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QuickBird Imagery Products

Product Guide

ISO 9002 CERTIFIED

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1. Introduction

QuickBird Imagery Products offer customers a variety of options for accurate and timely imagery. DigitalGlobe™ offers QuickBird Imagery Products at three processing levels: (1) Basic Imagery with the least amount of processing (geometrically raw), designed for customers desiring to process imagery into a useable form themselves, (2) Standard Imagery with radiometric and geometric correction, and delivered in a map projection, and (3) Orthorectified Imagery with radiometric, geometric, and topographic correction, and delivered in a map projection. Please refer to Section 5 for more details about QuickBird Imagery Products.

In addition to processing levels, DigitalGlobe offers QuickBird Imagery Products in five product options: (1) Black & White (panchromatic) products enable superior visual analysis, (2) Multispectral products cover the visible and near-infrared wavelengths and are ideal for multispectral analysis, (3) Bundle (black & white and multispectral) products, (4) Color (3-band natural color or color infrared) products that combine the visual information of three multispectral bands with the spatial information of the panchromatic band, and (5) Pan-sharpened (4-band) that combines the visual information of all four multispectral bands with the spatial information of the panchromatic band. Please refer to Section 6 for more details about QuickBird Imagery Product options.

DigitalGlobe provides customers with flexibility in Product Levels, Ordering Options, Delivery Options, and Licensing Options. This document discusses, in detail, QuickBird Imagery Products and ordering options, including:

QuickBird Satellite: The QuickBird satellite collects the highest resolution imagery commercially available.

Product Ordering: The DigitalGlobe Archive allows customers to order previously collected imagery. If the customer's area of interest is not covered in the archive, DigitalGlobe will task the image collection in one of three commercial tasking options.

Product Delivery: DigitalGlobe delivers its QuickBird Imagery Products to customers in industry standard image formats and media. Customers may receive their products via commercial delivery services or electronically via ftp (pull).

Product Levels: DigitalGlobe offers QuickBird Imagery Products in several processing and accuracy levels to suit customers' needs.

Product Options: DigitalGlobe offers products in a variety of multispectral options.

Product Naming: Product File Naming Conventions provide information about the acquisition of the QuickBird Imagery.

Product Licensing: DigitalGlobe licenses its imagery in a flexible manner to ensure that all personnel who need access to the imagery may use it.

Image Support Data: The metadata provided with QuickBird Imagery Products provides all the information needed to analyze and process imagery to the customer's specifications.

2. QuickBird Satellite

DigitalGlobe's QuickBird satellite provides the largest swath width, largest on-board storage, and highest resolution of any currently available or planned commercial satellite. QuickBird is designed to efficiently and accurately image large areas with industry-leading geolocational accuracy. The QuickBird spacecraft is capable of acquiring over 75 million square kilometers of imagery data annually (over three times the size of North America), allowing DigitalGlobe to populate and update its archive at unprecedented speed.

QuickBird Characteristics	
Launch Date	October 18, 2001
Launch Vehicle	Boeing Delta II
Launch Location	Vandenberg Air Force Base, California
Orbit Altitude	450 km
Orbit Inclination	97.2 degree, sun-synchronous
Speed	7.1 km/second
Equator Crossing Time	10:30 a.m. (descending node)
Orbit Time	93.5 minutes
Revisit Time	1-3.5 days depending on latitude (30° off-nadir)
Swath Width	16.5 km x 16.5 km at nadir
Metric Accuracy	23-meter horizontal (CE90%)
Digitization	11 bits
Resolution	Pan: 61 cm (nadir) to 72 cm (25° off-nadir) MS: 2.44 m (nadir) to 2.88 m (25° off-nadir)
Image Bands	Pan: 450 - 900 nm Blue: 450 - 520 nm Green: 520 - 600 nm Red: 630 - 690 nm Near IR: 760 - 900 nm

Note: maximum order polygon size for a single scene is approximately 14 km x 14 km

Table 1. QuickBird Spacecraft Characteristics.

3. Product Ordering

QuickBird products are either obtained directly from the DigitalGlobe archive or by tasking the spacecraft. This section details the different tasking and archive order types as well as the methods for specifying an order polygon.

3.1 QuickBird Tasking Orders

There are three Commercial Tasking options for QuickBird Imagery Products: Standard, Priority, and Rush. Tasking orders have single or multiple acquisition opportunities and customer-defined tasking parameters, depending on the tasking type selected. In addition, each tasking type has a priority level in relation to the other tasking types (see Table 2).

Tasking Type	Relative Priority
Commercial Standard	**3**
Commercial Priority	**2**
Commercial Rush	**1**

Table 2. QuickBird Tasking Types and Relative Priorities.

When preparing its collection plan, DigitalGlobe considers several factors, including order priority, date an order was received, the customer-specified collection window, and the cloud cover forecast. In rare instances, DigitalGlobe may pre-empt some orders due to collection efficiency and/or satellite calibration and maintenance. For Standard and Priority Tasking, the customer will be contacted to cancel or place a new order if all collection attempts are unsuccessful. For Rush Tasking, customers will receive an image even if it does not meet the cloud cover or image quality specifications. Those images greater than 20% cloud cover or Marginal or Poor image quality will receive a 50% discount off of the originally quoted tasking price. Tables 3, 4, and 5 define commercial tasking options and defaults.

3.1.1 Collection Feasibility

All QuickBird Tasking Orders must pass two feasibility studies prior to acceptance of the order:

- Physical Feasibility assesses the number of times that QuickBird has physical access to your target based upon the parameters you provide. Items that affect physical feasibility include off-nadir angle (wider angles will have more accesses than narrow angles), latitude (QuickBird has increased access to locations at higher latitudes), collection windows (the larger the collection window, the more access QuickBird will have).
- Competitive Feasibility assesses DigitalGlobe's ability to collect your order based upon other orders in the system. Items that affect competitive feasibility include orders already in the system- and orders that have a higher relative priority (see Table 2).

3.1.2 Standard Tasking

- An order placed at least five days before the start collect date.
- A collection window of 15 to 365 days. DigitalGlobe suggests a 90 day collection window to ensure enough time to collect imagery that meets your specifications. Larger areas will require a longer collection window.
- Up to 5 collection attempts, depending on off-nadir angle, latitude, competition, and length of collection window. A longer collection window will result in more physical collection opportunities and increased likelihood of a successful collect.
- Standard image processing.

Tasking Parameters - Standard Commercial		Customer Selected
Minimum Collection Area	1 scene for Basic Imagery 64km^2 for Standard and 1:4800 Orthorectified Imagery 100km^2 for 1:12,000 & Custom Orthorectified Imagery 150km^2 for 1:25,000 Orthorectified Imagery	
Maximum Collection Area	10,000km^2 for Basic and Standard Imagery 2,500km^2 for Orthorectified Imagery	Yes
Start Collection Date	>= 5 days from order placement	Yes
End Collection Date	15 to 365 days from Start Collection Date 90 days recommended	Yes
Maximum Cloud Cover	20%	
Off-Nadir Angle	0^o - 15^o; 0^o - 25^o Basic, Standard, and all Orthorectified Imagery (except 1:4800) 0^o - 15^o for 1:4800 Orthorectified Imagery	Yes
Maximum Number of Acquisition Attempts	5	
Sun Elevation	>= 15^o (as collected)	
Sun Azimuth	0^o - 360^o (as collected)	
Target Azimuth	0^o - 360^o (as collected)	

Table 3. Commercial Standard Tasking Parameters.

3.1.3 Priority Tasking

- An order placed at least four days before the start collect date.
- A collection window of 7 - 365 days.
- Up to 3 collection attempts, depending on off-nadir angle, latitude, and competition.
- Priority image processing.

Tasking Parameters - Priority Commercial		Customer Selected
Minimum Collection Area	1 scene for Basic Imagery 64km^2 for Standard and 1:4800 Orthorectified Imagery 100km^2 for 1:12,000 and Custom Orthorectified Imagery 150km^2 for 1:25,000 Orthorectified Imagery	
Maximum Collection Area	10,000km^2 for Basic and Standard Imagery 2,500km^2 for Orthorectified Imagery	
Start Collection Date	>= 4 days from order placement	Yes
End Collection Date	7 - 365 days from Start Collection Date	Yes
Maximum Cloud Cover	20%	
Off-Nadir Angle	0^o - 15^o; 0^o - 25^o Basic, Standard, and all Orthorectified Imagery (except 1:4800) 0^o - 15^o for 1:4800 Orthorectified Imagery	Yes
Maximum Number of Acquisition Attempts	3	
Sun Elevation	>= 15^o (as collected)	
Sun Azimuth	0^o - 360^o (as collected)	
Target Azimuth	0^o - 360^o (as collected)	

Table 4. Commercial Priority Tasking Parameters.

3.1.4 Rush Tasking

- An order placed at least 48 hours before the start collect date.
- A collection window of 1 - 14 days.
- A single collection attempt.
- Basic and Standard Imagery only.
- Rush image processing.

Tasking Parameters - Rush Commercial		Customer Selected
Minimum Collection Area	1 scene for Basic Imagery 100km^2 for Standard Imagery	
Maximum Collection Area	2,500km^2 (must be able to collect in a single pass)	
Start Collection Date	>= 48 hours from order placement	Yes
End Collection Date	1 - 14 days from Start Collection Date	Yes
Maximum Cloud Cover	20% to 100% (orders greater than 20% cloud cover will receive a discount off of full price)	
Off-Nadir Angle	0^o - 15^o; 0^o - 25^o Basic and Standard Imagery	Yes
Maximum Number of Acquisition Attempts	1	
Sun Elevation	>= 15^o (as collected)	
Sun Azimuth	0^o - 360^o (as collected)	
Target Azimuth	0^o - 360^o (as collected)	

Table 5. Commercial Rush Tasking Parameters.

3.2 Archive Ordering

In addition to tasking the satellite, customers may order QuickBird Imagery Products directly out of the DigitalGlobe archive. Customers may define their order polygons in several ways (see below). Archive orders receive the Standard level image processing, unless ordered as a Rush Archive.

3.2.1 Rush Archive Delivery

DigitalGlobe offers customers a Rush Archive delivery option for Basic and Standard Imagery already existing in the archive. This option features a 24 hour turnaround time between order confirmation and order shipment or FTP for Black & White, Multispectral, and Bundle products. For Color and Pan-sharpened products, a 48 hour turnaround time (between order confirmation and order shipment or FTP) is offered. Orders comprised of more than one scene for any one customer will be subject to a feasibility assessment.

There are special considerations and timelines for orders over the weekend. Orders received outside of normal business hours will have feasibility assessed on the next business day. Products ordered on Friday will not be sent to the FTP site or shipping dock until Monday morning (Black & White, Multispectral, and Bundle products) or Tuesday morning (Pan-Sharpened products). Processing will start on the next business day for orders confirmed outside of normal business hours.

3.3 Order Polygon

Each order, whether tasking or archive, scene based or area based, is defined by an Order Polygon. An Order Polygon may contain a minimum of 4 vertices and a maximum of 1,000 vertices, consisting of longitude/latitude (decimal degrees) geographic coordinates on the WGS84 ellipsoid.

The minimum and maximum size for an order polygon depends on the order type and the product selected. Refer to Tables 11, 12, and 13 for order polygon restrictions by product type. An order polygon may be defined using one of the following methods:

- Upper left and lower right corner coordinates if your area is rectangular.
- A center point and a height and width to define your area.
- Shapefile format –the .shp, .shx, and .dbf files must be supplied. A shapefile must contain only one polygon.
- ASCII text format (.gen) – Arc/Info Generate format. An ASCII text file must contain a closed polygon with a minimum of four points, and a maximum of 1,000 points (see Table 6).

Format	Example
"ID"	BRISBANE_AUSTRALIA
Longitude, Latitude	152.808,-27.671
Longitude, Latitude	153.244,-27.671
Longitude, Latitude	153.244,-27.236
Longitude, Latitude	152.808,-27.236
END	END

Table 6. Example of the ASCII text file format.

4. Product Delivery

DigitalGlobe provides its QuickBird Imagery Products to customers on a variety of industry standard image formats and media. In addition to the imagery products, DigitalGlobe also delivers the Image Support Data files in text format as described in Section 9.

4.1 File Formats

QuickBird Imagery Products are available in three image formats:

- GeoTIFF 1.0
- NITF 2.0
- NITF 2.1

4.2 Delivery Options

DigitalGlobe provides a variety of direct and timely delivery options for delivering QuickBird Imagery Products. These options include:

Standard Delivery Service: DigitalGlobe uses standard delivery services (FedEx, DHL, UPS) to deliver media directly to the customer in a timely fashion. DigitalGlobe selects the most reliable and quickest service based upon customer location.

Electronic Delivery Service: The customer may request electronic delivery. DigitalGlobe supports ftp (pull), where the customer logs on to the DigitalGlobe system and retrieves their imagery.

4.3 Media

DigitalGlobe supports a variety of magnetic and optical media for its QuickBird Imagery Products:

Media	Notes
CD	640 MB
4 mm Tape	12 GB (DDS3)
8 mm Tape	7 GB (8500 Density)
DLT	35 GB (7000 Density)
DVD	4 GB

Note: Basic Imagery not available on CD

Table 7. DigitalGlobe Supported Media.

Those customers who select electronic delivery via ftp (pull) will not receive imagery on media.

4.4 Tiling

Because some QuickBird Imagery Products cannot fit in their entirety on all available media types or may be cumbersome to work with due to their large size, DigitalGlobe offers you the option to break up imagery into smaller pieces called tiles. Tiles may be approximately 8,000 pixels by 8,000 pixels (8k x 8k), 14,000 pixels by 14,000 pixels (14k x 14k), or 16,000 by 16,000 pixels (16k x16k). Customers who do not wish to tile their imagery may change their media type to one that will accommodate the full size of their product, but should understand that large data files may be difficult to import into some software packages. Please note that most image processing, GIS, and cartographic applications cannot open files over 2 GB in size.

Tiling is an option for all QuickBird products, except Basic Imagery. Note that all pan-sharpened products must be tiled regardless of media type. Please see Section 5 for a complete definition of QuickBird products.

When an order polygon has boundaries that intersect multiple scenes, each scene is given a number associated with the order. When an individual scene exceeds the size limit for the media selected, it is tiled. Each tile, regardless of size option (8k, 14k, or 16k) is then given a number corresponding to its position in rows and columns. (See Figure 1.)

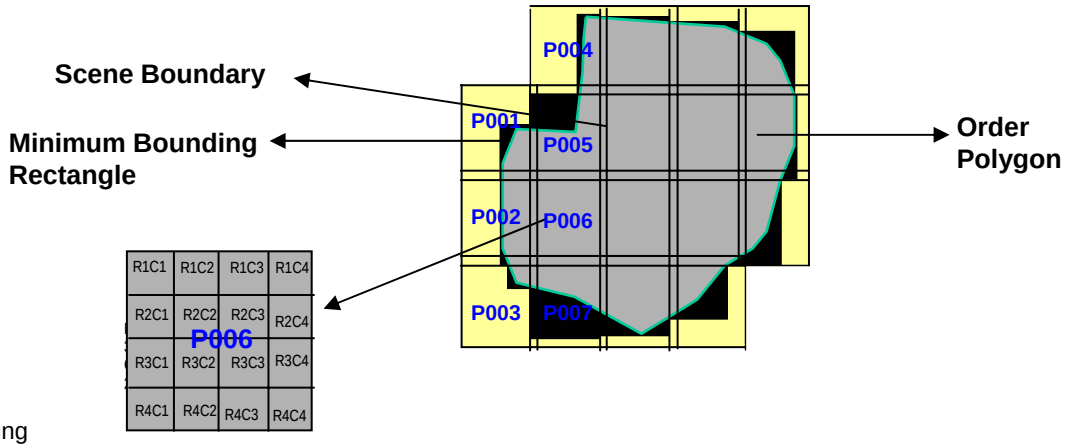

Figure 1. Tile Naming

A tile map file (.til) is delivered with every product to help place the tiles in product coordinates. For more information on the tile map file, see section 9.10.

