



VHR Image Acquisition Specifications for the CAP checks (CwRS and LPIS QA)

Eugenio GERVASINI, Blanka VAJSOVA
Ignacio San-Miguel, Pär Johan ÅSTRAND

2012

Specifications

VHR Image Acquisition Specifications for the CAP checks (CwRS and LPIS QA)

Author: Pär Johan ÅSTRAND	Status: v4.3
Co-authors: Eugenio GERVASINI, Blanka VAJSOVA Ignacio San-Miguel	Circulation: Internal/Commission, Image Providers, MS Administrations/contractors
Approved: Pär Johan ÅSTRAND	
Date: 18/01/2012	Int. ref: file://S:\FMPArchive\C\13923.doc

Contents:

Document History	4
1. Introduction	6
1.1. VHR Image Acquisition for the CAP checks Programme	6
1.2. Objectives, referencing and structure of this document	6
2. Zone Definition	7
2.1. General	7
2.2. Zone parameters	7
3. Acquisition Windows	10
4. Feasibility	11
5. Acquisition Request (AR)	12
6. QL (Browse Image) Upload	13
7. Validation	13
8. Ordering	15
9. Delivery	16
10. Invoicing	18
10.1. Pricing	18
10.2. Invoicing	18
11. Image Data Return and Image Access	18
11.1. Image Data Return	18
11.2. Image Access	19
12. Sensors and Products	19
12.1. GeoEye-1 (GE1) prime (or constellation with IK2)	19
12.2. WorldView2 (WV2) prime (or constellation with QB2 or QB2/WV1 or WV1)	21
12.3. Pleiades prime (PL1)	22
12.4. The Quickbird (QB2) prime (or constellation with WV2 or WV2/WV1) / speculative backup	24
12.5. The Ikonos2 “enhanced” (IK2) (constellation with GE1) / speculative backup	25
12.6. The WorldView1 (WV1) (constellation with WV2 or WV2/QB2) / speculative backup	25
12.7. The EROS B speculative backup	27
12.8. The SPOT5 Supermode (SPS/COL) speculative backup	27
12.9. The Formosat2 (F2) speculative backup	28
12.10. The THEOS speculative backup	29
13. Quality Assurance / Quality Control	30
13.1. Image Quality Control (QC)	30
13.2. Cloud Cover (CC)	30
14. Risk of Satellite Failure	31
15. Responsible and email address	31
16. References	32
17. Abbreviations and Acronyms	35
18. Annexes	36
18.1. XML File Specification for Image Provider	36
18.2. Relation elevation angle vs. off-nadir angle, and some satellite angles of importance	39

List of Figures

Figure 1 - Figure showing structure of document and image acquisition process flow	7
Figure 2 - F2: GSD at, at nadir is 2m PAN, and 8m MSP	28

Document History

Version	Date	Comment	Who	Modified Pages
1.0	01/05/2008	1 st release includes updates of 2007 specifications (FMP 7528) incorporating exclusion of OrbView3, changes to EROSB, changes to Formosat2, inclusion of WorldView1, backup procedure changes, image return etc.	PA, ME, Image providers	
1.1	30/05/2008	Final version after draft revision deadline 30/05/08	PA	
1.2	12/03/2009	Updates on GeoEye-1	Image Providers	
1.31	23/03/2009, 02/04/2009, 22/06/2009	Administrative routines, image return, change on EROS B, and SPOT backup; Final check, minor corrections §11.1.1 Image return, and 12.1.3 GE1 sw suites;	PA, ME, CA PA	
2.0	01/05/2010	New edits 2010: WV1, WV2, copyrights	EUSI, PA	
3.0 - 3.1	10/02/2011, 25/02/2011	Update of document for the 2011 Campaign: intro. of auto-backup, intro. of new backup approach, elevation angle restrictions, introduction of 2010 years edits including WV2 (ref doc JRC IPSC/G03 /C/PAR/par (2010)(11936)), introduction of the THEOS sensor, invoicing issues, other miscellaneous (e.g. sensor formats, zones: no 500/5 km rule on shapes); all edits in RED.	PA	
3.2	05/03/2011	Further updates according to EG, BW (minor clarifications, and edit to 3.1.9 pricing issue), updates on LIODOTNET by EG (e.g. upload with shapefile Annex 18.1, plus minor other changes); introduction of checksum by Image Providers and Contractors to be able to check correct image data delivery by FTP (§ 9.1.8) (AB)	EG, BW, SG, AB	
3.3	13/03/2011	Clarifications on data return, introduction of functional email LIODOTNET, ref. THEOS FC no., and THEOS products, elevation angle clarifications, clarifications upon EUSI input 10/3/2011 (e.g. inserted WV2 tiling options, deleted minimum width of an AOI, clarification on feasibility iterations, and references on benchmarks inserted).	PA	
3.31	17/03/2011	Grammatical edits, and minor clarification on item 4.1.4 (elevation angle), 11.2.1 (Image Data Access).	CA, PA	
3.32	04/04/2011	Accept of Image Providers: EUSI (no further input); e-GEOS (Minor corrections to 2.1.15, 2.1.16 allowing PAN to be prime upon MS request with a possible additional HR(VHR) if requested). Renumbering of erroneously numbered chapters	Michaela Weber, Bruno Biagini, Ricardo Nasini, (Image Providers)	
4.0	20/10/2011	New version for 2012 and future:	PA	

		Constellation tasking, feasibility categories, elevation angle thresholds for LPIS and for hilly/mountainous control zones, no dedicated VHR backup, tiling, LIODOTNET upgrades on zone definition parameters and on ordering. Moreover some chapters have been rearranged to avoid repetitions (e.g. the sensor zone description chapter has been moved to be together with the sensor product description)		
4.1	21/11/2011	Introduction of Constellation WV2 and WV1. Update on chapter on Feasibility. Updates on F2, Theos products.	PA, B Biagini, M Weber	
4.2	16/12/2011	Inputs after Tallinn Conference Nov 2011 - e-GEOS (4.1.5 elev angle typo, 11.2.3 on copyright text, 12.1.4 GE1 specs., 12.3.3 IK2 specs), EUSI (2.2.1 recommendation is to keep shapes of simple shape but no compulsory limit, 12.3 QB may be chosen as prime, 12.4.3 QB tiling).	PA, A Oddone, E Simon	
4.3	26/10/2012	<p>Updates on Unit name</p> <p>Introduction of the new VHR sensor – Pleiades (PL1)</p> <p>Updates on zone parameters</p> <p>Updates on speculative backup</p> <p>Updates on licensing text (Item 11.2.3.)</p>	EG, BV, PA	

1. Introduction

1.1. VHR Image Acquisition for the CAP checks Programme

- 1.1.1. Since 1993, DG AGRI has promoted the use of “Controls with Remote Sensing” (CwRS) as an appropriate control system suitable to checking if aids are correctly granted. On the basis of the Council Regulation (EC) 165/94 (ref i) and of the Commission Regulation (EC) 601/94, the Commission Services are required to centralize the satellite images acquisition. This task was transferred to DG JRC in 1998 (September 1998/VI/34942). It is managed through a cross delegation (sub-delegation of signature) by DG AGRI to DG JRC.
- 1.1.2. Following the real time evaluation in 2003 and the successful operational application since 2004, DG JRC, in agreement with DG AGRI, continues to supply Very High Resolution (VHR) Satellite Remote Sensing (SRS) data, to the MS Administrations for their CwRS of area-based subsidies.
- 1.1.3. Since 2010, DG AGRI calls for a yearly LPIS Quality Assessment (LPIS QA). VHR Imagery acquired under the CwRS Campaign can be used for LPIS Quality Assessment providing that the zones satisfy the issued technical LPIS QA recommendations (see further Chapter 2.1.2 below)

1.2. Objectives, referencing and structure of this document

- 1.2.1. This document constitutes the specifications for VHR imagery to be used within the CAP checks Programme (CwRS and LPIS QC). Its objective is to give the stakeholders¹ in the image acquisition process clarity in the technical details of the process and describes the process flow starting from zone definition, through the image use, reaching image return and possible re-use of imagery at end of Campaign (see Figure 1). This document is available on the EC, JRC Institute for Environment and Sustainability (IES), Digital Earth and Reference Data Unit, Community Image Data portal (CID) website at <http://cidportal.jrc.ec.europa.eu/home/image-acquisition/> , or through LIODOTNET at <http://lio2.jrc.it/LioDotNet/Default.aspx>), and the content is introduced in the MARS Unit WikiCAP at http://marswiki.jrc.ec.europa.eu/wikicap/index.php/Main_Page
- 1.2.2. Reference is made to the Common Technical Specifications (CTS) for the Remote Sensing Controls of area-based subsidies [ref ii]. Reference is also made to the WikiCAP website [ref iii, iv] for further recommendations. Reference is also made to the Guidelines for Best Practice and Quality Checking of Ortho Imagery (ref v).
- 1.2.3. Reference is also made to the HR Image Specifications for the CAP checks Programme [ref vi] which should be used in conjunction with present document.
- 1.2.4. Reference is also made to the terms and conditions of the satellite remote sensing (SRS) data Framework Contracts (FCs) for image procurement to the EC Services signed with Image Providers (IPs) [ref vii]

¹ Stakeholders, or Actors = JRC, Image Provider, Administration/Contractor performing the CAP Controls

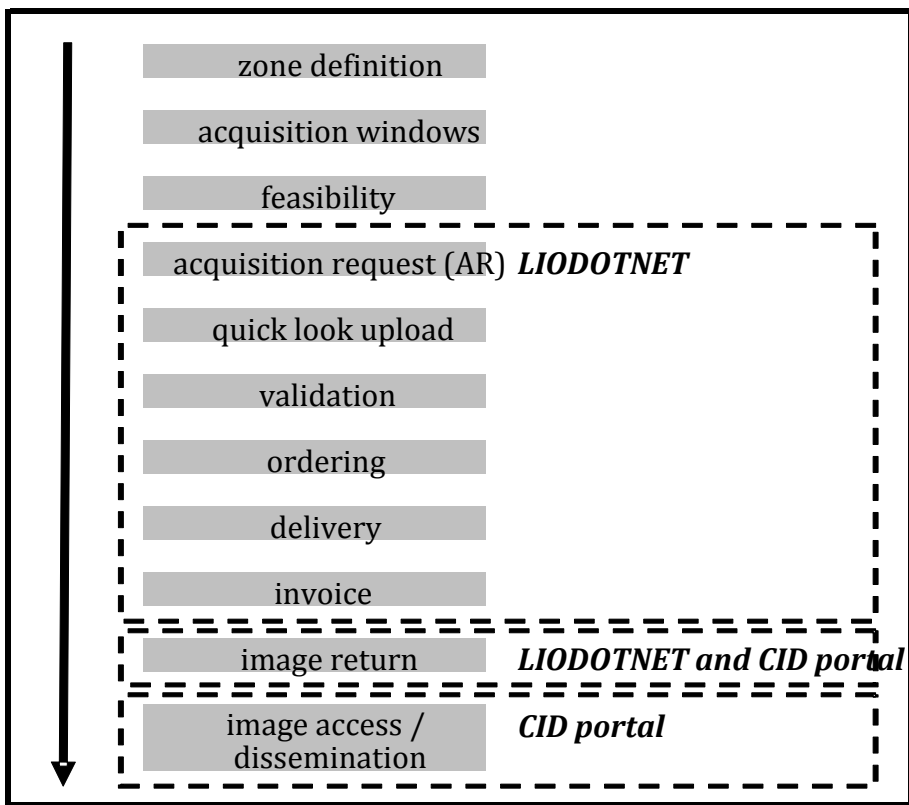


Figure 1 - Figure showing structure of document and image acquisition process flow

2. Zone Definition

2.1. General

2.1.1. The regulatory basis for the CwRS programme is given in Article 20 of Council Regulation (EC) 73/2009 [ref. i] and article 33 to 35 of Commission Regulation (EC) 1122/2009, which allow Member States to use remote sensing techniques as a means of carrying out on the spot (OTS) checks on agricultural parcels. These are further described in the Common Technical Specifications for the Remote Sensing Controls of area-based subsidies [ref ii]. The WikiCAP website [ref iii, iv] on “selection of control zones” recommends that: “*whether the control zones are selected on the basis of a risk analysis or at random, the technical constraints of satellite remote sensing sensors should be taken into account to optimize the probability of acquisition*”. These technical constraints, which are further detailed below, include: swath widths, elevation angles, Area Of Interest (AOI) definition, window adjustments, feasibility assessment, etc.

