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

-

VHR and VHR+ profiles

Campaign 2017

Text highlighted in YELLOW contains changes from 2016

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Document History

Version	Date	Comment	Author
1.0	01/05/2008	1st 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 on Image return, and 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 pricing issue), updates on LioDotNet by EG (e.g. upload with shapefile , plus minor other changes); introduction of checksum by Image Providers and Contractors to be able to check correct image data delivery by FTP (AB)	EG, BW, SG, AB
3.3	13/03/2011	Clarifications on data return, introduction of functional email LioDotNet, ref. THEOS FWC 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 elevation angle and Image Data Access.	CA, PA
3.32	04/04/2011	Accept of Image Providers: EUSI (no further input); e-GEOS (Minor corrections 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: 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)	PA
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 (elevation angle typo, on copyright text, GE1 specs, IK2 specs), EUSI (recommendation is to keep shapes of simple shape but no compulsory limit, QB may be chosen as prime, QB tiling).	PA, A Oddone, E Simon
4.3	26/10/2012	Updates on Unit name; Introduction of the new VHR sensor - Pleiades (PL1); Updates on zone parameters; Updates on speculative backup; Updates on licensing text	EG, BV, PA

Version	Date	Comment	Author
5.0	10/02/2013	Rework of document to fit the Framework Contract for supply of Satellite Remote Sensing (SRS) data and associated services in support to checks within the Common Agricultural Policy (CAP) - Very High Resolution (VHR) sensor independent profile	PA
5.1	26/03/2013	Edits after CID-IAT, and AB input on 5.0: roles of stakeholders, and other edits on Zone parameters, Acquisition windows, Feasibility, Delivery Image Data Return, and VHR Profile sensors.	PA, EG, BV, ISM, AB
5.2	26/06/2013	Corrections for LioDotNet, and Final Review before outsource tendering	CW, SG, PA, CD
6.0	03/02/2014	Corrections for changes due to the upgrade of LioDotNet to G-LIO.NET	GDM, PA
6.1	10/02/2014	Minor edits on Delivery notes and finalisation of the document	GDM, PA, ISM
6.2	20/02/2014	Various edits and comments by FWC VHR Profile EUSI	EUSI (ES, SO, AK, MW)
7.0	16/03/2014	Finalisation of campaign 2014 specification	PA
7.1	29/09/2014	Draft for improved VHR specifications 2015	EUSI
7.2	15/11/2014	Check, acceptance, and insertion of certain elements regarding iteration of specified area/shapefile/corrections; update of profiles, and complete check of document for the 2015 Campaign	JRC
7.3	01/12/2014	Update of Image return (provision to JRC)	JRC
7.5	17/12/2014	Update of Feasibility assessment (EUSI), Update of Profiles (JRC)	EUSI/JRC
7.6	30/09/2015	Updates by EUSI for campaign 2015	EUSI
7.7	06/10/2015	Updates for the use of G^{4}CAP, smaller textual edits	JRC
7.8	21/11/2015	Updates by JRC after meeting with EUSI, and AB 12/10/2015, and 29/10/2015)	JRC
8.0	29/02/2016	Final version after MS Administrations and Contractors input and LPIS A5 issue update (§ 12.1.3 and Table 1 p28)	JRC
8.1	15/03/2016	Final version after EUSI input on above, and on % of A5/A2 (§ 4.1.7-8); JRC edits in dense haze flag (becomes dense haze/snow/flood flag or meteo flag § 7.1.8).	JRC/EUSI
9.0	14/11/2016	JRC draft after input from EUSI as of Del. D.3.1 (17/10/2016)	JRC
9.1	13/03/2017	JRC final check, and edits on e.g. feasibility, and profiles	JRC

Abbreviations, Acronyms and Terms

Abbreviation/Term	Explanation
AOI	Area Of Interest (of a control zone)
AR(s)	Acquisition Request(s)
AR ID	Identifier of an Acquisition Request
CA	Contracting Authority
CAP	Common Agricultural Policy
CAPI	Computer Assisted Photo Interpretation
CC	Cloud Cover
CfT	Call for Tender
CID portal	Community Image Data portal
Contractor	A Contractor of the MS Administration responsible for the CAP subsidy diagnosis of the MS using the SRS imagery; not to be confused with the Successful Tenderer (ST) of the Framework Contract (FWC) signed in [ref. 6]
COTS	Commercial Off-The-Shelf software
CTS	Common Technical Specifications
CwRS	Control with Remote Sensing
DEM	Digital Elevation Model
DG AGRI	The Directorate General for Agriculture and Rural Development
DRA	Dynamic Range Adjustment
EC	European Commission
EC Services	in this text: Joint Research Centre of the European Commission
EFA	Ecological Focus Area
EPSG	European Petroleum Survey Group
EU	European Union
EULA	End User Licence Agreement
FC(s)	Framework Contract(s)
FW contractor/s	The successful tenderer who has been awarded a FWC with the EC Services (JRC)
FWC	Framework Contract
G^{4}CAP	Final evolution of *LIO systems, available from August 2015 on
GAEC	Good Agricultural and Environmental Condition (CAP Cross Compliance)
GCP	Ground Control Point
GEO/GEOSS	Group on Earth Observations / Global Earth Observation System of Systems
GSD	Ground Sampling Distance, the nominal size of one sensor pixel projected onto the imaged surface
HR	High Resolution (SRS imagery)
IACS	Integrated Administration and Control System (CAP)
ICP	Independent Check Point (used in ortho image external QC)
ICT	Information and Communication Technology
IDQA	Input Data Quality Assessment
IES	Institute for Environment and Sustainability, Joint Research Centre
INSPIRE	Infrastructure for Spatial Information in the European Community

Abbreviation/Term	Explanation
IP(s)	Image Provider(s), in this document considered the successful FW contractor/s or successful consortium of Image Providers who has signed a FC with the JRC as of [ref. 6]
IPR	Intellectual Property Right(s)
ITT	Invitation To Tender
JRC	Joint Research Centre of the EC
LD	Liquidated Damages
LF	Landscape Feature
LioDotNet, G-LIO.NET, NG-LIO.NET, G^{4}CAP	JRC Web-based software for the management of image acquisitions
LPIS	Land Parcel Identification System
LPIS QA	Land Parcel Identification System Quality Assurance
MARS	Monitoring Agricultural ResourceS Unit, JRC IES
MS	Member State(s)
MS Administration (or its Contractor)	A Contractor of the MS Administration responsible for the CAP subsidy diagnosis of the MS using the SRS imagery.
MS Contractor	Terms used in the CwRS community for a Contractor of the MS Administration responsible for the CAP subsidy diagnosis of the MS using the SRS imagery delivered by this framework contract
MSP	Multispectral
OTSC	On-The-Spot checks
PAN	Panchromatic
PSH	Pansharpened
QA	Quality Assurance
QC	Quality Control
QCR	Quality Control Records
QL(s)	Quick-Look (s)
RDSI	JRC Reference Data and Service Infrastructure
RFV	Rapid Field Visit (type of farm inspection under the CAP checks)
RMSE	Root Mean Square Error
SEIS	Shared Environmental Information System
SMR	Statutory Management Requirement (CAP Cross Compliance)
SPS	Single Payment Scheme
SRS	Satellite Remote Sensing
UTM	Universal Transverse Mercator
VHR	Very High Resolution (SRS imagery)
WGS 84	World Geodetic System 1985

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. The legal basis of the CwRS is the Council Regulation (EC) 1306/2013 (Articles 6(b), 21) and in its implementing regulations No. 908/2014 (Article 26), No. 809/2014 (Articles 24, 38, 39, 40), and No. 2333/2015 [ref **Error! Reference source not found.**].On this basis the Commission Services are required to centralize the Satellite Remote Sensing (SRS) image acquisition. This task was transferred to DG JRC in 1998 (September 1998/VI/34942) and it is managed through a horizontal co-delegation (Type I) between DG AGRI/DG JRC (via DG BUDG) to implement the yearly CAP image acquisition work programme.

1.1.2. Regards to timing of the operations the Commission Implementing Regulation (EU) No 908/2014, mentioned above, its art 26 says:

1. For the purposes of Article 21 of Regulation (EU) No 1306/2013, each Member State shall inform the Commission by 1 November of each year at the latest, as to: (a) whether it wishes the Commission to acquire the satellite images necessary for its programme of checks and/or for its Land Parcel Identification System Quality Assessment; (b) the area to be checked and the number of planned control zones.
2. Member States requesting the Commission to obtain the satellite images shall finalize, in cooperation with the latter and before 15 January following the communication of information referred to paragraph 1, the zones to be covered and the timetable for obtaining those images.

1.1.3. 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) SRS imagery, to the Member States' (MS) Administrations for their CwRS of area-based subsidies.

1.1.4. Since 2010, DG AGRI calls for a yearly LPIS Quality Assurance (LPIS QA). Reference is made to the legal basis for the LPIS QA, given in Delegated Regulation (EU) No 640/2014 (Article 6). Specific VHR imagery satisfying the technical LPIS QA recommendations (e.g. including specific conditions of elevation angle, and CC) is acquired for this purpose (see further §2.1.2 below and [ref. 3]).

1.1.5. As from the 2014 Campaign the detailed management of VHR image acquisitions - to cover the correct areas at the correct times of the growing season required for the CAP checks - has passed to industry to act within quality specifications managed by the JRC. This choice has been made since there are today several suppliers of SRS imagery that have a proven competency in supplying the JRC efficiently with the SRS data needed for the CAP checks.

1.1.6. There may be one or more FW contractor/s appointed by the Contracting Authority (CA) JRC, to perform above task. In these specifications the Image Provider (IP) therefore refers to the FW contractor/s with whom the JRC has signed a Framework Contract (FWC)[ref. 6].

1.2. Objectives, referencing and structure of this document

1.2.1. This document constitutes the VHR profile-based specifications to be used within the CAP checks Programme (CwRS and LPIS QC). Its objective is to give the stakeholders[1] 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 the Campaign (see Figure 1).

1.2.2. The JRC has an overarching role as responsible for the well-functioning of the framework contracts, and of the Quality Control (QC) of the operations, while most of the interaction necessary within the image acquisition process takes place between the FW contractor/s and the MS Administrations (or their Contractor/s performing the CAP checks). These specifications intend to describe these interactions.

1.2.3. This document is available in the Documentation section of G^{4}CAP Website [ref. 11]

1.2.4. Several references are made here: to the Common Technical Specifications (CTS) for the Remote Sensing Controls of area-based subsidies [ref. 2]; to the WikiCAP website [ref. 3] for further recommendations; to the Guidelines for Best Practice and Quality Checking of Ortho Imagery [ref. 4]; to the HR profile-based specifications [ref. 5] that shall be used in conjunction with the present document. Reference is also made to the terms and conditions of the Framework Contracts (FWCs) for image procurement to the EC Service [ref. 6].

[1] stakeholders, or actors are the JRC, the DG AGRI, the FW Contractor/s acting as image providers and operators and the Member State (MS) Administrations (or their contractor performing the CAP Checks).

1.2.5. In the following Figure we are representing in a graphical way the overall process of the SRS image acquisition process, split in macro-actions and colored in function of the type of user responsible for the single macro-action. This document tries to follow the same flow as the one depicted here after.

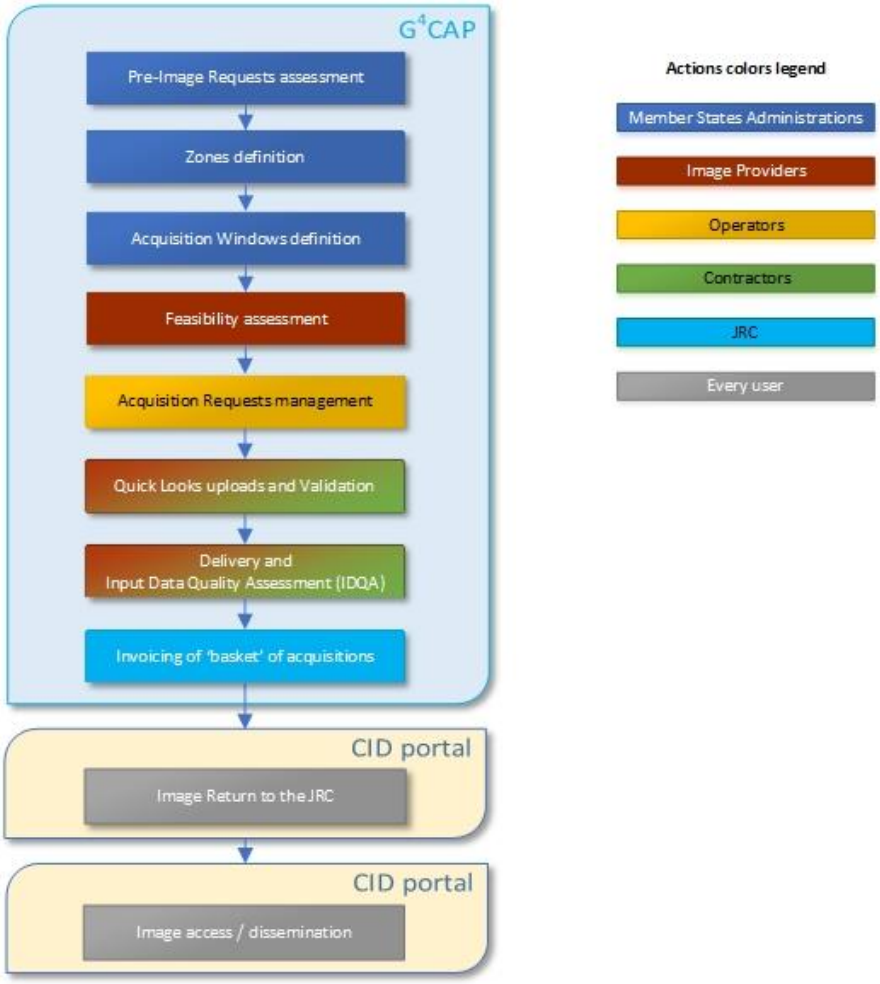


Figure 1 - Figure showing structure of this document and the SRS image acquisition process

1.3. G4CAP

1.3.1. The *LIO systems, that were born in 2005 to manage the CwRS Campaigns online, have been replaced in 2015 by the G4CAP system, a Web application that will be kept updated and constantly improved by the JRC to enhance the daily working experience of the campaign stakeholders.

