CARTOSAT-1 (IRS – P5)

DATA PRODUCTS SYSTEM

GeoTIFF Format for IRS Digital Data Products (Version-2)

March 2005

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DOCUMENT CONTROL AND DATA SHEET

1. Report No. and date	**:** IRS-P5/DP/SAC/RESIPA/SIPG/TN-15/March-2005
2. Title and sub-title	**:** GeoTIFF format for IRS Digital Data Products
3. Type of Report	**:** Technical
4. No. of pages	**:** 26
5. Authors	**:** Cartosat-1(IRS-P5) Data Products Team
6. Originating Unit	**:** Signal & Image Processing Group Remote Sensing Applications and Image Processing Area, SAC.
7. Abstract	**:** This document contains the GeoTIFF format specifications for IRS Digital Data Products
8.Key words	**:** Tagged Image File Format(TIFF),GeoTIFF, Image File Directories, Map Projections, Format Layouts
9.Security Classification	**:** Unrestricted
10. Distribution	**:** To identified individuals within ISRO/DOS and IRS Data Users

GeoTIFF format for IRS Digital Data Products

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1.0 Introduction

The spaceborne remote sensing images in digital form has gained wide spread popularity, over the last decade with the advances in the field of Digital Image Processing and Geographical Information System (GIS) and evolution of computer hardware and software. Although currently various data formats (e.g. PGM, GIF, BMP, TIFF) are in use for storage of raster image data, they have a common limitation in cartographic applications. The main problem is that, it is almost impossible to store any geographic information together with image data in a unified and well-defined way in the above mentioned formats. There was a requirement to develop a new standard or the extension of an existing one, by adding a formalism to store information about geo-location of the image, the underlying cartographic model, a set of tie points and other relevant data. This new format was required to have platform independency, flexibility and extensibility. The Aldus-Adobe's public domain Tagged Image File Format (TIFF) is one of the widely used raster file formats, which is platform independent and has provision for extension. In 1990 one positive initiative was started by the Intergraph Corp. and the JPL Cartographic Working Group, based on the TIFF standard. The basic idea was to exploit the extensibility feature of TIFF which allows to officially register new TIFF Tags in order to create a well established structured format/space for a variety of geographic information.

Though it is very difficult to standardize remote sensing satellite digital image data products' formats and its contents, GeoTIFF format is an effort for this considering widespread application of GIS packages worldwide. The basic idea behind this file format is to supplement the bare image data with all information necessary for the transformation from image space into a geographic or cartographic coordinate system.

This document contents are applicable for all IRS series of Data Products. **The aim of this document is not to give complete TIFF or GeoTIFF specification, but only the fields used to give details of a given IRS data product. For a full understanding of GeoTIFF, this document has to be read along with the original GeoTIFF (Revision 1.0) specification. The GeoTIFF specification can be down loaded from the site given in section 3.4.**

2.0 TIFF (Tagged Image File Format)

TIFF (Tagged Image File Format), is a tag-based file format for storing and interchanging raster images. The first version of TIFF specification was published by Aldus Corporation in 1986, after a series of meetings with various scanner manufactures and software developers. TIFF is to describe and store raster image data. *The main advantages of TIFF is its suitability for a wide range of applications and its independence of computer's architecture, operating system, and graphics hardware.* It is reasonably compact and handles black-and-white, grayscale, and color images, allowing a user to adjust for the unique characteristics of a scanner, monitor, or printer. TIFF allows color resolution up to 48 bits (a 16-bit field each for R, G, and B), either as full RGB color or in a 64k-color palette .*The TIFF 6.0 specification, released in June 1992 is taken as reference by GeoTIFF.*

There are two variants in revision 6.0 of TIFF: *baseline* and *extended* TIFF. Within both these variants, there are many optional capabilities. Furthermore, TIFF data vary according to photometric type and compression method. All TIFF 6.0 readers and writers must handle the baseline set of data fields. The way in which these data fields are handled, depends on whether they are mandatory or optional.

2.1 Overview of TIFF File Structure

The TIFF format has a three-level hierarchy. From highest to lowest, the levels are:

1) A file Header.
2) One or more directories called IFDs, containing codes and their data, or pointer to the data.
3) Data.

The graphical view of TIFF file structure is given in Fig.1.

The File Header

The TIFF file begins with an 8-byte header, which gives basic information about the file such as byte order (Little Endian or Big Endian), TIFF file ID or Version Number (which is always 42) and a pointer to first Image File Directory (IFD). The structure of TIFF file header is as follows:

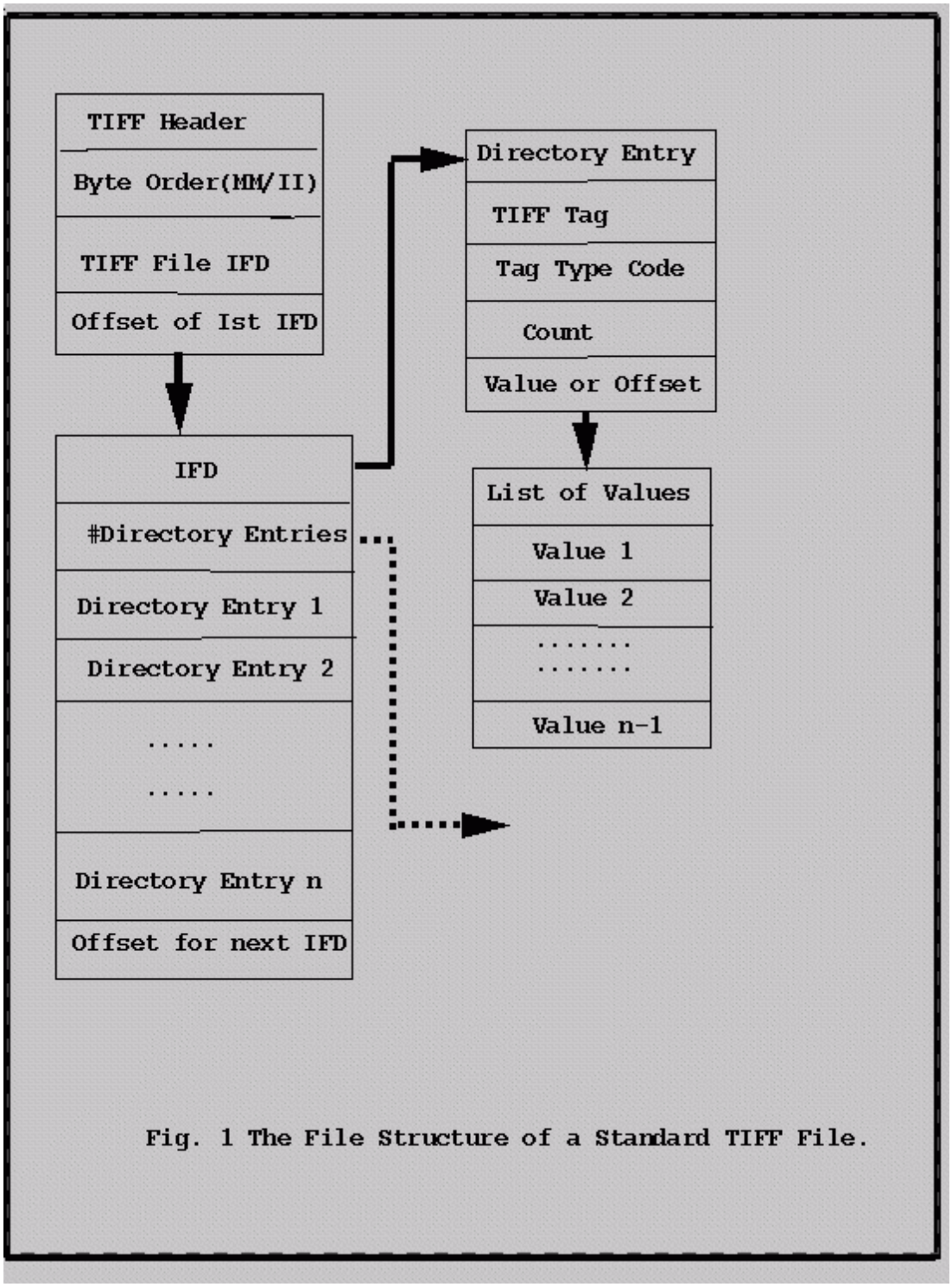

Fig. 1 The File Structure of a Standard TIFF File.

TABLE : 1 TIFF file Header

Offset	Length	Description
0	2	Byte Order: MM or II
2	2	"Version number ": which is always 42
4	4	Pointer to first IFD

***** ***Byte Order Field :*** The first header entry is in byte counts 0 and 1. It is a two-letter ASCII record containing the codes for the letters MM or II (4D4D hex or 4949 hex, respectively). MM stands for Motorola architecture, signifying that bytes comprising 16, 32 0r 64 bit numbers are stored in the order of most-to-least significant (big endian). II denotes file created in the Intel Architecture, where bytes are stored in the least-to-most significant order (little endian). By reading this record , a Mac or UNIX workstation-based file reader can detect a file created on a PC or vice versa, and interpret it properly.

***** ***Version field :*** The second header entry, a two byte number termed Version in the specification, actually has nothing to do with any version number or with the revision number of the specification. It is always the decimal number 42 (2A hex). For practical purposes, this code identifies the file as a TIFF file.

***** ***First IFD Offset pointer :*** The final header entry is a 4-byte pointer to the location of the first Image File Directory (IFD). The order of bytes here, as elsewhere, depends on the MM or II designation in the first entry. This pointer begins at an offset of 4, the fifth byte in the file.

Image File Directories (IFDs)

Most Likely, the next structure in the file after the header will be the first (or only) IFD, but not necessarily. From here on, everything is found by following pointers. So, to locate the first IFD, use the header's pointer.

An IFD consists of 12-byte entries, typically tagged pointers. The structure of an IFD and its entries are as follows:

TABLE : 2 TIFF IFD Structure

Offset	Length	Description
0	2	Entry Count
2	12	Entry 0
14	12	Entry 1
.	.	.
.	.	.
n*12 +2	12	Entry n
n*12 + 2 + 12	4	Pointer to subsequent IFD, if any, or 0000

**** Entry Count field :*** Since there may be any number of IFD entries, the first field in an IFD is a 2-byte count of number of entries.

*** IFD entries** : IFD entries are 12-byte fields, beginning with the tag code that specifies what type of data are present. The entries are ordered numerically within the IFD, according to the tag numbers, a feature that helps TIFF readers quickly determine which fields are present and which are not.

* **Terminating *field* :** The last entry in an IFD will be four bytes of zero, unless there is more than one IFD. If there is more than one IFD, the last entry of the preceding IFD contains a 4-byte pointer to the next one.

TABLE: 3 TIFF IFD Entry Structure

Offset	Length	Description
0	2	Tag
2	2	Type of Data
4	4	Count field
8	4	Data pointer or data field

*** *Tag* :** The first two bytes are tag, which , if public , may be looked up in the specification. These codes are assigned by the TIFF administrator (Aldus Developer's Desk), in blocks of five.

*** *Type code* :** The next two bytes comprise a code indicating the type of data in the pointed field. Note that some tags allow variety types, so TIFF readers should always check this code. TIFF 6.0 supports a veriety of data types; the codes, the data types, and their names are as follows:

TABLE: 4 TIFF 6.0 DATA TYPES

Data Type Code	No of Bytes	Standard Data Type
1	1-byte integer	type BYTE
2	1-byte integer, ASCII	type ASCII
3	2-byte integer	type SHORT
4	4-byte integer	type LONG
5	8-byte fraction	type RATIONAL (4-byte numerator followed by 4-byte denominator)
6	1-byte signed integer	type SBYTE
7	1-byte of anything	type UNDEFINED, e.g. a pointer to a complex data structure.
8	2-byte signed integer	type SSHORT
9	4-byte signed long	type SLONG
10	8-byte signed fraction	type SRATIONAL, SLONG numerator, SLONG denominator.
11	4-byte floating point	type FLOAT, IEEE format
12	8-byte floating point	type DOUBLE, double-precision IEEE

*** *Count field* :** The 4-byte field specifies the *number of values in the data field, not the number of bytes*. The number of bytes can be computed by multiplying the count by the number of bytes in the data type. For example, a count of 64 with a data type of LONG means there will be 256 bytes. (The count was referred to as the *length* in earlier revisions of TIFF.)