2.1.2. Article 6 (2) of above Commission Regulation (EC) 1122/2009, as modified by Commission regulation 146/2010, calls for a yearly LPIS QA. VHR Imagery acquired during the CwRS Campaign can be used for LPIS quality assessment providing that the zones satisfy the technical LPIS QA recommendations issued, including minimum elevation angle requirements [ref iv]. MS Administrations not participating in the CwRS programme can request specific acquisitions for LPIS assessment through the EC Services of the JRC.

2.2. Zone parameters

2.2.1. A CAP Control zone (or AOI) consists of a minimum of 4 vertices in Lat/Long Geographic coordinates (decimal degrees, WGS 84 ellipsoid). It is represented by a shapefile containing all files with extensions .shp, .shx, .dbf, .sbx, .sbn, .prj and should be provided by the MS Administration, via EC Services, to the Image Provider. The MS Administration should strive to make shape files of simple, **regular shapes and to avoid creating too narrow corridors (e.g. < 5 km width since IPs are not obliged to deliver bigger area to enable a smooth orthorectification of an image).** **The circles for autumn/winter windows will be used only when the MS Administration does not know the position of**

the VHR zones. VHR zones should fit within the circles. Zones shapes will be rejected by the EC Services if they: (1) overlap within the MS (only in exceptional cases (e.g. the control schemes/measures over the overlapping area are different and require separate windows like crops for vineyards) may this be allowed), (2) overlap adjoining MS borders (this includes Scotland/England/Wales), (3) cover large amounts of mountainous or other non-agricultural areas; (4) stretch into coastal waters. There is no regulatory limit to the number of vertices and no regulatory minimum distance between vertices of the shapefile. The minimum size of a zone is 100 km².

- 2.2.2. As imagery is acquired, depending on the sensor's technical characteristics, the zone is gradually covered entirely or strip-wise. The image provider, which is responsible for the implementation of an efficient image acquisition system, always aims to cover the zone in as few acquisitions as possible, but multi-temporal collection is valid if performed within the time limit of the acquisition window. Such multi-temporal acquisitions should be as close as possible in time since this favours crop interpretation, i.e. "multi-temporality" should be as short as possible.
- 2.2.3. All prime VHR zones are "dedicated zones". This has been judged to give the best programming and acquisition results. This means that for each zone the MS Administration has, after feasibility (see Chapter 4), accepted a dedicated single sensor or a dedicated sensor combination (Constellation Tasking) to be used to cover the zone.
- 2.2.4. Single sensor tasking - each zone is allocated to one prime dedicated sensor:
- GeoEye1 (GE1)
 - WorldView2 (WV2)
 - Quickbird2 (QB2)
 - Pleiades (PL1)[ref xvi]
- 2.2.5. Constellation Tasking - each zone is allocated to one constellation:
- GeoEye1 (GE1) with "enhanced" Ikonos (IK2)
 - WorldView2 (WV2) with Quickbird (QB2)
 - WorldView2 (WV2) with Quickbird (QB2) and WorldView (WV1)
 - WorldView2 (WV2) with WorldView1 (WV1)
- 2.2.6. Constellation GeoEye1 (GE1) with Ikonos (IK2) - here the image provider will task both sensors in an optimal manner to acquire the zone as soon as possible with any of the two sensors. Multi sensor acquisition is accepted. The GE1 product specification has $\leq 10\%$ CC and elevation angle 50-90° while the "enhanced" IK2 product has specification $\leq 5\%$ CC, and elevation angle 67-90°.
- 2.2.7. Constellation WorldView2 (WV2) with Quickbird (QB2) - here the image provider will task both sensors in an optimal manner to acquire the zone as soon as possible with either of the two sensors. Multi sensor acquisition is accepted. The WV2 and the QB2 products have the following specifications: $\leq 10\%$ CC and elevation angle 50-90°.
- 2.2.8. Constellation WorldView2 (WV2) with Quickbird (QB2) and WorldView (WV1) - here the Image Provider will task all three sensors in an optimal manner to acquire the zone as soon as possible with any of the three sensors. If a successful WV1 collection has been acquired, it will be uploaded into LIO as 'proposed'. As long as the contractor / JRC do not accept this image, Image Provider will continue in an 'optimal manner to programme the prime sensors WV2 and QB2 until the end of the window. If the contractor accepts the WV1 collection, all Acquisition Requests (ARs) for the relevant zone will be closed. If the window comes to an end without any WV2 or QB2 acquisitions (or partials only), the contractor is obliged to accept the WV1 collection (in case of partial for the remaining part). Multi sensor acquisition is accepted. The WV2, WV1 and the QB2 products specifications have; $\leq 10\%$ CC and elevation angle 50-90°.

- 2.2.9. Constellation WorldView2 (WV2) and WorldView (WV1) - here the Image Provider will task both sensors in an 'optimal manner to acquire the zone as soon as possible with any of the two sensors. If a successful WV1 collection has been acquired, it will be uploaded into LIO as 'proposed'. As long as the contractor / JRC do not accept this image, Image Provider will continue in an 'optimal manner to programme the prime sensor WV2 until the end of the window. If the contractor accepts the WV1 collection, all Acquisition Requests (ARs) for the relevant zone will be closed. If the window comes to an end without any WV2 acquisitions (or a partial one only), the contractor is obliged to accept the WV1 collection (in case of partial for the remaining part). Multisensor acquisition is accepted. The WV2, and WV1 products specifications have; $\leq 10\%$ CC and elevation angle 50-90°.
- 2.2.10. The positive aspects of the above "constellation tasking" alternatives are that there will be an efficiency gained to complete the zone faster i.e. a reduction of the acquisition time by adding satellite capacity. Also, even though we will have the possibility of having a zone completed by > 1 sensor, there will be more chance that a 2nd acquisition is closer in time to the 1st acquisition i.e. less multi-temporality. **This was demonstrated in the results of the campaign 2012.**
- 2.2.11. When completing any zone, the necessary overlap (E-W or N-S) between subsequent acquisitions or strips should be a minimum of 0.5km. Also there shall be an overlap of a minimum of 0.5 km between any partial acquisitions between sensors acting in constellation. Such overlap is necessary for the orthorectification process.
- 2.2.12. Dedicated backup will not be used as of campaign 2012 onwards. A "speculative" backup may be performed by the "backup sensors" accepted by the MS Administration, chosen from WorldView 1, EROS B, SPOT Supermode (SPS panchromatic or COL), F2, THEOS, IK2 or QB2. Upon request from the MS Administrations and in especially critical circumstances speculative backup may also be performed by **any prime sensor**. However, when the dedicated prime sensor, or constellation of sensors, has fully acquired the zone any speculative backup window will be closed. Speculative backup will be purchased only if necessary (see item 3.1.7)
- 2.2.13. The VHR zone will, if completed by the prime dedicated sensor, be covered either by a bundle image (PAN and MSP as separate bands) or the pansharpened product or the PAN only (case of WV1 acting in constellation). In the case of WV2 the bundle image may contain 4 or 8 MSP bands depending on MS product choice.
- 2.2.14. All zone definition parameters should be defined by EC Services, in conjunction with MS Administrations, and given to Image Providers in the feasibility communication. From the 2012 CAP checks Campaign the MS Administrations will insert main zone parameters directly into LIODOTNET. Relevant zone definition parameters:
- ✓ Member State
 - ✓ Zone name
 - ✓ Dedicated Sensor / Constellation
 - ✓ Speculative Backup Sensor
 - ✓ VHR window (from, to)
 - ✓ Product; bundle or pansharpened or PAN only
 - ✓ Requested Programming; default value: Priority Programming
 - ✓ Delivery; DVD or FTP
 - ✓ Shapefile; files with extensions .shp, .shx, .dbf, .sbx, .sbn, .prj (Lat/Long, WGS84)
 - ✓ Zone (AOI) area (rounded to whole km², UTM)
 - ✓ Maximum Cloud Cover (CC); default values: $\leq 10\%$ GE1, WV2, **PL1A**, WV1, QB2, EROS B, SPOT Supermode (SPS/COL), F2 and THEOS; $\leq 5\%$ IK2.

- ✓ Requested range of angle of elevation²; default values: 50-90° for GE1, WV2, PL1A, WV1, QB2; 57-90° for EROS B; 56-90° for SPOT5, 67-90° for IK2, F2
- ✓ An LPIS tagged zone automatically gets elevation angle uplift to 56-90° when using GE1, WV2, 63-90° when using QB2 and PL1A³ (ref. iv)
- ✓ A zone tagged as mountainous gets elevation angle uplift to 67-90° for all sensors.

3. Acquisition Windows

- 3.1.1. There is normally one VHR image acquisition window defined for each CAP Control zone. This window will be defined by the MS Administrations and will be scheduled suitable for the measurement of the largest number of agricultural parcels possible. Exact dates will depend on crop cycle and will vary with Latitude. In specific cases a second VHR window may be allowed upon request and needs to be justified accordingly. Programming of a second window will depend on available budget.
- 3.1.2. The VHR prime window should be at least 6 but preferably 8 weeks long. If an HR-1 window is open it will close when the VHR prime window opens.
- 3.1.3. If extraordinary weather conditions prevail in any region, a window may change (opening and closing dates move). This will be dealt with on a case by case basis. Such acquisition window date changes should occur in very rare cases. If feasible, notice will be given by the contractor to the EC Services (who will contact the Image Provider) at the latest 2 weeks before scheduled opening.
- 3.1.4. An acquisition window may be extended if none of the prime or constellation tasking or speculative backup tasking has successfully acquired the zone. This will be dealt with on a case by case basis. Notice will be given by the contractor to EC Services (who will contact the Image Provider) at the latest 5 working days before window closure. This will allow the image provider to continue tasking. Such extensions will be made if crop cycle permits, or if the zone has only been partially covered.
- 3.1.5. It is not useful to open an acquisition window too early in the season as the sun angle is generally low and the crops may not have developed sufficiently to provide a scene with adequate contrast for a good delineation of the parcels. It is suggested not to open any window when sun angle is less than 20 deg. in order to ensure sufficient contrast and to minimize the effect of shadows.
- 3.1.6. If a VHR dedicated sensor acquires late in the window, upon request and if budget is available, the EC Services may request an archive search for an earlier HR sensor acquisition within the window.
- 3.1.7. If a window comes to an end with no acquisition or only a partial acquisition, the procedure outlined below will apply:
- ✓ partial acquisition by dedicated prime or constellation sensor will be purchased (minimum deliverable area 100 km²)
 - ✓ area acquired by speculative backup will be purchased. Such speculative backup acquisition may be performed by any sensor requested by MS Administration on a zone. **A speculative acquisition request will be open at the beginning of the window in accordance with a MS image request or IP warning on a potentially difficult zone. The EC Services may therefore open a speculative**

² This document normally uses the term elevation angle and not off-nadir view angle. Relation between the two angles can be seen in Annex.

³ The provisional PL1A elevation angle uplift for LPIS checks is currently under technical evaluation. It could be changed for the CwRS Campaign 2014 based on 2013 Campaign results.

acquisition request over a critical zone during the window even if not chosen by MS Administration from the beginning. If a sensor has completed a speculative backup acquisition, it will be purchased for the area not covered by the dedicated sensor/s at the end of the window. In addition to this complementary area, an overlap area of 0.5km will be purchased. If more than one speculative backup exists the contractor will normally decide which to use (EC Services have the final decision). Decision will depend on elevation angle, resolution and date.

- ✓ acquisitions outside elevation angle specification or outside Cloud Cover (CC) thresholds may be uploaded by the Image Providers as “proposed” and will be accepted if no other imagery is available to cover zone and if the contractor accepts. The price will be the Framework Contract (FC) pricing for a “proposed” acquisition.
- ✓ acquisitions outside the window (i.e. recent archive imagery) may be uploaded by the Image Providers (e.g. upon suggestion by contractors accessing Image Providers’ on-line archives) at the end of the acquisition window. Such imagery will be chosen if no other imagery is available to cover zone and if the contractor accepts. The price will be the FC pricing for an archive acquisition.
- ✓ If none of the above options will provide enough images to complete the area, the acquisition window will be extended for the dedicated prime or constellation sensor and for the speculative backup. Each extension will last for 7 days. If within these 7 days no acquisition by the dedicated prime or constellation sensor is made, the speculative backup will be purchased. The MS will evaluate each week how many extensions are acceptable, based on the status of the cultures.