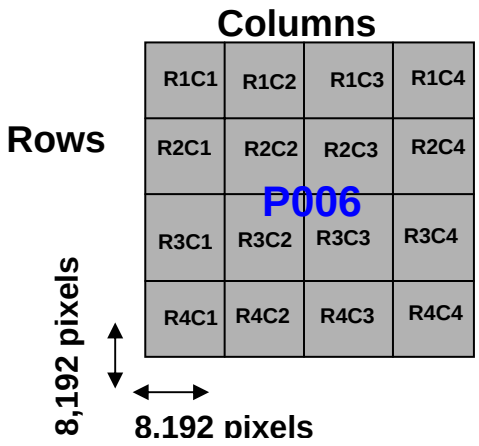

Figure 2 . Tile Map Naming Example

DigitalGlobe tiles imagery by first drawing a minimum-bounding rectangle (MBR) around the image-oriented map. That MBR is then divided into tiles, which are sized according to the tiling option selected. Four tiling options are available, giving you the ability to specify the amount of data in each tile. These are as follows: No Tiling, 8k x8k, 14k x14k, and 16k x16k.

No Tiling- DigitalGlobe strives to respect the wishes of its customers in regards to tile size selection. However individual scene size, file size, and media type may determine whether a scene requires tiling, regardless of the option selected. An order polygon whose boundaries intersect multiple scenes may need to have individual scenes tiled. An individual scene will be tiled if it is:

- Larger than 2 GB for any available media choice
- Larger than 640 MB for a CD

8k x 8k - 8k x 8k tiles have exactly 8,192 pixels by 8,192 pixels per tile. This tiling option may be easily read by commercial off the shelf (COTS) software products.

When the 8k option is selected, DigitalGlobe starts at the upper left corner of the MBR and counts 8000 x 8000 pixels to create the first tile. (The tiles are actually 8 multiplied by 1024 due to internal blocking, so the first tile would be composed of 8,192 by 8,192 pixels for a panchromatic product. Divide by 4 for a multispectral product). The next tile is generated starting where the first tile ends (pixel 8192, 0), and pixels are counted down and across. (This same process is applied to 14k x 14k and 16k x 16k tiling, although 1024 is multiplied by 14 or 16, respectively, for these options.)

If the amount of imagery in a tile is less than 8192 x 8192 pixels, then the tile is cut off at the edge of the imagery. Some padding, or blackfill, pixels may be included to complete the block. A block is comprised of 1024 panchromatic pixels or 256 multispectral pixels. Please note that DigitalGlobe recently implemented changes to its blackfill schema to reduce the amount of blackfill present in QuickBird imagery products. Imagery received prior to this change may have a greater amount of blackfill including tiles that are entirely blackfilled.

14k x14k -14k x14k tiles have exactly 14,336 by 14,336 pixels per tile.

16k x16k -16k x16k tiles contain 16,384 X 16,384 pixels per tile.

The following table shows file sizes for each of these tiling options.

	Black & White	Color (3-band)	Multispectral	Pan-sharpened (4-band)	Bit Depth
Basic Imagery (one scene)	800 MB	NA	200 MB	NA	8
	1600 MB	NA	400 MB	NA	16
Standard and Orthorectified Imagery (8k x 8k tile)	75 MB	200 MB	20 MB	270 MB	8
	150 MB	400 MB	40 MB	540 MB	16
Standard and Orthorectified Imagery (14k x 14k tile)	200MB	600MB	50Mb	800MB	8
	400MB	1200MB	100MB	1600MB	16
Standard and Orthorectified Imagery (16k x 16k tile)	300 MB	800 MB	75 MB	1080 MB	8
	600 MB	1600 MB	150 MB	2160 MB	16

Please see the *QuickBird Imagery Products FAQ* for more information on tiling, tile file sizes, and working with tiled imagery.

4.5 Delivery Timelines

Delivery time for products depends on the product and product options that a customer selects. Table 8, Expected Delivery Times by Product and Tasking Type, establishes the average timetables for product delivery. Times in this table indicate the number of business days to shipment, after DigitalGlobe receives all of the necessary support data to process an order. For Basic and Standard Imagery, this is after imagery acquisition. For Orthorectified Imagery, this is after imagery acquisition, and the collection of appropriate DEMs and GCPs. For archive imagery, this time is number of days after order confirmation.

	Standard Tasking	**Priority Tasking**	**Rush Tasking**	**Archive**	**Rush Archive**
Basic	10 days	5 days	60 hours	5 days	24 hours
Standard	10 days	5 days	60 hours	5 days	24 hours
Standard - Pan-sharpened	16 days	11 days	8.5 days	11 days	48 hours
Orthorectified	10 days	5 days	N/A	5 days	N/A
Orthorectified - Pan-sharpened	16 days	11 days	N/A	11 days	N/A
Processing assumes one image					
Additional contiguous scenes in a single order will add a nominal number of days					

Table 8. Expected Delivery Times, by Product Type and Tasking Type.

5. QuickBird Product Levels

DigitalGlobe offers QuickBird Imagery Products at several product levels. As shown in Table 9, the product levels equate to different levels of processing and geolocational accuracy.

Product Level	Processing	Absolute Accuracy		Geographic Availability
		CE90%	RMSE	
Basic Imagery	Sensor Corrected (Raw)	23-meters*	14-meters*	Worldwide
Standard Imagery	Georectified	23-meters**	14-meters**	Worldwide
Ortho 1:25,000	Orthorectified	12.7-meters	7.7-meters	Worldwide
Ortho 1:12,000	Orthorectified	10.2-meters	6.2-meters	US only
Ortho 1:4,800	Orthorectified	4.1-meters	2.5-meters	US only
Custom Ortho	Orthorectified	variable***	variable***	Worldwide

*Attained using supplied Image Support Data files and a user supplied DEM, excluding sensor and viewing geometry and topographic displacement

**Excluding viewing geometry and topographic displacement

*** Accuracy of the Custom Ortho is determined by the accuracy and quality of customer supplied support data.

Table 9. QuickBird Imagery Products and Associated Accuracies.

All imagery is placed in the DigitalGlobe archive. Prior to being placed in the archive, DigitalGlobe assesses all imagery for quality, including Cloud Cover ratings, Image Quality, and the National Image Interpretability Rating Scales (NIIRS). Imagery that receives a Marginal or Poor image quality rating is automatically retasked. Imagery that is greater than 20% cloud cover will also be retasked. For area-based products, the cloud cover assessment is performed on your Order Polygon. For scene-based products, the cloud cover assessment is performed on the full scene.

Image Quality	
Cloud cover rating ranges	5%; 10%; 15%; 20%; 30%; 40%; 50%; 60%; 70%; 80%; 90%; 100%
Image quality rating ranges	Excellent; Good; Fair; Marginal; Poor; Unavailable
Image quality metadata	NIIRS rating (0 - 9)

Table 10. Image Quality for QuickBird Imagery Products.

5.1 Basic Imagery Products

Basic Imagery products are the least processed of the QuickBird Imagery Products and are designed for customers having advanced image processing capabilities. Basic Imagery, together with the supplied attitude, ephemeris, and camera model information, is suitable for advanced photogrammetric processing (i.e., orthorectification).

Processing: Basic Imagery products are radiometrically corrected and sensor corrected, but not geometrically corrected nor mapped to a cartographic projection and ellipsoid. Image resolution varies between 61-centimeters (at nadir) to 72-centimeters (25° off-nadir look angle) for black & white products, and 2.44-meters (at nadir) to 2.88-meters (25° off-nadir look angle) for multispectral imagery. The image is resampled to a coordinate system defined by the ideal Basic Imagery camera model. The resulting GSD varies over the entire product as a function of the attitude & ephemeris during the imaging process. Basic Imagery products are not available with pan-sharpening.

The radiometric corrections applied to this product include:

- Relative radiometric response between detectors – removes differences in imagery due to sensitivity variations between pixels
- Non-responsive detector fill – fills in null values on imagery due to detectors that are no longer collecting data
- Conversion for absolute radiometry – calibrates overall detector response from known radiometric signals

The sensor corrections account for:

- Internal detector geometry – combines the six digital chip assemblies into a virtual array
- Optical distortion – corrects image distortion caused by sensor optics
- Scan distortion – corrects for distortions caused by slew and scan rate
- Line-rate variations – corrects for variations in the panchromatic scan rate
- Registration of the multispectral bands – all multispectral bands line up with each other, but the panchromatic and multispectral bands are not registered

Each scene in a Basic Imagery order is processed individually, therefore, multi-scene Basic Imagery products are neither spatially nor spectrally mosaiced.

Accuracies: The Basic Imagery product is in the satellite frame of reference, is not tied to ground location, and is therefore a geometrically raw product with no implied accuracy. However, when the data are processed with the supplied refined Image Support Data (ISD) and a user-supplied Digital Elevation Model, a horizontal geolocational accuracy of 23-meter CE90%, excluding viewing geometry and topographic displacement may be achieved. Basic Imagery products may be processed with a supported commercial imaging software application, which utilize the ISD associated with the image. Many software packages offer two ways to orthorectify QuickBird imagery: the QuickBird Rigorous Sensor Model which uses the supplied attitude and ephemeris files or Rational Polynomial Coefficients (RPCs) which provide a mathematical mapping from satellite coordinates to image coordinates. When Basic Imagery is processed with commercial software packages using high quality DEMs (e.g., DTED Level 2) and sub-meter GCPs, internal DigitalGlobe testing has produced orthorectification accuracies of 2-5 meters RMSE with the QuickBird Rigorous Sensor Model and orthorectification accuracies of 3-6 meters RMSE with the RPC method.

Physical Structure: Basic Imagery products are delivered as one or more full scenes. Each panchromatic Basic Imagery scene is 27,424 rows by 27,552 columns after processing, while the multispectral Basic Imagery scene is 6856 rows by 6888 columns (see Figure 3, Panchromatic and Multispectral Basic Imagery Scene Characteristics). The Basic Image scene has an approximate area of 272 km^2 (16.5 km by 16.5 km) at nadir.

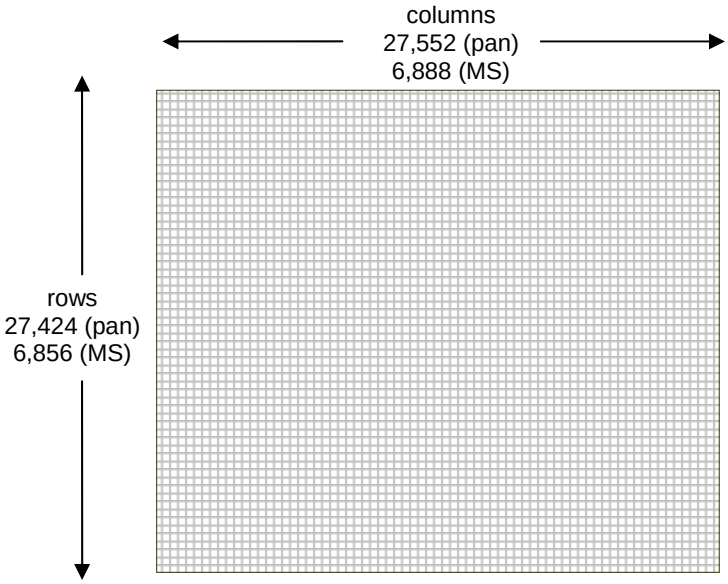

Figure 3. Panchromatic and Multispectral Basic Imagery Scene Characteristics.

As shown in Figure 4 , each order polygon that falls entirely within a single scene will result in a full Basic Imagery scene being delivered.

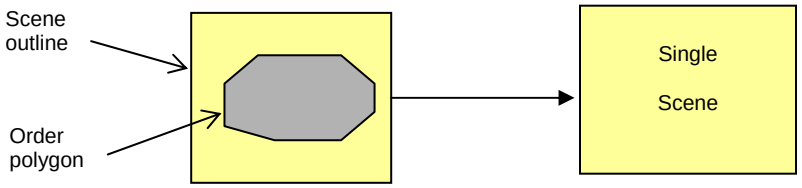

Figure 4. Final Product Structure for Sub-Scene Basic Imagery Products.

Figure 5, Final Product Structure for Multi-Scene Basic Imagery products, shows the final product structure for Basic Imagery products in which the order polygon intersects multiple scenes.

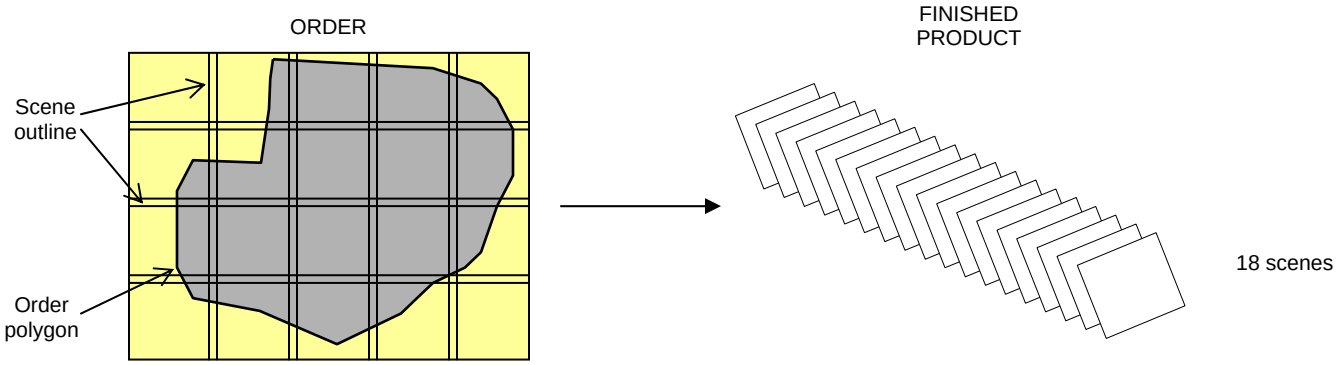

Figure 5. Final Product Structure for Multi-Scene Basic Imagery Products**.**

5.1.1 Specification Table for Basic Imagery Products

Table 11, Characteristics of Basic Imagery products, describes the processing specifications, product parameters, and delivered Image Support Data files for Basic Imagery products.

Physical Characteristics - Basic Imagery		Customer Selected
Minimum deliverable area	1 scene	
Maximum deliverable area	10,000 km^2 (approximately 6 x 7 scenes)	
Product Framing	Scene-based	
Final product physical structure	Scenes	
Pan scene dimensions (pixels col, row)	27,552 x 27,424	
Pan scene size (approximate at nadir)	16.5 km x 16.5 km	
MS scene dimensions (pixels col, row)	6,888 x 6,856	
MS scene size (approximate at nadir)	16.5 km x 16.5 km	
Processing Specifications		
Absolute geolocation accuracy (nadir)	Geometrically raw, supplied Image Support Data and user supplied DEM allows processing to 23-m CE90%, excluding viewing geometry and terrain displacement	
Additional geometric corrections applied	N/A	
Geolocation information applied	N/A	
Applied terrain information	N/A	
Spatial mosaicing applied	N/A	
Color balance applied	N/A	
Radiometric corrections	Relative radiometric response between detectors; non-responsive detector fill; conversion for absolute radiometry	
Sensor corrections	Internal detector geometry; optical distortion; scan distortion; line-rate variations; mis-registration of the multi-spectral bands	
Product Parameters		
Product Options	Black and White, MS, Bundle (Black and White & MS)	Yes
Number of bits/pixel deliverable image	8 or 16	Yes
Digital scaling method (applies to 8 bit only)	Linear with maximum value set to 255	
Resampling option	4x4 cubic convolution; 2x2 bilinear; Nearest neighbor; 8-pt sinc; MTF kernel	Yes
Output tile size options	N/A	
Output pixel spacing	Same as collected	
Map projections	N/A	
Ellipsoids and datums	N/A	
Output alignment	N/A	
Delivery Parameters		
Output product delivery media options	8mm; 4mm; DLT; DVD; ftp (pull)	Yes
Image data format options	NITF 2.0; NITF 2.1; GeoTIFF 1.0	Yes
Image Support Data		
ISD files supplied to customer	README file; image metadata file; ephemeris file; attitude file; geometric calibration file; RPC00B file; license text file; tile map file	
Spacecraft telemetry	Refined attitude/ephemeris (supplied with ISD)	

Table 11. Characteristics of Basic Imagery Products.

5.2 Standard Imagery Products

Standard Imagery products are suitable for users requiring modest absolute accuracy and/or large area coverage. Users of Standard Imagery products usually possess sufficient image processing tools and knowledge to manipulate and exploit the imagery for a wide variety of applications.

Processing: Standard Imagery products are radiometrically corrected, sensor corrected, geometrically corrected, and mapped to a cartographic projection. Standard Imagery products are available as black & white, color, or pan-sharpened with a 60-centimeter or 70-centimeter GSD, or multispectral with a 2.4-meter or 2.8-meter GSD. All Standard Imagery products have uniform pixel spacing throughout the entire product.

