Federal Agencies
Digitization Guidelines Initiative

Raster Still Images for Digitization
A Comparison of File Formats

Part 2. Detailed Matrix (multi-page)

This document presents the information on multiple, easily printable pages.

Part 1 provides the same information in a unified table to facilitate comparisons.

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The FADGI Still Image Working Group

http://www.digitizationguidelines.gov/still-image/

Raster Still Images for Digitization: A Comparison of File Formats

This is the template for the pages that follow. The reference is the detailed matrix in part 1 of this document set.

ATTRIBUTE:

- Scoring conventions:
- Questions to Consider:

TIFF	Common TIFF, Uncompressed	
	Common TIFF, Lossless Compressed	
	GeoTIFF/BigTIFF, Uncompressed	
	GeoTIFF/BigTIFF, Compressed	
JPEG 2000	JPEG 2000: JP2	
	JPEG 2000: JPX	
JPEG	JPEG (JFIF with EXIF)	
PNG	PNG	
PDF	PDF (1.1-1.7)	
	PDF/A (1, 1a, 1b, 2)	
	GeoPDF*	

* GeoPDF refers to either TerraGo GeoPDF or Adobe Geospatial PDF

ATTRIBUTE: Sustainability Factors: Disclosure

- Scoring Conventions: Good, Acceptable, Poor
- Questions to Consider: Does complete technical documentation exist for this format? Is the format a standard (e.g., ISO)? Are source code for associated rendering software, validation tools, and software development kits widely available for this format?

TIFF	Common TIFF, Uncompressed	Good
	Common TIFF, Lossless Compressed	Good
	GeoTIFF/BigTIFF, Uncompressed	Good
	GeoTIFF/BigTIFF, Compressed	Good
JPEG 2000	JPEG 2000: JP2	Good
	JPEG 2000: JPX	Good
JPEG	JPEG (JFIF with EXIF)	Good
PNG	PNG	Good
PDF	PDF (1.1-1.7)	Good
	PDF/A (1, 1a, 1b, 2)	Good
	GeoPDF	Good

ATTRIBUTE: Sustainability Factors: Adoption

- Scoring conventions: Wide Adoption, Moderate Adoption, Limited Adoption
- Questions to Consider: Is this format likely to become obsolete short, medium, or long-term? How widely adopted is the format in the digitization vendor community? Are there software tools available around this format? Are there user/developer communities that are actively discussing the format and its further development?

TIFF	Common TIFF, Uncompressed	Wide Adoption. Negligible support in browsers.
	Common TIFF, Lossless Compressed	Wide Adoption. Negligible support in browsers.
	GeoTIFF/BigTIFF, Uncompressed	Wide Adoption (Negligible support in browsers, adoption tends to be limited to geospatial communities, but is widely adopted there)
	GeoTIFF/BigTIFF, Compressed	Wide Adoption (Negligible support in browsers, adoption tends to be limited to geospatial communities, but is widely adopted there)
JPEG 2000	JPEG 2000: JP2	Adoption varies: moderate for still images in cultural heritage community, wide for moving image content in production and archiving. Limited support in still image software, negligible support in browsers and still cameras.
	JPEG 2000: JPX	Low to moderate adoption, less uptake than JP2 core coding.
JPEG	JPEG (JFIF with EXIF)	Wide Adoption (adoption is very high, ubiquitous)
PNG	PNG	Wide adoption
PDF	PDF (1.1-1.7)	Wide adoption
	PDF/A (1, 1a, 1b, 2)	Wide adoption
	GeoPDF	Wide adoption

ATTRIBUTE: Sustainability Factors: Transparency

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: Is it a linear bitmap or is it more complex (e.g., compression). Need to consider ability of each format to compensate for lack of transparency. What is the impact of having many options and potentially complex implementations?