3.1.8. Upon request from the EC Services, the Image Providers will inform the EC Services of image acquisition status over the zone (e.g. attempts left before window closure, or possible attempt soon afterwards).

4. Feasibility

- 4.1.1. The image requests from the MS Administrations including zone definition parameters (see § 2.2.14) are received by the EC Services.
- 4.1.2. A technical and competitive feasibility by the Image Provider includes among other things; satellite characteristics, zone size, zone shape, zone latitude, elevation angle, acquisition window, priority level, CC, statistical weather forecasting and other competitive tasking requests. All tasking made by EC Services is placed at priority (or rush, or RED) programming.
- 4.1.3. The feasibility assessment, performed by the Image Provider, should divide the zones in 3 categories:
 1. FEASIBLE WITHIN WINDOW (*) - **approaching** 100% probability
 2. FEASIBLE WITHIN WINDOW (*) - 80% probability (may need EXTENSION)
 3. NOT FEASIBLE WITHIN WINDOW - with suggestion to make feasible (extend window to..., allow elevation angle...)

(*) +/- 3 days adjustment of window to fit satellite pass allowed

- 4.1.4. One of the parameters of the feasibility assessment is the elevation angle. It is well known that a lower elevation angle puts higher requirements on ancillary data (DEM, GCPs, etc.) to reach orthorectification accuracy specification thresholds [ref v]. The elevation angle should be kept as high as possible by the Image Providers in order to facilitate

orthorectification. In very few cases the MS Administrations may request a higher threshold than the ones allowed by these Technical Specifications (see § 2.2.14): one is if zone is used within the LPIS Quality Assessment, the second is if the control zone is situated in “hilly”, or mountainous areas (with up to approx. 1000m topography change within control zone), and has complex topology.

- 4.1.5. Considering the cases above, the EC Services will allow 25% of the overall km² given to an Image Provider for feasibility to have an elevation angle restriction between 56°-90°. A maximum of 1/3 of this 25% may be between 67°-90° (i.e. remaining 2/3 between 56°-90°). These elevation angles fit with LPIS imagery restrictions since max. elevation angles are 56°(GE1, WV2) / 63°(QB2, PL1A) - 90°. The topographically difficult zone will have the higher restriction 67°-90°. MS Administrations should bear in mind that they should keep within these % in their request for restriction.
- 4.1.6. The feasibility request from the EC services to the relevant image Providers will be made during January - February of the month before the Campaign start.
- 4.1.7. The MS preferences for a specific sensor are considered as a first decision component for the feasibility, and the feasibility priority is to satisfy these MS requests. Those zones are passed to the relevant Image Provider with the request to perform a feasibility assessment.
- 4.1.8. If there are no or same preferences stated by the MS Administration the information is passed to all eligible Image Providers.
- 4.1.9. Upon return of the feasibility assessments, which should be no later than two weeks after EC Services request, the EC Services will perform a technical judgement with possible re-iterations: if a zone has feasibility class 1, 2 (see above item 4.1.3) it will be given to that Image Provider (class 2 might be re-iterated with the MS Administration to check if he prefers his second choice Image Provider), while if class 3 it will be re-iterated with the 2nd choice Image Provider.
- 4.1.10. Zones of same preference will be given to the provider which proves to give “best value for money”.
- 4.1.11. Finally, an optimum acquisition scenario should be reached, and this result is communicated for acceptance by the MS Administrations.

5. **Acquisition Request (AR)**

- 5.1.1. After the feasibility assessment, dedicated programming is known; an Acquisition Request (AR) for the product is opened in LIODOTNET⁴. Each AR has a unique identifier called ARid.
- 5.1.2. Upon request from Image Provider, or from the EC Services a speculative AR may also be opened over the zone.
- 5.1.3. An Acquisition Request (AR) will close 2 working days after a window end.
- 5.1.4. LIODOTNET functionality is described in its manual available on line from LIODOTNET [ref xiv]. It is a WEB-based informatics application developed by the EC Services in order to manage Acquisition Request (AR), browse image upload, validation, ordering, delivery, invoicing and image return/archiving of satellite images. LIODOTNET is the main communication tool between the CAP checks actors⁵ during the Campaign; its automatic email exchange can be used to synchronize actions between different actors. The web address is <http://lio2.jrc.it/LioDotNet/Default.aspx>.

⁴ LIODOTNET = Live Image Ordering system developed within Microsoft .NET domain [ref xiv]

⁵ Stakeholders, or Actors = JRC, Image Provider, Administration/Contractor performing the CAP Controls

- 5.1.5. Preview of uploaded QuickLooks (QLs) is made using the CID QL Browser which is an online application for displaying and browsing QLs and shape files from the image acquisitions. It is reachable directly from within LIODOTNET (or externally at <http://lio2.jrc.it/pub/lioqlbrowser12/>)

6. QL (Browse Image) Upload

- 6.1.1. Image Provider will “notify” the EC Services of an acquisition through an upload in the LIODOTNET system (or email in case of temporary system unavailability) within 2 working days of an acquisition (validated, proposed, or partial upload).
- 6.1.2. Uploading image acquisition details into the LIODOTNET starts by clicking on the proper AR (giving automatically some of the parameters: zone name, sensor, product, and acquisition type (dedicated, backup, or speculative)). Image details such as ARId, Country (ISO name), Zone Name, Product, Acquisition date (dd-mm-yyyy), CC (%), Haze Flag, Elevation angle, Display order (the display order of the given layer in the VHR Browser), Provider status (Validated, Proposed, not required), Filename etc. are defined in the XML⁶ file. The XML file with image QL, shapefile and other necessary files for georeferencing are zipped and uploaded.
- 6.1.3. Image Providers may also use an automatic upload of their image acquisition details. In this case email should be sent to a generic mailbox lio.net@jrc.ec.europa.eu The automatic upload will generate the same Email notification as a normal upload. In automatic upload it is essential to specify the ARId in the XML: <ARId>21041</ARId>⁵
- 6.1.4. Upon upload of dedicated or backup acquisition the LIODOTNET system will automatically send message to subscribed users. The other Image Providers are included in this message in order to avoid any unnecessary speculative backup tasking. User subscription in general is done through the LIODOTNET system, where also filters for which emails to receive may be applied.
- 6.1.5. A speculative backup is also introduced in LIODOTNET according to above procedure but will NOT be visible to contractors until the end of the window. **To enable an efficient programming of sensors a speculative collection uploaded in LIODOTNET is visible to other relevant IPs for which a speculative AR is opened.**
- 6.1.6. The Image Providers’ own archives may be consulted by the contractors (services are normally free of charge and subject to subscription). Such archives include DigitalGlobe Browse Tool for QB, WV2 and WV1⁷, SPOTImage (DALI) for SPOT images, GeoEye’s GeoFUSE⁸ for IK2 and GE1, **GEOSTORE of ASTRIUM for PL1A and SPOT family** etc. Contractors may consult these archives and propose any imagery suitable for their controls activity to the EC Services; the EC Services will proceed, via the Image Providers, to upload QLs of such imagery into LIODOTNET for acceptance.

7. Validation

- 7.1.1. Validation may be performed over the whole zone or over a part of a zone (partial upload). It is always done on intersection of the “upload (or acquisition)” with the zone shapefile. The “upload (or acquisition)” has one date, is a contiguous area, and has a regular and simple shape. It is a strip/multiple strip for GE1, IK2, WV2, **QB2**, WV1, **PL1A**, EROS B, and is images for SPOT5 Supermode, and F2.

⁶ XML File Specification – see Annex 18.1

⁷ <http://browse.digitalglobe.com/imagefinder>

⁸ <http://geofuse.geoeye.com/>

- 7.1.2. For a VHR zone the validation of an upload is done on the basis of CC content. Haze, which is not considered cloud by image provider, does not cause rejection but is flagged (see below § 7.1.99) and may trigger an extra re-tasking. The image provider uploads georeferenced QL and relevant XML file including CC assessment (following established CC threshold criteria) and haze assessment (haze flag) into LIODOTNET.
- 7.1.3. VHR CC thresholds are defined as follows:
- ✓ A “validated” acquisition is defined by a maximum CC of $\leq 10\%$ for GE1, WV2, PL1A, WV1, QB, EROS B, SPOT SPS, and F2; $\leq 5\%$ for IK2. Validation of imagery is done within 2 working days by EC Services (no action in required by contractor). Validated images are delivered directly to contractor (after order has been received by image provider from the EC Services) having passed through Quality Control (QC) of the Image Provider (see Chapter X Delivery, and X Quality Assurance / Quality Control)
 - ✓ A “proposed” acquisition is defined by a CC of $> 10 \leq 30\%$ for GE1, WV2, PL1A, WV1, QB, EROS B, SPOT SPS, and F2; $> 5\%$ for IK2. Proposed images are delivered to the contractor only upon final agreement by EC Services. Programming continues for better acquisitions during the period of accept/decline which must not exceed 3 working days. The Commission notifies the image provider through LIODOTNET and thus gives instructions on future collection. After an “accept” the proposed scene goes through QC of the Image Provider and is shipped to the contractor (after order has been received by image provider from the EC Services).
- 7.1.4. Validation of a series of “proposed” acquisitions (uploads) - the VHR Image Providers have agreed to provide “all” the “proposed” acquisitions to the contractor if the contractor accepts one “proposed” acquisition over his control zone. The contractor should therefore react within time limit on “proposed” acquisition (3 days), and reject if not usable; however keeping in mind that when further “proposed” acquisitions are made available over the same zone these can be used together with already rejected acquisitions by him.
- 7.1.5. In the case of constellation tasking (option Constellation including WV1 (see above Chapter 2.2.8, and 2.2.9), it should be noted that WV1 is uploaded as “proposed” and contractor may accept or let tasking of the prime WV2 with QB2, or prime WV2, continue until end of window.
- 7.1.6. The contractor and image provider should produce regular mosaics of “proposed” imagery to aid in decision on usability of such series of acquisitions. “Accept” of a series of “proposed” acquisitions will allow Image Providers to release satellite capacity for other zones.
- 7.1.7. Re-upload of a rejected acquisition – image provider may re-upload part of a rejected “proposed” acquisition if it, in combination with, a new “validated” acquisition serves to complete a zone. The re-uploaded “proposed” acquisition has to be of “validated” CC threshold, of one date, be a contiguous area, and has to have a regular and simple shape.
- 7.1.8. In case of a conglomeration of CC within part of a large acquisition, this part (minimum 100km²) can be re-tasked, upon request of the EC Services, even if whole acquisition is “validated”. A new AR will be issued for this part of the zone if contractor cannot use the portion of the validated acquisition covered by the CC conglomeration. Contractor will have to follow procedure similar to section below (Haze flag) in order to prove that the re-tasking is required by the EC Services. Decision will be taken by EC Services within 3 working days.
- 7.1.9. VHR Haze flag is validated as follows:
- ✓ Validated CC upload with flag for dense haze - the flag will trigger an e-mail to the Contractor who will assess if the dense haze prevents control of the parcels. This will be done within 3 working days by contractor who has to answer the EC Services on following issues in order for decision on possible re-tasking to be taken:
 - prepare a shape file of the control parcel structure (lat/long DD WGS 84);

- assess preliminary T4 coding due haze (reference CTS [ref ii]);
- check if any proposed image is available;
- check if any backup images are available (EC Services will inform of any speculative images are available);
- assess whether opening of an HR image may satisfy Computer Assisted Photo Interpretation (CAPI) needs and haze image is still acceptable for parcel measurement;
- assess whether the haze image can be used if an atmospheric correction sw is applied to imagery. It should be kept in mind that the image viewed is a QL, which is always inferior in quality compared to the real source image⁹.

If the above steps cannot ensure a successful control procedure:

- prepare (possible) new shape file, if not complete zone, to re-collect (minimum 100km²);
- decide on a new window, and assess the time delay that a re-tasking implies for the success of your control procedure;

Upon reception of above information from the contractor the EC Services will take a decision to collect additional imagery (re-task) over part of the control zone based on technical and financial justification.