1.3.2. G4CAP is the Web-based application used to manage the whole campaign workflow. Its functionalities are described in its manual, available on-line at the G4CAP Web site under the Documentations Tab., [ref. 11, 12]. G4CAP is also the main communication tool between the CAP checks actors during the Campaign: its automatic e-mails exchange are used to synchronize actions between different actors.

1.3.3. It is compulsory to use G4CAP by all the stakeholders involved in the CAP checks from 2015 campaign onwards.

2. Zones definition

2.1. General

2.1.1. The regulatory basis for the CwRS programme (see 1.1.1) allow MS to use remote sensing techniques as a means of carrying out On The Spot (OTS) checks on agricultural parcels. Guidance to this Regulation is given in the document “Guidance for on the-spot checks and area measurement” [ref. 2], which describes that a "control zone" is a geographical area defined on the basis of GIS analysis, taking account of technical constraints (e.g. standard satellite 'scenes'). 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. The Regulation (see 1.1.4) also calls for a yearly LPIS Quality Assurance (QA) [ref. 3]. Specific VHR imagery is acquired during the CwRS Campaign for this QA exercise (see 12.1.6). Also MS Administrations not participating in the CwRS programme can obtain specific acquisitions for LPIS assessment through the EC Services (JRC).

2.1.3. The MS Administrations (or their Contractor/s), the FW contractor/s, and the JRC obligatorily need to name one contact person (or functional e-mail address) to be used for interfacing with each other regarding the issues listed above and in all other communication during the Campaign.

2.2. Definition of Zone parameters for the Image Request

2.2.1. A CAP control zone (or AOI) consists of a minimum of 4 and a maximum of 999 vertices in Lat/Long Geographic coordinates (decimal degrees, WGS 84 ellipsoid), represented by a shapefile containing all files with extensions .shp, .shx, .dbf, .sbx, .sbn, .prj and should be provided by the MS Administration to the FW contractor/s. The MS Administration should strive to make shape files of simple, regular shapes and to avoid creating too narrow corridors (e.g. < 5km width since FW contractor/s is not obliged to deliver bigger area to enable a smooth orthorectification of an image). Zones shapes will be rejected by the JRC 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 with 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 minimum distance between vertices of the shape file. The MS Administration should however strive to create the simplest suitable zone which shall have a minimum size of 100km².

2.2.2. As imagery is acquired, depending on the sensor’s technical characteristics, the zone is gradually covered entirely or partially. The FW contractor/s, who is responsible for the implementation of an efficient image acquisition set-up, 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 favors crop interpretation, i.e. “multi-temporality” should be as short as possible.

2.2.3. The MS Administration will accept a VHR prime profile to be used to cover the zone. The MS Administration may also accept a VHR backup profile. Both prime and backup profiles will be entered by the MS Administration as

the Image Request is created in G^{4}CAP (see 2.2.10). The FW Contactor will programme accordingly to cover the control zone efficiently. The FW contractor/s may also propose a backup profile to the MS Administration whenever he considers it necessary to increase acquisition success during the Campaign and/or to achieve a positive feasibility result of at least 80%.

2.2.4. The zone may be covered by multiple sensors fitting the prime profile selected by the MS Administration (multi-sensor and multi-temporal acquisitions are allowed). The FW contractor/s will task the sensors in an optimal manner to acquire the zone as soon as possible with any of the sensors. It has been proven in earlier Campaigns that multiple sensor tasking has given an efficiency gain to complete the zone faster, i.e. a reduction of the acquisition time by adding satellite capacity. Also, even though there will be the possibility of having a zone completed by more than one sensor fitting to the selected prime profile, it has also been proven that there will be more chances that a 2nd acquisition is closer in time to the 1st acquisition, i.e. less multi-temporality.

2.2.5. In case a MS Administration accepts a VHR backup profile, a successful backup, if acquired, will be proposed to the MS Administration (or its Contractor). As long as the MS Administration (or its Contractor) does not accept this image, the Contractor will continue in an optimal manner to programme the prime profile until the end of the window. If the MS Administration (or its Contractor) accepts the backup collection, programming of the prime profile for the relevant zone will be closed. If the window comes to an end without any prime profile acquisitions (or a partial one only), the MS Administration (or its Contractor) can either accept the backup for the missing part in case a partial image is available, or ask for further extension of the prime profile. After maximum extension possible for the positive outcome of the MS Administration CAP checks, the MS Administration will need to accept acquisitions made by either prime or backup. See further under Chapter 3 - Acquisition windows.

2.2.6. When completing any zone, the FW Contractor shall guarantee an overlap (E-W or N-S) between subsequent acquisitions or strips, of a minimum of 0.5km. Also there shall be an overlap of a minimum of 0.5km between any partial acquisitions between different sensors. Such overlap is necessary for the orthorectification process.

2.2.7. MS who have selected control zones in a topographically 'difficult' terrain shall consider a buffer around their zones of at least 0.2km (in extreme hilly terrain 0.5km are recommended), depending on topography, to ensure complete coverage of zone after orthorectification. This is due to the fact that the FW contractor/s delivers Ortho Ready Standard products that are georeferenced to the average base height of a given area of interest (AOI), and there could therefore be a horizontal offset for each individual pixel depending on the height difference between the actual local height of the pixel and average base height of the AOI, which therefore in orthorectification may cause further "shift" due to topography. It is therefore highly recommended to consider a sufficient buffer around an AOI to ensure that the AOI is still completely covered with satellite data after orthorectification. The required buffer (equal to the max horizontal offset) can be calculated as follows, taking into account the terrain differences inside the AOI, as well as the minimum allowable SatElevation:

[*maximum possible height difference of the local height to the average base height of the AOI*] / TANGENS [*min allowable SatElevation*]

Please take care to calculate the average base height from the height of all pixels inside the AOI (not just taking highest and lowest height inside the AOI/2).

2.2.8. The VHR zone will be covered either by a bundle product (PAN and MSP as separate bands), or the pansharpened product[2], or the PAN only product. If the profile A4 (VHR Stereo) is requested, a stereo product will be delivered. Special profiles/products may be asked from the JRC; these will allow elevation angle uplift or certain GSD requirement [e.g. VHR+ Topographic, or VHR_EFA_LF etc.], or [8/16 bands and pan bundle data] (see Chapter 12), but MS Administrations will need to justify such option in detail (in the G^{4}CAP pre-Image Request Module (pre-IR)). It is recommended to try to avoid defining a lot of elevation angle restricted zones to be conglomerated.

2.2.9. All MS Administrations participating in the CAP Checks Campaign insert in the pre-IR module of G^{4}CAP his requests of imagery for the Campaign. These parameters (basic zone parameters) give information on:

- Relevant control method description;
- Number of zones and sum area to be acquired (rounded to whole km², UTM) for each type of prime profile (see Chapter 12);
- Number and type of acquisition windows (Period);
- Shapefiles of the control zones (files with extensions .shp, .shx, .dbf, .sbx, .sbn, .prj (Lat/Long, WGS84)).

2.2.10. It is the FW contractor/s responsibility to finalize the remaining parameters (see §2.2.11 below) in its contacts with the MS Administrations (or their Contractors). The G^{4}CAP web application shall be used also for this purpose where all relevant parameters shall be inserted in the Zone Definition and Image Requests modules by the MS Administrations. The FW contractor/s is also responsible for this process and the check on completeness of all the parameters serving the feasibility assessment to be undertaken within G^{4}CAP (see Chapter 4). When the FW contractor/s has completed this task, he shall report to the JRC who will validate final results inserted in G^{4}CAP before feasibility analysis starts.

2.2.11. The relevant remaining zone parameters are:

- zone name (≤ 5 characters), it needs to be unique for the whole Campaign;
- zone (AOI) area (rounded to whole km², UTM) in accordance with the shapefile area handed to the FW contractor/s by the JRC;
- VHR profile per zone and - if applicable - per Period (VHR1 and VHR2)
- Image request (IR) definition including acquisition windows (from and to dates), and relevant window parameters (e.g. dead period, earliest start date, latest start date, previous window etc., if applicable);
- possible VHR backup;
- product or image mode: bundle or pansharpened, or PAN only;
- delivery: DVD or FTP.

[2] please note that Pansharpened 4 Bands product always comes with the 4 first bands i.e. Blue, Green, Red, Near-IR1 (so-called MS1) It is not possible to produce Pansharpened 4 Bands product using the remaining 4 bands (so-called MS2) or SWIR bands.

3. Acquisition windows

3.1.1. There can be either one or two VHR image acquisition windows (VHR1, VHR2 Periods) defined for each CAP control zone. These windows 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. The programming of the second window depends on available budget, and is determined by the JRC at the pre-IR stage or latest at the basic zone definition stage (see § 2.2.8, 2.2.9).

3.1.2. The VHR prime window should be preferably 8 weeks long but never shorter than 6 weeks (42 calendar days). This statement is valid for the VHR2 windows too. If an HR window is still open, it will close the day before the VHR prime window opens; also the following HR windows opening will depend on the acquisition of the previous VHR image. Both these circumstances obligatorily need to be communicated between the VHR and HR FW contractor/s. Such communication is normally made via G^4CAP

3.1.3. When defining the VHR1 and VHR2 windows the MS Administrations shall keep in mind that the final window might need to be longer, compared to the initial requested one, to make an acquisition feasible. It shall also be taken into account that a potential shift of the VHR1 window end date may occur, and care must be taken that it does not overlap with any subsequent window (HR or VHR). Thus the subsequent window start may need to be modified.

3.1.4. If extraordinary weather conditions prevail in any region, a window may change (opening and closing dates will move). This will be dealt with on a case-by-case basis. Such acquisition window dates changes should occur in very rare cases. Notice shall be given by the MS Administration (or its Contractor) to the FW contractor/s at the latest 2 weeks before scheduled opening.

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 still below 20 deg., in order to ensure sufficient contrast and to minimize the effect of shadows.

3.1.6. Conversely, this is also true for late start dates of the VHR2 windows, where the sun elevation could drop below 20 degrees again.

3.1.7. If a VHR profile sensor (see Chapter 12.1.2) acquires imagery late in the window, the MS Administration may request an archive search for an earlier HR profile sensor acquisition within the window. In this case the FW contractor/s shall contact the JRC who will (or will not) give clearance. This obligatorily needs to be communicated between the FW contractor/s [see §3.1.2]. It is here however strongly advised to use Copernicus Sentinel 2 (S2) imagery.

3.1.8. An acquisition window may be extended if none of the prime or backup profile tasking has successfully acquired the zone. This will be dealt with on a case-by-case basis. Notice will be given by the MS Administration (or its Contractor) to the FW contractor/s at the latest 3 working days before window closure. This will allow the FW

contractor/s to continue tasking. Such extensions will be made if crop cycle permits and shall be as long as possible. The procedure outlined below will apply at window end:

- acquisitions outside elevation angle specification or outside Cloud Cover (CC) thresholds may be uploaded by the FW contractor/s, as proposed, and may be accepted by the MS Administration (or its Contractor);
- if above option does not provide enough images to complete the area, the acquisition window can be extended for the prime and backup VHR profiles. The MS Administration (or its Contractor) will evaluate the maximum acceptable window extension based on the status of the crop phenology.

3.1.9. MS Administration (or its contractors) is notified about windows coming to an end by selecting the dedicated e-mail selection feature in G4CAP. If no request for the extension of a window is received by the FW Contractor/s, the window will close at planned closure (end date window).

3.1.10. Upon request from the JRC, the FW contractor/s shall inform the JRC and the MS Administrations (or its Contractors) of image acquisition status over the zone (e.g. attempts left before window closure or possible attempt soon afterwards).

3.1.11. MS Administration should not allow a window to extend longer than any MS contractor contract end date. If the MS Administrations allows this, they will themselves be responsible for the proper use of the imagery in their controls procedure.

4. Feasibility assessment

4.1.1. The basic zone parameters for the Campaign (see §2.2.9) are received by the FW Contractor/s through the 'Reporting' or the 'Zones' modules in G^{4}CAP. They shall be made available to the FW Contractor by the JRC a minimum of 6 weeks before the first window starts. The basic parameters also form the basis for the relevant specific contracts (SCs) set up between the JRC and the VHR FW contractor/s.

4.1.2. The FW contractor/s are then responsible (see §2.2.10, §2.2.11) to interact with the MS Administrations (and their contractors) to check and finalize any remaining feasibility parameters, and perform the feasibility study in G^{4}CAP. For these tasks, a timeframe of at least 4 weeks shall be given to the FW contractor/s.

4.1.3. Since the feasibility is no longer made in one single batch, but by period and zone, if any window is requested to start earlier than others, this feasibility can start earlier. In fact, it is up to the IP to make feasibility as efficient as possible and start with the earliest windows in the PERIOD undergoing feasibility.

4.1.4. A technical and competitive feasibility assessment by the FW contractor/s 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 is placed at priority (select plus) programming for the CwRS and LPIS zones.