The radiometric corrections applied to this product include: relative radiometric response between detectors, non-responsive detector fill, and a conversion for absolute radiometry. The sensor corrections account for internal detector geometry, optical distortion, scan distortion, any line-rate variations, and registration of the panchromatic and multispectral bands. Geometric corrections remove spacecraft orbit position and attitude uncertainty, Earth rotation and curvature, and panoramic distortion.

Standard Imagery comes in two varieties:

Standard Imagery: Standard Imagery has a coarse DEM applied to it, which is used to normalize for topographic relief with respect to the reference ellipsoid. The degree of normalization is relatively small, so while this product has terrain corrections, it is not considered orthorectified.

Accuracies: Standard Imagery products have an average absolute geolocation accuracy of 23-meter CE90%, excluding any topographic displacement and off-nadir viewing angle. Ground location is derived from refined satellite attitude and ephemeris information without requiring the use of Ground Control Points (GCPs).

Ortho Ready Standard Imagery: Ortho Ready Standard Imagery has no topographic corrections, making it suitable for orthorectification. Ortho Ready Standard Imagery is projected to a constant base elevation, which is calculated as the average terrain elevation of the order polygon.

Accuracies: Ortho Ready Standard Imagery products have a delivered absolute geolocation accuracy of 23-meter CE90%, excluding any topographic displacement and off-nadir viewing angle. When processed using supplied RPCs, a high quality DEM (e.g. DTED Level 2), and submeter GCPs, accuracies in the range of 3 to 10 meters RMSE may be achieved.

With the exception of lack of terrain correction, Ortho Ready Standard Imagery products have all the same specifications as Standard Imagery products. All the specifications in this section apply to both Standard Imagery products and Ortho Ready Standard Imagery products. Please see section 5.3 for more detail and comparisons between Basic Imagery products, Standard Imagery products, and Ortho Ready Standard Imagery products.

If the order polygon crosses more than one scene, each scene will be processed individually. As the Standard Product is not mosaiced, one image file will be delivered for each scene the order polygon intersects.

Physical Structure: Standard Imagery products are area based and may be ordered by the square kilometer. Figure 6, Final Product Structure for Sub-Scene Standard and Orthorectified Imagery Products, shows the final product structure for order polygons that fall within a single scene for Standard Imagery products.

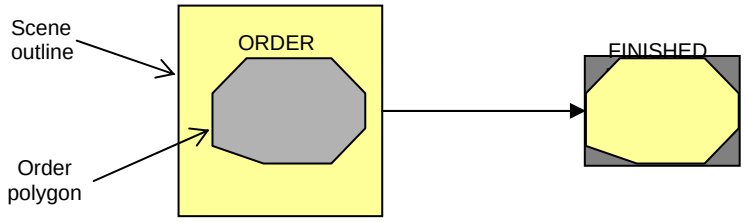

Figure 6. Product Structure for Sub-Scene Standard and Orthorectified Imagery Products.

Figure 7, Product Structure for Multi-Scene Standard and Orthorectified Imagery Products, shows the final product structure for a Standard Imagery product formed from multiple scenes.

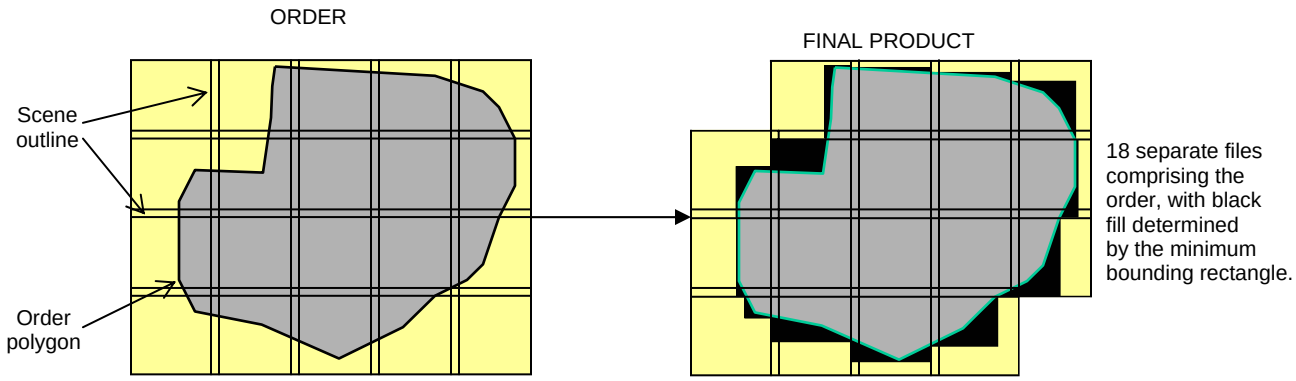

Figure 7. Product Structure for Multi-Scene Standard and Orthorectified Imagery Products.

Standard Imagery products are delivered as one image file for each scene the order polygon intersects. If the order polygon intersects more than one scene, the imagery in each scene will be delivered as separate files, will not be mosaiced together to form a single image, and will not be radiometrically balanced.

5.2.1 Specification Table for Standard Imagery Products

Table 12, Characteristics of Standard Imagery products, lists the processing specifications, product parameters, and delivered Image Support Data files for Standard Imagery products.

Physical Characteristics - Standard Imagery		Customer Selected
Minimum deliverable area	25km^2 (archive); 64 km^2 (new collection)	
Maximum deliverable area	10,000 km^2	
Product Framing	Area-based	
Final product physical structure	Blackfill to a MBR surrounding the ordered image pixels	
Pan scene dimensions (pixels col, row)	N/A	
Pan scene size (approximate at nadir)	N/A	
MS scene dimensions (pixels col, row)	N/A	
MS scene size (approximate at nadir)	N/A	
Processing Specifications		
Absolute geolocation accuracy (nadir)	23 m CE90% (excluding terrain distortion & viewing geometry)	
Additional geometric corrections applied	Spacecraft orbit position and attitude uncertainty; Earth rotation; Earth curvature; panoramic distortion; terrain elevation (coarse)	
Geolocation information applied	Ephemeris and attitude; rotation and alignment to map projection	
Spatial mosaicing applied	N/A	
Color balance applied	N/A	
Radiometric corrections	Relative radiometric response between detectors; non-responsive detector fill; conversion for absolute radiometry	
Sensor corrections	Internal detector geometry; optical distortion; scan distortion; any line-rate variations; mis-registration of the multi-spectral bands	
Terrain corrections	none (Ortho Ready Standard); coarse DEM (Standard)	Yes
Product Parameters		
Product Options	Black and White, MS, Bundle (Black and White & MS), Natural Color, Color Infrared, Pan-sharpened (4 band)	Yes
Number of bits/pixel deliverable image	8 or 16	Yes
Digital scaling method (applies to 8 bit only)	Linear with maximum value set to 255 (if highest DN is <= 255, no scaling is applied)	
Resampling option	4x4 cubic convolution; 2x2 bilinear; Nearest neighbor; 8-pt sinc; MTF kernel	Yes
Dynamic Range Adjustment (DRA) option	Color correction and contrast enhancement (8-bit only)	Yes
Output tile size options	None; 8k x 8k pixels; 14k x14k; 16k x 16k pixels	Yes
Output pixel spacing	60 or 70 centimeters for Black and White, Color, and Pan-sharpened; 2.4 or 2.8 meters for MS	Yes
Map projections	Listed in Table 14	Yes
Ellipsoids and datums	Listed in Table 14	Yes
Output alignment	Rotated to Map North up	
Delivery Parameters		
Output product delivery media options	8mm; 4mm; CD; DLT; DVD; ftp (pull)	Yes
Image data format options	NITF 2.0; NITF 2.1; GeoTIFF 1.0	Yes
Image Support Data		
ISD files supplied to customer	README file; image metadata file; RPC00B; license text file; tile map file	
Spacecraft telemetry	Refined attitude/ephemeris (used to create product)	

Table 12. Characteristics of Standard Imagery Products.

5.3 Comparison of Basic, Standard, and Ortho Ready Standard Imagery

Basic, Standard, and Ortho Ready Standard Imagery all have different attributes, making them appropriate for different uses. This section highlights some of the main differences between the products.

Basic Imagery: Basic Imagery allows orthorectification using the QuickBird Rigorous Sensor Model or RPCs. Results will be slightly better using the QuickBird Rigorous Sensor Model. Orthorectification must be done on a per scene basis.

Standard Imagery: Standard Imagery is most useful for applications requiring georeferenced imagery that are not terrain corrected. Standard Imagery has a coarse DEM applied to it, making it unsuitable for orthorectification.

Ortho Ready Standard Imagery: Ortho Ready Standard Imagery is a georeferenced product, designed for area-based orthorectification, using supplied RPCs. Achievable accuracies will be comparable to those attainable using Basic Imagery with RPCs. If orthorectification is not the goal, then Standard Imagery is recommended. Ortho Ready Standard Imagery is projected to the average base elevation of terrain covered by the order polygon. As such, it provides a close approximation of the order polygon on the ground. However, it could be off by several hundred meters, especially in areas of high relief, if the user does not apply terrain corrections.

5.4 Orthorectified Imagery Products

Orthorectified Imagery products are GIS-ready and are used as an image base map for a wide variety of applications. Orthorectified Imagery products are an ideal base for creating and revising mapping and GIS databases, or for registering existing feature layers. These products can also be used for change detection and other analytical applications that require a high degree of absolute accuracy.

Processing: Orthorectified Imagery products are radiometrically corrected, sensor corrected, geometrically corrected, orthorectified, and mapped to a cartographic projection and datum. Orthorectified Imagery products are available as black & white, color, or pan-sharpened, with a 60-centimeter or 70-centimeter resolution, or multispectral, with a 2.4-meter or 2.8-meter resolution. The radiometric corrections applied to this product include: relative radiometric response between detectors, non-responsive detector fill, and a conversion for absolute radiometry. The sensor corrections account for internal detector geometry, optical distortion, scan distortion, any line-rate variations, and registration of the multispectral bands. Geometric corrections remove spacecraft orbit position and attitude uncertainty, earth rotation and curvature, and panoramic distortion.

Orthorectified Imagery products require DEMs and GCPs to remove relief displacement and to place each pixel into its correct, map location. Before an order for an Orthorectified Imagery product is accepted, DigitalGlobe will determine whether it can obtain the appropriate support data to make the desired product. The accuracy of the DEMs and/or GCPs used to make each product depends on the scale of the Orthorectified Imagery product ordered. For Orthorectified Imagery products with stated accuracies (1:25,000, 1:12,000, and 1:4800), it is DigitalGlobe's responsibility to acquire the support data necessary to make the product.

DigitalGlobe also offers customers the opportunity to order Custom Orthorectified Imagery products. To create these products DigitalGlobe uses customer provided support data to orthorectify QuickBird Imagery. There is no stated accuracy associated with the Custom Orthorectified Imagery product because the quality and accuracy of the finished product is

directly dependent on the quality and accuracy of the support data. DEMs and GCPs are the most typical types of support data that customers provide to DigitalGlobe. Alternate forms of control, such as existing orthorectified data or high accuracy GIS data, may also be accepted. Please refer to *Specifications for Customer-Provided Support Data*, available from Customer Service, for detailed format requirements for support data.

Accuracies: Orthorectified products have an absolute geolocational accuracy, which varies depending on mapping scale (see Table 9, QuickBird Imagery Products and Associated Accuracies). Ground location is measured with refined satellite attitude and ephemeris information with Ground Control Points depending on final mapping scale.

Physical Structure: Orthorectified Imagery products are area-based and may be purchased by the square kilometer. The delivered area for Orthorectified Products is the order polygon, which is blackfilled to the Minimum Bounding Rectangle.

Figure 6, Product Structure for Sub-Scene Standard Imagery and Orthorectified Imagery products, shows the final product structure for order polygons that fall within a single scene for Orthorectified Imagery. Figure 7, Product Structure for Multi-Scene Standard and Orthorectified Imagery products, shows the final product structure for an Orthorectified product formed from multiple scenes.

5.4.1 Specification Table for Orthorectified Imagery Products

Table 13, Characteristics of Orthorectified Imagery products, lists the processing specifications, product parameters, and delivered Image Support Data files for Orthorectified Imagery products.

Physical Characteristics - Ortho Imagery		Customer Selected
Minimum deliverable area	100 km^2 for 1:12,000 and Custom products; 150km^2 for 1:25,000 products; 25km^2 for 1:4800 products	
Maximum deliverable area	5,000 km^2	
Product Framing	Area-based	
Final product physical structure	Blackfill to a MBR surrounding the ordered image pixels	
Pan scene dimensions (pixels col, row)	N/A	
Pan scene size (approximate at nadir)	N/A	
MS scene dimensions (pixels col, row)	N/A	
MS scene size (approximate at nadir)	N/A	
Processing Specifications		
Absolute geolocation accuracy (nadir)	See Table 9	
Additional geometric corrections applied	Spacecraft orbit position and attitude uncertainty; Earth rotation; Earth curvature; panoramic distortion; terrain elevation (fine)	
Geolocation information applied	Refined ephemeris and attitude; rotation; and alignment to map projection	
Spatial mosaicing applied	No	
Color balance applied	No	
Radiometric corrections	Relative radiometric response between detectors; non-responsive detector fill; conversion for absolute radiometry	
Sensor corrections	Internal detector geometry; optical distortion; scan distortion; any line-rate variations; mis-registration of the multispectral bands	
Product Parameters		
Product Options	Black and White, MS, Bundle (Black and White & MS), Natural Color, Color Infrared, Pan-sharpened (4 band)	Yes
Number of bits/pixel deliverable image	8 or 16	Yes
Digital scaling method (applies to 8 bit only)	Linear with maximum value set to 255 (if highest DN is <= 255, no scaling is applied)	
Resampling option	4x4 cubic convolution; 2x2 bilinear; Nearest neighbor; 8-pt sinc; MTF kernel	Yes
Dynamic Range Adjustment (DRA) option	Color correction and contrast enhancement (8-bit only)	Yes
Output tile size options	None; 8k x 8k pixels; 14k x14k; 16k x 16k pixels Product Units-customer specified (1"=400' ortho only)	Yes
Output pixel spacing	60 or 70 centimeters for Black and White, Color, and Pan-sharpened; 2.4 or 2.8 meters for MS	Yes
Map projections	Listed in Table 14	Yes
Ellipsoids and datums	Listed in Table 14	Yes
Output alignment options	Map north	
Delivery Parameters		
Output product delivery media options	8mm; 4mm; CD; DLT; DVD; ftp (pull)	Yes
Image data format options	NITF 2.0; NITF 2.1; GeoTIFF 1.0	Yes
Image Support Data		
ISD files supplied to customer	README file; image metadata file; RPC00B; license text file; tile map file	
Space craft telemetry	Refined attitude/ephemeris (used to create product)	

Table 13. Characteristics of Orthorectified Imagery Products.

5.5 Projections and Datums

DigitalGlobe supports the following map projections, ellipsoids, and datums:

Map Projections
Geographic (Lat/Long)
State Plane Coordinate System
UTM (default)

Ellipsoids and Datums
GDA 1994
GRS80
NAD27
NAD83
WGS84

Table 14. DigitalGlobe Supported Map Projections, Ellipsoids, and Datums.

6. QuickBird Imagery Product Options

Each of the QuickBird Imagery Product levels described in section 5 is available in a variety of product options. These product options use different spectral band combinations and imply differences in the pixel resolution of the final product. The QuickBird sensor collects five image bands. Table 15 describes the spectral bands that are used to produce each product option.

Product Option	Black & White	Blue	Green	Red	Near - IR
	450-900nm	450-520nm	520-600nm	630-690nm	760-900nm
Black & White (panchromatic)	XX				
Multispectral (MS)		XX	XX	XX	XX
Bundle (Pan & MS)	XX	XX	XX	XX	XX
Natural Color (3-band)	XX	XX	XX	XX	
Color Infrared (3-band)	XX		XX	XX	XX
Pan-sharpened (4-band)	XX	XX	XX	XX	XX

Table 15. The Relationship between Spectral Bands and Product Options.

6.1 Black & White (Panchromatic) Products

DigitalGlobe QuickBird black & white products enable superior visual analysis based on 61-centimeter resolution (at nadir) and 11-bit collected information depth. The panchromatic sensor collects information at the visible and near-infrared wavelengths and has a bandwidth of 450 – 900 nm.

