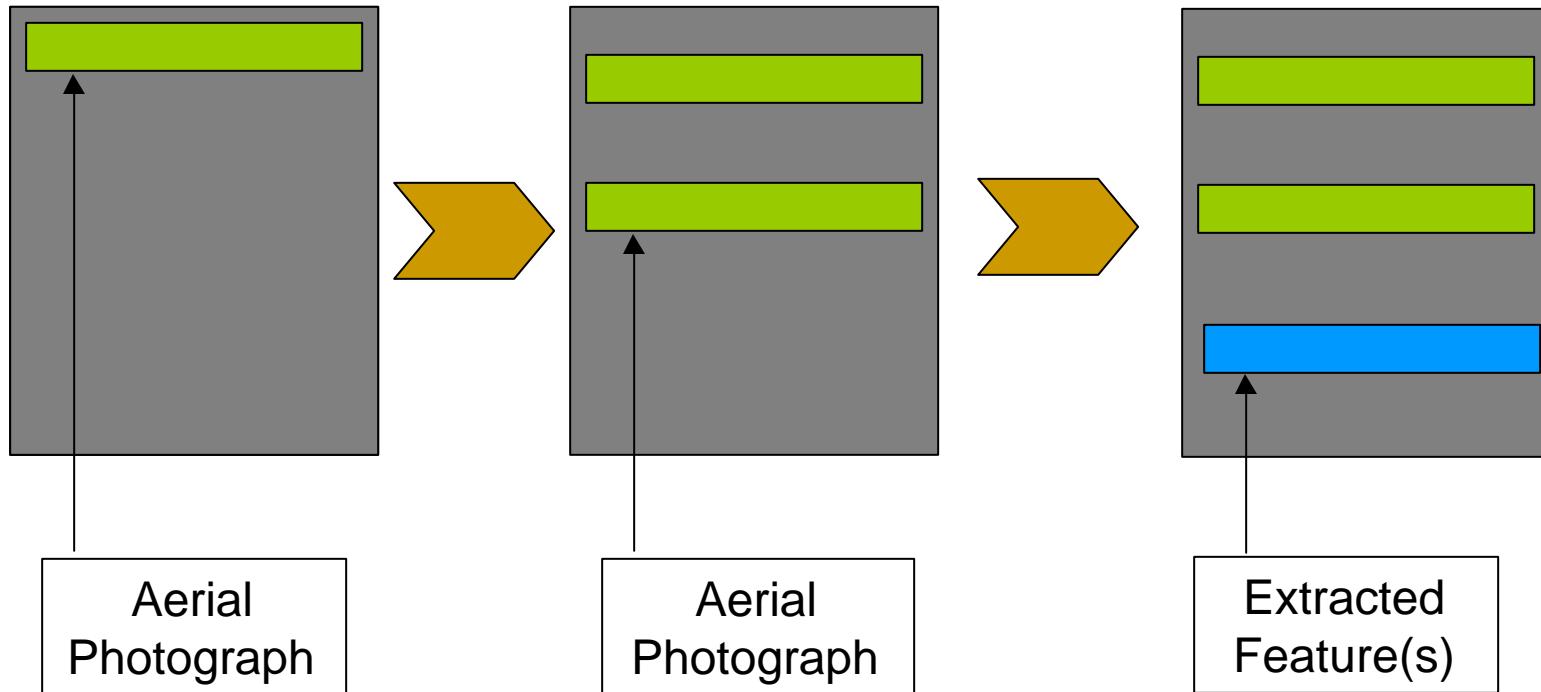
Packaging Image Annotations

# Use Case Review

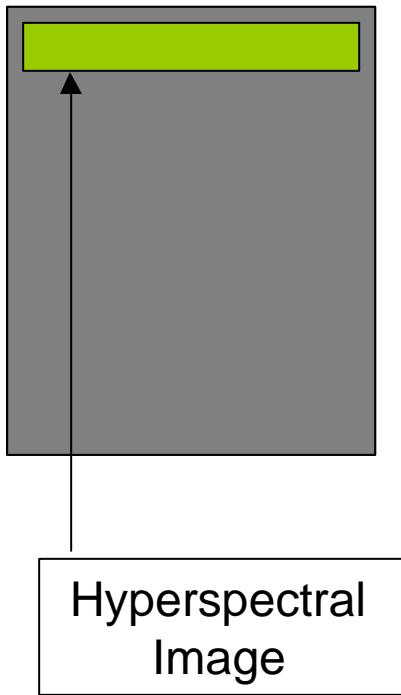


# Use Case Review

Creating a Stereo Pair



# Use Case Review



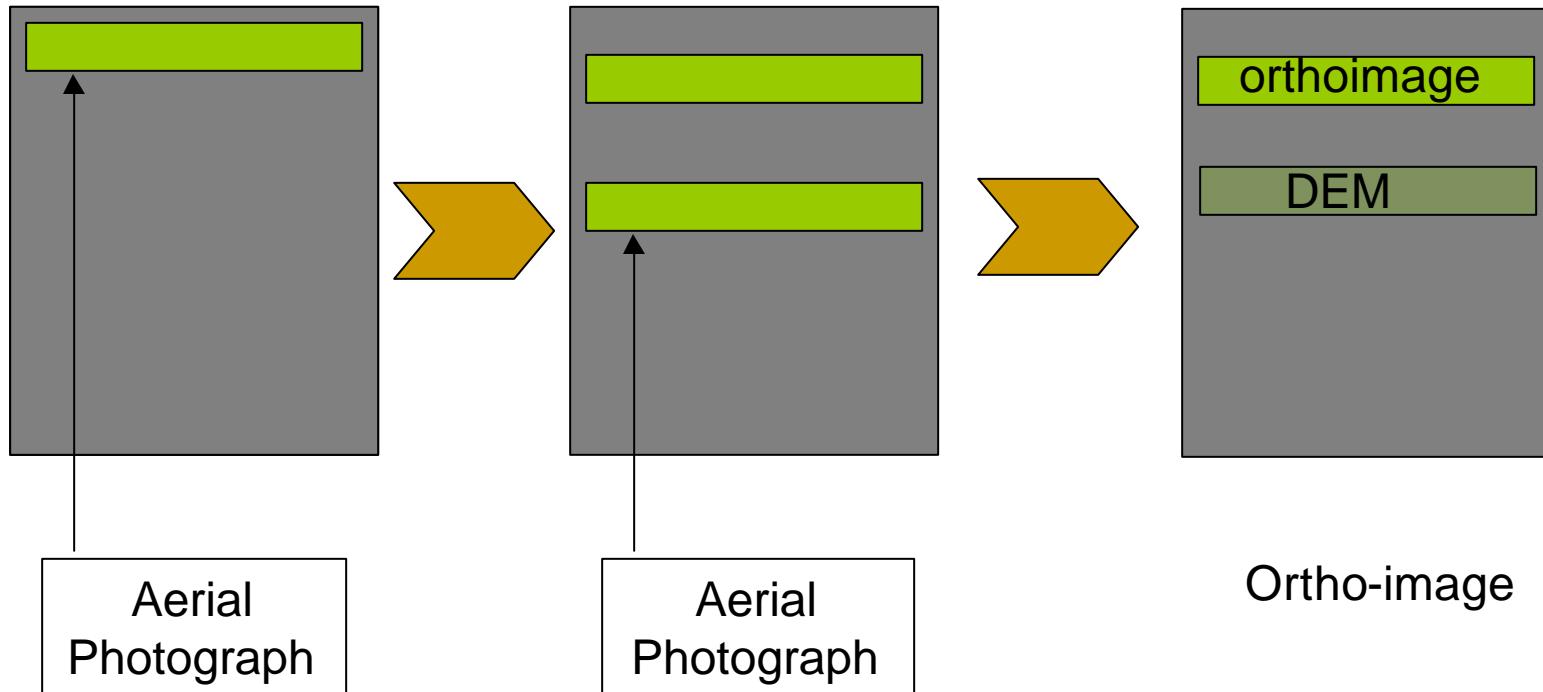