*** *Data pointer or data field* :** The final four bytes are usually a pointer to the start of a data field. Sometimes, however, this field contains not a pointer, but the actual data. If there are four bytes of data or less, as computed by the product of *count* and the byte count indicated by *type*, then the field contains data. Otherwise, the field is a pointer (the offset in bytes from the start of the file to the start of the data field).

2.2 Baseline TIFF

Baseline TIFF specification mostly affects TIFF readers. TIFF readers must be able to process all the fields given in *baseline table* or must assume the specified default, if the field is not present, regardless of the image-type expected. TIFF writers must include all fields required for the type of image data written, except where the default value is desired. Refer Table 5 and Table 6 for details of TIFF 6.0 Tags.

2.3 Extended TIFF

TIFF 6.0 defines numerous extensions. These allow TIFF to offer the following general capabilities.

* Alternative compression schemes: CCITT, LZW (with and without differencing), and JPEG.
* Alternative color-representation schemes: CMYK, YCbCr, and CIE L*a*b*.
* Image-quality enhancements: Halftone "hinting," RGB colorimetry.
* Special image effects: Alpha data (mating, masks and overlays), tiled images.
* Document storage and retrieval aids: document and page names, page numbers, and position on the page.

These extensions take the form of additional tags and/or special codes for baseline tags.

Baseline TIFF Tags and its usage in IRS DPS

IRS-DPS uses both Grayscale and RGB model to store image data as per product code and number of bands present. For each band of data a separate file with band name is given. In the following table the relevant/used fields of TIFF in context of IRS has been indicated.

Following additional TIFF tag fields contain information specific to each IRS satellite data product.

Extra Fields.

Software (305), *DateTime*(306), *Artist*(315), *HostComputer*(316).

TABLE 5: Mandatory/required fields and their defaults. X indicates field must be written in TIFF file for given image type(Bi-level, Grayscale, Palette, RGB)

Field /Tag Name	TagValue	Default	Bi-level	Grayscale	Palette	RGB	IRS-1C/1D/P6/P5(DPSUSE) Grayscale/RGB
ImageWidth	256	none	X	X	X	X	Yes
ImageLength	257	none	X	X	X	X	Yes
BitsPerSample	258	1		X	X	X	Yes
ColorMap	320	none			X		NotApplicable
Compression	259	1	X	X	X	X	Yes
PhotometricInterpretation	262	none	X	X	X	X	Yes
StripOffsets	273	none	X	X	X	X	Yes
RowsPerStrip	278	(2**32)-1	X	X	X	X	Yes
StripByteCounts	279	none	X	X	X	X	Yes
Xresolution	282	none	X	X	X	X	Yes
Yresolution	283	none	X	X	X	X	Yes
ResolutionUnit	296	2	X	X	X	X	Yes

TABLE 6: All Baseline fields/tags of TIFF 6.0 and IRS DPS Usage

Tag Name	**TagValue**	**IRS-1C/1D/P6/P5 (DPSUse)**	**Remarks in IRS DPS Context**
NewSubFileType	254	No	
SubFileType	255	No	
ImageWidth	256	Yes	Gives PixelsPerScanline or RecordLength.
ImageLength	257	Yes	Gives No of ScanLines in the given image.
BitsPerSample	258	Yes	For IRS DPS this is 8/10 based on sensor. 8 bit for LISS-3,LISS-4,PAN. 10 bit for AwiFS,FORE,AFT.
Compression	259	Yes	Code 1 is used in DPS showing no compression
PhotometricInterpretation	262	Yes	1: in GrayScale 2: in RGB
Thresholding	263	No	
CellWidth	264	No	
CellLength	265	No	
FillOrder	266	No	
DocumentName	269	Yes	
ImageDescription	270	Yes	Gives EOSAT/ISRO Fast Format Header only for IRS-1C/1D/P6 This field contains processing log information in case of IRS-P5.
Make	271	No	
Model	272	No	
StripOffsets	273	Yes	
Orientation	274	Yes	Code 1 is used : FisrtRowOnTop &FirstColumnOnLeft
SamplesPerPixel	277	No: GrayScale Yes : in RGB	GrayScale : NA RGB : 3
RowsPerStrip	278	Yes	

StripByteCounts	279	Yes	
MinSampleValue	280	Yes	Minimum possible gray value ("0" for IRS)
MaxSampleValue	281	Yes	Maximum possible Gray Value ("255" or “1023” based on 8/10 bit Data type of various IRS Sensors)
Xresolution	282	Yes	Number of pixels in one ResolutionUnit
Yresolution	283	Yes	No Of ScanLines in one ResolutionUnit
PlanarConfiguration	284	No	data i/o
PageName	285	No	
Xposition	286	No	
Yposition	287	No	
FreeOffsets	288	No	
FreeByteCounts	289	No	
GrayResponseUnit	290	No	
GrayResponseCurve	291	No	
Group3Options	292	No	
Group4Options	293	No	
ResolutionUnit	296	Yes	Code 3 is used to indicate unit as Centimeters.
PageNumber	297	No	
ColorResponseUnit	300	No	
TransferFunction	301	No	
Software	305	Yes	Software Release Number/Description.
DateTime	306	Yes	Date and Time of Product generation.
Artist	315	Yes	Authors name and organization name is give.
HostComputer	316	Yes	Processing System/Center Name is given.
Predictor	317	No	
WhitePoint	318	No	
PrimaryChromacities	319	No	
ColorMap	320	No	
TileWidth	322	No	
TileLength	323	No	
TileOffsets	324	No	
TileByteCounts	325	No	