The output Ground Sample Distance of black & white products varies with product level. Basic Imagery products are delivered at the GSD in which the data were collected (ranging from 61 cm at nadir to 72 cm at 25° off-nadir). For Standard and Orthorectified Imagery products the customer has the choice to resample to either a 60 cm or 70 cm GSD.

6.2 Multispectral Products

DigitalGlobe QuickBird multispectral products provide four discrete non-overlapping spectral bands and 11-bit collected information depth. The multispectral products cover the visible and near-infrared wavelengths in four bands. All four bands are delivered as one file when this product is ordered by the customer.

The output Ground Sample Distance of the Multispectral Product varies with product level. Basic Imagery products are delivered at the GSD in which the data were collected (ranging from 2.44 m to 2.88 m). For Standard and Orthorectified Imagery products the customer has the choice to resample to either a 2.4 m or 2.8 m GSD.

6.3 Bundle (Black & White and Multispectral) Products

The QuickBird satellite collects both multispectral and black & white (panchromatic) imagery concurrently, therefore customers have the option to order both black & white and multispectral products for the same area. When a customer selects the 'Bundle' option, the products will be processed to the same product level, the same product parameters, and delivered as two distinct products (one containing black & white imagery and one containing all four multispectral bands) with two sets of associated Image Support Data (ISD) files.

6.4 Color Products (3-band)

QuickBird Imagery Products are available in two 3-band color product options:

- Natural Color (using blue, green, and red bands)
- Color Infrared (using green, red, and infrared bands)

These pan-sharpened products combine the visual information of three multispectral bands, with the spatial information of the black & white band. Color Products are available as product options for Standard and Orthorectified Imagery, but not for Basic Imagery. Customers may choose between a 60 cm or 70 cm GSD. Currently, Color products are resampled using only the 4x4 cubic convolution or the 8 pt sinc methods.

6.5 Pan-sharpened Products (4-band)

QuickBird Imagery Products are also available in a 4-band pan-sharpened product option. These products combine the visual information of four multispectral bands (blue, green, red, and infrared), with the spatial information of the panchromatic band. Pan-sharpened Products are available as product options for Standard and Orthorectified Imagery, but not for Basic Imagery. Customers may choose between a 60 cm or 70 cm GSD. Currently, Pan-sharpened products are resampled using only the 4x4 cubic convolution or the 8 pt sinc methods.

Figure 8. 4-band Pan-sharpened Product, Natural Color on the Left and Color Infrared on the Right.

6.6 Dynamic Range Adjustment Option

Dynamic Range Adjustment (DRA) is a visual enhancement applied to QuickBird imagery. The DRA enhancement consists of two parts; color correction and contrast enhancement. This enhancement is strictly visual and does not affect the geographic location of the pixels. This product is recommended for users who don't have the tools to apply visual enhancements to QuickBird imagery. This product is not recommended for those users intending to perform scientific analysis or spectral classification using QuickBird imagery data. This option is available for 8 bit QuickBird Standard and Orthorectified Imagery Products.

7. Product Naming

DigitalGlobe's product naming provides key information about an image, including acquisition time and date, imaging bands, product level, and product identification. Specifically, the product name is comprised of:

<product file name> = <acquisition time>-<product info>-<product id>.<format extension>
Product File Name = 08SEP01123645-P2AS-000000000987_01_P001.TIF

<acquisition time> = 08SEP01 (date) 123645 (time). UTC time
<product info> = P (pan) 2A (standard imagery) S (single/sub-scene) _R1C1 (tile identifier)
<product id> = 000000000987 (order item id) _01 (increment) _P001 (offset)
<format extension> = TIF (GeoTIFF)

Additional parameters for the 'product info' parameter of the product naming convention are listed in Table 16, Product Naming Parameters.

Image Band	Product Level	Image Type	Tile Identifier (if product is tiled)	Image Format
P = Panchromatic	1B = Basic	S = Single/Sub-scene	R1C1 = row1,column1	TIF = GeoTIFF 1.0
M = Multispectral	2A = Standard	M = Mosaic	R1C2 = row1,column2	NTF = NITF 2.0, 2.1
S = Pan Sharpened	3B = Ortho (1:25,000)		R2C1 = row2,column1	
	3D = Ortho (1:12,000)		R2C2 = row2,column2	
	3G = Ortho (1:4800)		etc.	
	3X = Custom Ortho			

Table 16. Product Naming Parameters.

8. Licensing

DigitalGlobe offers flexible licensing options to meet your needs. Commercial Licensing options include:

License Type	Notes
Single Organization	Multiple users solely within one corporation or government agency at multiple locations within a single country. - One corporation (but not subsidiaries). - One county government (all departments). - One federal agency (below cabinet level in the U.S.). - One state or provincial government agency. - One city government (all departments).
Multiple Organizations	Licensee(s) must meet the conditions outlined in one of the following statements: - Includes up to a total of 10 non-federal government agencies or single commercial organizations (not including subsidiaries), or combinations of both, as long as the entities are identified up front at the time of order and are in the same country. - Includes up to two distinct levels of government entities (e.g. city and county, state and county, or one federal agency (below cabinet level in the U.S.) and state, or similar combinations outside the U.S.). - Includes single commercial organizations with up to 10 subsidiaries in multiple locations in a single country. - Includes up to 2 federal agencies (below cabinet level in the U.S.)
Civil Government	Multiple users within civil government or users engaged in a joint project with civil government. All users must be within a single country.
Single Organization Educational License	Multiple users within a single educational organization solely within a single country identified at the time of ordering. Available to accredited college, university, research institution, or school district.

Table 17. Commercial Imagery Licenses and Definitions.

Customers may select the license type at time of order. For Multiple Organization licenses, customers must identify the organizations at time of order.

9. Image Support Data

All QuickBird Imagery Products are delivered with a set of metadata files called Image Support Data (ISD). This section describes Version P of the ISD specification. The number and types of files delivered varies depending on the product ordered. The Image Support Data files can be viewed as a collection point for all useful ancillary data. Table 18 lists the Image Support Data files that are delivered with each product type.

File Name	Extension	Basic Imagery	Standard Imagery	Orthorectified Imagery
Top Level Readme	.txt	XX	XX	XX
Product Readme File	.txt	XX	XX	XX
License File	.txt	XX	XX	XX
Image Metadata File	.imd	XX	XX	XX
Shapefiles	.shx, .shp, .dbf	XX	XX	XX
Image Layout JPEG	.jpg	XX	XX	XX
Product Browse File	browse.jpg	XX	XX	XX
Tile Map File	.til		XX	XX
Attitude File	.att	XX		
Ephemeris File	.eph	XX		
Geometric Calibration File	.geo	XX		
RPC00B File	.rpb	XX	XX	
Manifest File	.man	FTP only	FTP only	FTP only
End of Transfer File	.eot	FTP only	FTP only	FTP only

Table 18. Image Support Data (ISD) Files Delivered with Product Type.

9.1 ISD File Description

Top Level Readme File – This file contains a list of names of the product files and the ISD files, along with copyright information for the entire product delivery.

Product Readme File – The README file provides copyright information and the names of the ISD files for a single product within a delivery.

License File – The license file contains the text of the selected license.

Image Metadata File – The image metadata file describes key attributes about the image product, including product level, corner coordinates, and projection information, and time of acquisition.

Shapefiles – These files spatially illustrate the product layout in a similar way to the image layout JPEG except in shapefile format. The files represent the order polygon, scene boundaries, product boundaries, and tile boundaries.

Image Layout JPEG – This file spatially illustrates how the delivery order is spread out across the media including product and order polygon extents. The map includes volume and product labels. The file is in the standard jpeg format. Media volume information is not included for electronic deliveries.

Product Browse File – The product browse file is a JPEG compressed browse image of the delivered product.

Tile Map – The tile map file assists the customer in determining what tile to ingest to look at a specific part of the order polygon.

Attitude File – The attitude includes the time of first data point, the number of points, and the interval between the points and attitude information.

Ephemeris File – The ephemeris file includes the time of first data point, the number of points, and the interval between the points and ephemeris information.

Geometric Calibration File – The geometric calibration file contains the standard photogrammetric parameters of a virtual camera that models the corresponding QuickBird camera and optical system for Basic Imagery products.

RPC00B File – The RPC00B file contains the RPC information, which can be used to rectify the image. This is a mathematical mapping from object space coordinates to image space coordinates.

Manifest File – This manifest file is included with electronic (FTP) deliveries, only. The file contains the directory listing of the files delivered with the product

End of Transfer File – The end of transfer file is included with electronic (FTP) deliveries, only. The appearance of this file on the FTP site indicates that DigitalGlobe has completed transferring all product files. It is a zero length file.

9.2 File Layout

This section describes the structure by which the ISD files are organized for delivery. Figure 9 diagrams the layout as it applies to delivery of imagery and ISD files for all media types.

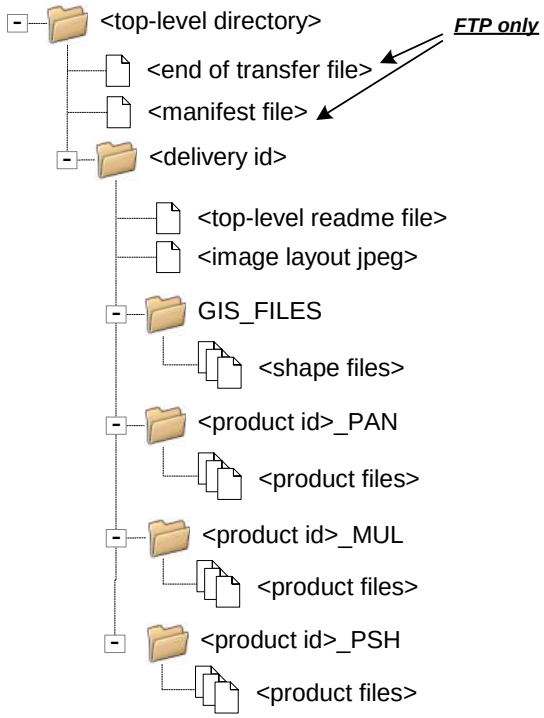

Figure 9. File Layout diagram

9.3 ISD File Format

ISD files are written in the Parameter Value Language (PVL). Each record consists of a variable length parameter name and a parameter value, in the form parameterName = value followed by a semi-colon. The value can be an integer (decimal, binary, octal, or hexadecimal), a floating point number, a character string, a UTC time, a set, or a list. The format for UTC time is YYYY-MM-DDThh:mm:ss.dddddddZ. Character strings values can be enclosed in quotation marks, although the quotation marks are not required if the string contains no special characters or whitespace. Sets are delimited by { }, and lists are delimited by ( ). Nested sets and lists are allowed. Comments in the file begin with a slash-asterisk /* and end with an asterisk-slash */.

Named groups begin with BEGIN_GROUP = GROUPNAME and end with END_GROUP = GROUPNAME. Nested groups are allowed. The end of a PVL module is indicated by the keyword END, followed by a semi-colon.

See sections 9.6.1, 9.6.2, and 9.6.3 for examples of the file structure.

9.4 Top Level Readme File

This file contains a list of names of the product files and the ISD files, along with copyright information for the entire product delivery. There is one Top Level README file delivered with each delivery, and it describes all of the files for all of the products delivered within that delivery. The Top Level README File is named for the 12 digit DigitalGlobe Order Item number and the 2 digit delivery increment, for example: 000000077583_01.TXT.

Top Level Readme File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
version	Version of the ISD.		
copyrightText	Copyright and restricted use text.		
mediaCreationDate	Time of media creation, in UTC.		
orderNumber	12 digit DigitalGlobe Order Item number, underscore, and 2 digit delivery increment.		
fileList	A list of all files in the delivery including path directories.		
areaDesc	Customer supplied description of order. 'Null' of no information supplied by the customer.		
DGOderNo	DigitalGlobe Order Number.		
DGOrderItemNo	12 digit DigitalGlobe Order Item Number.		
custOrderNo	Customer supplied order number. 'Null' if no information supplied by the customer.		
custOrderItemNo	Customer supplied order item number. 'Null' if no information supplied by the customer.		
collectionStart	Date, in UTC, of first image acquisition.		
collectionStop	Date, in UTC, of final image acquisition.		
countryCode	Two letter country code of center point of order polygon.		
productType	Product type of order:	Basic 1A Basic Mini Basic Basic Stereo Standard OR Standard Ortho, 50000 Ortho, 25000 Ortho, 24000 Ortho, 12000 Ortho, 10000	

		Ortho, 5000 Ortho, 4800 Ortho, custom	
cloudCover	Estimate of the max cloud-covered fraction of the image.	0.0 to 1.0 -999	Not applicable for Metadata Only -999 if not assessed
imageQuality	Textual description of image quality.	Excellent Good Fair Marginal Poor Unavailable	Not applicable for Metadata Only
NWLat	Latitude of NW corner of order polygon.	8 decimal places	
NWLong	Longitude of NW corner of order polygon.	8 decimal places	
SELat	Latitude of SE corner of order polygon.	8 decimal places	
SELong	Longitude of SE corner of order polygon.	8 decimal places	

Table 19. Top Level Readme File

9.5 Product Readme File

This file contains a list of names of the product files and the ISD files that are included in a particular delivery. The group of file name fields is repeated for each image product in the delivery. When more than one product is contained in a delivery, the README file is contained in each subdirectory to describe that product and an additional README.TXT is inserted at the main directory which describes all the lower directories.

README File		
FIELD	**DESCRIPTION**	**CONDITIONS**
copyrightText	Copyright and restricted use text., as follows: "©2003 EarthWatch Incorporated, DBA DigitalGlobe Longmont CO USA 80501-6700 EarthWatch, the EarthWatch and Digital Globe logos are trademarks of EarthWatch, Incorporated. The use and/or dissemination of this data and/or of any product in any way derived there from are restricted. Unauthorized use and/or dissemination is prohibited."	
version	Version of the ISD (MO)	
intro	Introduction. General textual information about the product and file contents.	
The following group is repeated for p = 1,…,N, i.e., for each of the N products in the delivery		
BEGIN_GROUP = PRODUCT_p		
LicenseTxtFilename	Licensing text file name	
IMFFilename	Image metadata file name	
ephemFilename	Ephemeris file name	
attFilename	Attitude file name	
tilFilename	Tile map file name	
geoCalFilename	Geometric calibration file name	
RPC00Bfilename	RPC00B file name	
END_GROUP = PRODUCT_p		
END;		

Table 20. ISD README File.

9.6 Image Metadata File

This file specifies the basic characteristics of an image. The following table describes the fields that you will see in the Image Metadata File. Note that these fields are divided into three sections with the following kinds of information:

1. Information that should be present for all products.
2. Information about images (Basic Imagery, Standard Imagery products). Each image in this category corresponds to a single imaging event.
3. Information about cartographic products in a map projection (all Standard Imagery and Orthorectified Imagery products).