TIFF	Common TIFF, Uncompressed	Good
	Common TIFF, Lossless Compressed	Acceptable (added layer of encoding due to compression)
	GeoTIFF/BigTIFF, Uncompressed	Good
	GeoTIFF/BigTIFF, Compressed	Acceptable (added layer of encoding due to compression)
JPEG 2000	JPEG 2000: JP2	Acceptable. Compression is compensated for by resiliency elements, intended to mitigate low levels of transparency. However, the format offers many options (tiling, quality layers, progression order, more), and some users have found that "legal" variations may not interoperate from one application to another.
	JPEG 2000: JPX	Acceptable. Compression is compensated for by resiliency elements, intended to mitigate low levels of transparency. However, the format offers many options (tiling, quality layers, progression order, more), and some users have found that "legal" variations may not interoperate from one application to another.
JPEG	JPEG (JFIF with EXIF)	Acceptable
PNG	PNG	Acceptable
PDF	PDF (1.1-1.7)	Acceptable
	PDF/A (1, 1a, 1b, 2)	Acceptable
	GeoPDF	Acceptable

ATTRIBUTE: Sustainability Factors: Self-Documentation

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: Does the technical metadata, typically in a header or equivalent, fully describe the characteristics of the file/file format? Does the format offer capabilities for descriptive metadata (aka "cataloging" or "about" metadata) that provide a reasonable level of information about the content within the file?

TIFF	Common TIFF, Uncompressed	Acceptable
	Common TIFF, Lossless Compressed	Acceptable
	GeoTIFF/BigTIFF, Uncompressed	Acceptable
	GeoTIFF/BigTIFF, Compressed	Acceptable
JPEG 2000	JPEG 2000: JP2	Good (includes Intellectual Property, XML, URL, and UUID metadata boxes)
	JPEG 2000: JPX	Good (includes Image Creation, Content Description, History, Intellectual Property Rights, and Image Identifier metadata boxes)
JPEG	JPEG (JFIF with EXIF)	Acceptable
PNG	PNG	Good
PDF	PDF (1.1-1.7)	Good
	PDF/A (1, 1a, 1b, 2)	Good
	GeoPDF	Good

ATTRIBUTE: Sustainability Factors: Native Embedded Metadata Capabilities

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: How well does this format support embedded metadata, including headers, as a part the format's own specifications (native metadata)?

TIFF	Common TIFF, Uncompressed	Acceptable (limited to header tags)
	Common TIFF, Lossless Compressed	Acceptable (limited to header tags)
	GeoTIFF/BigTIFF, Uncompressed	Acceptable (limited to header tags)
	GeoTIFF/BigTIFF, Compressed	Acceptable (limited to header tags)
JPEG 2000	JPEG 2000: JP2	Good (open and extensible, supports inclusion of user defined metadata and vendor specific metadata)
	JPEG 2000: JPX	Good (open and extensible)
JPEG	JPEG (JFIF with EXIF)	Acceptable (limited to technical metadata, not descriptive metadata)
PNG	PNG	Good
PDF	PDF (1.1-1.7)	Good
	PDF/A (1, 1a, 1b, 2)	Good
	GeoPDF	Good

ATTRIBUTE: Sustainability Factors: Embedded Metadata Capabilities Through Extension

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider:

TIFF	Common TIFF, Uncompressed	Good (XMP)
	Common TIFF, Lossless Compressed	Good (XMP)
	GeoTIFF/BigTIFF, Uncompressed	Good (Extended TIFF header elements are generally used rather than XMP)
	GeoTIFF/BigTIFF, Compressed	Good (Extended TIFF header elements are generally used rather than XMP)
JPEG 2000	JPEG 2000: JP2	Good (open and extensible)
	JPEG 2000: JPX	Good (open and extensible)
JPEG	JPEG (JFIF with EXIF)	Good (XMP for descriptive and EXIF for technical information such as camera, shutter speed, etc., requires a compliant reader)
PNG	PNG	Good (XMP)
PDF	PDF (1.1-1.7)	Good
	PDF/A (1, 1a, 1b, 2)	Good
	GeoPDF	Good

ATTRIBUTE: Sustainability Factors: Level of Work Necessary to Embed Native Metadata

- Scoring conventions: High, Medium, Low
- Questions to Consider: Is there a characteristic inherent to this format related to embedded metadata that distinguishes this format from others as far as level of effort required?