BadFaxLines	326	No	
CleanFaxData	327	No	
ConsecutiveBadFaxLines	328	No	
SubIFD	330	No	
InkSet	332	No	
InkNames	333	No	
DotRange	336	No	
TargetPrinter	337	No	
ExtraSamples	338	No	
SampleFormat	339	No	
SminSampleValue	340	No	
SmaxSampleValue	341	No	
JPEGTables	347	No	used by JPEG codec
YcbCrCoefficients	529	No	used by TIFFReadRGBAImage support
YcbCrSubsampling	530	No	tile/strip size calculations
YcbCrPositioning	531	No	
ReferenceBlackWhite	532	No	
Matteing	32995	No	none (obsoleted by ExtraSamples tag)
DataType	32996	No	none (obsoleted by SampleFormat tag)
ImageDepth	32997	No	tile/strip calculations
TileDepth	32998	No	tile/strip calculations

3.0 Brief Description of GeoTIFF

The GeoTIFF specification defines a set of TIFF tags provided to describe all "Cartographic" information associated with TIFF imagery that originates from satellite imaging systems, scanned aerial photography, scanned maps, digital elevation models, or as a result of geographic analyses. Its aim is to allow means for tying a raster image to a known model space or map projection. GeoTIFF does not intend to become a replacement for existing geographic data interchange standards, such as the USGS SDTS standard or the FGDC metadata standard. Rather, it aims to augment an existing popular raster-data format to support georeferencing and geocoding nformation.

3.1 Basic Features

GeoTIFF format fully complies with the TIFF 6.0 specifications, and its extensions do not in any way go against the TIFF recommendations, nor do they limit the scope of raster data supported by TIFF. It uses a small set of reserved TIFF tags to store a broad range of georeferencing information, catering to geographic as well as projected coordinate systems needs. Projections include UTM, US State Plane and National Grids, as well as the underlying projection types such as Transverse Mercator, Lambert Conformal Conic, etc.

It uses a "MetaTag" (GeoKey) approach to encode dozens of information elements into just 6 tags, taking advantage of TIFF platform-independent data format representation to avoid cross-platform interchange difficulties. These keys are designed in a manner parallel to standard TIFF tags, and closely follow the TIFF discipline in their structure and layout. New keys may be defined as needs arise, within the current framework, and without requiring the allocation of new tags from Aldus/Adobe.

GeoTIFF format uses numerical codes to describe projection types, coordinate systems, datums, ellipsoids, etc. The projection, datums and ellipsoid codes are derived from the EPSG list compiled by the Petrotechnical Open Software Corporation (POSC), and mechanisms for adding further international projections, datums and ellipsoids has been established. The GeoTIFF information content is designed to be compatible with the data decomposition approach used by the National Spatial Data Infrastructure (NSDI) of the U.S. Federal Geographic Data Committee (FGDC).

3.2 GeoTIFF System/Software Requirements

GeoTIFF requires support for all documented TIFF 6.0 tag data-types, and in particular requires the IEEE double-precision floating point "DOUBLE" type tag. Most of the parameters for georeferencing will not have sufficient accuracy with single-precision IEEE, nor with RATIONAL format storage. The only other alternative for storing high-precision values would be to encode as ASCII, but this does not conform to TIFF recommendations for data encoding.

It is worth emphasizing here that the TIFF spec indicates that TIFF-compliant readers shall honor the 'byte-order' indicator, meaning that 4-byte integers from files created on opposite order machines will be swapped in software, and that 8-byte DOUBLE's will be 8-byte swapped.

A GeoTIFF reader/writer, in addition to supporting the standard TIFF tag types, must also have an additional module, which can parse the "Geokey" MetaTag information

3.3 GeoTIFF File and "Key" Structure Hierarchy

This gives the abstract file-format and "GeoKey" data storage mechanism used in GeoTIFF. To see graphical view of the GeoTIFF file structure please refer Fig. 2.

A GeoTIFF file is a TIFF 6.0 file, and inherits the file structure as described in the corresponding portion of the TIFF spec. All GeoTIFF specific information is encoded in several additional reserved TIFF tags, and contains no private Image File Directories (IFD's), binary structures or other private information invisible to standard TIFF readers.

The number and type of parameters that would be required to describe most popular projection types would, if implemented as separate TIFF tags, likely require dozens or even hundred of tags, exhausting the limited resources of the TIFF tag-space. On the other hand, a private IFD, while providing thousands of free tags, is limited in that its tag- values are invisible to non-savvy TIFF readers (which don't know that the IFD_OFFSET tag value points to a private IFD).

To avoid these problems, a GeoTIFF file stores projection parameters in a set of "Keys" which are virtually identical in function to a "Tag", but has one more level of abstraction above TIFF. Effectively, it is a sort of "Meta-Tag". A Key works with formatted tag-values of a TIFF file the way that a TIFF file deals with the raw bytes of a data file. Like a tag, a Key has an ID number ranging from 0 to 65535, but unlike TIFF tags, all key ID's are available for use in GeoTIFF parameter definitions.

The Keys in GeoTIFF (also call "GeoKeys") are all referenced from the GeoKeyDirectoryTag, which defined as follows:

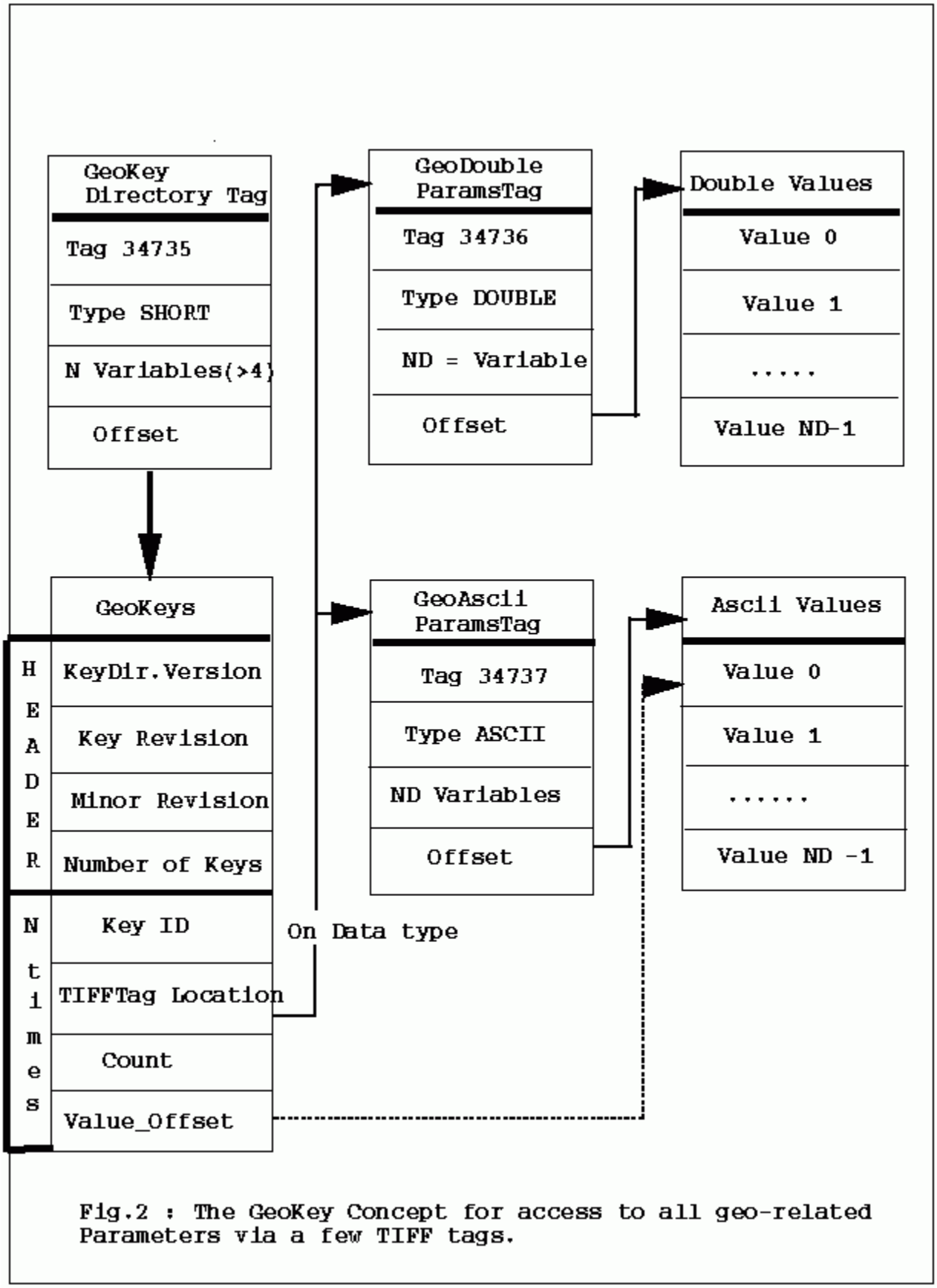

Fig.2 : The GeoKey Concept for access to all geo-related Parameters via a few TIFF tags.

GeoKeyDirectoryTag:

Tag = 34735 (87AF.H)
Type = SHORT (2-byte unsigned short)
N = variable, >= 4
Alias : ProjectionInfoTag, CoordSystemInfoTag
Owner: SPOT Image, Inc.

This tag may be used to store the GeoKey DirecGeoKey directory header information. The header values consist of the following information, in order:
Header={KeyDirectoryVersion, KeyRevision, MinorRevision, NumberOfKeys}
where

"***KeyDirectoryVersion***" indicates the current version of Key implementation, and will only change if this Tag's Key structure is changed. (Similar to the TIFFVersion (42)). The current DirectoryVersion number is 1. This value will most likely never change, and may be used to ensure that this is a valid Key-implementation.

"***KeyRevision***" indicates what revision of Key-Sets are used.

"***MinorRevision***" indicates what set of Key-codes are used. The complete revision number is denoted <KeyRevision>.<MinorRevision>

"***NumberOfKeys***" indicates how many Keys are defined by the rest of this Tag.

This header is immediately followed by a collection of <NumberOfKeys> KeyEntry sets, each of which is also 4-SHORTS long. Each KeyEntry is modeled on the "TIFFEntry" format of the TIFF directory header and is of the form:

KeyEntry = { KeyID, TIFFTagLocation, Count, Value_Offset }
where

"***KeyID***" gives the key-ID value of the Key (identical in function to TIFF tag ID, but completely independent of TIFF tag-space),

"***TIFFTagLocation***" indicates which TIFF tag contains the value(s) of the Key: if TIFFTagLocation is 0, then the value is SHORT, and is contained in the "Value_Offset" entry. Otherwise, the type (format) of the value is implied by the TIFF-Type of the tag containing the value.

"***Count***" indicates the number of values in this key.

"***Value_Offset***" Value_Offset indicates the index- offset *into* the TagArray indicated by TIFFTagLocation, if it is nonzero. If TIFFTagLocation=0, then Value_Offset contains the actual (SHORT) value of the Key, and Count=1 is implied. Note that the offset is not a byte-offset, but rather an index based on the natural data type of the specified tag array.

Following the KeyEntry definitions, the KeyDirectory tag may also contain additional values. For example, if a Key requires multiple SHORT values, they shall be placed at the end of this tag, and the KeyEntry will set TIFFTagLocation=GeoKeyDirectoryTag, with the Value_Offset pointing to the location of the value(s).

All key-values which are not of type SHORT are to be stored in one of the following two tags, based on their format:tory, which defines and references the "GeoKeys", as described below.The tag is an array of unsigned SHORT values, which are primarily grouped into blocks of 4. The first 4 values are special, and contain

GeoDoubleParamsTag:

Tag = 34736 (87BO.H)
Type = DOUBLE (IEEE Double precision)
N = variable
Owner: SPOT Image, Inc.