- ✓ Proposed CC upload with flag for dense haze - treated as proposed “acquisition”

8. Ordering

- 8.1.1. Normally an order is placed when the whole zone is fully covered, but a partially covered zone may be ordered at the MS contractor’s request. This is to be considered exceptional, and will only be accepted if contractor is clearly suffering a time constraint. The area to be ordered is calculated (rounded to whole km²) as the intersection between georeferenced QLs of collection (using final ephemeris data) with the zone in geographic projection UTM/WGS 84.
- 8.1.2. Ordering of all imagery will be made using the EC Services’ LIODOTNET system, and sent to the Image Provider in digital form. Order will contain all relevant acquisition details¹⁰ including:
- European Commission - Joint Research Centre (JRC), Institute for Environment and Sustainability, IES, order #, Acquisition Request ID (ARid)
 - VHR: country, zone, period, state, area, acquisition date, elevation angle, product, CC, delivery media
 - delivery address
 - any other order parameters according to Chapter 12 Products.
- 8.1.3. Orders will be made in order letters containing as many zones as possible /one country /one contractor. Only in exceptional cases will an individual or partial zone be ordered.
- 8.1.4. To reduce the administration ordering of all dedicated imagery will be done at regular intervals (e.g. end of week) after acceptance of validated acquisition (complete or partial).
- 8.1.5. Ordering of speculative backup imagery, and any archive imagery, will be done after window closure.

⁹ EUSI, provider of WV1, WV2and QB, may upon request provide final image on FTP for haze evaluation

¹⁰ Extracted from zones definition parameters (§ 2.2.13), and metadata as defined in XML (§ 6.1.2)

- 8.1.6. All orders will be placed with commercial priority tasking (GE1, IK2, WV2, WV1, QB2, PL1A, F2), rush service (EROS B), and Red Programming (SPOT).

9. Delivery

- 9.1.1. Delivery will normally take place after completion of the whole zone. The product will thus contain imagery covering the whole zone, possibly of more than one date (many validated partial acquisitions), in the format and on the media asked for. If requested by the contractor, delivery of validated "proposed" imagery will include "all" proposed uploads over the zone.
- 9.1.2. Partial delivery may occur upon special request by a contractor, or when acquisition window has come to an end, or when image provider reports his tasking over the zone is finished. As a minimum (single partial delivery) the product will have one acquisition date, be of a minimum 100km² of contiguous area, and have a regular and simple shape.
- 9.1.3. The contractual delivery period (production, internal QC, and ex-works availability) agreed with the EC Services from the date of ordering are 6 working days for VHR data.
- 9.1.4. Images (after validation according to procedure in Chapter 7) are delivered directly to the contractor after having passed through the internal Quality Control (QC) of the Image Provider.
- 9.1.5. The contractor receives a "delivery note", through LIODOTNET, as soon as the product is shipped by the Image Provider. The delivery note includes order #, Acquisition Request ID (ARid), Acquisition ID (Aid). If product is delivered via FTP, the delivery note will contain also the FTP address, username and password (in some cases such information is also contained in the comments textbox of the upload itself).
- 9.1.6. If product is delivered on FTP, please bear in mind that FTP download of e.g. a 1.4 GByte scene at 1MBit/sec takes approx. 3½ hours. The contractor must download the product within 8 working days of the day placed on ftp server by image provider.
- 9.1.7. All Image Providers will not only deliver product to the contractor on DVD or FTP as requested, but will also deliver product to the EC Services on specific FTP account for automatic harvest (see Chapter 11 Image Return)
- 9.1.8. Introduction of checksum for correct delivery between Image provider and Contractor:

Virtually all image data for the CAP checks campaigns are now downloaded by JRC and contractors via FTP from the servers of the Image Providers. Due to possible service and connection interruptions the correct and complete download of files needs to be ensured. Currently this check can only be performed by running the full processing chain since no information about the individual files is supplied.

In order to enable contractors (and JRC) to check correct and complete download of image data from the FTP servers of the Image Providers, the JRC requests the following implementation of MD5 checksum files from the Image Providers:

The Image Providers shall create a separate MD5 checksum file for every data directory/subdirectory that contains data. This file shall be named "checksum.md5" and shall be placed together with the data files in the same directory. The creation of the checksum files shall be performed **before** placing the image data on the FTP server (during the copy of the large files data can get corrupted, but the MD5 checksums must be calculated for the correct data files).

The "checksum.md5" file shall have one line per file starting with the MD5 alphanumerical (**not** hexadecimal) checksum followed by exactly 2 blanks (or 1 blank and an asterisk) and then the file name. A sample structure would be eg.:

- 9558cbff3cdb7e614fe0ce42c5be66b7 img_01.tif
- 106eca73e7f6104c93f279b15d3d7864 img_02.tif

- 6f8f0b02bdfb88e0310595ec5cd35cab img_01.gcp.txt

MD5 checksums can be read and created by all programming and scripting languages. So the creation of these checksum files can easily be integrated in any data preparation chain. Manual creation of the checksum files can easily be performed by using the command line tool md5sum (Unix/Mac) or md5sum.exe (MS Windows). The launch of this tool can also be put in simple scripts (like batch or shell scripts).

Creation of the checksum.md5 files with md5sum:

Unix console:

```
$ cd directory_of_the_data_files
directory_of_the_data_files$ md5sum * > checksum.md5
```

Windows command line:

```
d:\> cd directory_of_the_data_files
d:\directory_of_the_data_files\> md5sum.exe * > checksum.md5
```

Depending on CPU and the speed of file system, creating the md5 file for a directory with 15-20 GB data should take 2-3 minutes.

Using the checksum.md5 file to check complete download:

On the command line console:

```
d:\> cd directory_of_the_data_files
d:\directory_of_the_data_files\> md5sum.exe -c checksum.md5
```

this will give out something like

```
img_01.tif: OK
img_02.tif: OK
```

...

or (if some checksums do not match):

```
img_01.tif: OK
img_02.tif: FAILED
```

...

```
md5sum: WARNING: 1 of 28 computed checksums did NOT match
```

or if a file is missing give out

...

```
md5sum: img_03.tif: No such file or directory
md5sum: WARNING: 1 of 28 listed files could not be read
```

The checks can as well be integrated in download scripts to automatically check files after finished download.

The Windows executable can be downloaded e.g. here:

<http://etree.org/cgi-bin/counter.cgi/software/md5sum.exe>

On Linux this is usually already installed.

- 9.1.9. The contractors will insert the actual date of receipt of ALL products linked to the single order in LIODOTNET (order page). LIODOTNET will remind contractor to fill in the image receipt once a day every working day after 6 days (contractual delivery time). The contractor will also fill in the Input Data Quality Assessment (IDQA) on the order page within 5 working days of reception and LIODOTNET will, also here, remind contractor to fill this in. These actions will allow

- ✓ the EC Services to assess whether the observed delays comply with those agreed with the Image Providers
- ✓ to trigger the invoicing procedure

- ✓ assess initial quality of delivered imagery

If there is a delay in the nomination of the contractor then the MS Administration must perform all contractor actions.

9.1.10. Upon request from the EC Services, the Image Provider will inform on Image production/QC status (production pending, production finished, production date)

10. Invoicing

10.1. Pricing

10.1.1. Pricing for products will be according to Framework Contracts (FC) stipulated with the Image Providers [ref vii], or amendments thereto.

10.2. Invoicing

10.2.1. As soon as image dispatch has been made by the image provider, they will send a “draft” invoice to the EC Services. They will “tick” the draft invoice “sent” box in LIODOTNET (order page). Each “draft” invoice will be checked by the **Financial Unit of the EC Services** within 5 working days of reception.

10.2.2. **In previous Campaigns** a “final” invoice could be sent by the Image Provider to the EC Services only after the IDQA is **was** filled in by the contractor **or MS Administration** (see § 9.1.9 above). LIODOTNET will notify Image Provider when IDQA is filled in by contractor so Image Provider may issue final invoice. **From 2013 Campaign - if the IDQA is not filled in by the contractor or MS Administration in the established 7 working days from dispatch of the imagery, the Image Provider may send the final invoice to the EC Services. The order page in Lio.Net will be updated later.”**

10.2.3. If IDQA is not satisfactory and therefore fails (or issue is waiting to be solved) there is the possibility for the Image Provider to make partial invoicing of the orders that have been accepted and IDQA:ed positively.

10.2.4. Final Invoices are to be sent to the EC Services at the following address:

**European Commission
Joint Research Center
Unit B.05 Finance and Procurement
Via E. Fermi 2749, TP 263
I-21027 Ispra, Italy**

10.2.5. The **Financial Unit of the EC Services** will proceed with payment if imagery is collected according to given specifications and invoicing by image provider follows the procedures described above. The EC Services’ payment terms as defined in FCs is calculated from date of reception of final invoice in the CAD Office of the JRC, Ispra.

11. Image Data Return and Image Access

11.1. Image Data Return

11.1.1. Since the 2009 campaign all source imagery supplied to the EC Services has been harvested automatically by the EC Services. For this purpose each Image Provider will provide the EC services with access to either an FTP account with a "Country / Zone_name / Image_1" directory structure under it, or to one FTP account per country with a "Zone_name / Image_1" directory structure under each of them. The Image Provider should provide such account independent of delivery media to contractors.

11.1.2. The VHR ortho-corrected imagery used in the CAP checks Campaign must be returned to the EC Services at JRC, Ispra no later than 01.12.2013. The delivery should include the data and the necessary documentation:

- ✓ metadata describing content of CD/DVD will be introduced in LIODOTNET under the menu "Image Returns"; one image return # will be given for each PERIOD (VHR), and PROCESSING LEVEL (ortho).
- ✓ also, a specific XML metadata file needs to be compiled and provided. Please read carefully the instructions and use the online form at:

<http://cidportal.jrc.ec.europa.eu/public-tools/image-return/metadata/>

Fill in the required information, then create and save the XML file. Place this XML file together with your orthoimage file keeping the naming convention "*_meta.xml" as mentioned in the online instructions. All images will be stored on the CID portal server and will be available to the MS Administrations under specific conditions (see Chapter on Image Access below).

- 11.1.3. For the VHR images, for every single image received by the contractor, all bands that have been orthorectified shall be returned in GeoTIFF or Erdas IMAGINE (HFA) format. If an uncompressed (possibly pansharpened) mosaic of the zone is available, this can be returned instead or in addition to the single images. For mosaics of the full control zone it is not required to provide the "*_meta.xml" file as mentioned above for every single mosaic tile. In this case it is sufficient to provide the required information in a single file named "mosaic_meta.xml". It is absolutely mandatory to specify the coordinate reference system (CRS) associated to every single product as an EPSG code (<http://www.epsg.org/Geodetic.html>). In case an EPSG code does not exist for the CRS used in the product, the CRS specifications shall be provided in Well Known Text format (description in the OpenGIS Project document 01-009 available at <http://www.opengeospatial.org/docs/01-009.pdf>).

11.2. Image Access

- 11.2.1. MS Administrations may access imagery purchased by the EC Services. This image access needs to follow principles set up in the Licensing Agreement between the Supplier (Image Provider) and the EC Services, in the respective Framework Contract [ref. vii]. A specific EULA (End User License Agreement) following these principles will be presented to the user upon data access at CIDportal Registration [ref viii].
- 11.2.2. Images used in above operations may neither be disseminated nor the resulting products sold. Image access and return should be arranged through the CID server of the EC Services, Ispra.
- 11.2.3. **The EC Service purchases a limited right to the use of the images, but the images themselves remain the property of the Image Providers.**

The End User of the imagery provided must abide the provisions of the End User Licence Agreement (EULA), which is compliant with the Licensing Terms and Conditions agreed upon by the JRC and the Supplier. In accordance with the EULA (Ref. viii, Chapter 6 on IPRs) imagery must have proper references. When using the imagery the Licensee needs to refer to the supplier with the exact display of the credits as specified in the product's metadata e.g.:

"© owner or supplier name or mission name (year of acquisition, or validity of Framework Contract), all rights reserved)". In addition, the End User should indicate the following information: "data received via the Joint Research Centre of the European Commission".

12. Sensors and Products

12.1. GeoEye-1 (GE1) prime (or constellation with IK2)

- 12.1.1. The GE1 system is built to acquire large areas in a single pass (up to 100x100 Km or 300x50 Km), anyway the best efficiency (meaning the capacity to acquire as many zones per pass as possible) is achieved with zones up to 40x40 Km.