TIFF	Common TIFF, Uncompressed	Low (header tags)
	Common TIFF, Lossless Compressed	Low (header tags)
	GeoTIFF/BigTIFF, Uncompressed	Low (header tags)
	GeoTIFF/BigTIFF, Compressed	Low (header tags)
JPEG 2000	JPEG 2000: JP2	Low (caveats: more time and effort may be required due to learning curve and available tools. Main obstacle is the format that metadata needs to adhere to, not inherent in the file format itself. There may be a need to establish your own specification for metadata)
	JPEG 2000: JPX	Low (caveats: more time and effort may be required due to learning curve and available tools. Main obstacle is the format that metadata needs to adhere to, not inherent in the file format itself. There may be a need to establish your own specification for metadata)
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Low
	PDF/A (1, 1a, 1b, 2)	Low
	GeoPDF	Low

ATTRIBUTE: Sustainability Factors: Level of Work Necessary to Embed Metadata Through Extension

- Scoring conventions: High, Medium, Low
- Questions to Consider: How well does this format support forms of embedded metadata that are not part of the format's own specification (metadata defined by extension)?

TIFF	Common TIFF, Uncompressed	Low (XMP)
	Common TIFF, Lossless Compressed	Low (XMP)
	GeoTIFF/BigTIFF, Uncompressed	Low (Extended TIFF header elements are generally used rather than XMP)
	GeoTIFF/BigTIFF, Compressed	Low (Extended TIFF header elements are generally used rather than XMP)
JPEG 2000	JPEG 2000: JP2	Low to medium; (not all readers and writers support all metadata features)
	JPEG 2000: JPX	Medium (not all readers and writers support all metadata features)
JPEG	JPEG (JFIF with EXIF)	Low (XMP)
PNG	PNG	Low (XMP)
PDF	PDF (1.1-1.7)	Low (XMP)
	PDF/A (1, 1a, 1b, 2)	Low (XMP)
	GeoPDF	Low (XMP)

ATTRIBUTE: Sustainability Factors: Geo-referencing Metadata

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: How well does this format support embedded geo-referencing metadata?

TIFF	Common TIFF, Uncompressed	Not supported
	Common TIFF, Lossless Compressed	Not supported
	GeoTIFF/BigTIFF, Uncompressed	Good
	GeoTIFF/BigTIFF, Compressed	Good
JPEG 2000	JPEG 2000: JP2	Not supported (see JPX)
	JPEG 2000: JPX	Good (OGC GMLJP2 specification available to handle this)
JPEG	JPEG (JFIF with EXIF)	Limited grid coordinate data may be held in EXIF data. Richer GIS data provided by sidecar "world file" (jgw extension) supported by some applications.
PNG	PNG	Not supported
PDF	PDF (1.1-1.7)	Not supported
	PDF/A (1, 1a, 1b, 2)	Not supported
	GeoPDF	Good; TerraGo geo display functionality may be limited to Windows app

ATTRIBUTE: Sustainability Factors: Level of Effort to Embed Geo-referencing Metadata

- Scoring conventions: High, Medium, Low
- Questions to Consider: What level of effort is required to embed extension metadata?

TIFF	Common TIFF, Uncompressed	N/A (GIS data can be provided by sidecar 'world file' (tfw extension) supported by some applications.)
	Common TIFF, Lossless Compressed	N/A (GIS data can be provided by sidecar 'world file' (tfw extension) supported by some applications.)
	GeoTIFF/BigTIFF, Uncompressed	Low (open source tools)
	GeoTIFF/BigTIFF, Compressed	Low (open source tools)
JPEG 2000	JPEG 2000: JP2	N/A
	JPEG 2000: JPX	Low-medium (tools available to embed GML data)
JPEG	JPEG (JFIF with EXIF)	Low (tools available in GIS software)
PNG	PNG	N/A
PDF	PDF (1.1-1.7)	N/A
	PDF/A (1, 1a, 1b, 2)	N/A
	GeoPDF	Low

ATTRIBUTE: Sustainability Factors: Impact of Patents

- Scoring conventions: Possible impacts or No impacts
- Questions to Consider: Are there patents related to this format that could have a direct impact on the long-term sustainability of files produced in this format?

TIFF	Common TIFF, Uncompressed	No Impact
	Common TIFF, Lossless Compressed	No Impact (Patents on LZW compression have expired, alleviating a concern)
	GeoTIFF/BigTIFF, Uncompressed	No Impact
	GeoTIFF/BigTIFF, Compressed	Low Impact (Patents on LZW compression have expired, alleviating a concern)
JPEG 2000	JPEG 2000: JP2	Little or No Impact
	JPEG 2000: JPX	Possible Impact (some patents may apply)
JPEG	JPEG (JFIF with EXIF)	No Impact
PNG	PNG	No Impact
PDF	PDF (1.1-1.7)	No Impact
	PDF/A (1, 1a, 1b, 2)	No Impact
	GeoPDF	No Impact

ATTRIBUTE: Sustainability Factors: Technical Protection Mechanisms

- Scoring conventions: Possible impacts or No impacts
- Questions to Consider: Are there technical protection measures inherent to this format that would prohibit the creation of ample derivatives/other formats?