This tag is used to store all of the DOUBLE valued GeoKeys, referenced by the GeoKeyDirectoryTag. The meaning of any value of this double array is determined from the GeoKeyDirectoryTag reference pointing to it. FLOAT values should first be converted to DOUBLE and stored here.

GeoAsciiParamsTag:

Tag = 34737 (87B1.H)
Type = ASCII
Owner: SPOT Image, Inc.
N = variable

This tag is used to store all of the ASCII valued GeoKeys, referenced by the GeoKeyDirectoryTag. Since keys use offsets into tags, any special comments may be placed at the beginning of this tag. For the most part, the only keys that are ASCII valued are "Citation" keys, giving documentation and references for obscure projections, datums, etc.

Note on ASCII Keys:

Special handling is required for ASCII-valued keys. While it is true that TIFF 6.0 permits multiple NULL-delimited strings within a single ASCII tag, the secondary strings might not appear in the output of naive "tiffdump" programs. For this reason, the null delimiter of each ASCII Key value shall be converted to a "|" (pipe) character before being installed back into the ASCII holding tag, so that a dump of the tag will look like this.

AsciiTag="first_value|second_value|etc...last_value|"

A baseline GeoTIFF-reader must check for and convert the final "|" pipe character of a key back into a NULL before returning it to the client software.

3.4 Where to get GeoTIFF Specification

Following are the sites where details of GeoTIFF spec. is available.

EPSG/POSC tables, and source code is available via anonymous FTP at:

ftp://mtritter.jpl.nasa.gov/pub/tiff/geotiff/

and is mirrored at the USGS:

ftp://ftpmcmc.cr.usgs.gov/release/geotiff/jpl_mirror/

There are several subdirectories called spec/ tables/ and code/.

The USGS also has an archive of prototype GeoTIFF images at:

ftp://ftpmcmc.cr.usgs.gov/release/geotiff/images/

Information and a hypertext version of the GeoTIFF spec is available via WWW at the following site:

http://www-mipl.jpl.nasa.gov/cartlab/geotiff/geotiff.html

A mailing-list is currently active to discuss the on-going development of this standard. To subscribe to this list, send e-mail to:

GeoTIFF-request@tazboy.jpl.nasa.gov

with no subject and the body of the message reading:

subscribe geotiff your-name-here To post inquiries directly to the list, send email to: geotiff@tazboy.jpl.nasa.gov

4.0. IRS DPS Usage : Both TIFF and GeoTIFF Conventions

Following file naming conventions are used in Data Products of IRS – 1C/1D/P6/P5

4.1 File Naming Convention

Following are the file naming convention and directory structure for CDROM /DVD and DISK products. In case of GeoTIFF products no sequential media like DAT is supported.

4.1.1 Single Scene Case

(a) CDROM/DVD Products

Every CDROM/DVD product contains a file named CDINFO along with a directory PRODUCT1. The directory structure for normal single scene product in CDROM is as follows:

CDINFO
PRODUCT1/BANDn.tif (In case of Gray Scale Model GeoTIFF)
PRODUCT1/BAND_RGB.tif (In case of RGB Model GeoTIFF)
PRODUCT1/SATIDGeoTIFF.doc
PRODUCT1/PRODUCT_MET.TXT (Product Metadata file, Only for IRS-P5)

(b) DISK Products

The file naming convention in case of DISK products are as follows.

JobID_n.tif (In case of Gray Scale Model GeoTIFF), where 'n' is band number.
For IRS-P5 'n' stand for 'F' or 'A' for FORE and AFT Camera respectively
JobID_RGB.tif (In case of RGB Model GeoTIFF)
JobID_MET.TXT (Only for IRS-P5)

4.1.2 AOI(Area of Interest) and Orthokit Products (Only for IRS-P5)

For AOI and Orthokit products one product metadata file will be provided. In case of AOI products each product will be supplemented by three Shape files namely a) AOI Ordered (Order Shape file), b) Input scene Shape file, and c) Final product shape file for each scene. In case of Orthokit one RPC (Rational Polynomial coefficients) file will also be provided. Following are naming conventions for CDROM and DISK products.

(a) CDROM/DVD Products

CDINFO
PRODUCT1/BANDn_nn.tif (For AOI Products)
/BANDn.tif (For ORTHOKIT, similar convention as other products)
PRODUCT1/SATIDGeoTIFF.doc
PRODUCT1/ORDER.shp/dbf/shx (Product Order Shape File in case of AOI Products Only)
*PRODUCT1/SCENEnn.shp/dbf/shx (Input Scene Shape File)**
PRODUCT1/PRODUCTnn.shp/dbf/shx (Final Product Shape File)
PRODUCT1/PRODUCT_RPC.TXT (Product RPC File, Only for Orthokit)
PRODUCT1/PRODUCTnn_MET.TXT (Product Metadata file for AOI Scene nn)
/ PRODUCT_MET.TXT (For ORTHOKIT)

In case of DVD products to pack more than one products into a single DVD each product will be kept under a directory based on 12 character JobID(the unique Product Identification Number). Hence the directory structure for Multi Scene AOI products in DVD will look like

JobID(12 Char)/CDINFO
JobID(12 Char)/PRODUCT1/BANDn_nn.tif (For AOI Products)
/BANDn.tif (For ORTHOKIT, similar convention as other products)

JobID(12 Char)/PRODUCT1/SATIDGeoTIFF.doc
JobID(12 Char)/PRODUCT1/*ORDER.shp/dbf/shx (Product Order Shape File in case of AOI Products Only)*
JobID(12 Char)/*PRODUCT1/SCENEnn.shp/dbf/shx (Input Scene Shape File)*
JobID(12 Char)/*PRODUCT1/PRODUCTnn.shp/dbf/shx (Final Product Shape File)*
JobID(12 Char)/*PRODUCT1/PRODUCT_RPC.TXT (Product RPC File, Only for Orthokit)*
JobID(12 Char)/*PRODUCT1/PRODUCTnn_MET.TXT (Product Metadata file for AOI Scene nn)*
/ PRODUCT_MET.TXT (For ORTHOKIT)

NOTE:
***nn stands for AOI Scene number. Only in case of AOI products nn is added. For ORTHOKIT nn will not be present in image file and Metadata file.**

(b) DISK Products

The file naming convention in case of DISK products are as follows.