4.1.5. 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 orthocorrection accuracy specification thresholds [ref. 4]. The elevation angle should be kept as high as possible by the FW contractor/s in order to facilitate orthocorrection.

4.1.6. A higher elevation angle threshold may be requested for certain control zones, e.g. if the control zone is situated in hilly, or mountainous areas/complex topology (see 12.1.2). The allowed area for such elevation angle uplift will have been agreed between MS Administration and the JRC prior to the feasibility at the pre-Image Requests (pre-IR) stage, and the Basic Zone parameters §2.2.9 will include relevant profiles per MS.

4.1.7. MS Administrations should bear in mind that they should keep their requests for the A.2 plus A.6 plus A.5 profile elevation angle restriction to be ≤ 25% of their overall VHR campaign control area.

4.1.8. MS Administrations should bear in mind that they should keep their requests for the A.5 profile (the most severe elevation Angle and GSD constraints) to be ≤ 10% of their overall VHR campaign control area (preferably well-distributed for best acquisition success).

4.1.9. The MS Administrations should be aware that feasibility suffers if control zones with elevation angle restriction are too concentrated and close to each other; collection attempts will decrease substantially between an A.1 profile, to an A.2 profile, to an A.5 profile (see Chapter 2.2.8, Chapter 12). Therefore, MS Administrations are advised to consider maximum possible window length for control zones with elevation angle restriction (e.g. A2, A6 and especially A5 profiles) when defining their Image Requests.

4.1.10. Special profiles such as [A11, A12, A51, A52, A61, A62] i.e. 8/16 bands with relative elevation angles, will be provided depending on feasibility, and budget availability. These should be asked for by the MS Administrations already in the pre-IR stage since they require bilateral agreement with the JRC.

4.1.11. If the FW contractor/s notice any discrepancy between the areas/parameters, as of §2.2.9, given by the JRC and the areas/parameters inserted in G^{4}CAP by the MS Administrations and checked by the FW contractor/s, a final accept shall be obtained from the JRC before feasibility start.

4.1.12. The feasibility assessment performed by the FW contractor/s shall divide the windows in three categories:

1 GOOD (GREEN) - FEASIBLE WITHIN WINDOW - approaching 100% probability;

2 MEDIUM (YELLOW) - FEASIBLE WITHIN WINDOW - 80% probability (may need EXTENSION) - can have suggestion to improve probability of success;

3 LOW (RED) - NOT FEASIBLE WITHIN WINDOW - with suggestion to make feasible (e.g. extend window to…, change profile allowing a less strict elevation angle, accept backups).

In G^{4}CAP, after a suggestion to change the original window by the IP, the window will have an improved feasibility status compared to the original one and this status will be specified by FW contractor/s in the new suggestion.

In case the original window was not Feasible and it was not possible to find a valid agreement between FW contractor and MS Administration, the FW contractor has two possibilities, exploiting a fourth category:

4 BLACK - acquisition is not feasible within the requested window and 'no agreement has been reached between FW Contractor and MS Administration'.

FW contractor/s can:

a) program the window anyway, even if the feasibility is still "not feasible" or if the window is not compliant with technical specifications. In this case the FW contractor will make a new proposal having a BLACK feasibility status with same (or changed new) dates agreed with MS Administration, even if such change will not make the window feasible. Such window will NOT be counted in the Campaign statistics for the FW Contractor, and the MS Administrations MUST BE PREPARED TO USE ALTERNATIVE CONTROL METHOD SINCE NO IMAGE IS GUARANTEED.

b) Choose NOT to program the window. The FW contractor will upload a black feasibility without proposing a new solution. The window will be marked as "Refused" and no acquisition request will be open. The MS Administrations MUST USE ALTERNATIVE CONTROL METHOD SINCE NO IMAGE IS GUARANTEED.

4.1.13. Above feasibility results will require some iteration between the MS Administrations and the FW contractor/s. This will normally be made during February, latest March, before the Campaign starts. All interactions between MS Administration and the FW Contractor in this feasibility process are performed in the 'Feasibility' module of G^{4}CAP.

4.1.14. Finally, an optimum acquisition scenario shall be reached, with clearly defined profiles, zone constraints, final windows and products to be delivered, etc. This result, completed in G^{4}CAP, and accepted by the MS Administrations, will lie as basis for the campaign (accepted by all parties, including JRC) for each zone window, Feasibility should be ready not later than 2 weeks before the window opening, under the condition that the

timelines under §4.1.1 and §4.1.2 are met. In case a phased feasibility assessment is performed (see §4.1.3), the FW contractor/s and the JRC shall agree on a shorter timeframe to finalize the first feasibility assessment for the early zones (e.g. 1 week before the 1st VHR window of the early zones opens).

5. Acquisition Requests (ARs)

5.1.1. An AR is defined as the implementation by the FW contractor/s of the Image Requests (IRs) of the MS Administration to cover a zone in a specific window with its defined ancillary parameters. An AR is composed of one or more image acquisitions.

5.1.2. After the feasibility assessment, programming is known, and an AR for the product will be automatically opened in G4CAP 3 days before the acquisition window start date is reached. Each AR has a unique identifier called ID.

5.1.3. MS Administration (or its contractors) is notified about windows coming to an end by selecting the specific e-Mail Selection feature in G4CAP. If no request for the extension of a window is received by the FW Contractor/s, the window will close at planned closure (window end date).

5.1.4. Preview of uploaded QuickLooks (QLs) is made using the G4QLBrowser (G4QLB) which is an online application for displaying and browsing QLs and shape files from the image acquisitions. It is reachable directly from within G4CAP. MS Administrations can also use this tool at any time during campaign to check the overall status of the acquisitions over their Zones for a specific campaign.

6. QL (Browse Image) Upload

6.1.1. The FW contractor/s will notify an acquisition through its upload in the G4CAP system (or e-mail in case of temporary system unavailability) within 2 working days from the acquisition itself (validated/proposed, or partial/full upload).

6.1.2. Uploading image acquisition details into the G4CAP starts by clicking on the proper AR; this is done in order to give the right context to the upload. Image details such as AR ID, Acquisition Date (dd-mm-yyyy), Sensor, Comment, Cloud Cover (%), MeteoFlag (Haze, Snow, Flood, Mixed), File name (shape file, QL (Browse Image(s)), Elevation Angle etc. are defined in the metadata XML[3] file. This XML file is compressed in a .zip archive together with QL images, shapefile and other necessary files for georeferencing and is uploaded into G4CAP.

6.1.3. Upon upload of an acquisition, the G4CAP system will automatically send a dedicated message to interested actors. Users' subscriptions to these notifications are managed through the G4CAP system. By default, all users receive this message, unless they deactivate the notification option for this item.

6.1.4. The FW contractor/s's archives may be consulted by the MS Administrations (or their contractors), as services are normally free of charge, but subject to subscription. The FW contractor/s will have specific sensors fitting to the VHR profiles. These will be communicated to the MS Administrations (or their contractors). Archives of these sensors are included in the EUSI search tool[4], the DigitalGlobe Browse Tool[5] for WV2, GE1, WV1 and WV3. For

[3] XML metadata file specification – see Annex 17.1

[4] http://www.euspaceimaging.com/imagery-search

[5] http://browse.digitalglobe.com/imagefinder

KOMPSAT-3 the Arirang search tool can be checked[6] (a user account necessary). The MS Administrations (or their Contractors) may consult these archives and propose any imagery of the FW contractor/s suitable for their controls activity. The FW contractor/s will proceed to upload QLs of such imagery into G^{4}CAP for acceptance by the MS Administrations (or their Contractors).

[6] http://arirang.kari.re.kr/

7. Validation

7.1.1. Validation may be performed over the whole zone or over a part of a zone (partial upload, possibly defining an area to be validated by a vector shapefile. The area to be validated has to be contiguous and should have a regular and simple shape, it is composed of a strip or multiple strips). It is always done on intersection of the upload (or acquisition) with the zone shapefile.

7.1.2. For a VHR zone the validation of an upload (or acquisition) is done on the basis of CC content. Snow, flooding and haze, which is not considered cloud by the FW contractor/s, does not cause rejection, but is flagged and may trigger an extra re-tasking (see §7.1.77.1.8). The FW contractor/s uploads georeferenced QLs and relevant XML metadata file, including CC assessment (following established CC threshold criteria) and MeteoFlag assessment (haze, snow, flood, mixed) into G^{4}CAP.

7.1.3. VHR CC thresholds are defined as follows:

- a validated acquisition is defined by a maximum CC of ≤ 10% over the AOI. Validation of this imagery does not require any interaction with the MS Administration (or its Contractor). Validated images are delivered directly to the MS Administration (or its Contractor) after having passed through Quality Control (QC) of the FW contractor/s (see §10 and §13);
- a proposed acquisition is defined by a 10% < CC ≤ 30% over the AOI. Proposed images are delivered to the MS Administration (or its Contractor) only upon the MS Administration (or its Contractor) agreement in G^{4}CAP. Programming continues for better acquisitions during the period of accept/decline which must not exceed 3 working days. After having been accepted the proposed scene goes through QC of the FW contractor/s and is shipped to the MS Administration (or it's Contractor).

7.1.4. Validation of a series of proposed acquisitions (uploads) - the FW contractor/s for the VHR FWCs has agreed to provide all proposed acquisitions to the MS Administration (or its Contractor) if they accept one proposed acquisition over the control zone. The MS Administration (or its Contractor) should therefore react within time limit on proposed acquisition (3 working days), and reject if not usable. However, MS Administration (or its Contractor) needs to keep in mind that when further proposed acquisitions are made available over the same zone, they can be used together with acquisitions previously rejected by him.

7.1.5. The FW contractor/s will, on a best effort basis, produce regular mosaics of proposed imagery to aid in decision on usability of series of acquisitions. Accepting a series of proposed acquisitions will allow the FW contractor/s to release satellite capacity for other zones.

7.1.6. Re-upload of a rejected acquisition: the FW contractor/s may re-upload part of a rejected proposed acquisition if, in combination with a new validated acquisition, it will serve to complete a zone. The re-uploaded proposed acquisition has to be of validated CC threshold, acquired in one date, be a contiguous area, and has to have a regular and simple shape.

7.1.7. In case of a conglomeration of CC within part of a large acquisition, this part (minimum 100km²) may be re-tasked. Even if whole acquisition is validated, the MS Administration (or its Contractor) may ask the FW

contractor/s to perform such re-task. The FW contractor/s will contact the JRC, who will take a decision based on technical and financial justification. A new zone will be defined for this cloudy part and a new AR will be issued for this area. The MS Administration (or its Contractor) will follow a procedure similar to the one described in the section below MeteoFlag, in order to prove that the re-tasking is required.

7.1.8. A Meteoflag is validated as follows:

- validated CC upload with MeteoFlag for dense haze/snow/flood/mixed - the flag will trigger an e-mail to the MS Administration (or its Contractor), who will assess if the dense haze/snow/flood/mixed prevents control of the parcels within 3 working days and provide the JRC with information regarding the following issues in order for a decision on possible re-tasking to be taken.
    - To prepare a shape file of the control parcel structure (Lat/Long DD WGS 84);
    - to assess preliminary Technical Coding (e.g. T4) due to haze (reference Guidance for on-the-spot checks [ref 2]);
    - to check if any proposed image is available;
    - to assess whether the haze image can be used if an atmospheric correction or local lookup table stretch is applied to the 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 image[7].

  If the above steps cannot ensure a successful control procedure
    - to prepare (possible) new shape file, if not complete zone, to re-collect (minimum 100km²);
    - to decide on a new window, and assess the time delay that a re-tasking implies for the success of the control procedure;
- upon reception of information indicated above from the MS Administration (or its Contractor) the JRC will take a decision on whether to collect additional imagery (re-task) over part of the control zone based on technical and financial justification.
- Proposed CC upload with MeteoFlag for dense haze/snow/flood/mixed - treated as proposed acquisition.

[7] The FW contractor/s, may upon request provide final images on FTP for haze evaluation.

8. Ordering

8.1.1. Ordering follows procedures set up in the FWC signed by the FW contractor/s and the JRC [ref. 6]. This is managed via signature of specific contracts (SCs) within the FWC.

9. Delivery

9.1.1. Validated partial acquisitions covering a minimum of 100km² contiguous area, and having a regular and simple shape as defined in §7.1.1 will be delivered in the format and on the media requested. If demanded by the MS Administration (or its Contractor), the delivery of validated proposed imagery will include all proposed uploads over the zone.

9.1.2. The contractual delivery period that includes production, internal QC, and ex-works availability is 6 working days after acquisition for VHR data.

9.1.3. Images (after validation according to procedure in Chapter 7) are delivered directly to the MS Administration (or its Contractor) after having passed through the internal QC of the FW contractor/s.

9.1.4. The MS Administration (or its Contractor) receives a delivery notification, through G^{4}CAP, as soon as the product is confirmed as shipped by the FW contractor/s. This delivery notification includes the AR ID and the Acquisition identifier. If the product is delivered via FTP, G^{4}CAP displays the FTP address, username and password to access it, else by DVD a delivery note is uploaded in G^{4}CAP containing the information on the shipment.

9.1.5. The MS Administration (or its Contractor) must download the product within 6 working days from the day it has been placed on FTP server by the FW contractor/s.

9.1.6. The FW contractor/s will not only deliver the product to the MS Administration (or its Contractor) on DVD or FTP as requested, but will also deliver the product to the JRC on specific FTP account for automatic harvest (see Chapter 11).

9.1.7. The FW contractor/s will use checksum for correct delivery between FW contractor/s and MS Administration (or its Contractor), and for image data provision to the JRC (see Chapter 11).