TIFF	Common TIFF, Uncompressed	No Impact
	Common TIFF, Lossless Compressed	No Impact
	GeoTIFF/BigTIFF, Uncompressed	No Impact
	GeoTIFF/BigTIFF, Compressed	No Impact
JPEG 2000	JPEG 2000: JP2	No Impact
	JPEG 2000: JPX	No Impact
JPEG	JPEG (JFIF with EXIF)	No Impact
PNG	PNG	No Impact
PDF	PDF (1.1-1.7)	No Impact (protection mechanisms are available but not required and not a deterrent from choosing this format)
	PDF/A (1, 1a, 1b, 2)	No Impact (protection mechanisms are available but not required and not a deterrent from choosing this format)
	GeoPDF	No Impact (protection mechanisms are available but not required and not a deterrent from choosing this format)

ATTRIBUTE: Cost Factors: Implementation Cost

- Scoring conventions: High, Medium, Low
- Questions to Consider: Software/capture, Software/deliver, IT support [staff], Startup (training, support, expertise)

TIFF	Common TIFF, Uncompressed	Low
	Common TIFF, Lossless Compressed	Low
	GeoTIFF/BigTIFF, Uncompressed	Low
	GeoTIFF/BigTIFF, Compressed	Low
JPEG 2000	JPEG 2000: JP2	Medium-High
	JPEG 2000: JPX	Medium-High (may require added geo-referencing tool)
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Medium-high (tools can be expensive)
	PDF/A (1, 1a, 1b, 2)	Medium-high (tools can be expensive)
	GeoPDF	Medium-high (tools can be expensive)

ATTRIBUTE: Cost Factors: Cost of Software Tools

- Scoring conventions: High, Medium, Low
- Questions to Consider:

TIFF	Common TIFF, Uncompressed	Low
	Common TIFF, Lossless Compressed	Low
	GeoTIFF/BigTIFF, Uncompressed	Low
	GeoTIFF/BigTIFF, Compressed	Low
JPEG 2000	JPEG 2000: JP2	Medium-High (best toolsets available currently are proprietary; open source tools are not yet mature)
	JPEG 2000: JPX	Medium-High (best toolsets available currently are proprietary; open source tools are not yet mature)
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Medium-High (best toolsets available currently for this use case are proprietary tools)
	PDF/A (1, 1a, 1b, 2)	Medium-High (best toolsets available currently for this use case are proprietary tools)
	GeoPDF	Medium-High (best toolsets available currently for this use case are proprietary tools)

ATTRIBUTE: Cost Factors: Cost of equipment needed to produce files

- Scoring conventions: High, Medium, Low
- Questions to Consider:

TIFF	Common TIFF, Uncompressed	Low
	Common TIFF, Lossless Compressed	Low
	GeoTIFF/BigTIFF, Uncompressed	Low
	GeoTIFF/BigTIFF, Compressed	Low
JPEG 2000	JPEG 2000: JP2	Low-Medium (computationally intense compression)
	JPEG 2000: JPX	Low-Medium (computationally intense compression)
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Low-Medium
	PDF/A (1, 1a, 1b, 2)	Low-Medium
	GeoPDF	Low-Medium

ATTRIBUTE: Cost Factors: Storage Cost

- Scoring conventions: High, Medium, Low
- Questions to Consider: Are files created in this format usually large, medium, or small in size? (The values assigned in this category are especially rough-and-ready.)