JobID_n.tif (In case of Gray Scale Model GeoTIFF)
JobID_ORDER/SCENE/PRODUCT.shp/dbf/shx (Only for AOI Products)
JobID_ *RPC.TXT (Product RPC File, Only for Orthokit)*
JobID_ *MET.TXT (Product Metadata file)*

4.1.3 Contents of a typical CDINFO File(for IRS-P5)

```
PRODUCT 1:
Product number            :J4PC006TJ001
Satellite ID              :P5
Sensor                    :PAF  ( PAF for FORE Sensor, similarly PAA for AFT)
Path-Row                  :0042-001
Date, Time and  Scene Id. :12AUG04004204500:36:19F 1J4600
Product Code              :J4PC006TJ
Orbit Number              :21002
Image Layout              :BSQ
Number Of Bands           :1
Bands Present in Product  :P
Bands in this volume      :P
File Header               :0
Line Header (Prefix Bytes):0
Line Trailer(Suffix Bytes):0
Scan Lines                :5568
Pixels                    :4992
Bytes Per Pixel           :2
Image Record Length(Bytes):9984
No of Volume              :1/1
Current/Total AOI scenes   :01/01 (Valid for AOI Products)
```

4.1.4 Scene Identification Definition of IRS-P5

This Scene ID definition is also given as “Date, Time and Scene Id.” for CDINFO File of CDROM/DVD products for all Digital Products(Super structure, Fast Format,GeoTIFF).

1. 1:7 DDMMMYY (Date of Pass)
2. 8:11 Path
3. 12:14 Row
4. 15:22 HH:MM:SS (Time of acquisition in UT of Scene center)
5. 23:24 Sensor – ID (F for FORE, A for AFT, FA for FORE and AFT)
6. 25:25 No. of sensors
7. 26:27 Product type code (ST/SR)*
8. 28:28 Processing level (0 – RAW, 1 – RAD)*
9. 29:30 Shift percentage
10. 31:32 Blank Char

* In CDINFO File of CDROM/DVD products these fields will vary based on Product Type and Processing level for other digital products format(fast Format and Super Structure).

4.2 Ellipsoid/Datum and Map Projection supported

4.2.1 Map Projections

Following Map projections are supported by IRS DPS.

Projection Name	Mnemonic
Universal Transverse Mercator	UTM
State Plane Coordinate System	SPCS
Albers Conical Equal Area	ACEA
Lambert's Conformal Conic	LCC
Mercator	MER
Polar Stereographic	PS
Polyconic	POL
Equidistant Conic (Type A & B)	EC
Transverse Mercator (Gauss-Krueger)	TM
Stereographic	SG
Lamberts Azimuthal Equal Area	LAEA
Azimuthal Equidistant	AE
Gnomonic	GNO
Orthographic	OG
General Vertical Near-Side Perspective	GVNP
Sinusoidal	SIN
Equirectangular (Plate Career)	ER
Miller Cylindrical	MC
Van Der Grintern I	VDG
Oblique Mercator (Type A & B)	OM
Space Oblique Mercator	SOM

4.2.2 Earth Ellipsoids

Following are the list of Ellipsoids supported by IRS DPS.

Ellipsoid Name	**Semi-Major Axis (Meters)**	**Semi-Minor Axis (Meters)**	**Mnemonics**
Clarke 1866	6378206.400000	6356583.800000	CLARKE_1866
Clarke 1880	6378249.145000	6356514.869550	CLARKE_1880
International 1967	6378157.500000	6356772.200000	INTERNATL_1967
International 1909	6378388.000000	6356911.646130	INTERNATL_1909
WGS 66	6378145.000000	6356759.769356	WGS_66
WGS 72	6378135.000000	6356750.519915	WGS_72
WGS 84	6378137.000000	6356752.314000	WGS_84
GRS 1980	6378137.000000	6356752.314140	GRS_80
Airy	6377563.396000	6356256.910000	AIRY
Modified Airy	6377340.189000	6356034.448000	MODIFIED_AIRY
Everest	6377276.345200	6356075.41330	EVEREST
Modified Everest	6377304.063000	6356103.039000	MODIFIED_EVERES T
Mercury 1960	6378166.000000	6356784.283666	MERCURY_1960
Modified Mercury 1968	6378150.000000	6356768.337303	MOD_MERC_1968
Bessel	6377397.155000	6356078.962840	BESSEL
Walbeck	6376896.000000	6355834.846700	WALBECK
Southeast Asia	6378155.000000	6356773.320500	SOUTHEAST_ASIA
Australian Natl.	6378160.000000	6356774.719000	AUSTRALIAN_NATL
Krassovsky	6378245.000000	6356863.018800	KRASSOVSKY
Hough	6378270.000000	6356794.343479	HOUGH
6370997 Sphere	6370997.000000	6370997.000000	6370997_M_SPHERE