Multiple “Grey Scale Layers” ?

Or

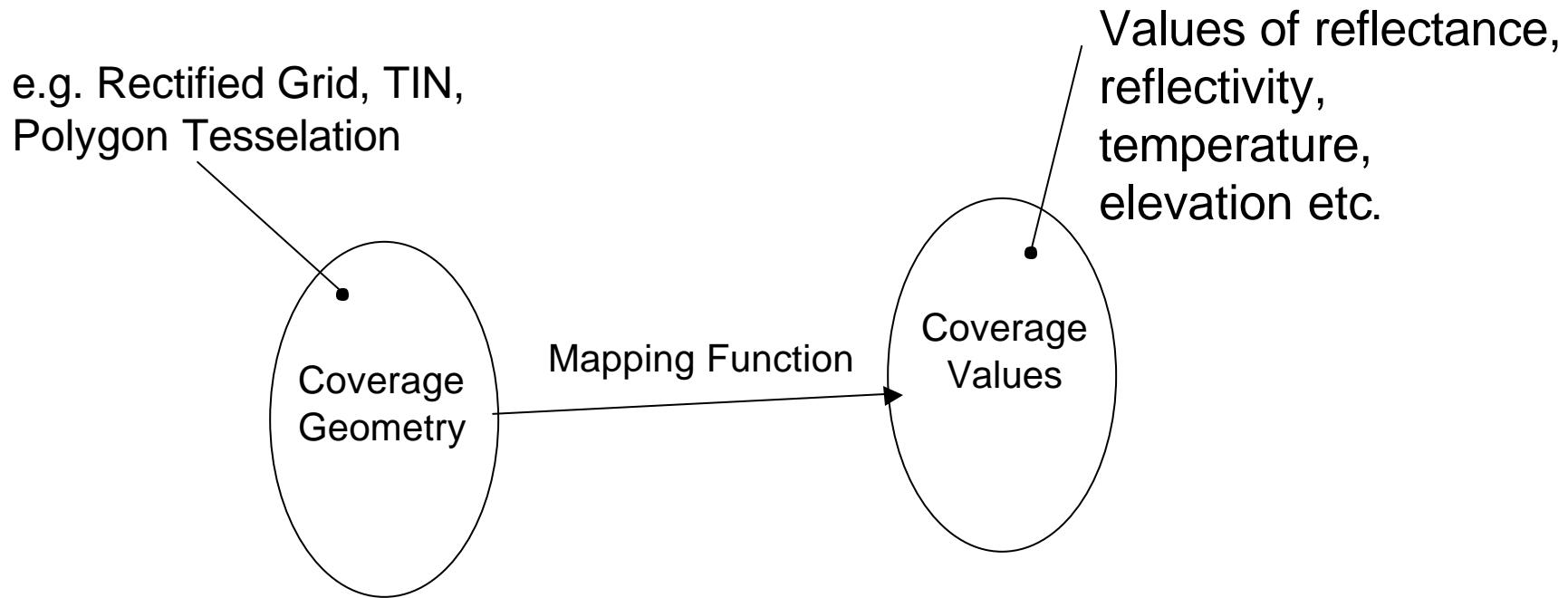
Single Codestream but use JPX ?

# Use Case Review

Creating an Orthoimage



# GML & JPEG 2000 - Basics



Geographic Image in OGC & ISO/TC 211  
Terminology is a Coverage