12.1.2. At launch the GE1 system could acquire forwards and backwards (bi-directional scan) giving a very high collection rate. Today it acquires only in one scan direction but is still capable of acquiring at a sufficient rate (thanks also to the recently introduced Enhanced Line Rate scanning mode, which allows to scan at 20,000 lps also for colour acquisitions), and can still acquire large zones in one orbit path. The satellite is designed to work in a preferred East-West scanning direction (but it works also North-South), therefore it is especially recommended for zones having an E-W orientation.

12.1.3. Due to its very high resolution and high geo-location accuracy, this satellite is especially recommended for zones where CAPI of specific crops could benefit from the higher resolution of both the panchromatic and multispectral data, or where there is a need to get very high ortho accuracies and there are not many (or good) GCPs.

12.1.4. For benchmark tests see [ref. ix]

12.1.5. For GE1 the products ordered will be /km²:

- Geo products (which include RPCs)
- Bundle (Panchromatic and 4 Multispectral bands as a single 4-layers file), or Pansharpened (4 multispectral bands at PAN resolution, provided as a single 4-layers file); on request Multispectral and Pansharpened products can also be produced as 4 separate files; Pansharpened orders will be acquired using the ELR (Enhanced Line Rate), while Bundle orders will be acquired as SLR (Standard Line Rate)
- Bundle (Panchromatic and 4 multispectral bands as 4 separate files or as a single 4-layers file), or Pansharpened (4 multispectral bands at PAN resolution, provided as 4 separate files or as a single 4-layers file)
- Resolution at nadir 0.41m PAN (resampled to 0.5m), 1.65m MSP (resampled to 2.0m)
- Swath width at nadir is 15.2km
- Elevation angle 50-90°
- Cloud cover “validated” 0 - ≤ 10%, “proposed” > 10 - ≤ 30% CC
- Resampling CC
- Format GeoTIFF
- DRA (dynamic range adjustment) off
- bit depth 16 bit (image 11bit)
- UTM Datum WGS84
- Commercial Priority Tasking
- DVD delivery or FTP delivery
- Until specific module is provided for GE1 by sw vendors the EC services have reached very good orthorectification results using:
 - ✓ PCI 10.1 Geomatica OrthoEngine (RPC IK2 model, degree 1 polynomial)
 - ✓ ERDAS LPS 9.2. (RPC IK2 model, degree 1 polynomial)
- GE1 maximum component size 4GB

12.2. WorldView2 (WV2) prime (or constellation with QB2 or QB2/WV1 or WV1)

12.2.1. The WV2 system is built to acquire large areas - typically more than 100x100 km in a single pass, as well as multiple single shot (point) targets. However, an efficient collection scheme is achieved with zones of approx. 40x40 km which will provide a moderate to high area yield per pass. Due to the extreme agility of the satellite another efficient collection scenario is multiple single shots of 15x15 km. A mix of both scenarios is also acceptable.

12.2.2. W2 acquires in forward and backward (bi-directional) scan. Together with the very fast slewing and the wide image swath of 16.4 km at nadir this leads to a very high collection rate. The satellite can scan in north-south, east-west or any other arbitrary direction (scan azimuth) in between. Because of the extreme agility of the satellite the individual orientation of each AOI is of less importance. However, in the interests of the overall project a consistent AOI orientation will be more auspicious, either a combination of a) more or less square zones plus north-south oriented zones, or b) square zones plus east-west oriented zones. Option a) is slightly preferable.

12.2.3. WV2 features a very high resolution, high geolocation accuracy, 8 multispectral bands and extreme agility. Therefore it is especially recommended for the following cases: a) zones where CAPI of specific crops benefits from the high spatial resolution of both the panchromatic and multispectral data, b) zones that need very high ortho accuracies, c) applications that may benefit from the increased spectral resolution, and d) areas with high density of control zones (AOIs) or exceptionally large control zones that benefit from the satellite's collection capacity due to its agility.

12.2.4. For benchmark tests see [ref. x]

12.2.5. For WV2 the products ordered will be /km²

- Ortho Ready Standard Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1))
- Ortho Ready Standard Pansharpened 4 Bands (BGRNIR)
- Ortho Ready Standard Bundle 8 bands (PAN plus 4 Bands MS (BGRNIR1) plus 4 Bands MS2 (Coastal, Yellow, RedEdge, NIR2))
- Resolution 0.46m PAN (resampled to 0.5m), 1.84m MSP (resampled to 2.0m)
- Swath width at nadir 16.4 km
- Elevation angle 50-90°
- Cloud cover "validated" 0 - ≤ 10%, "proposed" > 10 - ≤ 30% CC
- Resampling Cubic convolution
- Format GeoTIFF
- DRA (dynamic range adjustment) off
- bit depth 16 bit (image 11bit)
- UTM Datum WGS84
- **Special** Priority Tasking
- DVD delivery or FTP delivery
- UTM Datum WGS84
- Image tiling:
 - ✓ 4 Band Bundle (32k x 32k tiling): MUL files have a max of 537 MB/tile, PAN files have a max of 2,140 GB /tile
 - ✓ 8 Band Bundle (32k x 32k tiling): MUL files have a max of 1,073 GB/tile, PAN files have a max of 2,140 GB /tile
 - ✓ 4 bands PSH (22k x 22k tiling): files have a max of 3,872 GB/tile

12.3. Pleiades prime (PL1)

- 12.3.1. Pléiades is composed of two twin satellites (PL1A, and PL1B¹¹) operated as a real constellation: on the same orbit and phased 180° one from the other. This orbit phasing allows the satellites to revisit any point on the globe daily.
- 12.3.2. The Pleiades system can acquire large areas - strip mapping over large areas, typically up to 5 contiguous strips of 150 km each in a single pass, as well as multiple single shot (point) targets. Due to the extreme agility of the satellite another efficient collection scenario is multiple single acquisitions of 20x20 km during the same pass, typically 20 images within a country of 1000x1000 km. A mix of both scenarios can be used as well.
- 12.3.3. Pleiades acquires in forward and backward (bi-directional) scan. Together with the very fast slewing and the wide image swath of 20 km at nadir this leads to a very high collection rate. The satellite can scan in north-south, east-west or any other arbitrary direction (scan azimuth) in between.

12.3.4. For benchmark tests on PL1A see [ref. xv, xvi]

12.3.5. For Pleiades (PL1A) the products ordered will be /km²

- Primary Product (equivalent 1A level of processing): Bundle 4 bands (Panchromatic Band and the 4 Multispectral Bands (B,G,R,NIR)
- Primary Product: Pan-sharpened 4 Bands (B,G,R,NIR)
- Resolution: 0.50m Panchromatic and 2.00m Multispectral from GSD of 0.70m, 2.80m respectively
- Elevation angle: 50-90°
- Cloud cover: “validated” 0 - ≤ 10%, “proposed” > 10 - ≤ 30% CC
- Resampling: Shannon Sampling (Spline kernel), deconvolution/denoising/zooming
- Image format: GeoTIFF or JPEG 2000
- File format DIMAP V2
- Linear Adjustment optional on/off or tailored to need
- Bit depth: 8 or 12 bits for JPEG 2000, 8 or 16 bits for GeoTIFF
- Compression rate (for JPEG 2000 only): Optimised or Regular (= lossless)
- Tasking service: Standard, Priority
- DVD (4.7 GB max), FTP or Hard Drive (500 GB) delivery
- Swath width at nadir: 20 km
- UTM Datum WGS84
- Image tiling: Products exceeding a certain size limit are broken up into smaller pieces called “tiles” constituting the whole product. Each tile can be opened separately.

If a product is not tiled, the filename is: ‘product_R1C1.JP2’ (Row 1, Column 1)

If a product is tiled, there are as many image files as tiles, named ‘Product_RiCi.JP2’.

```
IMG_PHR1A_PMS_201202250025599_ORI_IPU_20120523_2858-001_R2C2.JP2
IMG_PHR1A_PMS_201202250025599_ORI_IPU_20120523_2858-001_R2C1.JP2
IMG_PHR1A_PMS_201202250025599_ORI_IPU_20120523_2858-001_R1C2.JP2
IMG_PHR1A_PMS_201202250025599_ORI_IPU_20120523_2858-001_R1C1.JP2
```

A georeferencing worldfile J2W (or TFW for GeoTIFF products) is associated to each image tile.

¹¹ Pleiades1-B (PL1B) was launched successfully on the 2/12/12 and is at presently undergoing commissioning. It will be included in the CAP checks as soon as benchmarked by the EC Services.

IMG_PHR1A_PMS_201202250025599_OR_T_IPU_20120523_2858-001_R2C2.J2W
IMG_PHR1A_PMS_201202250025599_OR_T_IPU_20120523_2858-001_R2C1.J2W
IMG_PHR1A_PMS_201202250025599_OR_T_IPU_20120523_2858-001_R1C2.J2W
IMG_PHR1A_PMS_201202250025599_OR_T_IPU_20120523_2858-001_R1C1.J2W

All other metadata (RPC XML and DIM XML) are not tiled and are applicable to the whole product

Tile size limit is approximately:

- 2 GB file size for GeoTIFF products
- Max. 4 GB file size for JPEG 2000

In the future, this limit could change as software capabilities progress.

The tile size is constant, meaning all tiles have the same volume (Mb/Gb), with a possible exception of the tiles in the last rows and columns, as black fill pixels are not included to fill the constant size.

- The tiles of the first row begin at the upper and left borders of the bounding rectangle of the AOI
- The tiles of the last row and column are trimmed to the bottom and right borders of the bounding rectangle of the AOI
- Tiles are not overlapping

12.3.6. The preferred software suites (with relative versions) for orthorectification are: standard Commercial Off-The-Shelf PCI Geomatica 2013, ERDAS 2011 (release 2011.0.5) and ENVI 5 (Service Pack 1, version classic), and Astrium in-house Pixel Factory 4 (Patch 6).

The Quickbird (QB2) prime (or constellation with WV2 or WV2/WV1) / **speculative backup**

12.3.7. The satellite tasking optimisation may be reached by ordering single areas of 14km width with variable length (approx. 20-90km). Up to two strips over one target can be acquired on specific near-nadir passes, but more than 1 strip usually requires multiple passes. The most efficient scenario is N-S aligned strips, although the satellite is capable of acquiring also diagonally, or horizontally, when necessary or more optimal in some cases.

12.3.8. Due to the very high resolution of the QB sensor there will be a tendency to assign this satellite sensor to zones with small parcel sizes, or where CAPI of specific crops could benefit from the higher resolution of both the panchromatic and multispectral data.

12.3.9. For QB2 the products ordered will be /km²:

- Standard Ortho-Ready (or Standard 2A)¹², Basic format (1B)¹³
- Bundle (Panchromatic and 4 multispectral separate bands; 2 files), or Pansharpened (4 multispectral bands at PAN resolution; 1 file)
- Resolution PAN 0.6 / MSP 2.4m
- Off-nadir angle 0-37° (elevation angle 50-90°), (see Annex for conversion between the two angles)
- Cloud cover “validated” 0 - ≤ 10%, “proposed” > 10 - ≤ 30% CC
- Resampling Cubic Convolution
- Format GeoTIFF 1.0
- bit depth 16 bit (image 11bit)
- UTM Datum WGS84
- **Special** Priority Tasking
- DVD delivery or FTP delivery
- Image tiling:
 - ✓ 4 Band Bundle (32k x 32k tiling): MUL files have a max of 537 MB/tile, PAN files have a max of 2,140 GB /tile (*) under implementation if not ready will be 16kx16k)
 - ✓ 4 bands PSH (22k x 22k tiling): files have a max of 3,872 GB/tile (*) under implementation if not ready will be 16kx16k)

¹². A Standard Image is radiometrically calibrated, corrected for sensor and platform-induced distortions and mapped to a cartographic projection. More in detail the radiometric corrections applied to the Standard 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 incorrect registration of the multi-spectral bands. Geometric corrections remove spacecraft orbit position and attitude uncertainty, earth rotation and curvature, and panoramic distortion. Additionally, a coarse DEM is used to normalize for topographic relief with respect to the referenced ellipsoid. The degree of normalization is relatively small, so while this product has terrain corrections, it is not considered orthorectified. The Ortho-Ready Standard product (OR Standard 2A) is also available, without use of the mentioned coarse DEM, which allows ortho-rectification with accuracies comparable to those obtained from Basic Imagery. EC Services are obtaining very good orthorectification accuracies with this Std Ortho Ready format (OR Standard 2A) using the Rational Polynomial Coefficients (RPCs), and adequate ancillary data (GCPs, DEM) both for QB, and in initial tests of WV1.