9.1.8. The MS Administration (or its Contractor) will fill in the Input Data Quality Assessment (IDQA) on the acquisition page of G^{4}CAP within 12 calendar days (i.e.8 working days) after the image has been delivered. This actions will allow the JRC to obtain Quality Control Records (QCRs) on products, and on delivery performance of the FW contractor/s;

9.1.9. If the MS Administration experiences a delay to nominate its Contractor, he/she will have to perform all necessary actions by itself. This means that the MS Administration will act as contractor in G^{4}CAP, in order not to delay delivery, and subsequent invoicing.

9.1.10. The JRC will when above has been performed, set the Acquisition as “ready to be invoiced” and move it to the “basket” of invoiceable acquisitions.

9.1.11. If the required IDQA is not filled in by the MS Administration (or its Contractor) in 12 calendar days (i.e.8 working days) from delivery of the imagery, the IDQA state will be assumed to be "accepted" to allow for timely basketification. Even though the contractual relation is held between the JRC and the FW Contractor, an email will in these cases be sent manually by the JRC to the responsible MS Administration telling them that they cannot file complaint on any image characteristics that could have been discovered in the IDQA. This means that all imagery that were delivered more than 12 calendar days ago will be basketified in any case, irrespective of the IDQA status, at the beginning of each month.

9.1.12. If in the above IDQA procedure the MS Administration (or its Contractor) notes that the image area delivered[8] does not match with the area the FW contractor/s has stated, he will enter his measured area in G^{4}CAP. JRC will have a final validation role on non-compliances.

9.1.13. An AR is closed only after the whole area has been imaged and the acquisitions have been accepted through IDQA by the Contractor (unless other circumstance cause closure, e.g. window comes to an end).

9.1.14. If IDQA is not satisfactory for any other reason, the FW contractor/s and the MS Administration (or its Contractor) shall solve the situation bilaterally by either an acceptance by the MS Administration (or its Contractor), of a reproduction (e.g. different product type, or product of specified quality) or a partial or complete re-task by the FW contractor/s. If no agreement is reached the FW contractor/s will report to the JRC, who has final decisive role on what action to undertake. Relevant provisions of the FWC [ref. vii] shall apply.

9.1.15. Upon request from the JRC, the FW contractor/s will inform status of image production/QC status (production pending, production finished, and production date) at any time of the Campaign.

[8] calculated (rounded to whole km²) as the intersection between validated acquisition (using final ephemeris data) with the zone in geographic projection UTM/WGS 84.

10. Pricing and Invoicing

10.1. Pricing

10.1.1. Pricing for products will be in accordance with the FWC signed by the FW contractor/s and the JRC [ref. 6].

10.2. Invoicing - the VHR 'basket'

10.2.1. The FW contractor/s can invoice any single acquisition delivered more than 12 calendar days ago and that has been accepted (IDQA PASS) by the MS Administration (or its Contractor) and that JRC thereafter has set to the status "ready to be invoiced" (also for all acquisitions where the time delay from delivery is more than 12 calendar days). G^{4}CAP will at this point move the acquisition to the "VHR basket" of invoiceable acquisitions.

10.2.2. Such invoicing shall normally be made cumulatively once per month, according to the rules established in the FWC signed by the FW contractor/s and the JRC [ref. 6]. The identification value for an acquisition to be invoiced is the **AcqId** displayed in the basket.

10.2.3. If accepted and delivered imagery turns out to be inadequate, relevant provisions of the FWC shall apply [ref. 6], where FW contractor/s image warranty applies.

11. Image data provision to the JRC (image-return) and image access

11.1. Image-return to the JRC by FW contractor/s

11.1.1. The FW contractor/s shall provide the SRS image data to JRC for incorporation into the CID Image Portal. This data provision shall cover the source SRS data as well as orthorectified data, derived from the source data that are created and processed by the MS Administrations (or their Contractors).

11.1.2. The source data shall be made available to JRC by the FW contractor/s directly after data acquisition with minimum delay, contemporaneously with the data provision to Member States and their Contractors.

11.1.3. The FW contractor/s shall also collect the orthorectified data at the end of every Campaign from the MS Administrations (and/or their Contractors) on behalf of JRC and provide them to JRC. The deadline for this data collection is at the end of the control Campaign year (i.e. 31st December of each year for CwRS), and 31st of January of the year after the campaign for LPIS QA). The FW Contractor has to check the data for correctness and complete the JRC metadata file (see 11.1.7). Ortho images shall be handed to the FW contractor as soon as possible once the FTP details for their upload are communicated. The detailed specifications for the orthorectified data is provided to the FW contractor/s by the JRC. The FW contractor/s shall ensure the compliance with these specifications by communicating minimum requirements to the MS Administrations (or their Contractors).

11.1.4. Both source data and orthorectified data shall be provided to the JRC via standard FTP[9] protocol. The FW contractor/s shall set up an FTP service and create a dedicated FTP account for the JRC. The FW contractor/s shall ensure minimal transfer speeds of the FTP service of 1 Megabytes/s per connection, with a minimum of 4 possible contemporary connections, and guarantee an uptime of the service of at least 99.0 %. The minimum retention time for data on the FTP server of the FW contractor/s shall be 4 weeks for source data, and 6 weeks for orthorectified data.

11.1.5. All SRS image data shall be placed on the dedicated FTP account mentioned above and sorted by image type: The source data shall be placed into the folder “SOURCE”, the orthorectified data shall be placed under the folder “ORTHO”. Upon agreement with JRC, the “ORTHO” data can be handed back on a dedicated HDD. It is also possible to create two separate FTP accounts for source data and orthorectified data.

11.1.6. Below these folders the first sub-division in subfolders shall be based on the MS for which the image data have been acquired, using the country 2-digit ISO code (ISO 3166-2) of the MS as naming of the subfolders. The next sub-division level in sub-folders shall be based on the platform name. The next sub-division level (corresponding to sub-folders) below platform name will be the zone name as defined by JRC during the acquisition process. SRS image data of an acquisition together with their metadata shall be placed here. If multiple acquisitions exist for one zone, they shall be placed in subsequent sub-folders under the zone accordingly. All data with their metadata

[9] http://en.wikipedia.org/wiki/Ftp

files must be provided in uncompressed and unpackaged files and directories. Packaging data files and directories into archive formats (like ZIP, RAR, TAR, etc.) is not permitted.

11.1.7. All acquisitions must be accompanied with a metadata XML file, by default named jrc_metadata.xml, describing minimum metadata homogeneously for any type of sensor. Depending on the data structure a different file naming convention for the metadata XML file can be mutually agreed if more suitable. This metadata XML file shall include e.g. the unique acquisition ID, acquisition date/time (ISO format), zone name, platform name, image files covered by the metadata file, etc. (see link to schema below). The metadata XML file will be of different format for Source Data and Orthorectified Data. The full specifications of this metadata XML file together with an XML schema for validation are provided to the FW contractor/s see ref. vii]. The FW contractor/s must ensure correct XML structure and content of the metadata XML file and validate it against the provided XML schema. The XML schemas provide sufficient information about required information to be added and some restrictions of the possible content of the metadata XML files. The XML schema files are available from JRC under the following locations: [10]. It is important that the XML file is placed in the same directory as the scene data..

For the source data:

http://cidportal.jrc.ec.europa.eu/public-tools/schema/image-acquisition/jrc_metadata_vhr_source.xsd

For the ortho data:

http://cidportal.jrc.ec.europa.eu/public-tools/schema/image-acquisition/jrc_metadata_vhr_ortho.xsd

11.1.8. For *source data* the creation of the metadata XML files lies in the sole responsibility of the FW contractor/s using the metadata information from their proprietary metadata files and the G4CAP system, and converting them into the required metadata XML file structure.

11.1.9. Finally, in order to enable the JRC (and the MS Administrations or their Contractors) to run checks of complete data transfer, the FW contractor/s shall provide MD5 checksums for every file included in an acquisition. These MD5 checksums must be added to checksum files named checksum.md5 and placed in the same folder as the data, referencing all files in that folder. The content and structure of the checksum files must follow the syntax of the md5sum tool[11], using UNIX style line breaks (newline). The creation of the MD5 checksum files must be performed at the earliest possible stage of the data acquisition workflow.

11.2. Ortho image return (OIR) by the Member States to the FW contractor

11.2.1. For SRS based *ortho images* (CwRS and LPIS QA) to be returned by the Member States and their contractors, the FW contractor/s shall request the minimum required information from the Member States and their contractors in order to compile the requested metadata XML file (11.1.7) The information requested from the Member States and their contractors shall include:

- **Ortho image file name,**

[10] for HR data replace “vhr” with “hr”

[11] http://en.wikipedia.org/wiki/Md5sum

- **Zone name,**
- **Acquisition id's (Acq_ID)** ,
- Mission (platform) name and version,
- **Coordinate reference system as EPSG code and/or WKT,**
- **Band order with respect to the original sensor bands**,
- Imaging date & time[12].

11.2.2. Items in **bold** are essential. Any additional information required for the compilation of the metadata XML files shall be in the sole responsibility of the FW contractor/s and shall be taken from source image delivery based on the acquisition batch Id's. In case it is not clear which data were used to create the ortho images the FW contractor/s can request this information from the Member States.

11.2.3. Description of the requested image formats of the **uncompressed** ortho imagery:

a) return images **only** as GeoTiff (.TIF) or optionally standard Erdas IMAGINE HFA (.IMG) format
b) return images with **all** source bands, in original band order.
c) returned images must preserve original radiometric resolution and dynamic range (data type, i.e. number of bytes/pixel). Rescaling from 16 bit to 8 bit is **not** allowed.

11.2.4. In case source imagery has been delivered as BUNDLE product, return ortho imagery as a BUNDLE product. In case source imagery has been delivered as PANSHARPENED product, return ortho imagery as PANSHARPENED product. If you have created your own pansharpened product, it will be accepted as valid OIR only if it preserves the original radiometric resolution of the delivered source BUNDLE. Do **not** rescale from 16 bit, (respective 11/12 bit) to 8 bit.

11.2.5. Image mosaics are accepted only if they preserve original radiometric resolution and all bands in original band order. In case of non-original radiometric resolution and band order, then please return the orthocorrected image strips as received with original radiometric resolution and including all bands. The mosaic may be returned as additional product but does not constitute a full OIR.

11.2.6. Generally speaking, return imagery, except of the orthorectification, as un-processed as possible, which facilitates re-use of data for other allowed users.

11.2.7. For ORTHO data where the returned images are a mix of several platforms the XML shall use "SATELLITE" for <MISSION> since currently an image can only be related to 1 platform/sensor. The <IMAGING_DATE> should then always be the latest date of all involved images, <IMAGING_TIME> should be always "00:00:00".

11.3. Ortho Image Return to JRC via EUSI

11.3.1. Pls. refer to Annex 17.2 for information on the xml metadata file specification

[12] If the imaging time tag is empty in the source imagery, it is not required to retrieve it. The field may in such case be filled in with "00:00:00" and provide to JRC a list with the files where this has happened. Further, it is asked that FW Contractor keep all metadata.xml files received from the MS and make them available to JRC upon request.

11.4. VHR Image access

11.4.1. MS Administrations (and their Contractors) may access imagery purchased through the FWC [ref. 6]. This image access needs to follow principles set up in the licensing agreement between the FW contractor/s and the JRC, as agreed in the FWC [ref. 6]. An End User License Agreement (EULA) based on the same principles will bind the users from the moment of their registration to CIDportal [ref 7], or their registration to G^{4}CAP [ref. 11].

11.4.2. In accordance with the EULA, images used in above operations may neither be disseminated nor the resulting products sold. Image access should be arranged through the CID server of the JRC, Ispra.

11.4.3. The EC Service purchases a limited right of use, but the images themselves remain the property of the FW contractor/s. In addition, according to the EULA [ref. 7, § 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 which will take the form:

"© 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 under FWC xxx.yyy "

where the FWC number is available from the EC Services (JRC)

For the presently running FWCs [ref. 6], with EUSI the first sentence above shall be substituted with:

- "WorldView3-data, © DigitalGlobe ™, provided by European Space Imaging"
- "WorldView-2 data, © European Space Imaging/DigitalGlobe ™, year of acquisition, distributed by European Space Imaging"
- "WorldView-1 data, © European Space Imaging/DigitalGlobe ™, year of acquisition, distributed by European Space Imaging"
- "GeoEye-1 data © DigitalGlobe ™, year of acquisition
- "EROS B data, © ImageSat International N.V ™, year of acquisition, distributed by European Space Imaging"
- "Kompsat 3 data, © Satrec Initiative, provided by European Space Imaging"

12. VHR prime, LPIS and backup profiles

12.1.1. As of Campaign 2014 the MS and its contractors can request a sensor independent profile of interest for the control zone from an available menu of profiles (see Table 1). Each profile is defined by certain parameters and it is in the FW contractor/s responsibility to coordinate collections and assign the sensors in the most efficient and suitable way.