4.2.3 Ellipsoid and Datum Mnemonics

Ellipsoid Name	**Ellipsoid Mnemonic**	**Possible Datum Name**	**Datum Mnemonics**
Clarke 1866	CLARKE_1866	Datum_North_American _Datum_1927	NAS-E
Clarke 1880	CLARKE_1880	Datum_Adindan	ADI-M
International 1967	INTERNATL_1967	Datum_New_Zealand_G eodetic_Datum_1949	GEO
International 1909/1924	INTERNATL_1909	Datum_European_Datum _1950	EUR-M
WGS 66	WGS_66	WGS_66	WGS_66
WGS 72	WGS_72	WGS_72	WGS_72
WGS 84	WGS_84	WGS_84	WGS_84
GRS 1980	GRS_80	Datum_North_American _Datum_1983	NAR-B
Airy	AIRY	Datum_OSGB_1936	OGB_M
Modified Airy	MODIFIED_AIRY	Datum_TM65	IRL
Everest	EVEREST	Datum_Indian_1975	IND-I
Modified Everest	MODIFIED_EVEREST	Datum_Indian_1975	IND-I
Mercury 1960	MERCURY_1960	NOT DEFINED	
Modified Mercury 1968	MOD_MERC_1968	NOT DEFINED	
Bessel	BESSEL	Datum_Tokyo	TOY-M
Walbeck	WALBECK	Datum_European_Datum _1950	EUR-M
Southeast Asia	SOUTHEAST_ASIA	Datum_Southasia	SOA
Australian Natl.	AUSTRALIAN_NATL	Datum_Australian_Geod etic_datum_1984	AUG
Krassovsky	KRASSOVSKY	Datum_Pulkovo_1942	PUK
Hough	HOUGH	Datum_Wake-Eniwetok_1960	ENW
6370997 Sphere	6370997_M_SPHERE	NOT DEFINED	

4.3 Contents of a typical IRS GeoTIFF Product

The content of a IRS-1C/1D Geocoded product in GeoTIFF format and various fields are shown below.
The various fields of TIFF used by IRS -1C/1D Data Products are as follows:

TIFF Tags used in IRS Dataproducts

No Of IFD Entry = 20

TagName(Tag)	DataTypeCode	Count	Offset/Value	Remark
ImageWidth(256)	4(LONG)	1	1109	Pixels
ImageLength(257)	4(LONG)	1	1256	ScanLines
BitsPerSample(258)	3(SHORT)	1	8	
Compression(259)	3(SHORT)	1	1	No Compression
PhotoInterpretation(262)	3(SHORT)	1	1	BlackIsZero
ImageDescription(270)	2(ASCII)	4609	*	Same as FastFormat Header
StripOffsets(273)	4(LONG)	180	*	Pointer to strips
Orientation(274)	3(SHORT)	1	1	FirstRowOnTop & FirstColumnOnLeft
RowsPerStrip(278)	4(LONG)	1	1	
StripByteCounts(279)	4(LONG)	180	*	
MinSampleValue(280)	3(SHORT)	1	0	Min possible greyvalue
MaxSampleValue(281)	3(SHORT)	1	255	Max possible greyvalue
XResolution(282)	5(RATIONAL)	1	*	No. of pixels in one ResolutionUnit
YResolution(283)	5(RATIONAL)	1	*	No. of scanlines in One ResolutionUnit
ResolUnit(296)	3(SHORT)	1	3	Centimeter
ModelPixelScaleTag(33550)	12(DOUBLE)	3	*	GeoTIFF Hook to TIFF
ModelTiepointTag(33922)	12(DOUBLE)	30	*	GeoTIFF Hook to TIFF
GeoKeyDirectoryTag(34735)	3(SHORT)	108	*	GeoTIFF Hook to TIFF
GeoDoubleParamsTag(34736)	12(DOUBLE)	12	*	GeoTIFF Hook to TIFF
GeoAsciiParamsTag(34737)	2(ASCII)	119	*	GeoTIFF Hook to TIFF

NOTE : Where Count >1, Offset/Value field contains *,indicating ByteOffsetPointer.

The various fields of GeoTIFF used by IRS-1C/1D Data Products are as follows:

GeoKeys used by IRS Data products & its contents for a Geocoded product

```
No. of GeoKey Entries = 26
```

GeoKey	Contents
ModelTypeGeoKey(1024)	= 1(ModelTypeProjected)
RasterTypeGeoKey(1025)	= 1(RasterPixelIsArea)
GTCitationGeoKey(1026)	=GeoTIFF Version 1.8.1 October 31,1995 http://www.earthlink.net/~ritter/geotiff/geotiff.html
GeographicTypeGeoKey(2048)	= 32767(User Defined)
GeogCitationGeoKey(2049)	= EVEREST
GeodeticDatumGeoKey(2050)	= 32767(User Defined)
PrimeMeridianGeoKey(2051)	= 8901(PM_Greenwich)
PrimeMeridianLongGeoKey(2061)	= 0.000000
AngularUnitsGeoKey(2054)	= 9102(Angular_Degree)
EllipsoidGeoKey(2056)	= 32767(User Defined)
MajorAxisGeoKey(2057)	= 6377.276345
MinorAxisGeoKey(2058)	= 6356.075413
InvFlatteningGeoKey(2059)	= 300.801698
CSTTypeGeoKey(3072)	= 32767(User Defined)
PCSCitationGeoKey(3073)	= Polyconic
ProjectionGeoKey(3074)	= 32767(User Defined)
CoordTransGeoKey(3075)	= 22(CT_Polyconic)
LinearUnitsGeoKey(3076)	= 9001(Linear_Meter)
NatOriginLongGeoKey(3080)	= 73.325005
NatOriginLatGeoKey(3081)	= 28.325001
FalseEastingGeoKey(3082)	= 0.000000
FalseNorthingGeoKey(3083)	= 0.000000
CenterLongGeoKey(3088)	= 77.325005
CenterLatGeoKey(3089)	= 28.325001
CenterEastingGeoKey(3090)	= 0.000000
CenterNorthingGeoKey(3091)	= 0.000000

```
ModelPixelScaleValues(33550)(ScaleX,ScaleY,0) = (12.5,12.5,0.0)

ModelTiepointValues(33922),(I,J,0.0,X,Y,0.0)

where I=Pixel,J=Scanline and X,Y are Projection co-ordinate in
ProjLinearUnits.

ModelTiepointValues(33922)  =
UL value              (  0.0,   0.0,0.0,-13859.989552, 15694.420408,0.0,
UR value             1109.0,   0.0,0.0, 13840.010419, 15694.396435,0.0,
LL value                0.0,1256.0,0.0,-13859.989714,-15680.581002,0.0,
LR value             1109.0,1256.0,0.0, 13840.010581,-15680.604694,0.0,
Center value          554.5, 628.0,0.0,   -47.489552,    31.941094,0.0)
```