¹³ Basic format (1B) is delivered only upon request since the Std Ortho Ready format (2A) with Rational Polynomial Coefficients (RPCs) is giving very good results⁴. Basic imagery is the least processed image product; only corrections for radiometric distortions and adjustments for internal sensor geometry, optical and sensor distortions have been performed. This imagery is more difficult to handle, it has pixel size depending on off-nadir view angle, requires reference data of higher quality, and more GCPs to orthorectify. The format however includes orbital parameters (ATT and EPH) updated every 0,02 seconds of an acquisition scan and allows more accurate modelling of the acquisition. In the specific case a sw suite requires the Basic format for orthorectification this format may be delivered by the EC Services.

- With the delivered QB products there is the folder named GIS_FILES with detailed shape files of the different tiles provided, which gives an overview of the product structure.

12.4. The Ikonos2 “enhanced” (IK2) (constellation with GE1) / speculative backup

12.4.1. The most efficient IK zone, for the purposes of a large set of CAP Control zones, is a 30x30 km² square acquired in one pass consisting of 3 strips of 10km width (technically the IK2 sensor may acquire also larger areas in one acquisition; 20x40km, 20x60km, 40x60km).

12.4.2. The IK2 system can acquire forwards and backwards giving a high collection rate, which means that there will be a tendency to acquire larger zones with this satellite sensor.

12.4.3. For IK2 the products ordered will be /km²:

- Geo products (which include RPCs)
- Bundle (Panchromatic and 4 Multispectral bands as a single 4-layers file), or Pansharpened (4 multispectral bands at PAN resolution, provided as a single 4-layers file); on request Multispectral and Pansharpened products can also be produced as 4 separate files
- Resolution at nadir 0.82m PAN (products can be provided at full resolution or resampled to 1m), 3.28m MSP (products can be provided at full resolution or resampled to 4m)
- Swath width at nadir is 11.3 km
- Elevation angle 67-90° (i.e. off-nadir angle 0-36° for IK), (see Annex for conversion between the two angles)
- Cloud cover “validated” 0 - ≤ 5 %, “proposed” > 5 - ≤ 30 % CC
- Resampling Cubic convolution
- Format GeoTIFF 1.0
- DRA (dynamic range adjustment) off
- bit depth 16 bit (image 11bit)
- UTM Datum WGS84
-
- Commercial Priority Tasking
- DVD delivery or FTP delivery
- IK2 maximum component size 4GB

12.5. The WorldView1 (WV1) (constellation with WV2 or WV2/QB2) / speculative backup

12.5.1. WV1 acquires in forward and backward (bi-directional) scan. Together with the very fast slewing and the wide image swath of 17.6 km at nadir this leads to a very high collection rate. The satellite can scan in north-south, east-west or any other arbitrary direction (scan azimuth) in between. Because of the extreme agility of the satellite the individual orientation of each AOI is of less importance. However, in the interests of the overall project a consistent AOI orientation will be more auspicious, either a combination of a) more or less square zones plus north-south oriented zones, or b) square zones plus east-west oriented zones. Option a) is slightly preferable.

12.5.2. WV1 features a very high resolution, high geolocation accuracy, and extreme agility. Therefore it is especially recommended for the following cases: a) zones where CAPI of specific crops benefits from the high spatial resolution of the panchromatic data, b) zones that need very high ortho accuracies, and c) areas with high density of control zones (AOIs) that benefit from the satellite's collection capacity due to its agility.

12.5.3. The quality and efficiency of the WV1 data has been assessed by the EC Services (ref xi)

12.5.4. WV1 data will normally be used as a speculative backup at the Administration's request and most often in difficult climatic zones (e.g. above 45 ° Lat.), or of zones which present difficulties in the feasibility assessment.

12.5.5. For WV1 the products ordered will be /km²:

- Standard Ortho-Ready (OR Standard 2A), Basic format (1B)
- the data is panchromatic (PAN)
- Resolution 0.50m
- Off-nadir angle 0-37°, (elevation angle 50-90°), (see Annex for conversion between the two angles)
- Cloud cover "validated" 0 - ≤ 10%, "proposed" > 10 - ≤ 30% CC
- Resampling Cubic Convolution
- Format GeoTIFF 1.0
- bit depth 16 bit (image 11bit)
- UTM Datum WGS84
- **Special** Priority Tasking
- DVD delivery or FTP delivery
- recommended minimum versions of software suites that can ortho correct WV1 data are e.g. ERDAS Imagine 9.2 (Basic format using rigorous modelling, Std Ortho-Ready format using QB RPC model), ERDAS Imagine 9.1 (std ortho ready format using QB RPC model), PCI 10.1.2., Keystone SIPOrtho.
- Tiling:
 - ✓ Image tiling 32k x 32k tiling: PAN files have a max of 2,140 GB /tile

12.6. The EROS B speculative backup

- 12.6.1. The swath width of the EROS B satellite is 7km, but a mosaic of multiples of this can be acquired in the same path. The most efficient EROS B zone is 26kmx28km.
- 12.6.2. EROS B data only exists as PAN.
- 12.6.3. Such data will normally be used as a speculative backup at the Administration's request and most often in difficult climatic zones (e.g. above 45° Lat.), or for zones which present difficulties in the feasibility assessment.
- 12.6.4. MS Administrations need to ensure that their contractors can handle EROS B data orthorectification otherwise such backup will not be programmed by the EC Services.
- 12.6.5. Zones programmed with EROS B will be imaged starting half a second earlier and finishing half a second later in order to ensure correct telemetry at start/end of scene, this will allow usage of GCPs close to the boarder of the zones (a problem which was noted in 2008 Campaign)
- 12.6.6. The quality and efficiency of the EROS B data has been assessed by the EC Services (ref xi).
- 12.6.7. For EROS B the products ordered will be /km²:
- EROS B level 1A (plus pass file); panchromatic
 - Resolution 0.7m.
 - Swath width at nadir is 7km
 - Maximum off-nadir view angle 30° (i.e. 57-90° elevation angle), (see Annex for conversion between the two angles)
 - Cloud cover "validated" 0 - ≤10%, "proposed" > 10 - ≤ 30% CC
 - Format tiff (1A)
 - Bit depth 16 bit (image 11 bit)
 - UTM Datum WGS84
 - Commercial Rush Service
 - DVD delivery or FTP delivery
 - SW recommended – Socet Set (EROS B model), ERDAS Imagine 9.2 and PCI Geomatica 10.1.1.

12.7. The SPOT5 Supermode (SPS/COL) speculative backup

- 12.7.1. For SPOT5 "Supermode", the zone may be a full scene (60x60km) or where possible ½ scene (40x40km), ¼ scene (30x30km), 1/8 scene (20x20km). The EC Services will provide the size of scene fitting the CAP Control zone.
- 12.7.2. The SPOT5 HRG sensor, with its "Supermode" 2.5m resolution imagery (resulting from interleaving, interpolation, restoration of 2 simultaneous HRG 5m PAN images) will be programmed as a speculative backup at MS Administrations' request and most often in difficult climatic zones (e.g. above 45° Lat.), or of zones which present difficulties in the feasibility assessment. It will be used where the mean parcel size of the claimed area allows the use of such resolution, with relevant buffer tolerance [ref ii and iii]. The MS Administrations keep the responsibility of allowing usage of this type of data.
- 12.7.3. Acquisition of SPOT5 with its "Supermode" 2.5m and SPOT 5 MSP (10m) is possible contemporarily in order to obtain the requested MSP component over the zone for the VHR window. This may be performed in order to

produce SPOT 2.5m COL (which however reduces SPOT 5 HRG instruments' chances of looking elsewhere since one of the HRG instruments must acquire three images simultaneously).

12.7.4. For SPOT 5 Supermode (SPS/COL) the products ordered will be:

- full scene 60x60km, ½ scene 40x40km, ¼ scene 30x30km, or 1/8 scene 20x20km
- SPOT5 Supermode; BW, 1A
- upon request SPOT5 COL5m, COL 2.5m
- Off-nadir view angle 0-30° (56-90° elevation angle)
- Cloud cover "validated" 0 - ≤10%, "proposed" > 10 - ≤ 30% CC
- Resampling Cubic convolution
- Format GeoTIFF 1.0
- **File format DIMAP**
- bit depth 16 bit (image 11bit)
- UTM Datum WGS84
- Blue / Red Programming Service
- DVD delivery or FTP delivery

12.8. The Formosat2 (F2) speculative backup

12.8.1. The most efficient F2 zone will be a single scene 24x24 km or a longer N-S strip of 24 km width. The nature of the satellite being geo- and sun- synchronous permits a daily revisit time of locations on earth which can be reached from its orbit.

12.8.2. F2 bundle data (PAN plus 4 MSP bands) or pansharpened (upon request) of 2m respectively 8m GSD at nadir will be used as a speculative backup at MS Administrations' request and most often in difficult climatic zones (e.g. above 45° Lat.), or of zones which present difficulties in the feasibility assessment.

12.8.3. The quality and efficiency of the F2 data has been evaluated by the EC Services [ref. xii]. $RMSE_{1D}$ and have been set conservatively to 5m which may be revised downward after further assessment. Restrictions have also been set on the across/along angles to 20/25 deg. These restrictions on off-nadir view angles, not only ensure reaching required location accuracy, but are also consistent with GSD as a function of satellite viewing angles. GSD remains below 2.5m if mentioned restrictions on angles are maintained, and F2 may therefore be considered similar to SPOT Supermode as far as the panchromatic image content is concerned.

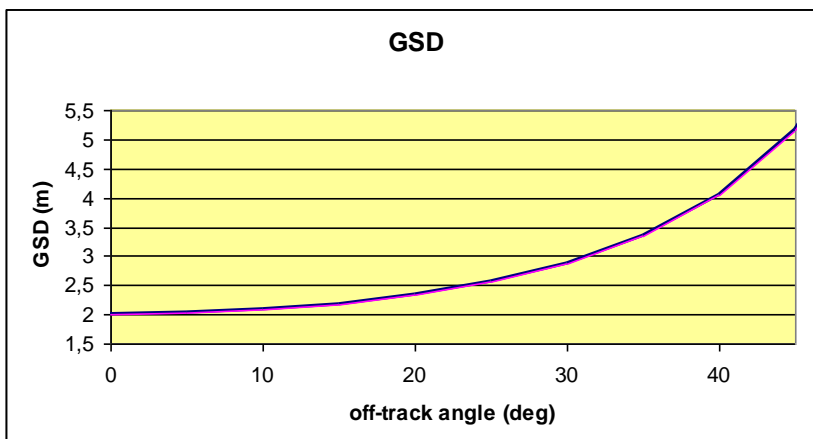


Figure 2 - F2: GSD at, at nadir is 2m PAN, and 8m MSP

12.8.4. For F2 data the product order will be /scene:

- Processing level - Radiometrically corrected level 1A with basic radiometric normalisation for detectors calibration, but with no geometric correction.
- Swath width at nadir is 24km
- Resolution is 2m PAN, 8m MSP
- Product options: PAN, and pansharp
- DIMAP format (image in GeoTIFF, and metadata in XML file METADATA.DIM); F2 is delivered with filtered ephemeris and attitude data, refined focal plane calibration.
- Elevation angles 67-90° (across), and 61-90° (along) (i.e. across 0-20°, along 0-25°); (see Annex for conversion between off-nadir and elevation angle)
- Cloud cover “validated” 0 - ≤ 10%, “proposed” > 10 - ≤ 30% CC
- 8 bits/pixel
- priority tasking
- recommended minimum versions of sw suites are PCI Geomatica 10 with fix 10031, Erdas Imagine 9.1 with fix 33599, Erdas IMAGINE 9.2, Keystone SIPOrtho, Prodigeo of EADS SPOTImage and Socet Set.