12.1.2. A summary of the profile characteristics is given in the table below.

Image Profile ID	Description	Spatial resolution requirement (*)	Radiometric resolution (**) and spectral bands	Minumum Elevation Angle restriction (***)	Threshold abs. 1-D rmse to be proven in geometry benchmark	Cloud Cover (CC) over AOI	Acquistion programming	Resampling	Remarks	Example of sensors
A1. VHR prime - CwRS [std]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	> 50	x,y ≤ 2m	≤10%	Priority programming	sensor dependent	standard CwRS profile	WV3,WV2, GE1, K3, possibly others not benchmarked yet
		GSD≤3m	MS (at least 4 bands)							
	Pan-sharpened	PAN GSD≤0.75 m, MS GSD≤3 m	at least 4 bands							
A11. VHR prime - CwRS [VHR+][8]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	> 50	x,y ≤ 2m	≤10%	Priority programming	0.50m		WV3, WV2, possibly others not benchmarked yet
		GSD≤3m	MS (at least 8 bands)					2m		
	Pan-sharpened	PAN GSD≤0.75 m, MS GSD≤3 m	at least 8 bands					0.50m		
A12. VHR prime - CwRS [VHR+][16]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	> 50	x,y ≤ 2m	≤10%	Priority programming	0.50m		WV3, possibly others not benchmarked yet
		GSD≤3m	MS (16 bands; 8 SWIR bands may have coarser resolution)					2m		
	Pan-sharpened	PAN GSD≤0.75 m, MS GSD≤3 m	at least 16 bands					0.50m		
A2. VHR prime - [Topographic] [less strict than A5]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	see paragraph below on off-nadir/elevation angle restrictions for the A2 profile (see also Appendix 1 to Technical Specifications)	x,y ≤ 2m	≤10%	Priority programming	sensor dependent		WV3,WV2, GE1, K3, possibly others not benchmarked yet
		GSD≤3m	MS (at least 4 bands)							
	Pan-sharpened	PAN GSD≤0.75 m, MS GSD≤3 m	at least 4 bands							
A3. VHR prime - CwRS [Pan only]	Pan	GSD≤0.75m	PAN	> 50	x,y ≤ 2m	≤10%	Priority programming	sensor dependent		WV3, WV2, GE1, WV1, possibly others not benchmarked yet
A4. VHR prime - CwRS [Stereo]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	according to IP specifications	x,y ≤ 2m	≤10%	Priority programming	sensor dependent		WV3, WV2, GE1, possibly others not benchmarked yet
		GSD≤3m	MS (at least 4 bands)							
	Pan-sharpened	PAN GSD≤0.75m, MS GSD≤3m	at least 4 bands							
A5. VHR prime - CwRS [VHR+ Topographic]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 67	x,y ≤ 2m	≤10%	Priority programming	0.40m		WV3,WV2, GE1, possibly others not benchmarked yet
		GSD≤2m	MS (at least 4 bands)	> 67				1.60m		
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2m	at least 4 bands	> 67				0.40m		
A51. VHR prime - CwRS [VHR+ Topographic][8]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 67	x,y ≤ 2m	≤10%	Priority programming	0.40m		WV3, WV2, possibly others not benchmarked yet
		GSD≤2m	MS (at least 8 bands)	> 67				1.60m		
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2m	at least 8 bands	> 67				0.40m		
A52. VHR prime - CwRS [VHR+ Topographic][16]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 67	x,y ≤ 2m	≤10%	Priority programming	0.40m		WV3, possibly others not benchmarked yet
		GSD≤2m	MS (16 bands; 8 SWIR bands may have coarser	> 67				1.60m		
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2m	at least 16 bands	> 67				0.40m		

Image Profile ID	Description	Spatial resolution requirement (*)	Radiometric resolution (**) and spectral bands	Minumum Elevation Angle restriction (***)	Threshold abs. 1-D rmse to be proven in geometry benchmark	Cloud Cover (CC) over AOI	Acquistion programming	Resampling	Remarks	Example of sensors
A6. VHR prime - CwRS [VHR_EFA_LF]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN					0.50m		
		GSD≤2m	MS (at least 4 bands)	> 50	x,y ≤ 1.5m	≤10%	Priority programming	2m	new profile	WV3,WV2, GE1, possibly others not benchmarked yet
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2m	at least 4 bands					0.50m		
A61. VHR prime - CwRS [VHR_EFA_LF][8]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN					0.50m		
		GSD≤2m	MS (at least 8 bands)	> 50	x,y ≤ 1.5m	≤10%	Priority programming	2m	new profile	WV3, WV2, possibly others not benchmarked yet
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2m	at least 8 bands					0.50m		
A62. VHR prime - CwRS [VHR_EFA_LF][16]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN					0.50m		
		GSD≤2m	MS (16 bands; 8 SWIR bands may have coarser	> 50	x,y ≤ 1.5m	≤10%	Priority programming	2m	new profile	WV3, possibly others not benchmarked yet
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2m	at least 16 bands					0.50m		
A7. VHR prime - near nadir profile [VHR_NN_50]; LPIS	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 80				0.50m		
		GSD≤2.00m	MS (at least 4 bands)	> 80	x,y ≤ 1.5m	close to cloud free, haze free, better than ≤10%	Image Provider (IP) best programming, when sensor available	2.00m	new profile; longer acquistion window: typically March-August; AOI chosen by IP within large areas given by JRC	WV3,WV2, GE1, possibly others not benchmarked yet
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2.0m	at least 4 bands	> 80				0.50m		
A71. VHR prime - near nadir profile [VHR_NN_50]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 80				0.50m		
		GSD≤2.00m	MS (at least 4 bands)	> 80	x,y ≤ 1.5m	≤10%	Priority programming	2.00m	new profile	WV3, WV2, GE1, possibly others not benchmarked yet
	Pan-sharpened	PAN GSD≤0.50 m, MS GSD≤2.0m	at least 4 bands	> 80				0.50m		
A8. VHR prime - near nadir profile [VHR_NN_40]; LPIS	Pan+Multispectral (Bundle)	GSD≤0.40m	PAN	> 80				0.40m		
		GSD≤1.60m	MS (at least 4 bands)	> 80	x,y ≤ 1.5m	close to cloud free, haze free, better than ≤10%	Image Provider (IP) best programming, when sensor available	1.60m	new profile; longer acquistion window: typically March-August; AOI chosen by IP within large areas given by JRC	WV3, GE1, possibly others not benchmarked yet
	Pan-sharpened	PAN GSD≤0.40 m, MS GSD≤1.6m	at least 4 bands	> 80				0.40m		
A81 VHR prime - near nadir profile [VHR_NN_40]	Pan+Multispectral (Bundle)	GSD≤0.40m	PAN	> 80				0.40m		
		GSD≤1.60m	MS (at least 4 bands)	> 80	x,y ≤ 1.5m	≤10%	Priority programming	1.60m	new profile	WV3, GE1, possibly others not benchmarked yet
	Pan-sharpened	PAN GSD≤0.40 m, MS GSD≤1.6m	at least 4 bands	> 80				0.40m		
B. VHR archive	as any of above	as any of above	as any of above		as any of above	as any of above	Archive	sensor dependent	used for archive search for any profile	WV3,WV2, GE1, K3
C. VHR re-task	as any of above	as any of above	as any of above		as any of above	as any of above	Priority programming	sensor dependent	used for re-task for any profile	WV3,WV2, GE1, K3
D. VHR proposed	as any of above	as any of above	as any of above		as any of above	10%>CC≤30%	Priority programming	sensor dependent	proposed for any profile	WV3,WV2, GE1, K3
E. VHR back up	Pan+Multispectral (Bundle)	GSD≤3m	PAN							
		GSD≤12m	MS (at least 3 bands)		x,y ≤ 5.0m	≤10%	Priority programming	sensor dependent	backup for any profile	WV3,WV2, GE1, K3
	Panchromatic	GSD≤3m	PAN							
	Pan-sharpened	GSD≤3m	at least 3 bands							

(*) GSD in both directions (across track, along track) including the effect of earth curvature should satisfy this criterium

(**) Dynamic range, minumum ≥ 11 bits/pixel

(***) Elevation angle (ELA) of any uploaded strip of an acquisition should satisfy this criterium

Table 1 - VHR profiles adopted within the CAP checks.

12.1.3. For the A.2 profile the following restrictions on off-nadir/elevation angle exist when used as VHR prime [Topographic] profile

Satellite (sensor)	Maximum off-nadir angle (degrees)	Minimum elevation angle (degrees)
GeoEye-1	30	56
WorldView-2	30	56
WorldView-3	31	56
KOMPSAT-3	15	73

Table 2 - Off-nadir/elevation angles necessary for the A2. VHR prime [Topographic] profile

12.1.4. Due to new CAP requirements, all VHR imagery should have spatial resolution compliant at least with scale of 1:5.000 or larger. This translates into a required positional accuracy of maximum 1.25 m 1D RMSE and a GSD/pixel size at least 70cm or smaller. Although in the profile table above the threshold for an absolute 1-D RMSE is set to 2m / 1.5m, RMSEs of VHR sensors (WV1, WV2, WV3, GE1) were in JRC's geometry benchmark studies proved to be below 1.25m. Regarding Kompsat-3 the RMSE for a maximum allowed off nadir angle 15° resulted 1.5m, however in other more extensive studies dealing with geolocation accuracy of Kompsat-3 imagery the RMSE below 1m can be found [15], [16].

12.1.5. For a better overview of the existing profiles, and to facilitate for the MS Administrations in their choice of correct profile for their controls, the profiles can be represented in a graph of Ground Sampling Distance (GSD) versus Elevation Angle (ELA). See Figure 2 below.

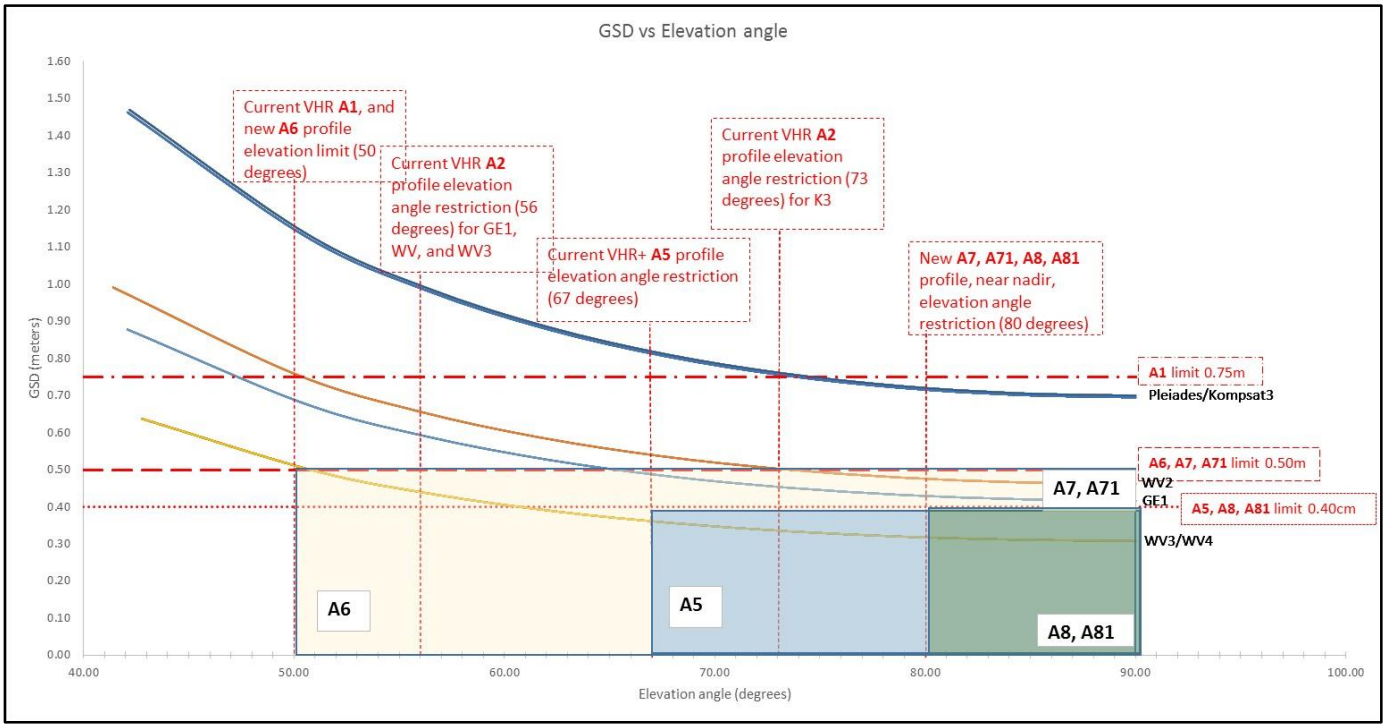


Figure 2 - GSD vs. Elevation Angle (ELA) for the VHR Profiles

12.1.6. For the LPIS QA Campaign, the VHR image acquisition approach guarantees close to nadir (threshold > 80 deg elevation angle (ELA)), haze free, and close to cloud free (0-10% CC) imagery. The acquisition window for the LPIS QA VHR imagery to be acquired will normally be March - August.

12.1.7. JRC will provide to the IPs the LPIS regions (large areas) indicating the number of LPIS images (small areas) to be collected within these LPIS regions. Possibly there will also be additional 'bonus' images which will be communicated to the IP in due time.

12.1.8. The IP will perform the feasibility study providing the JRC with the resulting three categories (1-3) as described further in chapter 4. Feasibility (§ 4.1.12)

12.1.9. The IP will, after JRC accept, be responsible for acquiring the requested number of LPIS images per LPIS region. The IP will select LPIS image/s randomly taking into account collection efficiency (within priority tasking), weather forecast, real time weather development and in accordance with the image profile requirement (image profiles see Chapter 12).

12.1.10. The sensor which collects will decide upon the LPIS image (small area) extent, which is swath dependent. The resampling will be to best accommodate a 1:1 ratio in [acquired GSD]: [delivered output pixel]. For the 40cm output pixel case the small area extent will be 13x13=169km^2, while for the 50cm case the area will be 15x15=225km^2.