Image Metadata File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
version	Version of the ISD		
generationTime	Time of file generation, in UTC.		
productOrderId	Order Item ID of product		Optional if product does not originate from DG or co-producer
imageDescriptor	This is a combination of product name and product level		Level 1 name = Basic Level 2 name = Standard Level 2 name = ORStandard Level 3 name = Orthorectified
productScale	This is the NMAS mapping scale of the Orthorectified Product	1:25,000 1:12,000 1:4,800 Custom Unavailable	Orthorectified Imagery Only
productAccuracy	The RMSE (in meters CE90%/1.6449) of the Orthorectified Product	12.707.72 10.166.18 4.06 Unavailable	Orthorectified Imagery Only
bandId	Identifies the spectral band. "P" = Panchromatic, "Multi" = all Multi-spectral bands (Blue + Green + Red + Near-IR + Red + Green + Blue), "RGB" = Red + Green + Blue, "NRG" = Near-IR + Red + Green, "BGRN" = Blue + Green + Red + Near-IR. Both RGB and NRG are pan-sharpened color images, stored at the panchromatic spatial resolution.	P Multi RGB NRG BGRN	
panSharpenAlgorithm	Identifies the algorithm used to create pan sharpened products. HIS = Hue, Intensity, Saturation algorithm. PCA = Principal Component Analysis algorithm, DG = DigitalGlobe algorithm, UNB = University of New Brunswick algorithm.	HIS PCA DG UNB None	
numRows	Number of rows.		
numColumns	Number of columns.		
productLevel	Product level that indicates the radiometric and geometric corrections.	LV1B, LV2A, LV3B, LV3D, LV3G, LV3X	
radiometricLevel	Options for radiometric correction.	Corrected	
radiometricEnhancement	Option for Contrast Enhancement	DRA	Standard and Ortho

Image Metadata File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
		Off	Imagery only
bitsPerPixel	The number of bits per pixel in the product image files. This value will be either 8 or 16, depending on the product ordered. Note that this is the number of bits stored in the image file for each pixel value, not the number of significant bits which define the pixel brightness value (ie, for a product which is delivered as 16 bits per pixel, only 11 bits define the brightness value of each pixel).	8, 16	
The following group is repeated for each spectral band in the delivered image product. The index b in the group name is one of (P,N,R,G,B) to differentiate the band group names			
BEGIN_GROUP = BAND_b			
ULLon ULLat ULHAE	Geodetic coordinates of the upper left pixel of the image. ULLon and ULLat are in degrees, ULHAE (height above the WGS 84 ellipsoid) is in meters.	ULLon = 8 decimal places ULLat = 8 decimal places ULHAE = 2 decimal places	
URLon URLat URHAE	Geodetic coordinates of the upper right pixel of the image. URLon and URLat are in degrees, URHAE (height above the WGS 84 ellipsoid) is in meters.	ULLon = 8 decimal places ULLat = 8 decimal places ULHAE = 2 decimal places	
LRLon LRLat LRHAE	Geodetic coordinates of the lower right pixel of the image. LRLon and LRLat are in degrees, LRHAE (height above the WGS 84 ellipsoid) is in meters.	ULLon = 8 decimal places ULLat = 8 decimal places ULHAE = 2 decimal places	
LLLon LLLat LLHAE	Geodetic coordinates of the lower left pixel of the image. LLLon and LLLat are in degrees, LLHAE (height above the WGS 84 ellipsoid) is in meters.	ULLon = 8 decimal places ULLat = 8 decimal places ULHAE = 2 decimal places	
absCalFactor	The conversion factor, K_{nTDI}, that converts the relative radiance values in an image file into corresponding absolute radiance, measured in watts/sq m/ster. (This is calibrated 6000 °K blackbody radiance, integrated over the appropriate spectral window)		-999 = "None" to be u when radiometricEnhancement "DRA"
END_GROUP = BAND_b			
rowUncertainty colUncertainty	Position uncertainty of the corner coordinates in line and pixel directions, in meters. These are 3 sigma, one dimensional values.		
outputFormat	External product image format.	GeoTIFF NITF	
The following group is repeated for each n = 1,…,numImagesInProduct, i.e., for all images used to create the image product. For single image products (Metadata, LV1A, LV1B, LV2A, Stereo 1A, Stereo 1B) there is one .IMD file per image or strip, so the group will appear only once. For multiple image products (LV3A, LV3B, LV3C, LV3D, LV3E, LV3F, LV3G, LV3X), the following group will be repeated for each image in the image product. The index "n" in the group name is a sequential number of the image used to produce the product (1,2,3,…,n) to differentiate the image group names.			

Image Metadata File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
BEGIN_GROUP = SINGLE_IMAGE_PRODUCT			Only for single image products (Basic and Standard Imagery)
satId	Satellite Id.	QB02	
CatId	DigitalGlobe catalog Id for the raw data used in this product		
SceneID	Identifier for the scene within the strip referenced by this product		
TLCTime	Absolute time of the first time-tagged line count record, in UTC.		Only for Basic Imagery products
numTLC	Number of time-tagged line count records in the TLCList.		Only for Basic Imagery products
TLCList	List of time-tagged line count (TLC) records. Each TLC record consists of 1. lineNumber (I) 2. timeOffset (F) lineNumber is the image line number for a line in the snap. This number will be negative if the TLC record precedes the snap. timeOffset is the recorded time tag for this line, in seconds after TLCTime.		Only for Basic Imagery products
firstLineTime	Exposure time for the first line in the snap, in UTC		Only for Basic Imagery products
avgLineRate	Average number of image lines exposed per second	avgLineRate = 2 decimal places	Only for Basic Imagery products
exposureDuration	Duration of the exposure interval for each line, in seconds.		Only for Basic Imagery products
collectedRrowGSD	Original, collected GSD of the product in the row direction, in meters. The Pan GSD is used for Panchromatic and Pan sharpened products, the MS GSD is used for MS products.Mean ground sample distance in the row direction, in meters.		
collectedCcolGSD	Original, collected GSD of the product in the column direction, in meters. The Pan GSD is used for Panchromatic and Pan sharpened products, the MS GSD is used for MS products.Mean ground sample distance in the column direction, in meters.		
meanCollectedGSD	Mean GSD of the original, collected row and column GSD, in meters. The Pan GSD is used for Panchromatic and Pan sharpened products, the MS GSD is used for MS products.		
rowUncertainty colUncertainty	Position uncertainty of the corner coordinates in line and pixel directions, in meters. These are 3 sigma, one dimensional values.		
sunAz	Azimuth angle of the sun measured from north clockwise, in degrees. This is measured from the scene center, corresponding to the center pixel of the image.	0.0 to 360.0	
sunEl	Elevation angle of the sun from horizontal, in degrees. This is measured from the scene center, corresponding to the center pixel of the image.	-90.0 to +90.0	

Image Metadata File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
satAz	Azimuth angle of the satellite with respect to the center of the image, in degrees.	0.0 to 360.0	
satEl	Elevation angle of the satellite with respect to the center of the image, in degrees.	-90.0 to +90.0	
inTrackViewAngle	The dihedral angle measured at the spacecraft from the nominal spacecraft YZ plane to the plane that contains the ground projection of image center and the spacecraft Y axis, in degrees. A positive angle indicates the sensor is looking forward.	-90.0 to +90.0	
crossTrackViewAngle	The dihedral angle measured at the spacecraft from the nominal spacecraft XZ plane to the plane that contains the ground projection of the image center and the spacecraft X axis, in degrees A positive angle indicates the sensor is looking to the right.	-90.0 to +90.0	
offNadirViewAngle	The spacecraft elevation angle measured from nadir to the image center as seen from the spacecraft		
cloudCover	Estimate of the max cloud-covered fraction of the image. 1.0 corresponds to a cloud cover of 100%. Note that this cloud cover percentage refers to the entire scene and not necessarily the cloud cover percentage within the customer's order polygon.	0.0 to 1.0 -999	-999 if not assessed
PNIIRS	Predicted image quality on the National Imagery Interpretability Rating Scale (NIIRS), as computed by the General Image Quality Equation (GIQE).	0.0 to 9.0	
imageQuality	Textual description of image quality.	Excellent Good Fair Poor Marginal	
resamplingKernel	Method used to resample the image. "NULL"=no resampling kernel, "NN"=nearest neighbor, "BL"=bilinear,"CC"=cubic convolution, "DS8"=8 point sinc, "MTF" = MTF kernel	NULL NN BL CC DS8 MTF	Only for Basic Imagery products
TDILevel	Level of the time-delayed integration, as commanded to the spacecraft.	10,13,18,24,32	Panchromatic only
positionKnowledgeSrc	Source of knowledge of the satellite position. "I" = Initial, from spacecraft telemetry, "R" = Refined.	I R	
attitudeKnowledgeSrc	Source of knowledge of the satellite attitude. "I" = Initial, from spacecraft telemetry, "R" = Refined.	I R	
revNumber	Orbit revolution number at the time of exposure.		
END_GROUP = SINGLE_IMAGE_nPRODUCT	Only for single image products (Basic and Standard Imagery)		
BEGIN_GROUP = MAP_PROJECTED_PRODUCT			Only for map projected products (Standard and Orthorectified Imagery)

Image Metadata File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
earliestAcqTime			Acquisition time (UTC) of the first line of the earliest image contained in the product
latestAcqTime	Acquisition time (UTC) of the first line of the latest image contained in the product		For a single image product this value will be the same as earliestAcqTime
collectedGSD	Original, collected GSD of product prior to resampling	As collected, 2 decimal places	
datumName	Name of product datum. GDA = GDA 1994 NAR = NAD83 NAS = NAD27 RF = GRS80 WE = WGS84	GDA NAR NAS RF WE	
semiMajorAxis	Length of semi-major axis of the datum ellipsoid, in meters.	semiMajorAxis = 4 decimal places	
inverseFlattening	Inverse flattening of the datum ellipsoid, 1/f. Some useful relationships between flattening (f), semi-major axis (a), semi-minor axis (b), and eccentricity squared (e^2) are: $f = (a - b) / a$ $e^2 = (a^2 - b^2) / a^2$ $= 2f - f^2$ $b = a (1 - f)$	inverseFlattening = 9 decimal places	
datumOffset	X, Y, Z offset of the center of the datum ellipsoid relative to the origin of the WGS 84 system, in meters.		
mapProjName	Name of product map projection.	Geographic (Lat/Long) State Plane Coordinates UTM	
mapProjCode	Integer code for the map projection that was used.		
mapZone	Zone used for the map projection.		Only for UTM and State Plane projections
mapHemi	Code indicating the hemisphere used for the map projection.	N S	Only for UTM projection
mapProjParam	A list of up to 15 parameters that describe the particular map projection. The meaning of each parameter depends on the map projection selected in mapProjCode. Note: all latitude and longitude values are in decimal degrees, not degrees-minute-seconds.	mapProjParam = 9 decimal places	
productUnits	Units of projected product	DD = Decimal Degrees M = Meters USF = US Survey Feet	
originX	Easting of the center of the upper left pixel of the image, in productUnits.	originX = 8 decimal places	
originY	Northing of the center of the upper left pixel of the image, in productUnits.	originY = 8 decimal places	
orientationAngle	Azimuth angle measured clockwise from map north to the “up” direction at the center of the image, in degrees. This is a	0 to 360.0 orientationAngle =	

Image Metadata File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
	rotation between raster image and the map coordinate systems.	1 decimal places	
colSpacing	GSD of the image in the column direction, in productUnits	colSpacing = 2 decimal places for non-geographic projected products colSpacing = scientific notation for geographic projected products	
rowSpacing	GSD of the image in the row direction, in productUnits.	rowSpacing = 2 decimal places for non-geographic projected products rowSpacing = scientific notation for geographic projected products	
edgeMatch	Indication of the use of edge matching for orthomosaic products.		Ortho products only
colorBalance	Indication of the use of color balance for ortho mosaic products.		Ortho products only
ULX ULY ULH	Easting, northing, and height above the ellipsoid of the upper left pixel of the image in the specified datum and map projection, in productUnits. ULH in meters.	ULX = 8 decimal places ULY = 8 decimal places ULH = 2 decimal places	
URX URY URH	Easting, northing, and height above the ellipsoid of the upper right pixel of the image in the specified datum and map projection, in productUnits. ULH in meters.	URX = 8 decimal places URY = 8 decimal places URH = 2 decimal places	
LRX LRY LRH	Easting, northing, and height above the ellipsoid of the lower right pixel of the image in the specified datum and map projection, in productUnits. ULH in meters.	LRX = 8 decimal places LRY = 8 decimal places LRH = 2 decimal places	
LLX LLY LLH	Easting, northing, and height above the ellipsoid of the lower left pixel of the image in the specified datum and map projection, in productUnits. ULH in meters.	LLX = 8 decimal places LLY = 8 decimal places LLH = 2 decimal places	
DEMCorrection	Level of the DEM used for the terrain correction.	"none" "Base Elevation" "Coarse DEM" "Fine DEM"	
terrainHAE	The constant value of the height above the ellipsoid that was used for the terrain correction, in meters.		Only when DEMCorrection = "Base Elevation".
numGCP	Number of ground control points used to create this product.		
END_GROUP = MAP_PROJECTED_PRODUCT			
END;			

Table 21. ISD Image Metadata File.

9.6.1 Image Metadata File – Basic Imagery

This section contains a complete example of an Image Metadata File for Basic Imagery.

```
version = "P";
generationTime = 2003-11-15T07:45:53.000000Z;
productOrderId = "000009200303_01_P001";
imageDescriptor = "Basic1B";
bandId = "P";
panSharpenAlgorithm = "None";
numRows = 28656;
numColumns = 27552;
productLevel = "LV1B";
radiometricLevel = "Corrected";
bitsPerPixel = 8;
compressionType = "None";
BEGIN_GROUP = BAND_P
      ULLon =   -0.00286611;
      ULLat =   52.27526140;
      ULHAE =    77.94;
      URLon =    0.24511973;
      URLat =   52.27399754;
      URHAE =    88.14;
      LRLon =    0.24261960;
      LRLat =   52.11460981;
      LRHAE =   114.64;
      LLLon =   -0.00491068;
      LLLat =   52.11592135;
      LLHAE =    93.48;
      absCalFactor = 3.427412e-01;
END_GROUP = BAND_P;
outputFormat = "GeoTIFF";
BEGIN_GROUP = IMAGE_1
      satId = "QB02";
      CatId = "10100100003C5301";
      SceneID = "1";
      TLCTime = 2002-03-29T11:06:00.037029Z;
      numTLC = 2;
      TLCList = (
      (0,  0.000000),
      (28656,  4.153043)      );
      firstLineTime = 2002-03-29T11:06:00.037029Z;
      avgLineRate = 6900.00;
      exposureDuration = 0.0026087;
      collectedRowGSD =   0.618;
      collectedColGSD =   0.615;
      meanCollectedGSD =   0.616;
      rowUncertainty =   40.45;
      colUncertainty =   33.33;
      sunAz = 160.9;
      sunEl =  39.9;
      satAz = 180.1;
      satEl =  85.5;
      inTrackViewAngle =  -3.9;
      crossTrackViewAngle =   0.8;
      offNadirViewAngle =   3.9;
      autoCloudCover =   0.0;
      manualCloudCover =   0.0;
      PNIIRS = 4.5;
```

```
      imageQuality = "Excellent";
      resamplingKernel = "DS8";
      TDILevel = 18;
      positionKnowledgeSrc = "R";
      attitudeKnowledgeSrc = "R";
      revNumber = 2487;
END_GROUP = IMAGE_1;
END;
```

9.6.2 Image Metadata File – Standard Imagery

This section contains a complete example of an Image Metadata File for Standard Imagery.

```
version = "P";
generationTime = 2003-12-15T23:03:44.000000Z;
productOrderId = "000000000011_01_P001";
imageDescriptor = "Standard2A";
bandId = "Multi";
panSharpenAlgorithm = "None";
numRows = 3067;
numColumns = 2982;
productLevel = "LV2A";
radiometricLevel = "Corrected";
radiometricEnhancement = "DRA";
bitsPerPixel = 8;
compressionType = "None";
BEGIN_GROUP = BAND_B
      ULLon =  -22.72462266;
      ULLat =   64.02699553;
      ULHAE =    66.00;
      URLon =  -22.55387310;
      URLat =   64.02892186;
      URHAE =    66.03;
      LRLon =  -22.54960306;
      LRLat =   63.95190983;
      LRHAE =    90.70;
      LLLon =  -22.71988393;
      LLLat =   63.94999003;
      LLHAE =    71.04;
      absCalFactor = -9.990000e+02;
END_GROUP = BAND_B;
BEGIN_GROUP = BAND_G
      ULLon =  -22.72462266;
      ULLat =   64.02699553;
      ULHAE =    66.00;
      URLon =  -22.55387310;
      URLat =   64.02892186;
      URHAE =    66.03;
      LRLon =  -22.54960306;
      LRLat =   63.95190983;
      LRHAE =    90.70;
      LLLon =  -22.71988393;
      LLLat =   63.94999003;
      LLHAE =    71.04;
      absCalFactor = -9.990000e+02;
END_GROUP = BAND_G;
BEGIN_GROUP = BAND_R
      ULLon =  -22.72462266;
```

```
      ULLat =   64.02699553;
      ULHAE =    66.00;
      URLon =  -22.55387310;
      URLat =   64.02892186;
      URHAE =    66.03;
      LRLon =  -22.54960306;
      LRLat =   63.95190983;
      LRHAE =    90.70;
      LLLon =  -22.71988393;
      LLLat =   63.94999003;
      LLHAE =    71.04;
      absCalFactor = -9.990000e+02;
END_GROUP = BAND_R;
BEGIN_GROUP = BAND_N
      ULLon =  -22.72462266;
      ULLat =   64.02699553;
      ULHAE =    66.00;
      URLon =  -22.55387310;
      URLat =   64.02892186;
      URHAE =    66.03;
      LRLon =  -22.54960306;
      LRLat =   63.95190983;
      LRHAE =    90.70;
      LLLon =  -22.71988393;
      LLLat =   63.94999003;
      LLHAE =    71.04;
      absCalFactor = -9.990000e+02;
END_GROUP = BAND_N;
outputFormat = "GeoTIFF";
BEGIN_GROUP = IMAGE_1
      satId = "QB02";
      CatId = "1010010001ABDC01";
      SceneID = "1";
      collectedRowGSD =   2.517;
      collectedColGSD =   2.563;
      meanCollectedGSD =   2.540;
      rowUncertainty =   41.47;
      colUncertainty =   59.39;
      sunAz = 165.1;
      sunEl =  16.6;
      satAz = 116.1;
      satEl =  79.5;
      inTrackViewAngle =  -1.7;
      crossTrackViewAngle =   9.5;
      offNadirViewAngle =   9.4;
      cloudCover =   0.1;
      PNIIRS = 2.8;
      imageQuality = "Good";
      TDILevel = 32;
      positionKnowledgeSrc = "R";
      attitudeKnowledgeSrc = "R";
      revNumber = 7628;
END_GROUP = IMAGE_1;
BEGIN_GROUP = MAP_PROJECTED_PRODUCT
      earliestAcqTime = 2003-02-26T12:45:46.463836Z;
      latestAcqTime = 2003-02-26T12:45:46.463836Z;
      datumName = "WE";
      semiMajorAxis = 6378137.0000;
```

```
      inverseFlattening = 298.257223563;
      datumOffset = (
           0.000,
           0.000,
           0.000 );
      mapProjName = "UTM";
      mapProjCode = 1;
      mapZone = 27;
      mapHemi = "N";
      mapProjParam = (
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000 );
      productUnits = "M";
      originX =     415734.19999304;
      originY =    7101162.59999970;
      orientationAngle =    0.0;
      resamplingKernel = "CC";
      colSpacing =  2.80;
      rowSpacing =  2.80;
      ULX =  415734.19999304;
      ULY = 7101162.59999970;
      ULH =      66.00;
      URX =  424080.99999665;
      URY = 7101162.59999976;
      URH =      66.03;
      LRX =  424080.99999671;
      LRY = 7092577.79999976;
      LRH =      90.70;
      LLX =  415734.19999317;
      LLY = 7092577.79999970;
      LLH =      71.04;
      DEMCorrection = "Coarse DEM";
      numGCP = 0;
END_GROUP = MAP_PROJECTED_PRODUCT
END;
```

