

JPEG 2000 Migration Considerations

Steve Kerr

Bernie Brower

JPEG 2000 Migration Plan

- Integration of national and tactical systems so that all users (national, tactical, allies) can use data no matter where data came from
 - Consistent message to all components of the NSGI architecture
 - Consistent recommendations for all collection systems so that the data is consistent
 - The first compression is the most important in the developing of functionality and quality for dissemination and the end user
 - Buy-in for all important parties
 - NIMA has incorporated JPEG 2000 in NITFS 2.1 and is developing the standard
 - All systems that are NITFS 2.1 compliant will be required to handle JPEG 2000
 - DCGS has started the migration planning and two other projects on JPEG 2000
 - U2 is developing the baseline technology for JPEG 2000
 - NRO has identified JPEG 2000 as a standard that future systems must use
 - Currently working with NATO to incorporate into STANAG 4545

Migration Plan

- JPEG 2000 is more than a change in the compression. It is a paradigm shift in how we collect, store, transmit and use image information
- A three phase approach has been defined
 - Phase 1: Replacement of current compression algorithms in NSGI
 - Phase 2: Modify the way systems process imagery (focused on library)
 - Phase 3: Modify the client/server interface to be more functional and interactive
- Continue to review requirements for all components to ensure that we are meeting all requirements
 - Expect MS and HSI specific compression to become a requirement
- Inform the masses (NIMA, NRO, NATO, users, developers, commercial)
 - Highly informative profile with recommendations and examples
 - Users conference or symposium
 - Develop training for developers, users, and management
- Continue to support the ISO standards to ensure that the future standards support the NSGI requirements

Three Phase Migration

- Phase 1: Replace the current compression algorithms with JPEG 2000
 - Have proved the quality versus bit rate for six of the current compression algorithms (4.3 DPCM, 2.3 DCT, 1.3 DCT, NITFS JPEG DCT, NITFS JPEG lossless, NIMA method 4/downsampled JPEG DCT).
 - May only replace bi-level compression for graphics (bi-level is required for interoperability with facsimile machines)
 - The future NSGI will use JPEG 2000 from collection to the end user, there is no need to change compression
 - The proper selection of parameters and definition of the first compression will enable any future capability and the next phases.
 - The recommended compression parameters are defined in a profile document

Three Phase Migration

- Phase 2: Change the processing chain to improve throughput and efficiency of the architecture
 - Currently, most systems (library, ELT) start with decompression and finish with re-compression in their processing chain
 - This is common even if they do not want to modify the pixels
 - Most of today's procedures can be achieved in JPEG 2000 without decompression
 - Chipping data by tiles
 - Reducing quality or increasing compression ratio
 - Reducing resolution
 - Other procedures still under investigation
 - Document these procedures with example procedures in the profile to help developers and users understand the J2
 - Examples of parsing and repackaging the data for quality, resolution, and tiles are included in the current version of the profile (1.3).

Three Phase Migration

- Phase 3: Increase the interactiveness between the clients (ELTs) and servers (libraries)
 - Enable the progressive transmission by quality, resolution or tile
 - Enable ROI on the client and server
 - Enable a client to update (get better resolution or quality) a given tile or ROI of an image on the server
 - Need to support the ISO JPEG 2000 Part 9 (interactive protocols) or whatever becomes the commercial standard for the internet
 - Continue to influence the development of the Part 9 standard\
 - Part 9 is not complete yet
 - Once the protocol (JPIP or other commercial standard) is complete, include it in the GIAS specifications
 - Commercial applications will take advantage of JPEG 2000
 - Currently NIMA libraries are more functional then most commercial libraries.
 - Future commercial libraries will be significantly more functional

What can you do today

- Currently, you can produce a compliant JPEG 2000 Part 1 Profile 1 system and be ready for JPEG 2000
 - The general recommendations for encoding are stable
 - But do not hardwire your encoder, you should continue to support other profiles
 - A certified Cclass 1 or Cclass 2 reader should not quit for the recommended conditions
- Parsing data for resolution, tile, and quality layer
 - These procedures are the same across all profiles
- Commercial systems will support JPEG 2000
 - There are implementations that can take advantage J2K functionality
- What may not be ready for prime time
 - Codeblock parsing
 - Transcoding from one progression to another
 - Transcoding from less quality layers to more quality layers
 - Enhancement in the wavelet domain

Commercial Support

- Enabling commercial products
 - ASIC and DSP products have been announced
 - Five software developers kits are being sold
- Commercial products
 - We expect several commercial products to support JPEG 2000 within the 2002
 - Microsoft has demonstrated a browser
 - Several plug-ins have been demonstrated (Photoshop and Navigator)
 - Adobe will support JPEG 2000 in PDF
 - Expect that other Adobe products and formats will follow
 - Apple Quick Time 6 will support the reading and writing JPEG 2000
- Publications
 - JPEG 2000 book from USNB member Dr. Michael Marcellin (SAIC/UofA) is in the second publishing
 - Over 50 technical papers on JPEG 2000 and JPEG 2000 technology were presented in different journals and technical symposiums

Current Issues

- Support to legacy data and legacy systems
 - Conversion from other systems to JPEG 2000
 - Have defined the quality impacts (mathematically)
 - Do not have a requirement for this yet
 - Conversion from JPEG 2000 to JPEG or other compression
 - Currently have not reviewed techniques to achieve the best quality
 - Have not reviewed the quality impacts of this
- Production and display of thumbnails
 - The JPEG 2000 recommendations are for 5 Wavelet decompositions, resulting in R5
 - Thumbnail generation is commonly R8 or greater
 - Expect to define techniques in Profile
 - Most likely will continue to use JPEG/JFIF to display for web browsing

Current Issues

- We need to define procedures to ensure the accuracy of correlate support data (metadata) to the J2K imagery and derived imagery products
 - Positioning and attribute metadata are almost always correlated to the imagery via the row/col indices of the imagery
 - The accuracy of exploitation tools and tasks are dependent on the pixel/metadata relationship
 - Sensor models, rational polynomial equations, affine transform, etc.
 - Common procedures may change the accuracy of the pixel/metadata relationship
 - Chipping, parsing reduced resolutions, parsing qualities, rotating, combinations

Current Issues

- Define procedures to ensure the accuracy of correlate support data (metadata) to the J2K imagery and derived imagery products (continued)
- Two choices for dealing with the support data
 - Reformulate the support data to match the new pixel locations
 - Include information that matches the new image (pixel locations) to the original image and support data (NTM common method).
 - ICHIP B has the capability to handle most common procedures
 - Rotation, resolution change, change in pixel/geometry, position (chipping)

Future Issues

- We are currently not developing or testing JPEG 2000 for these types of data (waiting for requirements to research these data types)
 - Elevation data (DTED)
 - LIDAR
 - Complex SAR (I&Q and Video Phase History)
 - Maps and image-map products
- Evaluating the requirements for MS and HSI compression
 - Will compare band-by-band compression and 3-D compression
 - Will define the issues (positive and negative) associated with this modification
- Reviewing enhancements in the compressed domain
 - Have shown the capability to do DRA and MTFC in compressed domain
 - Have not reviewed for quality of these procedures
- Texture decoding
 - Technique that improves the quality of decompression of imagery at low bit rates (especially for SAR data)