12.1.11. The shape of the small area shall be as simple as possible and is normally, as mentioned above, a 13x13km or a 15x15km plain image. However, it may be that an LPIS region (large areas) has an irregular/complex shape giving following effect on the small area image:

12.1.12. Shapes with only four vertices:

- Square shape (a=b i.e. 15x15 or 13x13km);
- Rectangular shape (a≠b) with total area of 169 or 225km2;
- Regular but not rectangular shapes (parallelogram, rhombus, kite etc.), with total area of 169 km2 or 225km2;
- Irregular shapes;

12.1.13. Shapes with more than four vertices (when the shape is depending on borderline, coastline, inland water or created to exclude cloud):

- Manual creation of the shape to exclude clouds (and larger parts of the lakes/sees at the border of small area). This applies only to exclude outer perimeter of the initial shape

12.1.14. Cut out by using coastal line shapefile, provided by the JRC. Small islands (without Agricultural Parcels) and reefs shall be excluded.

12.1.15. The VHR zone will be covered either by a bundle product (PAN and 4 bands MSP as separate bands), or the pan-sharpened product, or the PAN only product. If the profile A4 (VHR Stereo) is requested, a stereo product will be delivered. PAN and 8 bands MSP products (A.11/A.51/A.61 profiles) or PAN and 16 bands MSP products (A.12/A.52/A.62 profiles) are also options but the requirement for such profiles needs to be negotiated bilaterally with JRC at the pre-Image Request (pre-IR) stage.

12.1.16. Technical details of the sensors that fit above profiles are explained in the Annex 17.4.

13. Quality Assurance / Quality Control

13.1. Quality Assurance / Quality Control (QA/QC)

13.1.1. The principal objective of the CAP image acquisition is to reach the goal of minimum 95% success rate of image supply on time, according to specifications. In order to ensure this, result an adequate QA/QC needs to be put in place; the FW contractor/s shall therefore apply a QA and internal QC to the imagery and to the process of performing image acquisition. Then JRC will have an overarching role in making external Quality Control on the

procedures that the FW contractor/s has set up. This is performed through specific deliverables, QC records (QCRs), and QC visits throughout the contract running between the FW contractor/s and the JRC [ref. 6].

13.1.2. 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. QC aims to detect non-conformities in a product.

13.1.3. QC includes assessment of issues such as data integrity, data completeness, CC, haze or thin clouds, cloud shadows, fog, smoke, smog, snow, flares, etc. It also includes assessing the product geometry, radiometry, image characteristics (dropouts etc.), and finally the production parameters (resampling algorithm, bit depth), etc.

13.1.4. The FW contractor/s will follow their internally-defined QA/QC procedures on their products including at least the above mentioned 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. A proposed image can also be e.g. an acquisition at elevation angle below requirement.

13.2. Specificities on 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. It does not include cloud shadow. Dense haze which causes consistent muting of imagery should be included.

13.2.2. There are different CC assessment routines, e.g.:

a) 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.;

b) manual photo interpretation and subsequent vector digitizing: if a definite boundary between affected pixels and un-affected pixels is visible it is a cloud.

13.2.3. The JRC decided that imposing of a common CC assessment approach on the FW contractor/s is not efficient. The CC assessment should result in an agreement between FW contractor/s and the MS Administrations (or their Contractors) otherwise the FW contractor/s needs to report to the JRC, who has the right to decide.

13.2.4. Both approaches in §13.2.2 are accepted by JRC. The MS Administration (or their Contractors) and the FW contractor/s should however, in order to arrive to an efficient CAP checks programme with successful outcome, aim for an optimisation of the image use.

13.2.5. CC validation and Meteo flagging should follow the procedure described in Chapter 7.

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 FW contractor/s is responsible for communicating any technical problem connected to a satellite sensor, to the receiving station or to the processing chain as soon as possible to the JRC. This is important in order to limit risks to the Campaign by allowing switching to other satellite sensors or switching to traditional on-the-spot checks for the control of the area-based subsidies.

15. JRC responsibles and e-mail addresses

15.1.1. D Sustainable Resources / Unit D.5 / scientific image acquisition par-johan.astrand@ec.europa.eu

15.1.2. D Sustainable resources / Unit D.5 / contractual FWC; and scientific CAP related issues philippe.loudjani@ec.europa.eu

16. References

1 EUR Lex Access to European Union law: http://eur-lex.europa.eu/homepage.html

2 Technical Guidance document (campaign 2016) for On-The-Spot Checks (OTSC) and area measurement
Technical Guidance document on the On-The-Spot Check of Crop Diversification requirements
Technical Guidance document on the On-The-Spot Check of Ecological Focus Areas requirements
https://marswiki.jrc.ec.europa.eu/wikicap/index.php/Main_Page

3 LPIS quality assessment and CwRS imagery used for this assessment (WikiCAP) https://marswiki.jrc.ec.europa.eu/wikicap/index.php/Main_Page

4 Guidelines for Best Practice and Quality Checking of Ortho Imagery [Issue 3.0 available at: https://g4cap.jrc.ec.europa.eu/g4cap/Portals/0/Documents/10133.pdf

5 HR 'profile based' Specs (ref. http://ies-intranet/h04/apps/Chrono/21450.docx). See also G^{4}CAP under Documentation.

6 FWCs for satellite image purchase held at the JRC:

a. Framework contracts for supply of Satellite Remote Sensing (SRS) data and associated services in support to checks within the Common Agricultural Policy (CAP); (1) VHR profile FWC 389.911 (expiry after campaign 2017), VHR profile II FWC 931.886, VHR+ profile FWC 199.309, with **European Space Imaging** GmbH, (2) HR profile FWC 389.912 (discontinued after campaign 2017), and HHR profile FWC 198.995 both with **Airbus Defence and Space**.

b. Framework contract for supply of any type of Satellite Remote Sensing Data; broker FWC 391.782.

7 The CID portal EULA http://cidportal.jrc.ec.europa.eu/home/idp/licensing/eula

8 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.J]

a. 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

b. PUBSY: http://publications.jrc.ec.europa.eu/repository/

9 Benchmarking Worldview2

a. 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

b. 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.

c. 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.

d. 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

e. PUBSY: http://publications.jrc.ec.europa.eu/repository/

10 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,

11 URL to G^{4}CAP is https://g4cap.jrc.ec.europa.eu

12 G^{4}CAP manual, see under Documents in G^{4}CAP: https://g4cap.jrc.ec.europa.eu

13 VAJSOVÁ Blanka; WALCZYNSKA Agnieszka; BÄRISCH Samuel; AASTRAND Paer, HAIN Sussanne ; New sensors benchmark report on Kompsat-3, [PUBSY JRC93093, EUR 27064 EN, ISBN 978-92-79-45054-9, ISSN 1831-9424, doi:10.2788/240349], available at: http://publications.jrc.ec.europa.eu/repository/handle/JRC93093

14 Vajsova, B., Walczynska, A., Åstrand, P., Bärisch, S., Hain, S., (2015). New sensors benchmark report on WorldView-3. Geometric benchmarking over Maussane test site for CAP purposes; [PUBSY JRC99433, EUR 27673 EN, ISBN 978-92-79-54236-7, ISSN 1831-9424, doi:10.2788/237561, available at: http://publications.jrc.ec.europa.eu/repository/handle/JRC99433

15 Satrec initiative – white paper: http://store.cloudeo-ag.com/sites/default/files/product_details/Planimetric%20Accuracy%20Kompsat3.pdf

16 Jeong Jaehoon, Kim Jaein, Kim Taejung; Analysis of Geolocation Accuracy of KOMPSAT-3 Imagery; Korean Journal of Remote Sensing; DOI: 10.7780/kjrs.2014.30.1.4, http://koreascience.or.kr/article/ArticleFullRecord.jsp?cn=OGCSBN_2014_v30n1_37

17. Annexes

17.1. XML metadata file specification for image providers used for the QL upload

The following XML structure is under evolution due to the re-engineering of the acquisition upload process, so the following description is merely indicative, based on last version of the process (2016). As soon as the new process will be placed in production, FW contractors will receive the updated and correct version of this section, and these specifications will be updated accordingly.

Zip Archive

The provider must upload a zip archive 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 archive does not include information about geo reference, see <?xml version="1.0" encoding="UTF-8" standalone="yes"?>

```
<G4CAP xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="tobedefined.xsd">
        <Acquisition>
                <ARId>65843</ARId>
                <AcquisitionDate>12.02.2016</AcquisitionDate>
                <Sensor>WORLDVIEW02</Sensor>
                <Comment>This is a comment for you.</Comment>
                <CloudCover>1.98</CloudCover>
                <MeteoFlag>Snow</MeteoFlag>
        <Shape>
        <Filename>test.shp</Filename>
        </Shape>
        <Strips>
        <Strip>
                                        <Elevation>64.15</Elevation>
                                        <Filename>WV20250071G101P_000040462_Browse_0.jpg</Filename>
                                </Strip>
                                <Strip>
                                        <Elevation>68</Elevation>
                                        <Filename>WV20250071G101P_000040462_Browse_1.jpg</Filename>
                                </Strip>
                </Strips>
        </Acquisition>
</G4CAP>
```

2. Figure 3 - Sample XML metadata file structure (including shape file);
3. image file(s);
4. shape file(s);
5. other file(s) for geo referencing (if applicable).

XML Structure

```
<root>
        <Acquisition>


                <MeteoFlag>
                </MeteoFlag>
                <Shape>
```

```
                </Shape>
                <Strips>
                        <Strip>
                        </Strip>
                        <Strip>
                        </Strip>
                </Strips>
        </Acquisition>
</root>
```

A section <**Image>** must be included in the file for each image uploaded in the zip file used in the validation process. The same should be done with the shapefile, to be defined in the **<Shape>** section.

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/Shape section

The **<Image>** and **<Shape>** sections can contain the following sub-nodes.

Node name	Description	Data type	Compulsory
ARId	Acquisition Request ID	Integer	Yes
Country	Country abbreviation (see list)	String	Yes
Site	Zone name	String	Yes
Path	Image path	String	No
Shift	Image shift	String	No
AcquisitionDate	Acquisition Date, interpreted in function of the country setting in your G^{4}CAP profile), must be inside the window defined in the **Acquisition** Request	DateTime	Yes
AcquiredArea	Amount of valid acquired area covered by current acquisition	Double	Yes
Elevation	Elevation Angle	String	No
CloudCover	Cloud coverage percentage	Integer (0≤CC≤100)	Yes
DisplayOrder	To be used by the G^{4}QL Browser	Integer (>0)	Yes
ProviderStatus	See values list in following tables	String	Yes
Filename	Name of the file linked to this Image item	String	Yes
HazeFlag	Presence of haze in the image	String (Yes – No)	No
Comment	Any kind of comment on the image	String	No
Profile	Profile for current upload	String	Yes
Sensor	Information about the sensor having provided the current image. This value will be shown in the acquisition comments	String	Yes

Table 3 - XML metadata file, 'Image'/'Shape' sections possible sub-nodes

METADATUM	TYPE	DESCRIPTION	VALUES	REQ.
ARId	Integer	AR Unique Identifier	Just the ID of current AR	X
AcquisitionDate	Date	Date of acquisition	dd.MM.yyyy - inside the AW and in the past	X
Sensor	Enum	Name of sensor having acquired the imagery	See Sensors table	X
Comment	String (4096)	Acquisition comment, to be used for any kind of non-standard communication about the Acquisition itself, or for issues that could be useful at AUDIT level, or that could need to be reminded after several time from upload	Free text (4096 characters)	
CloudCover	Double	Cloud Coverage percentage over the whole Acquisition area	0.00 <= CC <= 100.00	X
MeteoFlag	Enum	Whether the imagery presents some meteo issue	See Meteo table	
Filename	String	Name of the file inside the .zip archive	Name of one of the files in the uploaded .zip archive	X
Elevation	Double	Elevation Angle over the single Strip	0.00 <= ELA <= 90.00	X

Table 4: XML metadata file - values

Value	Description	Possible Profiles
UK-DMC2		F0, G
WORLDVIEW02		A1, A11, A2, A3, A4, A5, A51, A6, A61, A7, A71, B, C, D, E
GEOEYE01		A1, A2, A3, A4, A5, A6, A7, A71, A8, A81, B, C, D, E
WORLDVIEW01		A3, B, C, D, E
WORLDVIEW03		A1, A11, A12, A2, A3, A4, A5, A51, A52, A6, A61, A62, A7, A71, A8, A81, B, C, D, E
WORLDVIEW04	(after benchmarking)	A1, A2, A3, A4, A5, A6, A7, A71, A8, A81, B, C, D, E
KOMPSAT03		A1, A2, B, C, D, E
KOMPSAT03A	(after benchmarking)	A1, A2, B, C, D, E
SPOT6		F0, F1, F2, G
SPOT7		F0, F1, F2, G
PLEIADES 1A		Broker
PLEIADES 1B		Broker
DEIMOS-1		F0, G
DEIMOS-2		F1, F2, G
SENTINEL-2A/B		

Table 5: Possible values for the Sensor tag and their combination with Profiles

Value	Description
Haze	Haze in the imagery
Snow	Presence of snow in the imagery
Flood	Presence of flood in the imagery
Mixed	Presence of different issues in the imagery, or impossibility to distinguish the actual issue

Table 6: Possible values for the Meteo flag and their description

Country list and abbreviation

Country	Abbreviation
AUSTRIA	AT
BULGARIA	BG
CROATIA	HR
CYPRUS	CY
CZECH REPUBLIC	CZ
DENMARK	DK
ENGLAND	UK_EN
ESTONIA	EE
EU LPIS QA	EUL
FINLAND	FI
FLANDERS	BE_FL
FRANCE	FR
GERMANY	DE
GREECE	GR
HUNGARY	HU
IRELAND	IE
ITALY	IT
LATVIA	LV
LITHUANIA	LT
LUXEMBOURG	LU
MACEDONIA	MK
MALTA	MT
NETHERLANDS	NL
NORTHERN IRELAND	UK_NI
POLAND	PL
PORTUGAL	PT
ROMANIA	RO
SCOTLAND	UK_SC
SLOVAKIA	SK
SLOVENIA	SI
SPAIN	ES
SWEDEN	SE
WALES	UK_WA
WALLONIA	BE_WA