12.9. The THEOS speculative backup

12.9.1. THEOS is an Earth observation mission of Thailand, developed at EADS Astrium SAS, Toulouse, France. GISTDA (Geo-Informatics and Space Technology Development Agency) of Bangkok is the owner of the satellite and is Thailand’s leading national organization in the field of space activities and applications. The Thai Ministry of Science and Technology is funding the programme. The EC Services have signed a FC with the Swedish Space Corporation (SSC) for the procurement of imagery (FC 386.601)

12.9.2. The THEOS System allows 2 different missions: panchromatic, high resolution with rather small field of view (FOV) and multispectral, medium resolution with large FOV

- Panchromatic, or pansharpened
 - Class of QB2 to F2 (10 to 20 km swath)
 - To be used in CAP checks VHR speculative backup scenario (GSD 2m PAN and 15m MSP)
- Multispectral
 - Class of SPOT, Landsat, IRS (>60 km swath)
 - To be used in CAP checks HR 1st come 1st served scenario (GSD 22m PAN and 90m MSP)

12.9.3. THEOS will be programmed as a speculative backup, if requested by MS Administrations. Such backup will be speculative; on zones declared as “difficult” at feasibility; or on zones declared as “critical” towards end of window.

12.9.4. The quality and efficiency of the THEOS data has been assessed by the EC Services [ref xiii].

12.9.5. For THEOS data the product order will be /scene.

- Level 1A - radiometrically corrected [product annotations provide information about the image localization (see THEOS User Guide, 2009)].

- Level 2A - geometrically corrected of systematic effects, e.g., panoramic effect, earth curvature and rotation, in addition to radiometric correction. The imagery is projected to a standard cartographic projection (UTM WGS84 by default) using a terrain model without ground control points. (THEOS User Guide, 2009). Requires systematic error elimination.
- Level 3 - Orthorectified by Spacemetric Keystone
- Resolution: 2 m (PAN) and 15m (MS) at nadir
- Scene based PAN 22x22km, pansharp 22x22km
- Product options: PAN, and pansharp
- Off-nadir view angles 65-90° (i.e. off-nadir 0-22°); (see Annex for conversion between off-nadir and elevation angle)
- SW suites for orthocorrection: ERDAS Imagine and LPS 10.3 version and PCI Geomatics 10.3.0 version supports only the rigorous THEOS sensor model that requires 1A level of processing image (THEOS RPC still to be implemented)
- Other SW suites for orthocorrection: Spacemetric Keystone that requires 1A level of processing image
- SW suites under development: Pixel Factory, ENVI and Keystone

13. **Quality Assurance / Quality Control**

13.1. **Image Quality Control (QC)**

- 13.1.1. Quality Assurance (QA) may be defined to be the steps performed in order to ensure that the production of a product meets a set of accepted standards. Quality Control (QC) aims to detect non-conformities in a product.
- 13.1.2. QC includes assessment of issues such as data integrity, completeness, CC, haze or thin clouds, fog, smoke, smog, snow, flares and possibly cloud shadows, etc. It will proceed on the image product where geometry, radiometry, image characteristics (dropouts etc.), production parameters (resampling algorithm, bit depth), etc. are evaluated.
- 13.1.3. The Image Providers will follow their internally-defined QC procedures including at least the above issues. They will deliver a conformal product (or propose a non-conformal product for evaluation clearly stating reasons for QC failure – such image will be treated as a “proposed” image). Such image can also be e.g. an acquisition at elevation angle below requirement.
- 13.1.4. The contractor receiving the product needs to report on any non-conformity within 5 days of reception of imagery, through the update of IDQA information in LIODOTNET.

13.2. **Cloud Cover (CC)**

- 13.2.1. Cloud will be defined as white opaque with little or no image information available of the ground features below. Dense haze which causes consistent muting of imagery should be included.
- 13.2.2. IP have different CC assessment routines¹⁴;

¹⁴ http://agrifish.jrc.it/marspac/meetings/Toulouse2006/Parallel3/S3_PMilenov_CC_Assessment.pdf

1. Automatic or semi-automatic thresholding, with subsequent quality factor including issues of dense haze, haze, smoke, pollution, snow, shadow, etc. A visual observation after classification is required to adjust CC taking into account issues of dense haze, cloud conglomeration, etc.
 2. Manual photo interpretation and subsequent vector digitizing; if a definite boundary between affected pixels and un-affected pixels is visible it is cloud.
- 13.2.3. It has been decided by the EC Services that a common CC assessment approach by all Image Providers does not solve CAP checks assessment problems. The Image Providers' routines are used commercially world-wide and are difficult to homogenize, but the CC is interpreted rather similarly by the methods used. Among the contractors there are varying opinions.
- 13.2.4. Both of above approaches are therefore accepted by the EC Services who insist on the need to manage the CAP checks programme efficiently (limited budget) and to guarantee success of the programme. They also insist on the need to have clear decision rules, common definitions and to optimise the use of acquired imagery. These issues should be considered by all actors¹ in the CAP checks programme for common benefit.
- 13.2.5. CC validation and haze flagging should therefore follow the procedure described in Chapter 7 Validation.
- 13.2.6. The accuracy to which CC will be performed is to a better than 1% definition.

14. Risk of Satellite Failure

- 14.1.1. The Image Providers are responsible for communicating any technical problem connected to a satellite system, to the receiving station or to the processing chain as soon as possible to the EC Services. This is important in order to limit risks to the Campaign by allowing switching to other satellite systems or switching to traditional on-the-spot checks for the control of the area-based subsidies.

15. Responsible and email address

15.1.1. IES / CID Action

Responsible for the CID (Community Image Data portal) Action par-johan.astrand@jrc.ec.europa.eu
 Responsible for the CAP checks image acquisition work package eugenio.gervasini@jrc.ec.europa.eu

Contacts for CAP checks image acquisition and CID portal:

blanka.vajsova@jrc.ec.europa.eu	responsible for the VHR acquisition
ignacio.san-miguel@jrc.ec.europa.eu	co-responsible for the VHR acquisition
eugenio.gervasini@jrc.ec.europa.eu	responsible for the HR acquisition
cherith.aspinall@jrc.ec.europa.eu	co-responsible for the HR acquisition
cherith.aspinall@jrc.ec.europa.eu	image ordering preparation in LIODOTNET
Daria.KONITZ@ec.europa.eu	order dispatch to IPs, invoicing
simone.gentilini@ext.jrc.ec.europa.eu	responsible for LIODOTNET development
juergen.breunig@ext.jrc.ec.europa.eu	responsible for image return and image upload to CID portal;
armin.burger@jrc.ec.europa.eu	responsible CID portal development

Please note that a functional email box has been introduced for the CID CAP checks image acquisition services in order to simplify the communication interface between the CAP Control stakeholders. Email to Image acquisition team: cid-iat@jrc.ec.europa.eu (< 500 Kbyte)

Such a mailbox has already been introduced for LIODOTNET issues/requests" e.g.: creation/updates of users, acquisition upload problems and visualization issues, use: lio.net@jrc.ec.europa.eu

15.1.2. IES / GEOCAP Action

Contacts for CAP checks at GeoCAP

philippe.loudjani@jrc.ec.europa.eu

paolo.pizziol@jrc.ec.europa.eu

16. References

- i) EUR Lex Access to European Union law:
http://eur-lex.europa.eu/RECH_menu.do?ihmlang=en
- ii) European Commission (2011); Common Technical Specifications; CTS link:
<http://marswiki.jrc.ec.europa.eu/wikicap/index.php/Category:CTS>
- iii) WikiCAP link: http://marswiki.jrc.ec.europa.eu/wikicap/index.php/Main_Page
- iv) LPIS quality assessment and CwRS imagery used for this assessment (WikiCAP)
http://marswiki.jrc.ec.europa.eu/wikicap/index.php/LPIS_Control_Zones_and_reference_orthoimagery_2011
- v) Guidelines for Best Practice and Quality Checking of Ortho Imagery [Issue 3.0 available at:
<http://mars.jrc.ec.europa.eu/mars/News-Events/New-version-of-the-Guidance-for-Best-Practice-and-Quality-Checking-of-Ortho-Imagery>
- vi) CID HR Specifications (see <http://cidportal.jrc.ec.europa.eu/home/image-acquisition/>) ref
<file:///S:/FMPArchive/C/12923.doc>
- vii) FC for satellite image purchase held at the JRC IES today <file:///S:/FMPArchive/C/12764.xls>
 - Contract 255442 (e-GEOS) for Ikonos and GeoEye images
 - Contract 255607 (EUSI) for WorldView images,
 - Contract 255602 (EUSI) for Quickbird images,
 - Contract 255594 (ImageSat) for EROS images,
 - Contract 386747 (SPOT Image) for SPOT Supermode and Formosat2 images
- viii) The CID portal EULA <http://cidportal.jrc.ec.europa.eu/home/idp/licensing/eula>
- ix) Benchmarking GeoEye-1

WorldView-2, GeoEye-1, Cartosat-2, Kompsat-2, RapidEye and THEOS image [JRC Oral presentation Cat3.4 JRC60286 JRC IPSC/G03/C/JNO/jno D(2010)(12136),Int. ref. file:///S:/FMPArchive/C/12136.ppt – Presented at the MARS Unit’s GEOCAP Action’s Control Methods Workshop - 2010 campaign; 13-14 April 2010; Ispra (Italy); Authors: Nowak Da Costa J.K, Åstrand P.]

Nowak Da Costa J, Walczynska A. Evaluating the WorldView-2, GeoEye-1, DMCII, THEOS and KOMPSAT-2 Imagery for use in the Common Agricultural Policy Control with Remote Sensing Programme. Oral presentation in: 16th Conference on `Geomatics in support of the CAP`; 24 November 2010; Bergamo (Italy); GeoCAP Action of the MARS Unit, IPSC, DG JRC (Organiser). 2010. JRC61995

PUBSY: <http://publications.jrc.ec.europa.eu/repository/>
- x) Benchmarking Worldview2

Nowak Da Costa J, Walczynska A. Evaluating the WorldView-2, GeoEye-1, DMCII, THEOS and KOMPSAT-2 Imagery for use in the Common Agricultural Policy Control with Remote Sensing Programme. Oral presentation in: 16th Conference on `Geomatics in support of the CAP`; 24 November 2010; Bergamo (Italy); GeoCAP Action of the MARS Unit, IPSC, DG JRC (Organiser). 2010. JRC61995

Geometric quality analysis of the WorldView2 Basic (level 1A) and OrthoReady (level 2A) images acquired over the JRC MARS Unit's Maussane Terrestrial Test Site. [JRC Scientific and Technical Report Cat 2.2, no.24525 EN, ISSN 1018-5593, ISBN 978-92-79-15625, JRC PUBSY Category 2.2, No. JRC60424 file://S:\FMPArchive\C\12126.pdf Authors: Nowak Da Costa, J.K., 2010] – with supplementary Annex post Bergamo Conference PUBSY JRC64624 EUR 24525 EN file://S:\FMPArchive\C\12527.pdf.

Further: "Sensitivity analysis of the WorldView-2 satellite orthoimage horizontal accuracy ..." [ref. JRC IES/H04/C/PAR/par D(2011)(13754) file://S:\FMPArchive\C\13754.doc], PUBSY JRC66797.

Further: "WorldView-2 potentialities for orthoimage production within the Control with Remote Sensing Programme of the European Commission" [ref. file://S:\FMPArchive\C\13959.doc], PUBSY JRC67516

PUBSY: <http://publications.jrc.ec.europa.eu/repository/>

- xi) Benchmarking the WorldView-1 and EROS B sensors for use in the Common Agricultural Policy Control with Remote Sensing programme [PUBSY # JRC49378, Category 3.4 Oral presentation, Available at: http://mars.jrc.ec.europa.eu/mars/News-Events/MARS-Conference-2008/Agenda-and-Presentations/T2_Nowak_WV1_EROS2_JRC
- xii) Orthorectification of Formosat-2 data for use in the Common Agricultural Policy Control with Remote Sensing Programme - Title of paper: "Orthorectification Tests Continued..." [JRC IPSC/G03/C/PAR/ D(2008)(9233 V 1.1)]
- xiii) Benchmarking Theos - WorldView-2, GeoEye-1, Cartosat-2, Kompsat-2, RapidEye and THEOS image [JRC Oral presentation Cat3.4 JRC60286 JRC IPSC/G03/C/JNO/jno D(2010)(12136), Int. ref file://S:\FMPArchive\C\12136.ppt – Presented at the MARS Unit's GEOCAP Action's Control Methods Workshop - 2010 campaign; 13-14 April 2010; Ispra (Italy); Authors: Nowak Da Costa J.K, Åstrand P.]