TIFF	Common TIFF, Uncompressed	High
	Common TIFF, Lossless Compressed	Medium for LZW on tonal images (NOTE: LZW on high-bit or pictorial images will increase the size and therefore the storage footprint/cost) Low for bitonal with group 4
	GeoTIFF/BigTIFF, Uncompressed	High
	GeoTIFF/BigTIFF, Compressed	Medium for LZW on tonal images Low for bitonal with group 4 (unlikely scenario)
JPEG 2000	JPEG 2000: JP2	Low
	JPEG 2000: JPX	Low
JPEG	JPEG (JFIF with EXIF)	Low-medium
PNG	PNG	Medium
PDF	PDF (1.1-1.7)	Low (you would generally use PDF in cases where you could take advantage of compression)
	PDF/A (1, 1a, 1b, 2)	Low (you would generally use PDF in cases where you could take advantage of compression)
	GeoPDF	Low (you would generally use PDF in cases where you could take advantage of compression)

ATTRIBUTE: Cost Factors: Network Cost

- Scoring conventions: High, Medium, Low
- Questions to Consider: Does the transfer of files in this format affect performance of internal networks to the point where it would cost more to implement this format? File transfer for ingest into archive, transfer to "working area" for processing and access derivative creation.

TIFF	Common TIFF, Uncompressed	High
	Common TIFF, Lossless Compressed	Medium for LZW on tonal images Low for bitonal with group 4
	GeoTIFF/BigTIFF, Uncompressed	High
	GeoTIFF/BigTIFF, Compressed	Medium for LZW on tonal images Low for bitonal with group 4 (unlikely scenario)
JPEG 2000	JPEG 2000: JP2	Low
	JPEG 2000: JPX	Low
JPEG	JPEG (JFIF with EXIF)	Low-medium
PNG	PNG	Medium
PDF	PDF (1.1-1.7)	Low (you would generally use PDF in cases where you could take advantage of compression)
	PDF/A (1, 1a, 1b, 2)	Low (you would generally use PDF in cases where you could take advantage of compression)
	GeoPDF	Low (you would generally use PDF in cases where you could take advantage of compression)

ATTRIBUTE: Cost Factors: Ongoing Cost of Production

- Scoring conventions: High, Medium, Low
- Questions to Consider: Scanner speed/file transformation and compression? How many scans per hour can be accomplished? CPU usage calculations to produce derivatives?

TIFF	Common TIFF, Uncompressed	Medium-High
	Common TIFF, Lossless Compressed	Medium
	GeoTIFF/BigTIFF, Uncompressed	Medium-High
	GeoTIFF/BigTIFF, Compressed	Medium
JPEG 2000	JPEG 2000: JP2	Low-Medium
	JPEG 2000: JPX	Low-Medium
JPEG	JPEG (JFIF with EXIF)	Low-Medium
PNG	PNG	Medium
PDF	PDF (1.1-1.7)	Medium (longer post process. could vary greatly dependent on original and number of pages, etc.)
	PDF/A (1, 1a, 1b, 2)	Medium (longer post process. could vary greatly dependent on original and number of pages, etc.)
	GeoPDF	Medium (longer post process. could vary greatly dependent on original and number of pages, etc.)

ATTRIBUTE: Cost Factors: Cost of Providing Access

- Scoring conventions: Medium (derivatives needed), Low (copy of master serves access)
- Questions to Consider: Are derivatives necessary in order to provide broad access?

TIFF	Common TIFF, Uncompressed	Medium
	Common TIFF, Lossless Compressed	Medium
	GeoTIFF/BigTIFF, Uncompressed	Medium
	GeoTIFF/BigTIFF, Compressed	Medium
JPEG 2000	JPEG 2000: JP2	Medium
	JPEG 2000: JPX	Medium
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Low
	PDF/A (1, 1a, 1b, 2)	Low
	GeoPDF	Low

ATTRIBUTE: Cost Factors: Cost of Preservation Processing

- Scoring conventions: High, Medium, Low
- Questions to Consider: Costs in relation to emulation, migration, etc. File integrity monitoring (bit level preservation, etc.) Tools that are needed to execute migration, emulation. Are there tools that are available that are cheap or free, or will there be custom development or large investment necessary?

TIFF	Common TIFF, Uncompressed	Medium (assumption is that raster easily available for migration processing)
	Common TIFF, Lossless Compressed	Medium (assumption is that raster easily available for migration processing)
	GeoTIFF/BigTIFF, Uncompressed	Medium (assumption is that raster easily available for migration processing)
	GeoTIFF/BigTIFF, Compressed	Medium (assumption is that raster easily available for migration processing)
JPEG 2000	JPEG 2000: JP2	Medium
	JPEG 2000: JPX	Medium (caveat: if your profile is known, it would be the same level as JP2, but if not, the cost may be higher)
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Medium (could vary based on complexity)
	PDF/A (1, 1a, 1b, 2)	Medium (could vary based on complexity)
	GeoPDF	Medium (could vary based on complexity)

ATTRIBUTE: System Implementation Factors: Level of difficulty/complexity

- Scoring conventions: High, Medium, Low
- Questions to Consider: What is the level of effort associated with the implementation of this format? Are there special requirements for this format that would change the nominal workflow for digitization/information life cycle? Cost of applications, software, etc.