Table 7 - Country list and standard abbreviations

States used for the upload of Acquisitions (Provider state)

Provider status	Description
Proposed	This acquisition is proposed
Validated	This acquisition is validated
Disable	This acquisition is disable
Backup	This acquisition has the backup profile

Table 8 - Possible values for Provider state

Example of metadata XML file for QL image upload

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<G4CAP xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="tobedefined.xsd">
        <Acquisition>
                <ARId>65843</ARId>
                <AcquisitionDate>12.02.2016</AcquisitionDate>
                <Sensor>WORLDVIEW02</Sensor>
                <Comment>This is a comment for you.</Comment>
                <CloudCover>1.98</CloudCover>
                <MeteoFlag>Snow</MeteoFlag>
        <Shape>
        <Filename>test.shp</Filename>
        </Shape>
        <Strips>
        <Strip>
                                        <Elevation>64.15</Elevation>
                                        <Filename>WV20250071G101P_000040462_Browse_0.jpg</Filename>
                                </Strip>
                                <Strip>
                                        <Elevation>68</Elevation>
                                        <Filename>WV20250071G101P_000040462_Browse_1.jpg</Filename>
                                </Strip>
                </Strips>
        </Acquisition>
</G4CAP>
```

Figure 3 - Sample XML metadata file structure (including shape file)

17.2. XML metadata file specification for image providers used for the ortho data return to JRC by FW contractor/s

Node name	Description	Data type	Compulsory
CWRS_CAMPAIGN	Campaign Year	Integer	yes
ACQUISITION_ID	G^{4}CAP Acquisition ID	String	yes
ZONE_ID	Zone name	String (maxLength value=5)	yes
COUNTRY_ID	Country abbreviation (see list)	NCName (maxLength value=2)	yes
COPYRIGHT	EC_JRC_FC389.911 EC_JRC_FC199.309 EC_JRC_FC931.886	String (enumeration value="EC_JRC_FC389.911")	yes
PRODUCT_TYPE	ORTHO_CWRS	String (enumeration value="ORTHO_CWRS"/>	yes
PROCESSING_LEVEL	Processing level of imagery returned	String (enumeration value="3")	yes
IMAGE_TYPE	Type of the returned image	String (enumeration value="MUL" or "PAN" or "PSH")	yes
LINEAGE	Data processed according to CwRS guidelines.	String	yes

MISSION	Information about the sensor having provided the source image from which ortho image has been created.	String (enumeration value="WORLDVIEW" or " GEOEYE" or "EROS" or "KOMPSAT 3")	yes
MISSION_INDEX	Sensor/mission index	String (enumeration value="1" or " 2" or "3" or "B1")	yes
IMAGING_DATE	YYYY-MM-DD	Date	yes
IMAGING_TIME	HH-MM-SS	Time	yes
DATA_FILE_FORMAT	Format of retuned orthos	String (enumeration value="GEOTIFF" or " HFA")	yes
DATA_FILE_ORGANISATION	Information on the organization of the files	String (enumeration value=" BAND_COMPOSITE " or " BAND_COMPOSITE ")	yes
Data_File	data files of each returned image file	String	yes
EPSG	EPSG code of CRS used for ortho correction of imagery	Integer	yes
WKT	Description of CRS, essential if no EPSG code is defined.	String	yes
BAND_INDEX	Band index	Integer (enumeration value="1" or "2" or "3" or "4" or "5" or "6" "7" or "8")	yes
BAND_DESCRIPTION	Band description	Integer (enumeration value="1" or "2" or "3" or "4" or "5" or "6" "7" or "8")	yes
DATA_TYPE	Type of returned data	String (enumeration value="BYTE" or "SHORT" or "LONG ")	yes
NBITS	Number of bits per pixel	Integer (enumeration value="8" or "14"or"16" or "32")	yes
NBANDS	Number of returned bands		yes

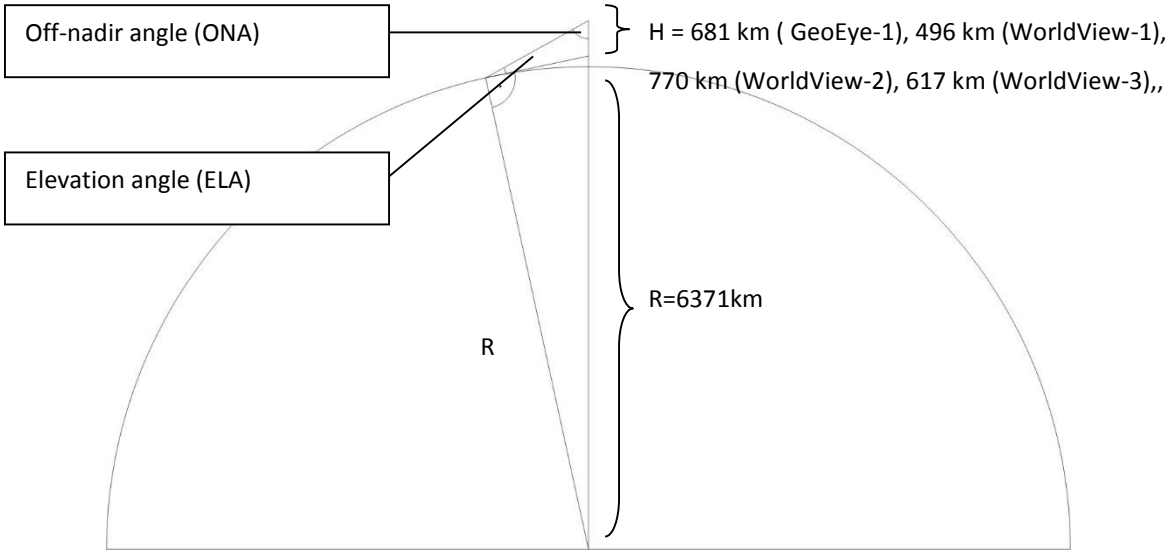
Table 9 - Description of XML metadata file specification for ortho data return to JRC by FW contractor/s

```
<?xml version="1.0" encoding="UTF-8"?>
<Metadata_JRC                              xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://cidportal.jrc.ec.europa.eu/public-tools/schema/image-acquisition"    version="1.0"
xsi:schemaLocation="VHR-OIR        http://cidportal.jrc.ec.europa.eu/public-tools/schema/image-
acquisition/jrc_metadata_vhr_ortho.xsd">
      <Data_Acquisition>
             <CWRS_CAMPAIGN>2016</CWRS_CAMPAIGN>
             <Order_Information>
                    <ACQUISITION_ID>44444</ACQUISITION_ID>
             </Order_Information>
             <Zone>
                    <ZONE_ID>PIPO</ZONE_ID>
                    <COUNTRY_ID>IE</COUNTRY_ID>
             </Zone>
      </Data_Acquisition>
      <Dataset_Id>
             <COPYRIGHT>EC_JRC_FC389.911</COPYRIGHT>
      </Dataset_Id>
      <Production>
             <PRODUCT_TYPE>ORTHO_CWRS</PRODUCT_TYPE>
             <PROCESSING_LEVEL>3</PROCESSING_LEVEL>
                     <IMAGE_TYPE>PSH</IMAGE_TYPE>
             <LINEAGE>
                    Data processed according to CwRS guidelines.
                    </LINEAGE>
      </Production>
      <Dataset_Sources>
             <Source_Information>
                    <MISSION>WORLDVIEW</MISSION>
                    <MISSION_INDEX>2</MISSION_INDEX>
                    <Scene_Source>
                           <IMAGING_DATE>2016-05-30</IMAGING_DATE>
                           <IMAGING_TIME>11:33:10</IMAGING_TIME>
                           <Data_Access>
                              <DATA_FILE_FORMAT>HFA</DATA_FILE_FORMAT>
                              <DATA_FILE_ORGANISATION>BAND_COMPOSITE</DATA_FILE_ORGANISATION>
                                   <Data_File>
                                      <DATA_FILE_PATH href="PIPO_20160530113310_psh.img" />
                                   </Data_File>
                           </Data_Access>
                    </Scene_Source>

             </Source_Information>
      </Dataset_Sources>
```

```
      <Coordinate_Reference_System>
             <EPSG>32630</EPSG>
        <WKT>PROJCS["WGS 84 / UTM zone 30N",GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS
84",6378137,298.257223563,AUTHORITY["EPSG","7030"]],TOWGS84[0,0,0,0,0,0,0],AUTHORITY["EPSG","63
26"]],PRIMEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",0.01745329251994328,AUTHORIT
Y["EPSG","9122"]],AUTHORITY["EPSG","4326"]],PROJECTION["Transverse_Mercator"],PARAMETER["latitu
de_of_origin",0],PARAMETER["central_meridian",-
3],PARAMETER["scale_factor",0.9996],PARAMETER["false_easting",500000],PARAMETER["false_northing
",0],UNIT["metre",1,AUTHORITY["EPSG","9001"]],AUTHORITY["EPSG","32630"]]</WKT>
      </Coordinate_Reference_System>


      <Image_Interpretation>
             <Spectral_Band_info>
                    <BAND_INDEX>1</BAND_INDEX>
                    <BAND_DESCRIPTION>1</BAND_DESCRIPTION>
             </Spectral_Band_info>
             <Spectral_Band_info>
<BAND_INDEX>2</BAND_INDEX>
<BAND_DESCRIPTION>2</BAND_DESCRIPTION>
</Spectral_Band_info>
<Spectral_Band_info>
<BAND_INDEX>3</BAND_INDEX>
<BAND_DESCRIPTION>3</BAND_DESCRIPTION>
</Spectral_Band_info>
<Spectral_Band_info>
<BAND_INDEX>4</BAND_INDEX>
<BAND_DESCRIPTION>4</BAND_DESCRIPTION>
</Spectral_Band_info>
</Image_Interpretation>


      <Raster_Encoding>
             <DATA_TYPE>SHORT</DATA_TYPE>
                     <NBITS>16</NBITS>
      </Raster_Encoding>


      <Raster_Dimensions>
                    <NBANDS>4</NBANDS>
       </Raster_Dimensions>