THEOS Geometric Image Quality Testing – Initial Findings - JRC Scientific and Technical Report Category 2.2 no.24655 EN, ISSN 1831-9424, ISBN 978-92-79-18908-1. JRC PUBSY No. JRC61992, Int. ref: <file://S:\FMPArchive\C\12154.pdf>, Authors: Walczynska, A, Nowak Da Costa, J.K., 2010]

Nowak Da Costa J, Walczynska A. Evaluating the WorldView-2, GeoEye-1, DMCII, THEOS and KOMPSAT-2 Imagery for use in the Common Agricultural Policy Control with Remote Sensing Programme. Oral presentation in: 16th Conference on 'Geomatics in support of the CAP'; 24 November 2010; Bergamo (Italy); GeoCAP Action of the MARS Unit, IPSC, DG JRC (Organiser). 2010. JRC61995

THEOS Geometric Quality Assessment for use in the Common Agricultural Policy Control - Scientific poster for the 16th Conference on 'Geomatics in support of the CAP' in Bergamo, Italy, 24-26 November 2010. [JRC PUBSY No. JRC61994, Poster Presentation Category 3.5, Authors: Nowak Da Costa, J.K., Walczynska, A., 2010].

PUBSY: <http://publications.jrc.ec.europa.eu/repository/>

- xiv) LIODOTNET manual JRC IPSC/G03/C/PAR/mfo D(2011)(13899),
<file://S:\FMPArchive\C\13899.doc> Link to LIODOTNET:
<http://lio2.jrc.it/LioDotNet/Default.aspx>

- xv) [Benchmarking of Pleiades data](#), Int. ref: <file:///S:/FMPArchive/C/14323.pdf>, Author: Grazzini J.
- xvi) [Pleiades Benchmarking – Geometry and some radiometry test](#). Oral presentation: 18th MARS Annual Conference, 21-23 November 2012 Paphos (Cyprus), ASTRIUM/JRC/NEO <ftp://mars.jrc.ec.europa.eu/Paphos2012/Presentations/>

17. Abbreviations and Acronyms

AOI	Area Of Interest
AR(s)	Acquisition Request (s)
ARid	Identifier of an Acquisition Request
CAPI	Computer Assisted Photointerpretation
CID	Community of Image Data Portal
CTS	Common Technical Specifications
CwRS	Control with Remote Sensing (Campaign)
DEM	Digital Elevation Model
DRA	Dynamic Range Adjustment
EC	European Commission
EPSG	European Petroleum Survey Group
EULA	End User Licence Agreement
FC(s)	Framework Contract(s)
GCP	Ground Control Point
GSD	Ground Sampling Distance
HR	High Resolution imagery
IES	Institute for Environment and Sustainability- Joint Research Centre
IDQA	Input Data Quality Assessment
IP(s)	Image Provider(s)
IPR	Intellectual Property Rights
EC SERVICES	Joint Research Centre of the European Commission
LIODOTNET	EC SERVICES web-based software for the management of HR and VHR images acquisition
LPIS	Land Parcel Identification System
LPIS QA	Land Parcel Identification System Quality Assessment
MSP	Multispectral
OTS	On the Spot Checks
PAN	Panchromatic
PSH	Pansharpened
QC	Quality Assessment
QL(s)	Quick-Look (s)
SRS	Satellite Remote Sensing data
UTM	Universal Transverse Mercator
VHR	Very High Resolution Imagery
WGS 84	World Geodetic System 1984

18. Annexes

18.1. XML File Specification for Image Provider

Zip File

The provider must upload a zip file containing the following files:

1. One XML file with the information of the image file(s) or shape(s) used in the validation process. The XML File does not include information about geo reference.
2. Image file(s).
3. Shape file(s)
4. Other file(s) for geo referencing.

XML Structure

```
<root>
  <Images>
    <Image>
      See nodes needed for the image
    <Image>
  </Images>
</root>
```

A section **<Image>** must be included in the file for each image uploaded in the zip file used in the validation process.

Other information included by standard XML generator is supported:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
```

```
<root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
```

Image section

The **<Image>** section must contain the following node:

Node Name	Description	Type	Obligatory
ARId	Acquisition Request ID	Integer	Yes, if uploaded via email
Country	Country Abbreviation (see list)	String	Yes
ProductType	Type of product	String	No
Zone	Zone Name	String	Yes
Path		String	No
Shift		String	No
AcquisitionDate	Acquisition Date, interpreted in function of the country setting in your LioDotNet profile), must be inside the window defined in the Acquisition Request	DateTime	Yes

Node Name	Description	Type	Obligatory
SpotSceneId	Specific for Spot upload	string	No
CustomId		String	No
Elevation	Elevation Angle	String	No
CloudCover		Integer (0><100)	Yes
CloudCode		String	No
DisplayOrder	Used by the VHR browser	Integer (>0)	Yes
ProviderStatus	see for list	String	Yes
Filename		String	Yes
Haze Flag	Haze Flag (Yes – No)	String	No
Comment		String	No

Country list and abbreviation

Country	Abbreviation
AUSTRIA	AT
BELGIUM	BE
BULGARIA	BG
CROATIA	HR
CYPRUS	CY
CZECH REPUBLIC	CZ
GERMANY	DE
DENMARK	DK
ESTONIA	EE
SPAIN	ES
FINLAND	FI
FRANCE	FR
GREECE	GR
HUNGARY	HU
ICELAND	IS
IRELAND	IE
ITALY	IT
LITHUANIA	LT
LUXEMBOURG	LU
LATVIA	LV
MACEDONIA	MK
MALTA	MT
NETHERLANDS	NL
POLAND	PL
ROMANIA	RO
PORTUGAL	PT
SWEDEN	SE
SLOVENIA	SI
SLOVAKIA	SK
UNITED KINGDOM	UK

Provider state

Provider Status	Description
Proposed	This acquisition is proposed
Retained	This acquisition is proposed
Validated	This acquisition is validated

Not Requested

A status for this acquisition is not requested

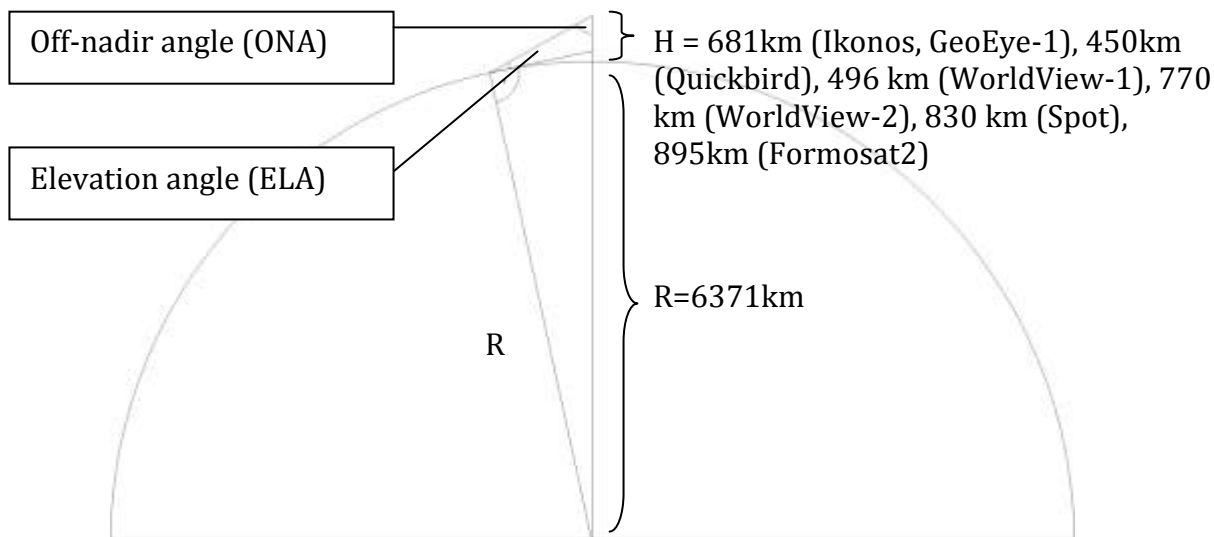
Typical XML structure (including shape file):

```

1  <?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
2  <root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
3    <Images>
4      <Image>
5        <Country>DK</Country>
6        <Site>FLYM</Site>
7        <ARId>40099</ARId>
8        <ProductType>Bundle</ProductType>
9        <AcquisitionDate>10.04.2010</AcquisitionDate>
10       <CloudCover>not requested</CloudCover>
11       <HazeFlag>No</HazeFlag>
12       <Elevation>60</Elevation>
13       <DisplayOrder>1</DisplayOrder>
14       <ProviderStatus>not requested</ProviderStatus>
15       <Filename>DK_FLYM_20100410_Strip1.tif</Filename>
16     </Image>
17     <Image>
18       <Country>DK</Country>
19       <Site>FLYM</Site>
20       <ARId>40099</ARId>
21       <ProductType>Bundle</ProductType>
22       <AcquisitionDate>10.04.2010</AcquisitionDate>
23       <CloudCover>not requested</CloudCover>
24       <HazeFlag>No</HazeFlag>
25       <Elevation>80</Elevation>
26       <DisplayOrder>2</DisplayOrder>
27       <ProviderStatus>not requested</ProviderStatus>
28       <Filename>DK_FLYM_20100410_Strip2.tif</Filename>
29     </Image>
30   </Images>
31   <Shapes>
32     <Shape>
33       <Country>DK</Country>
34       <Site>FLYM</Site>
35       <ARId>40099</ARId>
36       <ProductType>Bundle</ProductType>
37       <AcquisitionDate>10.04.2010</AcquisitionDate>
38       <CloudCover>5</CloudCover>
39       <HazeFlag>No</HazeFlag>
40       <Elevation>80</Elevation>
41       <DisplayOrder>3</DisplayOrder>
42       <ProviderStatus>Validated</ProviderStatus>
43       <ImageFile>DK_FLYM_20100410_Strip2.tif</ImageFile>
44       <Filename>DK_FLYM.shp</Filename>
45     </Shape>
46   </Shapes>
47 </root>

```

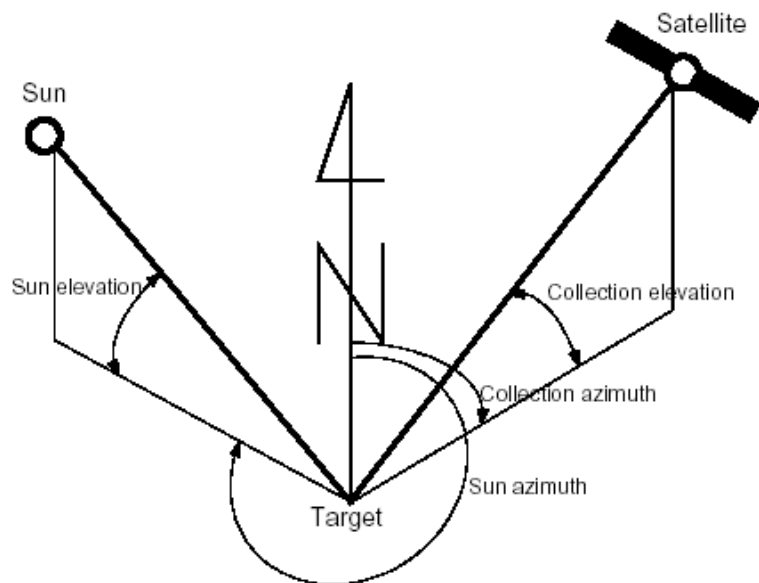
18.2. Relation elevation angle vs. off-nadir angle, and some satellite angles of importance



$$\frac{R}{R+H} = \frac{\sin(ONA)}{\sin(90^\circ+ELA)} = \frac{\sin(ONA)}{\cos(ELA)}$$

$$ELA = \arccos\left[\sin(ONA) * \frac{R+H}{R}\right]$$

$$ONA = \arcsin\left[\cos(ELA) * \frac{R}{R+H}\right]$$



(end document)