9.6.3 Image Metadata File – Orthorectified Imagery

```
version = "P";
generationTime = 2003-12-16T16:48:04.000000Z;
productOrderId = "000005200312_01_P001";
imageDescriptor = "OrthoRectified3D";
productScale = "1:12,000";
productAccuracy = 10.17;
bandId = "RGB";
```

```
panSharpenAlgorithm = "PCA";
numRows = 10394;
numColumns = 15195;
productLevel = "LV3D";
radiometricLevel = "Corrected";
radiometricEnhancement = "Off";
bitsPerPixel = 16;
compressionType = "None";
BEGIN_GROUP = BAND_R
      ULLon = -112.05094575;
      ULLat =   33.48438648;
      ULHAE =   323.64;
      URLon = -111.93649614;
      URLat =   33.48445764;
      URHAE =   375.85;
      LRLon = -111.93648122;
      LRLat =   33.41885795;
      LRHAE =   334.88;
      LLLon = -112.05084469;
      LLLat =   33.41878697;
      LLHAE =   306.95;
      absCalFactor = 1.267350e-02;
END_GROUP = BAND_R;
BEGIN_GROUP = BAND_G
      ULLon = -112.05094575;
      ULLat =   33.48438648;
      ULHAE =   323.64;
      URLon = -111.93649614;
      URLat =   33.48445764;
      URHAE =   375.85;
      LRLon = -111.93648122;
      LRLat =   33.41885795;
      LRHAE =   334.88;
      LLLon = -112.05084469;
      LLLat =   33.41878697;
      LLHAE =   306.95;
      absCalFactor = 1.438470e-02;
END_GROUP = BAND_G;
BEGIN_GROUP = BAND_B
      ULLon = -112.05094575;
      ULLat =   33.48438648;
      ULHAE =   323.64;
      URLon = -111.93649614;
      URLat =   33.48445764;
      URHAE =   375.85;
      LRLon = -111.93648122;
      LRLat =   33.41885795;
      LRHAE =   334.88;
      LLLon = -112.05084469;
      LLLat =   33.41878697;
      LLHAE =   306.95;
      absCalFactor = 1.604120e-02;
END_GROUP = BAND_B;
outputFormat = "GeoTIFF";
BEGIN_GROUP = IMAGE_1
      satId = "QB02";
      CatId = "1010010000C58801";
      SceneID = "1";
```

```
      collectedRowGSD =   0.612;
      collectedColGSD =   0.619;
      meanCollectedGSD =   0.616;
      rowUncertainty =   34.06;
      colUncertainty =   43.57;
      sunAz = 118.6;
      sunEl =  69.7;
      satAz = 254.7;
      satEl =  84.3;
      inTrackViewAngle =  -2.0;
      crossTrackViewAngle =  -4.9;
      offNadirViewAngle =   5.0;
      cloudCover =   0.0;
      PNIIRS = 4.2;
      imageQuality = "Excellent";
      TDILevel = 13;
      positionKnowledgeSrc = "R";
      attitudeKnowledgeSrc = "R";
      revNumber = 4092;
END_GROUP = IMAGE_1;
BEGIN_GROUP = MAP_PROJECTED_PRODUCT
      earliestAcqTime = 2002-07-11T18:16:42.910477Z;
      latestAcqTime = 2002-07-11T18:16:42.910477Z;
      datumName = "NAR";
      semiMajorAxis = 6378137.0000;
      inverseFlattening = 298.257222101;
      datumOffset = (
           0.000,
           0.000,
           0.000 );
      mapProjName = "State Plane Coordinates";
      mapProjCode = 2;
      mapZone = 202;
      mapProjParam = (
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000,
        0.000000000 );
      productUnits = "F";
      originX =     659059.87532809;
      originY =     903795.76771548;
      orientationAngle =    0.0;
      resamplingKernel = "CC";
      colSpacing =  2.30;
      rowSpacing =  2.30;
      edgeMatch = "Off";
      colorBalance = "Off";
```

```
      ULX =  659059.87532809;
      ULY =  903795.76771548;
      ULH =     323.64;
      URX =  693954.23228347;
      URY =  903795.76771547;
      URH =     375.85;
      LRX =  693954.23228346;
      LRY =  879927.32939525;
      LRH =     334.88;
      LLX =  659059.87532809;
      LLY =  879927.32939524;
      LLH =     306.95;
      DEMCorrection = "Fine DEM";
      numGCP = 0;
END_GROUP = MAP_PROJECTED_PRODUCT
END;
```

9.7 Product Delivery Shapefile

DigitalGlobe delivers a series of product delivery shapefiles with each product to enable users to view the components that comprise their product and to visualize how these fit together geographically. These components include the requested Area of Interest polygon, product boundaries, scene boundaries, and tile boundaries. Up to four separate shapefiles will be delivered with each QuickBird imagery product purchased. These are the Order Polygon, Tile, Scene, and Product shapefiles.

Shapefile Description

Order- The Order Polygon shapefile illustrates the customer's order polygon. This is the Area of Interest that was specified and confirmed by the user at the time that their order was placed. Because Basic Imagery products are purchased on a per-scene basis, no Order shapefile is delivered with this product level.

Tile- The Tile shapefile illustrates how an order polygon has been tiled to fit onto a selected media format. For images that are not tiled the shapefile will simply show one square tile, illustrating the four corners of tile boundary. This tile shall be named R1C1. (The actual product name will be listed in the "Product" attribute field.)

Scene- The Scene shapefile illustrates the boundaries of the scenes within which the order polygon falls as well as the overlap between these scenes. Because Basic imagery products are purchased on a per-scene basis, the scene/scenes ordered will be illustrated by the Scene shapefile (as opposed to the Order Polygon shapefile) for this product level.

Product- The Product shapefile indicates the number of products within the delivered product Order Polygon. (For Standard and Orthorectified Imagery products, if an order polygon crosses over scene boundaries, each portion of the polygon within a separate scene is considered a separate product, denoted as P001, P002, etc.) Additionally, media volume numbers are listed as an attribute field within the shapefile so that users can identify which volume (e.g.CD1, 2, or 3) each tile is located.

Shapefile Attributes

Table 22 shows the attributes that are delivered with each shapefile as well as an example of the type of information one might expect to see for each of these attribute types.

Shape-file Name	Attributes	Description	Example	Attribute Type	Attribute Length (#Characters)
Order	Item_No	Item number corresponding with associated order polygon	75160	Text	12
Tile	Tile_Name	Tile Name	R1C1	Text	4
	Product	Product name as defined in QuickBird Product Guide		Text	40
	Product_ID	Unique product identifier	P001	Text	4
Scene	CAT_ID	Catalogue ID number for the scene/scenes ordered or through which the order polygon crosses.	101001000002365a	Text	16
Product	Product_ID	Unique product identifier	P002	Text	4
	Volume_No	Volume number of the media on which tiles are located.	1	Text	1

Table 22. Shapefile Attributes

9.8 Image Layout JPEG

To help in locating portions of your imagery quickly, a diagram of how the order polygon is distributed across multiple pieces of media and multiple scenes is included with every order (see Figure 10, Sample Image Layout). This file will be in jpeg format and will be located in the top level directory of the media. The name of this file will be in the form of 000000022010 (order item id) _01 (increment) _LAYOUT.jpg. In this example, the order polygon crosses 2 scenes (P001 and P002), and all of the data will not fit on the specified media (CD-ROM). The part of the order polygon covered by scene 1 will be written to volumes 1 and 2, and the part covered by scene 2 will be written to volumes 3, 4, and 5.

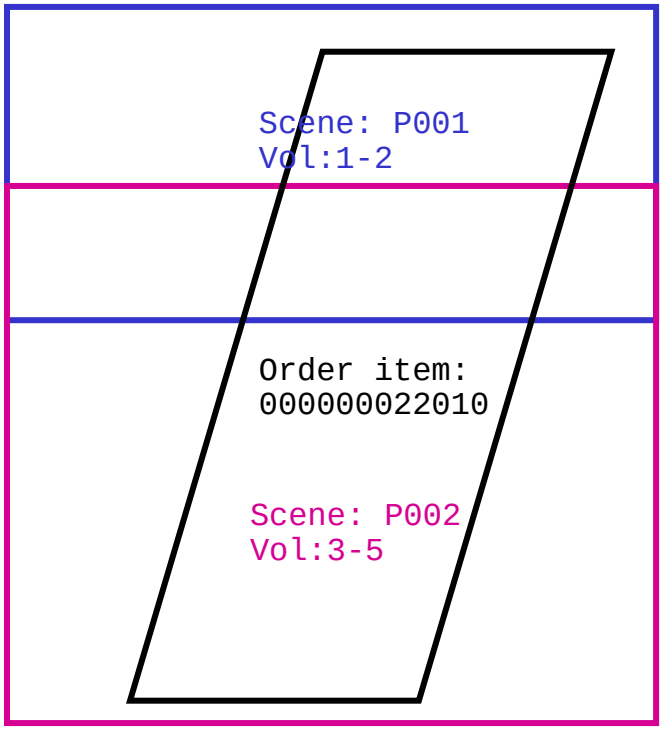

Figure 10. Sample Image Layout.

9.9 Product Browse file

The product browse file is a compressed JPEG file of the delivered product. The product browse file will be consistent with the bands ordered for the final product, except for multispectral and 4-band pan-sharpened products for which natural color browse imagery will be supplied. Figure 11 is sample of a natural color-product browse file.

Figure 11. Sample Product Browse File

9.10 Tile Map File

Large images are tiled into sub-images and distributed as a group of sub-image files, called tiles. Tiles may differ in size. If the image does not fill the whole tile, blackfill will be extended to the next blocking boundary. The tile map file in the ISD provides the row and column offset for the corner pixels of each tile, relative to the upper left corner of the base image product, as well as the latitude and longitude, and the coordinates in product units of the pixel corners in each tile. Only Standard and Orthorectified Imagery products can be tiled.

Tile Map File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
bandId	Identifies the spectral band. "P" = Panchromatic, "Multi" = all Multi-spectral bands (Blue + Green + Red + Near-IR), "RGB" = Red + Green + Blue, "NRG" = Near-IR + Red + Green, "BGRN" = Blue + Green + Red + Near-IR. Both RGB and NRG are pan-sharpened color images, stored at the panchromatic spatial resolution.	P Multi RGB NRG BGRN	
numTiles	The number of tiles for this product.		
tileSize	Size of each tile in either product units or pixels	50 – 50,000	
tileUnits	Units of tiles	Pixels Meters Feet	
tileOverlap	Overlap of tiles, in tile units	0 – 10,000	
The following group is repeated for n = 1,…,numTiles, i.e., once for each of the tiles.			
BEGIN_GROUP = TILE_n			
filename	Filename of the tile.		
ULColOffset	Column offset of the upper left pixel of this tile, relative to the upper left pixel of the base image.	>=0	
ULRowOffset	Row offset of the upper left pixel of this	>=0	

Tile Map File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
	tile, relative to the upper left pixel of the base image.		
URColOffset	Column offset of the upper right pixel of this tile, relative to the upper left pixel of the base image.		
URRowOffset	Row offset of the upper right pixel of this tile, relative to the upper left pixel of the base image.		
LRColOffset	Column offset of the lower right pixel of this tile, relative to the upper left pixel of the base image.		
LRRowOffset	Row offset of the lower right pixel of this tile, relative to the upper left pixel of the base image.		
LLColOffset	Column offset of the lower left pixel of this tile, relative to the upper left pixel of the base image.		
LLRowOffset	Row offset of the lower left pixel of this tile, relative to the upper left pixel of the base image.		
ULLon	The geodetic longitude of the center of the upper left pixel in the tile, in degrees.	±180.00000000 ULLon = 8 decimal places	
ULLat	The geodetic latitude of the center of the upper left pixel in the tile, in degrees.	±90.00000000 ULLat = 8 decimal places	
URLon	The geodetic longitude of the center of the upper right pixel in the tile, in degrees.		
URLat	The geodetic latitude of the center of the upper right pixel in the tile, in degrees.		
LRLon	The geodetic longitude of the center of the lower right pixel in the tile, in degrees.		
LRLat	The geodetic latitude of the center of the lower right pixel in the tile, in degrees.		
LLLon	The geodetic longitude of the center of the lower left pixel in the tile, in degrees.		
LLLat	The geodetic latitude of the center of the lower left pixel in the tile, in degrees.		
ULX	Easting of the center of the upper left pixel of the tile in the specified map projection, datum, and units of the product.		
ULY	Northing of the center of the upper left pixel of the tile in the specified map projection, datum, and units of the product.		
URX	Easting of the center of the upper right pixel of the tile in the specified map projection, datum, and units of the product.		
URY	Northing of the center of the upper right pixel of the tile in the specified map projection, datum, and units of the product.		
LRX	Easting of the center of the lower right pixel of the tile in the specified map		

Tile Map File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
	projection, datum, and units of the product.		
LRY	Northing of the center of the lower right pixel of the tile in the specified map projection, datum, and units of the product.		
LLX	Easting of the center of the lower left pixel of the tile in the specified map projection, datum, and units of the product.		
LLY	Northing of the center of the lower left pixel of the tile in the specified map projection, datum, and units of the product.		
END_GROUP = TILE_n			
END;			

Table 23. ISD Tile Map File.

9.11 Attitude File

This file contains sampled mean and covariance estimates of the attitude of the spacecraft system relative to the ECF system. These files are produced for a continuous imaging period (a scene), and span the period from at least four seconds before the start of imaging to at least four seconds after the end of imaging.

Attitude File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
SatId	Satellite Id.	QB02	
RevNumber	Orbit revolution number at startTime. The revolution number is incremented at the ascending node crossing each orbit.		
StripId	Unique 6 character strip Id. Data is represented as an ASCII-encoded hexadecimal integer.		
Type	Type of data . "I" = initial attitude, "R" = refined attitude.	I R	
Version	Version of the data. "A" for first version, "B" for second, etc.	A, B, C, etc.	
GenerationTime	Time of file generation, in UTC.		
StartTime	Time of first data point, in UTC.		
NumPoints	Number of points in the file.		
TimeInterval	Time interval between points, in seconds.	TimeInterval = 3 decimal places	

Attitude File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
AttList	List of attitude data. This is a time-sequential list of records for point = 1,…,numPoints. Each record is a list with 15 fields in the following order: (Type of field is in parenthesis). 1. point (I); Following is the attitude quaternion for this point: 2. q1 (D); 3. q2 (D); 4. q3 (D); 5. q4 (D); Following are the upper-right elements of the attitude quaternion covariance matrix for this point: 1. (1,1) element (F) 2. (1,2) element (F) 3. (1,3) element (F) 4. (1,4) element (F) 5. (2,2) element (F) 6. (2,3) element (F) 7. (2,4) element (F) 8. (3,3) element (F) 9. (3,4) element (F) 10. (4,4) element (F) The quaternions describe the rotation of the spacecraft coordinate system relative to the ECF frame.	AttList = 16 decimal places	
END;			

Table 24. ISD Attitude File.