TIFF	Common TIFF, Uncompressed	Low
	Common TIFF, Lossless Compressed	Low
	GeoTIFF/BigTIFF, Uncompressed	Low
	GeoTIFF/BigTIFF, Compressed	Low
JPEG 2000	JPEG 2000: JP2	Medium-high
	JPEG 2000: JPX	Medium-high
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Medium (could vary)
	PDF/A (1, 1a, 1b, 2)	Medium (could vary)
	GeoPDF	Medium (could vary)

ATTRIBUTE: System Implementation Factors: Technical Complexity

- Scoring conventions: High, Medium, Low
- Questions to Consider: This is about the complexity of the implementation.

TIFF	Common TIFF, Uncompressed	Low
	Common TIFF, Lossless Compressed	Low
	GeoTIFF/BigTIFF, Uncompressed	Low
	GeoTIFF/BigTIFF, Compressed	Low
JPEG 2000	JPEG 2000: JP2	Medium-high
	JPEG 2000: JPX	Medium-high
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Medium (could vary)
	PDF/A (1, 1a, 1b, 2)	Medium (could vary)
	GeoPDF	Medium (could vary)

ATTRIBUTE: System Implementation Factors: Toolset Complexity

- Scoring conventions: High, Medium, Low
  Questions to Consider: This factor relates to the level of difficulty/complexity of the toolsets avaialble to implement. Are there many or few applications that support the format?

TIFF	Common TIFF, Uncompressed	Low
	Common TIFF, Lossless Compressed	Low
	GeoTIFF/BigTIFF, Uncompressed	Medium
	GeoTIFF/BigTIFF, Compressed	Medium
JPEG 2000	JPEG 2000: JP2	Medium-high
	JPEG 2000: JPX	Medium-high
JPEG	JPEG (JFIF with EXIF)	Low
PNG	PNG	Low
PDF	PDF (1.1-1.7)	Low
	PDF/A (1, 1a, 1b, 2)	Low
	GeoPDF	Low

ATTRIBUTE: System Implementation Factors: Availability of tools

- Scoring conventions: Wide availability, Moderate availability, Limited availability
- Questions to Consider: Are there tools available for this format? Are the tools open source? Are tools reliable when creating files that precisely meet the format specification? If a future digital archeologist had the format specification, how easy would it be to write an application?

TIFF	Common TIFF, Uncompressed	Wide Availability
	Common TIFF, Lossless Compressed	Wide Availability
	GeoTIFF/BigTIFF, Uncompressed	Moderate Availability
	GeoTIFF/BigTIFF, Compressed	Moderate Availability
JPEG 2000	JPEG 2000: JP2	Limited to Moderate Availability (not all tools support all features)
	JPEG 2000: JPX	Limited to Moderate Availability (not all tools support all features)
JPEG	JPEG (JFIF with EXIF)	Wide Availability
PNG	PNG	Wide Availability
PDF	PDF (1.1-1.7)	Wide Availability
	PDF/A (1, 1a, 1b, 2)	Wide Availability
	GeoPDF	Wide Availability

ATTRIBUTE: System Implementation Factors: Ease and accuracy for OCR

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: Can the format be OCR'd at all? To what extent does the file format carry the optimal information necessary for clear and accurate OCR? Are there any distinguishing characteristics of this file related to OCR?

TIFF	Common TIFF, Uncompressed	Good
	Common TIFF, Lossless Compressed	Good
	GeoTIFF/BigTIFF, Uncompressed	Acceptable
	GeoTIFF/BigTIFF, Compressed	Acceptable
JPEG 2000	JPEG 2000: JP2	Acceptable
	JPEG 2000: JPX	Acceptable
JPEG	JPEG (JFIF with EXIF)	Good
PNG	PNG	[no information]
PDF	PDF (1.1-1.7)	Good
	PDF/A (1, 1a, 1b, 2)	Good
	GeoPDF	Good

ATTRIBUTE: System Implementation Factors: Ease and accuracy of File validation

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: Can the format be validated using DROID/PRONOM or JHOVE/JHOVE2, or other tools? Does the format specification include concepts and methods for conformance?