</Metadata_JRC>
```

Figure 3 – Sample VHR Ortho Image Return (OIR) metadata.xml-file structure

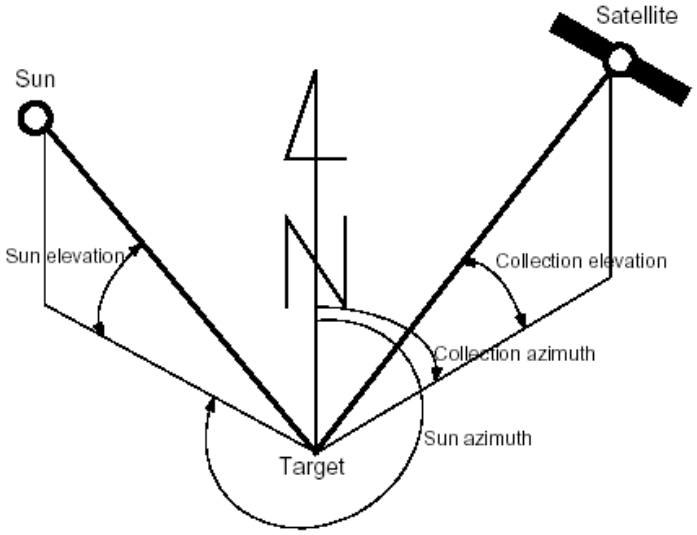
17.3. Relation elevation angle vs. off-nadir angle, and some satellite angles of importance



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

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

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



17.4. VHR and VHRplus Sensors

WorldView-2	
SATELLITE Specification	
Launch Information	Date: October 8, 2009 Launch Vehicle: Delta 7920 (9 strap-ons) Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 770 kilometers Type: Sun synchronous, 10:30 am descending node Period: 100 minutes
Sensor Bands	Panchromatic: 450 - 800 nm 8 Multispectral: 4 standard colors: blue / green / red / NIR1 + 4 new colors: coastal / yellow / red edge / NIR2 Coastal Blue: 400 - 450 nm; Blue: 450 – 510 nm Yellow: 585 - 625 nm; Green: 510 – 580 nm Red: 630 – 690 nm, Red Edge: 705 - 745 nm NIR1: 760 – 900 nm, NIR2: 860 - 1040 nm
Sensor Resolution GSD (Ground Sample Distance)	Panchromatic: 0.46m at nadir Multispectral: 1.85m at nadir
Dynamic Range	11-bits per pixel
Swath Width	16.4 kilometers at nadir
Retargeting Agility	Time to Slew 200 kilometers: 10 seconds
Max Contiguous Area Collected in a Single Pass (at 30°ONA)	138 x 112 km mono (8 strips) 63 x 112 km stereo (4 pairs)
Revisit Frequency	1.1 days at 1 meter GSD or less 3.7 days at 20° off-nadir or less (0.52 meter GSD)
Geolocation Accuracy (CE 90)	Demonstrated <3.5 m CE90 without ground control
PRODUCT Specification	
Tasking Level	Special Priority Tasking (Select Plus Level)
Product Options	Ortho Ready Standard Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard panchromatic only Ortho Ready Standard Bundle 8 bands (PAN plus 4 Bands MS (BGRNIR1) plus 4 Bands MS2 (Coastal, Yellow, RedEdge, NIR2) Ortho Ready Standard Stereo Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Stereo Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard Stereo panchromatic only Ortho Ready Standard Stereo Bundle 8 bands (PAN plus 4 Bands MS (BGRNIR1) plus 4 Bands MS2 (Coastal, Yellow, RedEdge, NIR2)
Resolution	Panchromatic: 0.5m– for VHR+ profiles A5, A51, A52, A8, A81 0.4m Multispectral: 2.0m – for VHR+ profile A5, A51, A52, A8, A81 1.6m
Cloud Cover	Cloud cover “validated” 0 - ≤ 10 %, “proposed” 10 % < CC ≤ 30 %;
Resampling Kernel	Cubic Convolution
Format	GeoTIFF
DRA	off
Bit Depth	16bit
Projection/ Datum	UTM/ WGS84
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
Delivery Medium	DVD or FTP

WorldView-3	
SATELLITE Specification	
Launch Information	Date: August 13, 2014 Launch Vehicle: Atlas V - 401 Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 617 kilometers Type: Sun synchronous, 10:30 am descending node Period: 97 minutes
Sensor Bands	Panchromatic: 450 - 800 nm 8 VNIR Bands: 4 standard colors: blue / green / red / NIR1 (Multispectral) + 4 new colors: coastal / yellow / red edge / NIR2 Coastal Blue: 400 - 450 nm; Blue: 450 – 510 nm Yellow: 585 - 625 nm; Green: 510 – 580 nm Red: 630 – 690 nm, Red Edge: 705 - 745 nm NIR1: 770 – 895 nm, NIR2: 860 - 1040 nm 8 SWIR Bands: SWIR-1: 1195 - 1225 nm; SWIR-2: 1550 - 1590 nm (Multispectral) SWIR-3: 1640 - 1680 nm; SWIR-4: 1710 - 1750 nm SWIR-5: 2145 - 2185 nm; SWIR-6: 2185 - 2225 nm SWIR-7: 2235 - 2285 nm; SWIR-8: 2295 - 2365 nm 12 CAVIS Bands: Desert Clouds: 405 – 420 nm; Aerosol-1; Aerosol-1: 459 – 509 nm; Green: 525 – 585 nm; Aerolos-2: 635 – 685 nm; Water-1: 845 – 885 nm; Water-2: 897 – 927 nm; Water-3: 930 – 965 nm; NDVI-SWIR: 1220 – 1252 nm; Cirrus: 1365 – 1405 nm; Snow: 1620 – 1680 nm; Aerosol-1: 2105 – 2245 nm; Aerosol-2: 2105 – 2245 nm
Sensor Resolution GSD (Ground Sample Distance)	Panchromatic: 0.31m at nadir VNIR: 1.24m at nadir SWIR: 3.70m at nadir CAVIS: 30m at nadir
Dynamic Range	11-bits per pixel (Pan, MS), 14-bits per pixel (SWIR)
Swath Width	13.1 kilometers at nadir
Retargeting Agility	Time to Slew 200 kilometers: 12 seconds
Max Contiguous Area Collected in a Single Pass (at 30° ONA)	65.5 x 112 km mono (5 strips) 26.2 x 112 km stereo (2 pairs)
Revisit Frequency	1.0 days at 1 meter GSD or less 4.5 days at 20° off-nadir or less
Geolocation Accuracy (CE 90)	Predicted <3.5 m CE90 without ground control
PRODUCT Specification	
Tasking Level	Special Priority Tasking (Select Plus Level)
Product Options	Ortho Ready Standard Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard panchromatic only Ortho Ready Standard Bundle 8 bands (PAN plus 4 Bands MS (BGRNIR1) plus 4 Bands MS2 (Coastal, Yellow, RedEdge, NIR2) Ortho Ready Standard Stereo Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Stereo Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard Stereo panchromatic only Ortho Ready Standard Stereo Bundle 8 bands (PAN plus 4 Bands MS (BGRNIR1) plus 4 Bands MS2 (Coastal, Yellow, RedEdge, NIR2) SWIR Band Product 1
Resolution	Panchromatic: 0.5m– for VHR+ profiles A5, A51, A52, A8, A81 0.4m Multispectral: 2.0m – for VHR+ profile A5, A51, A52, A8, A81 1.6m SWIR: 7.5m
Cloud Cover	Cloud cover “validated” 0 - ≤ 10 %, “proposed” 10 % < CC ≤ 30 %;
Resampling Kernel	Cubic Convolution
Format	GeoTIFF

DRA	off
Bit Depth	16bit
Projection/ Datum	UTM/ WGS84
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 SWIR Product 1default tiling
Delivery Medium	DVD or FTP

GeoEye-1	
SATELLITE Specification	
Launch Information	Date: September 6, 2008 Launch Vehicle: Delta II Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 681 kilometers Type: Sun-synchronous, 10:30 am descending node Period: 98 minutes
Sensor Bands	Panchromatic: 450 - 800 nm 4 Multispectral: Blue: 450 - 510 nm Green: 510 - 580 nm Red: 655 - 690 nm NIR: 780 - 920 nm
Sensor Resolution GSD (Ground Sample Distance)	Panchromatic: 0.41m at nadir Multispectral: 1.65m at nadir
Dynamic Range	11-bits per pixel
Swath Width	15.3 kilometers at nadir
Retargeting Agility	Time to Slew 200 kilometers: 20 seconds
Max Contiguous Area Collected in a Single Pass (at 30° ONA)	44 x 112 km mono (3 strips) 28 x 224 km stereo (2 pairs)
Revisit Frequency	2.6 days at 30° off-nadir
Geolocation Accuracy (CE 90)	5m CE90 without ground control
PRODUCT Specification	
Tasking Level	Special Priority Tasking (Select Plus Level)
Product Options	Ortho Ready Standard Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard panchromatic only Ortho Ready Standard Stereo Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Stereo Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard Stereo panchromatic only
Resolution	Panchromatic: 0.5m– for VHR+ profiles A5, A51, A52, A8, A81 0.4m Multispectral: 2.0m – for VHR+ profile A5, A51, A52, A8, A81 1.6m
Cloud Cover	Cloud cover “validated” 0 - ≤ 10 %, “proposed” 10 % < CC ≤ 30 %;
Resampling Kernel	Cubic Convolution
Format	GeoTIFF
DRA	off
Bit Depth	16bit
Projection/ Datum	UTM/ WGS84
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 4 bands PSH (22k x 22k tiling): files have a max of 3,872 GB/tile
Delivery Medium	DVD or FTP

WorldView-1	
SATELLITE Specification	
Launch Information	Date: September 18, 2007 Launch Vehicle: Delta 7920 (9 strap-ons) Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 496 kilometers Type: Sun synchronous, 10:30 am descending node Period: 95 minutes
Sensor Bands	Panchromatic: 400 - 900 nm
Sensor Resolution GSD (Ground Sample Distance)	Panchromatic: 0.5 m at nadir
Dynamic Range	11-bits per pixel
Swath Width	17.7 kilometers at nadir
Retargeting Agility	Time to Slew 200 kilometers: 10 seconds
Max Contiguous Area Collected in a Single Pass (at 30° ONA)	111 x 112 km mono (6 strips) 51 x 112 km stereo (3 pairs)
Revisit Frequency	1.7 days at 1 meter GSD or less 5.4 days at 25° off-nadir or less (0.55 meter GSD)
Geolocation Accuracy (CE 90)	Demonstrated <4.0 m CE90 without ground control
PRODUCT Specification	
Tasking Level	Special Priority Tasking (Select Plus Level)
Product Options	Ortho Ready Standard panchromatic only Ortho Ready Standard Stereo panchromatic only
Resolution	Panchromatic: 0.5m
Cloud Cover	Cloud cover “validated” 0 - ≤ 10 %, “proposed” 10 % < CC ≤ 30 %;
Resampling Kernel	Cubic Convolution
Format	GeoTIFF
DRA	off
Bit Depth	16bit
Projection/ Datum	UTM/ WGS84
Tiling	32k x 32k, PAN files have a max of 2,140 GB /tile
Delivery Medium	DVD or FTP

WorldView-4 (available after benchmarking)	
SATELLITE Specification	
Launch Information	Date: November 11, 2016 Launch Vehicle: Atlas V - 401 Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 617 kilometers Type: Sun synchronous, 10:30 am descending node Period: 97 minutes
Sensor Bands	Panchromatic: 450 - 800 nm 4 VNIR Bands: (Multispectral) 4 standard colors: blue / green / red / NIR1
Sensor Resolution GSD (Ground Sample Distance)	Panchromatic: 0.31m at nadir VNIR: 1.24m at nadir
Dynamic Range	11-bits per pixel
Swath Width	13.1 kilometers at nadir
Retargeting Agility	Time to Slew 200 kilometers: 10.6 seconds
Max Contiguous Area Collected in a Single Pass (at 30° ONA)	65.5 x 112 km mono (5 strips) 26.2 x 112 km stereo (2 pairs)
Revisit Frequency	1.0 days at 1 meter GSD or less 4.5 days at 20° off-nadir or less
Geolocation Accuracy (CE 90)	Predicted <4m CE90 without ground control
PRODUCT Specification	
Tasking Level	Special Priority Tasking (Select Plus Level)
Product Options	Ortho Ready Standard Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard panchromatic only Ortho Ready Standard Stereo Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Ortho Ready Standard Stereo Pansharpened 4 Bands (BGRNIR) Ortho Ready Standard Stereo panchromatic only
Resolution	Panchromatic: 0.5m– for VHR+ profiles A5, A51, A52, A8, A81 0.4m Multispectral: 2.0m – for VHR+ profile A5, A51, A52, A8, A81 1.6m
Cloud Cover	Cloud cover “validated” 0 - ≤ 10 %, “proposed” 10 % < CC ≤ 30 %;
Resampling Kernel	Cubic Convolution
Format	GeoTIFF
DRA	off
Bit Depth	16bit
Projection/ Datum	UTM/ WGS84
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 4 bands PSH (22k x 22k tiling): files have a max of 3,872 GB/tile
Delivery Medium	DVD or FTP

Kompsat-3	
SATELLITE Specification	
Launch Information	Date: May 18, 2012 Launch Vehicle: H-IIA launch system Launch Site: Tanegashima Space Center, Japan
Orbit	Altitude: 685 kilometers Type: Sun-synchronous, 13:30 pm ascending node Period: 98 minutes
Sensor Bands	Panchromatic: 450 - 900 nm 4 Multispectral: Blue: 450 - 520 nm Green: 520 - 600 nm Red: 630 - 690 nm NIR: 760 - 900 nm
Sensor Resolution GSD (Ground Sample Distance)	Panchromatic: 0.7m at nadir Multispectral: 2.8m at nadir
Dynamic Range	14-bits per pixel
Swath Width	16 kilometers at nadir
Retargeting Agility	Time to Slew 200 kilometers: 10 seconds
Max Contiguous Area Collected in a Single Pass (at 30° ONA)	48 x 110 km mono (3 strips) 16 x 200 km stereo (2 pairs)
Revisit Frequency	3.5 days at 30° off-nadir
Geolocation Accuracy (CE 90)	70m (50cm-expectation) CE90 without ground control
PRODUCT Specification	
Tasking Level	Priority Plus Tasking
Product Options	Level 1R Option Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Level 1R Option pansharpened 4 Bands (BGRNIR)
Resolution	Panchromatic: 0.7m Multispectral: 2.8m
Cloud Cover	Cloud cover “validated” 0 - ≤ 10 %, “proposed” 10 % < CC ≤ 30 %;
Resampling Kernel	Cubic Convolution
Format	GeoTIFF
DRA	off
Bit Depth	14bit
Projection/ Datum	UTM/ WGS84
Tiling	default
Delivery Medium	DVD or FTP

Kompsat-3A (available after benchmarking)	
SATELLITE Specification	
Launch Information	Date: March 26, 2015 Launch Vehicle: RS20 rocket (Dnepr Launch Vehicle) Launch Site: Yasny Launch Base, Orenburg region, Russia
Orbit	Altitude: 528 kilometers Type: Sun-synchronous, 13:30 pm ascending node Period: 98.5 minutes
Sensor Bands	Panchromatic: 450 - 900 nm 4 Multispectral: Blue: 450 - 520 nm Green: 520 - 600 nm Red: 630 - 690 nm NIR: 760 - 900 nm
Sensor Resolution GSD (Ground Sample Distance)	Panchromatic: 0.55m at nadir Multispectral: 2.2m at nadir Infrared: 5.5m at nadir
Dynamic Range	14-bits per pixel
Swath Width	>12 kilometers at nadir
Retargeting Agility	Time to Slew 200 kilometers: 10 seconds
Max Contiguous Area Collected in a Single Pass (at 30° ONA)	48 x 110 km mono (3 strips) 16 x 200 km stereo (2 pairs)
Revisit Frequency	3.5 days at 30° off-nadir
Geolocation Accuracy (CE 90)	70m (50cm-expectation) CE90 without ground control
PRODUCT Specification	
Tasking Level	Priority Plus Tasking
Product Options	Level 1R Option Bundle 4 bands (PAN plus 4 Bands MS (BGRNIR1) Level 1R Option pansharpened 4 Bands (BGRNIR)
Resolution	Panchromatic: 0.55m Multispectral: 2.2m Infrared: 5.5m
Cloud Cover	Cloud cover “validated” 0 - ≤ 10 %, “proposed” 10 % < CC ≤ 30 %;
Resampling Kernel	Cubic Convolution
Format	GeoTIFF
DRA	off
Bit Depth	14bit
Projection/ Datum	UTM/ WGS84
Tiling	default
Delivery Medium	DVD or FTP

(end document)