9.12 Ephemeris File

This file contains sampled mean and covariance estimates of the position of the spacecraft system relative to the ECF system. These files are produced for a continuous imaging period (a scene), and span the period from at least four seconds before the start of imaging to at least four seconds after the end of imaging.

Ephemeris File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
satId	Satellite Id.	QB02	
revNumber	Orbit revolution number at startTime. The revolution number is incremented at the ascending node crossing each orbit.		
stripId	Unique 6 character strip Id. Data is represented as an ASCII-encoded hexadecimal integer.		
type	Type of data . “I” = initial ephemeris, “R” = refined ephemeris.	I R	
Version	Version of the data. “A” for first version, “B” for second, etc.	A, B, C, etc.	
GenerationTime	Time of file generation, in UTC.		
StartTime	Time of first data point, in UTC.		
NumPoints	Number of points in the file.		
TimeInterval	Time interval between points, in seconds.	TimeInterval = 3 decimal places	
EphemList	List of ephemeris data. This is a time-sequential list of records for point = 1,…,numPoints. Each record is a list with	EphemList = 16 decimal places	

	13 fields in the following order (field type is in parenthesis): 1. point (I); Following is the spacecraft position and velocity for this point: 2. X position (D); 3. Y position (D); 4. Z position (D); 5. X velocity (D); 6. Y velocity (D); 7. Z velocity (D); Folowing are the upper-right elements of the position covariance matrix for this point: 8. (1,1) element (F); 9. (1,2) element (F); 10. (1,3) element (F); 11. (2,2) element (F); 12. (2,3) element (F); 13. (3,3) element (F); All measurements are in the ECF coordinate system. Positions are in meters and velocities in m/sec. Positon variances and covariances are in m^2.		
END;			

Table 25. ISD Ephemeris File.

9.13 Geometric Calibration File

This file contains standard photogrammetric parameters of a virtual camera that models the imaging and optical system (the QuickBird camera). Most of these are intrinsic parameters that relate a ray inside the camera (behind the optics) to a particular pixel address on one of the linear detector arrays. The file also contains some information that is needed to compute the position and orientation of the QuickBird camera for any given line of an image. This information, also known as the exterior orientation of the camera, can be computed from the following sources:

(1) The position and orientation of the spacecraft coordinate system relative to the Earth Centered Fixed (ECF) coordinate system, as provided in the attitude file and the ephemeris file.

(2) The position and orientation of the camera with respect to the spacecraft coordinate system. This information is relatively constant, and is provided in the geometric calibration file.

The Basic Imagery camera models the system as a moving camera with a single continuous linear detector array on the focal plane for each spectral band.

Geometric Camera Calibration File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
effectiveTime	Effective date and time of this calibration, in UTC.		
satId	Satellite Id.	QB02	
geoModelLevel	Specifies the geometric model. "LV1B" is for Basic Imagery products.	LV1B	
BEGIN_GROUP = PRINCIPAL_DISTANCE			
generationTime	Time of group generation, in UTC.		
PD	The principal distance of the camera, in millimeters. This is the perpendicular distance from the perspective center to the focal plane	PD = 3 decimal places	
END_GROUP = PRINCIPAL_DISTANCE			
BEGIN_GROUP = OPTICAL_DISTORTION			
generationTime	Time of group generation, in UTC.		
polyOrder	Order of each of the bivariate image correction polynomials. An N degree polynomial will have (N+1)*(N+2)/2 terms.	0,1,2,3,4,5	
aList	List of correction coefficient for the camera X coordinate of an image point. There are (polyOrder+1)*(polyOrder+2)/2 elements in the list.	AList = 6 decimal places	
bList	List of correction coefficient for the camera Y coordinate of an image point. There are (polyOrder+1)*(polyOrder+2)/2 elements in the list.	BList = 6 decimal places	
END_GROUP = OPTICAL_DISTORTION			
BEGIN_GROUP = PERSPECTIVE_CENTER			
generationTime	Time of group generation, in UTC.		
CX CY CZ	The perspective center of the camera in the spacecraft coordinate system, in meters. This is the origin of the camera coordinate system.	CX = 3 decimal places CY = 3 decimal places CZ = 3 decimal places	
END_GROUP = PERSPECTIVE_CENTER			
BEGIN_GROUP = CAMERA_ATTITUDE			
generationTime	Time of group generation, in UTC.		
qcs1 qcs2 qcs3 qcs4	The unit quaternion for the attitude of the camera coordinate system in the spacecraft body system, i.e., the quaternion for the rotation of the spacecraft body frame into the virtual frame. $\mathbf{q}^{c}_{s}$. qcs4 is the scalar part.	qcs1 = 16 decimal places qcs2 = 16 decimal places qcs3 = 16 decimal places qcs4 = 16 decimal places	
END_GROUP = CAMERA_ATTITUDE			
BEGIN_GROUP = DETECTOR_MOUNTING			
generationTime	Time of group generation, in UTC.		
The following group is repeated for each spectral band in the delivered image product. The index b in the group name is one of (P,N,R,G,B) to differentiate the band group names.			
BEGIN_GROUP = BAND_b			
bandId	Identifies the spectral band. "P" = Panchromatic, "N" = Near –IR, "R" = Red, "G" = Green, "B" = Blue.	P N R G B	
The following group is repeated for n = 1,…,numDetArr, i.e., for each of the linear detector arrays in the spectral band. For the Basic Imagery camera model, n = 1.			

BEGIN_GROUP = DETECTOR_ARRAY_n			
detArrId	Specifies the detector array Id. (1 for the Basic Imagery camera model.)	1	
detOriginX detOriginY	X and Y coordinates of the pixel 0 of the linear detector array in the camera coordinate system, in mm.	detOriginX = 16 decimal places detOriginY = 16 decimal places	
detRotAngle	Rotation of the detector coordinate system as measured in the camera coordinate system, in degrees. Positive values indicates a positive rotation of the detector coordinate system about the camera +Z axis.	detRotAngle = 16 decimal places	
detPitch	The pitch or pixel spacing of the detector in the detector Y direction, in mm. This is the distance between centers of adjacent pixels in the array.	detPitch = 16 decimal places	
END_GROUP = DETECTOR_ARRAY_n			
END_GROUP = BAND_b			
END_GROUP = DETECTOR_MOUNTING			
END;			

Table 26. ISD Geometric Calibration File.

9.14 RPC00B File

This file contains the coefficients for Rapid Positioning Capability, also called Rational Polynomial Coefficients (RPC). This is a mathematical mapping from object space coordinates to image space coordinates. This mapping includes non-ideal imaging effects, such as lens distortion, light aberration, and atmospheric refraction.

RPC00Bs express the normalized column and row values in an image, (c_n, r_n) , as a ratio of polynomials of the normalized geodetic latitude, longitude, and height, (P, L, H). Normalized values are used instead of actual values in order to minimize numerical errors in the calculation. The scales and offset of each parameter are selected so that all normalized values fall in the range [-1, 1]. The normalization used is as follows:

P = (Latitude - LAT_OFF) / LAT_SCALE
L = (Longitude - LONG_OFF) / LONG_SCALE
H = (Height - HEIGHT_OFF) / HEIGHT_SCALE
r_n = (ROW - LINE_OFF) / LINE_SCALE
c_n = (Column - SAMP_OFF) / SAMP_SCALE

Each polynomial is up to third order in (P, L, H), having as many as 20 terms. The rational functions are

$$r_n = \frac{\sum_{i=1}^{20} LINE\_NUM\_COEF_i \bullet p_i(P,L,H)}{\sum_{i=1}^{20} LINE\_DEN\_COEF_i \bullet p_i(P,L,H)} \quad and \quad c_n = \frac{\sum_{i=1}^{20} SAMP\_NUM\_COEF_i \bullet p_i(P,L,H)}{\sum_{i=1}^{20} SAMP\_DEN\_COEF_i \bullet p_i(P,L,H)}$$

The image coordinates are expressed in pixels. The ground coordinates are latitude and longitude in decimal degrees, and geodetic elevations (height above the ellipsoid) in meters.

RPC00B File			
FIELD	**DESCRIPTION**	**RANGE**	**CONDITIONS**
satId	Satellite Id.	QB02	
bandId	Identifies the spectral band. "P" = Panchromatic, "Multi" = all Multi-spectral bands (Blue + Green + Red + Near-IR), "RGB" = Red + Green + Blue, "NRG" = Near-IR + Red + Green, "BGRN" = Blue + Green + Red + Near-IR. Both RGB and NRG are pan-sharpened color images, stored at the panchromatic spatial resolution.	P Multi RGB NRG BGRN	
SpecId	Identification of the specification which defines the RPC implementation used for generating and/or interpreting the coefficients	RPC00B	
BEGIN_GROUP = IMAGE			
errBias	Bias error, in meters. 68% non time-varying error estimate for correlated images.	See Note #1	
errRand	Random error, in meters. 68% time-varying error estimate for correlated images.	See Note #1	
lineOffset	LINE_OFFSET, in pixels.	See Note #1	
sampOffset	SAMP_OFFSET, in pixels.	See Note #1	
latOffset	LAT_OFFSET, in degrees.	See Note #1	
longOffset	LONG_OFFSET, in degrees.	See Note #1	
heightOffset	HEIGHT_OFFSET, in meters.	See Note #1	
lineScale	LINE_SCALE	See Note #1	
sampScale	SAMP_SCALE	See Note #1	
latScale	LAT_SCALE	See Note #1	
longScale	LONG_SCALE	See Note #1	
heightScale	HEIGHT_SCALE	See Note #1	
lineNumCoef	LINE_NUM_COEF. Twenty coefficients for the polynomial in the numerator of the r_n equation.	See Note #1	
lineDenCoef	LINE_DEN_COEF. Twenty coefficients for the polynomial in the denominator of the r_n equation.	See Note #1.	
sampNumCoef	SAMP_NUM_COEF. Twenty coefficients for the polynomial in the numerator of the c_n equation.	See Note #1	
sampDenCoef	SAMP_DEN_COEF. Twenty coefficients for the polynomial in the denominator of the c_n equation.	See Note #1	
END_GROUP = IMAGE			
END;			

Table 27. ISD RPC00B File.

Note 1: The range of values for each numeric parameter is as specified in The Compendium of Controlled Extensions (CE) for the National Imagery Transmission Format (NITF), NIMA document STDI-0002, Version 2.1, 16 November 2000. Out of range coefficients are set to zero.

9.15 Manifest File

The manifest file outlines the directory structure for products delivered by FTP. Below is an example of the manifest file delivered for a Standard Multispectral Imagery product.

./000009200305_01
./000009200305_01.MAN
./000009200305_01/000009200305_01_LAYOUT.JPG
./000009200305_01/GIS_FILES
./000009200305_01/000009200305_01_README.TXT
./000009200305_01/000009200305_01_P001_MUL
./000009200305_01/000009200305_01_P001_PAN
./000009200305_01/GIS_FILES/000009200305_01_ORDER_SHAPE.shp
./000009200305_01/GIS_FILES/000009200305_01_ORDER_SHAPE.shx
./000009200305_01/GIS_FILES/000009200305_01_ORDER_SHAPE.dbf
./000009200305_01/GIS_FILES/000009200305_01_PRODUCT_SHAPE.shx
./000009200305_01/GIS_FILES/000009200305_01_PRODUCT_SHAPE.shp
./000009200305_01/GIS_FILES/000009200305_01_PRODUCT_SHAPE.dbf
./000009200305_01/GIS_FILES/000009200305_01_TILE_SHAPE.dbf
./000009200305_01/GIS_FILES/000009200305_01_TILE_SHAPE.shx
./000009200305_01/GIS_FILES/000009200305_01_TILE_SHAPE.shp
./000009200305_01/GIS_FILES/000009200305_01_SCENE_SHAPE.shp
./000009200305_01/GIS_FILES/000009200305_01_SCENE_SHAPE.shx
./000009200305_01/GIS_FILES/000009200305_01_SCENE_SHAPE.dbf
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS-000009200305_01_P001-BROWSE.JPG
./000009200305_01/000009200305_01_P001_MUL/MUL_README.TXT
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R1C2-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R1C3-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R1C1-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R2C2-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R2C3-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R2C1-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/<License-Type>_LICENSE.TXT
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R3C2-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R3C3-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS_R3C1-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS-000009200305_01_P001.TIL
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS-000009200305_01_P001.RPB
./000009200305_01/000009200305_01_P001_MUL/02JUN25001236-M2AS-000009200305_01_P001.IMD
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS-000009200305_01_P001-BROWSE.JPG
./000009200305_01/000009200305_01_P001_PAN/PAN_README.TXT
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R1C2-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R1C3-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R1C1-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R2C2-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R2C3-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R2C1-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN//<License-Type>__LICENSE.TXT
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R3C2-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R3C3-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS_R3C1-000009200305_01_P001.TIF
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS-000009200305_01_P001.TIL
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS-000009200305_01_P001.RPB
./000009200305_01/000009200305_01_P001_PAN/02JUN25001236-P2AS-000009200305_01_P001.IMD

10. ISD Coordinate Conventions

For geolocation purposes, ISD files for all product levels must reference both image coordinates and earth coordinates. In addition, ISD files for Basic Imagery products contain information about the position and orientation of the spacecraft, camera, and the linear detector arrays on the focal plane. This section describes the coordinate systems that are associated with each of these entities.

10.1 Earth Coordinates (E)

Earth coordinates are expressed relative to an earth-centered fixed (ECF) reference system that rotates with the earth. In particular, all ECF coordinates in ISD files are given in the WGS 84 reference system, including geocentric cartesian coordinates (X_E , Y_E , Z_E) and geodetic coordinates (latitude, longitude). The WGS 84 Z_E-axis points in the direction of the Conventional Terrestrial Pole (CTP); the X_E-axis lies along the intersection of the meridian plane and the CTP equator, pointing outward at Greenwich; the Y_E-axis completes the right-handed orthogonal coordinate system.

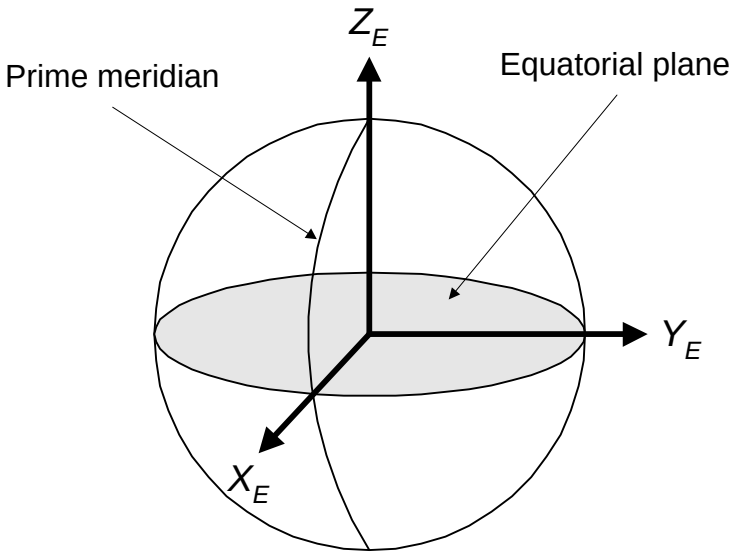

Figure 12. Earth Coordinate System.

All heights are in meters with respect to the WGS 84 ellipsoid. All easting and northing values in any of the ISD files are specified in the projection determined by the datum and map projection fields in the image metadata file.

10.2 Spacecraft Coordinates (S)

The spacecraft coordinate system has its origin near the spacecraft center of mass, and its axes roughly aligned with the camera frame. The Z_S-axis is approximately parallel to the line-of-sight vector and points toward the ground; the X_S-axis points roughly in the along-track imaging direction; the Y_S-axis completes the right-handed orthogonal coordinate system and points toward the across-track direction. To an imaginary viewer riding on the spacecraft and facing forward, the X_S-axis points forward in the direction of the imaging scan, the Y_S-axis points toward the right, and the Z_S-axis points down.