TIFF	Common TIFF, Uncompressed	Good (JHOVE TIFF module; JHOVE2 module)
	Common TIFF, Lossless Compressed	Good (JHOVE TIFF module; JHOVE2 module)
	GeoTIFF/BigTIFF, Uncompressed	Good for GeoTIFF (JHOVE TIFF module; JHOVE2 module) Poor for BigTIFF (validation tool unknown)
	GeoTIFF/BigTIFF, Compressed	Good for GeoTIFF (JHOVE TIFF module; JHOVE2 module) Poor for BigTIFF (validation tool unknown)
JPEG 2000	JPEG 2000: JP2	Good (JHOVE module)
	JPEG 2000: JPX	Good (JHOVE module)
JPEG	JPEG (JFIF with EXIF)	Good (JHOVE module)
PNG	PNG	Poor (validation tool unknown)
PDF	PDF (1.1-1.7)	Good for versions 1.4, 1.5, and 1.6 (JHOVE module) Poor for version 1.7 (validation has ad hoc character)
	PDF/A (1, 1a, 1b, 2)	Good for version 1 formats (JHOVE module) Poor for version 2 (validation has ad hoc character)
	GeoPDF	Poor (validation has ad hoc character)

ATTRIBUTE: System Implementation Factors: Ease and accuracy of monitoring of quality

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: How easy is it to obtain or build a tool that would ensure that you are producing a well formed, high quality file that complies with a user specification profile for this format?

TIFF	Common TIFF, Uncompressed	Good
	Common TIFF, Lossless Compressed	Good
	GeoTIFF/BigTIFF, Uncompressed	Good
	GeoTIFF/BigTIFF, Compressed	Good
JPEG 2000	JPEG 2000: JP2	Good
	JPEG 2000: JPX	Good (not clear about validating geo-referencing metadata)
JPEG	JPEG (JFIF with EXIF)	Good
PNG	PNG	Acceptable
PDF	PDF (1.1-1.7)	Good
	PDF/A (1, 1a, 1b, 2)	Good
	GeoPDF	Good

ATTRIBUTE: Settings and Capabilities: Clarity

- Scoring conventions: Pass, Fail
- Questions to Consider: Does the format support elements that contribute to what is named by the deliberately imprecise term clarity? Two important characteristics are pixels per linear unit and bit depth ("bits per pixel"); clarity may also depend upon color accuracy and gamut, and will be adversely affected by lossy compression.

TIFF	Common TIFF, Uncompressed	Pass
	Common TIFF, Lossless Compressed	Pass
	GeoTIFF/BigTIFF, Uncompressed	Pass
	GeoTIFF/BigTIFF, Compressed	Pass
JPEG 2000	JPEG 2000: JP2	Pass
	JPEG 2000: JPX	Pass
JPEG	JPEG (JFIF with EXIF)	Pass (DCT has lower level of clarity than DWT; and 8-bit has lower level of clarity than 16 bit)
PNG	PNG	Pass
PDF	PDF (1.1-1.7)	Pass (for cetain categories of material, we would want a greater bit depth)
	PDF/A (1, 1a, 1b, 2)	Pass (for cetain categories of material, we would want a greater bit depth)
	GeoPDF	Pass (for cetain categories of material, we would want a greater bit depth)

ATTRIBUTE: Settings and Capabilities: Support for Color Maintenance

- Scoring conventions: Good, Acceptable, Poor
- Questions to Consider: How does the format support the documentation/metadata about the maintenance of color, e.g., tracking ICC profiles, or supporting the specification of sRGB, proRGB, eciRGB, Adobe RGB, or other color spaces?