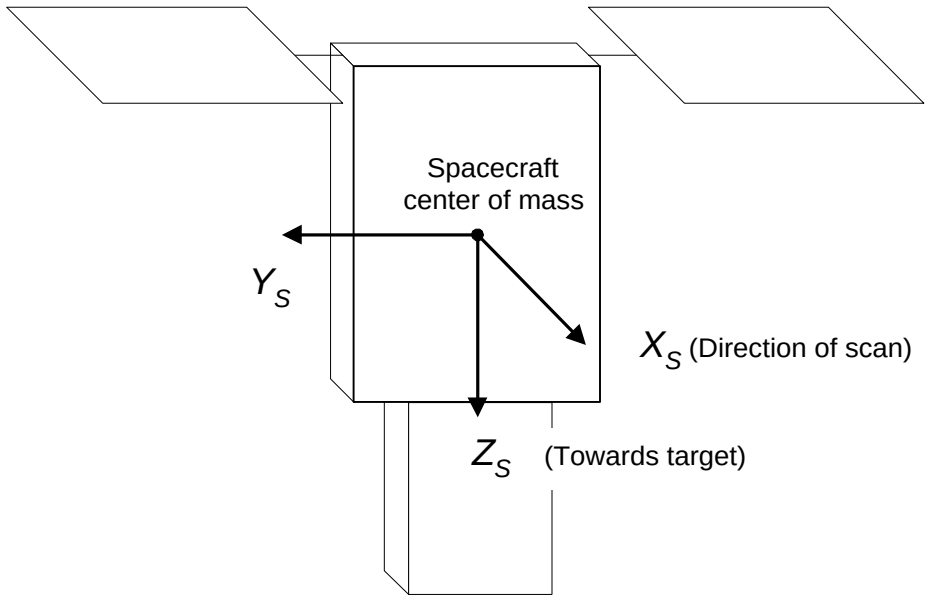

Figure 13. Spacecraft Coordinate System.

10.3 Camera Coordinates (C)

The term "camera" is used here to include the telescope and image detectors. The camera coordinate system is fixed relative to the spacecraft body frame. The origin is the perspective center of the telescope for rays on the object or ground side of the optics. The Z_C-axis is parallel to the optic axis of the telescope and points toward the ground; the X_C-axis points in the direction of the scan; the Y_C-axis completes the right-handed orthogonal coordinate system and is parallel to the long axis of the detector arrays.

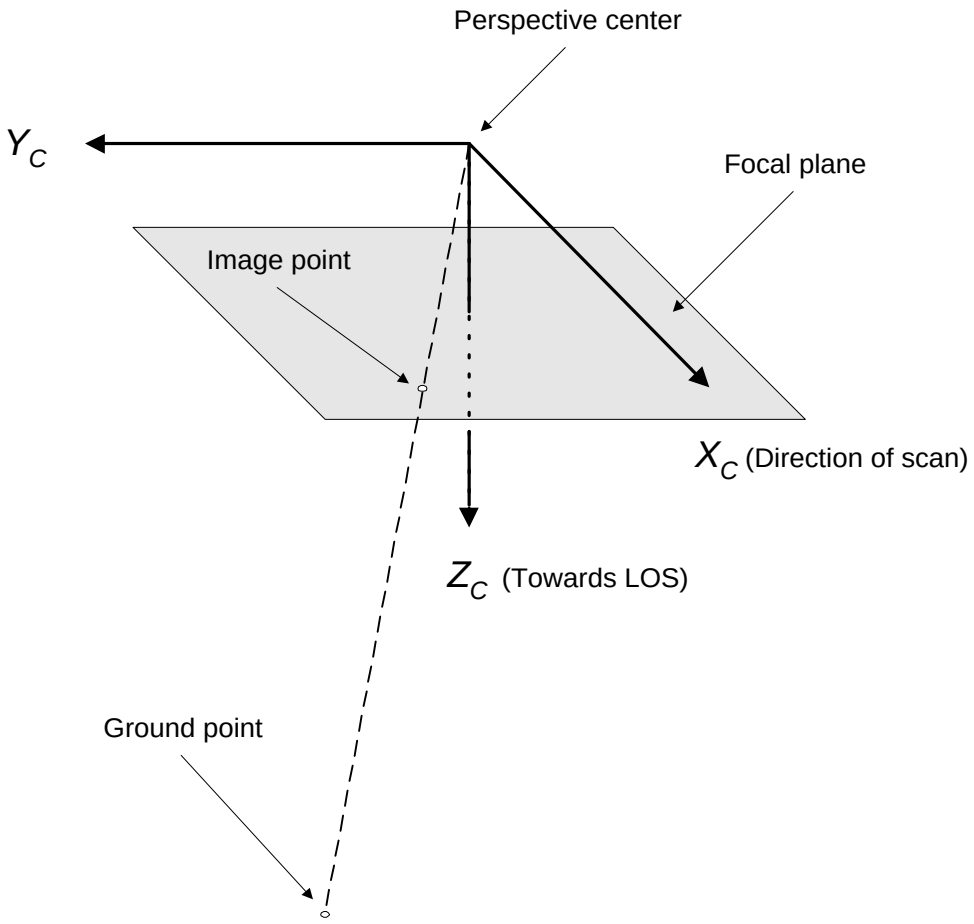

Figure 14. Camera Coordinate System.

10.4 Detector Coordinates (D)

Each photosensitive detector in one of the N-element linear detector arrays on the focal plane has an integer column coordinate, ranging from 0 to N-1. The detector coordinate numbers increase in the direction of decreasing Y_C.

A detector coordinate system can be erected for each of the linear detector arrays. The origin of each such coordinate system is the center of the detector in column 0 of the corresponding detector array. The Z_D-axis of the detector system is parallel to the camera Z_C-axis; the Y_D-axis of the array is parallel to the long axis of the array, pointing approximately in the $+Y_C$ direction; the X_D-axis completes the right-handed orthogonal coordinate system. The X_D-axis is perpendicular to the linear array and points approximately in the direction of the image scan.

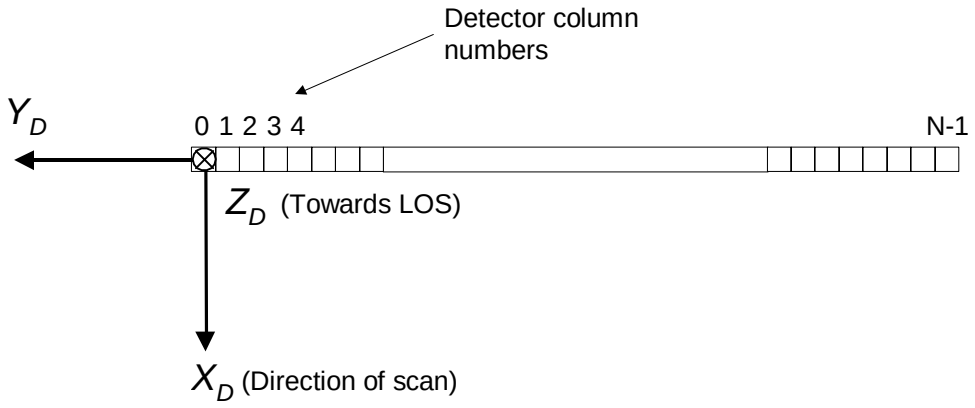

Figure 15. Detector Coordinate System.

10.5 Image Coordinates

An image address is specified as a (column, row) pair. When the image is displayed, column numbers should increase toward the right and row numbers should increase in the downward direction. Address (0, 0) corresponds to the pixel displayed in the upper left corner. Adherence to these display conventions ensures that a displayed image will have the same sense as an aerial view of the ground—differing from an aerial view by a proper rotation.

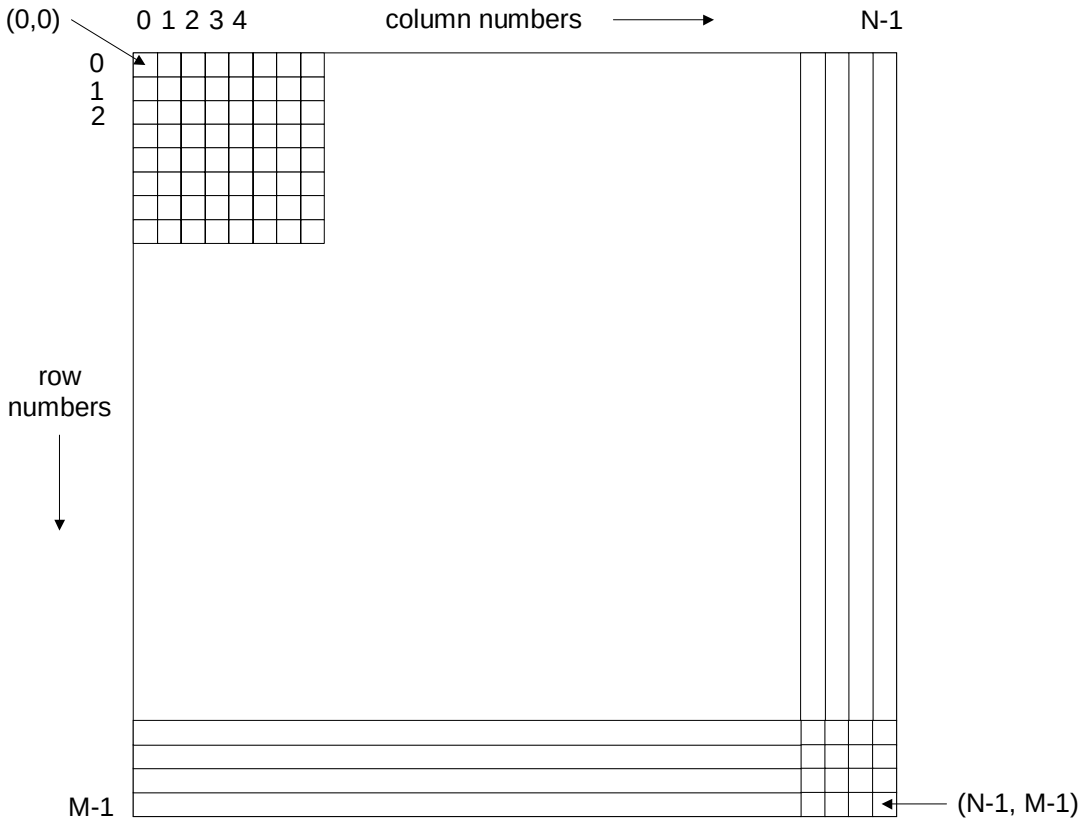

Figure 16. Image Coordinate System.

The detector in column 0 of a detector array produces the pixels in column 0 of the corresponding Basic image. The ground location of a specific pixel in the image is the geolocation of the center of that pixel.

10.6 Time

All absolute times are in UTC in the format YYYY-MM-DDThh:mm:ss.ddddddZ.

Relative time offsets from a fixed absolute time are measured in seconds, unless specified otherwise.

An example of both absolute UTC time and relative time is the time-tagged line count (TLC) data in the image metadata file. The TLC data, which are pairs of line numbers and the associated exposure times, provide a way to accurately estimate the time of exposure of any line in the image. The first such timing event for an image is reported in the image metadata file as an absolute UTC time, but subsequent events are reported as time offsets, in seconds, relative to this initial time.

11. Appendix A - Abbreviations, Acronyms, and Terms

Table 26, Abbreviations and Acronyms, contains a listing of the abbreviations and acronyms and their associated meaning as used in this document.

Abbreviation or Acronym	Meaning/Definition
CE	Circular Error
DEM	Digital Elevation Model
DN	Digital Number
ECF	Earth Centered Fixed
FOR	Field of Regard
ftp	File Transfer Protocol
GCP	Ground Control Point
GPS	Global Positioning System
GSD	Ground Sample Distance
IOC	Initial Operating Capability
ISD	Image Support Data
km	Kilometers
LE	Linear Error
m	Meters
MBR	Minimum Bounding Rectangle
mm	Millimeters
NIIRS	National Image Interpretability Rating Scales
NITF	National Imagery Transmission Format
nm	Nanometers
NRG	Near-Infrared, Red, Green
MS	Multispectral
Pan	Panchromatic
PanMS	Panchromatic and Multispectral
PanSh	Pan-sharpened Natural Color or Color Infrared
PD	Principal Distance
PNIIRS	Predicted National Image Interpretability Rating Scales
PVL	Physical Volume Library
QB	QuickBird
RGB	Red, Green, Blue
RMSE	Root Mean Square Error
RPC	Rational Polynomial Coefficient Rapid Positioning Capability
TDI	Time Delay Integration
TIFF	Tagged Image Format File
TLC	Time-tagged Line Count
UTC	Coordinated Unversal Time
WGS	World Geodetic System

Table 28. Abbreviations and Acronyms.

The following section contains a listing of QuickBird Imagery Products terms and associated definitions as used in this document.

Digital Elevation Model – A digital model of terrain relief, usually derived from stereo imagery. A DEM is used to remove terrain distortions from Orthorectified Imagery products.

Digital Number (DN) – Value assigned to a pixel in a digital image. This gray density number represents the intensity of reflected light from a feature collected by the sensor for a particular spectral range.

Digitization Scaling Method – The method used to scale 11-bit data to 8-bit data.

Dynamic Range – The number of possible DN values for each band in an image. QuickBird has an 11-bit dynamic range which translates into 2048 possible DN values.

Field of Regard – The area on the ground visible to the QuickBird satellite. Also known as the sensor footprint.

Ground Control Point (GCP) – A known geographic coordinate location on the ground. Can be collected from ground survey or maps (Primary GCP), or derived via triangulation of primary GCPs (Secondary GCP). GCPs can be planimetric (x, y; latitude, longitude) or vertical (x, y, z; latitude, longitude, elevation).

Ground Sample Distance (GSD) – The size of one pixel, as measured on the ground.

Image Support Data (ISD) – A set of files which contain all the necessary data necessary to use and process QuickBird Imagery Products. These files can be viewed as a collection point for all ancillary data that is expected to be useful to a customer.

Metadata – Ancillary data that describes and defines the imagery product. DigitalGlobe provides metadata in a set of Image Support Data files.

Multispectral – QuickBird imagery with data recorded in 4 discrete spectral bands.

Nadir – The point on the ground which is directly below the QuickBird spacecraft.

Off-nadir Angle – The angle between nadir and the point on the ground that the QuickBird sensor is pointing. Off-nadir angle can be measured in the along-track (forward) direction or across-track (sideways) direction.

Orthorectification – The correction of distortions caused by terrain relief displacement.

Panchromatic – A wide spectral band which is comprised of reflected light in the visible spectrum (blue, green, red and NIR). It is displayed as a black and white image.

Photogrammetry – The art, science, and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring, and interpreting photographic images and patterns of electromagnetic radiant imagery.

Pixel – Picture Element – smallest element comprising a digital image.

Product Framing – The manner in which QuickBird Imagery Products are delivered. Products are either Scene-based or Area-based.

Radiometric Correction – The correction of variations in data that are not caused by the object or scene being scanned, such as non-responsive detectors, scanner inconsistencies, and atmospheric interference.

Remote Sensing – The measurement or acquisition of data about an object by an instrument not in contact with the object. Satellite imagery, aerial photography, and radar are all types of remote sensing.

Repeat Coverage – The amount of time it takes to image the same spot on the ground.

Resolution – The resampled image pixel size derived from GSD.

Scale – The ratio of distance on a map as related to the true distance on the ground. Products with a larger scale have higher geometric accuracies than products with a smaller scale.

Sensor Correction – The correction of variations in data that are caused by variations in sensor geometry, attitude, and ephemeris.

Spatial Mosaic – The assembly of multiple scenes, each of which shows a portion of the order polygon, into a single image. Usually involves edge matching adjacent scenes.

Sun Azimuth – The azimuth of the sun as seen by an observer sitting on the target measured in a clockwise direction from north.

Sun Elevation – The angle of the sun above the horizon.

Sun-Synchronous – An orbit which rotates around the Earth at the same rate as the Earth rotates on its axis.

Swath Width – The width of an image. The QuickBird satellite has a Swath Width of 16.5 km at nadir.

Target Azimuth – The azimuth of the target as seen by an observer sitting on the spacecraft measured in a clockwise direction from north.

Terrain Correction – The correction for variations in data caused by terrain displacement due to off-nadir viewing.