TIFF	Common TIFF, Uncompressed	Good (caveat: to insert an ICC profile or declare certain color spaces, you must use an "extended tag set")
	Common TIFF, Lossless Compressed	Good (caveat: to insert an ICC profile or declare certain color spaces, you must use an "extended tag set")
	GeoTIFF/BigTIFF, Uncompressed	Good (caveat: to insert an ICC profile or declare certain color spaces, you must use an "extended tag set")
	GeoTIFF/BigTIFF, Compressed	Good (caveat: to insert an ICC profile or declare certain color spaces, you must use an "extended tag set")
JPEG 2000	JPEG 2000: JP2	Good (good but not perfect documentation of color space. Standards group working on these)
	JPEG 2000: JPX	Good (better documentation of color space than JP2)
JPEG	JPEG (JFIF with EXIF)	Good (Requires EXIF or other extension for embedding ICC profile. EXIF version is preferred for JPEG)
PNG	PNG	Good (metadata possible for chromaticity, gamma, and ICC profile)
PDF	PDF (1.1-1.7)	Good
	PDF/A (1, 1a, 1b, 2)	Good
	GeoPDF	Good

ATTRIBUTE: Settings and Capabilities: Searchable Text Embedding

- Scoring conventions: Pass, Fail
- Questions to Consider: Can searchable text be embedded? Note: Although this format comparison is focused on raster image data from scanning, some users who scan printed matter or manuscripts may be interested in identifying formats that can also carry searchable text.

TIFF	Common TIFF, Uncompressed	Fail (Not natively supported)
	Common TIFF, Lossless Compressed	Fail (Not natively supported)
	GeoTIFF/BigTIFF, Uncompressed	Fail (Not natively supported)
	GeoTIFF/BigTIFF, Compressed	Fail (Not natively supported)
JPEG 2000	JPEG 2000: JP2	Fail (Not natively supported)
	JPEG 2000: JPX	Fail (Not natively supported)
JPEG	JPEG (JFIF with EXIF)	Fail (Not natively supported)
PNG	PNG	Fail (Not natively supported)
PDF	PDF (1.1-1.7)	Pass
	PDF/A (1, 1a, 1b, 2)	Pass
	GeoPDF	Pass

ATTRIBUTE: Settings and Capabilities: Multi-Page (Multi-Image) Capability

- Scoring conventions: Pass, Fail
- Questions to Consider: Can the format carry multiple pages or images within the same file?

TIFF	Common TIFF, Uncompressed	Pass
	Common TIFF, Lossless Compressed	Pass
	GeoTIFF/BigTIFF, Uncompressed	Pass
	GeoTIFF/BigTIFF, Compressed	Pass
JPEG 2000	JPEG 2000: JP2	Fail (Not natively supported)
	JPEG 2000: JPX	Fail (Not natively supported)
JPEG	JPEG (JFIF with EXIF)	Fail (Not natively supported)
PNG	PNG	Fail (Not natively supported)
PDF	PDF (1.1-1.7)	Pass
	PDF/A (1, 1a, 1b, 2)	Pass
	GeoPDF	Pass

ATTRIBUTE: Settings and Capabilities: Notes on Maximum File Size

TIFF	Common TIFF, Uncompressed	Up to 4GB
	Common TIFF, Lossless Compressed	Up to 4GB
	GeoTIFF/BigTIFF, Uncompressed	GEO TIFF: up to 4GB BigTIFF: up to 18,000 petabytes Like TIFF format, GeoTIFF uses 32-bit offsets, thus limiting its extent to 4 gigabytes. The needs of GIS, large format scanners, medical imaging and other fields have prompted development of the variant BigTIFF format, which transcends the 4 GB TIFF limit using 64-bit offsets thereby supporting files up to 18,000 petabytes in size.
	GeoTIFF/BigTIFF, Compressed	GEO TIFF: up to 4GB BigTIFF: up to 18,000 petabytes Like TIFF format, GeoTIFF uses 32-bit offsets, thus limiting its extent to 4 gigabytes. The needs of GIS, large format scanners, medical imaging and other fields have prompted development of the variant BigTIFF format, which transcends the 4 GB TIFF limit using 64-bit offsets thereby supporting files up to 18,000 petabytes in size.
JPEG 2000	JPEG 2000: JP2	Practical limits may arise depending on application and/or pixel count (may be limited to 537 megapixels)
	JPEG 2000: JPX	Practical limits may arise depending on application and/or pixel count (may be limited to 537 megapixels)
JPEG	JPEG (JFIF with EXIF)	Practical limits may arise depending on application and/or pixel count
PNG	PNG	Practical limits may arise depending on application and/or pixel count
PDF	PDF (1.1-1.7)	Generally accepted practical limit is 2GB, based on reader applications
	PDF/A (1, 1a, 1b, 2)	Generally accepted practical limit is 2GB, based on reader applications
	GeoPDF	Generally accepted practical limit is 2GB, based on reader applications